A Project Report
on
IOT BASED BIDIRECTIONAL VISITOR COUNTER

Submitted in partial fulfillment of the requirements

for the award of degree of

BACHELOR OF TECHNOLOGY

in

Information Technology

by

G. Esha (19WH1A1221)
P. Preethi (19WH1A1231)
M. Harshini (19WH1A1233)
I. Harshitha (19WH1A1257)

Under the esteemed guidance of
Mr. Ch. Anil Kumar
Assistant Professor

Department of Information Technology

BVRIT HYDERABAD College of Engineering for Women

Rajiv Gandhi Nagar, Nizampet Road, Bachupally, Hyderabad – 500090

(Affiliated to Jawaharlal Nehru Technological University, Hyderabad)

(NAAC ‘A’ Grade & NBA Accredited- ECE, EEE, CSE IT)

June, 2023

DECLARATION

We hereby declare that the work presented in this project entitled **"IoT based Bidirectional Visitor Counter"** submitted towards completion of Project in IV year II sem of B.Tech IT at "BVRIT HYDERABAD College of Engineering for Women", Hyderabad is an authentic record of our original work carried out under the esteem guidance of Mr Ch Anil Kumar, Assistant Professor, Department of Information Technology.

G. Esha (19WH1A1221)

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CERTIFICATE

This is to certify that the Major-Project report on **"IoT based Bidirectional Visitor Counter"** is a bonafide work carried out by **G. Esha (19WH1A1221), P. Preethi (19WH1A1231), M. Harshini (19WH1A1233)** and **I. Harshitha (19WH1A1257)** in the partial fulfillment for the award of B.Tech degree in **Information Technology, BVRIT HYDERABAD College of Engineering for Women, Bachupally, Hyderabad** affiliated to Jawaharlal Nehru Technological University, Hyderabad under my guidance and supervision.

The results embodied in the project work have not been submitted to any other university or institute for the award of any degree or diploma.

Internal Guide	**Head of the Department**
Mr. Ch. Anil Kumar	**Dr. Aruna Rao S L**
Assistant Professor	**Professor & HoD**
Department of IT	**Department of IT**

External Examiner

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G. Esha (19WH1A1221)

P. Preethi (19WH1A1231)

M. Harshini (19WH1A1233)

I. Harshitha (19WH1A1257)

ABSTRACT

In today's world there is a continuous need for automated appliances, with the increase in the living standard, there is an immediate need for developing circuit that would change the complexity of life to simplicity. The model is designed in order to count the visitors of an offices, auditoriums, hall, sport venue. When a person enters the room, count would be increased, whereas on leaving, the count would decrease. This count will be very accurate and it will beep a warning alarm if the number of people exceeds the limit. The aggregate number of people will appear on the LCD. In the circuit an Arduino UNO Board is utilized. This will help in the accurate measurement of the visitors and is less complex compared to a microcontroller. The Arduino will get signals from the sensors and those signals work under the control of a programming code which is put away in the ROM of the Arduino. The Infrared Receivers will continuously monitor any entity which passes both outside the building and inside the building. According to the number of guests inside the industry, electronic appliances like lights, fans and coolers will be triggered on and off. This automation will save lots of electricity. There will also be a temperature and humidity sensor which will detect the temperature of an industry. If the temperature exceeds for any reason the circuit will beep, a warning alarm.

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LIST OF ABBREVIATONS

Abbreviation	Meaning
IoT	Internet of Things
UML	Unified Modeling Language
LCD	Liquid Crsytal Display
DHT11	Digital Humidity and Temparature
USB	Universal Serial Bus
RX	Recieve
TX	Transmit
TTL	transistor-transistor logic
LED	Light Emitting Diode
MCU	microcontroller unit
RS	Register Selection Signal
R/W	Read Write Signal
IR Sensor	Infrared Sensor

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1. INTRODUCTION

Industries require a huge number of work force and maintenance. Here we have taken steps to ease the industry work by reducing the consumption of electricity and providing safety features which will not lead to dangerous situations. This will ease the work of electricity maintenance.

