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PROJECT WORK

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
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CAMPUS NAVIGATION USING AUGMENTED REALITY

A Project Report

submitted to

the APJ Abdul Kalam Technological University

in partial fulfillment of the requirements for the degree of

Bachelor of Technology

by

AALAP RAGESH (VML19CS001)

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April 2023

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CERTIFICATE

This is to certify that the report entitled **Campus Navigation Using Augmented Reality** submitted by **Aalap Ragesh** (VML19CS001), **Alenteena Sebastian** (VML19CS022), **Diya S** (VML19CS053) & **Sona P** (VML19CS107) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech degree in Computer Science and Engineering is a bonafide record of the project work carried out by them under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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Head of the department
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DECLARATION

We hereby declare that the project report **Campus Navigation Using Augmented Reality**, submitted for partial fulfillment of the requirements for the award of degree of Bachelor of Technology of the APJ Abdul Kalam Technological University, Kerala is a bonafide work done by us under supervision of **Mr. Rijin I.K**.

This submission represents our ideas in our own words and where ideas or words of others have been included, we have adequately and accurately cited and referenced the original sources.

We also declare that we have adhered to ethics of academic honesty and integrity and have not misrepresented or fabricated any data or idea or fact or source in our submission. We understand that any violation of the above will be a cause for disciplinary action by the institute and/or the University and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been obtained. This report has not been previously formed the basis for the award of any degree, diploma or similar title of any other University.

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Abstract

In the coming years, an artificially facilitated world will dominate, and Augmented Reality will have a crucial part to play in shaping it. This research investigates the utilization of augmented reality technology on smartphones for indoor navigation purposes. Our goal is to develop an Augmented Reality-based campus navigation system to assist individuals who may be unfamiliar with the campus layout. To determine one's location precisely, and then formulate a route and subsequently adhere to it, is the process or undertaking being referred to. The realm of navigation encompasses various branches, such as terrestrial navigation, nautical navigation, aviation navigation, and astrogation. The primary objective of this tool is to assist with finding one's way around the campus. Most individuals struggle with exploring unfamiliar territories or discovering new places on their own. Hence the application system will serve as a helper to them and lead in navigation through the campus, as we have selected the college campus area for our study. We currently working at developing a system that shall enable a new person to explore unknown campus areas which he is unfamiliar with. Furthermore, the proposed project may be extended at a larger scale and we can set a large number of data as a trained data in the database.

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Introduction

1.1 Overview

Our project aims at providing proper guidance and navigation via a simple android app that is easy to understand and use. The AR would make it easier and more interactive for users to find a certain location. The use of Augmented Reality (AR) technology on smartphones for indoor navigation is becoming increasingly important in today's artificially facilitated world. This technology has the potential to revolutionize navigation, and this research aims to develop an AR-based campus navigation system to assist individuals who are unfamiliar with the layout of the campus.

1.2 General Background

In an AR system, real-world objects are overlaid with digital objects that can contain information and graphics. With an AR system, real-world and computer environments are combined. AR systems overcome the cognitive dimensional challenge by providing information and graphics to be superimposed and correctly aligned with the real-world environment which enhances the real and digital experience [1]. AR is one of the emerging technologies that is transformed through progressive and replacement of technologies due to the advancement of computer power that enables mobile devices to

be equipped with better processes, capacity, and flexibility. This makes AR compatible to be used on mobile devices that are typically built-in with a camera, screen, global positioning system (GPS) receiver, and cellular or wifi networks for communications, which these features are used by an AR system. In 2020, 14.02 billion mobile devices are operating worldwide and 91 percentage of the total Internet users use mobile Internet which shows the suitability of mobile AR. Augmented reality(AR) has the unique quality of providing a direct link between the physical reality and virtual information about that reality. In the application of a visitor visiting the campus with a smartphone, the location and pose information of the phone are acquired and calculated in real time [2].

AR applications have spanned and explored into many sectors. It has been seen that this augmented reality-based application provides better interface and experience than the traditional 2D maps or the paper maps that are displayed outside buildings to help in the navigation [3]. Many of these AR applications are well-known such as Pokemon-Go and Snapchat in the gaming and entertainment industry, and in commerce such as IKEA Place and Dulux Visualiser. AR has also been applied in the education sector where many educators opted the use of metaverse and Aurasma in creating AR-based content. In addition to those applications, AR has also been used in navigation systems. An AR navigation system is a system that combines navigation information that is virtual with the real-world environment. The systems can be applied to a variety of scenarios such as vehicular navigation, pedestrian navigation, indoor and outdoor navigation. In all of these scenarios, the navigation system is used to help the user to reach the destination more efficiently by combining the real world with virtual information.

1.3 Problem statement

Design a system that aims to improve the navigation system specifically for campus navigation. This proposed navigation system includes AR to allow specific places that are being searched to be viewed interactively from different angles devices. The

system is expected to be used as an alternative way of finding the location of the lecture halls, tutorial rooms, laboratories, and offices within the campus. The system uses augmented reality (AR) to provide several dimensions of the image of the searched location. Precise information of the searched location within the buildings, and even over multiple floors is made possible through specific shielding characteristics.

1.4 Scope of the system

The scope of the application is determined by the time allocation, resources and customer demand. The scope of the program is limited and can grow the way it is done. Users can navigate the building with the advice provided by the AR browser. They can view construction, locations etc. Or they are searching for places. Having access to advanced handsets people tend to navigate large indoor spaces hassle-free as they might be puzzled looking at larger structures and multiple sign boards, they tend to use an easy way to access all the directions on their phones. This brings Indoor Navigation systems into play. Having an Augmented Reality based Indoor Navigation system at their disposal makes users navigate seamlessly and also aid vendors for advertising in malls etc.

1.5 Objective

Provide an easy-to-use, mobile-based solution system, which will contain all the necessary information, to ensure convenience, accurate navigation and identification of various buildings, doors and to help guests reach their desired location without difficulty. In the study, we presented an augmented reality- based indoor navigation application that uses localized environmental features, the Shortest Path finding algorithm to help people navigate in indoor environments. The application can be implemented on mobile devices such as a smartphone providing both visual and textual instructions.

Chapter 2

Literature Review

2.1 Campus Navigation Using Augmented Reality

This project aims at providing proper guidance and navigation via a simple android app that is easy to understand and use. The AR would make it easier and more interactive for users to find a certain location [4]. This would help the users to navigate through the campus area in a hassle-free manner It would reduce the confusion regarding the various academic and administrative blocks in the campus area.

The main purpose of the project to develop an android/unity application or handheld application. Provide effective information for navigation through the application, which contains all the necessary information and provide an accurate destination point for users on request. The project gives users an experience of AR while navigation and Android applications are cost-effective.

System analysis plays the most important role in our project success. The parts to identify its objectives. The processes of this phase include the collection of data, validation.

To develop a system, choosing an appropriate methodology is important. The methodology provides the basic guidelines that will guide the developer to accomplish the project task. This section, which is the best methodology need to be applied to this project are discussed.

The system of Mobile application is to guide the user to identify the buildings/departments inside the campus and mainly focuses on finding destinations and details of officials easily. Mainly five modules have been used to implement the application to make the development easier. The modules are as follows.

- Indoor navigation AR module
- Administration module
- official's login module
- official and student management module

There are several commercial navigation applications - such as Google Maps, Yahoo Maps and MapQuest that provide users with directions from one place to another. However, these applications must search along existing roads; they will not able to provide routes that are as precise as an on-campus path would require. In this Project we combine IPS with augmented reality without any external mechanism like sensors to determine the position, just the IPS principle. Real-time mapping can effortlessly make the visitors reach any location inside the facility within a stipulated time. Also, this feature affects the productivity of the facility in the long run, having real-time information on our Smartphone screen.

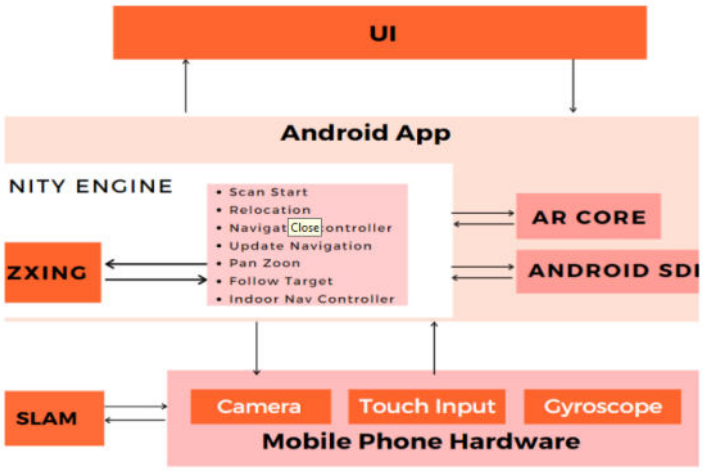

Figure 2.1: Architecture Diagram

2.2 Augmented Reality Indoor Navigation System

There is currently no low-cost scalable smartphone solution available on the market that effectively navigates the consumer from one location to another indoors. Such an app will help users who are unfamiliar with the area. Tourists, for example, would be able to maneuver confidently inside a tourist attraction without assistance. In places such as museums and art galleries, the application could be expanded to include the most optimal or 'common' paths.

Our solution will be using AR Core [5] to display the navigation path to the user on his mobile phone with the help of Anchors which are based on the nav path generated with the help of navmesh. Here the navmesh is created with the help of a floor plan of the area to be navigated. To track the user's position, we use some simple calculations of distance and angle from the previous position to the current position. The user will also have a 2D mini-map for reference while trying to navigate. To run AR Core Applications the device needs to be certified as AR Core compatible. Certification is given by Google where they decide which device to certify based on the quality of the camera, motion sensors, and the design architecture is expected to perform to a standard. Also, the device needs to have a powerful enough CPU that integrates with the hardware design to ensure good performance and effective real-time calculations.

The primary objective of the application is to eliminate all the dependencies like Wi-Fi Access points, Bluetooth beacons, Internet and other devices which require additional sources to realize Indoor navigation. We relied on new but a reckonable technology on Augmented reality to help us realize Indoor Navigation on the device itself. This requires the mobile handset to be ARCore certified from Google during manufacture(nowadays all the units come with this capability) and a QR Code pre-programmed with the location indoors.

The first step in the navigation process is to scan a QR code. As the user opens the application, the user gets an interface for scanning QR-code, once the user points his device camera towards a QR code the application starts operating. The QR-codes are placed at key locations where the users are most likely to pass from. As the user

scans the QR-code, the user is presented with a drop-down box where they can select the destination and a clear view button to clear the previous destination if selected. To aid the user with smooth navigation, there is also a mini-map of the floor, locating his current position and also showing a path to his destination which the user can zoom in and pan if needed. To start navigation the user needs to select his desired destination from the drop-down box, thus setting the path from the starting position and the destination, then the user is shown an AR floating arrow (AR-based anchor) which navigates the user towards the destination in the real environment. As the user reaches his/her destination an AR floating PIN is placed at the destination which indicates that the user has reached the destination.

Our project can successfully help navigate a user in a given space without any additional resources like external hardware or even the Internet. In this project, the space we choose to build is our department floor and the approach we have used can be adapted to any other place. Even with these advantages, it should be kept in mind that there is a need of making a NavMesh of the location be navigated, but its great trade-off compared to buying expensive hardware or installation of such hardware. Moreover, NavMesh can easily be generated by an existing floor plan.

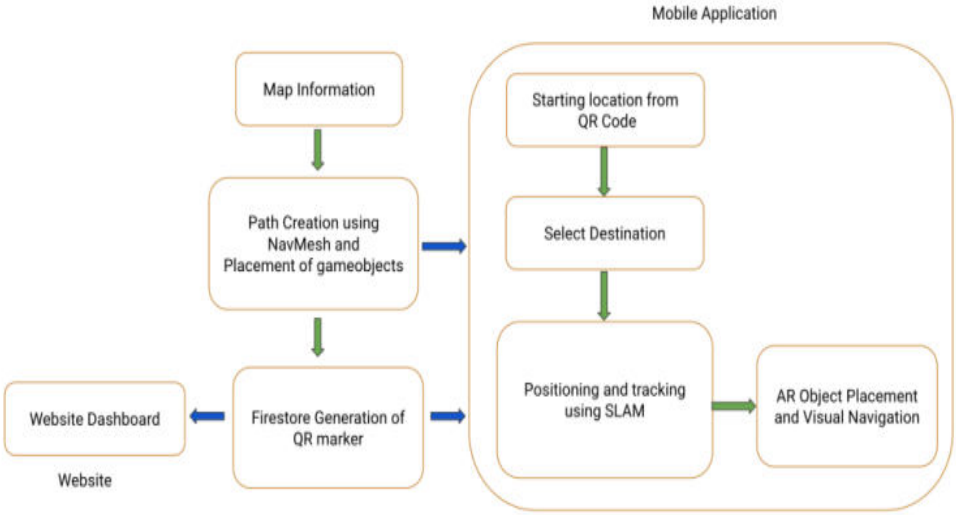

Figure 2.2: Architecture Diagram

2.3 A Web-Based Campus Navigation System With Mobile Augmented Reality Intervention

This project aims to improve the navigation system specifically for campus navigation within UUM. This proposed navigation system includes AR to allow specific places that are being searched to be viewed interactively from different angles [6]. This is important as the UUM campus covers an immense area of 1061 hectare site. UUM consists of 3 main colleges, College of Arts and Sciences (CAS), College of Business (COB), and College of Law, Government and International Studies (COLGIS). These colleges have a total of 17 distinct schools that offer many different programs of study. In addition to that, within the campus area, there are 15 student residential halls and other campus facilities such as the mall, library, university health center, sports center, golf course, and others. All these may make navigation through the campus intimidating for those unfamiliar with the university. Due to these reasons, the main objective of this project is to develop a campus navigation system with AR called as AR-UUM Campus Navigation System which is accessible by mobile devices to guide users within the UUM campus.

In the user design phase, users feedback is gathered to determine the system's requirements such as the options that they expect to have in the system based on the initial idea. This allows initial modeling and prototypes to be created. The user design phase consisted of prototype development, testing, and refinement based on the requirements. In the prototype development, the AR-UUM Campus Navigation System used HTML, JavaScript, and PHP to create the website for the application which is accessible through Glitch. ARToolKit, which is an open-source software library to create AR applications, is also used in this system. ARToolKit uses a computer vision algorithm in tracking the user's viewpoint to enable virtual imagery to be drawn in relative to the AR markers in real-time. This allows tracking through markers within the physical world, and virtual image interaction to run smoothly. In the testing phase, each of the functions was tested independently to ensure requirements were met. AR-UUM Campus Navigation System will be refined until it reaches a

satisfactory design as an effective navigation system with AR technology.

AR-based navigation systems have the potential to improve existing navigation systems by augmenting information onto the real-world object. This paper described the design and development of the AR-UUM Campus Navigation System that is web-based, to navigate locations on the UUM campus. It uses AR to overlay the information as images in three dimensions of the searched location on campus. This enables the user to view the buildings and the location that they are looking for. AR is a promising technology which the implementation of it in the development of a navigation system has shown to improve the user's experience based on the feedback received. AR-UUM Campus Navigation has the potential to be widely used on campus once the system is fully developed and completed. The following figure shows the system requirements of this proposed system.

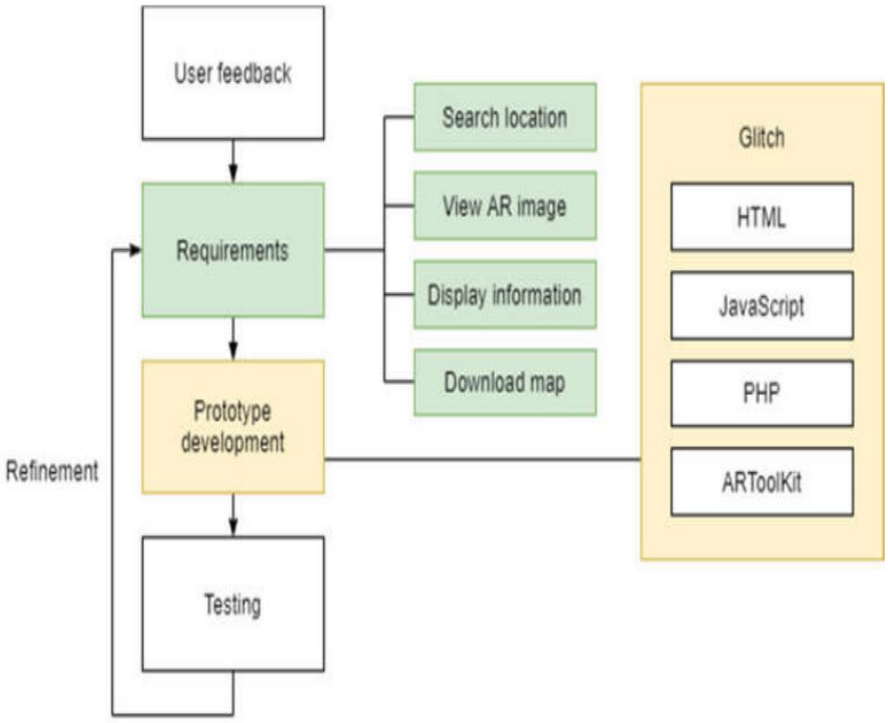

Figure 2.3: System Requirements

2.4 Augmented Reality Navigation

The main purpose of this application is to provide a mobile- based, controlled-to-visitor solution as they move around any buildings such as College, Supermarket, Hospital, etc., and,the purpose is to reduce time-consumption, split-group and gain efficiency, accuracy [7], application friendliness, as well as the speed, of the application for a small area of the building.

Provide an easy-to-use, mobile-based solution system, which will contain all the necessary information, to ensure convenience, accurate navigation and identification of various buildings, doors and to help guests reach their desired location without difficulty. The scope of the application is determined by the time allocation, resources and customer demand. The scope of the program is limited and can grow the way it is done. Users can navigate the building with the advice provided by the AR browser. They can view construction, locations etc. Or they are searching for places.The project aims to use augmented reality to develop the type of advertising that facilitates circulation within the home. An augmented reality is the idea of a real world transmitted by some kind of sensory input to a production such as sound or graphic. This app is designed for smartphones as almost all smartphones today are equipped with the camera and the processing power of the graphics that provide access to other graphics. This program is developed using the Android SDK and the Vuforia Augmented Reality SDK.

This paper presented a rigorous literature review of AR navigation techniques including design considerations and various navigation types. It also presents a variety of opportunities and challenges for using AR in navigation. Augmented reality is a very powerful way to improve user experience in navigation applications. Apart from the user experience, it extends far beyond driver safety. Examination of research literature suggests that AR significantly increases driver's attention. Although the current technologies are far from a full-fledged AR experience, research is moving fast and several institutions and companies such as BMW, Pioneer, and Toyota are working on development in navigation. It is important to note that the use of AR in

navigation is highly dependent on advances in the field of augmented reality. Also, the acceptance for AR navigation will depend on the better user experience. It will be interesting to see how this technology develops in the future.

In general, augmented reality navigation can work as follows:

1. Get real-world views from the user's perspective.
2. Get user tracking location information. This information typically links GPS.
3. Generate visual world information based on real-world views and geographical location.
4. Register the physical information generated by the real world view and display the user information, thus creating augmented reality.

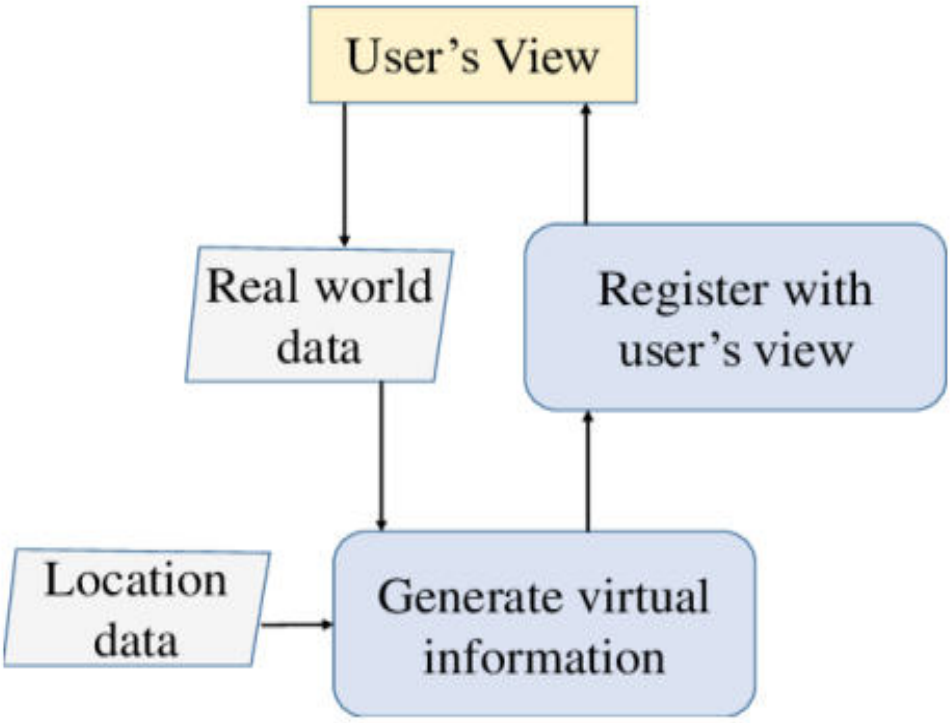

Figure 2.4: Flow Chart for AR Navigation

2.5 PrismAR: A Mobile Augmented Reality Mathematics Card Game For Learning Prism

As the age of digital learning has evolved, augmented reality (AR) has grown in popularity. Although AR incor- porate virtual objects into the real world, virtual reality incorporates a physical object into the virtual world. By overlaying digital content on top of the real world, AR will create new experiences. AR is a powerful instructional technique that combines multiple instructional strategies to bolster the learning process. With the rise in popularity of smart devices, the development of AR technology in daily life has accelerated dramatically. Using digital infor-mation [8] such as graphics and sounds, AR is common for improving user experience. The growing popularity of AR applications with location awareness is a result of recent advancements in mobile technology.

This project aims to assist primary 3 students (9 years old) in developing their mathematical abilities and making prism mathematical concepts more interactive. It is con- structed using Augmented Reality (AR) technology, which enables users to interact with the educational materials. PrismAR has lessons that include learning exercises and quiz. It can show the prism's edges and vertices in both 2D and 3D views. This game involves flashcards that must be scanned with the help of the mobile application. This mobile game will assist students in visualizing the prism in three dimensions and will provide students with fun ways to learn about prisms. Additionally, it is capable of exposing students to AR games and facilitating immersive teaching and learning.

The waterfall model of the System Development Life Cycle (SDLC) is used to complete this project. This model is composed of five stages, the first of which is the requirement. The project's requirements are analysed. The second stage is the design phase, during which the application's interfaces and artefacts are designed following the previous phase's precise specifications. The third stage is the production phase, which is followed by the testing phase. The final step is maintenance, during which any issues that arose during the testing phase would be resolved. In mobile application

when a user first launches the program, they can enter the homepage by pressing the start button.To view the prism tab, the user must first press the start button.

To see the prism, the user must scan the marker after pressing the start button. The prism page will be shown if the marker is found. If the marker is already unable to be identified, the user must re-scan it. The prism's details are available on the prism website. The user will choose a different view of the detected prism, with views available in 2D or 3D, Faces, Vertexes, and Edges. The next tab is the test page. After viewing the prism, the user can access the evaluation. The user must press the test button located on the prism tab. The prism subject is covered in the test page's questions. The answers to each question are given impartially. After the user clicks the response button, the programme will display whether the answer selected is correct or incorrect.The user is provided with a home button to allow them to return and select a different marker.

In conclusion, our project has shown that it is a fun and engaging method of learning about prisms. The results indicate that using an augmented reality-based card game format to teach prism has been successful in increasing students' mathematics competence. Based on the testing and evaluation, Overall, the assessment returned an average mean of 4.98, which was interpreted as 'highly acceptable.' The pre-test mean result is 12.6 (S.D. = 2.012), while the post-test mean result is 14.6 (S.D. = 1.789). In the future, we will enhance the marker's accuracy. The test section's use of language to include test questions also needed to be strengthened, as some users found the questions confusing. Apart from that, the app can be enhanced by incorporating animation to capture the user's attention. By including some sound effects and narration about the prism material, the app could be improved. Additionally, the 3D prism model can be enhanced by using the movement of the model without rotating the marker.

PAPER	PROBLEM STATEMENT	ALGORITHM	FINDINGS
Campus Navigation Using Augmented Reality	To implement an android or unity application that provide effective information for navigation through the application.	A* Algorithm	Scan QR code for downloading app.
Augmented Reality Indoor Navigation System	To design and build an indoor navigation system,with the assistance of a mobile device camera and gyroscope.	NavMesh	Display the navigation path to the user on his mobile phone with the help of Anchors
A Web-Based Campus Navigation System with Mobile Augmented Reality Intervention	This proposed navigation system includes AR to allow specific places that are being searched to be viewed interactively from different angles.	Computer Vision Algorithm	Using of AR ToolKit
Augmented Reality Navigation	The main purpose of this application is to provide a mobilebased,controlled-to-visitor solution as they move around any buildings.	A* Algorithm	Design of Mobile Application
PrismAR: A Mobile Augmented Reality Mathematics Card Game for Learning Prism	This project aims to assist primary 3 students in developing their mathematical abilities and making prism mathematical concepts more interactive.	No algorithm	Scanning of QR code

Table 2.1: Consolidated table

Chapter 3

Requirement Specification

3.1 Functional Requirements

The main aim of the project is to have a campus navigation system that assists the user to get around the campus. For that we require a detailed campus map, the application should allow the user to type in a destination and the anchor shows which path to navigate, a pop up message containing the details of current person in charge, for instance the details of current HOD, when the anchor passes by HOD's cabin. It also requires camera's permission as the navigation is done through the mobile camera.

3.1.1 Location Module

- Verify user's location

- When the user opens the application, it will prompt the user to confirm the current location.

3.1.2 Recognizing A Building Module

- Find buildings and locations and then turn them into targets to be augmented.

- Once the user confirms the location, application's camera opens and building recognition process starts.

3.1.3 Augmentation Module

- View an augmented targets through their camera .

3.2 Users And Human Factors Requirements

Different types of users that the system supports

1. The users will mainly be campus students, visitors, and Faculty.

The skill level of each type of user

1. They must possess the ability to use and navigate an android phone.
2. They must be able to navigate the Google Play Store.

Type of training and documentation that is provided for each user.

1. The app should be able to be picked up and used.
2. If during our user testing phase many users had trouble, we could include a small tutorial on the app.

The system detection and prevention from misusing the software

1. Detect if there is no internet connection, and ask the user to connect to wifi or find a signal.

3.3 Security Requirements

Due the nature of our application, security is not an issue. We don't store or collect any personal information including but not limited to user's location, passwords, emails, addresses, name, social security number, credit card number, etc.

3.4 Quality Assurance Requirements:

Availability

Available as long as the user has internet connection, and Google's server is up.

Maintainability

New versions can be updated via the Google Play Store.

Portability

This app will be portable as the user's phone is.

Chapter 4

Proposed System and Design

4.1 Proposed system

Our system is an augmented reality application system based on mobile terminals, which provide navigation to users in the form of 3D maps. Thus, it can provide users with good sensory experience by combining augmented reality information. The main modules of this system can be divided into the 3D virtual and reality fusion module, SLAM navigation module and Unity interactive module. Each module is designed with the principle of high cohesion and low coupling. The details of the main modules of the system are shown in Figure 4.1.

Our system will be using AR Core to display the navigation path to the user on his mobile phone with the help of Anchors which are based on the nav path generated with the help of NavMesh. Here the NavMesh is created with the help of a floor plan of the area to be navigated. To track the user's position, we use some simple calculations of distance and angle from the previous position to the current position.

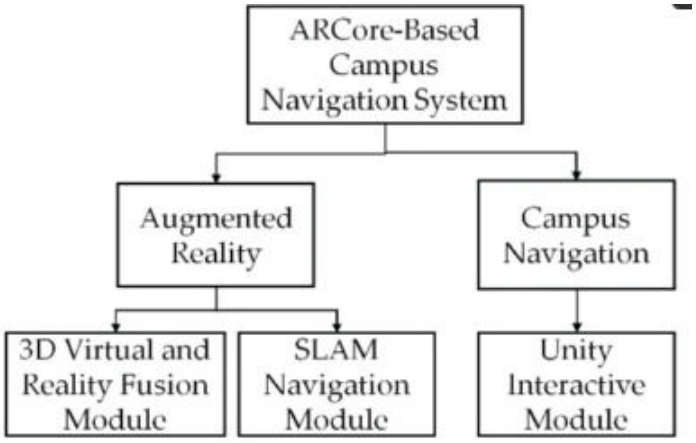

Figure 4.1: Block Diagram

4.2 Feasibility Study

All projects are feasible when given unlimited resources and infinite time. It is both necessary and prudent to evaluate the feasibility of a project at the earliest possible/ time. An estimate is made of whether the identified user needs may be satisfied using current software and hardware technologies. The study will decide if the proposed system will be cost effective from the business point of view and if it can be developed in the given existing budgetary constraints. The feasibility study should be relatively cheap and quick. The result should inform the decision of whether to go ahead with a more detailed analysis. The project is economically feasible as the only cost involved is having a mobile phone with minimum requirements. For the user to access the application only cost involved will be getting access to the internet. The application requires technical guidance in the beginning to get the users acquainted with the application. The feasibility study is done in these phases:

- Technical feasibility
- Operational feasibility
- Economic feasibility

4.2.1 Technical Feasibility

Technical feasibility study deals with the hardware as well as software requirements. The scope was whether the work for the project is done with the current equipment and the existing software technology. In our system we are using augmented reality based techniques. This is system build using the programming language c sharp.

