B.N.M. Institute of Technology

An Autonomous Institution under VTU

Approved by AICTE, Accredited as Grade A Institution by NAAC till 31.12.2026.
All Eligible UG branches – CSE, ECE, EEE, ISE & Mech. Engg. Accredited by NBA till 30.06.2025
Post box no. 7087, 27th cross, 12th Main, Banashankari 2nd Stage, Bengaluru- 560070, INDIA
Ph: 91-80- 26711780/81/82 Email: principal@bnmit.in, www.bnmit.org

INTRODUCTION TO IOT (22ETC115)

(Project Based Learning Course)

PROJECT REPORT

ON

"BI-DIRECTIONAL VISITOR COUNTER USING ARDUINO"

by

ARYA KRISHNA	**22IS007**
PRADYUMNA M	**22IS030**
PRAJWAL ATHREYAS S	**22IS032**

Under the guidance of
Sudarshan
Asst. Professor
Dept. of ECE
BNMIT

B.N.M. Institute of Technology

An Autonomous Institution under VTU

Approved by AICTE, Accredited as Grade A Institution by NAAC till 31.12.2026.
All Eligible UG branches – CSE, ECE, EEE, ISE & Mech. Engg. Accredited by NBA till 30.06.2025
Post box no. 7087, 27th cross, 12th Main, Banashankari 2nd Stage, Bengaluru- 560070, INDIA
Ph: 91-80- 26711780/81/82 Email: principal@bnmit.in, www.bnmit.org

Department of Electronics and Communication Engineering

Vidyayāmruthamashnuthe

CERTIFICATE

Certified that the Project entitled **"BI-DIRECTIONAL VISITOR COUNTER USING ARDUINO"** carried out by **Arya Krishna(22IS007), Pradyumna M(22IS030),** and **Prajwal Athreyas S(22IS032),** bonafide students of **I semester,** during the year **2022-2023,** for the fulfillment of the academic requirements for the Project Based Learning Course **Introduction to IOT (22ETC115).**

The Project report has been approved as it satisfies the academic requirements in respect to the course.

Sudarshan	**Dr. P. A. Vijaya**	**Dr.S.Y.Kulkarni**
Asst. Professor	Professor and Head	Additional Director
Dept. of ECE	Dept. of ECE	BNMIT
BNMIT, Bangalore	BNMIT, Bangalore	Bangalore

External Examination:

Sl. No.	Name of the Examiners	Signature and date
1		
2		

Abstract

A bidirectional visitor counter is a device that counts the number of people entering and exiting a particular area. It is commonly used in public places such as malls, museums, and transportation terminals to keep track of the number of visitors. The counter consists of two sensors, one placed at the entrance and the other at the exit, which are connected to a central processing unit. The counter works by detecting the movement of people through the sensors. When a person enters the area, the sensor at the entrance is triggered and sends a signal to the central processing unit, which increments the count by one. Similarly, when a person leaves the area, the sensor at the exit is triggered, and the count is decremented by one. The bidirectional counter has several advantages over a unidirectional counter, such as being able to provide more accurate data on the number of visitors, including those who leave and come back. It also helps in identifying the peak hours of visitor traffic, which can aid in planning for staffing, security, and other operational needs. The counter can be designed using different technologies such as infrared, ultrasonic, or radiofrequency identification (RFID) sensors. The choice of technology depends on the specific needs of the area where the counter will be used, such as the distance between the sensors, the number of visitors expected, and the layout of the space. Overall, a bidirectional visitor counter is an essential tool for managing visitor traffic and improving the overall visitor experience in public places. By providing accurate data and insights, it enables effective planning and decision-making, leading to better resource allocation and operational efficiency.

Acknowledgment

We would like to place on record our sincere thanks and gratitude to the concerned people, whose suggestions and words of encouragement has been valuable.

We express our heartfelt gratitude to **BNM Institute of Technology**, for giving us the opportunity to pursue Degree of **INFORMATION SCIENCE AND ENGINEERING ,** and helping us to shape our career. We take this opportunity to thank **Prof. T. J. Rama Murthy**, Director, **Dr. S.Y. Kulkarni,** Additional Director**, Prof. Eishwar N Maanay,** Dean and **Dr. Krishnamurthy G.N.,** Principal for their support and encouragement to pursue this project. We would like to thank **Dr. P. A. Vijaya,** Professor and Head, Dept. of Electronics and Communication Engineering, for her support and encouragement.

We would like to thank our Guide **Sudarshan,** Asst. prof**,** Dept. of Electronics and Communication Engineering**,** who has been the source of inspiration throughout our project work and has provided us with useful information at every stage of our project.

Finally, we are thankful to all the teaching and non-teaching staff of Department of Electronics and Communication Engineering for their help in the successful completion of our project. Last but not the least we would like to extend our sincere gratitude to our parents and all our friends who were a constant source of inspiration.

Arya Krishna

Pradyumna M

Prajwal Athreyas S

Table of Contents

List of Figures

CHAPTER 1
INTRODUCTION

Chapter 1

INTRODUCTION

Introduction:

In this era of automation, every type human intervention is getting reduced bringing in more efficiency and productivity. In this paper we are presenting about automatic digital counters. Over many years counting was done using manual way. In our project we are demonstrating usage of digital counter comprising an Arduino board for better results and less complexity. The sensors used in this circuit are very efficient in terms of execution in comparison to the micro controller counter.

