VIMAL JYOTHI
ENGINEERING COLLEGE

APPROVED BY AICTE AND AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Jyothi Nagar, Chemperi P.O, Kannur Dt. Kerala - 670632 | www.vjec.ac.in

PROJECT WORK

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Signature Not Verified

Principal.VJEC

Contents

VIMAL JYOTHI ENGINEERING COLLEGE
DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
LIST OF UG STUDENTS UNDERTAKING PROJECT WORK

SL NO	REGISTER NUMBER	NAME
1	VML19EC001	AAVANI M
2	VML19EC002	ABDUL BASITH C C
3	VML19EC003	ADARSH V K
4	VML19EC004	ADWAITH KRISHNA
5	VML19EC005	AMAL PRAMOD
6	VML19EC006	ANGITHA N
7	VML19EC007	ANJANA MUKUNDAN K
8	VML19EC008	ANUSREE K V
9	VML19EC009	ANUSREE P M
10	VML19EC010	ARCHANA T
11	VML19EC011	ASHIK BENNY
12	VML19EC012	ASWIN SURENDRAN
13	VML19EC013	ATHUL GEORGE
14	VML19EC014	BRAJESH P V
15	VML19EC015	CHAITHRA P PRADEEPAN
16	VML19EC016	CHITHRA S
17	VML19EC017	DHANUSH C H
18	VML19EC018	DONA CHACKO
19	VML19EC019	FLEMY
20	VML19EC020	GEETHIKA T
21	VML19EC021	GEOFFIN SAJAN
22	VML19EC022	GOPIKA GOPALAKRISHNAN
23	VML19EC024	JACOB JAMES
24	VML19EC025	JOBIN JOSEPH
25	VML19EC026	JOSHUA NOYAL
26	VML19EC027	KEERTHI PRADEEP KUMAR
27	VML19EC028	KRIS PARUKUNNEL THANKACHAN
28	VML19EC029	MALAVIKA AJITH
29	VML19EC030	MANAS TOM
30	VML19EC031	MARTIN P THOMAS
31	VML19EC032	MELVIN JOSEPH
32	VML19EC033	MUHAMMAD RASHID M P

Signature Not Verified

Principal.VJEC

33	VML19EC034	NAYANA SAJI
34	VML19EC035	NEVIN SAJI
35	VML19EC036	NISWARTH A V
36	VML19EC037	OLIVIA ANN MATHEW
37	VML19EC038	RUBY SHARIN
38	VML19EC039	SAGAR UNNIKRISHNAN
39	VML19EC040	SAISHNA SHAMEJ
40	VML19EC041	SANATH K
41	VML19EC042	SARANG K
42	VML19EC043	SAVIO JOSE
43	VML19EC044	SEBASTIAN GEORGE
44	VML19EC045	SHILPA M NAIR
45	VML19EC046	SHREYA DEEP ANAND
46	VML19EC047	SHRUTI BALACHANDRAN
47	VML19EC048	SIDHARTH K
48	VML19EC049	SNEHA SAJEEVAN T
49	VML19EC050	SOURAV K R V
50	VML19EC051	SWATHI LAKSHMI K V
51	VML19EC052	TOMS RAJU
52	VML19EC054	VARSHA K V
53	VML19EC055	VIMAL KUMAR P P
54	VML19EC056	VISHNU SHANKAR V K
55	LVML19EC057	ABHIJITH C
56	LVML19EC058	ABHINAV K V
57	LVML19EC059	AKHIL SUNNY
58	LVML19EC060	AKSHAY JANARDHANAN
59	LVML19EC061	ANJALI K P
60	LVML19EC062	HEERA PRADEEP
61	LVML19EC063	JEENA GEORGE
62	VML20EC029	KANNAN MOHAN
63	VML20EC005	AKASH BENNY
64	VML20EC046	SANJU P S
65	VML20EC024	GOKUL KRISHNAN
66	VML20EC042	RONEX PALLATH
67	VML20EC050	THOMAS GEORGE
68	VML20EC035	MELWIN PAUL

Signature Not Verified

Principal.VJEC

69	VML20EC008	ALEX DANIEL
70	VML20EC020	BOBIT BENNY
71	VML20EC003	AJAY BINU
72	VML20EC016	ASHISH MATHEW
73	VML20EC049	SREEJISHNU P A
74	**VML20EC015**	**APARNA K**
75	**VML20EC043**	**SANDHWANA DAS**
76	**VML20EC021**	**C. P VARSHA**
77	VML20EC028	JOHNS JIJI
78	VML20EC007	ALAN P MATHEW
79	VML20EC033	MATHEW M J
80	**VML20EC026**	**HARICHANDANA D**
81	**VML20EC002**	**ABHINAYA HARINDRAN**
82	VML20EC036	NAVANEETH V
83	VML20EC023	GAUTHAM KRISHNA K
84	VML20EC018	ASWIN DIVAKARAN
85	**VML20EC044**	**SANDRA ELIZEBATH ALEX**
86	**VML20EC027**	**HELNA SAJI**
87	**VML20EC022**	**DEVIKA DINESH E**
88	VML20EC047	SARATH SASEENDRAN
89	VML20EC040	PRANAV N
90	**VML20EC010**	**AMRUTHENDU K**
91	VML20EC017	ASWIN AJITH
92	VML20EC019	BINIL KURIAN
93	**VML20EC039**	**PARVANA PRADEEP**
94	VML20EC004	AJIMON FRANCIS
95	**VML20EC031**	**KRISHNAPRIYA V S**
96	VML20EC030	KIRAN K
97	VML20EC045	SANJAY MANOJ
98	**VML20EC034**	**MEGHANA SUMESH M**
99	**VML20EC014**	**ANUSREE C**
100	**VML20EC025**	**GOPIKA SANIL**
101	**VML20EC037**	**NAVYA M**
102	**VML20EC013**	**ANULAKSHMI C**
103	**VML20EC011**	**ANAMIKA P V**
104	VML20EC001	ABHINAV M

Signature Not Verified

Principal.VJEC

105	VML20EC051	VAIBHAV S
106	VML20EC038	NIBIN B V
107	**VML20EC006**	**ALAIDA THOMAS**
108	**VML20EC041**	**PRANEETHA A K**
109	**VML20EC012**	**ANJIMA T K**
110	**VML20EC032**	**KSHEERA SAJEESH**
111	**VML20EC052**	**VISHNU PRIYA K**
112	**VML20EC009**	**ALFONSA**
113	LVML20EC053	SREERAG K P

Signature Not Verified

Principal.VJEC

ROBO LeECH – LONGITUDINALLY EXTENSIBLE CONTINNUM ROBOT

A PROJECT REPORT

Submitted by

AMAL PRAMOD (VML19EC005)

GEOFFIN SAJAN (VML19EC021)

MARTIN P THOMAS (VML19EC031)

SHREYA DEEP ANAND (VML19EC046)

to

the APJ Abdul Kalam Technological University

in partial fulfillment of the requirement for award for the Degree

of

BACHELOR OF TECHNOLOGY

in

ELECTRONICS AND COMMUNICATION ENGINEERING

Department of Electronics and Communication Engineering

VIMAL JYOTHI ENGINEERING COLEGE
CHEMPERI
JUNE 2023

DECLARATION

I undersigned hereby declare that the project report "**ROBO LeECH-LONGITUDINALLY EXTENSIBLE CONTINUUM ROBOT",** submitted for partial fulfillment of the requirement for the award of degree of Bachelor of Technology of the Kerala Technical University, Kerala is a bonafide work done by us under the supervision of **Dr. JAYESH GEORGE.** The submission represents our ideas in our own words and, where the ideas or words of others have been included; we have adequately and accurately cited and referenced the original sources. We also declare and 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.

Place: Chemperi

Date : 28/04/2023

AMAL PRAMOD
GEOFFIN SAJAN
MARTIN P THOMAS
SHREYA DEEP ANAND

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

VIMAL JYOTHI ENGINEERING COLEGE
CHEMPERI
JUNE 2023

CERTIFICATE

This is to certify that the report entitled **"ROBO LeECH- LONGITUDINALLY EXTENSIBLE CONTINUUM ROBOT"** submitted **AMAL PRAMOD, GEOFFIN SAJAN, MARTIN P THOMAS AND SHREYA DEEP ANAND** to the A P J Abdul Kalam Technological University in partial fulfillment of the requirement for the award of the Degree of Bachelor of Technology in ELECTRONICS AND COMMUNICATION 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 University or Institute for any purpose.

Project Guide

Dr. JAYESH GEORGE

Assosciate Professor
Department of ECE Engineering
Vimal Jyothi Engineering College
Chemperi, Kannur

Project Coordinator

Dr. JAYESH GEORGE

Assosciate Professor
Department of ECE Engineering
Vimal Jyothi Engineering College
Chemperi, Kannur

Head of Department

DR. D ANTO SAHAYA DHAS

Professor and Head
Department of ECE Engineering
Vimal Jyothi Engineering College
Chemperi, Kannur

Signature Not Verified
Principal.VJEC

23/6/2023

ACKNOWLEDGEMENT

All glory and honors of God, the Almighty without his grace our project would not have seen the light of success. Motivation is the driving source behind every successful venture. With regard to the completion of this project, we wish to acknowledge the following people who are the source of motivation behind it.

We express our thanks to **Dr. BENNY JOSEPH**, Principal, **Dr. D ANTO SAHAYA DHAS**, Head of the Department, Tutors and all the other staffs of Department of Electronics and Communication Engineering, Vimal Jyothi Engineering College, Chemperi, for their valuable suggestion and co-operation.

We wish to extend our heartfelt thanks to our guide **Dr. JAYESH GEORGE** , Professor in the department of ECE, for his guidance, support and cooperation during the course of this project.

Thanks to **Dr. JAYESH GEORGE**, Assosciate Professor, who have been to co-ordinate the project. Last but not the least we would thank our parents and friends whose encouragement and advice helped us a lot during the period of this work.

ABSTRACT

A robot inspired by land leeches, which are excellent climbers in nature. Their bodies are so light and soft that they are not subjected to great damage from a fall from height. With the use of this robot we can send in for inspection for Factory pipes inspection, vertical wall climbing, sewage pipes inspection, gas and water pipe inspection, inspection of tunnels and pipes where human can't let in. In the case of Wall Climbing Robot (WCR) design, nature has always been one of the biggest inspirations. While WCR designs have been incorporating adhesion techniques inspired by organisms, including reptiles, insects, amphibians and marine invertebrates, most efforts have been focusing mainly on adhesion for dry surfaces. For WCRs to become widely applicable under all environments, given the vast areas of this planet described by high precipitation, the ability to scale vertical surfaces in wet conditions should be considered a design necessity. To this goal, this project focuses on the most commonly adopted adhesion mechanisms, while providing an overview on recent WCR technological advances through the prism of wet adhesion. An extensive outlook is also detailed, including promising research directions yet to be trialed in bio-inspirations and recent material developments, which could further bridge the gap between WCR design and wet adhesion towards all-environment climbing robots.

CONTENTS

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

1.1 General backround

LEeCH — Longitudinally Extensible Continuum — is inspired by the animal subclass Hirudinea. Inspired by land leeches, which are excellent climbers in nature, LEeCH is capable of elongating and bending its body without any constraints and, thanks to elongation and compression mechanism and two suction cups, the robot has successfully climbed up and down a vertical wall and transitioned horizontally to reach the other side.

Locomotion of soft-bodied organisms, such as amoeba, worms, and octopuses, is safe, robust, and adaptable and has great promise for applications in complex environments. While such organisms fully exploit the potential provided by their soft structures, engineering solutions commonly constrain soft deformation in favor of controllability. In this study, we study how soft deformations can enhance the climbing capabilities of a robot. We introduce a robot called Longitudinally Extensible Continuum-robot inspired by Hirudinea (LEeCH), which has few shape constraints. Inspired by real leeches, LEeCH has a flexible extensible body and two suction cups at the ends. It is capable of performing 3D climbing locomotion using two suction cups driven by vacuum pumps and tri-tube soft actuators which have only three DC motors. The large deformations occurring in LEeCH extend its workspace compared to robots based on constant curvature models, and we show successful locomotion transition from one surface to another at angles between 0° and 180° in experiment. We develop a model based on multibody dynamics to predict the nonlinear deformations of the robot, which we verify in the experiment. The model reveals a nondimensional morphological parameter, which relates the robot's shape to its mass, stiffness, and size. The workspace of LEeCH as a function of this parameter is studied in simulation and is shown to move beyond that of robots based on constant curvature models. The hardest task is to reach the other side of the wall. A robot

capable of climbing up to the top of the wall has to face extreme difficulty in traversing the summit over to the other side.

Wall-climbing robots have a wide range of potential applications, including building inspection and maintenance, plus search and rescue tasks at disaster sites. Climbing straight up vertical walls is fairly easy to accomplish. However, in reality, the robot may have to navigate over obstacles on the wall such as steps and transition to walls with different directions.The team has developed a robot inspired by land leeches, which are excellent climbers in nature. The land leeches, usually found in forests or mountains, can move around complex terrain and walls using two suction cups on both ends of bodies and soft extensible bodies. Their bodies are so light and soft that they are not subject to great damage from a fall from height.

1.2. Objectives

- The main objective of the project is to provide an efficient, digitally robot for inspection purposes.
- It can overcome the problem regarding the diameter on the pipes
- Climbing straight up vertical walls is to be made fairly easy.

Climbing robots have a wide range of potential applications, including building inspection, maintenance, construction, and search and rescue tasks. A challenging problem in climbing robots is increasing reachability to navigate and transition between obstacles such as steps and walls. Most climbing robots are yet to achieve such tasks, whereas soft-bodied animals such as leeches, slugs, and caterpillars easily complete them. One strategy often observed in such organisms is the exploitation of large deformations and, therefore, nonlinearities to increase reachability. Many climbing robots inspired by animals have been developed, but they mainly have focused on adhesion-based climbing inspired by, for example, gecko's van der Waals forces, or insect spikes.

Some robots that can climb at many angles and transition from wall to wall have been demonstrated. RAMR1,10 W-Climbot,11 and Shady3D12 (modular), which are biped robots that consist of several joints connected in series and two grippers attached to the ends, achieved transition from ground to wall and wall to ceiling. The high number of degrees of freedom can not only overcome obstacles and steps but also provide good dexterity when used as a manipulator. However, this comes at the cost of complicated control and larger torques. MultiTrack is composed of serially connected modules that have a caterpillar track with suction cups and can climb over a thin wall, that is, transitioning from wall to wall. It combines high mobility and maneuverability due to continuous locomotion and active joints. However, such a combination of multiple devices leads to complex controllability and a weight increase. Stickybot, Wallbot, and the Tank-Like robot are bioinspired robots using flat or fibrillar dry adhesives that can attach to various surfaces with low power consumption. Even though such robots successfully performed some transitions, there are some remaining issues such as loss of adhesion due to dirt. Since all climbing robots always have a risk of falling from large heights, being lightweight and flexible are desirable for safety and survival.

Unlike the aforementioned traditional robots with rigid links, soft robots have a great potential to interact with environments safely and adaptively. Some soft climbing robots with extreme compliance have been reported,but they can only generate simple locomotion on the wall. Despite the difficulties of modeling and control of soft robots arising from the many degrees of freedom in such systems, a few recent and very notable exceptions partially overcame these difficulties. Flippy23 is a cable-driven continuum robot with two grippers attached to the ends. It can transition between interior planes in different orientations by bending its body 180°. While this locomotion enables transition motion without complex sensing or control, its stride is restricted and increases the risk of collision with obstacles. Treebot24 has a continuum body that consists of three mechanical springs, and it can extend and bend in any direction by controlling the spring lengths. This provides a large working space and makes it possible to climb from a tree trunk to a branch. Treebot has superior maneuverability and adaptability, but the body deformation was only explored within the regime of deformations which was predicted by a constant curvature model, thus constraining

the range of possible robot postures. It is still an open challenge to achieve a wall-to-wall transition in soft robots and to model and control large nonlinear deformations.

In this project, we describe a continuum robot design, which is inspired by leeches, belonging to the subclass Hirudinea, to address the challenges of achieving the wall-to-wall transition. Leeches are excellent climbers, propelling themselves using soft extensible bodies and two suckers attached at both ends. They can elongate their body greatly and traverse confined spaces. Our proposed bioinspired robot called LEeCH (Longitudinally Extensible Continuum-robot inspired by Hirudinea) adopts the leech's suckers and flexible and extensible body, as shown in. With this morphology come the advantages and problems associated with the leech's motion control. While the flexibility allows for adaptive behavior, it also adds virtually infinite degrees of freedom, which need to be controlled for coordinated motion. The leech uses longitudinal, circular, and oblique muscles, which enable versatile body motions, including elongation and bending. We mimic this behavior with what we call a tri-tube soft actuator, consisting of three flexible tubes with helical grooves and a driving unit with three DC motors. Unsurprisingly, the full range of motion of the leech cannot be matched in our robot with only three degrees of actuation. For example, behaviors like twisting and body inflation are not directly achievable with the tri-tube soft actuator. However, the simple mechanism enables elongation/shortening and bending in all spatial dimensions, which we found to be sufficient for the rudimentary movements of leech-like climbing. LEeCH therefore integrates the skill of body extension, bending, and attachment to surfaces together with the flexibility of a leech's body.

1.3. Scope

Wall climbing robots have a wide range of potential applications, including building inspection and maintenance, and search and rescue tasks at disaster sites. In reality, the robot may have to navigate over obstacles on a wall, as well as transition to walls in different directions. The hardest task for a robot is being able to climb up onto the top of the wall and traverse the summit over to the other side – LEeCH has achieved this free movement in what is believed to be a world-first.

CHAPTER 2

LITERATURE SURVEY

[1] Yanjun Shen (2019): This paper presents the design of the permanent magnetic system for the wall climbing robot with permanent magnetic tracks. A proposed wall climbing robot with permanent magnetic adhesion mechanism for inspecting the oil tanks is briefly put forward, including the mechanical system architecture. The permanent magnetic adhesion mechanism and the tracked locomotion mechanism are employed in the robot system. By static and dynamic force analysis of the robot, design parameters about adhesion mechanism are derived. Two types of the structures of the permanent magnetic units are given in the paper. The analysis of those two types of structure is also detailed. Finally, two wall climbing robots equipped with those two different magnetic systems are discussed and the experiments are included in the paper.

[2] Chang Min Lee (2018): In this paper, we introduce a wall climbing robotic system for visual inspection of man-made structures. The adhesion mechanism of our system consists of an impeller and two-layer suction seals which provide sufficient adhesion forces for supporting the robot body on the non-smooth vertical wall and horizontal ceiling by generating pressure difference between the inside of the pressure chamber and the ambient environment. A comprehensive study is performed on the dynamic fluid modeling of the adhesion mechanism and the adhesion force is controlled by adjusting the pressure inside of the chamber. In addition, stable differential-driving locomotion on non-smooth surface are achieved by adapting a suspension mechanism for each wheel. A wall climbing robot, called LARVA, is successfully developed and its effectiveness of locomotion is verified with experiments on non-smooth vertical wall and horizontal ceiling surface..

[3] Md. Akhtaruzzaman(2019): The Robot, named as TRAIN WALL BOT, is designed to navigate on smooth vertical surfaces with the capability to avoid obstacles and overcome if the height is about 1cm. The design is inspired from train steel wheel movement that contains two actuated legs with rotary motion provided by a DC motor. The Robot uses Aluminium

system and the suction force is supplied by an air compressor that turns on intermittently. The suction force ensures the attachment of the robot with the wall by using 3 vacuum valves and 6 vacuum pads. The robot is controlled using PIC 16F877A. Two limit switches are used to acknowledge the contact with its navigating surface. Vacuum suction is controlled based on the ON OFF priority of the limit switches. Though the design is quiet simple but it is capable to walk, climb vertical smooth surfaces and avoid obstacles. Forward and backward movements are also faster, smoother and more stable (because of the coupling design) than other existing wall climbing Robots. In this paper, various aspects of prototype design and development of the Climbing Robot are conveyed including the body, leg, feet design and gait dynamics.

[4] Adnan Shujah. Hasan Habib(2021): This paper presents the wirelessly operated semi-independent wall climbing robot, capable of climbing vertical surfaces and ceilings. To increase the working efficiency and to save human life, the robot was designed. For the movement of the robot, a method of a centrifugal pump for continuous suction is utilized. Detailed analysis and scientific calculations are performed for the mechanical design of the robot. The design of the robot is unique and having a high degree of modification makes it suitable for different applications. All mechanical design parts of the robot are manufactured after complete study, including basic structure, the vacuum duct, driving assembly, and the camera mounting pad. The wireless transceiver is employed to control the robot and to transmit wireless video signal captured by the camera. This robot overcomes the design limitations of certain other prototypes. The robot could be used for inspection, surveillance and could provide information in hostage situations. The robot is overall lightweight and smaller in size.

[5] Haifei Zhu(2017): High-rise tasks such as cleaning, painting, inspection, and maintenance on walls of large buildings or other structures require robots with climbing and manipulating skills. Motivated by these potential applications and inspired by the climbing motion of inchworms, we have developed a biped wall-climbing robot-W-Climbot. Built with a modular approach, the robot consists of five joint modules connected in series and two suction modules mounted at the two ends. With this configuration and biped climbing mode, W-Climbot not only has superior mobility on smooth walls, but also has the function of attaching to and manipulating objects equivalent to a “mobile manipulator.” In this paper, we address several fundamental issues with this novel wall-climbing robot, including system de[illegible]ment,

analysis of suction force, basic climbing gaits, overcoming obstacles, and transiting among walls. A series of comprehensive and challenging experiments with the robot climbing on walls and performing a manipulation task have been conducted to demonstrate its superior climbing ability and manipulation function. The analytical and experimental results have shown that W-Climbot represents a significant advancement in the development of wall-climbing robots.

CHAPTER 3

METHODOLOGY

3.1. Introduction

Robotics is one of the major disruptive technologies helping multiple industries and organizations to boost productivity efficiently and effectively with moving, gripping, cleaning, and lifting objects. The world has already seen the development of multiple types of robots ranging from big industrial ones to micro-robots for assistance in the manufacturing, automotive as well as healthcare sectors. Recently, scientists and Robotics engineers have discovered that suction cups can be used in Robotics and their mission was also successful. Let's explore how suction cups in Robotics introduced wall-climbing robots into the world. It has been observed that multiple robots are assisting human employees in some horizontal areas such as a body, object, water, floor, etc. But there are vertical failures when the robots are climbing high walls of tanks, dams, or boilers. Researchers have infused magnets into the robots for climbing walls made of certain metals. But the robots fail to climb walls that are made of stainless steel, aluminum, glass, and so on. Yet, multiple industries use these materials to build tanks and boilers with high vertical walls. Thus, human employees tend to risk their lives for manually cleaning these walls regularly. That being said, researchers and scientists have introduced suction cups in Robotics for building wall-climbing robots to protect these human employees from a hazardous environment and occupational injuries.

LEeCH is capable of elongating and bending its body without any constraints and, thanks to its flexible structure (made of a shower hose material) and two suction cups, the robot has successfully climbed up and down a vertical wall and transitioned horizontally to reach the other side. Wall-climbing robots have a wide range of potential applications, including building inspection and maintenance, plus search and rescue tasks at disaster sites. Climbing straight up vertical walls is fairly easy to accomplish. However, in reality, the robot may have to navigate over obstacles on the wall such as steps and transition to walls with different directions.