4.2.2 Operational Feasibility

The purpose of the operational feasibility study is to determine whether the new system will be used if it is developed and implemented. Our system will operate after it is developed and be operative once it is installed. The system is operatable by the user easily. Thus the system is operationally feasible.

4.2.3 Economic Feasibility

The purpose of the economic feasibility assessment is to determine the positive economic benefits to the organization that the proposed system will provide.
Our system is economically feasible and it provides benefits to the organization. This product is cost effective, so that the new comers to the campus would be more benefited, as it is effortless in installation and maintenance.

4.3 Design

Design means the process of devising a system,component,or process to meet desired needs. My system contains both software and hardware components.Design is the process of intentionally creating something while simultaneously considering it's objective (purpose), function, economics, sociocultural factors, and aesthetics. A good design can make people trust you more, alter customer perception, make you memorable, get your message across, make your product work to the fullest, and shine.

4.3.1 Architecture Diagram

An architectural diagram gives the visual representation that maps out the implementation of the system. It shows the general structure of the system and the associations, limitations, and boundaries between each element.

By analyzing the user's needs and the main framework of the mobile AR navigation system, the logical architecture of the proposed system is shown in Figure 4.2. Firstly, the system obtains scene information from the current video stream by utilizing the mobile phone camera and sensor in order to finish map initialization and 3D objects initialization. Secondly, the system prompts users to enter the starting place and destination. Thirdly, the system transmits corresponding information of the starting place and destination to the server. Fourthly, the server sends transmitted information to the mobile phone after querying the database. Later, the mobile phone plans the path according to the coordinates of the interest point. During the process of navigation, the system adjusts the drift value for tracking match. If it loses tracking, area learning is used to recover from this situation. Finally, when the user arrives the destination, it superimposes the enhanced information with the interest point in order to achieve the virtual reality fusion effect.

The architecure diagram of our system can be explained as follow. Initially there is a map initialization where the floor map of the campus is given.Then thie map is build in 3D. Then we have to give an input destination to where we have to go. There will be a route plan to reach the destination.Then the tracking match is done using the camera and IMU. By incorporating an IMU into an AR-based campus navigation system, the device can track the user's movement and orientation in three-dimensional space, and use that information to provide real-time location-based information, including directional cues and points of interest. When we have reached the destination it will display the information of the destination. It also include SLAM. SLAM stands for Simultaneous Localization and Mapping, and it is a technology that allows a device or robot to create a map of an unknown environment while simultaneously keeping track of its own location within that environment.

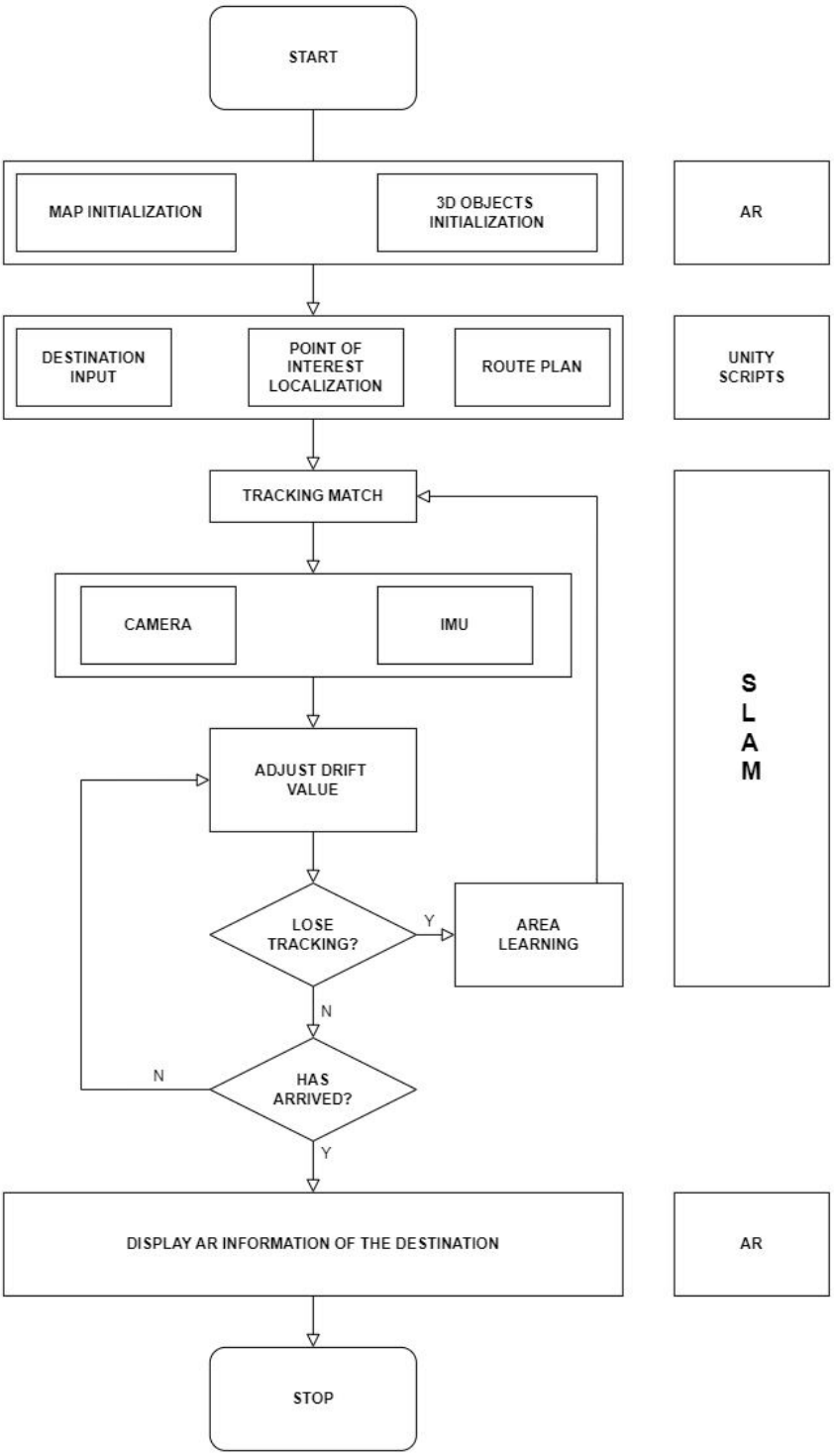

Figure 4.2: Architecture Diagram

4.3.2 Use case Diagram

A use case diagram is a graphical depiction of a user's possible interactions with a system. A use case diagram shows various use cases and different types of users the system has and will often be accompanied by other types of diagrams as well. The use cases are represented by either circles or ellipses. The actors are often shown as stick figures.

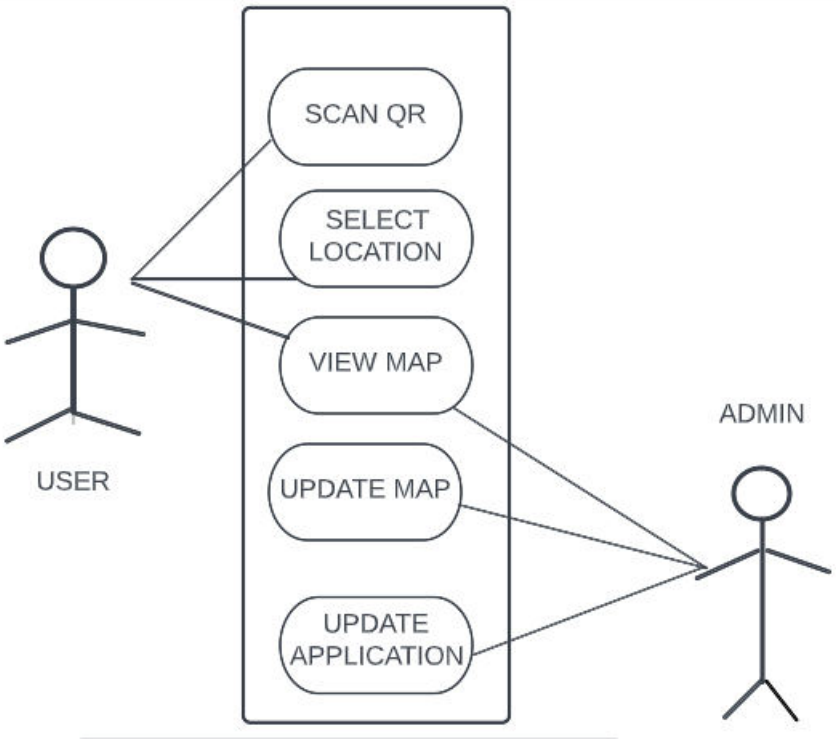

Figure 4.3: Use case Diagram

The Use case diagram of our system contains a user, admin and five different interactions that the user and admin makes. Here the user have to scan the QR code after that the user have to select the destination. Then the user gets the map showing to the destination. The admin can view the map and update the map according to the changes that have been made. The admin updates the application whenever new updates are available.

4.3.3 Data Flow Diagram

A data flow diagram (DFD) shows the flow of information of the system.Defined symbols like rectangles, circles and arrows, plus short text labels are used to show data inputs, outputs, storage points and the routes between each destination.
Our system has three levels of Data Flow Diagram, DFD LEVEL 0, DFD LEVEL 1, DFD LEVEL 2.

DFD (LEVEL 0)

DFD Level 0 is also called a Context Diagram. It's a basic overview of the whole system being modeled. It's designed to be an at-a-glance view, showing the system as a single high-level process, with its relationship to external entities. It should be easily understood by a wide audience, including stakeholders, business analysts, data analysts and developers. The DFD level 0 of our system includes the user and system.

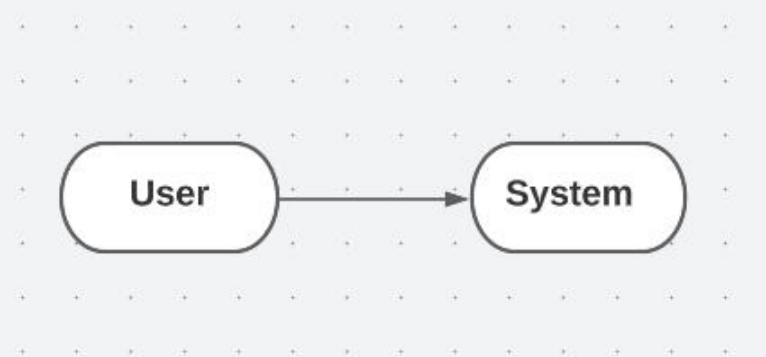

Figure 4.4: DFD level 0

DFD (LEVEL 1)

DFD Level 1 provides a more detailed breakout of pieces of the Context Level Diagram. This highlights the main functions carried out by the system, as you break down the high-level process of the Context Diagram into its subprocesses. The DFD level 1 of our system includes user, who gives the input destination and uploads the

road map to the destination. The system then analyses the user inputs and guides to the destination the user want to arrive.

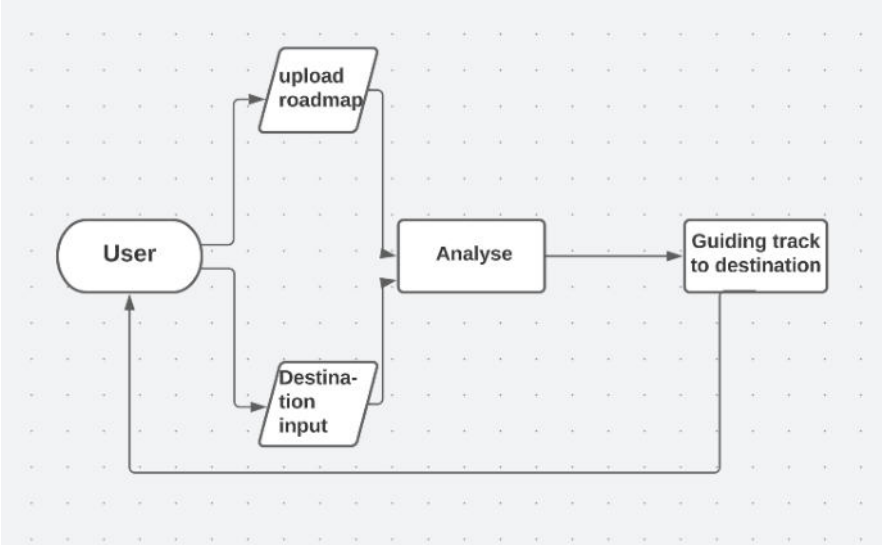

Figure 4.5: DFD level 1

DFD (LEVEL 2)

DFD Level 2 then goes one step deeper into parts of Level 1. It may require more text to reach the necessary level of detail about the system's functioning. The DFD LEVEL 2 of my system is as shown in the figure below.

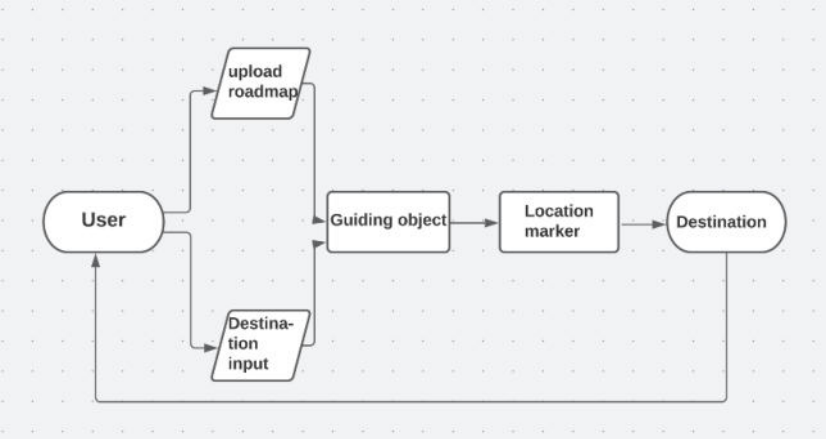

Figure 4.6: DFD level 2

4.4 Methods And Techniques

1. Setting up Unity: Start by downloading and installing Unity on your computer. Once installed, create a new Unity project.

2. Setting up the AR camera: Import the AR Foundation package from the Unity Asset Store and set up an AR camera in the scene. This will allow you to view the augmented reality environment through your mobile device's camera.

3. Creating a map: Create a map of the campus in Unity, including all the buildings and landmarks that you want to be included in the navigation system. You can use 3D models or simple sprites to represent the buildings and landmarks.

4. Adding markers: Place markers on the map to represent important locations, such as classrooms, offices, and restrooms. You can use 3D models or simple sprites for these markers as well.

5. Adding navigation logic: Write code to handle the navigation logic. This should include a way for users to select a destination, a pathfinding algorithm to calculate the best route, and a way to display the route on the screen.

6. Implementing AR features: Use AR Foundation to implement AR features, such as placing markers and displaying directions in the real world.

7. Testing: Test your app on a mobile device to ensure that everything is working as expected. You can use Unity's remote app to test the app on your device while still in the Unity editor.

8. Deploying the app: Once you are satisfied with your app, build and deploy it to your mobile device. You can distribute it through the App Store or Google Play Store or share it with other users through other methods such as email or direct download.

Chapter 5

Implementation

5.1 Module Split Up

Camera Module

A camera module is required in the working of the system since the system renders the device's camera as a background to the attached Unity camera component. When using the front-facing (selfie) camera, this temporarily inverts culling when rendering. There are different functions which helps in the smooth functioning of the system. Such functions which are used in this module can be as follows: **[RequireComponent(typeof(Camera))]**:

This function helps to import the camera's background as the systems background.

Indoor module

To play an audio attached to the collision object the red pointer is colliding with.On entering the destination a text message will be displayed. To stop playing the audio when the collision stops happening we use the function OnTriggerExit().

```
void OnTriggerEnter(Collider other)
{
    camPoseText.text = other.gameObject.name;
         if (other.gameObject.tag == "shuli")
        {
            if (other.GetComponent<AudioSource>() != null)
            {
               // other.GetComponent<AudioSource>().Play();
                baozhitozongjiao.SetActive(false);
            }
            _ShowAndroidToastMessage("The destination has arrived！");
            bookguide.SetActive(true);

            }
  }
```

Permission Control Module

In this module first set up touch input program while using instant preview in editor. Then for update this application we use the code.

```
if (Input.GetKey(KeyCode.Escape))
            {
                Application.Quit();
            }
            if (Session.Status != SessionStatus.Tracking)
            {
                const int lostTrackingSleepTimeout = 15;
                Screen.sleepTimeout = lostTrackingSleepTimeout;
            }
            else
            {
                Screen.sleepTimeout = SleepTimeout.NeverSleep;
            }

            if (m_IsQuitting)
            {
                return;
            }
```

If there is no unity activity,then

```
if (unityActivity != null)
            {
                AndroidJavaClass toastClass = new AndroidJavaClass
("android.widget.Toast");
                unityActivity.Call("runOnUiThread", new AndroidJavaRunnable(() =>
                {
                    AndroidJavaObject toastObject =
                        toastClass.CallStatic<AndroidJavaObject>(
                            "makeText", unityActivity, message, 0);
                    toastObject.Call("show");
                }
```

Follow Target Module

It will update the object's camera angle,camera height and eulerAngles as it undergoes movement.

```
  void LateUpdate()
  {
      if (!targetToFollow)
          return;
      Vector3 targetEulerAngles = targetRot.eulerAngles;
      float rotationToApplyAroundY = targetEulerAngles.y + 180.0f;
      float heightToApply = targetToFollow.position.y + heightOverTarget;
      float newCamRotAngleY = Mathf.LerpAngle(transform.eulerAngles.y,
       rotationToApplyAroundY, rotationSmoothingSpeed * Time.deltaTime);
      float newCamHeight = Mathf.Lerp(transform.position.y, heightToApply,
       heightSmoothingSpeed * Time.deltaTime);
      Quaternion newCamRotYQuat = Quaternion.Euler(0, newCamRotAngleY, 0);
      transform.position = targetToFollow.position;
      transform.position -= newCamRotYQuat * Vector3.forward * distanceToTargetXZ;
      transform.position = new Vector3(transform.position.x,
       newCamHeight, transform.position.z);
      transform.LookAt(targetToFollow);
  }
```

5.2 Tools and Techniques

Google ARCore

ARCore is Google's platform for building augmented reality experiences. Using different APIs, ARCore enables your phone to sense its environment, understand the world and interact with information. Some of the APIs are available across Android and iOS to enable shared AR experiences. ARCore uses three key capabilities to integrate virtual content with the real world as seen through your phone's camera:
- Motion tracking allows the phone to understand and track its position relative to the world.
- Environmental understanding allows the phone to detect the size and location of all type of surfaces: horizontal, vertical and angled surfaces like the ground, a coffee table or walls.
- Light estimation allows the phone to estimate the environment's current lighting conditions.

Unity

Unity is a tool that allows you to accomplish different types of tasks related to the game production process. Unity provides game developers with a 2D and 3D platform to create video games. What makes Unity so appealing to developers is that it's simple to use so that you don't need to start from scratch. Unity is a popular cross-platform game engine and development platform used to create video games, simulations, and other interactive 3D, 2D, virtual and augmented reality experiences. It provides developers with a comprehensive set of tools and features that enable them to design, develop, and deploy games and interactive applications for multiple platforms, such as PC, Mac, mobile devices, game consoles, and the web.

Unity allows developers to write code in C-Sharp or JavaScript, and provides a wide range of graphical tools and visual scripting options to create and manipulate game objects, animations, physics, audio, and user interfaces. It also includes a built-in editor with a real-time preview that allows developers to iterate quickly and see

the changes they make in real-time. Unity is used by game developers, artists, and designers worldwide to create a wide variety of games, from indie titles to AAA blockbuster hits. Additionally, it has been used in industries outside of gaming, such as architecture, engineering, and film production, to create interactive experiences and visualizations.

Android Studio

Android Studio is the official integrated development environment (IDE) for Google's Android operating system, built on JetBrains' IntelliJ IDEA software and designed specifically for Android development. It is available for download on Windows, macOS and Linux based operating systems. It is a replacement for the Eclipse Android Development Tools (E-ADT) as the primary IDE for native Android application development.

Android Studio was announced on May 16, 2013, at the Google I/O conference. It was in early access preview stage starting from version 0.1 in May 2013, then entered beta stage starting from version 0.8 which was released in June 2014. The first stable build was released in December 2014, starting from version 1.0. At the end of 2015, Google dropped support for Eclipse ADT, making Android Studio the only officially supported IDE for Android development.

On May 7, 2019, Kotlin replaced Java as Google's preferred language for Android app development. Java is still supported, as is C++.

Chapter 6

Result And Discussion

It navigates a fresher or a visitor through the campus. It will ask the user to give the required destination with in the campus.On reaching the destination it will Produce an audio signaling the fresher that they have reached their targeted place in the campus. A text message is also popped up when the destination is reached.

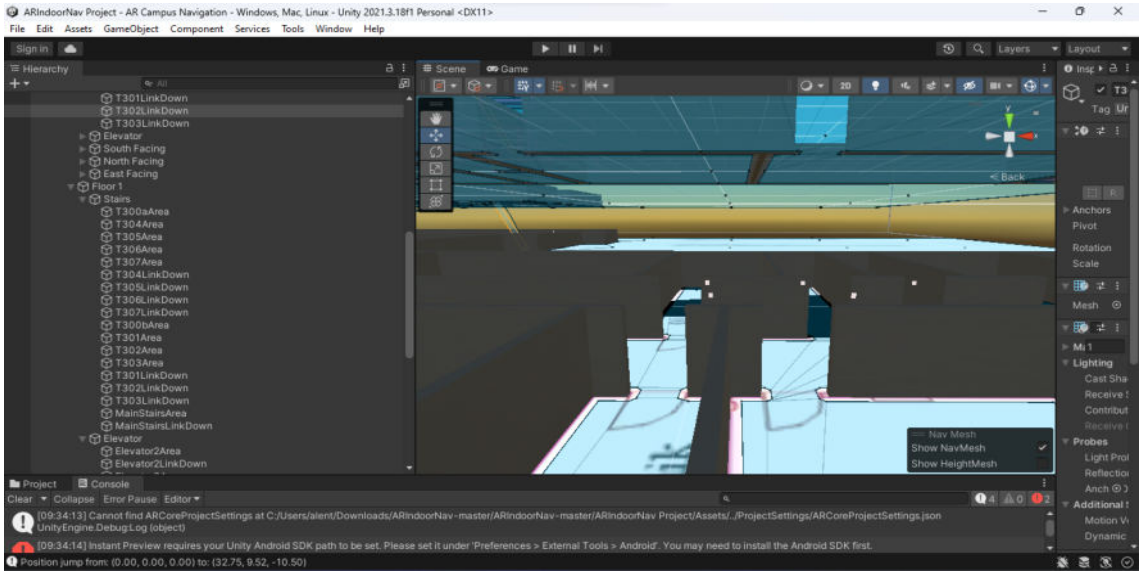

Figure 6.1: Map Design

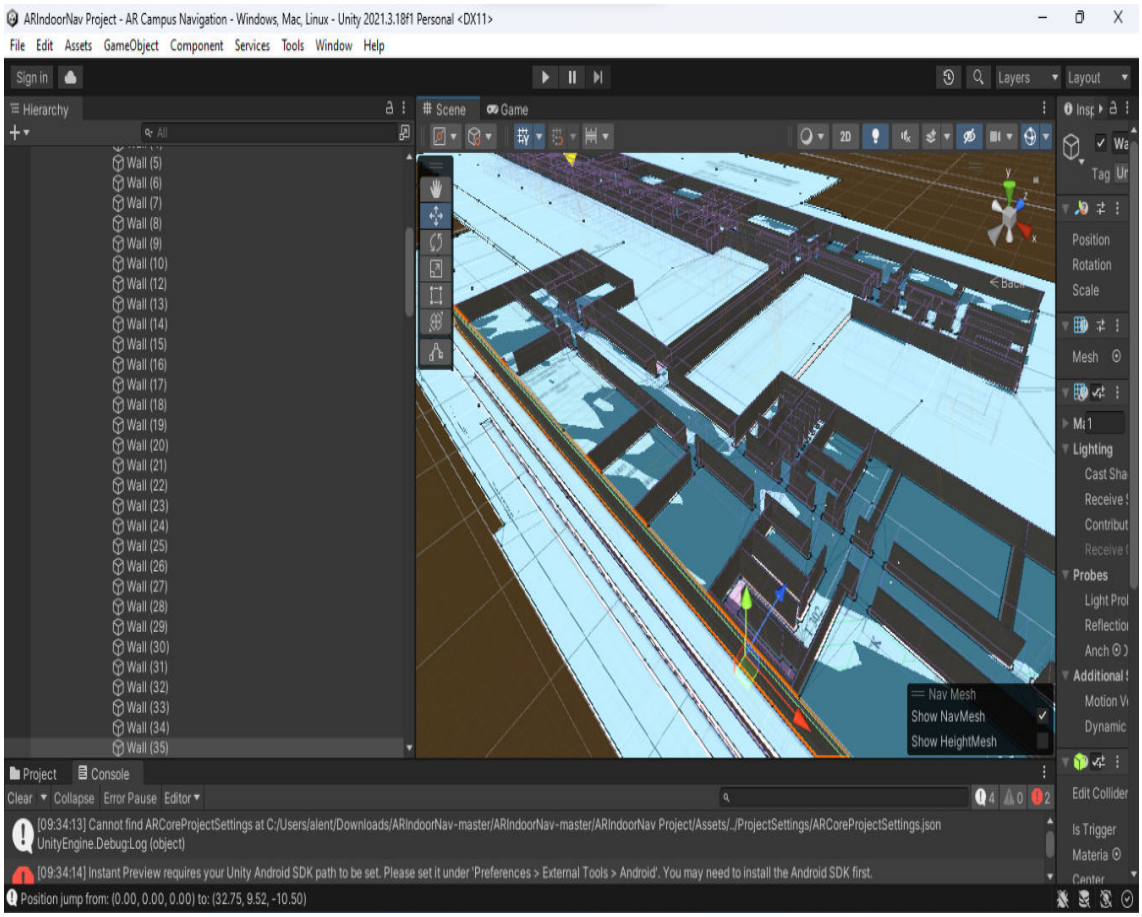

Figure 6.2: Map design

The figure shows a top view map of a campus navigation system. The map displays a simplified representation of the campus layout, including buildings, pathways, and points of interest such as classrooms, offices, and restrooms. The map is color-coded to highlight different areas and provide visual cues to the user.

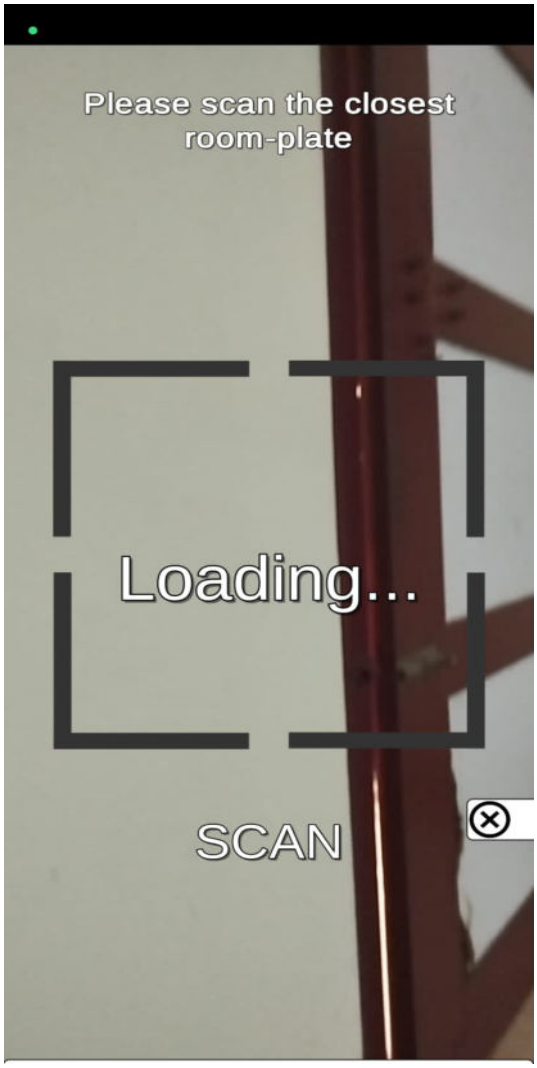

Figure 6.3: Scanning Interface

The figure shows a scanning interface of a map for an AR-based campus navigation system. Scanning interface is displayed when the user selects the scan option in the navigation system. The interface could include a camera view that shows the user's surroundings and a button to initiate the scan. The scanning interface provides an intuitive and interactive way for users to create and update the map of the campus environment, allowing for accurate and up-to-date navigation information to be provided in real-time.