Over many years guest, counters are used in many areas. Here microcontroller is replaced with 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 manual tally counter. This circuit can be used in many places like classroom halls, an auditorium, libraries, community halls, etc. It is a necessity to monitor the visitors for better human traffic management.

The initial method for counting the visitors involves 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 may be confusing for a person to tally the quantity of individual entering and leaving at a same time.

Our intension is to design and develop this system to manage human traffic in a large industry and also conserve the usage of electricity. Our main aim is constructing a visitor counter which will make a controller circuit model to count and calculate the number of guest in a building or room at a particular time and all the electrical appliances will be turned on and off accordingly.

IoT based Bidirectional Visitor Counter is a reliable Circuit that takes over the task of controlling the room lights as well us counting number of person's in the room very accurately when somebody enters into the room then the Counter is incremented by one value and the light in the room will automatically switched ON and when any one leaves the room then the counter is decremented by one value and the light will be only switched OFF until all the persons in the room go out.It is also our aim that this controller base circuit model beeps a warning alarm for safety purposes when the capacity of the building and the temperature exceeds.Also in addition the total number of person in the room be incremented value or decremented value will always be displayed in the LCD thus makes this system a very user friendly.

Bidirectional visitor counters employ various technologies to accurately track the movement of people entering and exiting a specific area. These technologies include infrared sensors, thermal imaging cameras, stereo cameras, or computer vision algorithms. The system detects individuals passing through an entrance or exit point and counts them accordingly. By differentiating between incoming and outgoing traffic, the counter maintains an accurate record of the number of visitors in real-time.

Accuracy and Reliability:

Bidirectional counters are designed to provide highly accurate and reliable visitor counting data. The advanced technologies used in these systems minimize errors and ensure precise counting. They can effectively distinguish between multiple individuals passing through the entrance or exit simultaneously and filter out false readings caused by environmental factors like shadows, reflections, or noise.

Real-time data and Analytics:

Bidirectional visitor counters provide real-time data on visitor traffic, allowing businesses and organizations to monitor and analyze footfall trends as they happen. This data can be accessed through a user-friendly interface or integrated with existing analytics platforms. By examining visitor patterns, peak hours, and trends, organizations can make data-driven decisions, optimize resource allocation, and enhance operational efficiency.

Integration and Compatibility:

Bidirectional counters can be seamlessly integrated with other systems and technologies. They can be connected to management software, POS systems, or access control systems, enabling businesses to synchronize visitor data and gain deeper insights. Integration with analytics tools, such as heat maps or customer journey analysis, provides a comprehensive view of visitor behavior, preferences, and engagement.

Customization and Scalability:

Bidirectional visitor counters can be customized to meet specific business needs. They can be configured for different entrance layouts, including single or multiple entry points, wide entrances, or narrow corridors. The systems are also scalable, allowing organizations to expand the counting infrastructure as needed to accommodate growing visitor volumes or additional locations.

Privacy Considerations:

Bidirectional counters typically prioritize privacy by employing non-intrusive technologies. They focus on counting individuals without capturing personally identifiable information (PII). The systems respect privacy regulations and guidelines, ensuring visitor anonymity and data protection.

Maintenance and support:

Bidirectional counters are designed for easy maintenance and typically require minimal upkeep. Manufacturers often provide comprehensive support, including software updates, troubleshooting assistance, and customer service to ensure the smooth operation of the system. By implementing a bidirectional visitor counter, businesses and organizations can gain valuable insights into visitor behavior, improve operational efficiency, enhance customer experiences, and make data-driven decisions that contribute to their overall success.

The bidirectional visitor counter employs innovative technologies such as infrared sensors, thermal imaging, or even sophisticated computer vision algorithms. These systems can detect and differentiate between individuals passing through an entrance or exit point, enabling accurate and reliable counting in both directions. By accurately measuring visitor flow in real-time, organizations gain valuable insights into customer behavior, peak traffic hours, and overall footfall trends.