The research team designed a new motion mechanism using tube structure of shower hose to mimic the advantageous properties of leeches, namely, lightweight, flexible and extensible.

The robot has a body composed of three flexible tubes that are connected in parallel. The body can bend or elongate by controlling the length of each flexible tube fed by the gear.

3.2 Different methods to adhere the robot into wall

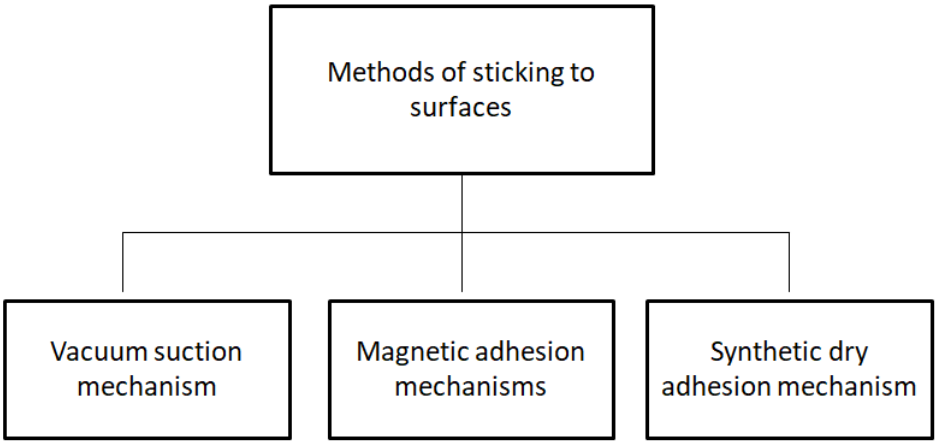


Fig 3.1 Types of methodologies

3.2.1 Vaccum suction mechanism

The most commonly used technique for making an robot capable of wall climbing is the Vacuum Suction Method. Its uses the concept of suction pumps to stick to the surface like shown in figure 3.2. The advantages is that by regulating the suction pressure as a function of weight, it can be used for carrying loads of various weights in vertical surfaces. Thus, increasing its range of operation. The no. of suction cups required for the robots depends upon the type of task to be performed. Suppose, for an WCR which is designed only to lift heavy loads, then it is required for the robot to have more suction cups (as per the load) is necessary and also in order "to prevent loss of pressure (and adhesion force) due to surface irregularities".The thing that is to be noted here is that the concept of pressure regulation of the suction cups, is limited after a certain extent. So, we must have to go for increase number of suction cups. For WCR developed specially for any purpose other than weight lifting in critical domains, we can generally go for less number of Suction Pumps per locomotors. With more research, a better WCR can be designed which will have the capacity to perform wide range of tasks assigned to it.

The limitation in this methods are :-

1). The first limitation is with Suction Adhesion Mechanism. If there is any hole in the suction seal, the robot may loosen its grip. Hence, the technique is applicable only for smooth

and non-porous surfaces.

2). Usually, more than one vacuum cup is used in each feet in order to prevent loss of pressure (and adhesion force) due to surface irregularities. This adds a limitation to the speed of the robot. Here, as we climb upwards, the effect of gravity on the robot will increase. This effect has to be taken care of simultaneously. So, the vacuum pressure has to be adjusted accordingly, for each step forward in order to generate sufficient adhesion force required. This effects the speed of locomotion of the robot.

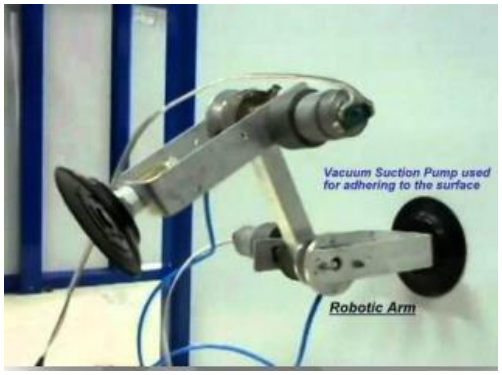


Fig 3.2 Robotic arm with suction used for sticking to the wall

3.2.2 Magnetic adhesion mechanism

Magnetic Adhesion Method is based on the principle of adhering of ferromagnetic materials into magnets. If the surface on which the robot is required to have locomotion is made up of ferromagnetic materials, then we can use magnetic arms of the robot for movement. It is more reliable in the sense, that the gripping is very strong in comparison to the Vacuum Suction Adhesion Method. But the use of magnetic materials makes the robot bulky. It is very surface specific, thus limiting the use of this technique.

3.2.3 Other adhesion principles

These days modern climbing robots, climb using gripping techniques that uses special glue for sticking to the surface. This glues are added in the climbing limbs, which makes them adhere to the surfaces. The main limitation of this method is the adhering capacity of the limbs decreases gradually, making loose sticking with the wall. This glues are produced either from natural products or synthetically prepared. It is similar to that of lizards. With the use of Bernoulli's Principle, the robot can also stick to the wall . Also, research in this field suggests new adhesion using biological findings.

CHAPTER 4

DESIGN AND DEVELOPMENT

4.1. Block diagram

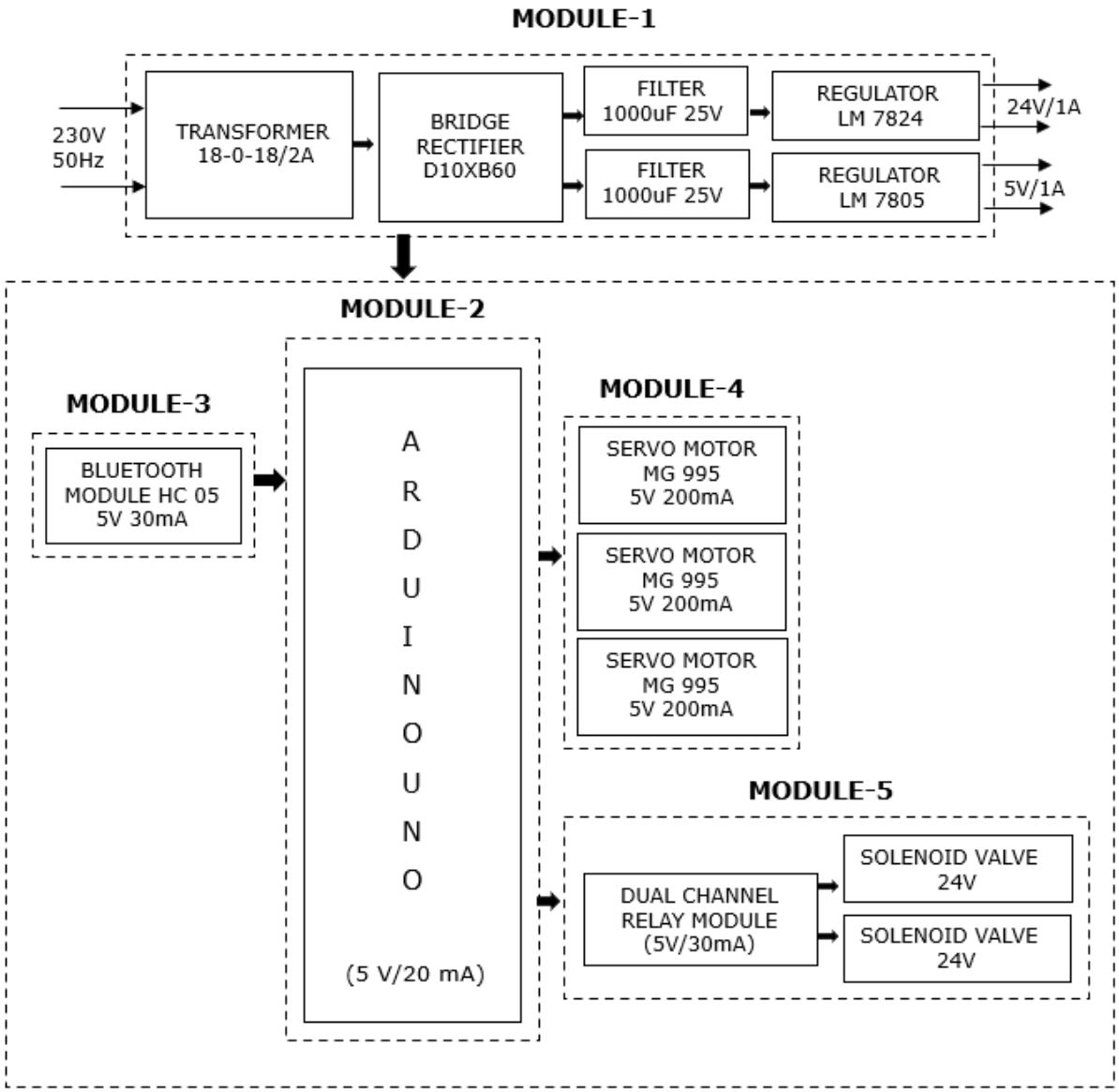


Fig 4.1 Block diagram

1. Power Supply: This is the power source for the entire system. It could be a battery or a DC power supply that provides the necessary voltage and current for the system to operate.

2. Bluetooth Module: This module allows wireless communication between the system and a mobile device. It could be used to send commands to the system from a smartphone or tablet.

3. Arduino Uno: This is the brain of the system. It controls the operation of the servo motors, relay module, and solenoid valves based on the input it receives from the Bluetooth module.

4. Servo Motors: These are the actuators that control the movement of various parts of the system. There are three servo motors in this system, and each of them is controlled by a separate pin on the Arduino Uno.

5. Dual Channel Relay Module: This module provides the capability to control two high-power devices, such as solenoid valves. The relay module is connected to the Arduino Uno and can be controlled by sending a signal to one of its pins.

6. Solenoid Valves: These are used to control the flow of fluids in the system. There are two solenoid valves in this system, and each of them is controlled by a separate pin on the relay module.

Here in figure 4.1, the Arduino Uno has 3 servomotors connected that helps in the elongation and compression movement of the robot and a Bluetooth module that connects the robot to the controller, ie. The smartphone where as per the need the forward, reverse, turn movements are done accordingly. The information sent to the Bluetooth modules then passes this to the solenoid valves where the suction or release mechanism from the surface of the suction cups are sent. All these are done with the help of a relay module. A separate 5V supply for each supply was designed on a PCB to regulate equal amounts of supply to the three motors without any fluctuation.

Overall, the block diagram shows that the Arduino Uno acts as the central controller for the system, receiving input from the Bluetooth module and using that information to control the servo motors and solenoid valves via the relay module. The Robo Leech Power Supply provides power to the entire system, allowing it to function properly.

4.2.circuit diagram

The figure 4.2 shows the circuit diagram in this the power supply section of the circuit includes two voltage regulators: the LM 7824 and the LM 7805. The LM 7824 is a 24V regulator and is used to regulate the input voltage to 24V for the dual channel relay module and the solenoid valve. The LM 7805 is a 5V regulator and is used to regulate the input voltage to 5V for the Arduino Uno and the HC-05 Bluetooth module. The Bluetooth module HC-05 is connected to the Arduino Uno via serial communication. The Arduino Uno receives commands from the HC-05 module and controls the servo motor and the relay module accordingly. The servo motor MG 995 is connected to the Arduino Uno via PWM signal. The PWM signal is generated by the Arduino Uno and controls the angle of rotation of the servo motor. The dual channel relay module is used to control the solenoid valve. The relay module is connected to the Arduino Uno and is used to switch the solenoid valve on and off. The solenoid valve is connected to the relay module and is used to control the flow of fluids in the system. The entire circuit is powered by the power supply section, which provides the necessary voltage and current for the components to operate properly.

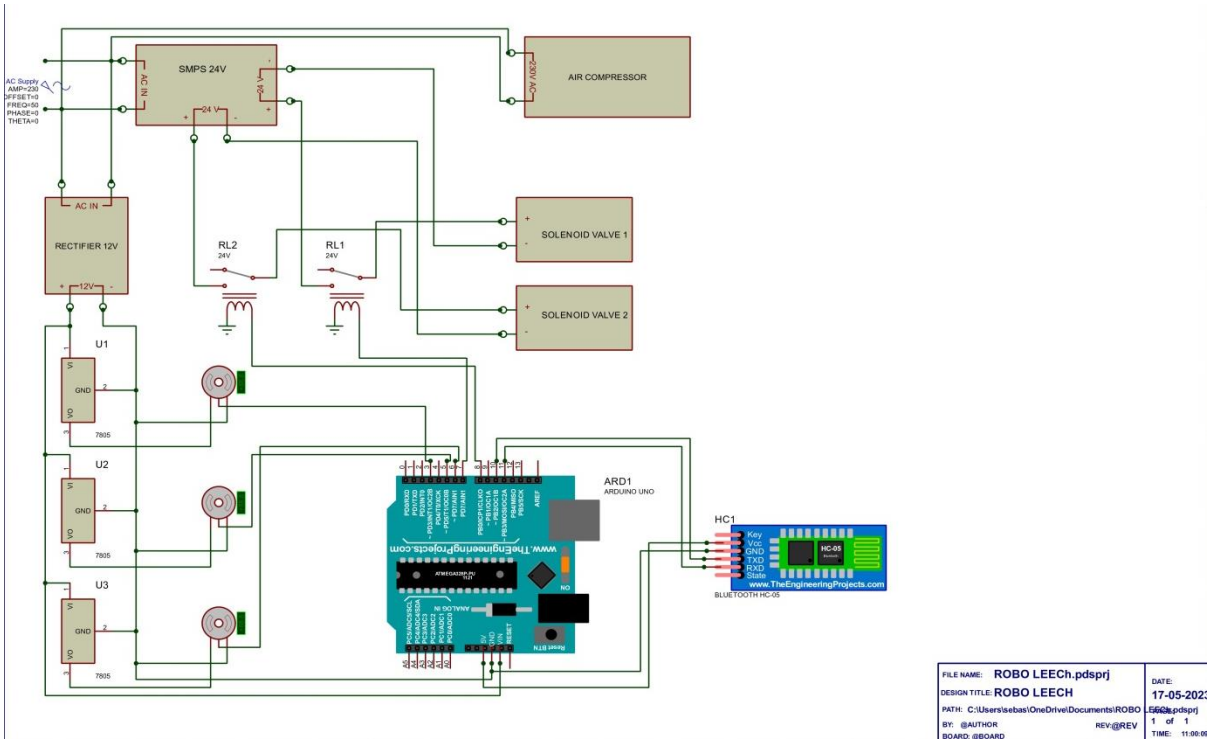


Fig 4.2 circuit diagram

Overall, the circuit diagram shows the connection between the different components of the system and how they interact with each other to achieve the desired function. The Bluetooth module sends commands to the Arduino Uno, which in turn controls the servo motor and the solenoid valve via the relay module. The power supply section provides the necessary power to the system to make it work properly.

4.3. HARDWARE DESCRIPTION

4.3.1 12/5v power supply

Figure 4.3 illusterates the power supply, In most of our electronic products or projects we need a power supply for converting mains AC voltage to a regulated DC voltage. For making a power supply designing of each and every component is essential. Here I'm going to discuss the designing of regulated 5V Power Supply.

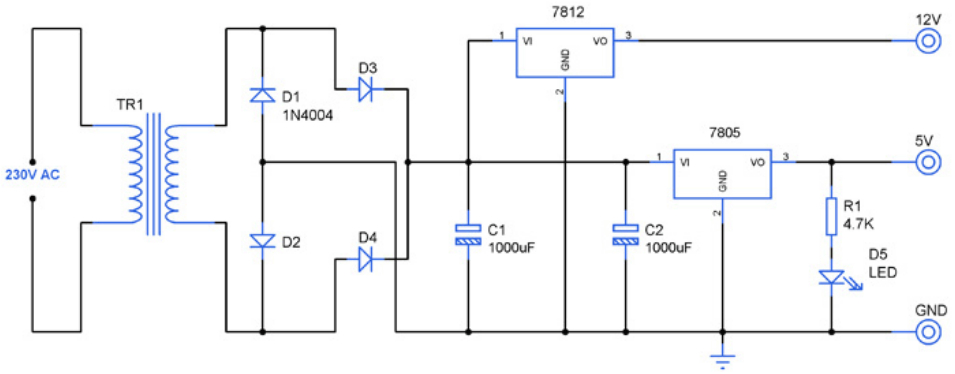


Fig 4.3 12/5v power supply

4.3.2. Arduino uno

Arduino Uno is a microcontroller board based on the ATmega328P chip as shown in figure 4.4. It is one of the most popular boards in the Arduino family due to its simplicity, versatility, and affordability. The board has 14 digital I/O pins, 6 of which can be used for PWM output, and 6 analog input pins. It can be powered through the USB connection or an

external power supply with a recommended input voltage of 7-12V, and it has a voltage regulator that ensures a stable 5V output. The Arduino Uno can be programmed using the Arduino Integrated Development Environment (IDE), which is available for Windows, Mac, and Linux. The IDE is based on the C/C++ programming language and provides a simple and easy-to-use interface for writing and uploading code to the board. It also comes with a vast library of pre-built functions and examples that can be used to interface with sensors, displays, and other modules. Overall, Arduino Uno is a powerful and affordable microcontroller board that is ideal for beginners and advanced users alike.

Hardware components :

- **ATmega328 Microcontroller**- It is a single chip Microcontroller of the ATmel family. The processor code inside it is of 8-bit. It combines **Memory (SRAM, EEPROM, and Flash), Analog to Digital Converter, SPI serial ports, I/O lines, registers, timer, external and internal interrupts, and oscillator.**
- **ICSP pin** - The In-Circuit Serial Programming pin allows the user to program using the firmware of the Arduino board.
- **Power LED Indicator**- The ON status of LED shows the power is activated. When the power is OFF, the LED will not light up.
- **Digital I/O pins**- The digital pins have the value HIGH or LOW. The pins numbered from D0 to D13 are digital pins.
- **TX and RX LED's**- The successful flow of data is represented by the lighting of these LED's.
- **AREF-** The Analog Reference (AREF) pin is used to feed a reference voltage to the Arduino UNO board from the external power supply.
- **Reset button**- It is used to add a Reset button to the connection.
- **USB**- It allows the board to connect to the computer. It is essential for the programming of the Arduino UNO board.
- **Crystal Oscillator**- The Crystal oscillator has a frequency of 16MHz, which makes the Arduino UNO a powerful board.
- **Voltage Regulator**- The voltage regulator converts the input voltage to 5V.

- **GND**- Ground pins. The ground pin acts as a pin with zero voltage.
- **Vin**- It is the input voltage.
- **Analog Pins**- The pins numbered from A0 to A5 are analog pins. The function of Analog pins is to read the analog sensor used in the connection. It can also act as GPIO (General Purpose Input Output) pins.

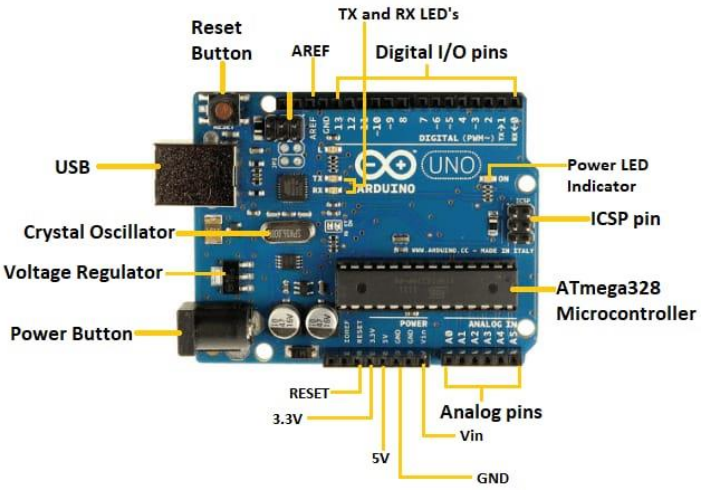


Fig 4.4 Arduino UNO module

4.3.3 Bluetooth module

The HC-05 is a popular Bluetooth module that can be used to add wireless communication capabilities to a wide range of devices, including microcontrollers, smartphones, and computers. Here's a detailed explanation of what the HC-05 is, how it works, and what you can do with it and the device is shown in figure 4.5. The HC-05 is a Bluetooth module that allows devices to communicate wirelessly over short distances. It uses the Bluetooth 2.0 protocol, which supports a range of up to 10 meters (or 33 feet) and a maximum data transfer rate of 2.1 Mbps. The module is compact and easy to use, and it can be powered from a variety of sources, including a 3.3V or 5V power supply. The HC-05 is a serial Bluetooth module, which means that it communicates with other devices using a serial

communication protocol. It has a built-in microcontroller that handles the Bluetooth communication and provides a simple interface for sending and receiving data. The module can be configured to operate in either slave or master mode, depending on how it will be used.

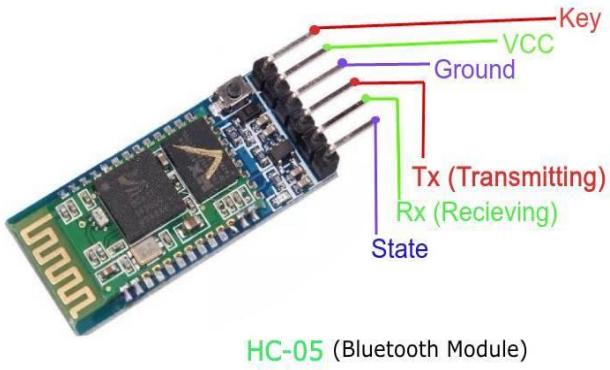


Fig 4.5 HC-05 Bluetooth Module

4.3.4. Servo motor

A servo motor is a type of motor that can rotate with great precision shown in figure 4.6. Normally this type of motor consists of a control circuit that provides feedback on the current position of the motor shaft, this feedback allows the servo motors to rotate with great precision. If you want to rotate an object at some specific angles or distance, then you use a servo motor. It is just made up of a simple motor which runs through a servo mechanism. If motor is powered by a DC power supply then it is called DC servo motor, and if it is AC-powered motor then it is called AC servo motor. A servo motor usually comes with a gear arrangement that allows us to get a very high torque servo motor in small and lightweight packages. Due to these features, they are being used in many applications like toy car, RC helicopters and planes, Robotics, etc. A **servo motor** is a type of motor that can rotate with great precision. Normally this type of motor consists of a control circuit that provides feedback on the current position of the motor shaft, this feedback allows the servo motors to rotate with great precision. If you want to rotate an object at some specific angles or distance, then you use a servo motor. It is just made up of a simple motor which runs through a **servo mechanism**. If motor is powered by a DC power supply then it is called DC servo motor, and if it is AC-powered motor then it is called AC servo motor. For this tutorial, we will be discussing only about the **DC servo motor working**. Apart from these major classifications, there are many other types of servo motors based on the type of

gear arrangement and operating characteristics. A servo motor usually comes with a gear arrangement that allows us to get a very high torque servo motor in small and lightweight packages. Due to these features, they are being used in many applications like toy car, RC helicopters and planes, Robotics, etc.