This circuit can be used in many places like classroom halls, auditoriums, libraries, community halls, public transport, work stations etc. It is necessary to monitor the visitors for better human traffic management. The initial method for counting the visitors involved hiring people to stand and manually calculate the number of guests or workers who enters or exits by a specific location. The human counting was unreliable and came at a great cost. It might be very confusing for a person to tally the quantity of individual entering and leaving at the same time. Our intension to design and develop this system is to manage human traffic in a large scale and also conserve the usage of electricity and power resources. Our main aim in this paper adds constructing a visitor counter which will make a controller circuit model to count and calculate the number of people in a building or room at a particular time and all the electrical appliances like air conditioning machine will be turned on and off accordingly. Apart from the usage of counting human entry/exit, even in industries output from various processes could be counted. This can also be further developed or improvised to use in surveillance systems to ensure security at public places.

1.1.Problem Statement:

To create a smart device that counts the number of people entering and leaving a particular place and also monitor it remotely.

1.2. Motivation:

The motivation of the project involves multiple reasons like Convenience, Easy management, Energy efficiency, Security etc.

1.3.Objective:

To provide a simple mechanism to count the number of people entering and leaving through a smart constructed hub involving a sensor, processor.

1.4. Organisation of the project:

Chapter 1: Introduction

Chapter 2: Literature surveys

Chapter 3: Hardware and software requirements

Chapter 4: Methodology

Chapter 5: Results and discussions

Chapter 6: Advantages, Disadvantages and Improvisation

Chapter 7: Conclusion

CHAPTER 2
LITERATURE SURVEY

CHAPTER 2:

LITERATURE SURVEY:

“Development of an Intelligent Bidirectional Visitor Counter System for Buildings" by S. Suresh, et al. This study presents the development of a bidirectional visitor counter system using infrared sensors and a microcontroller. The system includes features such as real-time monitoring and data storage. The authors also evaluate the performance of the system in terms of accuracy and reliability.[1]

"An Automated Bidirectional Visitor Counter System with Automatic Door Control" by P. G. Giri, et al. This study proposes a bidirectional visitor counter system using infrared sensors and a microcontroller. The system includes automatic door control based on the number of visitors in the building. The authors also evaluate the performance of the system in terms of accuracy and response time[2].

"Design and Implementation of a Bidirectional Visitor Counter Using Raspberry Pi" by S. MsHussain , et al. This study presents the design and implementation of a bidirectional visitor counter using Raspberry Pi and ultrasonic sensors. The system includes features such as data storage and remote monitoring. The authors also evaluate the performance of the system in terms of accuracy and energy consumption.[3]

"A Wireless Bidirectional People Counter System Based on ZigBee Networks" by T. Guo, et al. This study proposes a bidirectional visitor counter system based on ZigBee networks and infrared sensors. The system includes features such as wireless communication and real-time monitoring. The authors also evaluate the performance of the system in terms of accuracy and reliability.[4]

“Intelligent Visitor Counter with Bidirectional Feature Using Image Processing" by R. K. Singh and A. Kumar: This paper proposes an intelligent visitor counter system that uses image processing techniques to detect the entry and exit of people. The system uses a camera to capture images of the people and applies image processing algorithms to track their movement. [5]

"A Novel Visitor Counting System Based on Multiple Ultrasonic Sensors" by Jie Xu, et al. (2018). This paper proposes a novel approach to bidirectional visitor counting using multiple ultrasonic sensors. The system is designed to be more accurate and reliable than traditional infrared-based counters, which can be affected by environmental factors such as lighting and temperature. [6]

"Design and Implementation of Bidirectional Visitor Counter using Raspberry Pi" by Akshaykumar R. Shelke and Dr. Nitin M. Varte (2019)This paper describes the development of a bidirectional visitor counter using a Raspberry Pi microcontroller. The system uses infrared sensors to detect people entering and leaving a room and displays the count on an LCD screen. [7]

"Visitor Flow Monitoring and Analysis in a Museum" by Maria Valeria Delgado, et al. (2019)This study examines the use of bidirectional visitor counters in a museum setting to monitor and analyze visitor flow. The authors use data from the counters to create visualizations that show patterns of movement and identify areas of the museum that are particularly popular or congested. [8]

"Real-Time People Counting System Using Image Processing Techniques" by Aparna Sasidharan and K. R. Karthik (2018)This paper presents a bidirectional visitor counting system based on image processing techniques. The system uses cameras to capture images of people entering and leaving a room and analyzes the images to determine the count. The authors demonstrate the accuracy of their system in a real-world environment. [9]

CHAPTER 3

HARDWARE AND SOFTWARE REQUIREMENTS

CHAPTER 3:

HARDWARE AND SOFTWARE REQUIREMENTS:

3.1 Hardware Components:

The hardware requirements for bidirectional visitor counter includes ESP 32 development board, relay, IR Sensors and jumper wires

3.1.1 ESP32 development Board:

The ESP32 is a versatile microcontroller designed for Internet of Things (IoT) applications. It features a dual-core processor, wireless connectivity, and a variety of peripherals, making it an ideal choice for projects that require connectivity, processing power, and low power consumption. The ESP32 is manufactured by Espressif Systems, a semiconductor company based in China.ESP32 development typically involves using the ESP-IDF (Espressif IoT Development Framework), a set of libraries and tools for developing applications for the ESP32. The ESP-IDF includes components for Wi-Fi and Bluetooth connectivity, as well as drivers for common peripherals such as sensors, displays, and SD cards.Developers can use the ESP-IDF with a variety of programming languages, including C, C++, and MicroPython. The development process typically involves creating a project using the ESP-IDF's build system, writing code to interact with the ESP32's peripherals and sensors, and compiling and flashing the code to the ESP32 using a programmer such as the ESP-Prog.The ESP32 also supports the Arduino development environment, which allows developers to use the familiar Arduino IDE and programming language to develop applications for the ESP32. The ESP32 can be programmed using the Arduino core for ESP32, which includes libraries for Wi-Fi and Bluetooth connectivity, as well as support for common peripherals. Overall, the ESP32 is a powerful and flexible platform for developing IoT applications, with a wide range of development tools and programming languages available.