The benefits of bidirectional visitor counters are numerous. They provide businesses with essential data to optimize operations, improve customer service, and enhance security measures. Retailers can analyze footfall patterns to make informed decisions on staff scheduling, store layout, and product placement. Museums and exhibitions can monitor visitor engagement, ensuring an optimal experience for their patrons. Event organizers can evaluate attendance numbers and adjust logistics accordingly.

1.1 Objective

This project plans to create a bidirectional based visitor counter using arduino and sensors.

The objective of our work is to:

i) To make a microcontroller based model to count number of persons visiting particular room and accordingly light up the room.

ii) The model indicates the number of people and the temperature of the room is exceeding using an alarm.

iii) This model aims in saving the time of mannually counting the visitors in a place and saving electricity.

1.2 Problem Definition

Bidirectional visitor counter counts the number of people incoming and outgoing through any large industry and saves electricity based on the requirement using different sensors.

1.3 Internet of Things

Major Components of IoT

Figure 1.3.1: Internet of Things Process

Internet of Things

The Internet of Things (IoT) is a methodology that refers to the millions of physical devices across the world that are now connected to the internet. These devices collect and share data over the cloud. We can also say that Internet of things or IoT is a giant network of connected devices. These Physical devices or objects consists of some built in sensors that are connected to internet of things platform. These sensors are used to integrate data from devices and share the data through the internet. Bidirectional counters using arduino contribute to the overall safety and security of venues. By monitoring the number of people inside a building, emergency personnel can respond more effectively during critical situations, ensuring the well-being of everyone present.

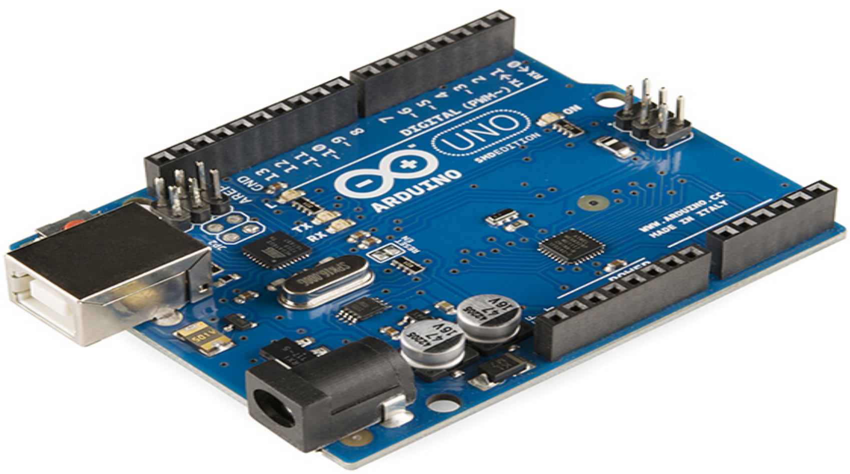

Figure 1.3.2: IoT with Arduino

2. LITERATURE SURVEY

Saikat Sarkar, Satyaki Nan, Priyanikar Ghosh [1] proposed an implementation to the idea of automatic visitor counting and load controlling using a microcontroller. Currently the main work that has been done on this proposed system is using ultrasonic sensors which give longer detection range compared to IR rays. If user wants to switch on and off the electrical appliances, he/she has to go to a specific area and on /off the appliance. But in this design, we are controlling the electrical loads remotely using RF Technology.

The user has RF Transmitter and RF receiver is kept at the application side. The user is able to control the electrical appliances within the range of 100 feet. We have also used LDR sensor to sense light condition and depending upon it controls the electrical light loads.

Abdel Rahman Osman [2] designed and presented that the count the visitors of an auditorium, hall, offices, malls, sports venue, etc. The system counts both the entering and exiting visitor of the auditorium or hall or other place, where it is placed. Depending upon the interrupt from the sensors, the system identifies the entry and exit of the visitor. On the successful implementation of the system, it displays the number of visitor present in the auditorium or hall.