Fig 4.6 MG995 Servo Motor

4.3.5. Solenoid valve

A solenoid valve is an electromechanical device that uses an electric current to control the flow of a liquid or gas. Figure 4.7 shows the structure of the solenoid valve. It consists of a coil of wire that generates a magnetic field when an electric current is passed through it. The magnetic field attracts a plunger or armature, which opens or closes a valve orifice to allow or block the flow of fluid. There are two main types of solenoid valves: direct-acting and pilot-operated. Direct-acting solenoid valves use the magnetic force generated by the coil to directly open or close the valve orifice. Pilot-operated solenoid valves use the magnetic force to actuate a pilot valve, which in turn controls the flow of fluid to the main valve. Solenoid valves are commonly used in a variety of applications, including in hydraulic and pneumatic systems, as

well as in the control of fluids in industrial and commercial settings. They can be used to control the flow of water, oil, gas, steam, and other fluids. One of the key advantages of solenoid valves is their ability to provide rapid and precise control over fluid flow. They are also relatively simple to install and operate, and can be controlled remotely through electrical signals. Solenoid valves are available in a wide range of sizes, pressure ratings, and materials to suit different applications and environments.

Fig 4.7 Solenoid valve

4.3.6. Air compressor

An air compressor is a mechanical device that converts power (usually from an electric motor or an internal combustion engine) into compressed air, which can be used for a variety of pneumatic applications, figure 4.8. In the context of pneumatic operation, an air compressor is typically used to power pneumatic tools and machinery, as well as to control pneumatic systems such as valves and actuators. Air compressors work by compressing air from the surrounding environment, typically by drawing in ambient air through an intake valve and then compressing it using a piston or a rotary screw. The compressed air is then stored in a tank or reservoir, where it can be used as needed. There are several different types of air compressors, including

reciprocating compressors, rotary screw compressors, and centrifugal compressors. Reciprocating compressors use a piston and cylinder arrangement to compress air, while rotary screw compressors use interlocking screws to compress air. Centrifugal compressors use a spinning impeller to accelerate air and increase its pressure. When selecting an air compressor for pneumatic operation, several factors should be considered, including the required air flow rate (measured in cubic feet per minute or CFM), the operating pressure (measured in pounds per square inch or PSI), and the duty cycle (i.e. how often the compressor will be used and for how long). Proper maintenance of an air compressor is also important to ensure efficient and reliable operation. This may include regular oil changes, filter replacements, and inspections for leaks and worn components. Overall, an air compressor is a versatile and essential tool for pneumatic operation, providing a reliable source of compressed air for a wide range of industrial and commercial applications.

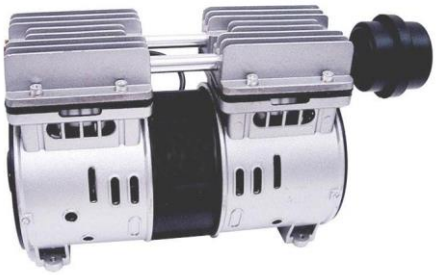


Fig 4.8 Air compressor

4.3.7. Suction cups

A suction cup, also known as a sucker, is a device or object that uses the negative fluid pressure of air or water to adhere to nonporous surfaces, creating a partial vacuum. Suction cups are peripheral traits of some animals such as octopuses and squids, and have been reproduced artificially for numerous purposes.

The working face of the suction cup is made of elastic, flexible material and has a curved surface as shown in figure 4.9.When the center of the suction cup is pressed against a flat, non-porous surface, the volume of the space between the suction cup and the flat surface is reduced, which causes the air or water between the cup and the surface to be expelled past the rim of the circular cup. The cavity which develops between the cup and the flat surface has little to no air or water in it because most of the fluid has already been forced out of the inside of the cup, causing a lack of pressure. The pressure difference between the atmosphere on the outside of the cup and the low-pressure cavity on the inside of the cup keeps the cup adhered to the surface.

When the user ceases to apply physical pressure to the outside of the cup, the elastic substance of which the cup is made tends to resume its original, curved shape. The length of time for which the suction effect can be maintained depends mainly on how long it takes for air or water to leak back into the cavity between the cup and the surface, equalizing the pressure with the surrounding atmosphere. This depends on the porosity and flatness of the surface and the properties of the cup's rim. A small amount of mineral oil or vegetable oil is often employed to help maintain the seal.

Fig 4.9 Suction for locomotion

4.3.8. Pneumatic pipe and connectors

Pneumatic pipes and connectors are an essential part of many industrial and manufacturing processes. They are used to transport compressed air or gases from one location to another, and they play a critical role in controlling the movement of machinery and equipment.

Pneumatic Pipes:

Pneumatic pipes are tubes made from various materials, including plastic, nylon, rubber, or metal, that are designed to transport compressed air or gases from one location to another, figure 4.10. These pipes come in a range of sizes and thicknesses to accommodate different flow rates and pressures. When selecting pneumatic pipes, it is essential to consider factors such as temperature, pressure, and chemical resistance. Pipes made from materials such as plastic or nylon are suitable for low-pressure applications, while those made from metal or reinforced rubber are better suited to high-pressure applications.

Pneumatic Connectors:

Pneumatic connectors are used to join two or more pneumatic pipes together. These connectors come in a variety of styles, including push-to-connect, threaded, and compression fittings. Push-to-connect fittings are the most common type of pneumatic connector. They are designed to be simple and easy to use, with a mechanism that allows you to push the pipe into the fitting to create a secure seal. Push-to-connect fittings are ideal for applications where frequent changes to the piping system are necessary. Threaded fittings are another type of pneumatic connector. These fittings have threads on the inside and outside, which allows them to be screwed together. Threaded fittings are suitable for high-pressure applications because they provide a secure seal that can withstand high levels of pressure. Compression fittings are designed to create a leak-free seal by compressing the pipe between two fittings. These fittings are typically used in applications where a high degree of reliability is required, such as in the medical or aerospace industries.

Fig4.10 Pneumatic pipe and connectors

4.3.9. Screws

A **Screw** and a bolt are similar types of fastener typically made of metal and characterized by a helical ridge, called a male thread (external thread) as shown in figure 4.11. Screws and bolts are used to fasten materials by the engagement of the screw thread with a similar female thread (internal thread) in a matching part. Screws are often self-threading (also known as self-tapping) where the thread cuts into the material when the screw is turned, creating an internal thread that helps pull fastened materials together and prevents pull-out. There are many screws for a variety of materials; materials commonly fastened by screws include wood, sheet metal, and plastic.

Fig 4.11 screws and hinges

4.3.10. Mobile phone

A smartphone is a portable computer device that combines mobile telephone and computing functions into one unit as shown in figure 4.12. They are distinguished from feature phones by their stronger hardware capabilities and extensive mobile operating systems, which facilitate wider software, internet (including web browsing over mobile broadband), and multimedia functionality (including music, video, cameras, and gaming), alongside core phone functions such as voice calls and text messaging. Smartphones typically contain a number of metal–oxide–semiconductor (MOS) integrated circuit (IC) chips, include various sensors that can be leveraged by pre-included and third-party software (such as

a magnetometer, proximity sensors, barometer, gyroscope, accelerometer and more), and support wireless communications protocols (such as Bluetooth, Wi-Fi, or satellite navigation).

Here we use the smartphone application to navigate the robot the future application would also help the robot move through obstacles and fix the issue accordingly.

Fig 4.12 Smart phone acting as a remote control

4.3.11. Connecting wires

Connecting wires allows an electrical current to travel from one point on a circuit to another, because electricity needs a medium through which to move. In the case of computers, wires are embedded into circuit boards, carrying pulses of electricity that are interpreted as binary signals of zeros and ones. Most wires in computers and electronic components are made of copper or aluminum. Copper is cheap and electrically conductive. Silver has higher conductivity but is far more expensive.

In a basic circuit, the wire comes from one terminal of a power source, such as a battery. It then connects to a switch that determines whether the circuit is open or closed. The wire then

connects to the device that is drawing power, allowing it to draw electricity and perform its task. Finally, the wire connects the load back to the opposite terminal of the power source.

Before a current can travel through the wire, the circuit has to be closed; in other words, there cannot be any breaks in the path. Electricity cannot easily travel through air, and if it does there is a risk of stray current leaking into the surroundings and causing damage or failing to power the appliance.

Fig 4.13 Male to female connecting wire

4.4 SOFTWARE DESCRIPTION

4.4.1 Arduino IDE

Arduino IDE is open-source software that is mainly used for writing and compiling the code into the Arduino Module. It is official Arduino software, making code compilation too easy that even a common person with no prior technical knowledge can get their feet wet with the learning process. It is easily available for operating systems like MAC, Windows, Linux and runs on the Java Platform that comes with inbuilt functions and commands that play a vital role for debugging, editing, and compiling the code in the environment. A range of Arduino modules available including Arduino Uno, Arduino Mega, Arduino Leonardo, Arduino Micro

and many more. Each of them contains a microcontroller on the board that is programmed and accepts the information in the form of code. The Arduino Integrated Development Environment contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino hardware to upload programs and communicate with them. Programs written using Arduino Software (IDE) are called sketches. These sketches are written in the text editor and are saved with the file extension. The editor has features for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and also displays errors. The console displays text output by the Arduino Software (IDE), including complete error messages and other information.

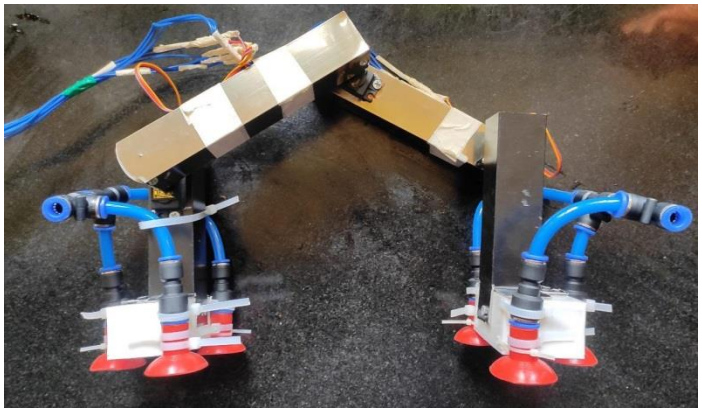
4.4.2 Proteus

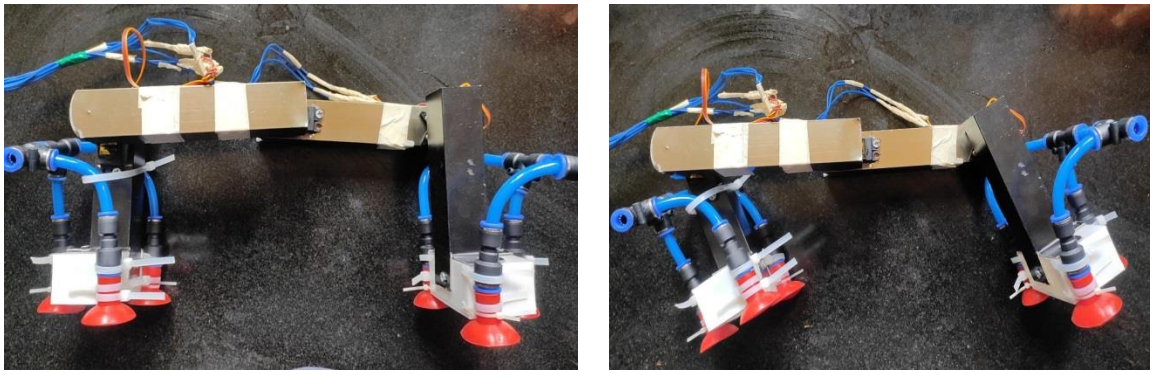
Proteus is used to simulate, design and drawing of electronic circuits. It was invented by the Labcenter electronic. By using proteus you can make two-dimensional circuits designs as well. With the use of this engineering software, you can construct and simulate different electrical and electronic circuits on your personal computers or laptops.There are numerous benefits to simulate circuits on proteus before make them practically.Designing of circuits on the proteus takes less time than practical construction of the circuit.The possibility of error is less in software simulation such as loose connection that takes a lot of time to find out connections problems in a practical circuit.Circuit simulations provide the main feature that some components of circuits are not practical then you can construct your circuit on proteus.There is zero possibility of burning and damaging of any electronic component in proteus.

CHAPTER 5

RESULT AND DISCUSSION

We successfully designed and completed the ROBO LeECH robot





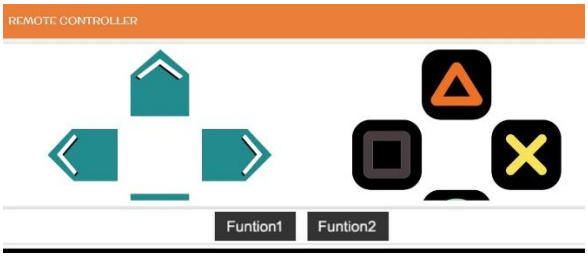


Fig 5.1 Leech robot with android application

5.1 Future scope

- Wall climbing robots that utilize suction for adhesion have significant potential for future advancements and applications. Here are some areas where suction-based wall climbing robots could find further development and use:
- High-rise Window Cleaning: Cleaning windows on tall buildings is a challenging and time-consuming task. Suction-based wall climbing robots can be designed specifically for window cleaning, providing a safe and efficient alternative to manual methods. They can navigate vertically and clean multiple windows in a single operation, reducing the need for human labor at great heights.
- Facade Inspection and Maintenance: Suction-based wall climbing robots equipped with cameras and sensors can inspect building facades for structural issues, cracks, or signs of wear and tear. They can autonomously move along the vertical surface, capturing high-resolution images and collecting data for maintenance purposes.
- Painting and Coating: Wall climbing robots utilizing suction can be adapted for painting or applying coatings on vertical surfaces. These robots can adhere to the wall while moving systematically, ensuring even coverage and reducing the need for scaffolding or manual labor in challenging environments.
- Industrial Cleaning: In industrial settings, suction-based wall climbing robots can be employed for cleaning tasks on large vertical surfaces such as tanks, silos, or chimneys. These robots can navigate the vertical structure, removing dirt, debris, or contaminants, and maintaining a clean and safe working environment.
- Construction and Assembly: Wall climbing robots with suction capabilities can assist in construction tasks by transporting materials or tools to different levels of a building under construction. They can adhere to vertical surfaces, ensuring secure transportation and reducing the need for human labor in accessing elevated areas.

- Logistics and Warehousing: Suction-based wall climbing robots can be utilized in logistics and warehousing facilities to transport goods vertically. They can efficiently move packages or pallets between different levels, optimizing storage space and improving operational efficiency.
- Surveillance and Security: Wall climbing robots using suction can be employed for surveillance and security purposes. Equipped with cameras, sensors, or other monitoring devices, these robots can autonomously patrol vertical surfaces, providing real-time video feeds or detecting anomalies in areas that are challenging to access for humans.
- Emergency Response: Suction-based wall climbing robots can play a vital role in emergency response scenarios. They can navigate vertically to reach people in distress, deliver supplies or medical aid, or assist in rescue operations in situations such as building collapses or natural disasters.

As technology progresses, suction-based wall climbing robots are likely to become more capable, versatile, and efficient. Advancements in suction technology, materials, and power systems will further expand their potential applications, enabling them to tackle complex tasks and operate in a wide range of environments.There are many other opportunities for future developments. For example, one problem is the reduction in controllability as the tube lengths increase, which makes it difficult to position the robot end. One way to improve controllability is to increase the number of the driving units controlling the flexible tubes. This allows the robot not only to assume various shapes but also to control the stiffness by changing the distance between the driving units. Such additional degrees of freedom will require an extension of our model to 3D, as out-of-plane bending, twist, and body inflation can occur which cannot be covered with our current planar model. Another opportunity for improvement is to prevent an unactuated helical degree of freedom of the flexible tubes. Even when a position of the driving unit is fixed, the axial rotation of the flexible tube is still possible due to the helical pitch of the tube grooves. Using a rotation stopper such as a set of a nut and slider used in lead screws may eliminate the rotational instability. Although this prototype robot has pumps, batteries, and a controller off-board, we could develop a self-contained robot by

integrating these devices into on-board because increasing the weight of the driving unit does not affect the reachability of the robot end.

5.2 Limitations

The concept of a wall climbing leech robot is intriguing, but such a design would have several limitations. Here are some of the potential challenges and constraints associated with wall climbing leech robots:

- Surface Compatibility: The leech robot may struggle to adhere to certain surfaces, especially those that are smooth, wet, or covered in debris. The effectiveness of its climbing ability would be limited to surfaces with sufficient traction.

- Power Source and Duration: Wall climbing requires a constant power source to drive the robot's locomotion and gripping mechanisms. The size and weight constraints of the robot may limit the capacity of its power source, potentially resulting in shorter operational durations or the need for frequent recharging or refueling.

- Payload and Manipulation: The leech robot's ability to carry or manipulate objects may be limited due to its design. It might be challenging to integrate additional mechanisms for carrying loads or performing complex tasks while maintaining effective climbing capabilities.

- Obstacle Negotiation: The leech robot might encounter difficulties navigating over obstacles such as corners, protrusions, or gaps. Its ability to adapt to different types of surfaces or irregularities on walls could be limited, affecting its overall mobility and climbing efficiency.

- Size and Weight Limitations: The size and weight of the leech robot could impose constraints on its practicality and applications. If the robot is too large or heavy, it may struggle to climb vertically, and its weight might exceed the load-bearing capacity of certain surfaces.

- Environmental Constraints: The leech robot's performance might be affected by environmental factors such as temperature, humidity, or extreme conditions. Harsh environments, such as high altitudes or extreme temperatures, could impact the robot's climbing ability, materials, or sensors.

- Maintenance and Wear: Wall climbing robots are subject to wear and tear due to constant contact with surfaces. The robot's gripping mechanisms, adhesive materials, or climbing components may require regular maintenance or replacement to ensure optimal performance.

- Safety Considerations: There are potential safety concerns associated with wall climbing leech robots. If the robot detaches from the surface or loses stability during climbing, it could fall and potentially cause damage or injury. Ensuring safe operation and implementing fail-safe mechanisms would be critical.

It's important to note that the limitations mentioned above are based on the current understanding and challenges associated with wall climbing robots in general. Future advancements in materials, adhesion technologies, power systems, and robotics could potentially address or mitigate some of these limitations.

CHAPTER 6

CONCLUSION

Climbing robots have a wide range of potential applications, including building inspection, maintenance, construction, and search and rescue tasks. Climbing robotics is still a challenging research field both theoretically and practically, but together, we have made significant contributions to advance this field by creating a robot, inspired by leeches, that can transition from one surface to another and can climb a vertical wall – without any constraints.

The flexibility of the robot in different angles to show the climbing mechanism through elongation and compression. A motor engages with the helical groove on the surface of the tube. The flexible tube moves back and forth by the rotational motion. The LEeCH robot has a body composed of 4 lightweight hollow rods that are connected in a pentagon shape. The body can bend or elongate by controlling the length of each flexible tube fed by the servomotor.The LEeCH robot successfully achieved upward/downward climbing and horizontal transition on a vertical wall. By combining these two transitions, the robot is capable of moving freely on a two-dimensional wall surface. The robot's flexible body with large deformation enabled it to transition from one side of a vertical wall to the other side. This is the world's first achievement in developing soft and flexible robot that is capable of free movement on a wall.

Moreover, we derived the nondimensional morphological parameter which defines the robot's shape and showed that the desired reachability can be designed by changing this parameter. In a real system, a change of shape parameter can be achieved by modifying system size, stiffness, mass density, or gravity. As the latter two are hard to alter and the system size might be constrained by the particular task at hand, a change in stiffness appears to be a reasonable tuning parameter, which could be achieved using variable stiffness actuators. In future work, we will investigate such mechanisms for live changes in shape parameters. Our study helps lay the foundation for soft robots that achieve complex locomotion such as overcoming obstacles and transitioning from wall to wall while using large and nonlinear deformation.

There are many other opportunities for future developments. For example, one problem is the reduction in controllability as the tube lengths increase, which makes it difficult to position the robot end. One way to improve controllability is to increase the number of the driving units controlling the flexible tubes. This allows the robot not only to assume various shapes but also to control the stiffness by changing the distance between the driving units. Such additional degrees of freedom will require an extension of our model to 3D, as out-of-plane bending, twist, and body inflation can occur which cannot be covered with our current planar model. Another opportunity for improvement is to prevent an unactuated helical degree of freedom of the flexible tubes. Even when a position of the driving unit is fixed, the axial rotation of the flexible tube is still possible due to the helical pitch of the tube grooves. Using a rotation stopper such as a set of a nut and slider used in lead screws may eliminate the rotational instability. Although this prototype robot has pumps, batteries, and a controller off-board, we could develop a self-contained robot by integrating these devices into on-board because increasing the weight of the driving unit does not affect the reachability of the robot end.

REFERENCES

[1] A. Kanada; F. Giardina; T. Howison; T. Mashimo; F. Iida, 'Reachability Improvement of a Climbing Robot Based on Large Deformations Induced by Tri-Tube Soft Actuators'. Soft Robotics (2019). DOI: 10.1089/soro.2018.0115

[2]Chu B, Jung K, Han CS, et al.. A survey of climbing robots: locomotion and adhesion. Int J Precis Eng Manuf 2010;11:633–647 [Google Scholar]

[3] Nansai S, Mohan R. A survey of wall climbing robots: recent advances and challenges. Robotics 2016;5:14 [Google Scholar]

[4]Miripour B. Climbing and walking robots. Silva MF, Machado JaT. (Eds). A Survey of Technologies and Applications for Climbing Robots Locomotion and Adhesion. London, UK: IntechOpen, 2010, pp. 1–22 [Google Scholar]

[5]Schmidt D, Berns K. Climbing robots for maintenance and inspections of vertical structures—a survey of design aspects and technologies. Rob Auton Syst 2013;61:1288–1305 [Google Scholar]

[6]Santos D, Heyneman B, Kim S, et al.. Gecko-inspired climbing behaviors on vertical and overhanging surfaces. In 2008 IEEE International Conference on Robotics and Automation (ICRA); California: IEEE, 2008, pp. 1125–1131 [Google Scholar]

[7]Murphy MP, Kute C, Mengüç Y, et al.. Waalbot II: Adhesion recovery and improved performance of a climbing robot using fibrillar adhesives. Int J Rob Res 2011;30:118–133 [Google Scholar]

[8]Lee G, Kim H, Seo K, et al.. MultiTrack: a multi-linked track robot with suction adhesion for climbing and transition. Rob Auton Syst 2015;72:207–216 [Google Scholar]

[9]Seo TW, Sitti M. Tank-like module-based climbing robot using passive compliant joints. IEEE Trans Robot 2013;18:397–408 [Google Scholar]

[10]K.-Y. Tu, T.-T. Lee, C.-H. Wang, and C.-A. Chang, Design of a fuzzy walking pattern (FWP) for a shape memory alloy (SMA) biped robot, Robotica, 17 (1999), 373–382.

[11]L. Schetky, Shape memory effect alloys for robotic devices, Robotics Age 6:(7) 1984, 13–17.

[12]Y. Nakano, M. Fujie, and Y. Hosada, Hitachi's robot hand, Robotics Age 6:(7) 1984, 18–20.

[13]M. Hashimoto, M. Takeda, H. Sagawa, I. Chiba, and K. Sato, Application of shape memory alloy to robotic actuators, J Robot Syst 2:(1) 1985, 3–25.