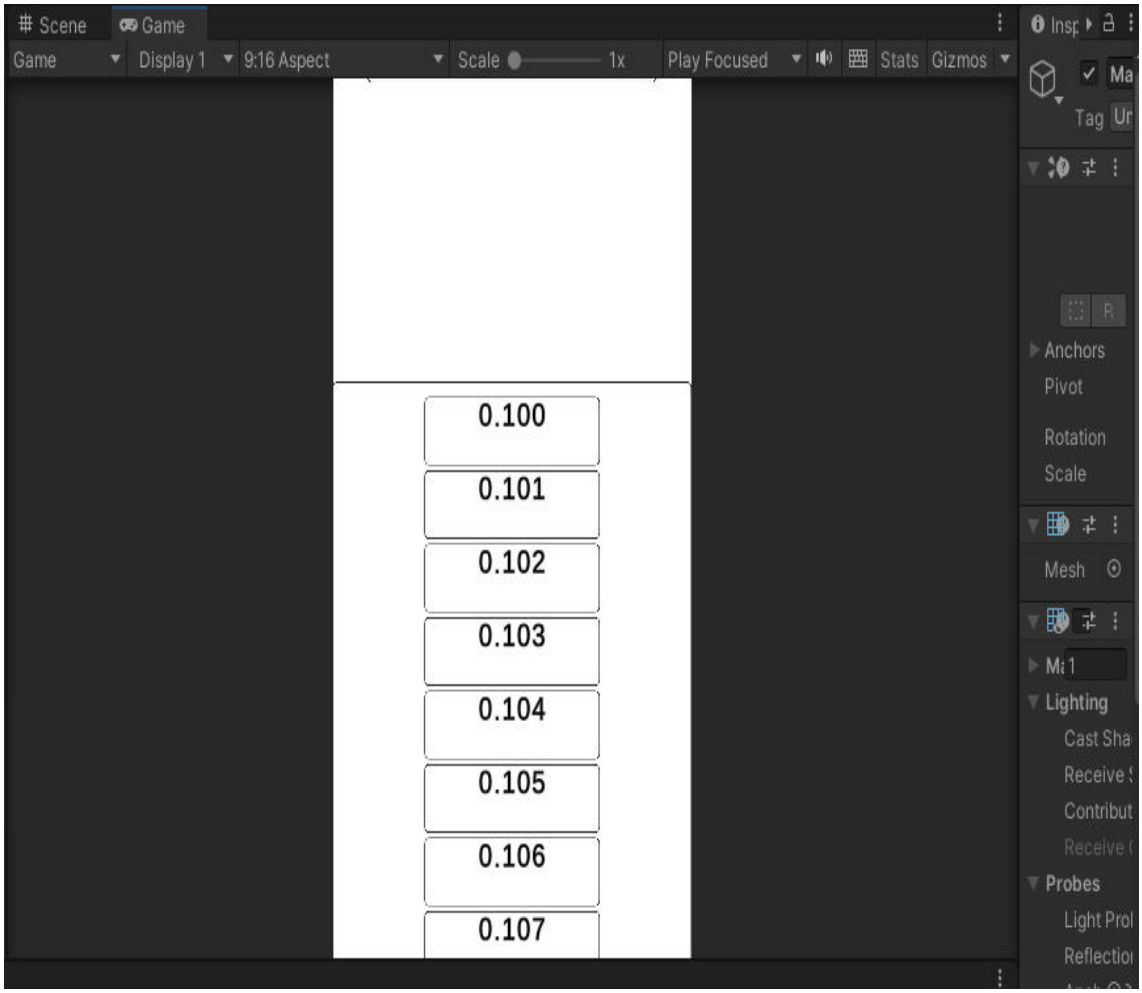

Figure 6.4: List of location

Once the marker is recognized, the navigation system can display information about the user's current location or nearby points of interest on the scanning interface.The user can select the desired location from the list given and they will be assisted accordingly

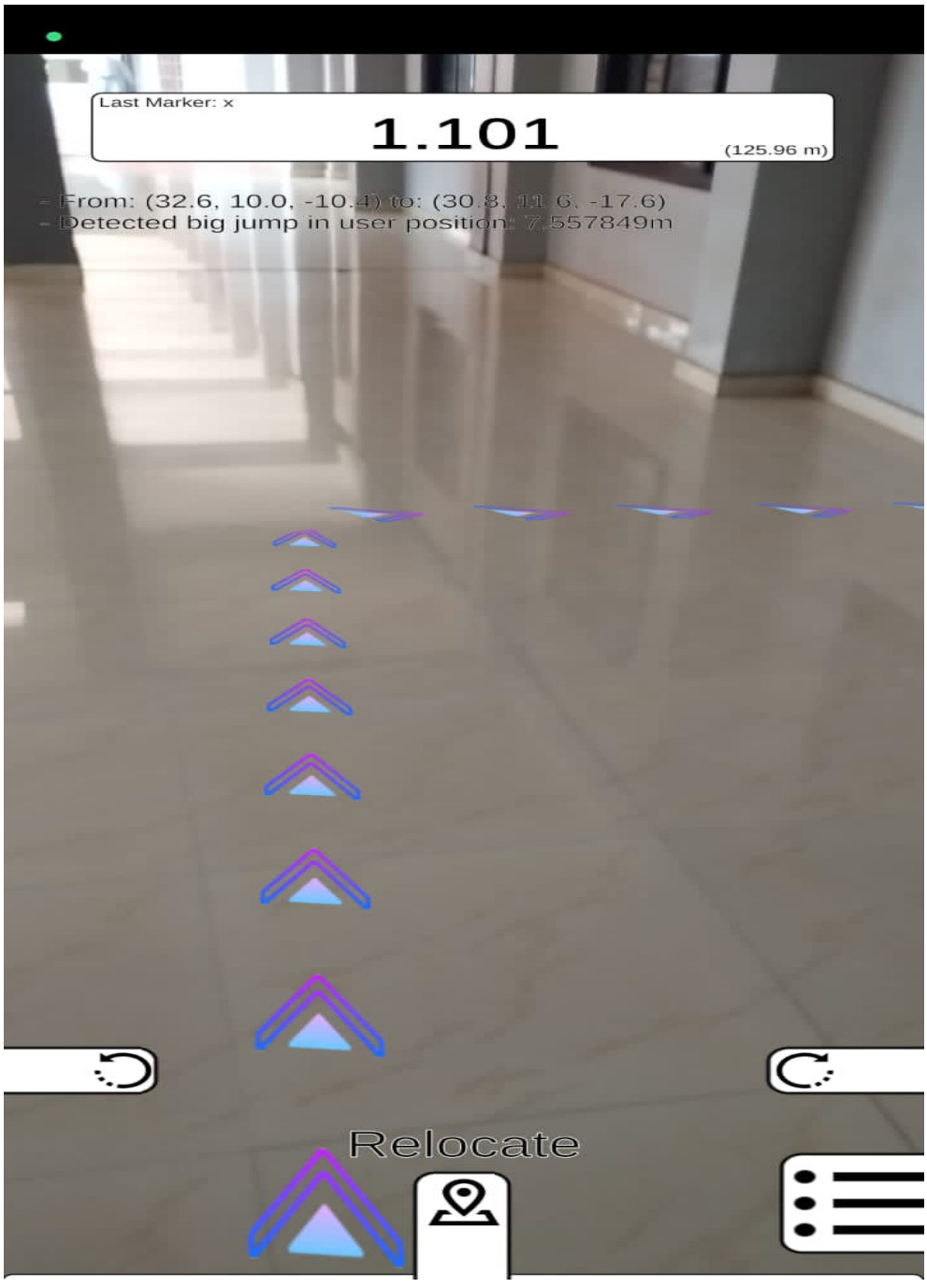

Figure 6.5: Result

Chapter 7

Conclusion

AR-based navigation systems have the potential to improve existing navigation systems by augmenting information onto the real-world object.Our project can successfully help navigate a user in a given space without any additional resources like external hardware. Real-time mapping can effortlessly make the visitors reach any location inside the facility within a stipulated time. Also, this feature affects the productivity of the facility in the long run, having real-time information on our Smartphone screen.

AR is a promising technology which the implementation of it in the development of a navigation system has shown to improve the user's experience based on the feedback received.It is important to note that the use of AR in navigation is highly dependent on advances in the field of augmented reali-ty. Also, the acceptance for AR navigation will depend on the better user experience. It will be interesting to see how this technology develops in the future.

There are several possible future enhancements for campus navigation systems that could improve their functionality and user experience. Here are a few potential ideas:

1. Integration with AI voice assistants: Integrating the campus navigation system with AI voice assistants like Siri or Google Assistant would allow users to receive real-time voice prompts and directions, without needing to look at their device's screen. This could make the navigation experience more hands-free and

convenient.

2. Integration with wearables: Integrating the navigation system with wearable devices like smartwatches or augmented reality glasses could allow users to receive navigation prompts and information directly on their wearable device, without needing to look at their smartphone.

3. Indoor positioning system: Implementing an indoor positioning system that utilizes Wi-Fi or Bluetooth signals to accurately determine a user's location within a building could improve the accuracy of the navigation system, particularly in areas where GPS signals are weak or unavailable.

4. Integration with social media: Integrating the navigation system with social media platforms like Facebook or Twitter could allow users to share their location and real-time updates with friends and colleagues, making it easier to coordinate and meet up with others on campus.

5. Personalized recommendations: Implementing a personalized recommendation system that uses machine learning algorithms to analyze a user's preferences and behaviors could provide customized recommendations for nearby restaurants, cafes, or other points of interest based on their individual interests and preferences.

   Overall, there are many potential future enhancements for campus navigation systems that could improve their functionality, accuracy, and user experience, making it easier and more convenient for users to navigate and explore campus environments.

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This is to certify that the report entitled **CROP MONITORING AND MATURITY DETECTION APP FOR PLANTATION CROPS USING DEEP LEARNING** submitted by **FAEZ MUHAMMED M** (VML19CS057), **MANU MATHEW JISS** (VML19CS070), **NIHAL V GEORGE** (VML19CS076) & **SHAHAN ABDULLA K** (VML19CS092) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering is a bonafide record of the project work carried out by them under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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This is to certify that the report entitled **Web Ennumeration And Vulnerability Detection** submitted by **Theerth M** (VML19CS112), **Anurag A M** (LVML19CS116), **Kiran P P** (LVML19CS118) & **Aromal Prakash K V** (LVML19CS117) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering is a bonafide record of the project work carried out by them under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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This is to certify that the report entitled **Skin disease prediction using SVM** submitted by **Abhijai K (VML19CS002), Adwaid Sahadevan M (VML19CS010), Akhil Kumar K (VML19CS015), Alan Saji (VML19CS019)** to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering is a bonafide record of the project work carried out by them under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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This is to certify that the report entitled **VOICE ASSISTANT FOR MAIL** submitted by **AKSHAY JAYACHANDRAN V V** (VML19CS017), **AYSHA NAHADHA** (VML19CS044), **GAYATHRI P V** (VML19CS081) & **DEEKSHITH K K** (VML19CS048) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering is a bonafide record of the project work carried out by them under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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This is to certify that the report entitled **Foculize: An Innovative Attention Detection System** submitted by **Adwetha Falgunan** (VML19CS012), **Diya P** (VML19CS052), **Darsan Dinesh** (VML19CS046) & **Sanjuktha Sanjay** (VML19CS091) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering is a bonafide record of the project work carried out by them under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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This is to certify that the report entitled **Fund Transfer Tracking Using DLT** submitted by **Adila Farha PK (VML19CS007), Adithya T K (VML19CS008), Nathasha K V (VML19CS074), Vismaya Vinoth Kumar (VML19CS114)** to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering is a bonafide record of the project work carried out by them under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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This is to certify that the report entitled **A Noval Driver Assistant Using MANET** submitted by **Achal Dev P** (VML19CS005), **Harold Prakash** (VML19CS061), **Sanand Chandran** (VML19CS089) & **Shijas P** (VML19CS096) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering is a bonafide record of the project work carried out by them under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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This is to certify that the report entitled **TRIP PLANNER- Optimized and improved system for an entire travel plan using hybrid recommender system** submitted by **Jithin Jose** (VML19CS065), **Sidharth A S** (VML19CS101) and **Sooraj Mohan** (VML19CS108) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering is a bonafide record of the project work carried out by them under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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This is to certify that the report entitled **BLOCKCHAIN IN HEALTHCARE AND PHARMACEUTICAL SUPPLY CHAIN** submitted by **Aleena Mathews** (VML19CS021), **Alisha Mathew** (VML19CS023), **Don Mariya** (VML19CS054) and **Kavya Pushpan** (VML19CS067) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech degree in Computer Science and Engineering is a bonafide record of the project work carried out by them under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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This is to certify that the report entitled **AUTOMATIC X-RAY REPORT GENERATOR USING DEEP LEARNING** submitted by **ANAGHA P P** (VML19CS026), **ANEESHA S** (VML19CS028), **ANUSREE VENU** (VML19CS037), **SHRADHA SUJITH** (VML19CS098) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering is a bonafide record of the project work carried out by them under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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This is to certify that the report entitled **Automatic Traffic Light Control System using Artificial Intelligence and Image Processing** submitted by **Janvin Joseph** (VML19CS063), **Kiran Valsalan Nair** (VML19CS069), **Sneha Anil** (VML19CS104) & **Sharanya Ullas** (VML19CS094) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering is a bonafide record of the project work carried out by them under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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This is to certify that the report entitled **HUMAN EMOTION DETECTOR** submitted by **ANJIMA GOVINDAN** (VML19CS030), **ARYA SAJIV** (VML19CS039), **RHEA RENJITH** (VML19CS084) and **ROBY K S** (VML19CS086) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering is a bonafide record of the project work carried out by them under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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This is to certify that the report entitled **WILD ANIMAL DETECTION** submitted by **ANNAPOORNA K K** (VML19CS031), **ANUPAMA K V** (VML19CS035), and **ATHIRA DAS** (VML19CS042) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering is a bonafide record of the project work carried out by them under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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This is to certify that the report entitled **Optimizing Redeployment of Medical Supplies Among Hospitals** submitted by **Nihal O** (VML19CS075), **Ranjul Arumadi** (VML19CS083), **Sreevedh Hareesh** (VML19CS110) & **Ashwin S Nambiar** (VML19CS040) to the APJ Abdul Kalam Technological University in partial fulfilment of the B.Tech. degree in Computer Science and Engineering is a bonafide record of the project work carried out by them under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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This is to certify that the report entitled **BATTERY LIFE PREDICTION USING MACHINE LEARNING** submitted by **Devika C** (VML19CS050), **Farisa K.P** (VML19CS058), **Mary Joy** (VML19CS071) & **Sona Jose** (VML19CS106) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering is a bonafide record of the project work carried out by them under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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This is to certify that the report entitled **OS accessibility using hand gestures** submitted by **Amalraj P** (VML19CS024), **Eaby Thomas C** (VML19CS055), **Muhammed Jassim PK** (VML19CS080) & **Sidharth Suresh Nambiar** (VML19CS103) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering is a bonafide record of the project work carried out by them under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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This is to certify that the report entitled **Security Automation Using Cloud Native Architecture** submitted by **Joshua Mathew** (VML19CS066), **Snigdha Sathyanathan** (VML19CS105), **Albin Thomas** (VML19CS020) & **Antony Thomas** (VML19CS033) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering is a bonafide record of the project work carried out by them under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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This is to certify that the report entitled **PC CONTROL USING VOICE RECOGNITION** submitted by **Ann Rose Issac** (VML19CS032), **Pournami V** (VML19CS079), **Keerthana K** (VML19CS068) & **Shani Thomas** (VML19CS093) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering is a bonafide record of the project work carried out by them under our guidance and supervision.This report in any form has not been submitted to any other University or Institute for any purpose.

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Air Writing Recognition and Detection

A Mini Project Report

submitted to

the APJ Abdul Kalam Technological University

in partial fulfillment of the requirements for the degree of

Bachelor of Technology

by

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April 2023

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This is to certify that the report entitled **AIR HANDWRITING RECOGNITION AND DETECTION** submitted by **KV HENATHRAJ** (VML20CS101), **NEHA BENNY** (VML20CS128), **RIYA GEEORGE** (VML20CS141) & **SREERAM PAVITHRAN** (VML20CS166) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering is a bonafide record of the project work carried out by him under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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DECLARATION

We hereby declare that the project report **Air Handwriting Recognition and Detection, submitted for partial fulfillment of the requirements for the award of degree of Bachelor of Technology of the APJ Abdul Kalam Technological University, Kerala is a bona fide work done by us under supervision of Ms Nayana Suresh**

This submission represents our ideas in our own words and where ideas or words of others have been included, we have adequately and accurately cited and referenced the original sources.

We also declare that I have adhered to ethics of academic honesty and integrity and have not misrepresented or fabricated any data or idea or fact or source in my submission. We understand that any violation of the above will be a cause for disciplinary action by the institute and/or the University and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been obtained. This report has not been previously formed the basis for the award of any degree, diploma or similar title of any other University.

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26-06-2023

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The Successful presentation of the mini project on the topic ”Air Handwriting Recognition and Detection” would have been incomplete without the mention of people who made it possible and whose constant guidance crowned our effort into success.

We convey thanks to our project guide Ms.Nayana Suresh of Computer Science and Engineering Department for providing encouragement,constant support and guidance which was of a great help to complete this project successfully.

Last but not the least,we wish to thank our parents for financing our studies in this college as well as for constantly encouraging us to learn engineering.Their personal sacrifice in providing this opportunity to learn engineering is greatly acknowledged.

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Abstract

Air writing recognition and detection is a project aimed at developing a system that can recognize and detect text written in the air by a user using hand gestures. The system will utilize machine learning and computer vision techniques to detect and recognize text, and it will provide an innovative and intuitive method of input for various applications. The proposed system will consist of a camera or a set of cameras to capture the hand movements of the user, which will be processed by the machine learning algorithms to recognize the text being written. The system will provide a user-friendly interface for the user to input the text, and it will also have the ability to store and recall previously written text.

The feasibility study of the project will include technical, operational, and economic aspects to determine the viability of the project. The design of the system will consist of an architecture diagram, use case diagram, data flow diagram, and an entity-relationship diagram.The project's objectives include creating an innovative and intuitive method of text input,improving accessibility for people with disabilities, and exploring the potential applications of air writing recognition and detection technology.

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Chapter 1

Introduction

1.1 Introduction

1.1.1 General Background

In this report we are aimed to present the first review of the project" Air Writing Recognition and Detection ". The concept of Air Writing Recognition and Detection builds upon the field of gesture recognition, which focuses on understanding and interpreting human body movements as a means of interaction with computers or other devices. While traditional gesture recognition systems typically rely on cameras or sensors to track hand movements, Air Writing Recognition and Detection often leverages advanced motion sensors, such as accelerometers and gyroscopes, in devices like smartphones, tablets, or wearable devices. In the field of Human- Computer Interaction (HCI), it can offer a novel and intuitive way of inputting text or commands, particularly in scenarios where physical contact with input devices is challenging or undesirable, such as in virtual reality (VR) or augmented reality (AR) environments.

1.1.2 Problem Statement

The air writing recognition and detection project addresses the difficulty faced by individuals who cannot write traditionally due to disabilities, injuries, or other reasons, as traditional methods require a physical surface. The air writing recognition and detection project aims to improve upon current assistive technologies, which may not provide a natural means of communication for everyone, particularly those with disabilities.

1.1.3 Scope of the system

- **Gesture Recognition: The system focuses on accurately capturing and interpreting handwriting gestures performed in the air. It aims to recognize and translate these gestures into digital text or commands.**
- **Usability and User Experience: The system aims to provide an intuitive and user-friendly experience. It should minimize the learning curve for users and offer smooth and responsive interaction.**
- **Accessibility: The system can contribute to accessibility by enabling individuals with mobility or dexterity limitations to interact with devices and communicate more effectively. It should consider the needs of users with disabilities and provide suitable accommodations.**
- **Accuracy and Performance: The system strives to achieve high accuracy in recognizing and interpreting air handwriting gestures. It should be robust against variations in handwriting styles, different writing speeds, and potential noise or interference.**

1.1.4 Objective

The objective of our project is to develop a system that can recognize and detect letters and words written in the air using a hand-held device. To create

a system that can detect and recognize air- written letters and words using a hand-held device, providing a natural communication method for those who cant write traditionally due to disabilities or injuries. The project aims to create a user- friendly interface, ensure accuracy, reliability, security, and accessibility, and potentially integrate with other technologies and applications to enhance functionality. Overall, the objective is to provide a comprehensive overview of Air Writing Recognition and Detection, showcasing its potential and significance in various domains.

Chapter 2

Literature Survey

2.1 Radar-Based Air-Writing Gesture Recognition Using a Novel Multistream CNN Approach

2.1.1 Abstract

Hand gestures, being a convenient and natural way of communication, is getting huge attention for human–computer interface designs. Among these gestures, detecting mid-air writing is one of the most promising applications. Existing radar-based solutions often perform the mid-air writing recognition by tracking the hand trajectory using multiple monostatic or bistatic radars. This article presents a multistream convolutional neural network (MS-CNN)-based in-air digits recognition method using a frequency-modulated continuous-wave (FMCW) radar. With one FMCW radar comprising of two receiving channels, a novel three-stream CNN network with range-time, Dopplertime, and angle-time spectrograms as inputs is constructed and the features are fused together in the later stage before making a final recognition. Unlike the traditional CNN, MS-CNN with multiple independent input layers enables the creation of a multidimensional deep-learning model for FMCW radars. Twelve human volunteers were invited to writing the digits from zero to nine in the air in

both home and lab environments. The three-stream CNN architecture-based air writing for digits has shown a promising accuracy of 95

2.1.2 Methodology

The overall methodology of digit writing is presented. A digit is written in the specified area and the corresponding radar returns are preprocessed to de-noise the received signal followed by the gesture duration extraction block. Since, the size of input layer in CNN is usually fixed, time to perform each gesture is fixed to 5 s. Afterward, the RTM, DTM, and ATM images are created, and then fed as input to the deep-learning-based classifier. The radar was installed on the right side to capture more variations in distance. Here, vertical angle (elevation) is calculated using only two receiving channels by exploiting Capon beamforming. Finally, training and test accuracy is computed to access the network performance. Next, we present the details of each block in the further sections

- **A. Radar Signal Preprocessing The waveform of the signal transmitted by the FMCW radar increases linearly with time, known as a chirp. A single frame comprises usually of one or more such chirps. Upon reflection from hand, the corresponding reflections are received at the receiver antennas. The transmitted signal x(t) having a bandwidth.**

- **B. RTM, DTM, and ATM Pattern Generation The raw IF signal x IF (t) contains several chirps. An IF signal containing N chirps can be arranged in the matrix form with each column representing an individual chirp and the row representing all the samples of that chirp to form a 2-D matrix of size M by N.**

- **C. Deep Learning Architecture The FMCW radar is capable of providing multidimensional information of target in different domains. The foremost or the basic information is the change in the distance caused by hand**

movement termed range-time variations or RTM. The RTM can further be processed to extract the (Doppler) velocity and the angle of arrival of hand with respect to the radar. The multistream CNN architecture here is aimed to be capable of extracting features from the available radar data simultaneously from RTM, DTM, and ATM.

2.1.3 Conclusion

In this study, we have introduced a new implementation of in-air digit recognition using the FMCW radar sensor. A multistream CNN model capable of extracting information from the range-time, Doppler-time, and angle-time patterns was proposed. The MS-CNN model combines different features from multiple input streams simultaneously and concatenates the features at the later stage that results in an overall better performance in comparison to the tradition CNN approaches. To introduce diversity and reduce the biasness, data were captured from 12 different participants at different physical environments. Preliminary experimental results have shown that high classification accuracy of 94.20

2.2 End-To-End Deep-Learning-Based Tamil Handwritten Document Recognition and Classification Model

2.2.1 Abstract

Handwriting recognition (HR) involves converting handwritten text into machine-readable text. Tamil handwritten document recognition remains a challenging process in various real-world applications owing to the differences in the sizes, styles and orientation angles of Tamil alphabets. Prior studies concentrated only on character-level segmentation, and each character was subsequently classified. The recently developed machine learning (ML) and deep learning (DL) approaches can be utilized for Tamil handwritten character recognition

(HCR). Objective: This paper attempts to present an end-to-end DL-based Tamil handwritten document recognition (ETEDL-THDR) model. Methods: Segmentation is used, first at the word level and then at the line level. ETEDL-THDR text recognition can be accomplished using two modules: line segmentation and line recognition. Initially, the ETEDL-THDR model targets improving input image quality using the median filtering (MF) technique. To create meaningful regions, more line and character segmentation activities are performed. A deep convolutional neural network (DCNN) based Mobile-Net approach is also applied to derive feature vectors. Finally, the water strider optimization (WSO) algorithm with a bidirectional gated recurrent unit (BiGRU) model is used to identify the Tamil characters. Results: Extensive experimental analyses of the ETEDL-THDR model have been carried out, and the results show that the ETEDL-THDR model performs better than more recent methodologies, with a maximum accuracy of 98.48in real time.

2.2.2 Methodology

THC identification has been improved in this work by using the new ETEDL-THDR model. To accomplish this, the ETEDL-THDR approach includes a series of procedures such as MF (for preprocessing), segmentation, Mobile-Net (for feature extraction), BiGRU recognition and WSO hyperparameter optimization. In the initial stage, the MF technique is used to eradicate the presence of noise. Next, the segmentation of characters takes place, and the Mobile-Net model is used to derive feature vectors. Then, the WSO–BiGRU approach is used for the recognition of THCs.

- **A. PREPROCESSING The MF function calculates the median of every pixel in the kernel window, and the central pixel is interchanged with this median value. This method can be highl effective in extracting salt-and-pepper noise. Noticeably, during the Gaussian and box filters, the filter values to the central element are values that could not occur from the**

original images.However, this is different in the MF approach, where the central element is continuously exchanged with any pixel value from the images.

- **B. SEGMENTATION PROCESS Segmentation is a crucial step in a recognition system that eliminates relevant portions to allow further examination. It has been widely used in images for object verification and boundaries, i.e., lines, curves, etc. The scanned images are separated into paragraphs using the spatial space recognition method, lines using a horizontal histogram, and paragraphs into lines using a vertical histogram. The accuracy efficiency of character identification is heavily dependent on segmentation performances.**

- **C. FEATURE EXTRACTION USING MobileNet MODEL Mobile-net is a CNN-related approach that is broadly utilized for classifying images. An important benefit of utilizing the Mobile-net structure is that it requires comparatively lesser computational power than the typical CNN technique, making it deployable on mobile devices and low-end computers. The Mobile-net architecture is a streamlined design that effectively combines a convolution layer based upon two global hyperparameters switching between parameter accuracy and latency.**

- **D. DOCUMENT RECOGNITION USING BiGRU MODEL To recognize the THCs, the BiGRU model is utilized. Recurrent neural network (RNN) distinguishes itself from other NN primarily by permitting data to survive through a circular infrastructure. The network recalls the features of the preprocessed data, ensures that NN has a memory, and connects the prior data to the current task.**

- **E. HYPERPARAMETER TUNING To effectually modify the hyperparameters related to the BiGRU model, the WSO algorithm is utilized. The WSO algorithm, whose formulation was inspired by the characteristics**

of insects known as water striders(WS), simulates their traits such as ripple communication, territorial life, foraging behavior, mating process, succession and death.

2.2.3 Conclusion

In this work, a novel ETEDL-THDR technique for the identification of THCs was developed. To accomplish this, the ETEDL-THDR approach incorporated a series of processes such as MF-based preprocessing, segmentation, MobileNet feature extraction, BiGRU recognition and WSO hyperparameter optimization. To effectively modify the hyperparameters related to the BiGRU model, the WSO algorithm was utilized, which helps in improving the recognition performance. A broad experimental investigation was conduct to verify the improved performance of the ETEDL-THDR model. Extensive comparative results reported the enhanced performance of the ETEDL-THDR approach as compared to other recent methodologies. In future, an ensemble of three DL-based fusion models can be introduced further to enhance the recognition results of the ETEDL-THDR model.

2.3 Air-Writing Recognition Based on Deep Convolutional Neural Networks

2.3.1 Abstract

Air-writing recognition has received wide attention due to its potential application in intelligent systems. To date, some of the fundamental problems in isolated writing have not been addressed effectively. This paper presents a simple yet effective air-writing recognition approach based on deep convolutional neural networks (CNNs). A robust and efficient hand tracking algorithm is proposed to extract air-writing trajectories collected by a single web camera. The algorithm

addresses the push-to-write problem and avoids restrictions on the users' writing without using a delimiter and an imaginary box. A novel preprocessing scheme is also presented to convert the writing trajectory into appropriate forms of data, making the CNNs trained with these forms of data simpler and more effective. Experimental results indicate that the proposed approach not only obtains much higher recognition accuracy but also reduces the network complexity significantly compared to the popular image-based methods.

2.3.2 Methodology

The proposed air-writing method is shown in FIGURE 1. It includes three stages: trajectory acquisition, data processing and network. The image sequence is acquired with a web camera. Based on the image sequence, a novel hand tracking algorithm is presented to calculate the trajectory of a stroke that a user writes in the air. Then, the trajectory data are processed and converted into two kinds of forms: 1D arrays and 2D arrays. The two kinds of data are formed into trajectory datasets, which are used to learn CNN models in the offline training phase. During online prediction, the system receives real-time data from the web camera and then predicts the digit (or symbol) that the user writes using the learned models. We describe the three main stages of the proposed system as follows.

- **A. TRAJECTORY ACQUISITION The purpose of this unit is twofold: to acquire the 2D image that the user writes in the air and to record the coordinate sequence of a stroke, called the trajectory of writing. The trajectory is formed by the coordinates of the center of a moving hand. Thus, detection and tracking of the moving hand from the 2D image sequence is essential in this unit. Hand detection/tracking has been studied for a long time. However, it is still a challenging issue if both robustness and real- time execution are required. In this paper, we combine skin and moving features to detect the moving skin region and then apply the Camshift algorithm to track the moving hand. The proposed algorithm is**

robust and can operate in real time.