This system can beeconomically implemented in all the places where the visitors have to be counted andcontrolled. Since counting the visitors helps to maximize the efficiency and effectiveness of employees, floor area and sales potential of an organization, etc

Anjali Sinha, Arpitha Singh, Deepa Singh [3] proposed that Microcontroller is a reliable circuit that takes over the task of controlling the room lights as well us counting number of persons/ visitors in the room very accurately. When somebody enters into the room then the counter is incremented by one and the light in the room will be switched ON and when any one leaves the room then the counter is decremented by one. The light will be only switched OFF until all the persons in the room go out. The total number of persons inside the room is also displayed on the seven segment displays. The microcontroller does the above job. It receives the signals from the sensors, and this signal is operated under the control of software which is stored in ROM. MicrocontrollerAT89S52 continuously monitor the Infrared Receivers, When any object pass through the IR Receiver's then the IR Rays falling on the receiver are obstructed , this obstruction is sensed by the Microcontroller.

TanayTripathi, Saurabh Gupta, Uzma Abrar, Sumit Kr Rai [4] proposed that when the LASER light is not falling on the LDR that means there is an obstruction.When the LASER light is falling on the LDR that means there is no obstruction. A set of same counter arrangement using laser will be applied at the Exit gate counter which will count the number of people leaving that place. Difference between the counting system of entrance and exit is that it counts the reverse ofthe entrance counting system in case of exit. Accept this all other configurations are same and also works on sameprinciple. A Counter called "Total counter" will be there at the center will keep counting for the number of people present on that place. This will be done by taking the data from both the counters which are present at the Entrance and at the Exit gate too. A simple human counting system has been designed, constructed and tested. It is useful for indoor security especially in small rooms, museums, jewelry stores and art galleries. For the advancement of the system it can be modified as a sound tracking system also for better protection.

Narayanan, Krishnan, and Robinson [5] propose a system that utilizes Internet of Things (IoT) technology to address the challenges posed by the COVID-19 pandemic in entertainment venues. The authors suggest an innovative approach to monitor the occupancy levels of these spaces in real-time and simultaneously screen individuals for potential COVID-19 symptoms. The proposed system incorporates various IoT sensors and devices to detect occupancy levels and collect health-related data. By leveraging this data, the system can provide accurate and timely information about the occupancy status of entertainment spots, enabling effective crowd management and social distancing measures. Additionally, the system performs COVID-19 screening by analyzing health parameters and symptoms, helping identify individuals who may require further testing or quarantine. Overall, the authors' proposal aims to enhance safety measures and contribute to the management of public health crises in entertainment venues during the COVID-19 pandemic.

Archana D, Rajani B. R, Shalini C. K, Vidyashree H. N, Shilpashri V N [6] addressed the need for efficient power usage in various settings by proposing a system that accurately monitors the number of people entering and exiting a specific area or building. The literature survey conducted for this project explores existing methods and technologies used in visitor counting systems and power management. The authors discuss previous studies and approaches, highlighting their limitations and shortcomings. By addressing these gaps, the proposed system aims to improve power management practices by providing real-time and accurate visitor count data. The study contributes to the field by offering a practical solution that can be implemented to optimize power consumption based on the number of occupants in a given space.

Siva. S.Sinthura, M. BindhuBhavani,.R. Anuradha, P. Tejasree [8] focused on the development of a smart road system that leverages the Internet of Things (IoT) to enhance the intelligence and safety of highways. The literature survey conducted for this project explores existing research and technologies related to smart road systems, with a specific emphasis on managing climate conditions and unexpected events or traffic congestion. The authors investigate previous studies, methodologies, and tools used in similar projects, identifying gaps and limitations in the existing literature. By addressing these challenges, the proposed system aims to provide real-time warning messages and diversions to drivers based on climate conditions, unexpected events, or traffic jams. The research contributes to the field by offering a comprehensive and intelligent solution for improving road safety and traffic management through the integration of IoT technologies.