[13] M. Bergamasco, F. Salsedo, and P. Dario, Shape memory alloy micromotors for direct-drive actuation of dexterous artificial hands, Sensors Actuators 17 (1989),115–119.

APPENDIX

Programming

```
#include <SoftwareSerial.h>

#include <Servo.h>



SoftwareSerial bluetooth(10, 11);  // RX, TX

Servo servo1;

Servo servo2;

Servo servo3;

Servo servo4;

int relayPin1 = 7;  // Pin connected to relay for Solenoid Valve 1

int relayPin2 = 8;  // Pin connected to relay for Solenoid Valve 2

char command;

void setup() {

Serial.begin(9600);

bluetooth.begin(9600);

servo1.attach(3);

servo2.attach(5);

servo3.attach(6);
```

```
servo4.attach(9);

pinMode(relayPin1, OUTPUT);

pinMode(relayPin2, OUTPUT);

digitalWrite(relayPin1, LOW);

digitalWrite(relayPin2, LOW);

}


void loop() {

if (bluetooth.available() > 0) {

char command = bluetooth.read();

Serial.print(command);


if (command == 'RST') {  // Forward

servo1.write(0);

servo2.write(0);

servo3.write(0);

servo4.write(0);

} else if (command == 'C') {  // Reverse

servo3.write(120);          //angle between 3rd and 4th servo arm 175 degree.

delay(2000);
```

```
servo1.write(110);  //angle between first and second servo arm 155 degree.

delay(2000);

servo2.write(125);  //angle between second and third arm 50 degree.

delay(2000);

servo3.write(100);  //angle between 3rd and 4th servo arm 155 degree.

delay(2000);

} else if (command == 'E') {  // Left

servo1.write(110);          //angle between first and second servo arm 160 degree.

delay(2000);

servo2.write(0);  //angle between second and third arm 180 degree.

delay(2000);

servo3.write(40);  // angle between arm 3 & 4 90 degree

delay(2000);

servo1.write(45);  //angle b/n 1&2 90 degree.

delay(2000);

} else if (command == '1') {     // Right

digitalWrite(relayPin1, LOW);  // Turn on Solenoid Valve 1

bluetooth.println("Solenoid valve 1 turned on");

} else if (command == '2') {      // Right

digitalWrite(relayPin1, HIGH);  // Turn on Solenoid Valve 1
```

```
bluetooth.println("Solenoid valve 1 turned off");

} else if (command == '3') {      // Right

digitalWrite(relayPin2, LOW);  // Turn on Solenoid Valve 1

bluetooth.println("Solenoid valve 2 turned on");

} else if (command == '4') {      // Right

digitalWrite(relayPin2, HIGH);  // Turn on Solenoid Valve 1

bluetooth.println("Solenoid valve 2 turned off");

}

}

}
```

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

VIMAL JYOTHI ENGINEERING COLEGE
CHEMPERI
JUNE 2023

CERTIFICATE

This is to certify that the report entitled **"ROBO LeECH- LONGITUDINALLY EXTENSIBLE CONTINUUM ROBOT"** submitted **AMAL PRAMOD, GEOFFIN SAJAN, MARTIN P THOMAS AND SHREYA DEEP ANAND** to the A P J Abdul Kalam Technological University in partial fulfillment of the requirement for the award of the Degree of Bachelor of Technology in ELECTRONICS AND COMMUNICATION 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 University or Institute for any purpose.

Project Guide	**Project Coordinator**	**Head of Department**
Dr. JAYESH GEORGE	**Dr. JAYESH GEORGE**	**DR. D ANTO SAHAYA DHAS**
Assosciate Professor Department of ECE Engineering Vimal Jyothi Engineering College Chemperi, Kannur	Assosciate Professor Department of ECE Engineering Vimal Jyothi Engineering College Chemperi, Kannur	Professor and Head Department of ECE Engineering Vimal Jyothi Engineering College Chemperi, Kannur

Signature Not Verified
Principal.VJEC

23/6/2023

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

VIMAL JYOTHI ENGINEERING COLLEGE, CHEMPERI

CERTIFICATE

This is to certify that the project report entitled **"IOT BASED SMART STREETLIGHT INTENSITY CONTROLLER SYSTEM"** submitted by **BRAJESH PV, DHANUSH CH, JOBIN JOSEPH** and **NISWARTH AV** to the APJ Abdul Kalam Technological University in partial fulfillment of the requirement for the award of the Degree of Bachelor of Technology in ELECTRONICS AND COMMUNICATION 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.

Project Guide

Mr. MANOJ K C

Associate Professor

Dept. of ECE

Vimal Jyothi Engg college

Chemperi, Kannur

Project Coordinator

Dr. JAYESH GEORGE M

Associate Professor

Dept. of ECE

Vimal Jyothi Engg college

Chemperi, Kannur

Head of the department

Dr. D ANTO SAHAYA DHAS

Professor and HoD

Dept. of ECE

Vimal Jyothi Engg college

Chemperi, Kannur

Signature Not Verified

Principal.VJEC

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

VIMAL JYOTHI ENGINEERING COLLEGE, CHEMPERI

CERTIFICATE

This is to certify that the project report entitled **'Gesture Controlled Pick and Place Robot'** submitted by **ANGITHA N, ANJALI KP, HEERA PRADEEP, JEENA GEORGE** to the APJ Abdul Kalam Technological University in partial fulfilment of the requirements for the award of the Degree of Bachelor of Technology in ELECTRONICS AND COMMUNICATION ENGINEERING is a bonafide record of the project 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.

PROJECT GUIDE	PROJECT COORDINATOR	HEAD OF THE DEPARTMENT
Ms. BINDU SEBASTIAN	Dr. JAYESH GEORGE	Dr. D ANTO SAHAYA DHAS
Associate Professor	Associate Professor	Professor and Head
Department of Electronics and Communication Engineering	Department of Electronics and Communication Engineering	Department of Electronics and Communication Engineering
Vimal Jyothi Engineering College Chemperi, Kannur	Vimal Jyothi Engineering College Chemperi, Kannur	Vimal Jyothi Engineering College Chemperi, Kannur

Signature N

Principa

DEPARTMENT OF ELECTRONICS AND COMMUNICATIONS ENGINEERING VIMAL JYOTHI ENGINEERING COLLEGE, CHEMPERI

CERTIFICATE

This is to certify that the project report entitled **"EMOTION AND SPEAKER RECOGNITION FROM SPEECH SIGNAL"** submitted by **ADARSH V K, ADWAITH KRISHNA, SAVIO JOSE, SOURAV K R V** to the APJ Abdul Kalam Technological University in partial fulfillment of the requirement for the award of the Degree of Bachelor of Technology in ELECTRONIC AND COMMUNICATION 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.

Project guide
Ms. ANUSHA CHACKO
Assistant Professor
Dept. of ECE
Vimal Jyothi
Engineering college
Chemperi, Kannur

Project coordinator
Dr. JAYESH GEORGE
Associate Professor
Dept. of ECE
Vimal Jyothi
Engineering college
Chemperi, Kannur

Head of the department
Dr. ANTO SAHAYA DHAS
Professor and HOD
Dept. of ECE
Vimal Jyothi
Engineering college
Chemperi, Kannur

Signature

Princip

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

BONAFIDE CERTIFICATE

This is to certify that the report entitled **"Arduino based smart medical pill box with voice and display reminder for patients"** submitted by **GEETHIKA T, SAISHNA SHAMEJ, SANATH K, SHILPA M NAIR** to the A P J Abdul Kalam Technological University in partial fulfillment of the requirement for the award of the Degree of Bachelor of Technology in **ELECTRONICS AND COMMUNICATION 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 University or Institute for any purpose.

Project Guide

Ms. SHIMNA P K

Assistant Professor
Dept. of ECE
Vimal Jyothi Engg College
Chemperi, Kannur

Project Coordinator

Dr. JAYESH GEORGE M
Associate Professor
Dept. of ECE
Vimal Jyothi Engg college
Chemperi, Kannur

Head of the Department

Dr. D ANTO SAHAYA DHAS
Professor and HoD
Dept. of ECE
Vimal Jyothi Engg college
Chemperi, Kannur

Signatu

Princ

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
VIMAL JYOTHI ENGINEERING COLLEGE, CHEMPERI

CERTIFICATE

This is to certify that the project report entitled **"VIRTUAL GREEN ROBOT USING RASPBERRY PI"** submitted by **ANJANA MUKUNDAN K, ARCHANA T, MALAVIKA AJITH, VARSHA KV** to the APJ Abdul Kalam Technological University in partial fulfillment of the requirement for the award of the Degree of Bachelor of Technology in ELECTRONICS AND COMMUNICATION 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.

Project guide	**Project coordinator**	**Head of the Department**
Mr. Adarsh KS	**Dr. Jayesh George**	**Dr. D Anto Sahayadhas**
Assistant Professor	Associate Professor	Professor and HOD
Dept. Of ECE	Dept. Of ECE	Dept. of ECE
Vimal Jyothi	Vimal Jyothi	Vimal Jyothi
Engineering college	Engineering college	Engineering college
Chemperi, Kannur	Chemperi, Kannur	Chemperi, Kannur

20/6/2023

Sign

Pri

Examiner 1 Examiner 2 Examiner 3

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

BONAFIDE CERTIFICATE

This is to certify that the report entitled **"IOT BASED WATER POLLUTION MONITORING RC BOAT"** submitted by **ASWIN SURENDRAN, ATHUL GEORGE, SARANG K** and **VISHNU SHANKAR** to the A P J Abdul Kalam TechnologicalUniversity in partial fulfilment of the requirement for the award of the Degree of Bachelor of Technology in **ELECTRONICS AND COMMUNICATION 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 University or Institute for any purpose.

PROJECT GUIDE
Ms. LEKSHMY S
Assistant Professor

Department of Electronics and Communication Engineering
Vimal Jyothi Engineering College
Chemperi, Kannur

PROJECT COORDINATOR
Dr. JAYESH GEORGE
Associate Professor

Department of Electronics and Communication Engineering
Vimal Jyothi Engineering College
Chemperi, Kannur

HEAD OF THE DEPARTMENT
DR. D ANTO SAHAYA DHAS
Professor and Head

Department of Electronics and Communication Engineering
Vimal Jyothi Engineering College
Chemperi, Kannur

Signature

Princip

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

VIMAL JYOTHI ENGINEERING COLLEGE, CHEMPERI

CERTIFICATE

This is to certify that the report entitled **'AQUATIC MICRO PLASTIC PARTICLE COLLECTION AND WATER PURITY CHECKING ROBOT'** submitted by **JACOB JAMES, JOSHUA NOYAL, NEVIN SAJI, SEBASTIAN GEORGE** to the APJ Abdul Kalam Technological University in partial fulfillment of the requirements for the award of the Degree of Bachelor of Technology in ELECTRONICS AND COMMUNICATION ENGINEERING is a bonafide record of the project 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.

PROJECT GUIDE	PROJECT COORDINATOR	HEAD OF THE DEPARTMENT
Dr. ROSHINI T V	Dr. JAYESH GEORGE	Dr. D ANTO SAHAYA DHAS
Professor	Associate Professor	Professor and HOD
Department of Electronics and Communication Engineering	Department of Electronics and Communication Engineering	Department of Electronics and Communication Engineering
Vimal Jyothi Engineering College	Vimal Jyothi Engineering College	Vimal Jyothi Engineering College
Chemperi, Kannur	Chemperi, Kannur	Chemperi, Kannur

Signature

Princip

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
VIMAL JYOTHI ENGINEERING COLLEGE, CHEMPERI

CERTIFICATE

This is to certify that the project report entitled **"ROBOT FOR RESCUE OPERATION FOR BOREWELL VICTIMS"** submitted by **AAVANI M, ANUSREE K V, KEERTHI PRADEEP KUMAR, RUBY SHARIN** to the APJ Abdul Kalam Technological University in partial fulfillment of the requirement for the award of the Degree of Bachelor of Technology in ELECTRONICS AND COMMUNICATION 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.

Project guide	**Project coordinator**	**Head of the department**
Ms. ANN MATHEW	**Dr. JAYESH GEORGE M**	**Dr. D ANTO SAHAYA DHAS**
Assistant Professor	Associate Professor	Professor and HOD
Dept. of ECE	Dept. of ECE	Dept. of ECE
Vimal Jyothi	Vimal Jyothi	Vimal Jyothi
Engineering college	Engineering college	Engineering college
Chemperi, Kannur	Chemperi, Kannur	Chemperi, Kannur

Signature N

Principa

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
VIMAL JYOTHI ENGINEERING COLLEGE,CHEMPERI

CERTIFICATE

This is to certify that the project report entitled **"AUTOMATIC SPICE DRYING MACHINE USING MICROCONTROLLER FOR DOMESTIC PURPOSE"** submitted by **FLEMY JOSE, GOPIKA GOPALAKRISHNAN, SHRUTI BALACHANDRAN, CHITHRA S** to the APJ Abdul Kalam Technological University in partial fulfillment of the requirement for the award of the Degree of Bachelor of Technology in ELECTRONICS AND COMMUNICATION 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.

Project guide	**Project coordinator**	**Head of the department**
Ms. JERRIN YOMAS	**Dr. JAYESH GEORGE**	**Dr. D ANTO SAHAYA DHAS**
Associate Professor	Associate Professor	Professor and HOD
Dept. of ECE	Dept. of ECE	Dept. of ECE
Vimal Jyothi	Vimal Jyothi	Vimal Jyothi
Engineering college Chemperi, Kannur	Engineering college Chemperi, Kannur	Engineering college Chemperi, Kannur

Signatur

Princi

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

BONAFIDE CERTIFICATE

This is to certify that the report entitled **"SOLAR POWERED WATER TRASH COLLECTOR"** submitted by **SAGAR UNNIKRISHNAN, MELVIN JOSEPH, TOMS RAJU** and **VIMAL KUMAR P P** to the APJ Abdul Kalam Technological University in partial fulfillment of the requirements for the award of the Degree of Bachelor of Technology in Electronics and Communication Engineering is a bonafide record of the project work carried out by them under my guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

Project Guide	Project Coordinator	Head of Department
Mr. BINIL KUMAR K	**Dr. JAYESH GEORGE M**	**Dr. D ANTO SAHAYA DHAS**
Assistant Professor	Associate Professor	Professor and Head of the
Department of Electronics and Communication Engineering	Department of Electronics and Communication Engineering	Department of Electronics and Communication Engineering
Vimal Jyothi Engineering College	Vimal Jyothi Engineering College	Vimal Jyothi Engineering College

Signature Not V

Principal.V

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

VIMAL JYOTHI ENGINEERING COLLEGE, CHEMPERI

CERTIFICATE

This is to certify that the report entitled **'HAND GESTURE BASED SECURE MILITARY MISSION'** submitted by **CHAITHRA P PRADEEPAN, DONA CHACKO, NAYANA SAJI, OLIVIA ANN MATHEW, SNEHA SAJEEVAN T** to the APJ Abdul Kalam Technological University in partial fulfillment of the requirements for the award of the Degree of Bachelor of Technology in ELECTRONICS AND COMMUNICATION ENGINEERING is a bonafide record of the project 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.

PROJECT GUIDE	PROJECT COORDINATOR	HEAD OF THE DEPARTMENT
Ms. SUDHARSANA VIJAYAN	Dr. JAYESH GEORGE	Dr. D ANTO SAHAYA DHAS
Assistant Professor	Associate Professor	Professor and HOD
Department of Electronics and Communication Engineering	Department of Electronics and Communication Engineering	Department of Electronics and Communication Engineering
Vimal Jyothi Engineering College Chemperi, Kannur	Vimal Jyothi Engineering College Chemperi, Kannur	Vimal Jyothi Engineering College Chemperi, Kannur

Signat

Princ

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

VIMAL JYOTHI ENGINEERING COLLEGE CHEMPERI

CERTIFICATE

This is to certify that the project report entitled "**AUTONOMOUS DRONE FOR THE DELIVERY OF PHARMACEUTICALS** "submitted by **Ms. ANUSREE P M (VML19EC009), Mr. MUHAMMAD RASHID M P (VML19EC033), Ms. SWATHI LAKSHMI KV (VML19EC051), Mr. ABDUL BASITH C C (VML19EC002)** to the APJ Abdul Kalam Technological University in partial fulfillment of the requirement for the award of the Degree of Bachelor of Technology in **ELECTRONICS AND COMMUNICATION ENGINEERING** is a bonafide 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.

Project guide	**Project coordinator**	**Head of the department**
Ms. GRACE JOHN M	**Dr. JAYESH GEORGE M**	**Dr. D ANTO SAHAYADHAS**
Assistant Professor	Associate Professor	Professor and HOD
Dept. ofECE	Dept. ofECE	Dept. ofECE
Vimal Jyothi	Vimal Jyothi	Vimal Jyothi
Engineering college	Engineering college	Engineering college
Chemperi, Kannur	Chemperi, Kannur	Chemperi, Kannur

Signature

Princip

DEPARTMENT OF ELECTRONICS AND COMMUNICATIONS ENGINEERING VIMAL JYOTHI ENGINEERING COLLEGE, CHEMPERI

CERTIFICATE

This is to certify that the project report entitled **"AUTOMATED POWER SUPPLY CHANGEOVER SWITCH FOR ON GRID DOMESTIC SOLAR PLANTS"** submitted by **ASHIK BENNY, MANAS TOM, SIDHARTH K, KRIS P THANKACHAN** to the APJ Abdul Kalam Technological University in partial fulfillment of the requirement for the award of the Degree of Bachelor of Technology in ELECTRONICS AND COMMUNICATION 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.

Project guide

DR. D ANTO SAHAYADHAS
Professor and HOD
Dept. of ECE
Vimal Jyothi
Engineering college
Chemperi, Kannur

Project coordinator

DR. JAYESH GEORGE
Associate Professor
Dept. of ECE
Vimal Jyothi
Engineering college
Chemperi, Kannur

Head of the department

DR. D ANTO SAHAYADHAS
Professor and HOD
Dept. of ECE
Vimal Jyothi
Engineering college
Chemperi, Kannur

Signat

Princ

DEPARTMENT OF ELECTRONICS AND COMMUNICATIONS ENGINEERING VIMAL JYOTHI ENGINEERING COLLEGE, CHEMPERI

CERTIFICATE

This is to certify that the project report entitled **"IMPLEMENTATION OF MARINE COMMUNICATION SYSTEM"** submitted by **ABHIJITH C, ABHINAV KV, AKHIL SUNNY, AKSHAY JANARDHANAN** to the APJ Abdul Kalam Technological University in partial fulfillment of the requirement for the award of the Degree of Bachelor of Technology in ELECTRONIC AND COMMUNICATION 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.

Project guide
Mr. VINOD J THOMAS
Associate Professor
Dept. of ECE
Vimal Jyothi
Engineering college
Chemperi, Kannur

Project coordinator
Dr. JAYESH GEORGE
Associate Professor
Dept. of ECE
Vimal Jyothi
Engineering college
Chemperi, Kannur

Head of the department
Dr. D ANTO SAHAYA DHAS
Professor and HOD
Dept. of ECE
Vimal Jyothi
Engineering college
Chemperi, Kannur

Sign

Pri

Arduino Based Student Attendance System with GSM and Fingerprint

A MINI PROJECT REPORT

Submitted

By

1. **APARNA K (VML20EC015)**
2. **KRISHNAPRIYA V S (VML20EC031)**
3. **GOKUL KRISHNA (VML20EC024)**
4. **GAUTHAM KRISHNA (VML20EC023)**

to

APJ Abdul Kalam Technological University

in partial fulfillment for the award of the degree of

BACHELOR OF TECHNOLOGY
In
ELECTRONICS AND COMMUNICATION ENGINEERING

DEPARTMENT OF ELECTRONICS AND COMMUNICATION

VIMAL JYOTHI ENGINEERING COLLEGE
CHEMPERI

JULY 2023

DECLARATION

We undersigned hereby declare that the project report "**Arduino Based Student Attendance System with GSM and Fingerprint** " , submitted for partial fulfillment of the requirement for the award of degree of Bachelor of Technology of the Kerala Technical University, Kerala is a bonafide work done by us under the supervision of Mr. Adarsh K. S. The submission represents our ideas in our own words and where the ideas or words of others have been included; we have adequately and accurately cited and referenced the original sources. We also declare and we have adhered to ethics of academichonesty 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 fordisciplinary 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 permissionhas 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.

Place : Chemperi
Date : 15-06-2023

APARNA K
KRISHNAPRIYA V S
GOKUL KRISHNA
GAUTHAM KRISHNA

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

BONAFIDE CERTIFICATE

This is to certify that the report entitled **"Arduino Based Student Attendance System with GSM and Fingerprint"** ,submitted by APARNA K, KRISHNAPRIYA V S, GOKUL KRISHNA, and GAUTHAM KRISHNA to the A P J Abdul Kalam Technological University in partial fulfillment of the requirement for the award of the Degree of Bachelor of Technology in **ELECTRONICS AND COMMUNICATION 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 University or Institute for any purpose

PROJECT COORDINATOR	**INTERNAL SUPERVISOR**	**HEAD OF THE DEPARTMENT**
Mr.ADARSH K S	Mr.ADARSH K S	DR.ANTO SAHAYA DHAS
Assistant Professor	Assistant Professor	Professor & HOD
Department of Electronics and Communication Engineering	Department of Electronics and Communication Engineering	Department of Electronics and Communication Engineering
Vimal Jyothi Engineering College Chemper,kannur	Vimal Jyothi Engineering College Chemperi, Kannur	Vimal Jyothi Engineering College Chemperi, Kannur

Signature Not Verified

Principal.VJEC

ACKNOWLEDGEMENT

All glory and honors of God, the Almighty without his grace our project would not have seen the light of success. Motivation is the driving source behind every successful venture. With regard to the completion of this project, we wish to acknowledge the following people who are the source of motivation behind it.

We express our thanks to **Dr. BENNY JOSEPH**, Principal, **Dr. ANTO SAHAYA DHAS**, Head of the Department, Tutors and all the other staffs of Department of Electronics and Communication Engineering, Vimal Jyothi Engineering College, Chemperi, for their valuable suggestion and co-operation.

We wish to extend our heartfelt thanks to our guide and who have been to co-ordinate the project, **Mr. ADARSH K S** Associate Professor in the department of ECE, for his guidance, support and cooperation during the course of this project. Last but not the least we would thank our parents and friends whose encouragementand advice helped us a lot during the period of this work.

ABSTRACT

The Arduino-based student attendance system with GSM and fingerprint technology is a novel approach to automate and streamline the attendance tracking process in educational institutions. This system integrates Arduino, Global System for Mobile Communications (GSM) module, and fingerprint sensor to accurately record and monitor student attendance.The system begins by enrolling the fingerprints of all the students into a database, associating each fingerprint with a unique identifier. When a student arrives at the institution, they place their finger on the fingerprint sensor, which captures their fingerprint image. The Arduino microcontroller processes the image and compares it with the stored fingerprints in the database to identify the student. Once the student is identified, the attendance record is updated in real-time. The Arduino communicates with the GSM module to send an SMS or notification to the designated individuals, such as teachers or parents, informing them about the student's arrival. This instant notification ensures prompt information dissemination and facilitates better monitoring of student attendance. Moreover, the system maintains a comprehensive attendance log, storing all the attendance records in a secure and centralized database. This allows for easy retrieval of attendance data for administrative purposes, such as generating reports, calculating attendance percentages, and identifying patterns or trends.