- **B. DATA PROCESSING As stated before, we convert the handwritten data into a 2D image. The original size of the captured image is 640 × 480. The user most likely writes commands in different positions in air. To attack the shift variance, we transform the captured image into an image that has a size of 360×360 and is located in the middle of a window.**

- **C. CONVOLUTIONAL NEURAL NETWORK DESIGN A basic CNN is composed of several convolutional layers for feature extraction, each of which is usually followed by a pooling layer. The last convolutional layer is also followed by one or more fully connected (dense) layers for classification. For the 1D and 2D trajectory data stated above, we design a 1D-CNN and 2D-CNN, respectively, to recognize the input digits (or directional symbols). The typical architectures of our proposed 1D-CNN and 2D-CNN for recognizing digits are consist of several 1D or 2D convolutional blocks. The architectures for directional symbols are similar; hence, they are neglected here. Each convolutional block contains convolution, maximal pooling, batch normalization, and activation function. The CNN (1D or 2D) applies batch normalization after convolution and before activation because it helps to improve the performance and stability of neural networks.**

2.3.3 Conclusion

In this paper, we have proposed deep CNNs for the recognition of air-writing digits and special direction symbols for smart-TV-like control. A robust air-writing trajectory acquisition algorithm based on a web camera is developed that performs hand tracking only, avoiding the use of complicated procedures for finger tracking. By preprocessing the writing trajectory, we obtain one-dimensional and two-dimensional data that are utilized to design 1D-CNN and 2D-CNN, respectively. Through careful design and optimization of hyperparameters, the

proposed CNNs achieve excellent performance with a recognition rate greater than 99networks, 1D-CNN is slightly better than 2D-CNN. The two CNN models based on trajectory data significantly outperform the existing popular methods using written images. In addition, the network complexity of our proposed neural networks is much lower than those of the popular methods, and our systems can operate in real time.

2.4 On-Air Hand-Drawn Doodles for IoT Devices Authentication During COVID-19

2.4.1 Abstract

In this paper, a new natural human interaction authentication method is proposed for Internet of Things (IoT) devices. In this method, the user draws a doodle on the air for authentication. On-air drawing refers to virtually drawing free hand-drawn doodle passwords through hand gestures on the air without touching anything that is recommended during COVID-19. This study uses the Google Quick Draw Doodle dataset for password doodles. The proposed method is based on a typical video camera, two lightweight convolutional neural networks (CNNs) and a Kalman filter. The first CNN for hand gesture classification was used to overcome dynamic hand gesture challenges on the air. Second CNN for authentication verification. A Kalman filter was used to correct and smooth the path drawn on the air. Two main goals must be achieved to accept the new authentication method: usability and security. The usability evaluation was based on the ISO 9241-11:2018 standard usability model. The results revealed that the accuracy of the proposed authentication method was 95acceptable. The evaluation of security was based on two threats related to IoT devices: guessing and physical observation. The results show that the password strength of the proposed authentication method is stronger than the traditional 4-digits PIN password. The proposed authentication method is also resistant to physical

observation threats.

2.4.2 Methodology

First, a computer vision technique was used for hand detection and the creation of a virtual pen. This virtual pen is automatically picked up by the hand when the hand is in front of the camera. Second, a lightweight deep CNN for dynamic hand gesture recognition was used to classify threehand gestures. An open-index finger gesture was used for the drawing. An open-hand gesture was used for the erasing. A closed-hand gesture was used to save. Third, the Kalman filter is a simple and lightweight algorithm. This algorithm was used to smooth hand-drawn symbols on the air. Fourth, login authentication and verification consists of three stages. First, the authentication key symbols are drawn to the login. Second, keys were extracted. Third, a lightweight deep CNN was used to verify authentication keys. The following subsections provide an in-depth explanation for each.

- **A. HAND DETECTION AND CATCH VIRTUAL PEN The aim of this stage was to achieve three goals. First, the hand is detected based on skin color. Second, the center of the hand was determined. Third, the topmost point of the hand representing the fingertip was determined. These three goals were achieved by capturing a hand image using a camera. The image of the hand then passes through several filters.**

  B. HAND GESTURES CLASSIFICATION MODEL The proposed solution to overcome the challenges of dynamic hand gesture recognition is a lightweight deep-learning CNN model. This CNN model is trained on an artificial image dataset that is tuned to hand gesture movements for drawing on air. There are two stages in this part: the training and prediction stages, as shown in Fig.8. In the training stage, an artificial image dataset was created and then tuned to train the CNN model. In the prediction stage, the trained CNN model was used to predict the hand gestures. The following subsections provide an in-depth explanation of each stage.

C. KALMAN FILTER This work proposes a Kalman filter to correct the drawn line path on the air by finding the nearest correct location of the virtual pen tip in the air. It has been used in two dimensions once for the X coordinate and the other for the Y coordinate. The Kalman filter is based on a Gaussian distribution GD. This is true in a real environment where there is no pure signal from the sensors. The readout produced by any sensor is not accurate, but has an error rate that depends on the accuracy of the sensor.

D. AUTHENTICATION LOGIN AND VERIFICATION This section contains three stages. The following sections will explain in detail the proposed method of hand-drawn symbols password and the three stages of authentication login and verification.

2.4.3 Conclusion

This paper proposes a new authentication method for Internet of Things IoT devices based on air hand-drawn passwords. The proposed method is based on a computer vision technique with a single camera, two lightweight deep CNN models, and a Kalman filter for signal processing to correct the drawn line path on the air. This combination is the main advantage of this framework over the existing approaches. The results showed that the proposed authentication method for usability parameters, such as accuracy, efficiency, and user satisfaction, is accepted and significant. In addition, the proposed method is secure and resistant to physical observation threats. This method is fully independent of any devices, wearable sensors, or depth cameras. In the future, the proposed method will be easy, simple, and suitable for controlling smart devices such as smart TVs, smartwatches, smart fridges, and smart air conditioning. The disadvantage of the proposed method is that it does not work in the dark.

Chapter 3

Requirement specification

3.1 Functional requirements

- **Programming Language: The system will be developed using Python, leveraging the capabilities of OpenCV and machine learning libraries.**
- **Operating System: Compatible operating system (e.g., Windows, Linux, macOS) to run the software.**

  Development Environment (IDE): VS Code or any other preferred IDE for Python development.
- **OpenCV Library: A computer vision library for image and video processing.**
- **Other Python Libraries**

3.2 Software requirements

- **OpenCV: OpenCV (Opensource Computer Vision Library) is a popular open-source library for computer vision and image processing tasks. It provides a wide range of functions for image capture, processing, feature**

extraction, and pattern recognition. Language(s): Python. Python is a high-level, interpreted, general purpose programming language.

3.3 User interfaces

- **The system should have a user-friendly interface for ease of use.**

3.4 Hardware interfaces

- **Web Camera with high resolution**
- **Processor and Memory**
- **GPU**
- **Input Devices**
- **Display for visual feedback**

3.5 Non Functional requirements

- **Scalability**
- **Usability**
- **Security**
- **Performance**

Chapter 4

Proposed system and Design

This chapter mainly discuss about the proposed system and design. Also the architecture and different technical diagrams are discussed in this chapter.

4.1 Proposed system

The device will be equipped with cameras to capture the hand movements and gestures. The system will use computer vision and machine learning algorithms to recognize and detect the letters and words written in the air. The system will have a user-friendly interface, providing clear instructions and feedback to guide the user through the air writing process. The interface will allow users to customize settings, such as font size and color, to make the text more readable for them.

4.2 Feasibility Study

A feasibility study is an analysis that considers all of a project's relevant factors including economic, technical, legal, and scheduling considerations to ascertain the likelihood of completing the project successfully.

4.2.1 Technical Feasibility

The proposed system is technically feasible as the required hardware components such as cameras and microcontrollers, as well as software tools such as computer vision and machine learning algorithms, are readily available. The skills required to develop the system, such as programming and data analysis, are also available.

4.2.2 Operational Feasibility

The system is demonstrated by its technical capability, compatibility with existing hardware and software, user-friendliness, scalability, and provisions for maintenance and support. It should have a reasonable learning curve, perform efficiently, and offer a cost-effective solution, ensuring practicality and viability in real-world operational scenarios.

4.2.3 Economic Feasibility

The system involves assessing its financial viability. This includes analyzing the costs associated with development, implementation, and maintenance, as well as estimating the potential benefits and returns on investment. Factors such as market demand, pricing models, cost savings, and revenue generation opportunities are considered to determine the system39;s economic viability.

4.2.4 Legal Feasibility

The system is assessed by ensuring compliance with privacy and data protection laws, intellectual property rights, accessibility standards, obtaining user consent, mitigating biases, and adhering to relevant regulations and industry-specific requirements.

4.3 Design

- 1. Sensing Technology: Selecting suitable sensing technology is crucial for accurately capturing air writing gestures. Options may include motion sensors like accelerometers, gyroscopes, or depth cameras, depending on the desired level of precision and the target platform.

  2. Gesture Recognition Algorithms: Developing robust gesture recognition algorithms is essential to interpret the captured motion data effectively. Machine learning techniques, such as deep learning or pattern recognition algorithms, can be employed to train models that can recognize and classify different air writing gestures.

  3. User Interface: Designing a user-friendly interface is important to provide a seamless interaction experience. The interface should display real-time feedback, allowing users to see their air writing gestures and any recognized text or commands. Visual cues, such as virtual writing trails or hand representations, can enhance the user understanding of their actions.

  4. Calibration and Personalization: Implementing a calibration process enables the system to adapt to individual user's writing styles and preferences. Calibration can involve capturing a user39;s reference gestures to establish personalized gesture models and improve recognition accuracy.

  5. Noise and Interference Handling: The system should be designed to handle noise and interference that may affect gesture recognition. Filtering techniques and algorithms can be applied to mitigate the impact of environmental factors, such as lighting variations or background movements.

  6. Integration and Compatibility: The system should be designed to integrate smoothly with various platforms, devices, or applications. It should support standard protocols and APIs, allowing for seamless integration into existing software ecosystems.

  7. Performance Optimization: Optimizing the system performance is crucial for

real-time gesture recognition. This may involve optimizing algorithms, minimizing computational overhead, and leveraging hardware acceleration techniques to ensure efficient processing and low latency.

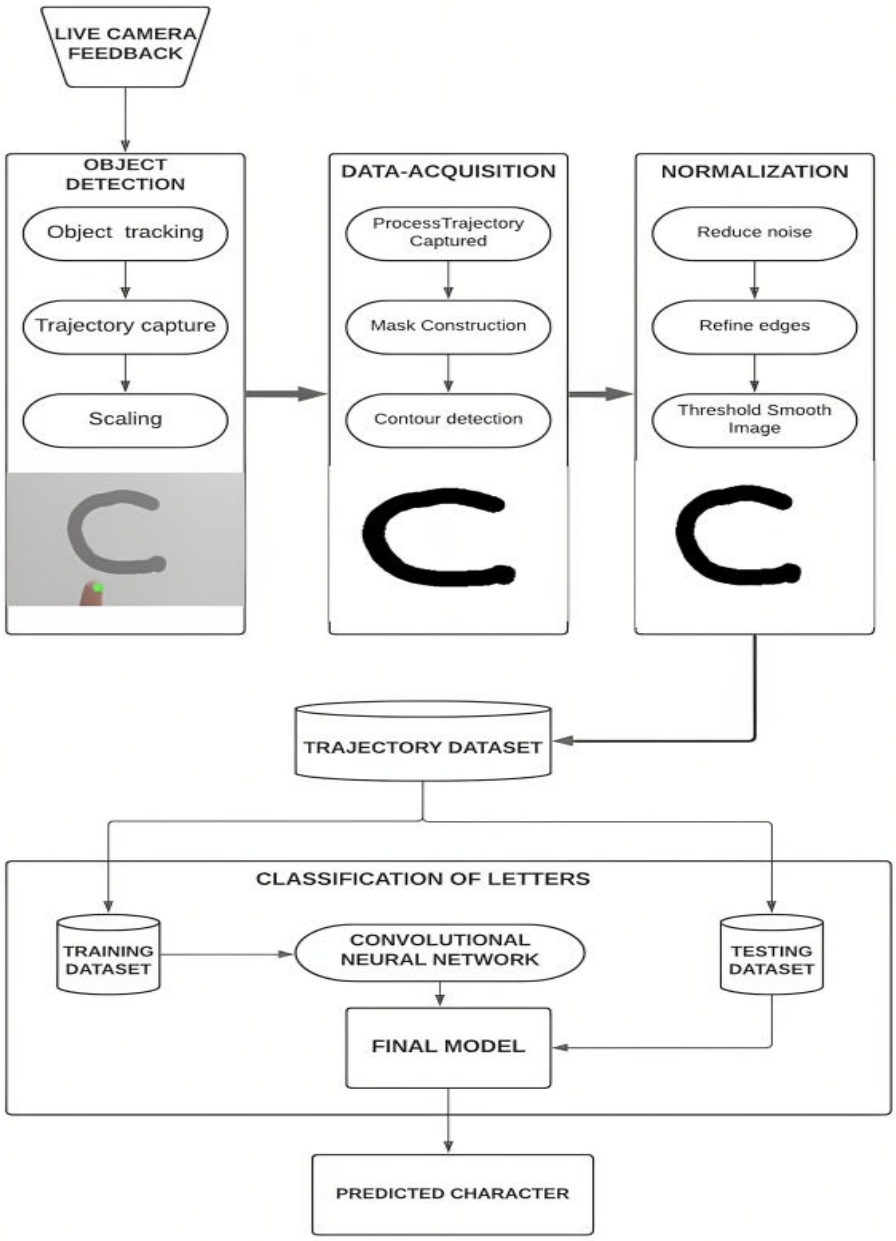
8. Security and Privacy: Designing the system with security and privacy in mind is essential. Implementing secure data transmission, encryption techniques, and adhering to privacy regulations can help protect user data and maintain confidentiality.

9. Testing and Validation: Thorough testing and validation should be conducted to ensure the system reliability and accuracy. This includes testing with diverse users, evaluating recognition rates, analyzing error rates, and gathering feedback for iterative improvements.

10. Scalability and Future Expansion: Designing the system with scalability in mind allows for future expansion and accommodating a growing user base. The system should be architected to handle increasing demands and support updates or enhancements as new technologies and requirements emerge.

4.3.1 Architecture Diagram

An architectural diagram is a diagram of a system that is used to abstract the overall outline of the software system and the relationships, constraints, and boundaries between components. It is an important tool as it provides an overall view of the physical deployment of the software system and its evolution roadmap.



4.3.2 Data Flow Diagram

A Data Flow Diagram (DFD) is a visual representation of the information flows within a system. It provides information on how data enters and leaves the system, the changes in the system and where the data is stored. Data flow diagrams visually represent systems and processes. It may be partitioned into levels that represent increasing information flow and functional details. Levels in DFD are numbered 0,1, 2 or beyond.

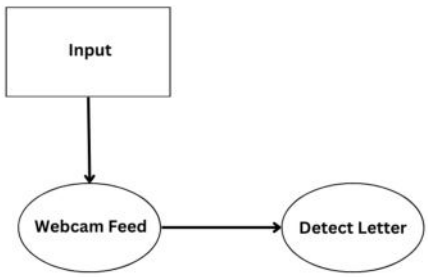


Figure 4.1: Data flow diagram-Level 0

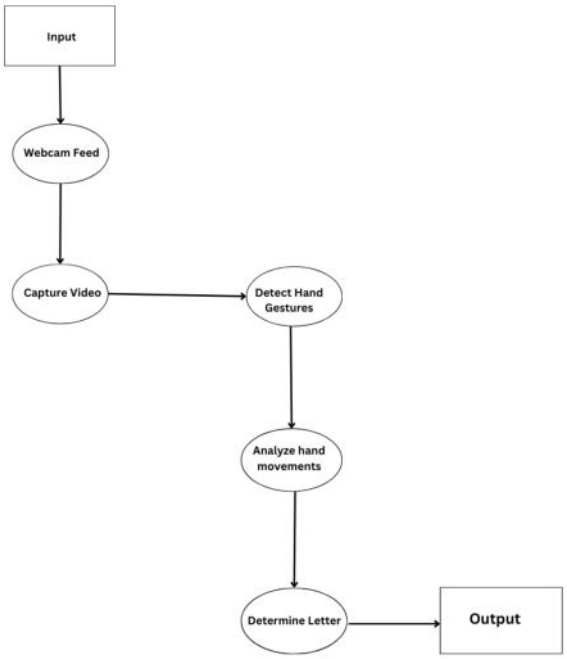


Figure 4.2: Data flow diagram-Level 1

Figure 4.3: Data flow diagram-Level 2

Chapter 5

Implementation

5.1 Implementation

air_writing_recognition.py > ...

```
# USAGE
# python ball_tracking.py --video ball_tracking_example.mp4
# python ball_tracking.py

# import computer vision packages
import cv2
import imutils
from imutils.video import VideoStream

# import keras packages
import keras
from keras import backend as K
from keras.models import load_model
from keras.models import model_from_json

# import statistic/data packages
from collections import deque
import numpy as np

# import utility packages
import argparse
import time
import os

```

air_writing_recognition.py > ...

```
characters = {0:'0', 1:'1', 2:'2', 3:'3', 4:'4', 5:'5', 6:'6', 7:'7', 8:'8', 9:'9',
10:'A', 11:'B', 12:'C', 13:'D', 14:'E', 15:'F', 16:'G', 17:'H', 18:'I', 19:'J',
20:'K', 21:'L', 22:'M', 23:'N', 24:'O', 25:'P', 26:'Q', 27:'R', 28:'S', 29:'T',
30:'U', 31:'V', 32:'W', 33:'X', 34:'Y', 35:'Z', 36:'a', 37:'b', 38:'c', 39:'d',
40:'e', 41:'f', 42:'g', 43:'h', 44:'i', 45:'j', 46:'k', 47:'l', 48:'m', 49:'n',
50:'o', 51:'p', 52:'q', 53:'r', 54:'s', 55:'t', 56:'u', 57:'v', 58:'w', 59:'x',
60:'y', 61:'z'}

# construct the argument parse and parse the arguments
ap = argparse.ArgumentParser()
ap.add_argument("-v", "--video",
    help="path to the (optional) video file")
#ap.add_argument("-b", "--buffer", type=int, default=64,
#    help="max buffer size")
#ap.add_argument("-vb", "--verbose", help="increase output verbosity",
#    action="store_true")
args = vars(ap.parse_args())

# load keras model
def load_model():
    # Load trained model
    #if args.verbose:
```

```
args = None
def load_model():
    # Load trained model
    if args.verbose:
        print("Loading cnn model from disk.....", end="")

    # Load JSON model
    if args.old:
        json_file = open('mode_saves/cnn_model-0.json', 'r')
    else:
        json_file = open('model_saves/cnn_model.json', 'r')
    model_json = json_file.read()
    json_file.close()
    model = model_from_json(model_json)

    # Load model weights
    if args.old:
        model.load_weights("model_saves/cnn_model_weights-0.h5")
    else:
        model.load_weights("model_saves/cnn_model_weights.h5")
    if args.verbose:
        print("...finished.")
    return model
```

EMS OUTPUT DEBUG CONSOLE TERMINAL

cnn_model_test.py > test_model

```
    # Load EMNIST-byclass data
    if args.verbose:
        print("Loading EMNIST byclass-testing data....", end="")
    emnist = MNIST(path='data', return_type='numpy')
    emnist.select_emnist('byclass')
    X_test, y_test = emnist.load_testing()
    if args.verbose:
        print("...finished.")

    # Restructuring data (batch, steps, channels)
    if args.verbose:
        print("Restructuring data...", end="")
    input_shape = None
    if K.image_data_format() == 'channels_first':
        X_test = X_test.reshape(X_test.shape[0], 1, img_rows, img_cols)
        input_shape = (1, img_rows, img_cols)
        if args.verbose:
            print("...Channels first...", end="")
    else:
        X_test = X_test.reshape(X_test.shape[0], img_rows, img_cols, 1)
        input_shape = (img_rows, img_cols, 1)
        if args.verbose:
            print("...Channels last...", end="")
```

```
            if len(gun_detect) != 0 :
                gun_detected=True
            if gun_detected :
                textGenerator("GUN",resized,gun_detect)
            if len(knives_detect) != 0:
                knife_detected=True
            if knife_detected :
                textGenerator("SHARP OBJECT", resized, knives_detect)
            if len(explsvs_detect) != 0:
                explsvs_detected=True
            if explsvs_detected:
                textGenerator("EXPLOSIVE", resized, explsvs_detect)
            cv.imshow("Weapon Detector",resized)
            if gun_detected or knife_detected or explsvs_detected :
                engine.say("Weapons Detected!")
                engine.runAndWait()
            #Press q to exit window
            if cv.waitKey(20) & 0xFF == ord('q') :
                break

        capture.release()
        cv.destroyAllWindows()
```

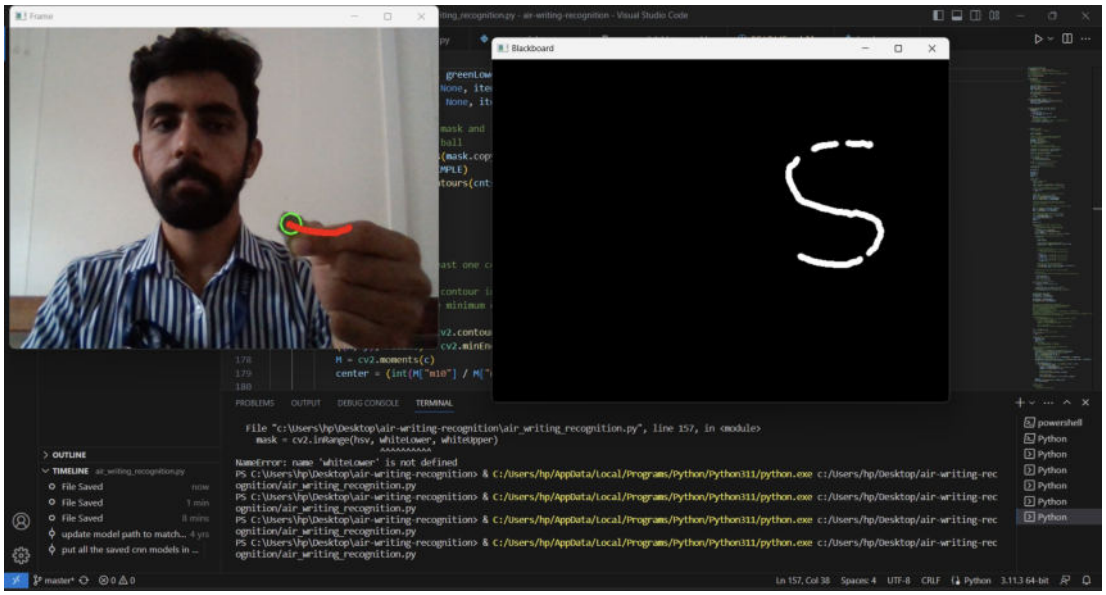
```
nn_model_test.py > test_model
    if args.old:
        print("Turned on: old")
    if args.input:
        print("Turned on: input")

    letters = {0:'0', 1:'1', 2:'2', 3:'3', 4:'4', 5:'5', 6:'6', 7:'7', 8:'8', 9:'9',
10:'A', 11:'B', 12:'C', 13:'D', 14:'E', 15:'F', 16:'G', 17:'H', 18:'I', 19:'J',
20:'K', 21:'L', 22:'M', 23:'N', 24:'O', 25:'P', 26:'Q', 27:'R', 28:'S', 29:'T',
30:'U', 31:'V', 32:'W', 33:'X', 34:'Y', 35:'Z', 36:'a', 37:'b', 38:'c', 39:'d',
40:'e', 41:'f', 42:'g', 43:'h', 44:'i', 45:'j', 46:'k', 47:'l', 48:'m', 49:'n',
50:'o', 51:'p', 52:'q', 53:'r', 54:'s', 55:'t', 56:'u', 57:'v', 58:'w', 59:'x',
60:'y', 61:'z'}

    if args.plot:
        plot_model()

    if args.test or args.input:
        model = load_model()
        if args.test:
            test_model(model)
        if args.input:
            # [0-9: digits][10-36: uppercase][37-62: lowercase
            prediction = predict_model(model, 'input_images/img-7.png')
```

Chapter 6

Results and Discussion

6.1 Results

6.1.1 Sample Output



Chapter 7

Conclusion

In conclusion, the implemented air handwriting recognition and detection project has shown promising results with an accuracy rate of 85 percent. While there is still room for improvement, this achievement marks a significant milestone in the development of a system capable of interpreting and understanding handwritten gestures in the air.

The project's success can be attributed to the dedicated efforts of the team and the utilization of advanced machine learning algorithms. The system has demonstrated its ability to accurately recognize and interpret various gestures made in the air, enabling users to input text or commands without physical contact.

However, the project's limitations are apparent in its current form. The accuracy and reliability of the handwriting recognition and detection algorithms need improvement. While the system can recognize some basic gestures, it struggles with more complex or intricate movements, resulting in recognition errors

Chapter 8

References

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[3] End-To-End Deep-Learning-Based Tamil Handwritten Document Recognition and Classification Model C. VINOTHENI AND S. LAKSHMANA PANDIAN

[4] Radar-Based Air-Writing Gesture Recognition Using a Novel Multistream CNN Approach Shahzad Ahmed , Wancheol Kim , Junbyung Park, and Sung Ho Cho , Member, IEEE

BookBuddies

A Mini Project Report

submitted to

the APJ Abdul Kalam Technological University

in partial fulfillment of the requirements for the degree of

Bachelor of Technology

by

ALEENA SUSAN (VML20CS029)

AMEYA P V (VML20CS032)

THEJAS K (VML20CS171)

VYSHNAV SREESHAN (VML20CS183)

under the supervision of

Ms. Rajitha K V

Assistant Professor

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

VIMAL JYOTHI ENGINEERING COLLEGE CHEMPERI

CHEMPERI P.O. - 670632, KANNUR, KERALA, INDIA

JUNE 2023

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DEPT. OF COMPUTER SCIENCE AND ENGINEERING

CERTIFICATE

This is to certify that the report entitled **BookBuddies** submitted by **ALEENA SUSAN** (VML20CS029), **AMEYA P V** (VML20CS032) , **THEJAS K** (VML20CS171) & **VYSHNAV SREESHAN** (VML20CS183) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering . This is a bonafide record of the project work carried out by them under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

Ms. Rajitha K V

(Project Guide)
Assistant Professor
Dept.of CSE
Vimal Jyothi Engineering College
Chemperi

Ms. Diya Rameshan
Ms. Rahna. C. M
(Project Coordinators)
Assistant Professors
Dept.of CSE
Vimal Jyothi Engineering College
Chemperi

Place : VJEC Chemperi
Date : 16-06-2023

Head of the department

HEAD OF THE DEPARTMENT
Dept. of Computer science & Engg.
Vimal Jyothi Engineering College
Chemperi-670 632

VIMAL JYOTHI ENGINEERING COLLEGE (Office Seal) Dated..... CHEMPERI-670 632

Signature Not Verified

Principal.VJEC

DECLARATION

We hereby declare that the project report titled **BookBuddies**, submitted for partial fulfillment of the requirements for the award of the degree of Bachelor of Technology of the APJ Abdul Kalam Technological University, Kerala, is a bonafide work done by us under the supervision of **Ms. Rajitha K V**.

This submission represents our ideas in our own words, and where ideas or words of others have been included, we have adequately and accurately cited and referenced the original sources.

We also declare that we have adhered to the ethics of academic honesty and integrity and have not misrepresented or fabricated any data, idea, fact, or source in our submission. We understand that any violation of the above will be a cause for disciplinary action by the institute and/or the University and can also evoke penal action from the sources that have thus not been properly cited or from whom proper permission has not been obtained.

This report has not previously formed the basis for the award of any degree, diploma, or similar title from any other University.

ALEENA SUSAN

AMEYA P V

THEJAS K

VYSHNAV SREESHAN

CHEMPERI

16-06-2023

ACKNOWLEDGEMENT

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We are really thankful to **Ms. Rajitha K V**, Assistant Professor, Department of Computer Science and Engineering, our project guide, and the rest of the faculty in the Department of Computer Science and Engineering for their valuable guidance and sincere cooperation in the success of this presentation. We are thankful to our classmates and well-wishers for sharing their knowledge and suggestions. We are also thankful to our parents and the Almighty.

ALEENA SUSAN

AMEYA P V

THEJAS K

VYSHNAV SREESHAN

Abstract

In today's fast-paced world, reading books has become a luxury that not everyone can afford. While there are libraries that offer book rentals, they often have limited selections, and borrowing a book can be inconvenient. To address this issue, we have proposed an idea of a book rental app that allows users to access a wide variety of books at no cost.

The aim of this project is to build a book rental system that not only facilitates borrowing and lending books but also fosters a community of readers who share a common passion for literature. The system includes several features such as a chat room for users to communicate, schedule meetups, and plan book-related events. One of the most unique features of the system is its prioritization of location-based results, making it easier for users to find books and connect with others in their area.