Fig: 3.1.1. ESP32 development Board

GPIO Pins of ESP32:

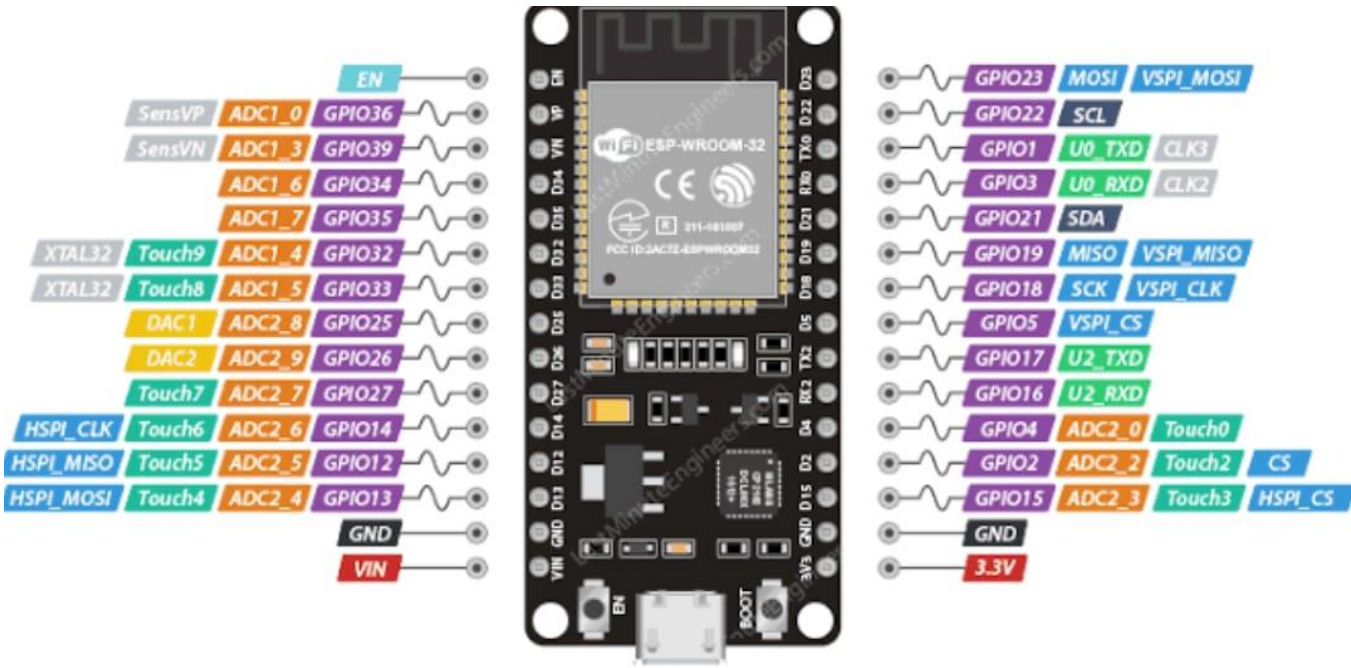

Fig: 3.1.1. GPIO Pins of ESP 32

3.1.2. IR sensors:

IR (Infrared) sensors, also known as IR detectors, are electronic devices that detect the presence or absence of infrared radiation in the surrounding environment. Infrared radiation is a type of electromagnetic radiation that is invisible to the naked eye and has longer wavelengths than visible light.IR sensors work by detecting the amount of infrared radiation emitted or reflected by an object. The sensor consists of an infrared emitter, which emits a beam of infrared radiation, and an infrared receiver, which detects the radiation and converts it into an electrical signal. When an object enters the sensor's field of view, it either reflects or emits infrared radiation, and this change is detected by the receiver.IR sensors are used in a wide range of applications, including proximity sensing, object detection, temperature measurement, and motion detection. They are commonly found in security systems, automated lighting systems, and home appliances.

There are two types of IR sensors: active and passive. Active IR sensors emit infrared radiation and measure the reflected radiation to determine the distance and presence of an object. Passive IR sensors detect the infrared radiation emitted by an object and can be used to detect changes in temperature, such as the body heat of a person or an animal. Overall, IR sensors are an important technology that plays a significant role in many industries and applications.