The Arduino-based student attendance system with GSM and fingerprint technology offers several advantages over traditional manual attendance systems. It eliminates the need for paper-based registers, reduces the chances of proxy attendance, minimizes administrative overhead, and enhances efficiency and accuracy in attendance tracking. In conclusion, this system presents an effective and reliable solution for automating student attendance management in educational institutions, utilizing Arduino, GSM, and fingerprint technology to ensure real-time attendance monitoring and convenient data management.

CONTENTS

CONTENTS

LIST OF FIGURES

ABBREVIATIONS

GSM - Global System for Mobile communication

RTC - Real Time Clock Signal

CHAPTER 1

INTRODUCTION

The Arduino based student attendance system using GSM and fingerprint and sending notification is an innovative solution for managing the attendance records of students in schools, colleges, and other educational institutions. The system uses an Arduino Uno R3 board, a GSM module, a fingerprint scanner, and an LCD display to provide a secure and efficient way of tracking the attendance of students.

Traditionally, attendance management has been a tedious and time-consuming process that requires a lot of manual effort. The use of a GSM module and a notification system also ensures that the user is notified about the attendance records of the students. The user can be notified through SMS or through an LCD display, making it easier for them to manage the attendance records. The attendance system is important role for any organization such as offices, companies, schools, universities and so on. In conventional attendance system, the teachers either call the name or identity number of the students or allow the students to sign on paper. It is not convenient to track the attendance for the increase number of students. So, it can have the problems such as proxy attendance and time consuming. The traditional system can also have the difficulty for manipulating the stationery materials of the attendance record and posting the attendance report to guardians. Biometrics authentication is used for taking attendance of students. The most common used of biometrics authentication methods are fingerprint, facial, iris, voice authentication and so on. In this system, fingerprint authentication method is used to record attendance because it is easy to use, more accuracy and cost effective. The attendance management system is also involved alerting system to perform together with guardians and the authorized person for the students to attend the class regularly. The main purpose of this research work is to make the attendance management system more efficient, secure, portable, easy to use and less time consuming.

Overall, the Arduino based student attendance system using GSM and fingerprint and sending notification provides a secure and efficient way of tracking the attendance of students, making attendance management more efficient and reliable.

1.1 OBJECTIVE

The objective of an Arduino based student attendance system with GSM and fingerprint technology is to create a reliable and efficient system that can accurately record the attendance of students using biometric data and send notifications to relevant parties.

1.2 SCOPE

Traditional methods of taking attendance, such as manual paper-based systems, are time-consuming, prone to errors, and lack accountability. The significance of an Arduino-based student attendance system with GSM and fingerprint lies in its ability to automate attendance-taking, increase accuracy, and reduce teachers' workload. By integrating GSM and fingerprint technologies, the system can record attendance in real-time, allowing teachers and school administrators to monitor and track easily attendance records.

The use of fingerprint technology ensures that attendance records are not falsified, as each student's unique biometric information has been recorded This system also provides added security measures, as only authorized personnel with registered fingerprints can access attendance records. Overall, an Arduino-based student attendance system with GSM and fingerprint has the potential to improve the efficiency and accuracy of attendance tracking, reduce workload for teachers, and enhance overall school security

1.3 DRAWBACK

While fingerprint technology has advanced significantly, there are still certain limitations to be aware of. Factors like dirty fingers, damaged fingerprints, or environmental conditions can impact the accuracy of fingerprint recognition. It's crucial to test and calibrate the system thoroughly to minimize false negatives or false positives.

1.4 APPLICATIONS

1. Schools and Colleges: The system can be used in educational institutions to automate the attendance process. Students can simply scan their fingerprints on the device, and the attendance data will be recorded and sent via GSM to a centralized database or server. This eliminates the need for manual attendance taking and reduces the chances of errors or proxy attendance.
2. Overall, the Arduino-based student attendance system with GSM and fingerprint capabilities offers a versatile solution for automating attendance tracking and management in various educational institutions, training centers, workshops, and other relevant settings.

CHAPTER 2

LITERATURE SURVEY

'Automatic Attendance System using Arduino and GSM Module[1]', published by International Research Journal of Engineering and Technology (IRJET) is a peer-reviewed, open access, Multidisciplinary journal in English for the enhancement of research in various disciplines of Engineering, Science, and Technology. The Prime Focus of the Journal is to publish articles related to the current trends of research. IRJET brings together Scientists, Academician, Engineers, Scholars, and Students of Engineering Science and Technology. Published by Fast Track Publications.

'SMART CLASS BASED ON FINGERPRINT ATTENDANCE SYSTEM AND SMART TV'[2] published by International Research Journal of Engineering and Technology (IRJET) is a peer-reviewed, open access, Multidisciplinary journal in English for the enhancement of research in various disciplines of Engineering, Science, and Technology. The Prime Focus of the Journal is to publish articles related to the current trends of research. IRJET brings together Scientists, Academician, Engineers, Scholars, and Students of Engineering Science and Technology. Published by Fast Track Publications.

'Smart and Secure Fingerprint Attendance System using Arduino UNO with GSM Alert', Authors: Ritam DuttaSiksha, Tenzing Wangmu Tamang, Pranoy Paul, Nitesh Kumar.

Apart from the studies given above, online articles on technology were also read and studied in detail.

2.1 OVERVIEW OF GSM AND FINGERPRINT TECHNOLOGY

An Arduino-based attendance system with GSM and fingerprint functionality combines the power of Arduino microcontrollers, GSM modules for mobile communication, and fingerprint sensors to create a secure and efficient solution for recording student attendance. This type of system offers several advantages over traditional attendance methods, such as paper-based sign-in sheets or RFID cards. Here's an overview of the key components and features of an Arduino-based attendance system with GSM and fingerprint. Arduino Board: The Arduino acts as the central processing unit of the system, controlling and coordinating the various components. Popular Arduino boards like Arduino Uno or Arduino Mega are commonly used for such projects. GSM Module: The GSM module enables communication between the Arduino and the mobile network. It allows the attendance system to send SMS messages or make calls to transmit attendance data to the concerned authorities or database. Fingerprint Sensor Module: A fingerprint sensor module is used to capture and verify the identity of students. It scans and stores fingerprints securely and compares them during attendance verification. Modules like R305 have commonly used fingerprint sensors in Arduino projects.

LCD Display: An LCD display can be integrated to provide visual feedback, such as displaying attendance status, messages, or instructions. Power Supply: The system can be powered either through a USB cable connected to a computer or a dedicated power supply like a battery. The workflow of an Arduino-based attendance system with GSM and fingerprint generally involves the following steps: Initialization: The system is initialized by setting up the necessary configurations for the Arduino, GSM module, and fingerprint sensor module. Enrollment: Students' fingerprints are enrolled and stored in the fingerprint sensor module's database. During enrollment, each student's fingerprint is scanned multiple times to ensure accurate recognition. Verification: When a student wants to mark their attendance, they place their finger on the fingerprint sensor. The fingerprint module compares the scanned fingerprint with the enrolled fingerprints to verify the student's identity. Attendance Recording: Upon successful verification, the Arduino records the student's attendance by storing the relevant data locally or transmitting it via the GSM module. This data can include the student's ID, timestamp, and attendance status. Communication: If the system is configured with a GSM module, it can send attendance data to a remote server or database using SMS messages or by making calls. This enables real-time monitoring and analysis of attendance records.

Feedback and Display: The system can provide visual feedback on an LCD display, indicating successful or unsuccessful verification, attendance status, or any relevant messages.

2.2 GSM AND FINGERPRINT TECHNOLOGY

GSM (Global System for Mobile Communications) and fingerprint technology are two distinct technologies used in different areas. GSM is a digital cellular network technology that is widely used for mobile communication around the world. It is the most commonly used standard for mobile phones. Here are some key points about GSM: GSM allows voice and data communication over a wireless cellular network. It uses digital modulation techniques to transmit and receive signals. GSM operates on different frequency bands, such as 900 MHz and 1800 MHz (in Europe) or 850 MHz and 1900 MHz (in the Americas).

It provides features like call forwarding, call waiting, and caller ID.

GSM SIM (Subscriber Identity Module) cards are used to authenticate and identify users on the network. GSM has evolved over the years to support higher data transfer rates with technologies like GPRS (General Packet Radio Service), EDGE (Enhanced Data Rates for GSM Evolution), and eventually 3G, 4G, and 5G.

Fingerprint technology refers to the use of fingerprints for identification and authentication purposes. It relies on the unique patterns present at an individual's fingertips. Here's some information about fingerprint technology: Fingerprint recognition is a biometric authentication method that matches an individual's fingerprint against a pre-recorded fingerprint template. The pattern of ridges and valleys on the fingertip is unique to each person, making fingerprints a reliable form of identification. Fingerprint scanners capture the fingerprint image using various methods like optical, capacitive, or ultrasonic sensors.

The captured image is then processed to extract key features and create a digital representation of the fingerprint, often called a fingerprint template.

During authentication, the fingerprint presented is compared to the stored templates to determine a match. Fingerprint technology is widely used for access control systems, unlocking smartphones, identification in forensic investigations, and various security applications. While both GSM and fingerprint technology are used in the field of telecommunications and security, they serve different purposes. GSM is a cellular network technology for communication, while fingerprint technology is biometric authentication method

2.3 GSM AND FINGERPRINT PROTOCOL

GSM (Global System for Mobile Communications) and fingerprint protocols are two distinct concepts in the field of telecommunications and biometrics, respectively. Let's discuss each of them separately:

GSM (Global System for Mobile Communications):
GSM is a standard protocol used for digital cellular networks. It is the most widely used mobile communication technology globally and supports voice calls, text messaging (SMS), and data services. The GSM protocol defines how mobile devices, such as smartphones, communicate with the cellular network infrastructure.
Key features of the GSM protocol include:

Frequency bands: GSM operates on various frequency bands, including 900 MHz and 1800 MHz in most parts of the world, and 850 MHz and 1900 MHz in North America.
Multiple access scheme: GSM uses a time-division multiple access (TDMA) scheme to allow multiple users to share the same frequency band.
Encryption: GSM incorporates encryption algorithms to provide security for voice and data transmissions.
Handover: GSM supports seamless handover of mobile devices between different base stations as users move within the network coverage area.
Fingerprint Protocol:
Fingerprint protocols are related to biometric authentication systems that use fingerprints as a means of identification. These protocols define the process of capturing, encoding, transmitting, and matching fingerprint data for authentication purposes.
Typically, fingerprint protocols involve the following steps:

Enrollment: During this stage, a person's fingerprint is captured using a fingerprint scanner, and relevant features are extracted and encoded into a unique template.
Transmission: The encoded fingerprint template is transmitted securely to a server or a matching device for comparison and authentication.
Matching: The received fingerprint template is compared against a database of pre-registered templates to determine a match or non-match.
Authentication: Based on the matching result, the system decides whether the fingerprint belongs to an authorized individual, granting or denying access accordingly.
Common fingerprint protocols include:

Automatic Fingerprint Identification System (AFIS): Used for large-scale fingerprint identification, typically in law enforcement applications.

Fast Identity Online (FIDO): A set of standards that enables secure and password less authentication using various biometric methods, including fingerprints.

It's important to note that GSM and fingerprint protocols serve different purposes within their respective domains and are not directly related to each other. GSM focuses on mobile communication, while fingerprint protocols are used for biometric authentication.

CHAPTER 3

COMPONENTS REQUIRED

In order to implement any product there are some tools required to do it. And the tools that used to implement a product are called the implementation tool.

The software and hardware tool can be pointed out as:

3.1 HARDWARE REQUIREMENT

3.1.1 ARDUINO UNO

General description

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer

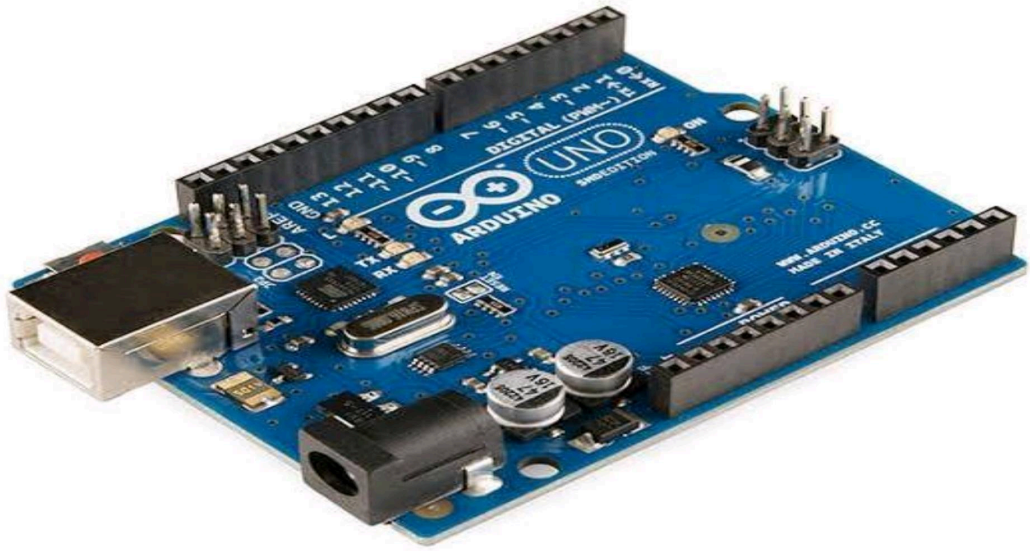


Fig.3.1.1: Arduino Uno

with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega8U2 programmed as a USB-to-serial converter. An Italian "Uno" means "One" in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno

and version 1.0 will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform for a comparison with previous versions, see the index of Arduino boards.

Product description

Microcontroller	-	ATmega328
Operating Voltage	-	5V Supply
Voltage (recommended)	-	7-12V
Maximum supply voltage	-	20V
Digital I/O Pins	-	14 (of which 6 provide PWM output)
Analog Input Pins	-	6
DC Current per I/O Pin	-	40 mA
DC Current for 3.3V Pin	-	50 mA
Flash Memory	-	32 KB (ATmega328) of which 0.5 KB used by boot loader
SRAM	-	2 KB (ATmega328)
EEPROM	-	1 KB (ATmega328)
Clock Speed	-	16 MHz

GSM MODULE

An Arduino-based student attendance system with GSM (Global System for Mobile Communications) and fingerprint technology is a project that utilizes various components and technologies to automate the process of recording and managing student attendance.

Arduino Board: The project starts with an Arduino microcontroller board, such as Arduino Uno or Arduino Mega, which serves as the main controller for the system.Fingerprint Sensor: A fingerprint sensor module is used to capture and verify the fingerprints of students. It can store multiple fingerprints in its database and match them with the input fingerprint to determine the identity of the student. GSM Module: A GSM module is integrated with the Arduino board to enable communication via mobile networks. This module allows the system to send SMS notifications or make calls to notify parents or authorized personnel about student attendance. LCD Display: An LCD (Liquid Crystal Display) is used to provide a visual interface for displaying relevant information, such as attendance

status, student names, or system messages. Keypad: A keypad can be connected to the Arduino to enable an input mechanism for system configuration or to allow administrators to access specific features. Database: The system maintains a database to store student information, including their names, IDs, and attendance records. The database can be implemented using an external storage device, such as an SD card or an EEPROM (Electrically Erasable Programmable Read-Only Memory).

Attendance Management: The Arduino board, along with the fingerprint sensor, keeps track of student attendance. When a student places their finger on the sensor, the system matches the fingerprint with the stored fingerprints in the database and registers the attendance accordingly. Communication and Notifications: The GSM module enables the system to send SMS notifications to parents or authorized individuals about student attendance. This can be done in real-time or at specific intervals, depending on the system's configuration. User Interface: The LCD display provides an interface for users to interact with the system. It can show attendance details, menu options, system status, and other relevant information. System Configuration: The keypad, along with the LCD display, can be used to configure system settings, such as adding or removing students, setting attendance thresholds, or updating contact information. Overall, this Arduino-based student attendance system with GSM and fingerprint technology offers an automated and efficient solution for recording and managing student attendance, providing real-time notifications to relevant stakeholders and simplifying administrative tasks in educational institutions.

Features

1. Arduino UNO R3 Development Board- 1x
2. Fingerprint Sensor (R305/R307 Fingerprint Sensor Module) - 1x
3. RTC Module (DS3231/DS1307 Real Time Clock Module) - 1x
4. 16x2 LCD Display - 1x
5. GSM Module - 1x
6. Push Buttons - 4x
7. 5V Buzzer - 1x
8. LED 5mm LED Any Color - 1x
9. Connecting Wires - 20x

3.1.2 FINGERPRINT SENSOR

An Arduino-based student attendance system with GSM and fingerprint functionality can be implemented using the following components: Arduino board: Choose an Arduino board compatible with your requirements. Arduino Uno or Arduino Mega are commonly used for such projects. Fingerprint sensor module: You will need a fingerprint sensor module that is compatible with Arduino. There are several options available, such as the Adafruit Fingerprint Sensor or the GT-511C3 Fingerprint Scanner. GSM module: To send attendance data via SMS, you will need a GSM module such as SIM800L or SIM900A. Make sure the module supports the frequency bands used by your cellular network provider. LCD display (optional): You can use an LCD display to show relevant information like attendance status or instructions to users. A popular choice is the 16x2 LCD display. Connecting wires: To establish connections between Arduino, fingerprint sensor, GSM module, and other components, you will need jumper wires or breadboard wires.

Once you have gathered the necessary components, follow these general steps to create the attendance system: Hardware connections: Connect the fingerprint sensor module to the Arduino board using the appropriate pins (usually serial or I2C).

Connect the GSM module to the Arduino board using the serial communication pins.

If you're using an LCD display, connect it to the Arduino following the specifications of the chosen display.

Software setup: Install the required libraries for the fingerprint sensor and GSM module. You can find these libraries on the Arduino website or in the Arduino Library Manager.

Write a code that initializes the fingerprint sensor and communicates with it using the provided library functions.

Implement the code to interface with the GSM module, enabling SMS functionality.

Attendance system logic: Design the logic for storing and retrieving student attendance data. This could involve using arrays, databases, or other storage methods.

Define functions to enroll new students' fingerprints, verify attendance, and store/update attendance records. Implement a user interface to guide students through the attendance process (e.g., displaying instructions on the LCD display).

Testing and deployment: Upload the code to the Arduino board.

Connect the system to a power source and ensure all components are working correctly.

Test the enrollment, verification, and attendance recording processes.

Make any necessary adjustments and improvements based on testing results.

Once satisfied with the system's functionality, deploy it in your desired environment.

Remember to consider security measures to protect the attendance data and ensure system

reliability. Additionally, make sure to comply with relevant legal and privacy regulations when collecting and storing biometric data.

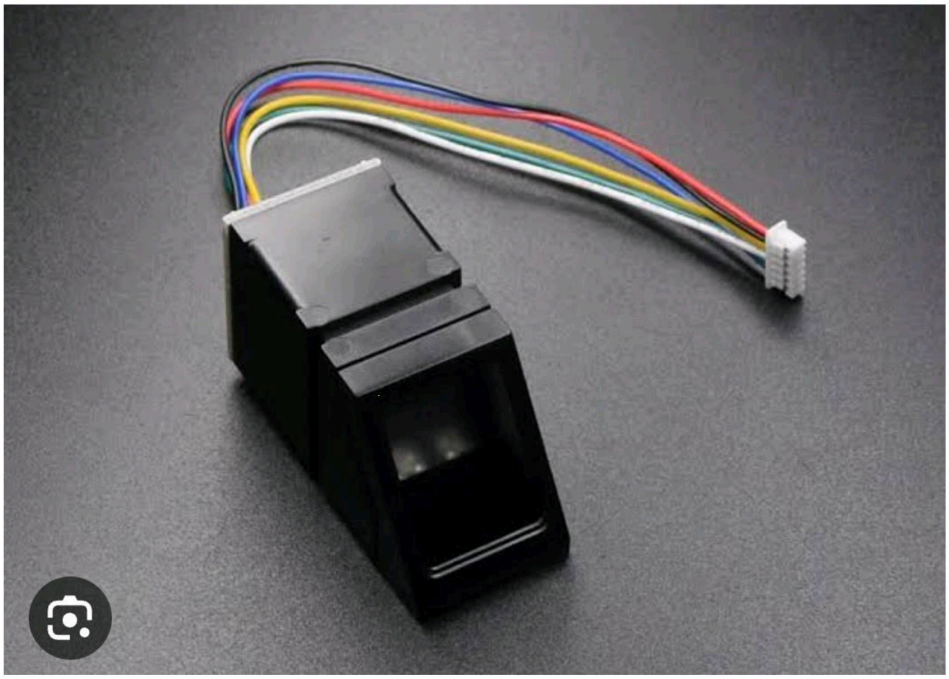


Fig.3.1.2: Finger print sensor

Operation of Fingerprint sensors:

An Arduino-based student attendance system with a GSM module and fingerprint sensor can be designed to record attendance using fingerprints and communicate the data through the GSM network. Here's an overview of how the fingerprint sensor operates within such a system: The skin on the palms or our hands have a special pattern called friction ridges that help us grab things effectively without slyping. These patterns consist of ridges and valleys arranged in certain configurations and is unique for each individual. Our finger tips also have them as you can see from the above image. Benefit comes in contact with a surface, the ridges make strong contact with the surface. When we strongly grab something. The moisture, oil, dirt, and dead skin cells on our finger can attached to the surface of the material, leaving an impression we call a fingerprint. Various forensic methods involving the use Chemicals are used to extract such fingerprints from crime scenes and are called a latent fingerprints. But an optical fingerprint scanner works a bit differently. So
fingerprint processing includes two parts : fingerprint enrollment and fingerprint matching (the matching can be 1:1or 1:N) when enrolling, user needs to enter the finger two times. The system will process the two time finger images, generate a template of the finger based on processing results and store them template. When matching user and is the finger through optical sensor and system will generated a template of the finger and compare it with templates of the finger library. For 1:1 matching, system will come where the live finger with a specific in the module, for 1:N matching, or searching, system will search the wall finger library for the matching finger in both circumstances, system will return the matching result, success or failure.

Features

When selecting a fingerprint sensor for an Arduino-based student attendance system with GSM and fingerprint capabilities, it's important to consider the following features:

Compatibility with Arduino: Ensure that the fingerprint sensor is compatible with the Arduino board you are using. Check for libraries or example codes available that support the sensor's integration with Arduino.

Image Quality and Accuracy: Look for a fingerprint sensor that provides good image quality and accuracy in capturing and matching fingerprints. Higher image quality enhances the accuracy of fingerprint recognition, resulting in more reliable attendance recording.

Template Storage Capacity: Consider the number of fingerprint templates the sensor can store. It should have sufficient capacity to store the fingerprints of all the students in your system. Some

sensors offer onboard storage, while others may require external storage options like an SD card.

Enrollment and Verification Speed: Check the enrollment and verification speed of the sensor. Faster processing speeds can ensure efficient enrollment and quick attendance verification, minimizing any delays in the attendance recording process.