Contents

List of Figures

Chapter 1

Introduction

1.1 Background and context

In recent years, there has been a growing interest in online platforms that enable users to borrow and lend books. Such platforms offer several advantages, such as access to a wider variety of books, lower costs, and a more sustainable use of resources. However, most of these platforms focus primarily on the technical aspects of the service, without paying enough attention to the social and community-building aspects that could make the service more engaging and meaningful for users. Our project aims to address this gap by creating a book rental system that is not only efficient and convenient but also fosters a sense of community among users who share a passion for reading.

1.2 Problem statement

The main challenge we identified is how to create a book rental system that is both functional and social. We want to provide a user-friendly platform where users can easily find and borrow books, but also a platform where users can interact with each other, share their thoughts and ideas, and discover new books and authors. Additionally, we need to ensure the security and privacy of users' data and transactions.

1.3 Objective

Our objectives for this project are to:

- Develop a cloud-based book rental system that is secure, reliable, and scalable.
- Implement social features such as a chat room, book reviews, and event planning to facilitate interaction and community-building among users.
- Prioritize location-based results to enhance the efficiency and convenience of the service.

1.4 Scope of the system

The scope of this project is limited to the design, development, and testing of the book rental system. We will not address issues related to book acquisition, cataloging, or physical storage.

1.5 Methodology

We will use an iterative and incremental development approach based on agile principles. We will involve users and stakeholders in the design and testing process to ensure that the system meets their needs and expectations.

Chapter 2

Literature Review

2.1 Centralized Routing for Bike-sharing Systems

The paper proposes a centralized routing algorithm for bike-sharing systems to optimize bike distribution between stations. The algorithm is based on a mixed integer linear programming model and has been demonstrated to be effective in reducing the number of empty and full stations. The proposed algorithm offers advantages such as improved bike availability, a comprehensive approach to routing optimization, centralized management, and greater coordination of bike distribution.

Findings:

- The proposed centralized routing algorithm improves bike availability and enhances user experience by minimizing the number of empty and full stations in a bike-sharing system.
- The algorithm considers various factors such as distance, bike demand, and availability of bikes and parking slots to optimize bike distribution between stations.
- The algorithm is based on a mixed integer linear programming model and has been demonstrated to be effective in reducing the number of empty and full

stations in a real-world dataset from a bike-sharing system in Beijing, China.

- The proposed algorithm offers advantages such as improved bike availability, a comprehensive approach to routing optimization, centralized management, and greater coordination of bike distribution.
- The algorithm provides a systematic and efficient solution to the bike routing problem, enabling better management of bike-sharing systems and enhancing the user experience.

2.2 A Privacy-Preserving Efficient Location-Sharing Scheme for Mobile Online Social Network Applications

The article presents a privacy-preserving and efficient location-sharing scheme for mobile online social network (mOSN) applications that aims to address the security and privacy concerns of mOSN users.

Findings:

- Effective and efficient privacy-preserving location sharing scheme for MOSN applications.
- Homomorphic encryption preserves user privacy.
- Computationally efficient and scalable for real-world applications.
- Accurate and efficient in identifying nearby users with low overhead.

2.3 Android-Based Chat Application Using Firebase

This paper aims to design and develop an android-based chat application using firebase. Web-based talking alludes to the way toward sending and getting messages utilizing

the web. There are different talking applications accessible on the lookout. In the principal quarter of 2017, the absolute number of clients utilizing visit applications are more than 5.03 Billion. For the extent of the venture, the function will be tried as the program is being created. An information base for the clients enrolled will be created and tried, a menu will be created and tried, a customer/worker interface will be created and tried, and GUI's will be created and tried, for the clients' advantages.

Findings:

- Firebase Realtime Database is a powerful tool for building real-time applications, including chat applications. It allows you to store and synchronize data in real-time across multiple devices.
- Firebase Authentication provides an easy-to-use authentication system that allows users to sign in with email and password, Google, Facebook, Twitter, and other providers.
- Firebase Cloud Messaging (FCM) is a messaging service that allows you to send notifications and data messages to Android, iOS, and web applications
- When some surprising accidents happen, Firebase gives an accident revealing assistance to manage these accidents.
- The project is economically feasible as the only requirement for a user is a functional smart-phone with the android operating system.
- We are creating an app for the target audience that has no age barriers, so age certainly is not a problem.
- We also aim to implement location tracking for the convenience of users.

2.4 Quick Aid:Mobile Application for Product Rental

This research study aims to design and develop Quick Aid app with an innovative idea of renting products in order to help people by supplying the essential/non-essential things. The primary objective is to create a product rental app, which enables the user to rent a product or require a service, so that the product/service can be used by the requestor. This system could also help in building a strong relationship among people and solve the problem of people not owning non-essential things readily.

Findings:

- If the item is self-bought and want to use it occasionally but can't find the people who might require it, Quick aid comes in handy.
- With the developed app, the user can request any type of product from the nearby location.
- The user can chat with the sender and receiver.
- User can complaint against any spam or scam activities.
- The location detection system is also available so that the people can meet at any common point to transfer the product.
- This app can also be used to earn money and this is considered as the main advantage of the proposed Quick Aid app.
- This app features a community feed page, where the users can type in any message and that message will be posted in the feed page, where the other users can also see and interact with the users, which will basically look like a group chat, where the user cannot create a group but a web of connections with the people for whom the message should be sent by the sender by enabling a flexibility for people within a certain distance to receive the messages.

- Flutter can also be used to develop Web applications too. Flutter is powered by Dart, a language optimized for fast apps on any platform.
- We use the Google firebase to store the database in real time.

Chapter 3

Requirement Specification

3.1 System Requirements

3.1.1 Functional Requirements

- Users can access a wide variety of books based on their proximity
- Users should be able to communicate with each other to arrange the rental and handover of the books. The app should provide a messaging system or chat room to facilitate communication between users.
- Users should be able to write reviews and give ratings for the books they have rented.
- Users should have a profile page that displays their personal information, their thoughts, ideas, ratings and reviews of the book they have read.

3.2 Software Requirements

1. Operating System: The app should be compatible with both Android and iOS operating systems.

2. Development Platform: The app should be developed using a suitable platform like Android Studio or Xcode.

3. Backend Services: The app should be integrated with suitable backend services such as Firebase or AWS for data storage, user authentication, and push notifications.

4. Programming Languages: The app should be developed using programming languages suitable for the platform like Java or Kotlin for Android and Swift for iOS.

5. Libraries and Frameworks: The app may require the use of certain libraries and frameworks like Flutter framework, along with relevant libraries like firebase_auth, firebase_core, and cloud_firestore.

3.3 Hardware requirements

The hardware requirements for developing the app are:

1. Minimum 2GHz processor speed.

2. At least 2GB of free storage space.

3. Internet connection for downloading required software and libraries.

Chapter 4

Proposed System And Design

4.1 Proposed System

The proposed system is a mobile application named ”BookBuddies” that allows users to rent and lend books to each other. The system will be developed using the Flutter framework, and will utilize Firebase for real-time database management, user authentication, and storage of user-generated content. The Book Rental application will have the following features:

4.1.1 User Registration and Authentication:

- Users can register and log in to the application using their email address and password.
- Users can also log in using their Google or Facebook accounts for easier access.
- User authentication will be handled by Firebase Authentication.

4.1.2 Profile Management:

- Users can create and manage their profiles.
- User profiles will contain basic information such as name, profile picture, and contact information.

- Users can view other user's profiles.

4.1.3 Book Listing:

- Users can create a book listing by adding details such as title, author, description, and cover photo.
- Users can search for books based on their proximity.
- Users can view details of the book listings such as description, owner, and availability status.

4.1.4 Booking:

- Users can request to rent a book from the owner by selecting the book from the listing.
- The owner can accept or reject the request.

4.1.5 Chat:

- Users can communicate with each other through the chat feature.
- Users can view their chat history and continue the conversation with the same user.

The proposed system will implement the following technologies and strategies to improve user experience and system security:

4.1.6 Cloud Computing:

- The use of Firebase as a real-time database management system, user authentication, and storage of user-generated content will improve system performance and scalability.

4.1.7 Centralized Routing:

- A centralized routing algorithm will be implemented to optimize the book search and booking process.

Location Sharing:

- Privacy-preserving and efficient scheme for sharing location information will be implemented to share the location of the users securely.

4.1.8 Chat Room:

- The chatroom feature will be implemented using a real-time database and cloud messaging service provided by Firebase.

4.2 Feasibility Study

The feasibility study is an essential part of any project, as it assesses the practicality and viability of the project. In this study, we have assessed the feasibility of developing the Book Rental application based on the following factors:

4.2.1 Technical Feasibility:

The Book Rental application requires the use of several technologies such as Flutter, Firebase, and various libraries and frameworks. These technologies are readily available and have been used in various applications. Therefore, the application is technically feasible.

4.2.2 Operational Feasibility:

The Book Rental application aims to solve a real-world problem by providing a platform for users to rent and borrow books easily. The application is user-friendly and can be operated by anyone who has a smartphone, making it operationally feasible.

4.2.3 Economic Feasibility:

The development cost of the Book Rental application is estimated to be within the budget allocated for the project. The application does not require any hardware infrastructure or special licenses, making it economically feasible.

4.2.4 Legal Feasibility:

The Book Rental application does not violate any intellectual property rights or any other legal requirements, making it legally feasible.

Conclusion:

Based on the above factors, it can be concluded that the development of the Book Rental application is feasible and can be implemented.

4.3 Design

4.3.1 Architecture Diagram

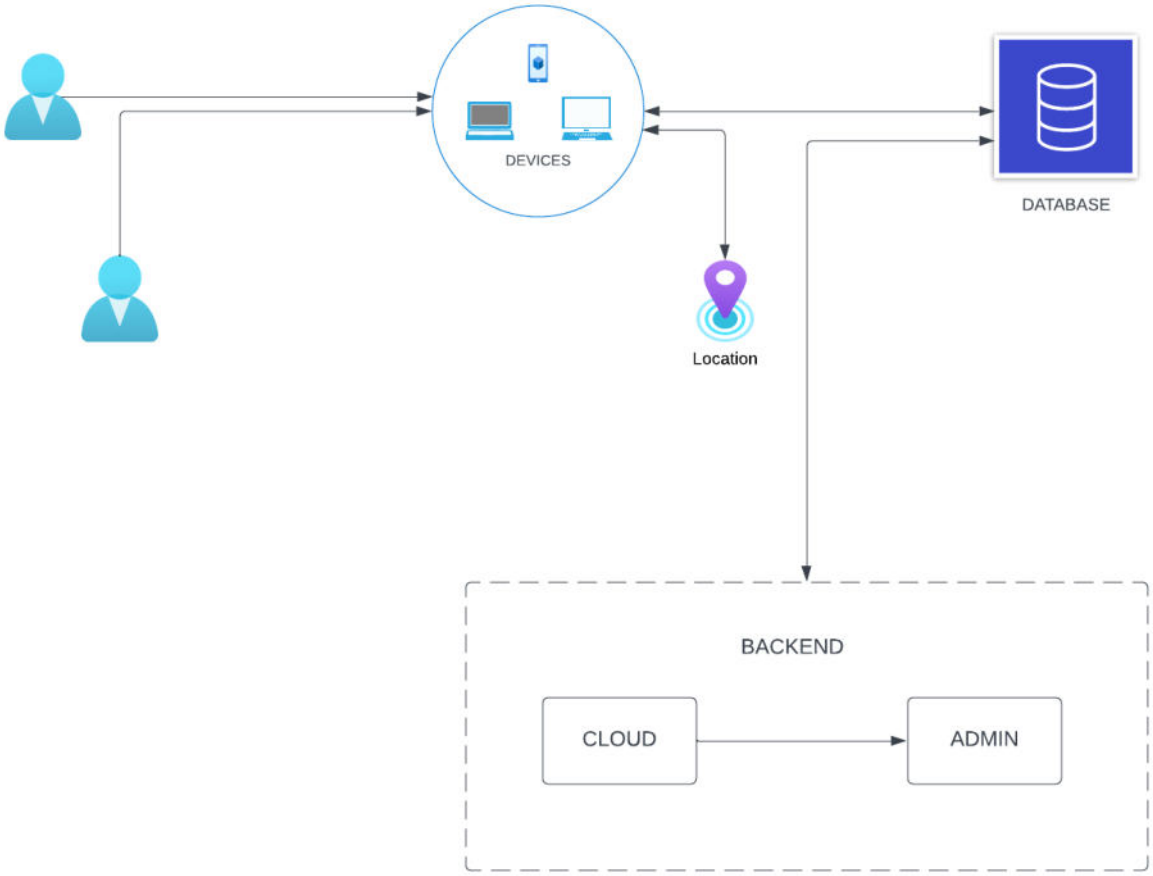


Figure 4.1: Architecture diagram

User Interface (UI):

This is the front-end component of your app that users interact with. It includes screens for login, feed, chat, book search, profile, and other features.

Authentication:

The app utilizes Google Firebase Authentication for user login and authentication. Users can sign in with their Google accounts, and their information is securely managed by Firebase.

Database:

Firebase Firestore is used as the database to store user profiles, posts, books, chat messages, and other relevant data. It provides real-time data synchronization and efficient querying capabilities.

Feed:

The feed component displays posts from other users in a chronological order. It retrieves post data from the Firestore database and presents it in a user-friendly format. Users can view, like, and comment on posts.

Chat:

The chat functionality allows users to communicate with each other through private chat rooms. When a user initiates a chat, the app checks if a chat room already exists between the two users. If not, a new chat room is created in the Firestore database. Messages sent between users are stored in the chat room document.

Book Search:

The book search feature enables users to find books available nearby. It utilizes the user's location and retrieves book data from the Firestore database based on proximity. Users can also search for books by title and view details such as the user who posted the book, book information, and initiate a chat for book inquiries.

4.3.2 Use Case Diagram

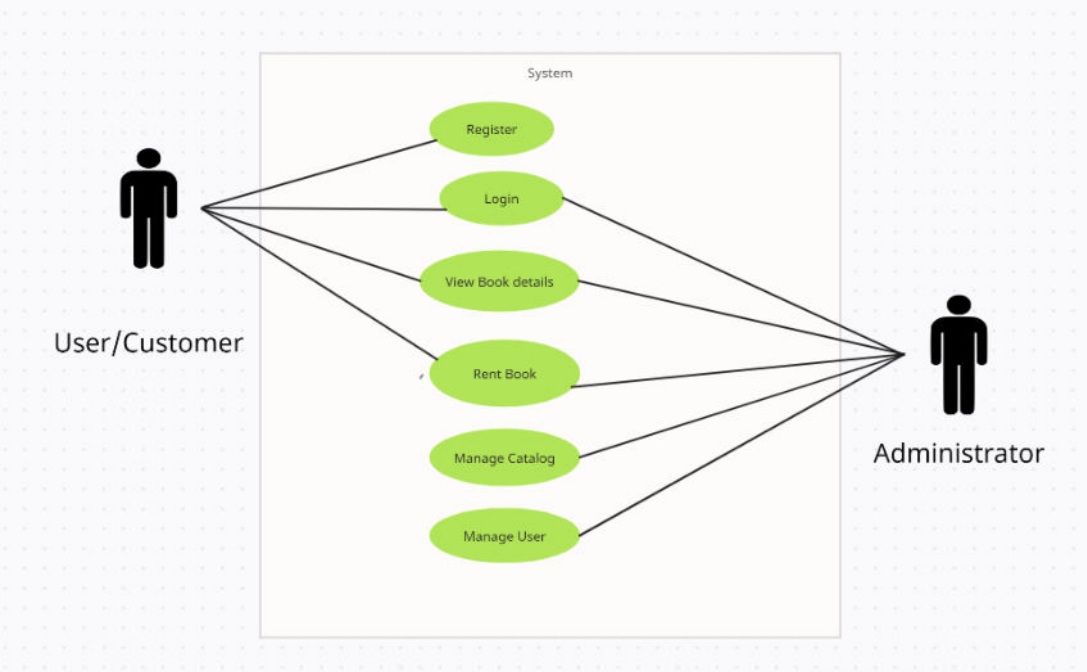


Figure 4.2: Use Case Diagram

4.3.3 ER Diagram

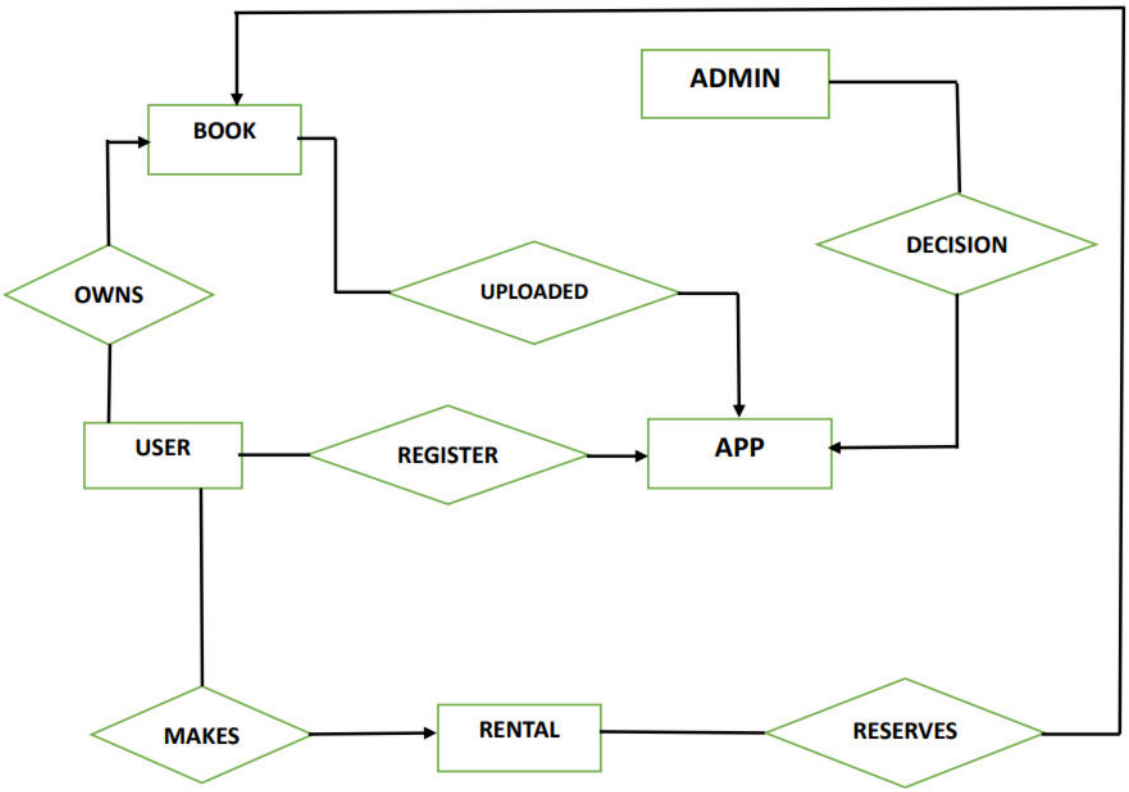


Figure 4.3: ER Diagram

4.3.4 Data Flow Diagram

A Data Flow Diagram (DFD) is a visual representation of the information flows within a system. It may be partitioned into levels that represent increasing information flow and functional details. Levels in DFD are numbered 0, 1, 2 or beyond.

Level 0 DFD

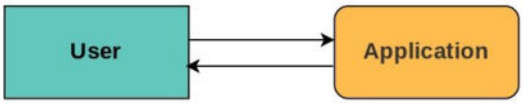


Figure 4.4: level 0 DFD

Level 1 DFD

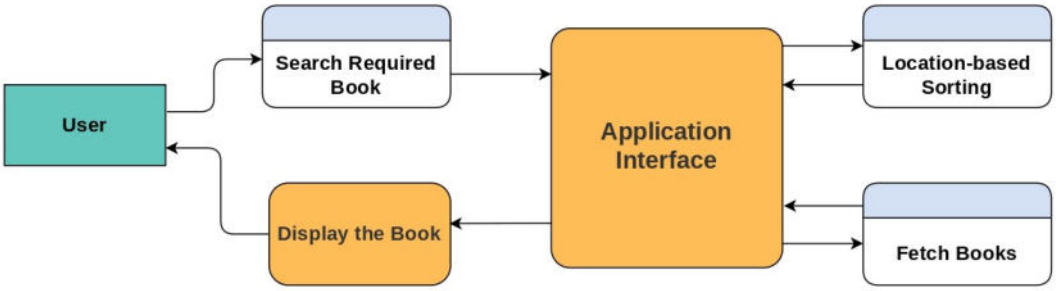


Figure 4.5: Level 1 DFD

Level 2 DFD

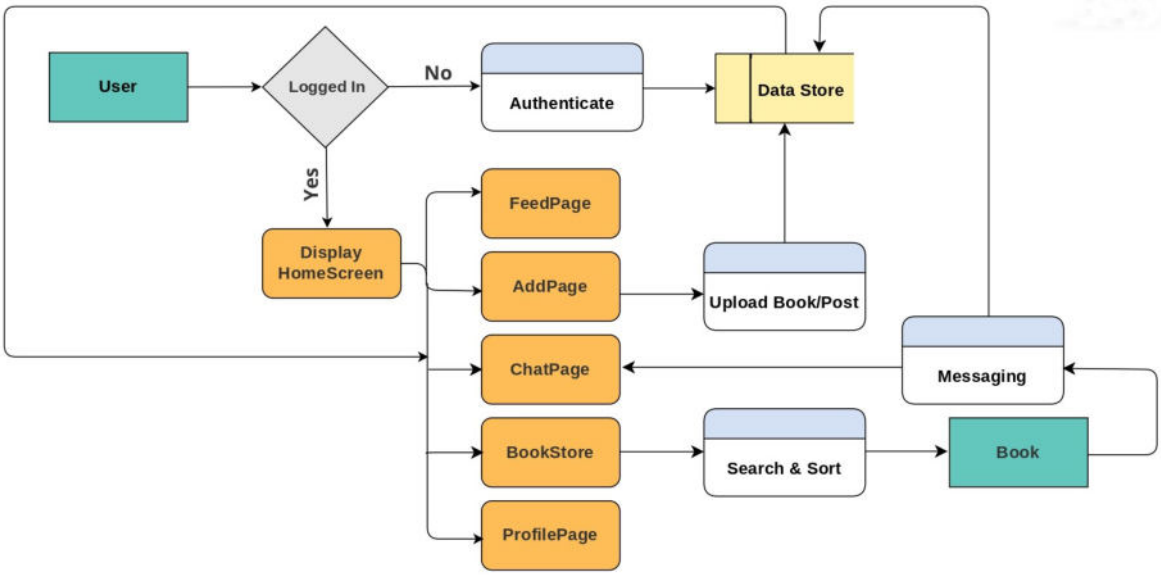


Figure 4.6: Level 2 DFD

Gantt chart

PROBLEM STATEMENT	FEBRUARY 2023			
LEARNING SURVEY		MARCH 2023		
LEARNING PHASE			APRIL 2023	
DESIGN			APRIL 2023	
IMPLEMENTATION				MAY 2023

Figure 4.7: Gantt chart

Chapter 5

Implementation

5.1 Technologies Used

Cloud computing plays a pivotal role in the implementation of our book rental application, providing a scalable and efficient infrastructure for seamless user experience. In this section, we will explore the key areas where cloud computing is utilized and its impact on our application's functionality.

Scalable Infrastructure

One of the significant advantages of cloud computing is its ability to dynamically scale infrastructure resources based on demand. By leveraging cloud services, such as Firebase, our application can effortlessly handle varying user loads without any disruptions. The cloud provider automatically manages resource allocation, ensuring optimal performance even during peak usage periods.

Serverless Architecture

Cloud computing empowers us to adopt a serverless architecture, eliminating the need for manual server management. With services like Firebase, the cloud provider takes care of infrastructure management, allowing us to focus on developing the

application's features and functionalities. This enables us to streamline development efforts and enhance productivity.

Data Storage and Retrieval

Cloud computing provides efficient and scalable data storage solutions. In our book rental application, we leverage Firebase Cloud Firestore as our cloud database. Cloud Firestore is a NoSQL document database that offers seamless integration with our application. It provides a structured storage mechanism and real-time synchronization of data across devices. This ensures that our users have access to up-to-date information and allows for efficient data retrieval and management.

Authentication and Security

Cloud computing platforms offer robust authentication and security mechanisms, ensuring the privacy and protection of user data. In our application, we utilize Firebase Authentication, which enables secure user authentication using Google accounts. This ensures that only authorized users can access the application's features and data, enhancing overall security.

API Integration

Cloud computing platforms provide a wide range of APIs that can be seamlessly integrated into our application. For instance, we integrate the Google Maps API to provide location-based services. This enables users to view nearby books available for rental and obtain navigation directions to the book owner's location. API integration enriches the functionality of our application, enhancing the user experience.

Reliability and Availability

Cloud computing platforms are designed to deliver high reliability and availability. With features like redundant data storage, automatic backups, and disaster recovery

mechanisms, our application's data is safeguarded and available to users at all times. This ensures that our users can access the application without interruptions and rely on its consistent performance.

By leveraging cloud computing, our book rental application benefits from a flexible and scalable infrastructure, efficient data storage and retrieval, enhanced security measures, and reliable performance. Cloud computing enables us to focus on developing and delivering a feature-rich application while offloading infrastructure management tasks to the cloud provider. This allows us to optimize resource utilization, minimize downtime, and provide an exceptional user experience.

Firebase Integration

- Firebase Authentication: We employed Firebase Authentication to enable user authentication within our application. Users can sign in using their Google accounts, which provides a secure and convenient login mechanism.

- Firebase Cloud Firestore: We utilized Firebase Cloud Firestore as our cloud-based NoSQL document database. It stores and retrieves data for our application, such as user profiles, posts, and books. Firestore's real-time synchronization capability ensures that users receive instant updates when new data is available.

Data Querying

To retrieve and manipulate data from Firestore, we employed Firebase's querying capabilities. We used Firestore queries to fetch relevant user profiles, posts, and books based on various criteria such as location, timestamp, and user preferences. This enabled us to present personalized content to users and facilitate efficient data retrieval.

Chat Feature Integration

To implement the chat feature, we utilized Firebase Cloud Firestore as the database solution. Within Firestore, we structured the data in a collection-based format, where

each chat room is represented as a document containing multiple message documents. To implement the chat feature, we utilized Firebase Cloud Firestore as the database solution. Within Firestore, we structured the data in a collection-based format, where each chat room is represented as a document containing multiple message documents.

Google Maps Integration

To provide location-based services, we integrated the Google Maps API into our application. Users can view nearby books available for rental, and by clicking on the navigation button, they are redirected to Google Maps with the owner's location marked. This integration enables users to navigate to the book owner's location easily.

User Authentication and User Interface

Through Firebase Authentication, we implemented secure user authentication, allowing users to sign in using their Google accounts. This authentication mechanism ensures that only authorized users can access the application's features and data.

In terms of the user interface, we utilized the Flutter framework, which offers a rich set of UI components and tools for building cross-platform applications. We designed intuitive and user-friendly screens using Flutter's widget system, ensuring a seamless and visually appealing experience for our users.

Social Features

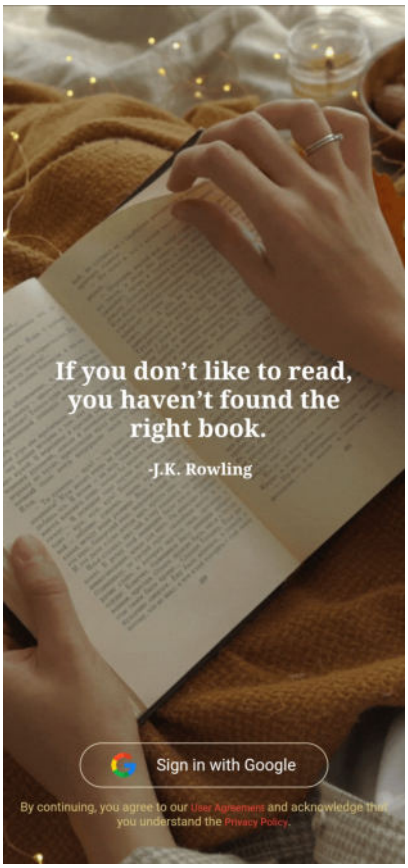
To enhance the social aspect of our application, we implemented various features such as user profiles, post sharing, and interactions. Users can create posts with captions and upload images, which are stored in Firebase Cloud Storage. User profiles showcase the user's posts and books, allowing others to explore their activity within the application.

In conclusion, the utilization of cloud computing in our book rental application has significantly contributed to its overall functionality and performance. The scalable infrastructure, secure data storage, and API integration capabilities offered by cloud

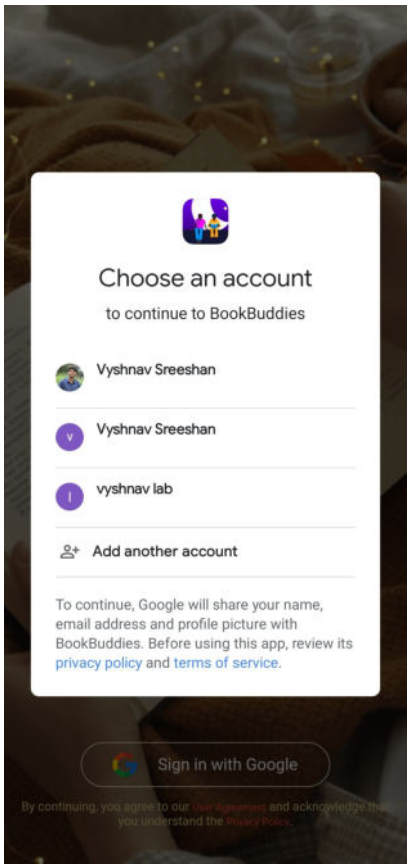
computing platforms have allowed us to create a robust and user-friendly application. Through cloud computing, we have achieved the necessary scalability, reliability, and security required for a successful book rental platform.