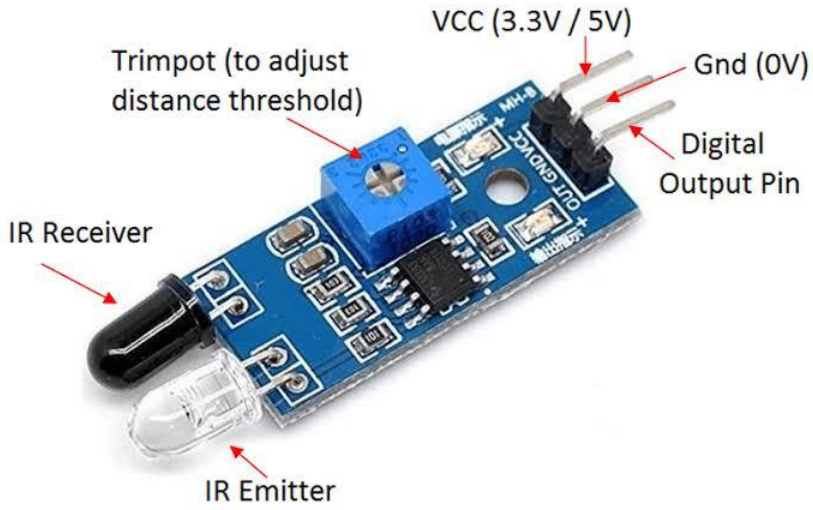

Fig: 3.1.2. IR sensor

3.1.3. Relay Module:

A relay module is an electronic device that allows an electrical circuit to be switched on or off by a low voltage signal. It consists of a relay, which is an electromechanical switch, and a control circuit, which controls the relay using a low voltage signal. Relay modules are commonly used in automation, control, and protection applications, where they are used to control electrical devices such as lights, motors, and solenoids. They are also used in home automation systems, where they can be used to control appliances such as heaters, air conditioners, and fans. Relay modules come in various shapes and sizes, and can be designed for different voltage and current ratings. They typically have several input and output terminals, and may include additional features such as diodes, fuses, and status LEDs. Some relay modules are designed to be mounted on a printed circuit board (PCB), while others are designed for panel mounting or DIN rail mounting. They can be controlled using various types of signals, including digital signals, analog signals, and pulse-width modulation (PWM) signals. Overall, relay modules are versatile and reliable devices that are widely used in many different industries and applications.

FIG: 3.1.3. Relay Module

3.2. Software Requirements

3.2.1. Libraries required:

1. Blynk.h: Platform connecting any hardware to the cloud and control the hardware via internet.

2.. Wire.h: Library that allows to communicate with I2C / TWI devices.

3. Wifi.h: Library that allows to connect to the internet.

4. WifiClient.h: Library that creates a client that can connect to specified port and IP address.

3.2.2. Blynk Server:

Blynk server is an open-source platform that allows developers to create their own IoT applications. It is designed to be flexible and easy to use, with a drag-and-drop interface that makes it simple to create custom projects .Blynk server supports a wide range of devices and protocols, including Arduino, Raspberry Pi, ESP8266, and more .It can be used to create mobile apps that control IoT devices, monitor sensor data, and more. Blynk server provides secure communication between devices and the cloud, ensuring that data is protected at all times. It offers a range of powerful tools and features, including real-time data visualization, push notifications, and email alerts. Blynk server is highly scalable, allowing developers to easily add new devices and users as their projects grow. .It can be deployed on a variety of platforms, including cloud servers, local servers, and even on-premises hardware .Blynk server provides extensive documentation and support, making it easy for developers to get up and running quickly .It is a popular choice among IoT developers, with a large and active community of users who share their projects and ideas.

FIG: 3.2. Blynk server

CHAPTER 4
METHODOLOGY

CHAPTER 4:

METHODOLOGY:

The system is based on the interruption of IR beam. An IR beam is used as the source of light beam. Bidirectional visitors counter with automatic room light controller and ESP32 as the master controller has two sections i.e. the transmitter which is an IR circle where it should be powered with 5 volt D C supply and fixed on one side of the door frame and other is the receiver which has R X at the front end.

A. Monitoring ESP32 Reading:-
   - ESP32 enables user to monitor various kinds of sensors such as IR sensor and motion detector in real time. The analog and digital pins on the ESP32 board can serve as general purpose input and output pins
   - The integer number is always proportional to the amount of the voltage being applied to the analog input. Any sensor operating on 5 volts can be directly connected to the ESP32 board. The prototype has been implemented on the board.

B. Controlling Actuators :-
   - The triggering is finally done by ESP32 gateway. While monitoring the sensor in real time, the ESP32 takes action in real time to turn on/off the led based on the entry/exit of the people.
   - This system has two sections one which is the transmitter section where the power supply and light output is given. The other one is receiver section where light input is taken and implemented on entry sensor circuit and exit sensor circuit which in turn makes the LED to turn on/off.

C. Blynk server:
   - In this section we have a platform called blynk which is operated through communication devices like mobile phones or computers, which collects the data from ESP 32 to display number of persons in the room as well as the number of people entering and leaving the room. The system is designed using the ESP32 (IDE) platform. When ESP32 check for zero condition (no one in room) and finds it is true then ESP32 turns off the bulb by deactivating the relay.
   - If zero condition is false i.e. if persons entering the room then corresponding signals are sent by the sensors to the ESP32 which makes ESP32 to turn on the light. This increment or decrement is displayed on the communication device wirelessly.

Block Diagram of Bidirectional Visitor Counter:

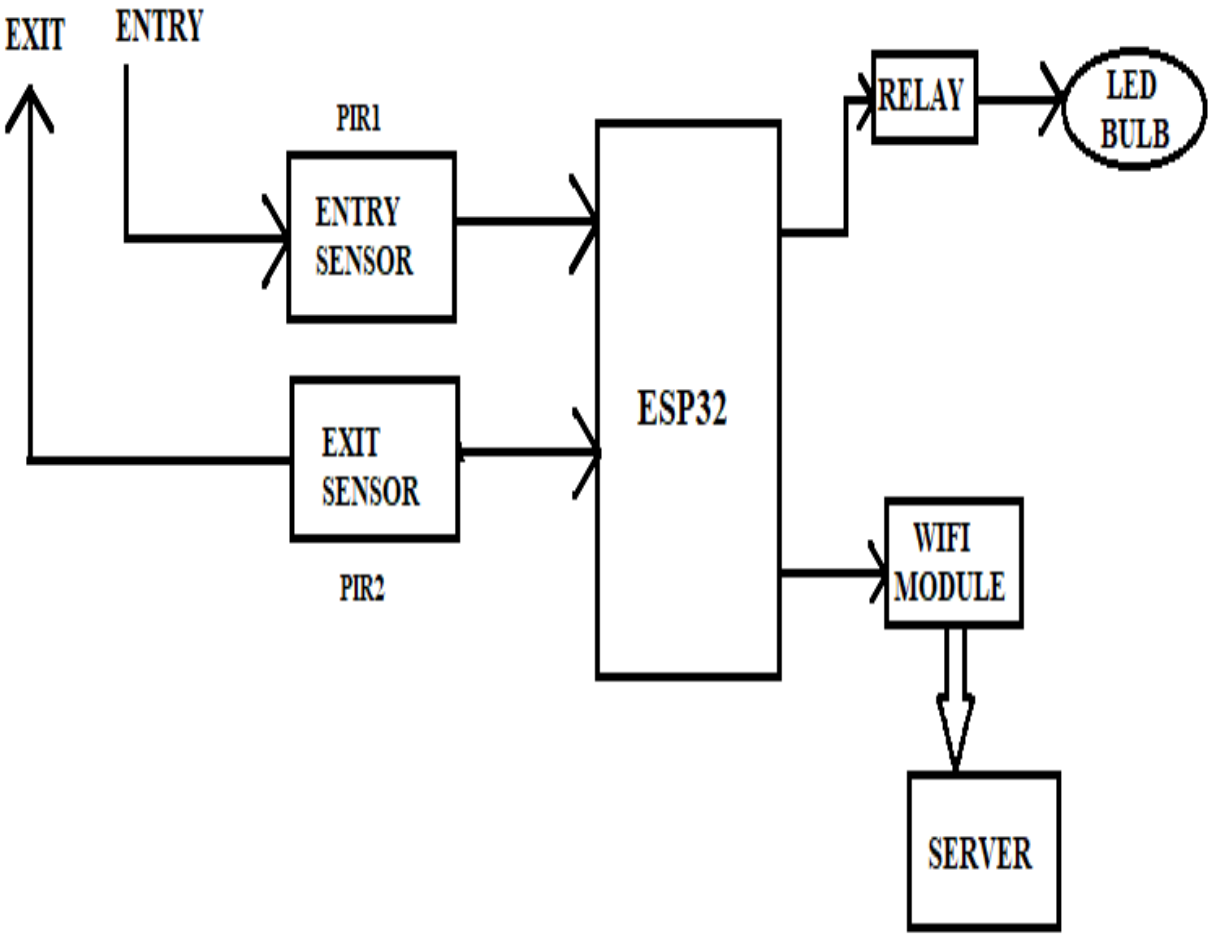

Fig : 4.1. Block diagram of Bidirectional Visitor Counter

Flowchart :

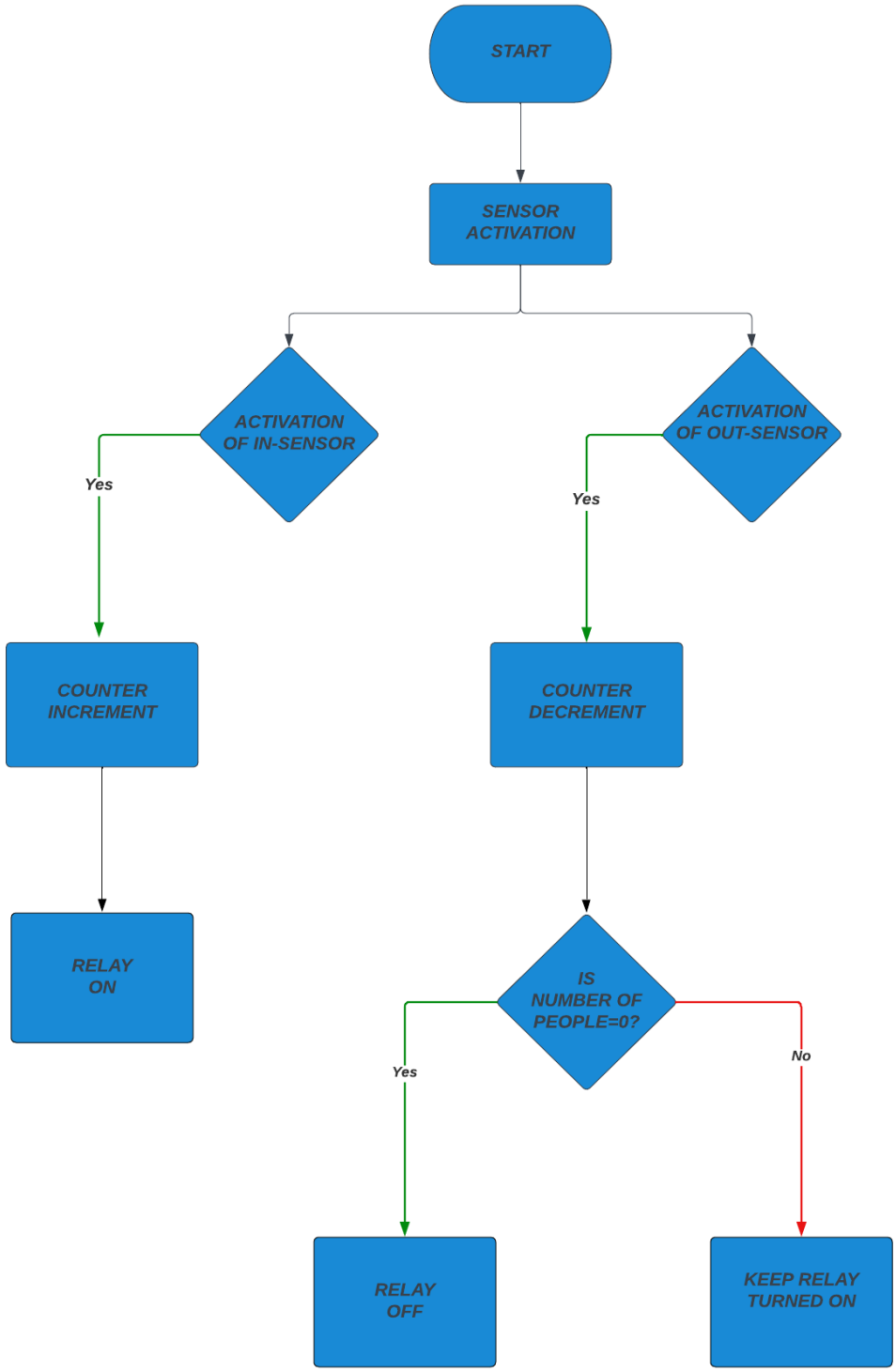

Fig: 4.2. Flowchart of Bidirectional Visitor Counter

Circuit diagram of Bi-directional visitor counter:

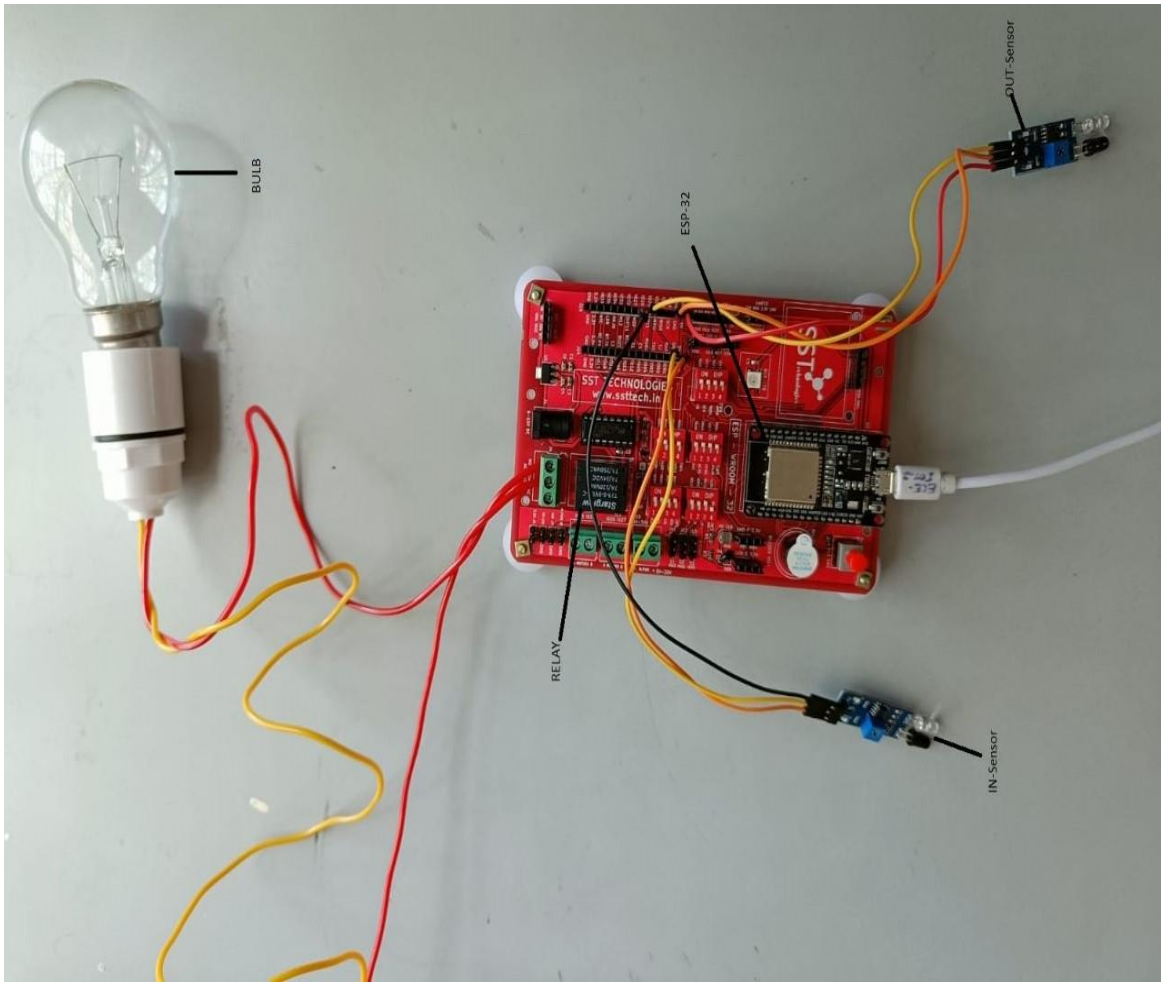

FIG: 4.3. Circuit diagram of bidirectional visitor counter

CHAPTER 5
RESULTS AND DISCUSSIONS

CHAPTER 5:

RESULTS AND DISCUSSIONS

5.1 Result:

The bidirectional visitor counter was successfully implemented using the Arduino ESP32 board and infrared sensors. The counter was tested by having people enter and exit the room multiple times. The LCD screen displayed the correct number of people entering and exiting the room.