Communication Interface: The fingerprint sensor should have a suitable communication interface for connecting with the Arduino board. Common interfaces include UART (Universal Asynchronous Receiver-Transmitter) or I2C (Inter-Integrated Circuit).

Power Requirements: Consider the power requirements of the fingerprint sensor, ensuring it can be adequately powered by the Arduino board or using a separate power supply if needed. Some sensors may have low-power modes to conserve energy.

Robustness and Durability: Look for a fingerprint sensor that is robust and durable, especially if the attendance system will be used in a school environment where it may be subject to frequent use and handling.

Documentation and Support: Ensure that the fingerprint sensor has good documentation and support available, including datasheets, user manuals, and access to a supportive community or technical support from the manufacturer. This will aid in the integration and troubleshooting process.

Consider researching and comparing different fingerprint sensor options to find the one that best meets your specific requirements for the Arduino-based student attendance system with GSM and fingerprint functionality.

GSM MODULE

In an Arduino-based student attendance system that incorporates GSM and fingerprint modules, the GSM module is responsible for sending attendance data to a remote server or notifying concerned individuals about the attendance status. Here's a general overview of how the GSM module would operate in such a system, Initialization: At the beginning, the Arduino initializes the GSM module by setting up the necessary communication parameters, such as baud rate and serial communication.SIM Card Handling: The GSM module requires a SIM card to establish a cellular connection. You need to ensure that the SIM card is properly inserted into the GSM module and is activated with a valid mobile network subscription. Network Registration: The GSM module attempts to connect to a mobile network by searching for available networks and registering with the one it finds. This step is crucial for establishing a cellular data connection. Establishing Data Connection: Once the GSM

module is registered with a network, it establishes a data connection using the network's internet services. This connection allows the Arduino to transmit data over the cellular network. Fingerprint Verification: As part of the attendance system, students would typically verify their identity using a fingerprint scanner connected to the Arduino. The Arduino communicates with the fingerprint module to capture and verify the fingerprint data of each student. Attendance Recording: After successful fingerprint verification, the Arduino records the attendance data (such as student ID or name) along with the timestamp. Data Transmission: The Arduino uses the GSM module to send the attendance data to a remote server or database. It packages the attendance data into a suitable format (e.g., JSON or CSV) and sends it over the cellular data connection established by the GSM module. Server Communication: The remote server receives the attendance data and processes it accordingly. It may store the attendance records in a database or perform any other required operations. Notification (optional): In addition to data transmission, the GSM module can be used to send notifications to concerned individuals, such as parents or teachers, about the attendance status of a student. This can be done through SMS or other communication channels supported by the GSM module.

Features

An Arduino-based student attendance system with GSM and fingerprint capabilities typically includes the following features:

GSM Module: The GSM module allows the Arduino to communicate with a cellular network. It enables sending and receiving SMS messages or making phone calls to transmit attendance data or receive commands remotely. Fingerprint Sensor: A fingerprint sensor is used to capture and store unique fingerprint data for each student. It can authenticate and verify the identity of students during the attendance process.LCD Display: An LCD display is commonly used to show relevant information such as attendance status, messages, and instructions. It provides a user-friendly interface for students and administrators. Keypad: A keypad can be incorporated to enable additional user interactions, such as entering PIN codes or selecting menu options. Real-time Clock (RTC) Module: An RTC module ensures accurate timekeeping in the attendance system. It provides the current date and time information to record attendance records with precise timestamps. Microcontroller (Arduino): The Arduino microcontroller serves as the core of the attendance system. It processes input from various sensors, controls the display, communicates with the GSM module, and manages the overall attendance system logic. Memory: The Arduino may utilize non-volatile memory (EEPROM) or an external storage device (such as an SD card) to store attendance records, student information, and other relevant data. Power Supply: The system requires a stable power supply, which can be provided by a battery or an external power source. It should be sufficient to power the Arduino, GSM module, fingerprint sensor, display, and other components. Attendance Database: The attendance system may incorporate a database to store attendance records. This database can be hosted locally on the Arduino or remotely on a server or cloud platform, depending on the system's design and

requirements. Integration with Software: The attendance system can be complemented with software running on a computer or server to manage attendance records, generate reports, and perform administrative tasks. The Arduino communicates with the software via the GSM module to transmit attendance data or receive instructions..

Figure 3.1.3

RTC Module

An RTC (Real-Time Clock) module is a crucial component in an Arduino-based student attendance system with GSM and fingerprint capabilities. The RTC module provides accurate timekeeping even when the Arduino is powered off or reset. It ensures that the attendance records are timestamped correctly, enabling proper tracking and management of student attendance. Arduino Board: The Arduino acts as the main controller of the attendance system. It interfaces with various modules and sensors to gather and process data. RTC Module: The RTC module is connected to the Arduino and provides real-time clock functionality. It includes an internal clock and a backup battery to ensure that the time is always accurate. The Arduino communicates with the RTC module to retrieve the current time and date for timestamping attendance records. Fingerprint Sensor: The fingerprint sensor is used to identify individual students. Each student has a unique fingerprint registered in the system. When a student places their finger on the sensor, the Arduino captures the fingerprint data, processes it, and matches it with the registered fingerprints in the database. GSM Module: The GSM module enables communication with a cellular network. It allows the Arduino to send SMS messages or make calls to notify administrators or parents about student attendance. For example, when a student is marked absent, an automated SMS can be sent to the student's parents. Attendance Database: The Arduino stores attendance records in an appropriate format, such as a microSD card or an external

EEPROM. The attendance records consist of the student's identification information, timestamp, and attendance status (present or absent). The database can be accessed later for generating reports or analyzing attendance patterns.

User Interface: The system may include a display module, such as an LCD screen, to provide a user interface. It allows administrators to view attendance data, register new students, or perform system configuration tasks. Overall, the Arduino-based student attendance system with GSM and fingerprint capabilities utilizes an RTC module to ensure accurate timekeeping, while the fingerprint sensor and GSM module enable student identification and communication functionalities, respectively. The system can be expanded or customized further based on specific requirements

Features

In an Arduino-based student attendance system with GSM and fingerprint capabilities, the RTC module offers several features that contribute to the overall functionality of the system. Here are some key features of the RTC module in this context: Accurate Timekeeping: The RTC module provides precise timekeeping, ensuring that attendance records are accurately timestamped. It includes a real-time clock chip with a built-in oscillator that maintains accurate time even when the Arduino is powered off or restarted.

Date and Time Retrieval: The Arduino communicates with the RTC module to retrieve the current date and time information. This data is used for timestamping attendance records and maintaining a synchronized system time. Backup Battery: The RTC module incorporates a backup battery to ensure continuous timekeeping, even during power outages or when the Arduino is not powered. The backup battery preserves the internal clock and prevents the need for resetting the time after a power interruption. Time Adjustment: The RTC module typically allows for time adjustment. It may provide buttons or other means to set or update the date and time information. This feature enables administrators to synchronize the RTC module with the correct time at the start and to make adjustments if necessary. Alarm Functionality: Some RTC modules include alarm features that can trigger specific actions or events at predefined times. In the attendance system, this could be utilized to generate reminders or notifications for regular attendance tracking or system maintenance tasks. Low Power Consumption: RTC modules are designed to operate with low power consumption, which is essential for energy-efficient systems. This feature helps prolong the battery life and overall system operation. Compatibility with Arduino: RTC modules are readily compatible with Arduino boards, allowing easy integration into the attendance system. They often use standard communication protocols such as I2C or SPI, making it simple to establish communication between the Arduino and the RTC module. By leveraging these features, the RTC module ensures accurate and reliable timekeeping, which is vital for proper attendance tracking and management in the Arduino-based student attendance system with GSM and fingerprint capabilities.

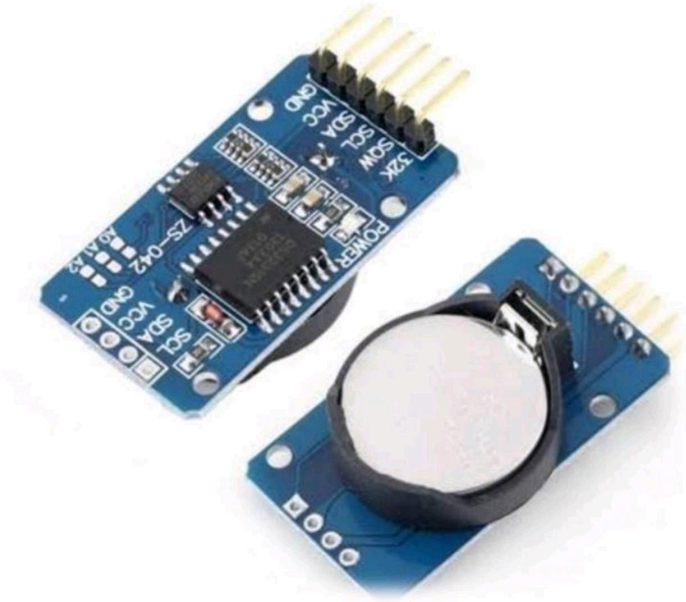


Figure 3.1.4

Buzzer

In an Arduino-based student attendance system with GSM and fingerprint capabilities, a buzzer can be used for various purposes, including providing audible feedback or alerts to administrators, students, or parents. Here's how the buzzer operation can be implemented in such a system: Presence Confirmation: When a student successfully registers their fingerprint and their attendance is marked as "present," the Arduino can trigger the buzzer to emit a short beep or tone. This audible feedback confirms to the student that their attendance has been recorded. Absence Alert: If a student fails to register their fingerprint or their attendance is marked as "absent," the Arduino can activate the buzzer to emit a distinct sound or a continuous beep. This audible alert notifies the student or an administrator that the attendance has not been recorded, prompting them to take the necessary action. System Status Indication: The buzzer can be used to indicate the system's status, such as power on/off, initialization, or error conditions. For example, a series of short beeps can indicate that the system is ready for fingerprint scanning and attendance recording. Low Battery Warning: If the system incorporates a battery-powered setup, the Arduino can monitor the battery level. When the battery charge drops below a certain threshold, the Arduino can trigger the buzzer to emit a specific pattern of beeps or tones, indicating a low battery warning. This alerts administrators to recharge or replace the battery. Emergency Notifications: In critical situations or emergencies, the Arduino can utilize the buzzer to emit a distinctive and continuous alarm sound. For example, if there is a security breach or an unauthorized access attempt, the system can activate the buzzer to draw immediate attention and alert administrators or security personnel. To control the buzzer, the Arduino typically uses a digital output pin. By setting the pin to HIGH or LOW, the Arduino can activate or deactivate the buzzer

accordingly. The tone and duration of the sound can be adjusted based on specific requirements, using functions and libraries available for Arduino programming. Implementing buzzer operation in the Arduino-based student attendance system enhances the user experience by providing audible feedback, alerts, and notifications. It helps ensure proper attendance tracking, system status awareness, and response to critical events.

Features

The buzzer in an Arduino-based student attendance system with GSM and fingerprint functionality serves as an audible indicator to provide feedback or alerts to the users. Here are some features and functions that the buzzer can have: Attendance Confirmation: The buzzer can produce a short beep sound to indicate successful attendance registration when a student's fingerprint is recognized and verified. Error Indication: In case of an error or unsuccessful attendance registration, the buzzer can produce a specific pattern or a continuous beep sound to alert the user about the issue. Low Attendance Alert: The buzzer can be programmed to sound an alert when the attendance count falls below a specified threshold, indicating that a minimum number of students are present. This can help in identifying potential issues or taking necessary actions. GSM Network Status: The buzzer can provide audio feedback about the status of the GSM network connection. For example, it can produce a specific pattern or sound to indicate network connectivity or signal strength. Initialization Feedback: When the attendance system starts up or resets, the buzzer can produce a unique sound or pattern to indicate that the system is ready for operation. Emergency Alerts: In case of emergency situations or specific events, the buzzer can be used to produce a distinct alarm sound to notify the students or staff members about the situation and prompt them to take appropriate actions. Customizable Sound Patterns: The buzzer can be programmed to produce different sound patterns or melodies, allowing customization based on specific requirements or preferences. Volume Control: Some buzzer modules come with volume control options, allowing adjustment of the sound level according to the environment or user preferences. These are some of the features that can be implemented with the buzzer in an Arduino-based student attendance system with GSM and fingerprint functionality. The actual implementation may vary depending on the specific hardware components and programming logic used in the system.

Figure 3.1.5

3.1.3 LCD

An electronic device that is used to display data and the message is known as LCD 16×2. As the name suggests, it includes 16 Columns & 2 Rows so it can display 32 characters (16×2=32) in total & every character will be made with 5×8 (40) Pixel Dots. So the total pixels within this LCD can be calculated as 32 x 40 otherwise 1280 pixels.

16 X2 displays mostly depend on multi-segment LEDs. There are different types of displays available in the market with different combinations such as 8×2, 8×1, 16×1, and 10×2, however, the LCD 16×2 is broadly used in devices, DIY circuits, electronic projects due to less cost, programmable friendly & simple to access.

pin configuration of LCD 16 X 2

- Pin1 (Ground): This pin connects the ground terminal.
- Pin2 (+5 Volt): This pin provides a +5V supply to the LCD
- Pin3 (Ground): This pin connects the ground terminal.
- Pin4 – Data Pin 8
- Pin5 (Ground): This pin connects the ground terminal.
- Pin6 – Data pin 9
- Pin7– No connection
- Pin8 – No connection
- Pin9 – No connection
- Pin10 : No connection
- Pin11- Data pin10
- Pin12-Data pin11
- Pin13-Data pin12
- Pin14-Data pin13
- Pin15 (+5 Volt): This pin provides a +5V supply to the LCD
- Pin 16 (Ground): This pin connects the ground terminal

Fig.3.1.6: 16×2 LCD Display

Features

- The operating voltage of this display ranges from 4.7V to 5.3V
- The display bezel is 72 x 25mm
- The operating current is 1mA without a backlight
- PCB size of the module is 80L x 36W x 10H mm
- HD47780 controller
- LED color for backlight is red
- Number of columns – 16
- Number of rows – 2
- Number of LCD pins – 16
- Characters – 32
- It works in 4-bit and 8-bit modes
- Pixel box of each character is 5×8 pixel
- Font size of character is 0.125Width x 0.200height

3.1.4 LED (LIGHT EMITTING DIODE)

.A light-emitting diode (LED) is a semiconductor light source. LEDs are used as indicator lamps in many devices, and are increasingly used for lighting. Introduced as a practical electronic component in 1962, early LEDs emitted low-intensity red light, but modern versions are available across the visible, ultraviolet and infrared wavelengths, with very high brightness. When a light emitting diode is forward biased (switched on), electrons are able to recombine with holes within the device, releasing energy in the form of photons. This effect is called electroluminescence and the color of the light (corresponding to the energy of the photon) is determined by the energy gap of the semiconductor. An LED is usually small in area (less than 1 mm2), and integrated optical components are used to shape its radiation pattern and assist in reflection. LEDs present many advantages over incandescent light sources including lower energy consumption, longer lifetime, improved robustness, smaller size, faster switching, and greater durability and reliability. LEDs powerful enough for room lighting are relatively expensive and require more precise current and heat management than compact fluorescent lamp sources of comparable output, The red LED lights up when the sensor is in use

Fig.3.1.7 LED

3.2 SOFTWARE REQUIREMENT

3.2.1 ARDUINO IDE

The Arduino Integrated Development Environment is a cross platform application (for Windows, Linux, macOS) that is written in function from c and C++. It is used to write and upload programs to Arduino compactable boards, but also, with the help of third party cores other vendor development boards.

The Arduino IDE is incredibly minimalistic, yet it provides a near-complete environment for most Arduino-based projects. The top menu bar has the standard options, including “File” (new, load save, etc.), “Edit” (font, copy, paste, etc.), “Sketch” (for compiling and programming), “Tools” (useful options for testing projects), and “Help”. The middle section of the IDE is a simple text editor that where you can enter the program code. The bottom section of the IDE is dedicated to an output window that is used to see the status of the compilation, how much memory has been used, any errors that were found in the program, andvarious other useful messages.

Projects made using the Arduino are called sketches, and such sketches are usually written in a cut-down version of C++ (a number of C++ features are not included). Because programming a microcontroller is somewhat different from programming a computer, there are a number of device-specific libraries (e.g., changing pin modes, output data on pins, reading analog values, and timers). This sometimes confuses users who think Arduino is programmed in an “Arduino language.” However, the Arduino is, in fact, programmed in C++. It just uses unique libraries for the device

3.2.2 C PROGRAMMING

C is a general-purpose computer programming language. It was created in the 1970s by Dennis Ritchie, and remains very widely used and influential. By design, C's features cleanly reflect the capabilities of the targeted CPUs. It has found lasting use in operating systems, device drivers, protocol stacks, though decreasingly for application software, and is common in computer architectures that range from the largest supercomputers to the smallest microcontrollers and embedded systems. A successor to the programminglanguage B, C was originally developed at Bell Labs by Dennis Ritchie between 1972 and 1973 to construct utilities running on Unix. It was applied to re-implementing the kernel of the

Unix operating system. During the 1980s, C gradually gained popularity. It has become one of the most widely used programming languages, with C compilers available for almost all modern computer architectures and operating systems. C has been standardized by ANSI since 1989 (ANSI C) and by the International Organization for Standardization (ISO).C isan imperative procedural language supporting structured programming, lexical variable scope,and recursion, with a static type system. It was designed to be compiled to provide low-level access to memory and language constructs that map efficiently to machine instructions, all with minimal runtime support. Despite its low-level capabilities, the language was designed to encourage cross-platform programming. A standards-compliant C program written with portability in mind can be compiled for a wide variety of computer platforms andoperating systems with few changes to its source code. Since 2000, C has consistently ranked among the top two languages in the TIOBE index, a measure of the popularity of programminglanguages

CHAPTER 4 BLOCK DIAGRAM

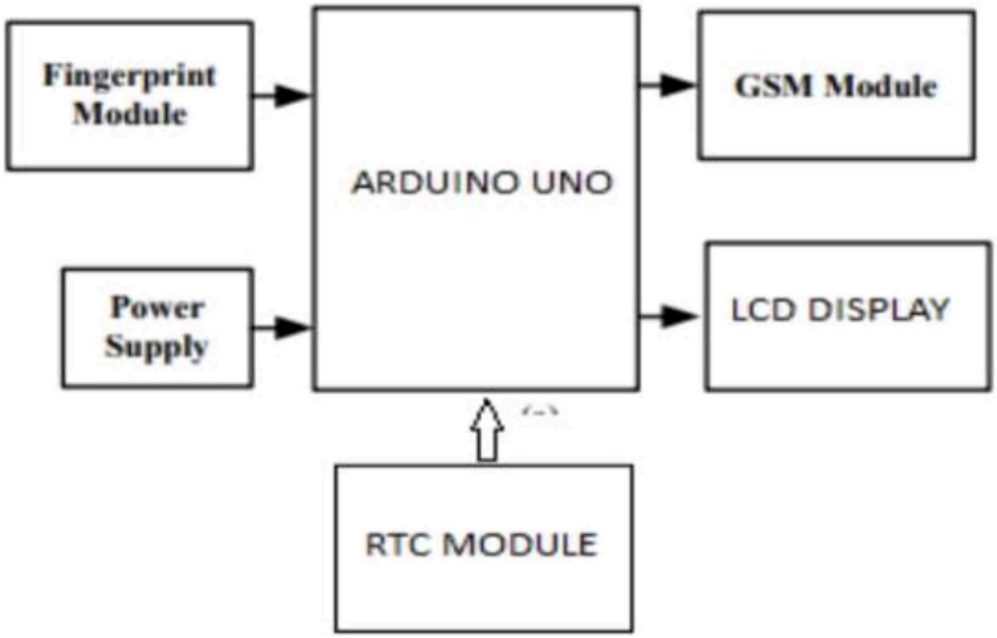


Fig.4.1: General Block Diagram

Explanation of the components:

Fingerprint Sensor Module: This module captures the fingerprint of a student for authentication.

Fingerprint Verification: The captured fingerprint is compared with the stored fingerprint data to verify the student's identity.

Arduino Microcontroller: It acts as the main control unit and processes the fingerprint data and attendance management.

Attendance Management: The Arduino stores the attendance records and manages the attendance system.

GSM Module/Device: This module enables the Arduino to communicate with the GSM network.

SMS Notifications: The Arduino uses the GSM module to send SMS notifications to designated recipients, such as teachers or parents, regarding the student's attendance status.

Database Management: A database is used to store and manage attendance records and student information.

In this system, when a student places their fingerprint on the fingerprint sensor module, the Arduino microcontroller captures and verifies the fingerprint against the stored data. If the verification is successful, the Arduino updates the attendance records in the database. Additionally, the Arduino can send SMS notifications via the GSM module to inform relevant individuals about the student's attendance status.

Please note that the diagram provides a high-level overview of the system architecture, and the actual implementation may involve additional components, such as power supplies, display modules, and communication interfaces.

Detailed Hardware Description

It has an Arduino that controls all the process of the project, push button for enrolling, deleting, selecting IDs and for attendance, a buzzer for alerting. LEDs for indication and LCD to instruct the user and show the resultant messages. As Shawn in the circuit diagram a push button is directly connected to pinA0(ENROL), A1(DEL), A2(UP), A3(DOWN) had dinner with respect to the ground and yellow LED is connected at a digital pin D7 of Arduino with a respected to ground through a 1 k resistor. Fingerprint modules RX and TX directly connected at serial pin D2 and D3 (Software Serial) of Arduino. 5V supply is used for powering fingerprint module take and from the Arduino board.A buzzer is also connected at pin A5.A 16*2 LCD is configured in 4-bit mode and its RS, EN, D4,D5,D6 and D7 are directly connected to the digital pin D13,D12,D11,D10, D9,and D8 of Arduino.

Software Implementation:

Arduino IDE: You will need Arduino IDE software to write and upload the programming logic on to the arduino uno board.

Adafrutt fingerprint sensor library: used for downloading the data to the serial monitor of the Arduino IDE and for refined capture of the fingerprints.