Chapter 6

Result And Discussion

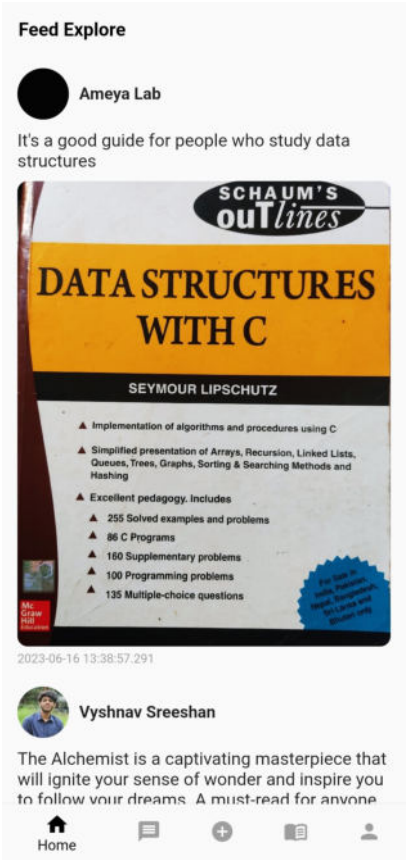


(a) Login Screen

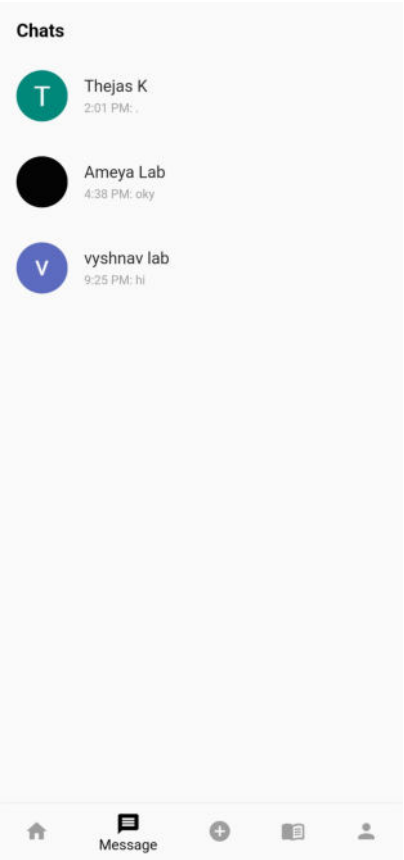


(b) Login

The first screenshot (a) shows the login screen of the application, while the second screenshot (b) displays the login interface.

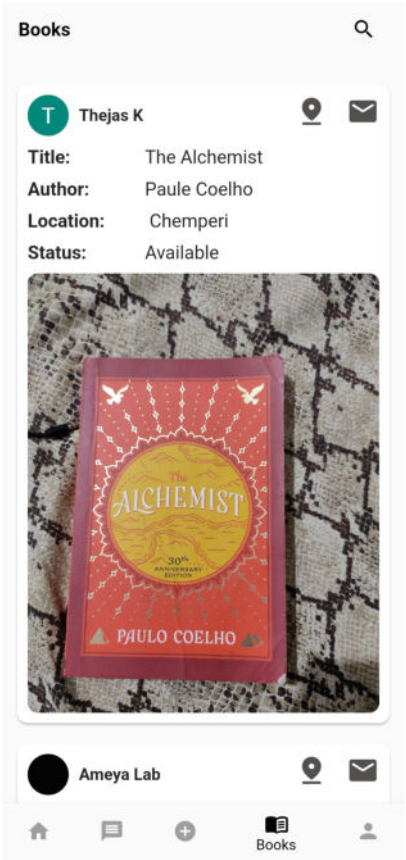


(c) Feed Screen

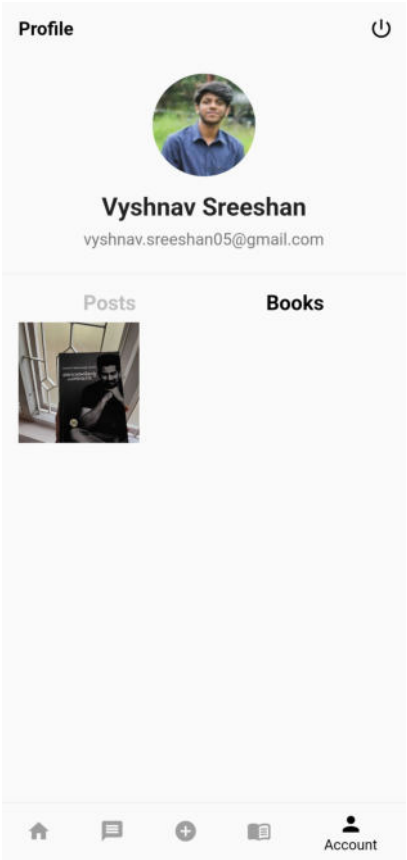


(d) Message Screen

On this page, the first screenshot (c) illustrates the feed screen, where users can view posts from other users. The second screenshot (d) showcases the message screen for user-to-user communication.

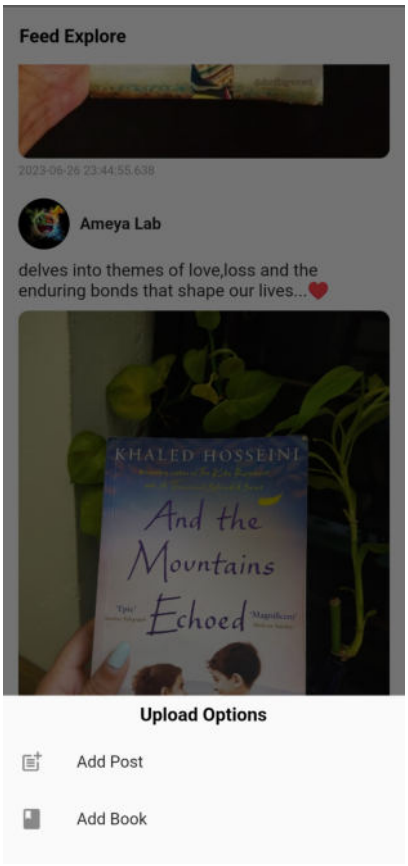


(e) Book Screen

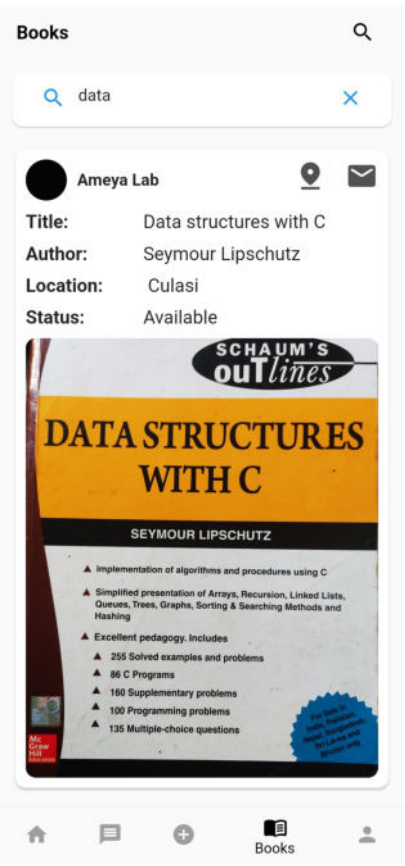


(f) Profile Screen

In the first screenshot (e) on this page, users can browse and interact with books. The second screenshot (f) shows the profile screen, where users can view and edit their profile information.



(g) Upload book



(h) Search Books

The first screenshot (g) demonstrates the options of uploading a post or book, while the second screenshot (h) depicts the search functionality to search books.

Chapter 7

Conclusion

In conclusion, the BookBuddies application is an innovative and practical solution for book enthusiasts who want to share and rent books among themselves. Based on our feasibility study, we can confidently say that the app is viable and has the potential to be successful in the market. Our team was inspired by the features of the different reference papers and proposed a solution that is tailored to the needs of our target audience. We have identified the software and hardware requirements, as well as the system architecture, needed to develop the app. Moving forward, the development of the BookBuddies application will require further planning, execution, and testing to ensure that it meets the expectations of our target users. We aim to make the app user-friendly, efficient, and secure. Overall, we believe that the BookBuddies application can make a significant impact on the book-sharing industry and we are excited to bring this idea to life.

7.1 Future Scope

- Expanded Physical Inventory: Book rental services can expand their collection of physical books, catering to customers who prefer the tangible experience of reading traditional print books.
- Advanced Recommendation Systems: Utilizing sophisticated algorithms, book

rental services can offer personalized book recommendations based on customers' reading habits and preferences, enhancing their overall rental experience.

- Collaborations with Publishers and Authors: Book rental services may forge partnerships with publishers and authors to offer exclusive rental deals and access to newly released titles. Such collaborations can provide a competitive edge by offering unique and sought-after content to customers, encouraging them to opt for rental services instead of traditional purchasing.

- Integration with Educational Institutions: Book rental services can establish partnerships with educational institutions, including schools and universities, to provide affordable textbook rental solutions for students. This can help alleviate the financial burden of purchasing textbooks and support sustainable practices within the education sector.

- Enhanced User Experience: Continuous improvement of user experience will remain a priority for book rental services. This includes intuitive and user-friendly online platforms, seamless rental processes, efficient customer support systems, and flexible rental terms to accommodate individual preferences.

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4. A. Sivasangari, Pravin V, Pranvesh B, "Quick Aid: Mobile Application for Product Rental," in *Proceedings of the International Conference on Electrical, Electronics, Signal, and Communication Engineering (ICESC 2022)*.

LATE COMER IDENTIFICATION SYSTEM

A Mini Project Report

submitted to

the APJ Abdul Kalam Technological University

in partial fulfillment of the requirements for the degree of

Bachelor of Technology

by

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June 2023

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DEPT. OF COMPUTER SCIENCE AND ENGINEERING

CERTIFICATE

This is to certify that the report entitled **LATE COMER IDENTIFICATION SYSTEM** submitted by **ANN MARIA SEBASTIAN** (VML20CS045), **LIDIYA JAMES** (LVML20CS187) **OV ANAGHA** (VML20CS095) & **VISMAYA MARIYA THOMSON** (VML20CS182) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering is a bonafide record of the project work carried out by them under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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Date : 26-06-2023

Head of the department

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Signature Not Verif

Principal.VJE

DECLARATION

We hereby declare that the project report **LATE COMER IDENTIFICATION SYSTEM**, submitted for partial fulfillment of the requirements for the award of degree of Bachelor of Technology of the APJ Abdul Kalam Technological University, Kerala is a bona fide work done by us under supervision of **Mr. ABHIRAM P**.

This submission represents our ideas in our own words and where ideas or words of others have been included, we have adequately and accurately cited and referenced the original sources.

We also declare that we have adhered to ethics of academic honesty and integrity and have not misrepresented or fabricated any data or idea or fact or source in my submission. We understand that any violation of the above will be a cause for disciplinary action by the institute and/or the University and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been obtained. This report has not been previously formed the basis for the award of any degree, diploma or similar title of any other University.

ANN MARIA SEBASTIAN
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CHEMPERI
26-06-2023

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ANN MARIA SEBASTIAN

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Abstract

There is a need for a system which identifies the late comers of an institution as there are many students who arrive late multiple times.At many institutions,there are staffs and faculties who are present at the entrance points of the institution just to identify the late coming students.This increases the workload of the staffs since they have to stand at the entrance points for so much time.

Face recognition is a method of identifing or verifing the identity of an individual using their face.Our project "Late Comer Identification System using face recognition" makes use of this face recognition technology and can help institution to monitor their students attendance and punctuality.This system uses a camera to capture an image of an individual's face,which is then compared to a pre-existing database of faces to verify the individual's identity.The system can accurately identify an individual even if they arrive late,making it a valuable tool for tracking the details of the students with the timestamp at which they have entered the institution.

The system has several advantages over traditional attendance tracking methods,including increased accurancy,efficiency and convenience.It eliminates the need for manual tracking and can significantly reduce administrative workload.

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List of Figures

Chapter 1

Introduction

1.1 Overview

In today's world, technology has advanced to great heights such that it helps in our day-to-day life. One such technology is face recognition.

Face recognition is a method of identifying or verifying the identity of an individual using their face. It is used in places like mobile phone unlocking, immigration process in airports, educational purposes like attendance systems, and healthcare.

Face recognition can be a support system for multi-modal biometrics applications because it is one of the most natural and "easy-to-collect" biometrics.

Because the ultimate goal of biometrics is security, facial biometrics is widely regarded as one of the most powerful deals in security authentication. User identification determines the person based on exhaustive verification in which the actual biometric features are compared to all registered references and the most similarity is determined.

When compared to traditional user authentication, the advanced approach of facial recognition has the potential to benefit educators and potential users by providing reli-

able results, minimising online exam anomalies (e.g., cheating, suspicious behaviours, etc.), strong validation of user's identity, and encouraging data efficiency.

Biometrics are used to identify and authenticate a person using a set of recognizable and verifiable data unique and specific to that person. In the case of facial biometrics, a face is captured. It then transforms it into digital data by applying an algorithm before comparing the image captured to those held in a database.

These automated systems can be used to identify or check an individual's identity in just a few seconds based on their facial features (geometry): spacing of the eyes, bridge of the nose, the contour of the lips, ears, chin, etc.

Artificial intelligence is a broad field of computer science concerned with creating intelligent machines capable of performing tasks that normally require human intelligence. Since the development of the digital computer in the 1940s, it has been demonstrated that computers can be programmed to perform extremely complex tasks with great proficiency, such as discovering proofs for mathematical theorems or playing chess. Despite ongoing advances in computer processing speed and memory capacity, no programmes can yet match human flexibility across broader domains or in tasks requiring extensive everyday knowledge. On the other hand, some programmes have surpassed the performance levels of human experts and professionals in performing specific tasks, so artificial intelligence in this limited sense can be found in applications ranging from medical diagnosis to computer search engines to voice or handwriting recognition.

Machine learning is a subfield of artificial intelligence (AI) and computer science that uses data and algorithms to imitate how humans learn, gradually improving its accuracy. Machine learning is used in a variety of fields,including data security, finance, healthcare, fraud detection, and retail.

A late comer attendance system using face recognition is a type of biometric technology that uses artificial intelligence to automatically identify and verify individuals based on their facial characteristics. These systems are commonly used to track attendance in workplaces, stores, and other organizations. The system captures an image of the individual's face and then compares it to a database of pre-registered faces. If a match is found, the system records the individual's attendance. These systems can be integrated with existing time and attendance software and can also be used for security and access control purposes.

1.2 Problem Statement

This project aim to develop an interface where the regular late coming students could be easily identified which doesn't require any manual help. Face recognition attendance systems have proven to help manage time and transform the school/college working atmosphere.

The aim of our project is to reduce work of staffs who regularly monitors infront of various gates to identify the late comers and saves time,it also provides accurate data instantly. Validating an individual through facial recognition requires no manpower.

1.3 Scope Of The System

The idea of the project is to identify students using face recognition algorithm. The processed image will then be compared against the existing stored record and then attendance is marked in the database accordingly.

This system provides scalability for handling large volumes of data, utilization of advanced algorithms for accurate identification, integration with databases for efficient attendance record management, real-time monitoring and reporting capabilities, and a user-friendly interface. This comprehensive system provides an efficient and reliable solution for attendance management in educational institutions Compared to existing

system traditional attendance marking system, this system reduces the workload of people.

1.4 Objective

The process of marking late comers attendance in the traditional manual way may be prone to human error, misinterpretation, or oversight.It is not only arduous but also consumes a significant amount of time. The traditional methods employed for attendance marking have long been a challenge in terms of accuracy, efficiency, and effectiveness. As the demand for efficient and automatic attendance marking techniques continues to rise, the field of face recognition has emerged as a promising avenue for addressing this growing challenge.

In recent years, numerous efforts have been made to develop automatic attendance marking systems, utilizing standard biometric modalities such as fingerprint scanning and Radio Frequency Identification (RFID) tags.However, these techniques often fall short in terms of reliability and practicality.It is in this context that the proposed project seeks to introduce an innovative automated attendance marking and management system, leveraging advanced face detection and recognition algorithms.

Unlike the conventional methods, this proposed system aims to revolutionize the attendance recording process by harnessing the power of facial recognition technology. By accurately identifying students through their facial features, the system eliminates the need for manual intervention and tedious administrative tasks. The core objective of this project is to create an attendance marking and management system that identifies the late comers that is not only efficient and time-saving but also simple and user-friendly.

In this system, facial recognition algorithms play a pivotal role. The faces of students will be detected and recognized, employing sophisticated algorithms capable of analyzing and matching facial features. The processed image will then be compared against the existing stored records. Subsequently, attendance of the arriving students will be seamlessly marked in the database, ensuring accurate and up-to-date records.

Compared to the traditional attendance marking system, which often relies on manual processes and paperwork, the proposed system significantly reduces the work-load on individuals responsible for attendance management. Using face recognition technology for late comer identification provides several advantages over traditional manual methods.

Firstly, it offers a higher level of accuracy compared to manual identification, eliminating the potential for human error. Additionally, face recognition systems operate with greater efficiency, enabling real-time identification of latecomers and allowing educators to promptly address attendance issues. The objective and unbiased nature of face recognition algorithms ensures fair and consistent identification of individuals. Furthermore, the data analysis capabilities of these systems allow educational institutions to gain insights into attendance patterns and make informed decisions. Moreover, utilizing face recognition technology reduces the administrative burden associated with manual attendance tracking, freeing up valuable time for educators. Lastly, the adoption of this technology promotes discipline and punctuality among students, fostering a responsible and accountable learning environment.

Chapter 2

Literature Review

2.1 A Review of Face Recognition Technology

ABSTRACT:

Face recognition technology is a type of biometric technology that identifies a person's facial features. Face images are collected of people, and the recognition equipment processes the images automatically [1].

Face recognition technology has gained a significant amount of attention due to its convenience and accuracy. The technology is based on the identification of facial features of a person, and it has been widely used in attendance access control, security, finance, logistics, retail, smartphone, transportation, education, real estate, government management, entertainment advertising, network information security, and other fields. Face recognition in a broad sense includes related technologies for building a face recognition system. It includes face detection, face position, identity recognition, image preprocessing etc.

Face detection algorithm is to find out the coordinate system of all faces in one image. This is the process of scanning the entire image to determine whether the candidate area is a face. The output of the face coordinate system can be square, rectangular,

etc. The face position is the coordinate position of the face feature in the face detection coordinate system.

There are three different stages in the development stage - early algorithm stage, artificial features and classifier stage, and deep learning stage. Early algorithm stages include PCA and LDA. People began researching how to teach machines to recognize faces in the 1950s. Face recognition engineering applied research officially began in 1964, primarily using face geometry for recognition. However, it has not been used in practice.

Deep learning stage includes neural networks and deep learning. Deep learning is a subset of machine learning that involves training deep neural networks to recognize patterns in data. Deep learning has revolutionized the field of face recognition by enabling the automatic extraction of features required for classification during the training process. This eliminates the need for feature extraction steps and results in more effective and accurate recognition of faces.

Artificial features and classifier stage and deep learning stage are two important stages in the development of face recognition technology. These techniques have enabled the development of more accurate and efficient face recognition systems.

METHODOLOGY:

Principal Component Analysis (PCA)

Principal Component Analysis (PCA) is a popular technique in data analysis, data visualization, and pattern recognition. It is a dimensionality reduction method that transforms high-dimensional data into a low-dimensional space while preserving the most important patterns in the data. PCA is used to analyze datasets with many variables, explore the relationship between variables, and identify the most significant patterns in the data.

It is a statistical process that uses orthogonal transformation to convert observations of correlated features into a set of linearly uncorrelated features. The Principal Components are the new transformed features. It is one of the most widely used tools for exploratory data analysis and predictive modeling. It is a method for extracting strong patterns from a given dataset by reducing variances.

PCA works by taking into account the variance of each attribute in the data. The high variance attributes are considered to be more important and are given more weight in the construction of the principal components.PCA has many real-world applications, including image processing, movie recommendation systems, and power allocation in communication channels.

Linear Discriminate Analysis (LDA):

Linear Discriminant Analysis (LDA) is a dimensionality reduction technique commonly used in machine learning to solve problems with more than two classes. It is also known as Discriminant Function Analysis (DFA) or Normal Discriminant Analysis (NDA) (DFA). LDA is a supervised learning technique, which means that it requires labeled data to train the algorithm. The goal of LDA is to find the linear combinations of features that can best separate the classes in the data. This can be used to project higher-dimensional features into lowerdimensional space in order to save resources and reduce dimensional costs.

Linear Discriminant analysis is used as a dimensionality reduction technique in machine learning, using which we can easily transform a 2-D and 3-D graph into a 1-dimensional plane. LDA is a powerful dimensionality reduction technique that can be used to reduce the number of features in a dataset while preserving the class structure of the data.

Support Vector Machine (SVM):

Support Vector Machine, or SVM, is a popular Supervised Learning algorithm that is primarily used for classification problems. SVM is a binary classification algorithm that tries to find the best line or decision boundary that separates the data points into

different classes.

Its goal is to find the best decision boundary or hyperplane for categorizing n-dimensional space, with support vectors being the data points that are closest to the hyperplane and have the most impact on its position and orientation. The classifier's margin is maximised by using these support vectors. The position of the hyperplane will change if the support vectors are removed. These are the elements that comprise an SVM.

Adaboost:

Boosting is an ensemble modeling technique introduced by Freund and Schapire in 1997, which has been popular for dealing with binary classification problems. The technique boosts prediction power by transforming a large number of weak learners into strong learners. The basic idea behind boosting algorithms is to build a model on the training dataset first and then build a second model to correct the errors in the first model. This procedure is repeated until the errors are minimized and the dataset is correctly predicted.

AdaBoost, also known as Adaptive Boosting, is a Machine Learning technique that is used as an Ensemble Method. The most common AdaBoost algorithm is decision trees with one level, which means decision trees with only one split. These trees are also referred to as Decision Stumps. The AdaBoost algorithm works by assigning weights to the training examples, with the misclassified examples getting higher weights. The algorithm then trains a weak learner on this modified dataset and continues this process until the desired level of accuracy is achieved.

CONCLUSION:

The development of face recognition technology has made significant progress due to advancements in science and technology. However, there are still areas where it can be improved in practical applications. One potential solution for improving face recognition technology is the development of a specialized camera that can improve

image quality, filter images, and reconstruct images, reducing issues such as noise and occlusion. Additionally, 3D technology can be used to supplement 2D images, which can help solve problems such as rotation and occlusion.

Overall, as technology continues to advance, we can expect to see significant improvements in face recognition technology, leading to enhanced accuracy and reliability in its practical applications.

2.2 Research on Face Recognition Technology Based on Deep Learning

ABSTRACT

Face recognition is a supervised classification problem that involves identifying and classifying faces in images or videos. The process involves extracting facial features, such as the position, size, and pose of the face, and then using those features to identify the person. There are many techniques used for face recognition, including machine learning algorithms like the K-NN algorithm and feature extraction methods like HOG (Histogram of Oriented Gradients). [2] These techniques are used to improve the accuracy and efficiency of face detection and recognition.

Face detection is a famous topic in biometrics. We have surveillance cameras in public places for video capture as well as safety purposes. The predominant benefits of this algorithm over different ones are uniqueness and approval. We need pace and accuracy to identify. But face detection is a sequence of countless associated problems: First, look at an image and discover all the faces in it. Second, focus on every face and recognise that even if a face is turned in a weird route or in bad lighting, it is still the identical person. Third pick out points which can be used to discover every face uniquely like the dimensions of the eyes, face, etc. Finally, to evaluate these features

as facts we have to locate the character's name.As humans, our brain is wired to do all of this automatically and instantly.Computers are no longer capable of this sort of high-level generalization, so we must educate them on how to do every step in this technique separately. The growth of face detection is mostly pushed by developing functions such as credit card verification, surveillance video images, authentication for banking, and security system access.

METHODOLOGY:

KNN Algorithm:

The K-Nearest Neighbour (KNN) algorithm is a simple, supervised machine learning algorithm that is widely used in the field of face recognition technology.It can be used for both classification and regression problems. The principle of face recognition technology is based on the KNN algorithm (KNearest Neighbour).

The basic principle of the KNN algorithm is to classify new data points based on the majority vote of the k-nearest neighbors in the training data. In the context of face recognition, the KNN algorithm is used to compare the facial features of an unknown face with the features of known faces in a database.The K-Nearest Neighbor algorithm uses neighborhood classification as the predictive value of a good instance value. The KNN set of rules can compete with the maximum models as it makes relatively accurate predictions.

HOG features:

Histogram of Oriented Gradients (HOG) is a feature descriptor that has become a popular tool for feature extraction in computer vision and image processing tasks.It is also an effective algorithm used in building face recognition systems [10].This technique is widely used in object detection tasks where the goal is to identify the presence and location of objects within an image.The HOG feature descriptor is particularly effective in face detection, as it allows for accurate extraction of facial features from an image.

The core concept of the directional gradient histogram (hog) feature is to calculate a cell unit with uniform size and dense grid and use overlapping local comparison normalization Technology to enhance the description strength.

Face Alignment Process:

Facial recognition technology relies on the accurate detection and analysis of facial features. One important aspect of this analysis is the shape of the face. However, the shape of a face is a high-dimensional feature, which can make it difficult to analyze and compare between different faces.

To address this issue, researchers have developed a technique called Principal Component Analysis (PCA), which is used to reduce the dimensionality of the face shape data. This technique involves calculating the eigenvalues and eigenvectors of a set of face shape data, and then using these values to form a lower-dimensional representation of the shape space. This lower-dimensional representation is much easier to analyze and compare between different faces.

Extracting Face Recognition Features From Images:

Facial feature extraction is an important step in the field of computer vision, particularly in facial recognition. The process involves detecting and extracting key facial features such as eyes, nose, mouth, and eyebrows from an image of a face. These features are then used as input to various algorithms for tasks such as face tracking, facial expression recognition, and face recognition.

Feature extraction refers to the method of reworking the raw image data into a set of numerical features that can be more easily processed by machine learning algorithms while keeping the data in the original records.It yields higher outcomes than making use of machine learning directly to the raw records.

CONCLUSION:

In conclusion, face recognition technology is an important field in biometrics that has

many practical applications. The process of face recognition involves extracting facial features, such as the position, size, and pose of the face, and using those features to identify the person. The KNN algorithm and HOG features are widely used in face recognition technology to improve accuracy and efficiency. Face alignment process, such as Principal Component Analysis (PCA), is also used to reduce the dimensionality of the face shape data, making it easier to analyze and compare between different faces. As technology continues to advance, face recognition technology is likely to become even more accurate and widespread in its applications.

2.3 Face Recognition System Using Machine Learning Algorithm

ABSTRACT:

While several face recognition techniques have been suggested, they are still challenging to use in real-world situations due to varying conditions like facial occlusion, illumination, and posture.The recent launch of new mobile phone variants by smartphone vendors highlights the growing interest in leveraging facial authentication functionality to enhance user experiences and security [5]. [3] has a detailed description of various face algorithms used for face recognition and expression detection It also gives a detailed description of PCA (Principal Component Analysis).

METHODOLOGY:

Haar Cascade:

Haar Cascade is a machine learning-based object detection algorithm that uses a series of square-shaped functions to form a family of wavelets or a base. It is commonly used in computer vision applications, such as face detection and object recognition.

The Haar Cascade algorithm organizes the pixels in an image into a square, which

can be used to identify different features such as edge features, line features, and four rectangle features.Haar Cascade is an effective algorithm for object detection in images, and its ability to identify different features allows for efficient and accurate detection of various objects.

Eigenfaces:

Eigenfaces is a popular face recognition algorithm that utilizes principal component analysis (PCA) to extract the most important features of a face image. The algorithm assumes that most face images lie in a low-dimensional subspace and uses PCA to find the vectors, or eigenfaces, that span this subspace.

Represents face images in the dataset as a linear combination of eigenfaces. First, take the mean face and subtract from the population and now the eigenvector is generated. Among these images, some are not clear due to lighting but the clear ones are taken as vectors.

Fisherface:

Fisherface is a face recognition algorithm that is similar to Eigenfaces in that it uses linear projection to extract features from face images. However, Fisherface differs from Eigenfaces in that it uses a more sophisticated statistical approach called Linear Discriminant Analysis (LDA) to extract features that distinguish one class from another which has maximum separation between means of projected classes and minimum variance within each projected class.

Local Binary Pattern:

Local Binary Pattern (LBP) is a feature extraction technique used in facial recognition that can minimize variations in features and improve the robustness of face recognition systems.It takes facial points for recognition and minimizes variations in features. It is of 9 pixels which are 3*3. Each pixel has a specific value and it is compared with the middle pixel. If the value is greater than or equal to the middle pixel then it is 1 else 0.

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One of the advantage of LBP is that if lighting changes then all values in the pixel change relatively hence binary pattern remains the same.

Principle Component Analysis:

Principle Component Analysis: First Principle components are found using various views on a graph that has attributes as its x and y coordinates. The view with the highest priority is chosen. It uses the orthogonal property which states that all views are independent.