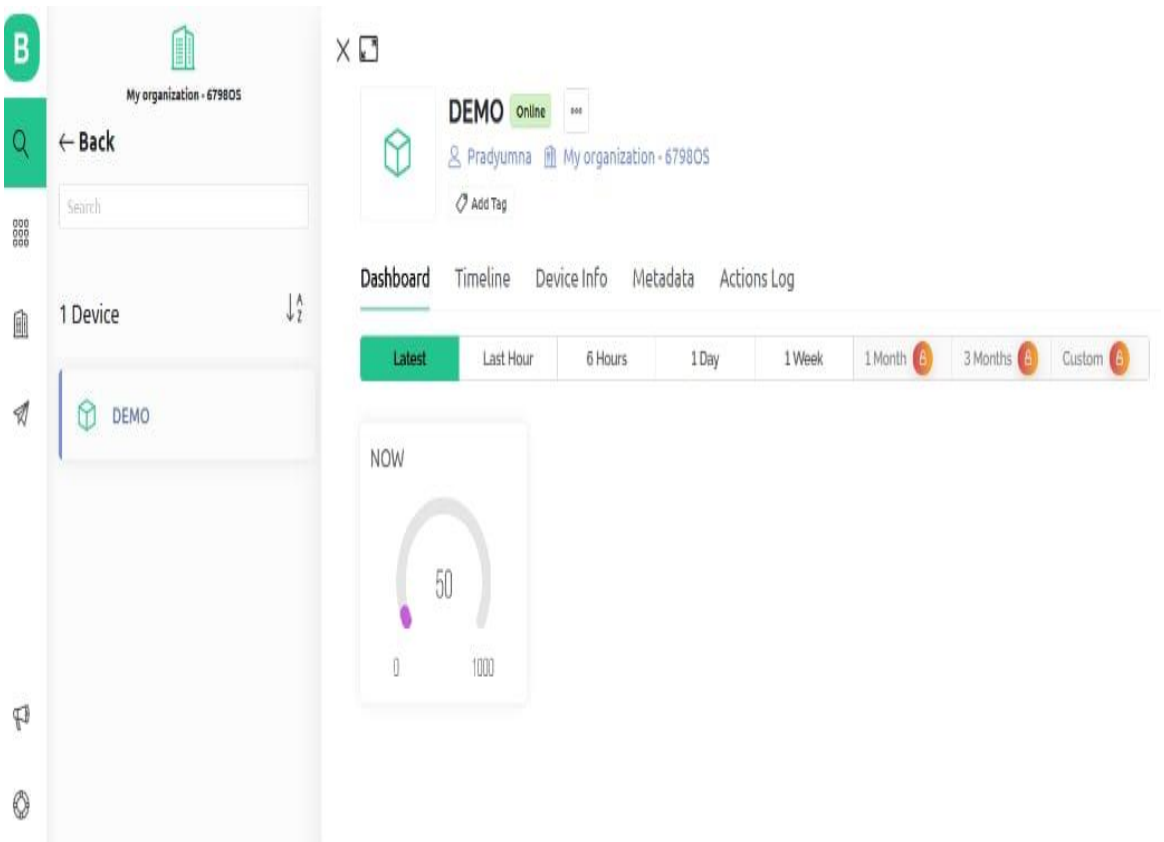

FIG: 5.1. No. of people present in the room at that instant of time

5.2 Discussion:

5.2.1 The bidirectional visitor counter has many practical applications. For example, it can be used to monitor the number of people in a building, control the flow of traffic in public places, or keep track of the number of visitors in a museum. The counter is also relatively easy to implement and can be customized to meet specific requirements.

5.2.2 In terms of limitations, the bidirectional visitor counter is dependent on the accuracy of the sensors. The infrared sensors used in this project can be affected by environmental factors such as lighting and temperature. This can result in inaccurate readings and affect the overall accuracy of the counter. It is important to calibrate the sensors regularly and ensure that they are functioning properly.

5.2.3 Another limitation of the bidirectional visitor counter is that it can only count people passing through the sensors. It cannot differentiate between people and objects, or determine the exact location of a person in the room. This can be problematic in situations where more precise tracking is required.

5.2.4 In conclusion, the bidirectional visitor counter is a useful device for tracking the flow of visitors in public places. While it has some limitations, it can be an effective tool for managing crowds and monitoring the occupancy of a building or room.

CHAPTER 6

ADVANTAGES, DISADVANTAGES AND IMPROVISATION

CHAPTER 6:

ADVANTAGES, DISADVANTAGES AND IMPROVISATION

6.1 Advantages:

6.1.1 Accurate Counting: Bidirectional visitor counters provide accurate counts of visitors entering and leaving a building, which can be useful for security, management, and planning purposes.

6.1.2 Real-time Monitoring: Many bidirectional visitor counters provide real-time monitoring of visitor traffic, allowing for immediate response to any issues or concerns.

6.1.3 Automatic Door Control: Some bidirectional visitor counters are equipped with automatic door control systems, which can be convenient for visitors and improve the efficiency of the building's operations.

6.1.4 Data Storage: Many bidirectional visitor counters store visitor data, which can be analysed and used for statistical and planning purposes.

6.1.5 Integration with other Systems: Bidirectional visitor counters can be integrated with other building management systems, such as security cameras and access control systems, for improved security and efficiency.

6.2 Disadvantages:

6.2.1 Cost: Bidirectional visitor counters can be expensive to install and maintain, depending on the technology used and the size of the building.

6.2.2 Reliability: The accuracy and reliability of bidirectional visitor counters can be affected by various factors, such as environmental conditions and sensor malfunctions, which can lead to inaccurate counts.

6.2.3 Privacy Concerns: The collection and storage of visitor data by bidirectional visitor counters can raise privacy concerns for visitors, which may require appropriate safeguards and data protection measures.

6.3 Improvisation:

There are several ways in which bidirectional visitor counters can be improved to enhance their accuracy and functionality. Here are a few suggestions for how to improvise bidirectional visitor counters:

7.1.1 Multiple sensors: Instead of relying on a single sensor to detect visitors, consider using multiple sensors placed strategically throughout the area being monitored. This can help to ensure that all visitors are accurately counted and reduce the risk of false readings.

7.2.2 Real-time data analysis: By integrating a data analytics system into the visitor counting system, businesses and organizations can receive real-time data on visitor traffic. This can help them to better understand visitor patterns, identify peak times, and adjust staffing and operations accordingly.