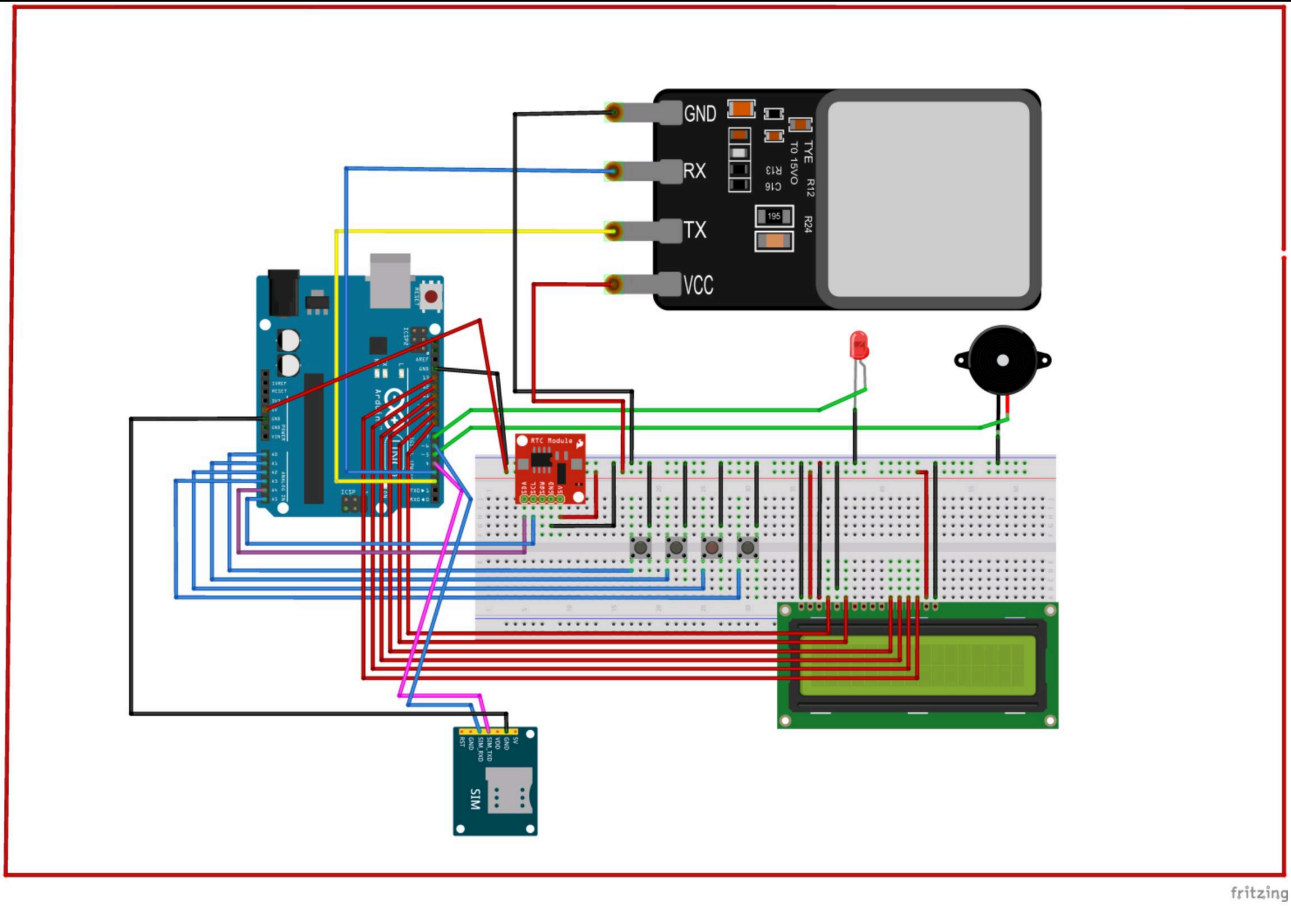


Fig 4.3 Circuit diagram

CHAPTER 5

WORKING

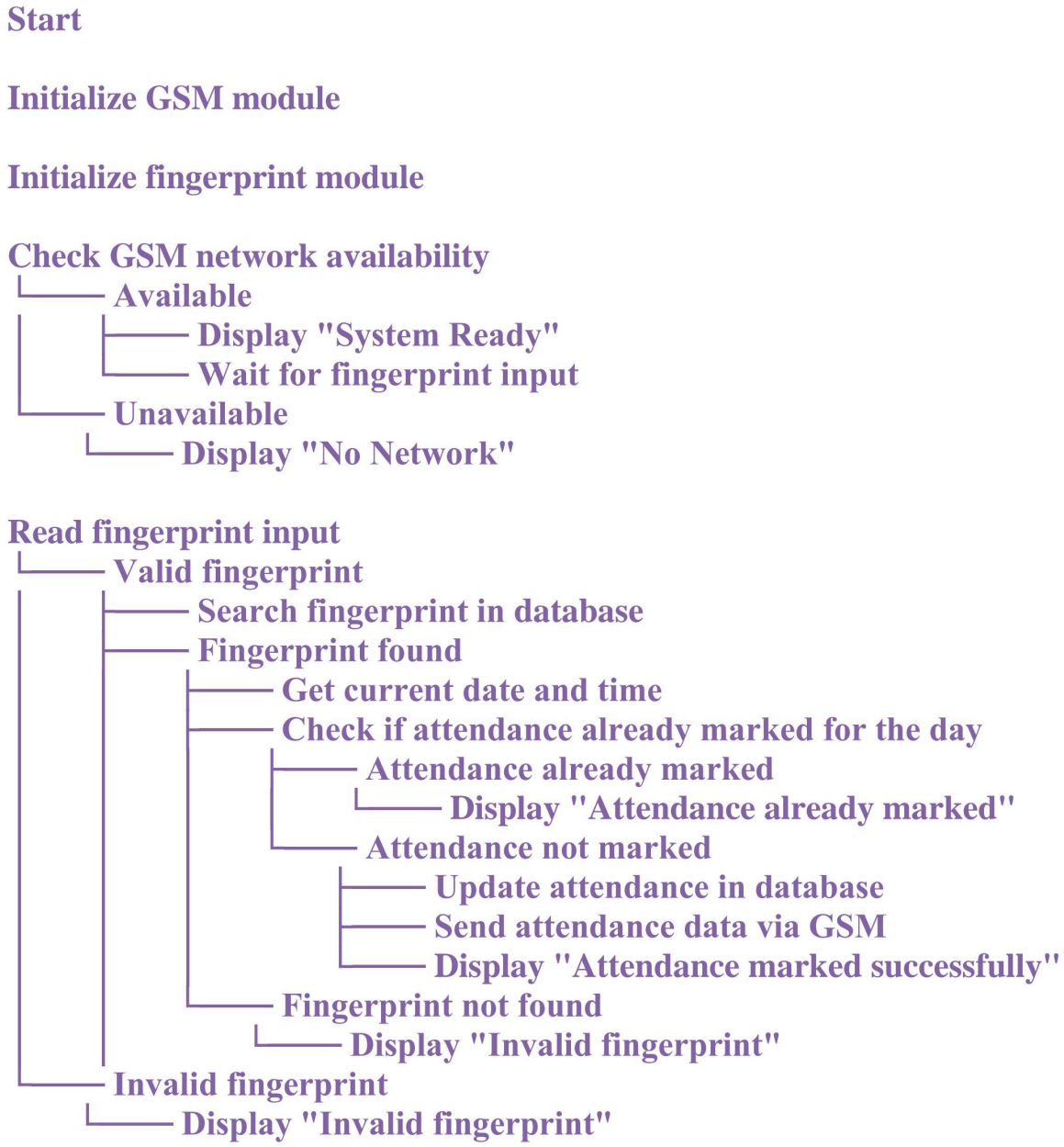


Fig 5.1.Flow chart

This flowchart outlines the basic steps of the system. It begins by initializing the GSM module and fingerprint module. Then, it checks if the GSM network is available. If it is, the system displays

"System Ready" and waits for fingerprint input. If the GSM network is unavailable, it displays "No Network." When a fingerprint is read, the system checks if it is a valid fingerprint. If it is valid, it searches for the fingerprint in the database. If the fingerprint is found, it proceeds to check if the attendance has already been marked for the day. If the attendance is already marked, it displays "Attendance already marked." If the attendance is not marked, it updates the attendance in the database, sends the attendance data via GSM, and displays "Attendance marked successfully."

If the fingerprint is not found in the database, the system displays "Invalid fingerprint." If the fingerprint is invalid, it displays "Invalid fingerprint."After processing each fingerprint input, the system checks for the next fingerprint input until the process is ended. An Arduino-based student attendance system with GSM and fingerprint functionality can be implemented using the following components and steps:

Components:

Arduino board (e.g., Arduino Uno)
GSM module (e.g., SIM900)
Fingerprint sensor module (e.g., R305)
LCD display
Pushbuttons
Buzzer
Jumper wires
Power supply
Steps:

Connect the Arduino board to your computer and open the Arduino IDE.

Install the necessary libraries for the fingerprint sensor and GSM module. You can find the libraries on the Arduino Library Manager or download them from the respective websites.

Connect the fingerprint sensor module to the Arduino board using jumper wires. Typically, the fingerprint module requires connections to power (VCC and GND) and data (TX and RX). Make sure to cross-connect the TX and RX pins between the Arduino and the fingerprint module.

Connect the GSM module to the Arduino board. The GSM module requires connections to power (VCC and GND) and communication (TX and RX). Connect the TX pin of the GSM module to the RX pin of the Arduino and the RX pin of the GSM module to the TX pin of the Arduino.

Connect the LCD display to the Arduino board using the appropriate connections for data (SDA and SCL) and power (VCC and GND). Refer to the datasheet of your specific LCD display for pin details.

Connect pushbuttons to the Arduino board to serve as input for attendance marking. You might use buttons for "Mark Present," "Mark Absent," and other necessary functions.

Connect a buzzer to the Arduino board, which can be used to provide audio feedback or alerts.

Write the Arduino code to control the attendance system. This involves initializing the fingerprint sensor, setting up the GSM module, handling LCD display, and managing button input. The code should include functionality to enroll and store fingerprints, compare fingerprints for authentication, send attendance data via SMS using the GSM module, and display relevant information on the LCD.

Upload the code to the Arduino board and verify that there are no errors.

Power the Arduino board using an appropriate power supply (USB or external).

Test the system by enrolling fingerprints, marking attendance using the pushbuttons, and verifying that the attendance data is being sent correctly via SMS.

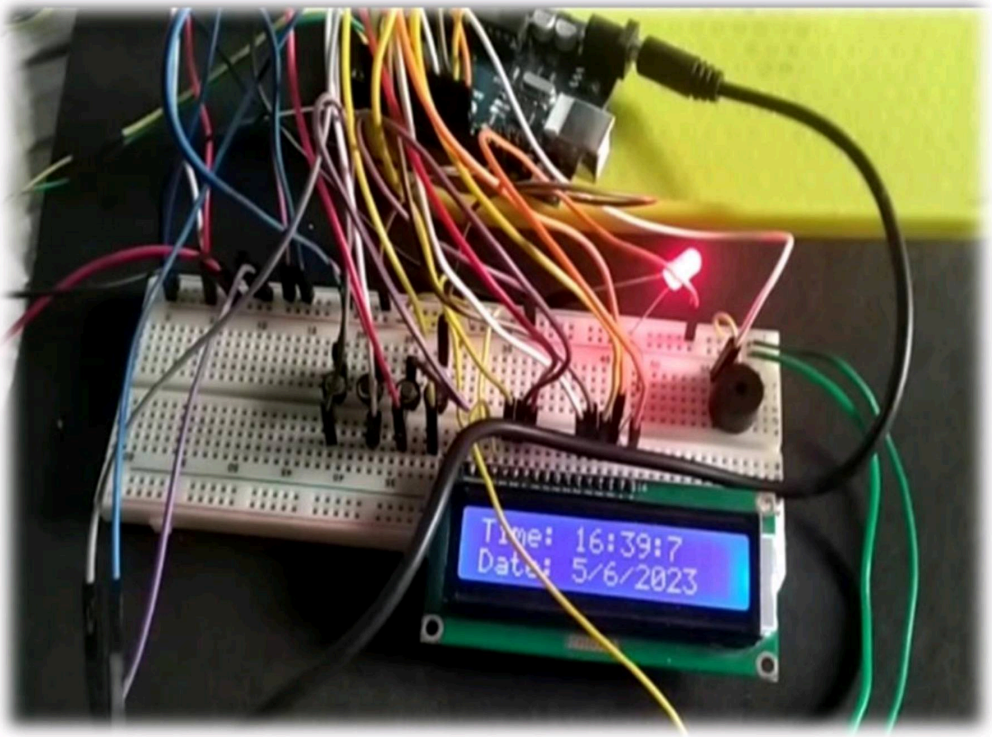


Fig 5.2 Working model

CHAPTER 6

RESULT

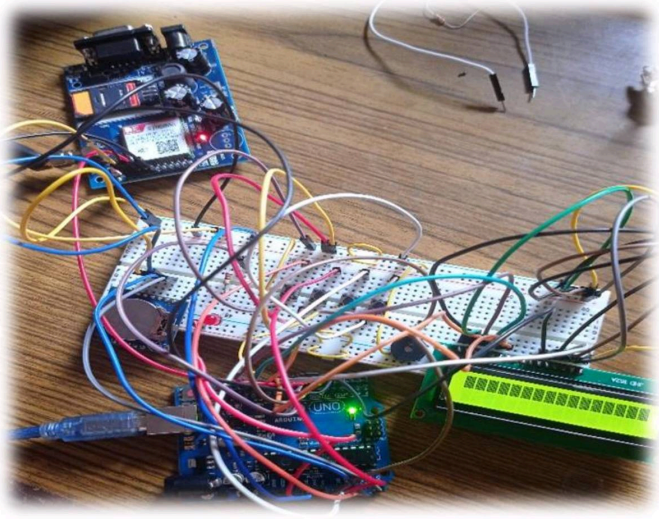


Fig 6.1 LCD Display

The final result of the Arduino based student attendance system using that can record the attendance of students and send a notification to a designed phone number via SMS.

one of the main findings of these project is that the fingerprint sensor module can be challenging to set up and may require some trouble shooting. Additionally, the GSM module may require a SIM card and active phone plan to send SMS messages, which can add to the cost of the project. However, over these project demonstrate the capabilities of the Arduino platform and its potential for building practical solutions to Real world problems.

CHAPTER 7

CONCLUSION

In conclusion, the Arduino-based student attendance system with GSM and fingerprint technology is an innovative mini project that offers an efficient and secure way to manage student attendance. By combining Arduino, GSM, and fingerprint recognition technologies, this system provides several benefits.Firstly, the system ensures accurate attendance tracking. The fingerprint recognition feature eliminates the possibility of proxy attendance, ensuring that only authorized individuals can mark their attendance. This enhances the reliability of attendance records, reducing the chances of errors or fraudulent activities. Secondly, the integration of GSM technology allows for real-time communication and data transfer. Attendance data can be instantly sent to a central database or a designated server, enabling immediate access to attendance records for administrators, teachers, and parents. This real-time feature enhances transparency and enables timely interventions when required. Moreover, the Arduino platform provides a flexible and customizable framework for implementing the attendance system. It allows for easy integration with other hardware components and sensors, facilitating future enhancements or modifications based on specific requirements. The Arduino community also offers extensive resources, tutorials, and libraries, making it accessible for beginners and experienced developers alike. Additionally, the project can serve as a learning opportunity for students interested in embedded systems, microcontrollers, and sensor integration. It provides hands-on experience in programming, circuit design, and system integration, fostering practical skills and knowledge in the field of electronics and automation. However, it is important to note that the success and effectiveness of the Arduino-based student attendance system rely on various factors such as the accuracy and reliability of the fingerprint sensor, GSM network availability, and proper implementation of the system. Additionally, the system's scalability and integration with existing infrastructure should be considered for larger educational institutions. Overall, this mini project demonstrates the potential of Arduino and related technologies in creating practical solutions for managing student attendance. It combines the convenience of GSM communication, the security of fingerprint recognition, and the flexibility of the Arduino platform to offer a reliable and efficient system for educational institutions.

REFERENCE

1. Aniebiet (2017) Design of RFID Based Automatic Attendance Management System, Unpublished final year Project, Department of Electrical and Electronics Engineering, University of Maiduguri.

2. Parvathy, V. R. Raj and M. Reddy,(2011). RFID based exam hall maintenance system, IJCA Special Issue on Artificial Intelligence
Techniques-Novel Approaches& Practical Applications (AIT).

3.M. Stephen, E. S. Johnson and R. W John, (2012). RFID Security Technology and Applications, Cambridge University Press.

4.E. Geoffrey, (2012). Automatic Access Control System using Students Identification Card based on RFID Technology, Unpublished Thesis, Faculty Of Electrical Engineering, University of Technologi, Malaysia.

5.Zhang and A. K. Jain, (2004). RFID Based Passport System, First International Conference on Biometric Authentication (ICBA), Hong Kong.

6.K. D. Mahajan, P. Pandey and B. K Pandher (2010). Application of RFID Technology in Libraries and Role of Librarian. pp. 109-118.