CONCLUSION:

In general, these techniques can help improve the accuracy of facial recognition by reducing the impact of factors such as lighting, pose,etc and by identifying the most important features or variables in the data. However, they also have limitations such as sensitivity to variations in the dataset and the need for extensive training data, and may require additional techniques or algorithms to address these limitations. Overall, these techniques play an important role in the development of facial recognition systems and continue to be refined and improved to meet the challenges of real-world applications.

2.4 Face Detection and Recognition Using OpenCV

ABSTRACT

The study of face recognition has been ongoing for many years, with early experiments such as Darwin's work on facial expressions being among the earliest findings. Today, facial features are often compared to other biometric features such as fingerprints and eye recognition. The development of advanced artificial intelligence methods has been aided by the Computer Vision library provided by Intel's open-source software, which has made programming easier for researchers in this field.

[4] provides a detailed description of various face algorithms used for face recognition and expression detection, including Principal Component Analysis (PCA). PCA involves finding the first principal components using various views on a graph, with attributes as its x and y coordinates.It uses the orthogonal property which states that all views are independent. OpenCV Structure and content: It has 5 main elements: CV, MLL, HighGUI and CXCORE.

OpenCV:

OpenCV is a python open-source library. CV refers to computer vision. It is used to process images and videos to identify objects and faces. It consists of main picture processing and a lower computer vision algorithm. Its major components are :

CV: Image processing and vision algorithm

MLL: Statistical Classifiers and Clustering Tools

HighGUI: GUI, Image and Video I/O

CXCORE: basic structure and algorithms, XML support, drawing functions

METHODOLOGY:

Face detection using Haar Cascades:

Face detection using Haar Cascades is a popular method for detecting human faces in images and videos. It involves using a sequence of square-shaped functions, known as Haar wavelets or Haar features, to organize pixels on the picture. These Haar features are based on edge features, line features, and four rectangle features, which are combined to form the Haar cascade.

Haar cascades are filters that can be used to extract features from images or videos, which can then be classified as either a face or non-face object. This approach is based on machine learning, where computers are trained using many positive and negative representations of faces. The positive examples are images that contain faces, while the negative examples are images that do not contain faces.

Eigenfaces:

Eigenfaces is a popular method for face recognition and detection that involves representing face images in a dataset as a linear combination of eigenfaces. Eigenfaces are a set of eigenvectors that represent the principal components of face images in the dataset. These eigenvectors are calculated from the covariance matrix of the face images.Machine learning is performed on these images.

Fisherface:

Fisherface is a method for face recognition and detection that is based on Linear Discriminant Analysis (LDA) which has maximum separation between means of projected classes and minimum variance within each projected class.

Local Binary Pattern:

Local Binary Pattern (LBP) is a texture descriptor that is commonly used for face recognition and detection. LBP takes facial points for recognition and minimizes variations in features by marking each pixel with its binary approximation. The output of LBP is a binary set of numbers that can be used to describe the texture of a face image.

It is discovered in the year 1994 and is powerful too for the classification of textures. It is used to increase efficiency. When LBP combines with histogram the face image can be described simply in terms of vectors.

It uses the concept of 8 Pixel neighborhood. A pixel is chosen and the neighboring pixels are considered. It is of 9 pixels which are 3x3. Baes on certain calculations done on the neighboring values, the central value is changed. This changed data set is used for face recognition. This changed pixel value is used for comparison to match faces.

Principal component analysis:

Principal Component Analysis (PCA) is a statistical technique that is commonly used in image processing for identification, detection, and compression of images. It is mainly used for activities such as calculating, reducing duplicates, and extracting functions.

PCA is a powerful technique for reducing the dimensionality of data, which can be particularly useful in image processing when dealing with large datasets. PCA can be used for a variety of tasks in image processing, including identifying sex and determining facial expressions.

CONCLUSION:

The earliest findings of face recognition date back to experiments like Darwin's feelings for facial expressions, and since then, significant advancements have been made in this field.Haar cascades, Eigenfaces, Fisherfaces, and Local Binary Patterns are some of the popular techniques used in face recognition. Each of these techniques has its unique strengths and can be used for specific applications.Additionally, Principal Component Analysis (PCA) is a powerful technique used for the identification, detection, and compression of images. It is commonly used in cluster monitoring, personal identification, and other applications.Overall, the use of these techniques has greatly contributed to the development of efficient and accurate face recognition systems.

Chapter 3

Requirement Specification

3.1 Functional Requirements

The functional requirements of a late comer identification system using face recognition include:

1.Face detection: The system should be able to detect faces in images captured by the camera.

2.Face recognition: The system should be able to recognize faces and match them against a database of stored faces.

3.Database management: The system should be able to manage a database of stored faces, including adding and deleting faces as necessary.

4.Record keeping: The system should be able to keep records of latecomers and their time of arrival for attendance purposes.

5.Performance and reliability: The system should be designed to perform reliably and efficiently, with fast response times and minimal errors.

3.2 Software Requirements:

Code Editor: PyCharm and VS Code. PyCharm is a popular Integrated Development Environment (IDE) for Python programming language, developed by JetBrains. It

provides developers with a complete set of tools for coding, debugging, testing, and deployment of Python applications. Visual Studio Code, commonly referred to as VS Code, is Microsoft's universal source code editor for Windows, Linux, and macOS. It includes debugging, syntax highlighting, smart code completion, snippets, code refactorings, and embedded Git support

Languages: Python. Python is a high-level, interpreted, general-purpose programming language. Its design philosophy emphasizes code readability with the use of significant indentation. Python can be used for implementing AI or image processing based projects.

Libraries: Python libraries such as OpenCV and Dlib,Flask are used.

3.3 Hardware Requirements:

Webcam: A webcam is needed to capture the person's face. Face recognition is performed using webcam

3.4 System Hardware Requirements:

1.**CPU:** 2+ Cores, 2.46+ Ghz

2.**RAM:** 6 GB or higher

3.**Disk:** 25 GB + free space

Chapter 4

Proposed System and Design

4.1 Proposed system

The system is set for identifying the students those who are coming late to college.The system is set up in such a way that first each students face is scanned using camera and enter student ID, name, and additional informations like department,year etc.The ID and name are then saved in one CSV file,and the additional details are saved in another.Face recognition is to identify the students and record their entering time to the college.Once we enter the details of each student it is already saved.The responsible authorities can view the details of the each student by entering the name and ID. The data will be fetched from the CSV file which consist of information of only those who come late to the college. The information consist of combination on both CSV file containing id, name and additional information like the time she/he entered.

4.2 Feasibility Study

4.2.1 Technical Feasibility

The main technologies and tools that are associated with this project are Python,OpenCV. Each of these is open source and freely available and the technical skills required

are manageable. In order for the program to run fully the webcam access must be provided.The information is stored in CSV files and its basic understanding is required. The algorithm used is Histogram of Oriented Gradients (HOG) and deep convolutional neural networks (CNNs).

4.2.2 Operational Feasibility

The entire program is working on a computer system and information like training images and the student entering time along with date are stored to a CSV file.The students those enter the college late are recorded separately.Thus the students who coming late to college frequently can easily identified.

4.2.3 Economic Feasibility

The project is economically feasible as the only cost involved is having a webcam. Also,since we use open-source libraries and tools, the cost of development tools can be eliminated.

4.3 Design

4.3.1 Architecture Diagram

The major process involved in this project is face recognition. Once the student enter the college, their face is detected using the webcam.Then it fetches the face detected from the already saved datas of the student.And enter their entering time and the date. The file and the data stored in them can be accessed by the corresponding authorities.

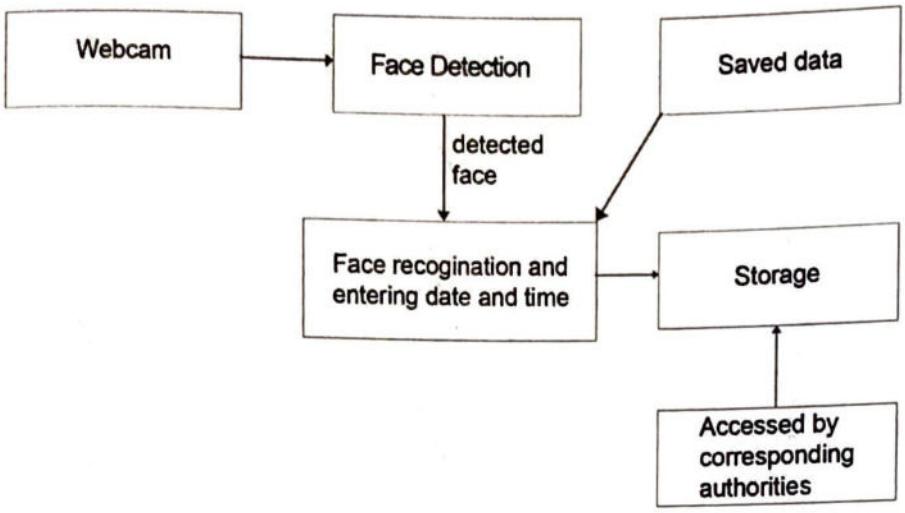


Figure 4.1: Architecture diagram

4.3.2 Use Case Diagram

There are four users for our project. Student is to scan their faces while entering the college.Admin can manage all activities that is to monitoring the time and date entered by the student to the college,adding and viewing attendance.Also manage in adding the corresponding faculties.Faculties are to monitor the students entering,viewing attendance.Technician is to provide technical support if required.

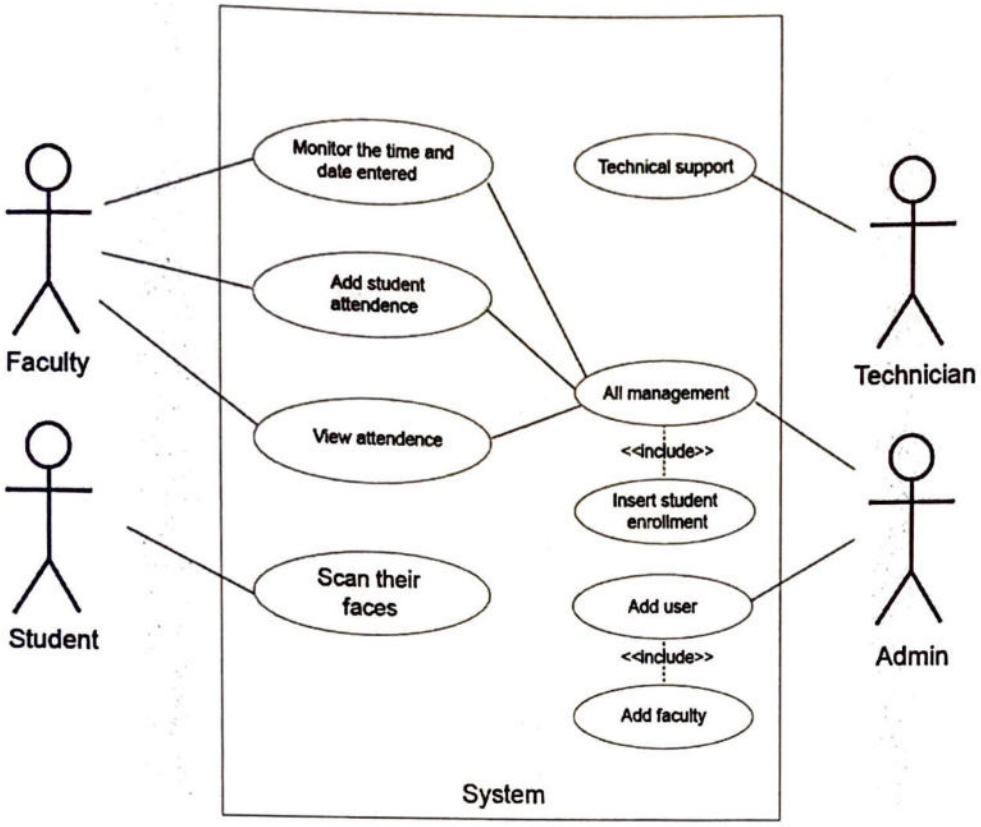


Figure 4.2: Use case diagram

4.3.3 Data Flow Diagram

A Data Flow Diagram (DFD) is a visual representation of the information flows within a system.It provides information about how data enters and exits the system, changes made on the system, and where the data is stored.

Level 0 DFD :The Level 0 DFD shows the main components of the system: The user interface allows the user to scan their face while entering the college. The late comers are detected by recording the time they entered the campus frequently using timestamp.And this updates the database.

Level 1 DFD :The Level 1 DFD expands on the user interface and faculties.The student scan their faces and record the entry time with date.The late comers are

updated correctly by detecting the faces which is already stored in the database. The records which contain student details along with the timestamp.These records are viewed and managed by corresponding authorities of the institution.The face and image detection uses facial recognition technology to identify the student and update the late comer database.

Note that this is a high-level DFD, and there may be additional components and processes involved in the actual system implementation.

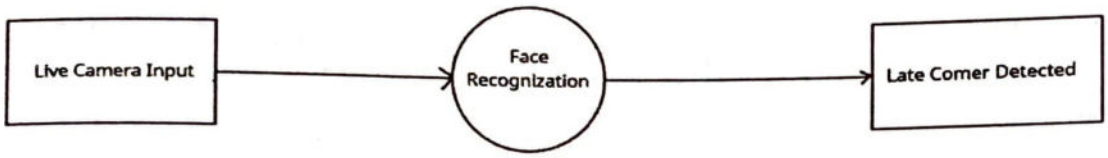


Figure 4.3: Level 0

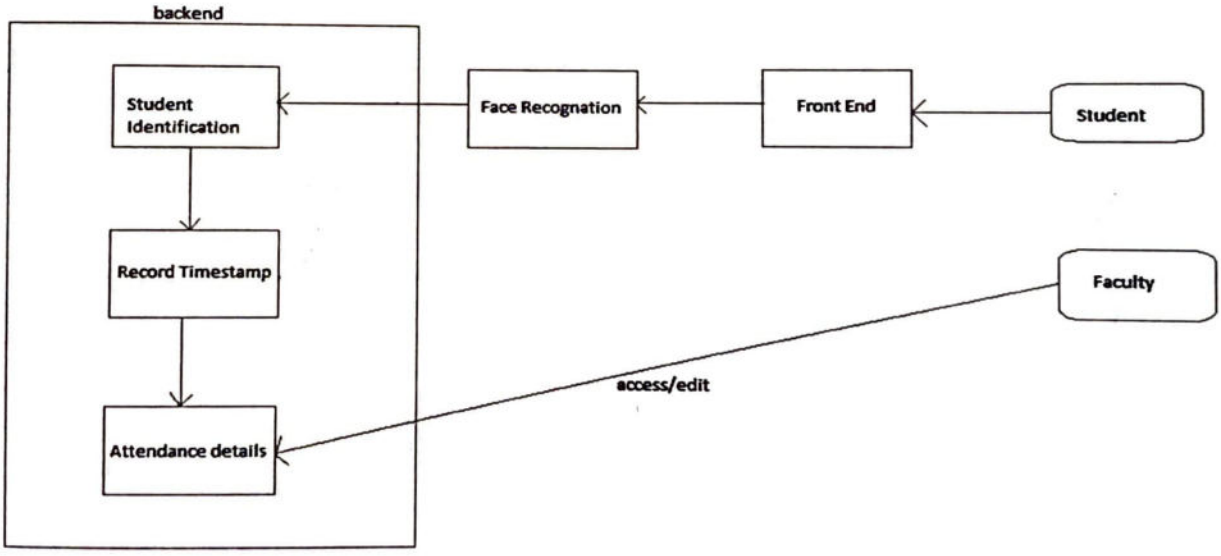


Figure 4.4: Level 1

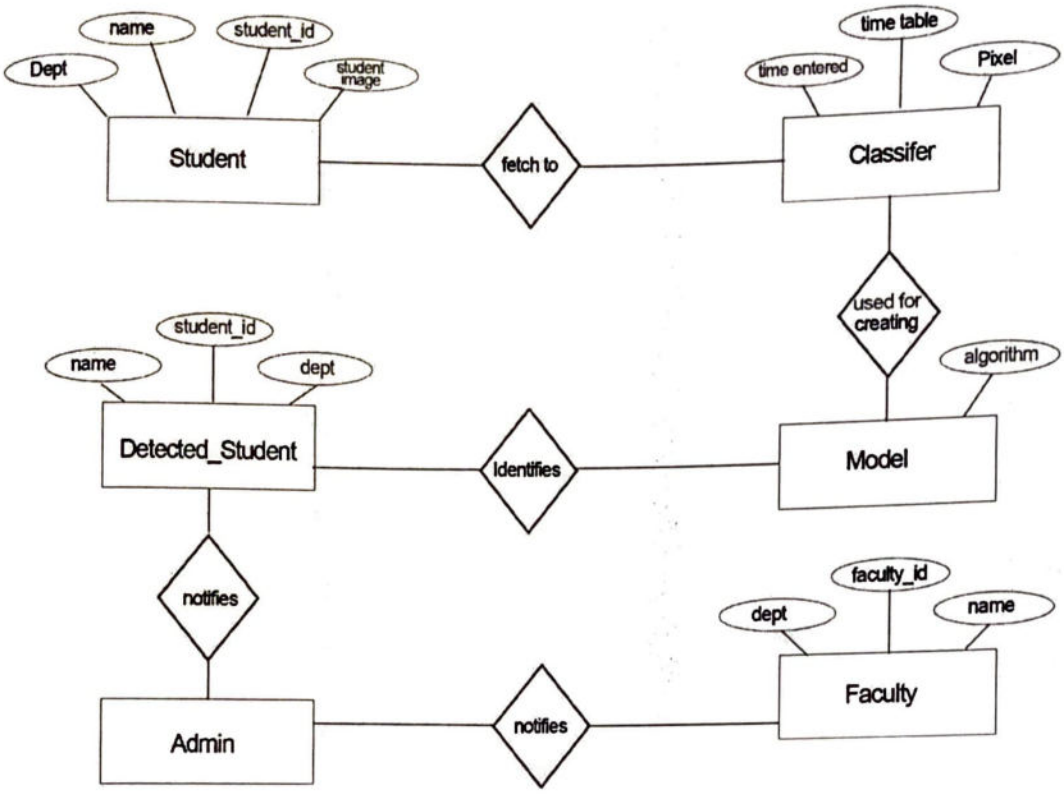


Figure 4.5: ER Diagram

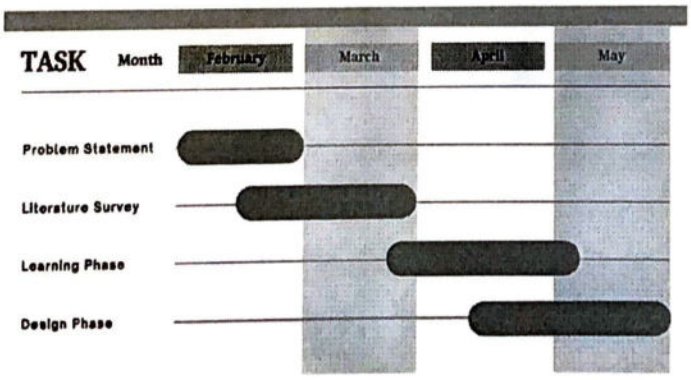


Figure 4.6: Gantt chart

Chapter 5

Implementation

The Late Comer Identification system is a python program developed using OpenCV, Numpy, and Flask libraries. Apart from these, other requirements are CSV files to fetch and store data and also a webcam to perform face recognition.The algorithm used is Histogram of Oriented Gradients (HOG) and deep convolutional neural networks (CNNs).

5.1 Flask

Flask is a lightweight web framework written in Python that provides a simple and flexible way to build web applications and APIs. It follows the microframework philosophy, focusing on simplicity and minimalism while still providing the necessary tools to develop robust web applications.

Key features of Flask include routing, request handling, templating, and response generation. With Flask, you can define routes that map to specific functions to handle different URL endpoints and HTTP methods. It allows you to access and process request data, such as form data and URL parameters, and generate dynamic responses using template engines like Jinja2.

5.2 Data Collection and Pre Processing

The initial step in the process involves the meticulous collection of a dataset, specifically comprising facial images representing the students. Great care is taken to ensure the dataset encompasses a diverse range of images, incorporating variations in lighting conditions, pose, and facial expressions. This comprehensive dataset serves as the foundation for subsequent analysis and model training.

Once the dataset is gathered, a sophisticated preprocessing stage is undertaken to extract relevant features from the preprocessed face images. To accomplish this, a pre-trained deep learning model, specifically Convolutional Neural Networks (CNNs), is employed.

As an accompanying element, a CSV file is meticulously maintained, containing essential details of the students whose datasets have been successfully collected. This comprehensive file ensures that vital information, including registration numbers, names, and any additional relevant data, is seamlessly recorded for future reference and analysis.

Subsequently, rigorous preprocessing procedures are applied to the collected images to optimize their quality and consistency. This preprocessing phase plays a pivotal role in enhancing the overall performance and accuracy of subsequent image analysis tasks.

Upon capturing frames from the webcam, the resulting images undergo a resizing operation to achieve a smaller size. Following this resizing process, the color space of the images is transformed from BGR to RGB. These preprocessing steps contribute significantly to improving the effectiveness and efficiency of subsequent face detection algorithms.

The resized RGB image, representative of the preprocessed data, serves as an input argument for the designated function. Within this function, a pre-trained Histogram of Oriented Gradients (HOG) model is internally leveraged to accurately detect facial regions within the image.

The function seamlessly returns a comprehensive list of face locations, encapsu-

lating precise coordinates that define the boundaries of each detected face's bounding box. These coordinates include the top, right, bottom, and left boundaries, thereby providing a comprehensive representation of the facial regions identified within the image.

	A	B	C	D	E	F	G	H	I	J	K
1	Reg	Name									
2	LVML20CS187	Lidiya James									
3	LVML20CS186	Amritha P									
4	VML20CS133	O.V Anagha									
5	VML20CS182	Vismaya Mariya Thomson									
6	VML20CS045	Ann Maria Sebastian									
7	VML20CS050	Anurenj M									
8	VML20CS095	Joseph Varghese									
9	VML20CS010	Abin Devasia									
10	VML20CS071	Diya Jojan									
11	VML20CS036	Ancily Sunny									
12											
13											
14											
15											
16											
17											
18											
19											
20											
21											
22											
23											

Figure 5.1: Data.csv

5.3 Attendance System

The initial landing page, denoted as Figure 5.2 and 5.3, successfully loads within the system, presenting a comprehensive interface comprising a video frame seamlessly integrated into the website's architecture, along with an array of other interactive functionalities.

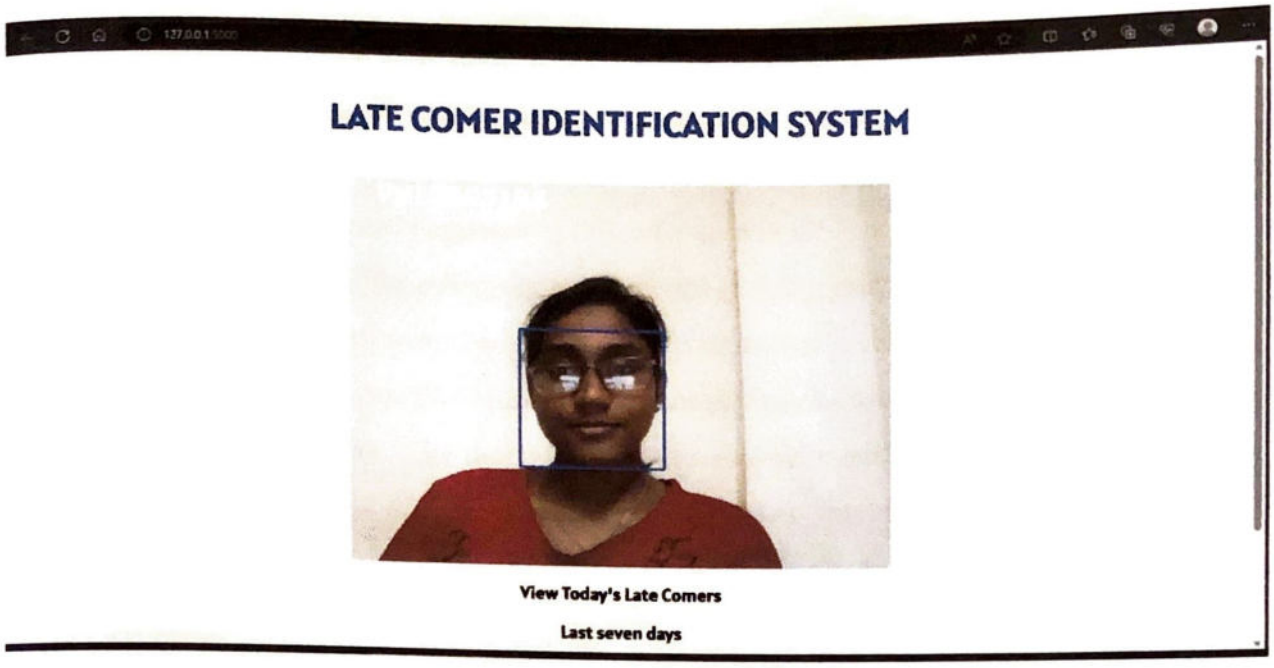


Figure 5.2: Main Page

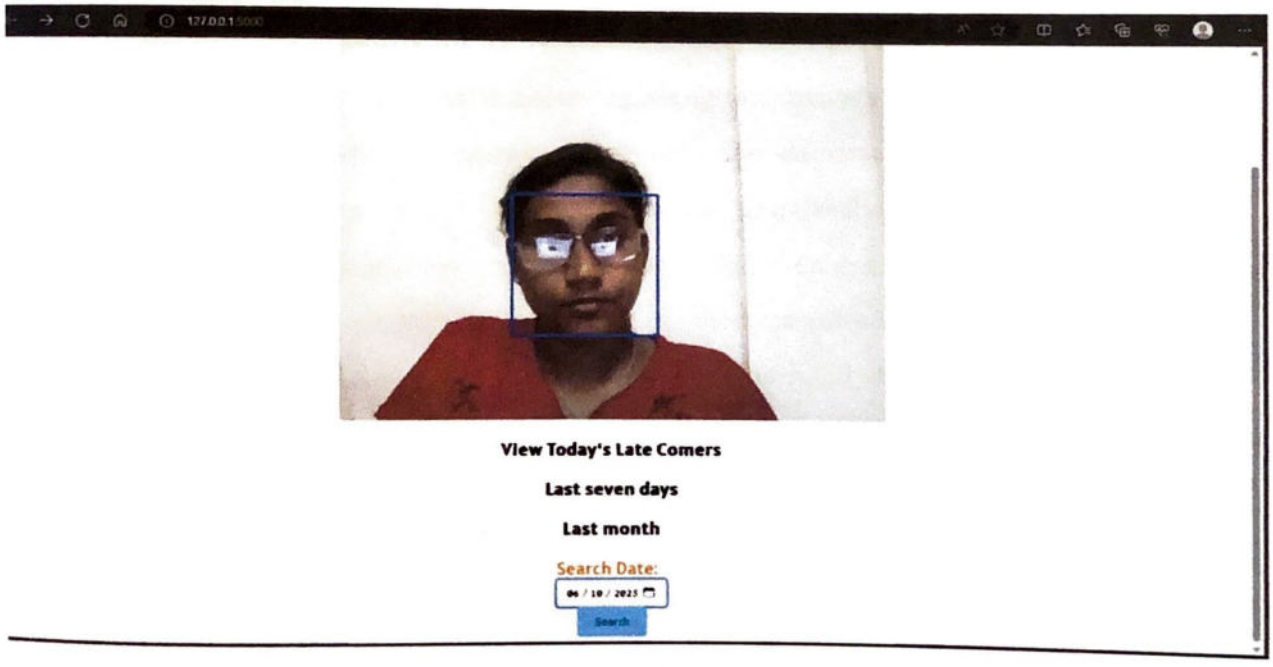


Figure 5.3: Main Page

Upon students displaying their facial features, the automated system promptly leverages advanced detection algorithms to accurately identify and correlate each individual student with their corresponding profile. Subsequently, the system meticulously records the student's unique registration number, capturing the precise date and time of their interaction, meticulously appending this information into a structured Comma-Separated Values (CSV) file for comprehensive record-keeping purposes.

The system adeptly scrutinizes the arrival timings of students, discerning instances where individuals exceed the predefined institutional time constraints, warranting categorization as latecomers. To facilitate efficient management and analysis, the system diligently generates separate, organized CSV files for each calendar day, systematically capturing essential details such as the student's registration number, name, date, and precise timestamp associated with their delayed arrival.

The system architecture incorporates an intuitive user interface, affording users the convenience of effortlessly accessing vital information pertaining to latecomers. By simply interacting with the designated "View Today's Latecomers" link, users are seamlessly redirected to a dedicated webpage, diligently rendering an up-to-date list, encompassing relevant details of students who exhibited tardiness on the selected day.

Enabling users to gain valuable insights regarding late arrivals over the preceding seven-day interval, the system empowers them to make informed decisions. Upon selecting the "Last Seven Days" option, users are seamlessly transported to an informative page that meticulously aggregates and presents an organized enumeration of students who have persistently demonstrated delayed arrival within the past week. Augmenting clarity, distinct dates are perceptibly incorporated, facilitating accurate differentiation between individual latecomers across various days.

Aligning with the objective of providing a comprehensive overview of latecomers within a monthly timeframe, the system incorporates a specialized interface. By selecting the "Last Month" option, users are efficiently navigated to an exclusive page that meticulously analyzes the contents of relevant CSV files corresponding to the previous month, proficiently extracting and showcasing pertinent student details, accompanied by their respective dates and timestamps, within an accessible and

succinct tabular format.