Jafrul Islam Sojol [9] reviewed previous studies, methodologies, and techniques employed in similar projects, emphasizing their strengths and limitations. The survey aims to identify gaps in the existing literature and propose an improved solution for accurately counting passengers in buses. By implementing a smart bus system with automated passenger counting, the research contributes to enhancing the efficiency of public transportation systems, optimizing resource allocation, and providing valuable data for better planning and management of bus routes. The study offers insights into the advancements and challenges in the field of automated passenger counting systems and provides a foundation for further research and development in this area.

Jain, Sarthak, Anant Vaibhav, and Lovely Goyal [10] suggested an approach that allows users to control and monitor various home appliances remotely using their email accounts. The proposed system leverages the capabilities of Raspberry Pi, a small, affordable computer, to act as a central controller for the home automation setup. Users can send specific commands or instructions via email to the Raspberry Pi, which then processes the commands and triggers the corresponding actions on the connected appliances. Additionally, the system enables real-time monitoring of the appliances' status, providing feedback to users via email. This proposed interactive home automation system through email offers convenience and flexibility to users, allowing them to control their home appliances remotely with ease.

Raju and Professor G [11] propose a system that utilizes Arduino technology to achieve automatic temperature control in various environments. The authors suggest an approach that aims to regulate temperature levels efficiently and accurately. The proposed system incorporates an Arduino microcontroller, temperature sensors, and actuators to monitor and adjust temperature levels based on predefined setpoints. The Arduino microcontroller continuously reads the temperature data from the sensors and compares it with the desired temperature range. If the temperature exceeds the setpoint, the system activates the appropriate actuators, such as fans or heaters, to bring the temperature back within the desired range. This automatic temperature control system offers a reliable and energy-efficient solution for maintaining optimal temperature conditions in different settings, ranging from homes and offices to industrial environments. The authors' proposal provides a cost-effective and scalable solution for achieving precise temperature control, enhancing comfort, and improving energy efficiency.

Nitin Sinha,Korrapati Pujitha, and John sahaya Rani Alex [12] propose a sensing and monitoring system that utilizes the Xively platform for Internet of Things applications. The authors suggest an approach that leverages the capabilities of Xively, a cloud-based IoT platform, to enable real-time sensing and monitoring of various parameters. The proposed system involves deploying sensors to collect data from the physical environment, such as temperature, humidity, or air quality. These sensors are connected to the Xively platform, which securely stores and processes the collected data. Users can then access the data remotely through a web-based interface or mobile application, allowing them to monitor the environment in real-time. The authors' proposal offers a scalable and efficient solution for deploying IoT-based sensing and monitoring systems, providing valuable insights into the physical world for applications such as smart homes, environmental monitoring, and industrial automation.

Kelly, Sean Dieter Tebje, Nagender Kumar Suryadevara, and Subhas Chandra Mukhopadhyay [14] suggested an approach that utilizes IoT technologies to enable remote monitoring and management of various environmental parameters within homes. The proposed system incorporates sensors to measure parameters such as temperature, humidity, and air quality. These sensors are connected to a central gateway that communicates with a remote server through the Internet. Users can access real-time data and control the environmental conditions through a web-based interface or mobile application. The authors' proposal aims to enhance comfort, energy efficiency, and health in residential settings by providing homeowners with valuable insights into the environmental conditions and enabling them to make informed decisions and adjustments. This implementation of IoT for environmental condition monitoring in homes presents a promising avenue for creating smarter and more sustainable living spaces.

Mr. Pranay P. Gaikwadli Mrs. Jyotsna P. Gabhane Mrs. Snehal S. Golait [15] proposed a survey-based exploration of smart home systems leveraging the IoT. The authors aim to provide an overview of the current state of smart home technologies, focusing on their integration with IoT platforms. The survey encompasses various aspects of smart homes, including architecture, communication protocols, sensor networks, and applications. The authors highlight the benefits of incorporating IoT into smart homes, such as improved automation, energy efficiency, and enhanced quality of life. Additionally, they discuss the challenges and potential solutions associated with the implementation of IoT-based smart homes, including privacy concerns, interoperability, and security issues. By presenting this comprehensive survey, the authors contribute to the understanding and advancement of smart home systems, shedding light on the potential of IoT technologies in transforming residential environments into intelligent and interconnected spaces.