7.2.3 Integration with other systems: Visitor counting systems can be integrated with other systems, such as security systems or inventory management systems, to provide a more comprehensive view of business operations. For example, a visitor counting system integrated with a security system can help to identify suspicious behaviour or unauthorized access.

7.2.4 Mobile access: Mobile access to visitor counting data can provide businesses and organizations with the flexibility to monitor visitor traffic from anywhere. Mobile access can be particularly useful for managers who are frequently on the go or who need to make real-time decisions based on visitor traffic.

7.2.5 Facial recognition: By incorporating facial recognition technology into visitor counting systems, businesses and organizations can more accurately track visitor traffic and behaviour. This technology can help to identify repeat visitors, monitor traffic flow, and provide a more personalized customer experience.

CHAPTER 7

CONCLUSION AND FUTURE SCOPE

Chapter 7:

CONCLUSION AND FUTURE SCOPE:

Conclusion:

In conclusion, bidirectional visitor counters are a valuable technology that can be used to count the number of people entering and exiting a particular area. This type of system can be useful in a wide range of settings, including retail stores, museums, and public buildings.

One of the major benefits of a bidirectional visitor counter is that it can provide accurate data on the number of people entering and exiting a particular area. This information can be used by businesses and organizations to make important decisions about staffing, marketing, and overall operations. Another benefit of a bidirectional visitor counter is that it can help improve the overall customer experience. By accurately tracking the number of people entering and exiting a particular area, businesses can better manage crowds and ensure that their customers have a positive experience. However, it is important to note that bidirectional visitor counters are not fool proof and can sometimes provide inaccurate data. For example, if someone enters an area without being detected by the sensor, or if the sensor malfunctions, the data collected may be incorrect. Despite these limitations, bidirectional visitor counters are a valuable technology that can provide important insights for businesses and organizations. As technology continues to advance, we can expect to see even more sophisticated visitor counting systems in the future**.** There are a variety of bidirectional visitor counter designs available, ranging from simple infrared sensors to more advanced systems that incorporate facial recognition technology. Depending on the specific needs of the project, different types of sensors and algorithms may be used to achieve the desired level of accuracy. Overall, a bidirectional visitor counter is a valuable tool for businesses, museums, libraries, and other organizations that want to better understand visitor traffic and behaviour. By providing accurate data on the number of people entering and leaving a particular area, these counters can help organizations make informed decisions about staffing, marketing, and facility management.

Future Scope:

The visitor counter system can be integrated with other systems such as access control systems, security systems, or building automation systems to provide a more comprehensive solution. The system can be enhanced with the use of advanced sensors such as 3D cameras, depth sensors, or LIDAR sensors for more accurate tracking of people and objects. The system can be further improved by applying machine learning algorithms for data analysis and prediction. For example, by analysing visitor traffic data over time, the system can predict peak hours or busy periods and provide insights for staffing and resource allocation. The system can be integrated with a mobile app to provide visitors with real-time information on visitor traffic, wait times, and other relevant information. The system can be developed as a cloud-based solution, allowing users to access the data and analytics from anywhere, anytime.

References:

[1]. "Bidirectional Visitor Counter using Arduino and IR Sensors" by Arindam Bose: This tutorial provides a step-by-step guide on how to build a bidirectional visitor counter using Arduino and IR sensors. It includes circuit diagrams, source code, and explanations of the working principle.

[2]. "Bidirectional Visitor Counter using 8051 Microcontroller" by Edgefxkits: This project tutorial provides a detailed explanation of how to build a bidirectional visitor counter using 8051 microcontroller and IR sensors. It also includes circuit diagrams, source code, and working principle.

[3]. "Bidirectional Visitor Counter using Raspberry Pi" by Circuit Digest: This tutorial explains how to build a bidirectional visitor counter using Raspberry Pi and IR sensors. It includes detailed instructions, circuit diagrams, and Python code for the project.

[4]. "Bidirectional Visitor Counter using PIC Microcontroller" by EngineersGarage: This tutorial provides a comprehensive guide on how to build a bidirectional visitor counter using PIC microcontroller and IR sensors. It includes circuit diagrams, source code, and working principle.

[5]. "Bidirectional Visitor Counter using Ultrasonic Sensor and Arduino" by Instructables: This project tutorial explains how to build a bidirectional visitor counter using ultrasonic sensors and Arduino. It includes detailed instructions, circuit diagrams, and source code for the project.

[6]. "Bidirectional Visitor Counter using PIR Sensor and Arduino" by DIY Hacking: This tutorial explains how to build a bidirectional visitor counter using PIR sensors and Arduino. It includes circuit diagrams, source code, and detailed explanations of the working principle.

[7]. "Bidirectional Visitor Counter using NodeMCU" by IoTBoys: This project tutorial provides a step-by-step guide on how to build a bidirectional visitor counter using NodeMCU and IR sensors. It also includes circuit diagrams, source code, and working principle.

[8]. "Bidirectional Visitor Counter using ESP32 and PIR Sensor" by Maker Pro: This tutorial explains how to build a bidirectional visitor counter using ESP32 and PIR sensors. It includes detailed instructions, circuit diagrams, and source code for the project.

[9]. "Bidirectional Visitor Counter using Ultrasonic Sensor and PIC Microcontroller" by Electronic Circuits and Diagrams: This project tutorial provides a comprehensive guide on how to build a bidirectional visitor counter using ultrasonic sensors and PIC microcontroller. It includes circuit diagrams, source code, and working principle.

[10]. "Bidirectional Visitor Counter using Raspberry Pi and OpenCV" by PyImageSearch: This tutorial explains how to build a bidirectional visitor counter using Raspberry Pi and OpenCV. It includes detailed instructions, source code, and explanations of the working principle.