Augmenting user flexibility and further enhancing the system's usability, a dedicated search functionality is thoughtfully incorporated. Users can conveniently specify a desired date by utilizing the intuitive calendar view. Upon selecting a specific date of interest, they can seamlessly trigger the search operation by activating the designated search button. Subsequently, users are promptly redirected to an information-rich page, meticulously presenting an extensive listing encompassing all students who were observed to have arrived late on the selected date, thoughtfully accompanied by their comprehensive individual details for comprehensive reference and analysis.

Chapter 6

Result and Discussion

Late comer identification systems based on face recognition typically involve using machine learning algorithms to analyze and identify individuals who arrive late to a specific location, such as a classroom or workplace. These systems often rely on computer vision techniques and can utilize cameras or other sensors to capture and process visual information.

Application Screenshots:

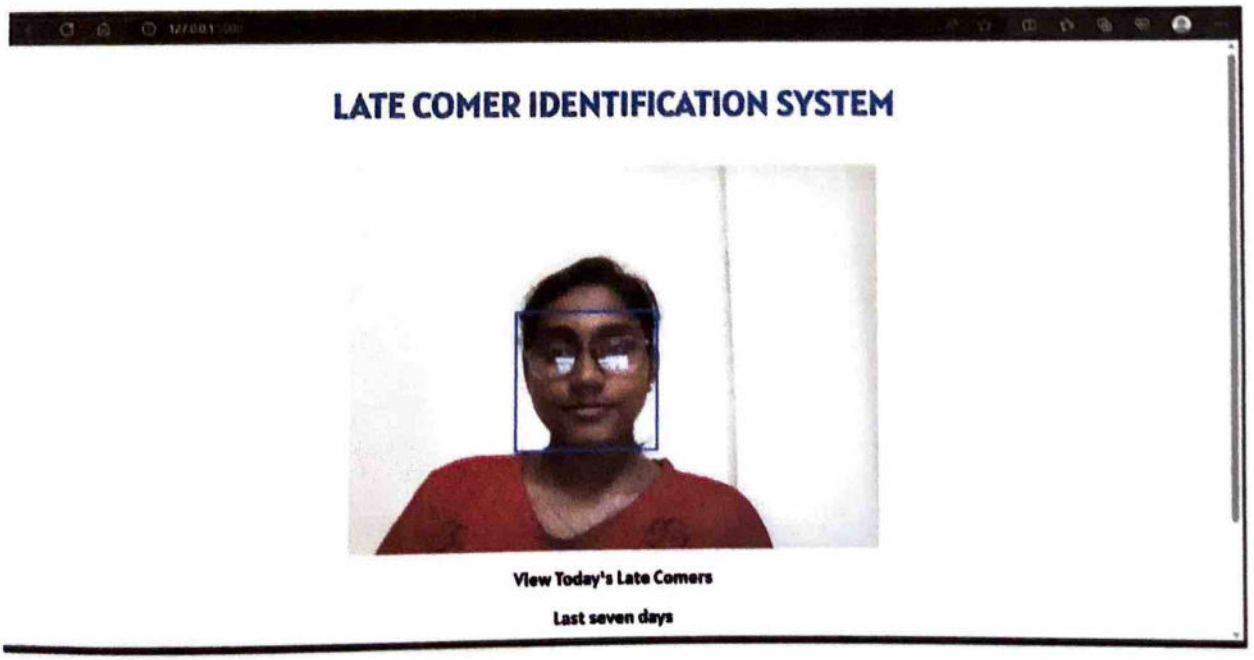


Figure 6.1: Main Page

The main page is loaded and the student scans their faces which is recognized by the system and shows the recognized students' registem numer in the frame.

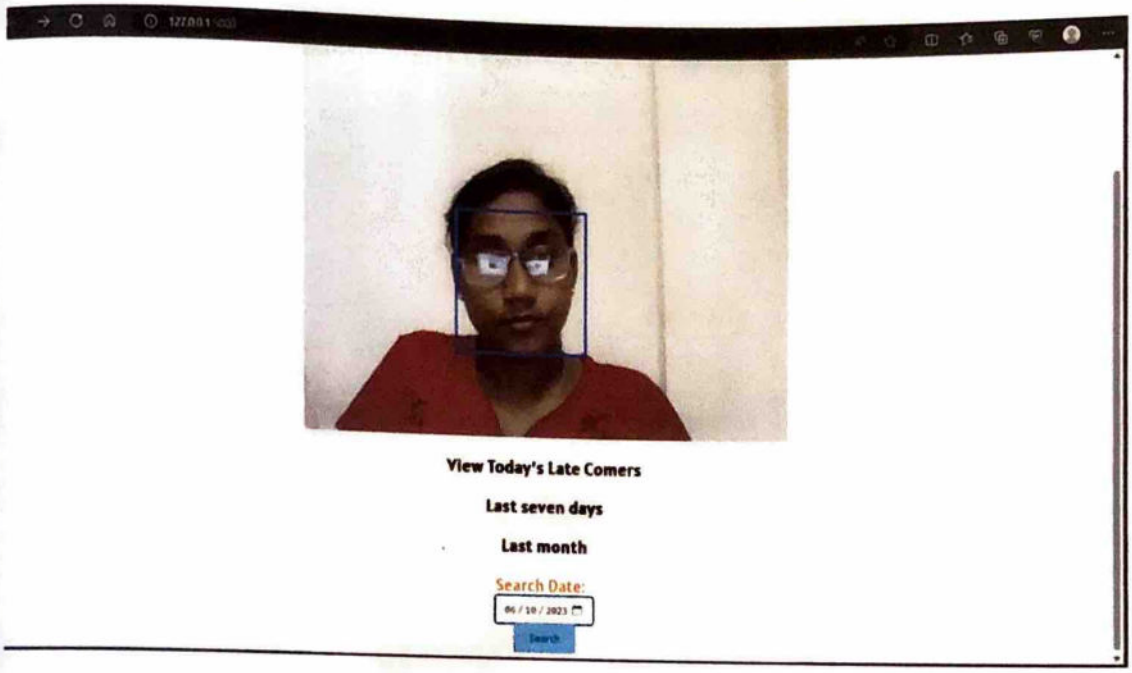


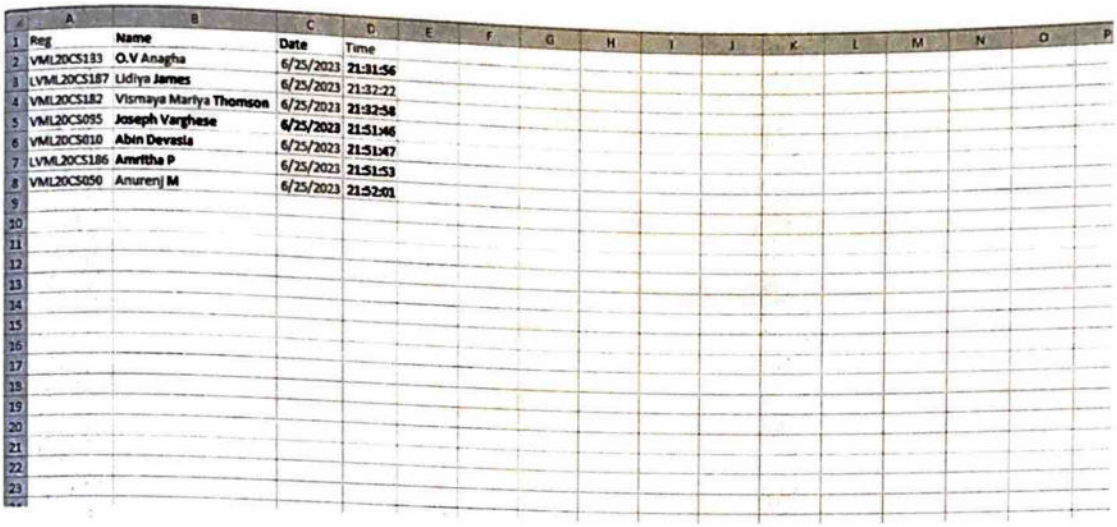
Figure 6.2: Main Page

A CSV file for that corresponding day with the date is created. It contains the register number,name,date and time stamp.

The list of the students who have arrived late on that particular day can be viewed.

Signature No

Principal



Reg	Name	Date	Time
VML20CS133	O.V Anagha	6/25/2023	21:31:56
LVML20CS187	Lidiya James	6/25/2023	21:32:22
VML20CS182	Vismaya Mariya Thomson	6/25/2023	21:32:58
VML20CS095	Joseph Varghese	6/25/2023	21:51:46
VML20CS010	Abin Devasia	6/25/2023	21:51:47
LVML20CS186	Amritha P	6/25/2023	21:51:53
VML20CS050	Anurenj M	6/25/2023	21:52:01

Figure 6.3: Today's Latecomers CSV File

Late Comers:

Reg	Name	Date	Time
VML20CS133	O.V Anagha	2023-06-25	21:31:56
LVML20CS187	Lidiya James	2023-06-25	21:32:22
VML20CS182	Vismaya Mariya Thomson	2023-06-25	21:32:58
VML20CS095	Joseph Varghese	2023-06-25	21:51:46
VML20CS010	Abin Devasia	2023-06-25	21:51:47
LVML20CS186	Amritha P	2023-06-25	21:51:53
VML20CS050	Anurenj M	2023-06-25	21:52:01

Figure 6.4: Today's Latecomers

The list of the students who have arrived late in the past 7 days and the past month with their details can be viewed.

Late Comers:

VML20CS133	O.V Anagha	2023-06-25	21:31:56
LVML20CS187	Lidiya James	2023-06-25	21:32:22
VML20CS182	Vismaya Mariya Thomson	2023-06-25	21:32:58
VML20CS095	Joseph Varghese	2023-06-25	21:51:46
VML20CS010	Abin Devasia	2023-06-25	21:51:47
LVML20CS186	Amritha P	2023-06-25	21:51:53
VML20CS050	Anureej M	2023-06-25	21:52:01
VML20CS133	O.V Anagha	2023-06-23	11:35:24

Figure 6.5: Latecomers of last 7 days

Signature N

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Late Comers:

VML20CS133	O.V Anagha	2023-06-25	21:31:56
LVML20CS187	Lidiya James	2023-06-25	21:32:22
VML20CS182	Vismaya Mariya Thomson	2023-06-25	21:32:58
VML20CS095	Joseph Varghese	2023-06-25	21:51:46
VML20CS010	Abin Devasia	2023-06-25	21:51:47
LVML20CS186	Amritha P	2023-06-25	21:51:53
VML20CS050	Anurenj M	2023-06-25	21:52:01
VML20CS133	O.V Anagha	2023-06-23	11:35:24
LVML20CS187	Lidiya James	2023-06-10	10:27:59
VML20CS133	O V Anagha	2023-06-10	10:28:00
VML20CS182	Vismaya Mariya Thomson	2023-06-10	10:28:09

Figure 6.6: Latecomers of last one month

Also the faculty can search up any day and the latecoming student details of that particular day can be viewed.

Signature N

Principa

Late Comers:

Reg	Name	Date	Time
LVML20CS187	Lidiya James	2023-06-10	10:27:59
VML20CS133	O.V Anagha	2023-06-10	10:28:00
VML20CS182	Vismaya Mariya Thomson	2023-06-10	10:28:09

Figure 6.7: Latecomers of 06-10-2023 using search

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Chapter 7

Conclusion

The report is based on the final review of the project "LATE COMER IDENTIFICATION SYSTEM". The project appropriately corresponds to the problem stated in the problem definition section.The project aims to provide an efficient and convenient way for institutions to track their latecomers.The system introduces a practical method for monitoring late arrivals, encompassing advantages such as streamlined attendance management, automated identification, real-time updates, and time-saving features.

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This is to certify that the report entitled **A MEDICAL CHAT-BOT APPLICATION FOR HEALTH DIAGNOSIS** submitted by **C C Nipun Das** (VML20CS066) **Abhinav Purushothaman** (VML20CS004), **Jishnu P** (VML20CS089) & **Joel Jose** (VML20CS092) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering is a bona fide record of the project work carried out by him under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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This is to certify that the report entitled **BOOK SHARING AND WRITING MANAGEMENT SYSTEM** submitted by **BASIM** (VML20CS062), **SURYA PRAKASH** (VML20CS167), **TRESA SEBASTIAN** (VML20CS175) & **NEHA E** (VML20CS129) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering is a bona fide record of the project work carried out by her under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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This is to certify that the report entitled **CHESS BOT USING MACHINE LEARNING** submitted by **Albert Tom George** (VML19CS065), **Sidharth Kesav** (VML20CS158) & **Shon Shaji** (VML20CS155) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering is a bona fide record of the project work carried out by him under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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DECLARATION

We hereby declare that the project report **CHESS BOT USING MACHINE LEARNING**, submitted for partial fulfillment of the requirements for the award of degree of Bachelor of Technology of the APJ Abdul Kalam Technological University, Kerala is a bona fide work done by us under supervision of **Ms.Dinsha p.k.**

This submission represents our ideas in our own words and where ideas or words of others have been included, we have adequately and accurately cited and referenced the original sources.

We also declare that we have adhered to ethics of academic honesty and integrity and have not misrepresented or fabricated any data or idea or fact or source in my submission. We understand that any violation of the above will be a cause for disciplinary action by the institute and/or the University and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been obtained. This report has not been previously formed the basis for the award of any degree, diploma or similar title of any other University.

Albert tom george

Sidharth kesav

Shon shaji

Sidharth sham lal

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This is to certify that the report entitled **Cloud Based Centralised Jail Management System** submitted by **Pranav Sunesh** (VML20CS136), **Ashwin M** (VML20CS053) **Vishnu Viswanath** (VML20CS180)& **Adarsh K** (VML20CS013) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering is a bona fide record of the project work carried out by him under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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This is to certify that the report entitled **DOMOTICS FOR ELDERLY AND DISABLED PEOPLE** submitted by **PRITHWIN RATNAN A** (VML20CS139), **THEERTHA HARIKRISHNAN** (VML20CS170), **KARTHIK SHIVA P R** (VML20CS096)& **NANDHANA K** (VML20CS123) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering is a bona fide record of the project work carried out by him under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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This is to certify that the report entitled **HAND WRITTEN CODE COMPILATION** submitted by **Angel Thomas** (VML20CS039), **Alan Joseph** (VML20CS022) & **Fathima Shana A** (VML20CS077)**Saayanth P**(VML20CS142) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering is a bona fide record of the project work carried out by him under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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This is to certify that the report entitled **INDOOR SHOPPING MALL NAVIGATION** submitted by **Abhirami K P** (VML20CS006), **Athulya T** (VML20CS059), **Nikhil P** (VML20CS132) & **Saranga Vinod** (VML20CS148) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering is a bona fide record of the project work carried out by him under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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This is to certify that the report entitled **LATE COMER IDENTIFICATION SYSTEM** submitted by **ANN MARIA SEBASTIAN** (VML20CS045), **LIDIYA JAMES** (LVML20CS187) **OV ANAGHA** (VML20CS095) & **VISMAYA MARIYA THOMSON** (VML20CS182) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering is a bonafide record of the project work carried out by them under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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This is to certify that the report entitled LOGO DETECTION AND CLASSIFICATION submitted by AJAL K (VML20C5019), MUFAZ MUSTHAFA (VML20CS116) and NAVEEN K MATHEW(VML20CS126) to the APJ Abdul Kalam Technological University in partial fulfilment of the B.Tech degree in Computer Science and Engineering is a bona fide record of the project work came out by him under our guidance and supervision. This report in any form has not been submitted to any other University or institute for any purpose

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This is to certify that the report entitled **QUANTUM COMPUTING** submitted by **AMRITHA P** (LVML19CS186), **ANJITHA NAMBIAR** (VML20CS042), **ELCITA JOSE** (VML20CS074) and **MARIA MANOJ** (VML20CS108) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech degree in Computer Science and Engineering is a bonafide record of the project work carried out by them under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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DECLARATION

We hereby declare that the mini project report **QUANTUM COMPUTING**,submitted for partial fulfillment of the requirements for the award of degree of Bachelor of Technology of the APJ Abdul Kalam Technological University, Kerala is a bonafide work done by us under supervision of **Dr. JEETHU V DEVASIA**.

This submission represents our ideas in our own words and where ideas or words of others have been included, we have adequately and accurately cited and referenced the original sources.

We also declare that we have adhered to ethics of academic honesty and integrity and have not misrepresented or fabricated any data or idea or fact or source in my submission. We understand that any violation of the above will be a cause for disciplinary action by the institute and the University and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been obtained. This report has not been previously formed the basis for the award of any degree,diploma or similar title of any other University.

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This is to certify that the report entitled **RESUME ANALYSIS USING DEEP LEARNING** submitted by **Aswin K** (VML20CS056), **Amal Binoy** (VML20CS056) **Mathew Abhijeet** (VML20CS111)& **Sandesh S N** (VML20CS145) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering is a bona fide record of the project work carried out by him under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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This is to certify that the report entitled **ROAD DAMAGE DETECTION** submitted by **Adil** (VML20CS016), **Dalven Jose** (VML20CS068) & **Shalwin Mathew Abraham** (VML20CS151) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering is a bona fide record of the project work carried out by him under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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This is to certify that the report entitled **SELF-CHECKOUT SYSTEM IN SHOPS** submitted by **Abin Devasia** (VML20CS010), **Anurenj M** (VML20CS050) & **Joseph Varghese** (VML20CS095) & **Thomas P S** (VML20CS173) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering is a bonafide record of the project work carried out by them under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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DECLARATION

We hereby declare that the project report **SELF-CHECKOUT SYSTEM IN SHOPS**, submitted for partial fulfillment of the requirements for the award of degree of Bachelor of Technology of the APJ Abdul Kalam Technological University, Kerala is a bona fide work done by us under supervision of **Ms.Divya K.**

This submission represents our ideas in our own words and where ideas or words of others have been included, we have adequately and accurately cited and referenced the original sources.

We also declare that we have adhered to ethics of academic honesty and integrity and have not misrepresented or fabricated any data or idea or fact or source in my submission. We understand that any violation of the above will be a cause for disciplinary action by the institute and/or the University and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been obtained. This report has not been previously formed the basis for the award of any degree, diploma or similar title of any other University.

Abin Devasia
Anurenj M
Joseph Varghese
Thomas P S

CHEMPERI
12-04-2023

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This is to certify that the report entitled **SENTIMENT ANALYSIS** submitted by **Dilna P** (VML20CS070) **Harsha Muraleedharan** (VML20CS083), **Irene Treesa Cibi** (VML20CS086) & **Malavika Muraleedharan** (VML20CS105) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering is a bona fide record of the project work carried out by him under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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This is to certify that the report entitled **VEGETABLE VENDING WEBSITE FOR VENDORS** submitted by **V ANSHI SHIBURAJ** (VML20CS177), **NACHIKETHAS V S** (VML20CS119) **MOHAMMAD ANZIL** (VML20CS114)to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering is a bona fide record of the project work carried out by them under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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This is to certify that the report entitled **AI FITNESS TRAINER** submitted by **Nandakishore A** (VML20CS120), **Navaneeth K** (VML20CS120) **Saketh KM** (VML20CS143)& **Shijin P** (VML20CS154) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering is a bona fide record of the project work carried out by him under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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This is to certify that the report entitled **AI NPC INTERACTION IN VIDEO GAMES** submitted by **ADARSH V SUJITH**(VML20CS014), **BERNISE JACOB JOHN** (VML20CS063), **JEWEL JOHN**(VML20CS087) & **VISHNUNATH K**(VML20CS178) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering is a bonafide record of the project work carried out by them under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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This is to certify that the report entitled **BookBuddies** submitted by **ALEENA SUSAN** (VML20CS029), **AMEYA P V** (VML20CS032) , **THEJAS K** (VML20CS171) & **VYSHNAV SREESHAN** (VML20CS183) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering . This is a bonafide record of the project work carried out by them under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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This is to certify that the report entitled **FABRIC DEFECT DETECTION** submitted by **NAYAN ROSE MATHEW** (VML20CS127), **K V SONA** (VML20CS102), **GOPIKA MOHANDAS** (VML20CS081) & **KEERTHANA RAJEEV** (VML20CS098) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech degree in Computer Science and Engineering . This is a bonafide record of the project work carried out by them under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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This is to certify that the report entitled **INTELLIGENT ANIMAL DETECTION SYSTEM** submitted by **ANIGETH. K. K** (VML20CS040), **MANJIMA ANN BIJU** (VML20CS106), **HRISHINANDAN. N** (VML20CS084) & **ALBIN JOE THOMAS** (VML20CS026) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering . This is a bonafide record of the project work carried out by them under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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This is to certify that the report entitled **INTELLIGENT MEDIA PLAYER** submitted by **SANDRA GANESHAN** (VML20CS048), **SREENANDH M** (VML20CS165), **SIDHARTH P V** (VML20CS159) & **ABIN KRISHNA** (VML20CS011) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering. This is a bonafide record of the project work carried out by them under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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This is to certify that the report entitled **KADHAKALI MUDRA RECOGNITION** submitted by **Abhisanth K C** (VML20CS008), **Aswin Raj C** (VML20CS057), **Jishnu Prasad** (VML20CS090) & **Rahul Raj T** (VML20CS140) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering is a bonafide record of the project work carried out by them under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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This is to certify that the report entitled **MILE 2 PARK** submitted by **ANSON LEON SEBASTIAN** (VML20CS048), **EMLIN ELIZABETH BIJU** (VML20CS075) , **SONA SAJI** (VML20CS162) & **VAISHNAV KRISHNA** (VML20CS176) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering. This is a bonafide record of the project work carried out by them under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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This is to certify that the report entitled **PASSIVE WLAN PACKET CAPTURE** submitted by **SAYANDH S ANAND** (VML20CS149), **SIDDHARTH P KUMAR** (VML20CS156) , **PRAJWAL P** (VML20CS134) & **SHARANG P M** (VML20CS152) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering . This is a bonafide record of the project work carried out by them under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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This is to certify that the report entitled **PORTABLE SEED GERMINATION KIT** submitted by **Alan Jyothis Thomas** (VML20CS048), **Ankith Baby** (VML20CS043), **Augustine Felix Joshy** (VML20CS060) & **Calvin O** (VML20CS065) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering . This is a bonafide record of the project work carried out by them under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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This is to certify that the report entitled **SMART ID** submitted by **FATHIMATH RAJIYA P K** (VML20CS078), **KARTHIK T V** (VML20CS097) , **K K NASIF** (VML20CS100) & **LISNA C H** (VML20CS103) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering. This is a bonafide record of the project work carried out by them under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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This is to certify that the report entitled **STEGA-A Steganography Website** submitted by **AKHILA RAGHUNATH** (VML20CS020), **ANEKH S** (VML20CS037) , **NEHA PREMARAJAN** (VML20CS130) & **PRECIOUS PP** (VML20CS137) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering . This is a bonafide record of the project work carried out by them under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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This is to certify that the report entitled **STUDY ON QUANTUM COMPUTING** submitted by **ABHINAV VISWANATH** (VML20CS045), **ASWATHY CHANDRADAS** (VML20CS054) , **DEVIKA S** (VML20CS069) & **SWETHA N** (VML20CS168) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering is a bona fide record of the project work carried out by them under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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This is to certify that the report entitled **VETERINARY HEALTH MANAGEMENT SYSTEM** submitted by **ANN RIYA SIBY** (VML20CS040), **JOEL SCARIA JUSTINE** (VML20CS093) , **ABHIJITH A** (VML20CS002) & **DIYA K.P** (VML20CS072) to the APJ Abdul Kalam Technological University in partial fulfillment of the Bachelor of Technologyin Computer Science and Engineering .This is a bonafide record of the project work carried out by them under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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This is to certify that the report entitled **AIR HANDWRITING RECOGNITION AND DETECTION** submitted by **KV HENATHRAJ** (VML20CS101), **NEHA BENNY** (VML20CS128), **RIYA GEEORGE** (VML20CS141) & **SREERAM PAVITHRAN** (VML20CS166) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering is a bonafide record of the project work carried out by him under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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This is to certify that the report entitled **CROP YIELD PREDICTION** submitted by **Kiran Kumar K P** (VML20CS099), **Prithvi Raj M** (VML20CS138), **Pranav K G** (VML20CS135) & **Hamras Haris** (VML20CS082) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering is a bonafide record of the project work carried out by him under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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This is to certify that the report entitled **CROWDFUNDING USING BLOCKCHAIN** submitted by **SONA SANTHOSH VENIYIL** (VML19CS065), **JITHINA RAJ P** (VML20-CS091) & **NANDANA C P** (VML20CS121) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering is a bonafide record of the project work carried out by them under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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This is to certify that the report entitled **DESIGNING A SECURE AND EFFICIENT MEDICAL RECORD STORAGE SYSTEM USING IPFS AND BLOCKCHAIN TECHNOLOGY** submitted by **Adeena S** (VML20CS015), **Ancil Tresa Sunil** (VML20CS035) , **Blessy Seby** (VML20CS064) ,**Anoushka Sebastin** (VML20CS047) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering is a bona fide record of the project work carried out by him under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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This is to certify that the report entitled **DETECTION OF FACULTY MEMBERS AND THEIR LOCATION** submitted by **Mereena Philip** (VML20CS113), **Anjima S** (VML20CS041) & **Sheethal CP** (VML20CS153) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering is a bonafide record of the project work carried out by them under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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This is to certify that the report entitled **Disease Detection In Tomato Plants By Image Processing** submitted by **Ann Maria George** (VML20CS045), **Vismaya Hemanth Nambiar** (VML20CS181) & **Angel John** (VML20CS038) () to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering is a bona fide record of the project work carried out by them under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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This is to certify that the report entitled **DROWSINESS DETECTION USING IMAGE PROCESSING** submitted by **Vishnu Veenadharan** (VML20CS179), **Abin B P** (VML20CS009), **Edwin M** (VML20CS073) & **Sidharth R** (VML20CS160) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering is a bonafide record of the project work carried out by him under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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This is to certify that the report entitled **E-LEARNING ASSISTANT** submitted by **Geo Nobins** (VML20CS079), **Muhammed Ajnas O K** (VML20CS118) , **Athira K K** (VML20CS058) & **Alan K Johnson** (VML20CS024) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering is a bona fide record of the project work carried out by him under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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This is to certify that the report entitled **FRUITS AND VEGETABLES DISEASE IDENTIFICATION USING IMAGE PROCESSING** submitted by **ABHIRAM SANTHOSH** (VML20CS007), **AKSHAY. P. V** (VML20CS021), **SHAEEM IBRAHIM** (VML20CS150) and **YASHIN. T. M** (VML20CS184) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering is a bonafide record of the project work carried out by him under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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This is to certify that the report entitled **HANDWRITTEN TO TEXT CONVERTOR WITH GRAMMATICAL ERROR CORRECTION** submitted by **ANAGHA AJAI** (VML20CS033), **AFRAH NABEEL** (VML20CS018), **NANDANA KRISHNAN** (VML20CS122) and **TREESA BINOY** (VML20CS174) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering is a bonafide record of the mini project work carried out by them under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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This is to certify that the report entitled **LEFTOVER FOOD MANAGEMENT SYSTEM** submitted by **Abhinav Mathew Kurian** (VML20CS003), **Abin Sebastian** (VML20CS012) **Celestian Thomas** (VML20CS067) & **John Joseph** (VML20CS094) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering is a bona fide record of the project work carried out by him under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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This is to certify that the report entitled **MULTIPLE FACE RECOGNITION ATTENDANCE SYSTEM** submitted by **Aurang V** (VML20CS061), **Manu V S** (VML20CS107), **Anugrah MP** (VML20CS049) & **Salvin T Sajan** (VML20CS144) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering is a bonafide record of the project work carried out by him under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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This is to certify that the report entitled **PHISHING WEBSITE DETECTION SYSTEM** submitted by **SAPHAL SANTHOSH-** (VML20CS147), **IMTHIYAZ IBRAHIM-** (VML20CS085) , **MOHAMMED SHAMIL P-** (VML20CS115) & **THANSEEH AYANIYAD-** (VML20CS169) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering is a bona fide record of the project work carried out by him under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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This is to certify that the report entitled **CHRONIC KIDNEY DISEASE PREDICTION USING MACHINE LEARNING** submitted by **Navanith Vipin** (VML20CS125), **Malavika A Manoj** (VML20CS104) , **Thejus Dhanesh** (VML20CS172) & **Albin Joseph** (VML20CS027) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering is a bona fide record of the project work carried out by him under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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This is to certify that the report entitled **SMART WASTE BIN** submitted by **Fathima Noureen**(VML20CS076),**Masroor Ahmad**(VML20CS110) , **Nihadh Mohammed**(VML20CS131)& **Sidharth Jayachandran**(VML20CS157) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering is a bonafide record of the project work carried out by him under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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This is to certify that the report entitled **TOUR GUIDE USING MACHINE LEARNING** submitted by **Allen Adhvaith** (VML20CS030), **Jishnu Chandran** (VML20CS088), **Aswindas C** (VML20CS055) & **Ashil Mathew** (VML20CS052) to the APJ Abdul Kalam Technological University in partial fulfillment of the B.Tech. degree in Computer Science and Engineering is a bona fide record of the project work carried out by him under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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