APPENDIX

PROGRAMMING

TRANSMITTER PROGRAM:

```
#include "Adafruit_Fingerprint.h" //fingerprint library header file
#include<EEPROM.h> //command for storing data
#include<LiquidCrystal.h> //lcd header file
LiquidCrystal lcd(8,9,10,11,12,13);
#include <SoftwareSerial.h>
SoftwareSerial fingerPrint(2, 3); //for tx/rx communication between arduino & r305 fingerprint sensor

#include <Wire.h>
#include "RTClib.h" //library file for DS3231 RTC Module
RTC_DS3231 rtc;

uint8_t id;
Adafruit_Fingerprint finger = Adafruit_Fingerprint(&fingerPrint);

#define register_back 14
#define delete_ok 15
#define forward 16
#define reverse 17
#define match 5
#define indFinger 7
#define buzzer 5

#define records 10 // 10 for 10 user

int user1,user2,user3,user4,user5,user6,user7,user8,user9,user10;

DateTime now;
SoftwareSerial SIM900(4, 6);
void setup()
{
delay(1000);
lcd.begin(16,2);
Serial.begin(9600);
SIM900.begin(19200);
pinMode(register_back, INPUT_PULLUP);
pinMode(forward, INPUT_PULLUP);
pinMode(reverse, INPUT_PULLUP);
pinMode(delete_ok, INPUT_PULLUP);
pinMode(match, INPUT_PULLUP);
pinMode(buzzer, OUTPUT);
pinMode(indFinger, OUTPUT);
digitalWrite(buzzer, LOW);
if(digitalRead(register_back) == 0)
{
digitalWrite(buzzer, HIGH);
delay(500);
digitalWrite(buzzer, LOW);
```

```
lcd.clear();
lcd.print("Please wait !");
lcd.setCursor(0,1);
lcd.print("Downloding Data");

Serial.println("Please wait");
Serial.println("Downloding Data..");
Serial.println();

Serial.print("S.No. ");
for(int i=0;i<records;i++)
{
digitalWrite(buzzer, HIGH);
delay(500);
digitalWrite(buzzer, LOW);
Serial.print(" User ID");
Serial.print(i+1);
Serial.print(" ");
}
Serial.println();
int eepIndex=0;
for(int i=0;i<30;i++)
{
if(i+1<10)
Serial.print('0');
Serial.print(i+1);
Serial.print(" ");
eepIndex=(i*7);
download(eepIndex);
eepIndex=(i*7)+210;
download(eepIndex);
eepIndex=(i*7)+420;
download(eepIndex);
eepIndex=(i*7)+630;
download(eepIndex);
eepIndex=(i*7)+840;
download(eepIndex);
eepIndex=(i*7)+1050;
download(eepIndex);
eepIndex=(i*7)+1260;
download(eepIndex);
eepIndex=(i*7)+1470;
download(eepIndex);
eepIndex=(i*7)+1680;
download(eepIndex);
Serial.println();
}
}
if(digitalRead(delete_ok) == 0)
{
lcd.clear();
lcd.print("Please Wait");
lcd.setCursor(0,1);
lcd.print("Reseting.....");
for(int i=1000;i<1005;i++)
EEPROM.write(i,0);
for(int i=0;i<841;i++)
EEPROM.write(i, 0xff);
lcd.clear();
lcd.print("System Reset");
delay(1000);
```

```
}

lcd.clear();
lcd.print(" Fingerprint ");
lcd.setCursor(0,1);
lcd.print("Attendance System");
delay(2000);
lcd.clear();

digitalWrite(buzzer, HIGH);
delay(500);
digitalWrite(buzzer, LOW);
for(int i=1000;i<1000+records;i++)
{
if(EEPROM.read(i) == 0xff)
EEPROM.write(i,0);
}

finger.begin(57600);
Serial.begin(9600);
lcd.clear();
lcd.print("Finding Module..");
lcd.setCursor(0,1);
delay(2000);
if (finger.verifyPassword())
{
Serial.println("Found fingerprint sensor!");
lcd.clear();
lcd.print(" Module Found");
delay(2000);
}
else
{
Serial.println("Did not find fingerprint sensor :(");
lcd.clear();
lcd.print("Module Not Found");
lcd.setCursor(0,1);
lcd.print("Check Connections");
while (1);
}

if (! rtc.begin())
Serial.println("Couldn't find RTC");

// rtc.adjust(DateTime(F(_DATE), F(TIME_)));

if (rtc.lostPower())
{
Serial.println("RTC is NOT running!");
// following line sets the RTC to the date & time this sketch was compiled
rtc.adjust(DateTime(2018, 6, 7, 11, 0, 0));
// This line sets the RTC with an explicit date & time, for example to set
// June 7, 2018 at 11am you would call:
// rtc.adjust(DateTime(2018, 6, 7, 11, 0, 0));
}
lcd.setCursor(0,0);
lcd.print(" Press Match to ");
lcd.setCursor(0,1);
lcd.print(" Start System");
delay(3000);
```

```
user1=EEPROM.read(1000);
user2=EEPROM.read(1001);
user3=EEPROM.read(1002);
user4=EEPROM.read(1003);
user5=EEPROM.read(1004);
lcd.clear();
digitalWrite(indFinger, HIGH);

}

void loop()
{
now = rtc.now();
lcd.setCursor(0,0);
lcd.print("Time: ");
lcd.print(now.hour(), DEC);
lcd.print(':');
lcd.print(now.minute(), DEC);
lcd.print(':');
lcd.print(now.second(), DEC);
lcd.print(" ");
lcd.setCursor(0,1);
lcd.print("Date: ");
lcd.print(now.day(), DEC);
lcd.print('/');
lcd.print(now.month(), DEC);
lcd.print('/');
lcd.print(now.year(), DEC);
lcd.print(" ");
delay(500);
int result=getFingerprintIDez();
if(result>0)
{
  SIM900.println("AT+CMGF=1"); // Set SMS mode to text
  delay(1000);
  SIM900.println("AT+CMGS=\"+1234567890\""); // Replace +1234567890 with the phone number you
want to send the SMS to
  delay(1000);
  SIM900.println("Attendance #" + String(result) + " registered!"); // Replace this with the message you want
to send
  delay(1000);
  SIM900.println((char)26); // End the SMS message with a Ctrl+Z character
  delay(1000);
digitalWrite(indFinger, LOW);
digitalWrite(buzzer, HIGH);
delay(100);
digitalWrite(buzzer, LOW);
lcd.clear();
lcd.print("ID:");
lcd.print(result);
lcd.setCursor(0,1);
lcd.print("Please Wait....");
delay(1000);
attendance(result);
lcd.clear();
lcd.print("Attendance ");
lcd.setCursor(0,1);
lcd.print("Registered");
delay(1000);
digitalWrite(indFinger, HIGH);
return;
```

```
}
checkKeys();
delay(300);
}

// dmyyhms - 7 bytes
void attendance(int id)
{
int user=0,eepLoc=0;
if(id == 1)
{
eepLoc=0;
user=user1++;
}
else if(id == 2)
{
eepLoc=210;
user=user2++;
}
else if(id == 3)
{
eepLoc=420;
user=user3++;
}
else if(id == 4)
{
eepLoc=630;
user=user4++;
}
else if(id == 5)
{
eepLoc=0;
user=user5++;
}
else if(id == 6)
{
eepLoc=840;
user=user5++;
}
else if(id == 7)
{
eepLoc=1050;
user=user7++;
}
else if(id == 8)
{
eepLoc=1260;
user=user8++;
}
else if(id == 9)
{
eepLoc=1470;
user=user9++;
}
else if(id == 10)
{
eepLoc=1680;
user=user8++;
}
/*else if(id == 5) // fifth user
{
```

```
eepLoc=840;
user=user5++;
}*/
else
return;

int eepIndex=(user*7)+eepLoc;
EEPROM.write(eepIndex++, now.hour());
EEPROM.write(eepIndex++, now.minute());
EEPROM.write(eepIndex++, now.second());
EEPROM.write(eepIndex++, now.day());
EEPROM.write(eepIndex++, now.month());
EEPROM.write(eepIndex++, now.year()>>8 );
EEPROM.write(eepIndex++, now.year());

EEPROM.write(1000,user1);
EEPROM.write(1001,user2);
EEPROM.write(1002,user3);
EEPROM.write(1003,user4);
// EEPROM.write(4,user5); // figth user
}

void checkKeys()
{
if(digitalRead(register_back) == 0)
{
lcd.clear();
lcd.print("Please Wait");
delay(1000);
while(digitalRead(register_back) == 0);
Enroll();
}

else if(digitalRead(delete_ok) == 0)
{
lcd.clear();
lcd.print("Please Wait");
delay(1000);
delet();
}
}

void Enroll()
{
int count=1;
lcd.clear();
lcd.print("Enter Finger ID:");

while(1)
{
lcd.setCursor(0,1);
lcd.print(count);
if(digitalRead(forward) == 0)
{
count++;
if(count>records)
count=1;
delay(500);
}

else if(digitalRead(reverse) == 0)
```

```
{
count--;
if(count<1)
count=records;
delay(500);
}
else if(digitalRead(delete_ok) == 0)
{
id=count;
getFingerprintEnroll();
for(int i=0;i<records;i++)
{
if(EEPROM.read(i) != 0xff)
{
EEPROM.write(i, id);
break;
}
}
return;
}

else if(digitalRead(register_back) == 0)
{
return;
}
}
}

void delet()
{
int count=1;
lcd.clear();
lcd.print("Enter Finger ID");

while(1)
{
lcd.setCursor(0,1);
lcd.print(count);
if(digitalRead(forward) == 0)
{
count++;
if(count>records)
count=1;
delay(500);
}

else if(digitalRead(reverse) == 0)
{
count--;
if(count<1)
count=records;
delay(500);
}
else if(digitalRead(delete_ok) == 0)
{
id=count;
deleteFingerprint(id);
for(int i=0;i<records;i++)
{
if(EEPROM.read(i) == id)
{
```

```
EEPROM.write(i, 0xff);
break;
}
}
return;
}

else if(digitalRead(register_back) == 0)
{
return;
}
}
}

uint8_t getFingerprintEnroll()
{
int p = -1;
lcd.clear();
lcd.print("finger ID:");
lcd.print(id);
lcd.setCursor(0,1);
lcd.print("Place Finger");
delay(2000);
while (p != FINGERPRINT_OK)
{
p = finger.getImage();
switch (p)
{
case FINGERPRINT_OK:
Serial.println("Image taken");
lcd.clear();
lcd.print("Image taken");
break;
case FINGERPRINT_NOFINGER:
Serial.println("No Finger");
lcd.clear();
lcd.print("No Finger Found");
break;
case FINGERPRINT_PACKETRECIEVEERR:
Serial.println("Communication error");
lcd.clear();
lcd.print("Comm Error");
break;
case FINGERPRINT_IMAGEFAIL:
Serial.println("Imaging error");
lcd.clear();
lcd.print("Imaging Error");
break;
default:
Serial.println("Unknown error");
lcd.clear();
lcd.print("Unknown Error");
break;
}
}

// OK success!

p = finger.image2Tz(1);
switch (p) {
case FINGERPRINT_OK:
```

```
Serial.println("Image converted");
lcd.clear();
lcd.print("Image converted");
break;
case FINGERPRINT_IMAGEMESS:
Serial.println("Image too messy");
lcd.clear();
lcd.print("Image too messy");
return p;
case FINGERPRINT_PACKETRECIEVEERR:
Serial.println("Communication error");
lcd.clear();
lcd.print("Comm Error");
return p;
case FINGERPRINT_FEATUREFAIL:
Serial.println("Could not find fingerprint features");
lcd.clear();
lcd.print("Feature Not Found");
return p;
case FINGERPRINT_INVALIDIMAGE:
Serial.println("Could not find fingerprint features");
lcd.clear();
lcd.print("Feature Not Found");
return p;
default:
Serial.println("Unknown error");
lcd.clear();
lcd.print("Unknown Error");
return p;
}

Serial.println("Remove finger");
lcd.clear();
lcd.print("Remove Finger");
delay(2000);
p = 0;
while (p != FINGERPRINT_NOFINGER) {
p = finger.getImage();
}
Serial.print("ID "); Serial.println(id);
p = -1;
Serial.println("Place same finger again");
lcd.clear();
lcd.print("Place Finger");
lcd.setCursor(0,1);
lcd.print(" Again");
while (p != FINGERPRINT_OK) {
p = finger.getImage();
switch (p) {
case FINGERPRINT_OK:
Serial.println("Image taken");
break;
case FINGERPRINT_NOFINGER:
Serial.print(".");
break;
case FINGERPRINT_PACKETRECIEVEERR:
Serial.println("Communication error");
break;
case FINGERPRINT_IMAGEFAIL:
Serial.println("Imaging error");
break;
```

```
default:
Serial.println("Unknown error");
return;
}
}

// OK success!

p = finger.image2Tz(2);
switch (p) {
case FINGERPRINT_OK:
Serial.println("Image converted");
break;
case FINGERPRINT_IMAGEMESS:
Serial.println("Image too messy");
return p;
case FINGERPRINT_PACKETRECIEVEERR:
Serial.println("Communication error");
return p;
case FINGERPRINT_FEATUREFAIL:
Serial.println("Could not find fingerprint features");
return p;
case FINGERPRINT_INVALIDIMAGE:
Serial.println("Could not find fingerprint features");
return p;
default:
Serial.println("Unknown error");
return p;
}

// OK converted!
Serial.print("Creating model for #"); Serial.println(id);

p = finger.createModel();
if (p == FINGERPRINT_OK) {
Serial.println("Prints matched!");
} else if (p == FINGERPRINT_PACKETRECIEVEERR) {
Serial.println("Communication error");
return p;
} else if (p == FINGERPRINT_ENROLLMISMATCH) {
Serial.println("Fingerprints did not match");
return p;
} else {
Serial.println("Unknown error");
return p;
}

Serial.print("ID "); Serial.println(id);
p = finger.storeModel(id);
if (p == FINGERPRINT_OK) {
Serial.println("Stored!");
lcd.clear();
lcd.print(" Finger Stored!");
delay(2000);
} else if (p == FINGERPRINT_PACKETRECIEVEERR) {
Serial.println("Communication error");
return p;
} else if (p == FINGERPRINT_BADLOCATION) {
Serial.println("Could not store in that location");
return p;
} else if (p == FINGERPRINT_FLASHERR) {
```

```
Serial.println("Error writing to flash");
return p;
}
else {
Serial.println("Unknown error");
return p;
}
}

int getFingerprintIDez()
{
uint8_t p = finger.getImage();

if (p != FINGERPRINT_OK)
return -1;

p = finger.image2Tz();
if (p != FINGERPRINT_OK)
return -1;

p = finger.fingerFastSearch();
if (p != FINGERPRINT_OK)
{
lcd.clear();
lcd.print("Finger Not Found");
lcd.setCursor(0,1);
lcd.print("Try Later");
delay(2000);
return -1;
}
// found a match!
Serial.print("Found ID #");
Serial.print(finger.fingerID);
return finger.fingerID;
}

uint8_t deleteFingerprint(uint8_t id)
{
uint8_t p = -1;
lcd.clear();
lcd.print("Please wait");
p = finger.deleteModel(id);
if (p == FINGERPRINT_OK)
{
Serial.println("Deleted!");
lcd.clear();
lcd.print("Finger Deleted");
lcd.setCursor(0,1);
lcd.print("Successfully");
delay(1000);
}

else
{
Serial.print("Something Wrong");
lcd.clear();
lcd.print("Something Wrong");
lcd.setCursor(0,1);
lcd.print("Try Again Later");
delay(2000);
return p;
```

```
}
}

void download(int eepIndex)
{

if(EEPROM.read(eepIndex) != 0xff)
{
Serial.print("T->");
if(EEPROM.read(eepIndex)<10)
Serial.print('0');
Serial.print(EEPROM.read(eepIndex++));
Serial.print(':');
if(EEPROM.read(eepIndex)<10)
Serial.print('0');
Serial.print(EEPROM.read(eepIndex++));
Serial.print(':');
if(EEPROM.read(eepIndex)<10)
Serial.print('0');
Serial.print(EEPROM.read(eepIndex++));
Serial.print(" D->");
if(EEPROM.read(eepIndex)<10)
Serial.print('0');
Serial.print(EEPROM.read(eepIndex++));
Serial.print('/');
if(EEPROM.read(eepIndex)<10)
Serial.print('0');
Serial.print(EEPROM.read(eepIndex++));
Serial.print('/');
Serial.print(EEPROM.read(eepIndex++)<<8 | EEPROM.read(eepIndex++));
}
else
{
Serial.print("----------------------------");
}

Serial.print(" ");
}
```

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

BONAFIDE CERTIFICATE

This is to certify that the report entitled **"AUTOMATIC WATER TAP USING ARDUINO"**, submitted by **ABHINAV M, ASHISH MATHEW, AJIMON FRANCIS, SANJAY MANOJ** to the A P J Abdul Kalam Technological University in partial fulfillment of the requirement for the award of the Degree of Bachelor of Technology in **ELECTRONICS AND COMMUNICATION 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 University or Institute for any purpose.

PROJECT COORDINATOR	INTERNAL SUPERVISOR	HEAD OF THE DEPARTMENT
Mr. ADARSH K S	Mr. MANOJ K C	Dr. ANTO SAHAYADHAS
Assistant Professor	Assistant Professor	Professor & HOD
Department of ECE	Department of ECE	Department of ECE
VJEC Chemperi	VJEC Chemperi	VJEC Chemperi

Signature Not Verified

Principal.VJEC

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

BONAFIDE CERTIFICATE

This is to certify that the report entitled "**BLUETOOTH-CONTROLLED FLOOR CLEANING ROBOT** " , submitted by **VAIBHAV S, NIBIN BV, ASWIN DIVAKARAN AND SREEJISHNU PA** to the A P J Abdul Kalam Technological University in partial fulfillment of the requirement for the award of the Degree of Bachelor of Technology in **ELECTRONICS AND COMMUNICATION 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 University or Institute for any purpose.

PROJECT COORDINATOR	INTERNAL SUPERVISOR	HEAD OF THE DEPARTMENT
Mr.ADARSH K S	MR.BINIL KUMAR K	Dr.ANTO SAHAYA DHAS
Assistant Professor	Assistant Professor	Professor & HOD
Department of Electronics and Communication Engineering	Department of Electronics and Communication Engineering	Department of Electronics and Communication Engineering
Vimal Jyothi Engineering College Chemper,kannur	Vimal Jyothi Engineering College Chemperi, Kannur	Vimal Jyothi Engineering College Chemperi, Kannur

Signature Not Verified

Principal.VJEC

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

BONAFIDE CERTIFICATE

This is to certify that the report entitled **"Arduino Based Student Attendance System with GSM and Fingerprint"** ,submitted by APARNA K, KRISHNAPRIYA V S, GOKUL KRISHNA, and GAUTHAM KRISHNA to the A P J Abdul Kalam Technological University in partial fulfillment of the requirement for the award of the Degree of Bachelor of Technology in **ELECTRONICS AND COMMUNICATION 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 University or Institute for any purpose

PROJECT COORDINATOR	**INTERNAL SUPERVISOR**	**HEAD OF THE DEPARTMENT**
Mr.ADARSH K S	Mr.ADARSH K S	Dr.ANTO SAHAYA DHAS
Assistant Professor	Assistant Professor	Professor & HOD
Department of Electronics and Communication Engineering	Department of Electronics and Communication Engineering	Department of Electronics and Communication Engineering
Vimal Jyothi Engineering College Chemper,kannur	Vimal Jyothi Engineering College Chemperi, Kannur	Vimal Jyothi Engineering College Chemperi, Kannur

Signature Not Verified

Principal.VJEC

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

BONAFIDE CERTIFICATE

This is to certify that the report entitled **"Heart Pulse Monitoring And Notification System"**, submitted by AMRUTHENDU K, ANAMIKA P V, ANULAKSHMI C, DEVIKA DINESH E to the APJ Abdul Kalam Technological University in partial fulfillment of the requirement for the award of the Degree of Bachelor of Technology in **ELECTRONICS AND COMMUNICATION 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 University or Institute for any purpose.

PROJECT COORDINATOR	**INTERNAL SUPERVISOR**	**HEAD OF THE DEPARTMENT**
Mr.ADARSH K S	Dr. RO[illegible] V	Dr. ANTO SAHAYADAS
Assistant Professor	Professor	Professor & HOD
Department of Electronics and Communication Engineering	Department of Electronics and Communication Engineering	Department of Electronics and Communication Engineering
Vimal Jyothi Engineering College Chemperi,Kannur	Vimal Jyothi Engineering College Chemperi, Kannur	Vimal Jyothi Engineering College Chemperi, Kannur

Signature Not Verified

Principal.VJEC

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

BONAFIDE CERTIFICATE

This is to certify that the report entitled **"ARDUINO BASED BRIGHTNESS CONTROLLING SYSTEM WITH USING BLUETOOTH MODULE"**, submitted by **MEGHANA SUMESH M, ALEX DANIEL, KIRAN K, MELWIN PAUL** to the A P J Abdul Kalam Technological University in partial fulfillment of the requirement for the award of the Degree of Bachelor of Technology in **ELECTRONICS AND COMMUNICATION 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 University or Institute for any purpose.

PROJECT COORDINATOR	INTERNAL SUPERVISOR	HEAD OF THE DEPARTMENT
Mr. ADARSH KS	Ms. SHIMNA P K	Dr. ANTO SAHAYADHAS
Assistant Professor	Assistant Professor	Professor & HOD
Department of Electronics and Communication Engineering	Department of Electronics and Communication Engineering	Department of Electronics and Communication Engineering
Vimal Jyothi Engineering College Chemperi, Kannur	Vimal Jyothi Engineering College Chemperi, Kannur	Vimal Jyothi Engineering College Chemperi, Kannur

Signature Not Verified

Principal.VJEC

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

BONAFIDE CERTIFICATE

This is to certify that the report entitled **"SMART DUSTBIN USING ARDUINO ULTRASONIC SENSOR AND SERVO MOTOR"**, submitted by **PARVANA PRADEEP, KANNAN MOHAN, ALFONSA, and ANJIMA TK** to the A P J Abdul Kalam Technological University in partial fulfilment of the requirement for the award of the Degree of Bachelor of Technology in **ELECTRONICS AND COMMUNICATION ENGINEERING** is a Bonafede 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 University or Institute for any purpose

PROJECT COORDINATOR	**INTERNAL SUPERVISOR**	**HEAD OF THE DEPARTMENT**
Mr. ADARSH K S Assistant Professor Department of Electronics and Communication Engineering Vimal Jyothi Engineering College Chemperi,kannur	Mr.VINOD J THOMAS Assistant Professor Department of Electronics and Communication Engineering Vimal Jyothi Engineering College Chemperi,kannur	Dr.ANTO SAHAYA DHAS Professor & HOD Department of Electronics and Communication Engineering Vimal Jyothi Engineering Chemperi,Kannur

Signature Not Verified

Principal.VJEC

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

BONAFIDE CERTIFICATE

This is to certify that the report entitled "**WOMEN SAFETY SYSTEM USING AURDINO UNO MICROCONTROLLER**", submitted by **ALAIDA THOMAS, SARATH SASEENDRAN, THOMAS GEORGE, VISHNU PRIYA K** to the A P J Abdul Kalam Technological University in partial fulfillment of the requirement for the award of the Degree of Bachelor of Technology in **ELECTRONICS AND COMMUNICATION 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 University or Institute for any purpose.

PROJECT COORDINATOR	INTERNAL SUPERVISOR	HEAD OF THE DEPARTMENT
Mr. ADARSH K S	Ms. LEKSHMY S	Dr. ANTO SAHAYADHAS
Assistant Professor	Assistant Professor	Professor & HOD
Department of Electronics and Communication Engineering	Department of Electronics and Communication Engineering	Department of Electronics and Communication Engineering
Vimal Jyothi Engineering College Chemperi, Kannur	Vimal Jyothi Engineering College Chemperi, Kannur	Vimal Jyothi Engineering College Chemperi, Kannur

Signature Not Verified

Principal.VJEC

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

VIMAL JYOTHI ENGINEERING COLLEGE

CHEMPERI, KANNUR -2023

CERTIFICATE

*This is to certify that the report entitled "**HAND GESTUR CONTROLLED ROBOT**", submitted by **ALAN PMATHEW, BOBIT BENNY, BINIL KURIAN,MATHEW MJ** to the A P J Abdul Kalam Technological University in partial fulfillment of the requirement for the award of the Degree of Bachelor of Technology in **ELECTRONICS AND COMMUNICATION ENGINEERING** is bonafide record of the project work carried out by them under our guidance and supervision. This reportin any form has not been submitted to any University or Institute for any purpose.*

Project Guide	Project Coordinator	Head of Department
Miss. Ann Mathew	**Mr. Adarsh K S**	**Dr. Anto Sahaya Dhas**
Assistant Professor	Assistant Professor	Professor & HOD
Department of ECE	Department of ECE	Department of ECE
VJEC Chemperi	VJEC Chemperi	VJEC Chemperi

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

BONAFIDE CERTIFICATE

This is to certify that the report entitled "**AUTOMATIC ROOM LIGHTS USING ARDUINO AND PIR SENSOR**" , **submitted by ABHINAYA HARINDRAN, ASHWIN AJITH, HELNA SAJI** and **SANJU PS** to the A P J Abdul Kalam Technological University in partial fulfillment of the requirementfor the award of the Degree of Bachelor of Technology in **ELECTRONICS AND COMMUNICATION 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 University or Institute for any purpose

PROJECT COORDINATOR	**INTERNAL SUPERVISOR**	**HEAD OF THE DEPARTMENT**
Mr. ADARSH K S	Ms. Jerrin Yomas	Dr. ANTO SAHAYA DHAS
Assistant Professor	Associate Professor	Professor & HOD
Department of Electronics and Communication Engineering	Department of Electronics and Communication Engineering	Department of Electronics and Communication Engineering
Vimal Jyothi Engineering College Chemperi, Kannur	Vimal Jyothi Engineering College Chemperi, Kannur	Vimal Jyothi Engineering College Chemperi, Kannur

Signature Not Verified

Principal.VJEC

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

BONAFIDE CERTIFICATE

This is to certify that the report entitled **"ACTIVE MOBILE PHONE DETECTOR"** ,submitted by **ANUSREE C , GOPIKA SANIL , SANDHWANA DAS** and **NAVANEETH V** to the A P J Abdul Kalam Technological University in partial fulfillment of the requirement for the award of the Degree of Bachelor of Technology in **ELECTRONICS AND COMMUNICATION 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 University or Institute for any purpose

PROJECT COORDINATOR	INTERNAL SUPERVISOR	HEAD OF THE DEPARTMENT
Mr.ADARSH K S	MS.GRACE JOHN M	Dr.ANTO SAHAYA DHAS
Assistant Professor	Assistant Professor	Professor & HOD
Department of Electronics and Communication Engineering	Department of Electronics and Communication Engineering	Department of Electronics and Communication Engineering
Vimal Jyothi Engineering College Chemper,kannur	Vimal Jyothi Engineering College Chemperi, Kannur	Vimal Jyothi Engineering College Chemperi, Kannur

Signature Not Verified

Principal.VJEC

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

BONAFIDE CERTIFICATE

This is to certify that the report entitled **"BLUETOOTH BASED HOME AUTOMATION SYSTEM USING ARDUINO "** , submitted by AJAY BINU , AKASH BENNY , C P VARSHA, PRANEETHA A K to the A P J Abdul Kalam Technological University in partial fulfillment of the requirement for the award of the Degree of Bachelor of Technology in **ELECTRONICS AND COMMUNICATION ENGINEERING** is a bonafide record of the project work carried out by them under our guidance and superyision. This report in any form has not been submitted to any University or Institute for any purpose.

PROJECT COORDINATOR	**INTERNAL SUPERVISOR**	**HEAD OF THE DEPARTMENT**
Mr. ADARSH K S	Ms. BINDU SEBASTIAN	Dr. ANTO SAHAYADHAS
Assistant Professor	Associate Professor	Professor & HOD
Department of Electronics and Communication Engineering	Department of Electronics and Communication Engineering	Department of Electronics and Communication Engineering
Vimal Jyothi Engineering College	Vimal Jyothi Engineering College	Vimal Jyothi Engineering College
Chemperi , Kannur	Chemperi ,Kannur	Chemperi , Kannur

Signature Not Verified

Principal.VJEC

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

VIMAL JYOTHI ENGINEERING COLLEGE, CHEMPERI

CERTIFICATE

This is to certify that the Project Report entitled **"RFID DOOR LOCK, Door Lock System Using Arduino Uno & RFID RC522 Module"**, is a bona fide record of the Project done by **KSHEERA SAJEESH (VML20EC032), PRANAV N (VML20EC040), NAVYA M (VML20EC037), SREERAG K P (VML20EC053)** under our guidance towards the partial fulfilment of the requirements for the award of the Degree of Bachelor of technology in Electronics & communication Engineering of the APJ Abdul Kalam Technological University through Vimal Jyothi Engineering College, Chemperi.

COORDINATOR	INTERNAL GUIDE	HEAD OF DEPARTMENT
Mr. ADARSH K S	**Ms. ANUSHA CHACKO**	**Dr. D ANTO SAHAYA DHAS**
Assistant Professor	Assistant Professor	Professor & HOD
Department of ECE	Department of ECE	Department of ECE
VJEC, Chemperi	VJEC, Chemperi	VJEC, Chemperi

Signature Not Verified

Principal.VJEC

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

BONAFIDE CERTIFICATE

This is to certify that the report entitled "**WATER QUALITY MONITORING AND NOTIFICATION SYSTEM**", submitted by **HARICHANDANA D, JOHNS JIJI, RONEX PALLATH** and **SANDRA ELIZEBATH ALEX** to the A P J Abdul Kalam Technological University in partial fulfillment of the requirement for the award for the Degree of Bachelor of Technology in **ELECTRONICS AND COMMUNICATION 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 University or Institute for any purpose.

PROJECT COORDINATOR	**INTERNAL SUPERVISOR**	**HEAD OF THE DEPARTMENT**
Mr. ADARSH K S	Mis. SUDHARSANA VIJAYAN	Dr. ANTO SAHAYADHAS
Assistant Professor	Assistant Professor	Professor & HOD
Department of Electronics and Communication Engineering	Department of Electronics and Communication Engineering	Department of Electronics and Communication Engineering
Vimal Jyothi Engineering College Chemper, kannur	Vimal Jyothi Engineering College Chemper, kannur	Vimal Jyothi Engineering College Chemper, kannur

Signature Not Verified

Principal.VJEC