J. JeyaPadmini, K.R.Kashwa [16] proposed a solution to optimize power utilization and conservation in smart homes through the integration of Internet of Things technology. The authors suggest an approach that leverages IoT devices and sensors to monitor and control power consumption in various household appliances and systems. The proposed system collects real-time data on energy usage from smart meters, sensors, and smart plugs deployed throughout the home. This data is analyzed to identify energy-intensive areas and appliances, allowing for targeted energy conservation strategies. The authors emphasize the importance of effective power utilization and conservation in reducing energy wastage and promoting sustainable practices in smart homes. By utilizing IoT technologies, the proposed system offers the potential to optimize energy consumption, enhance energy efficiency, and contribute to environmental preservation.

3. SYSTEM DESIGN

3.1 UML Diagrams

3.1.1 Activity Diagram

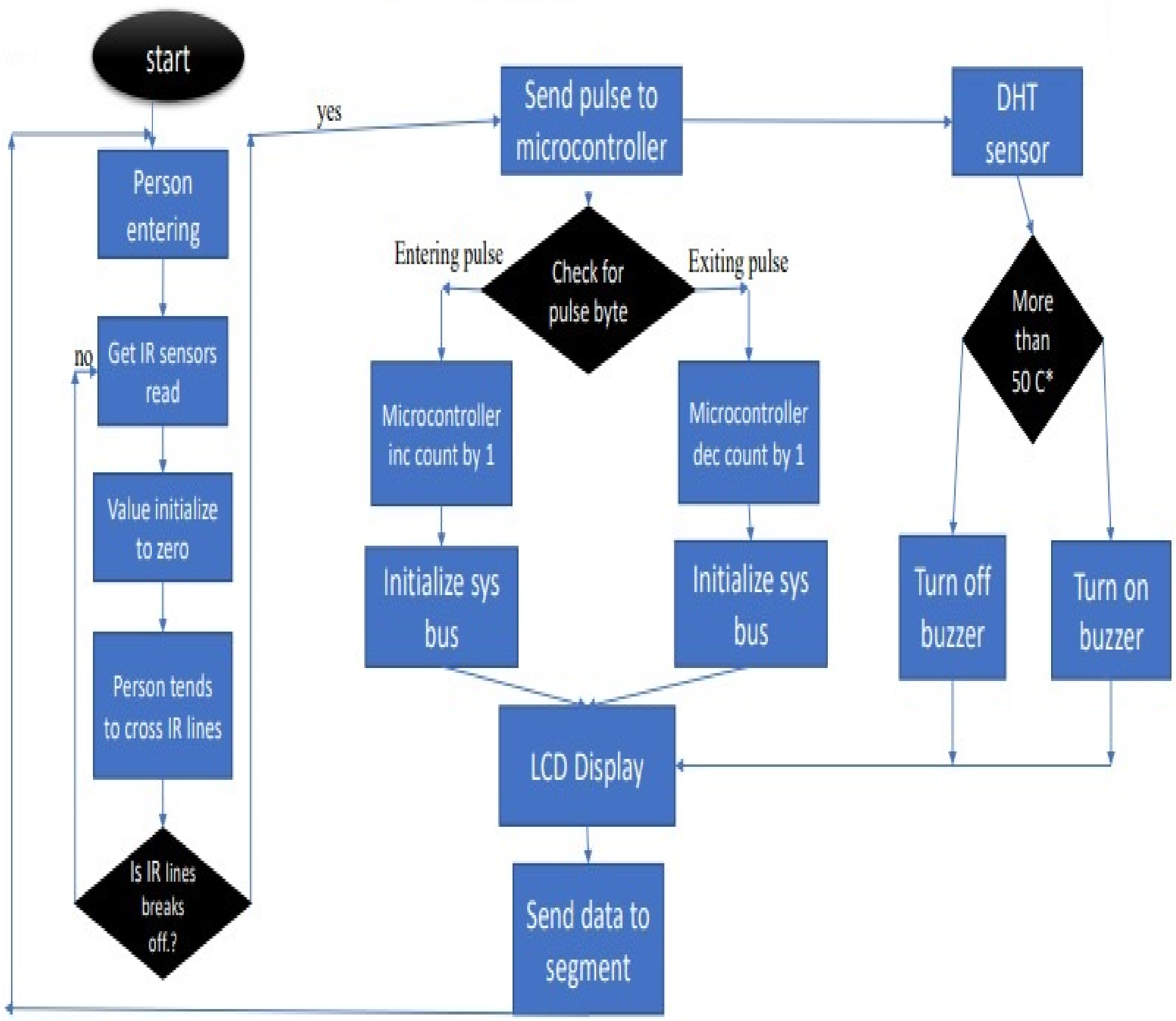

Figure 3.1.1.1: Activity Diagram

In the beginning of the activity UML Diagram the sensor 1 is interfered first then the arduino will search for the sensor 2. Furthermore, on the off chance that is intruded on the arduino will add the count. When the first individual goes inside the room then the counter goes to 1 and that time the FAN/LIGHT will turn on. Again the sensor 2 is interfered with first then the arduino will search for the sensor 1. And if it is interrupted then the count will be decreased.

When all people in the room leaves then counter goes to 0 and then the FAN/LIGHT will turn off. If there are excess numbers of persons the buzzer will start beeping and will stop buzzing once the excess members leaves the room. Also if the temperature of the room exceeds than certain limit the buzzer will start beeping and this will add as a safety feature.

3.1.2 Sequence Diagram

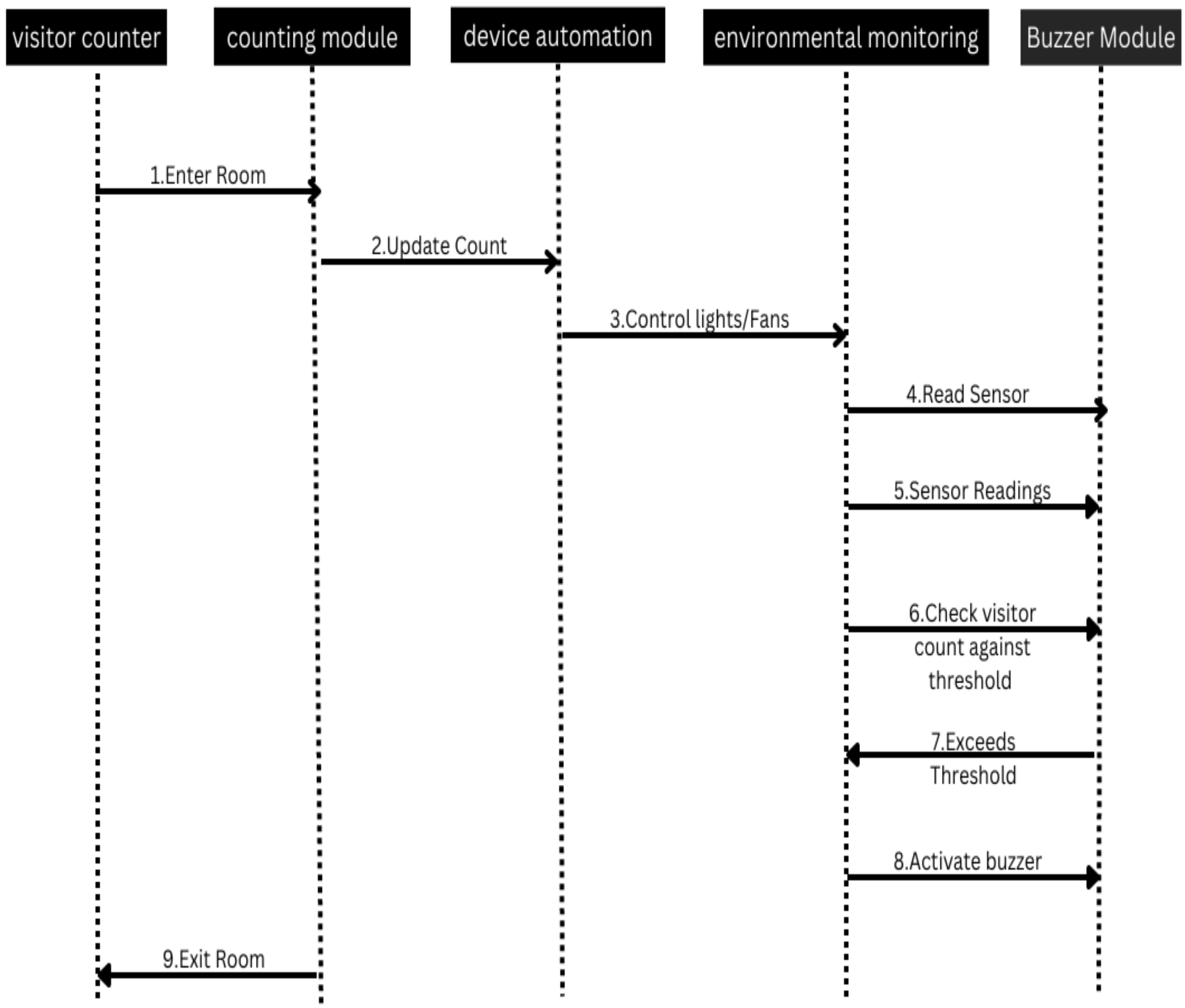

Figure 3.1.2.1: Sequence Diagram

Explanation of the sequence diagram:

Enter Room: The visitor person enters the room, triggering the visitor counting process.

Update Count: The Counting Module receives the count update, either incrementing or decrementing the visitor count.

Control Lights/Fans: The Device Automation module controls the lights and fans based on the visitor count received from the Counting Module.

Read Sensor: The Environmental Monitoring module reads the sensor data, such as temperature and humidity.

Check Sensor Readings: The Environmental Monitoring module checks the sensor readings and processes the data.

Check Visitor Count against Threshold: The Environmental Monitoring module compares the visitor count with the defined threshold.

Exceeds Threshold: If the visitor count exceeds the threshold, the Environmental Monitoring module identifies this condition.

Activate Buzzer: The Buzzer module is activated to produce a sound, alerting about the threshold being exceeded.

Exit Room: The visitor person exits the room, triggering the decrement of the visitor count.

The sequence diagram showcases the sequence of interactions and messages exchanged between the different modules and components involved in the IoT-based bi-directional visitor counter system.

3.1.3 Use Case Diagram

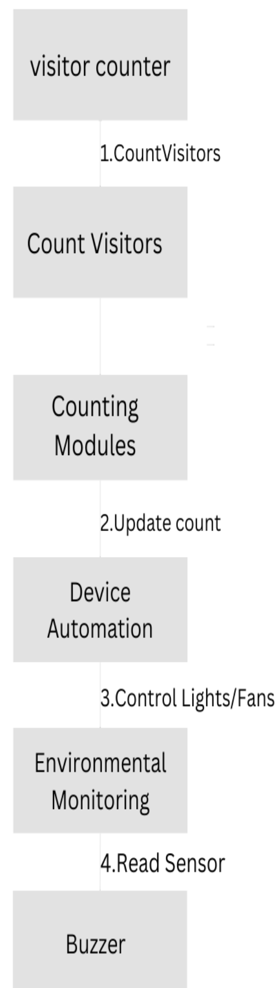

Figure 3.1.3.1: Use Case Diagram

Explanation of the use case diagram:

Count Visitors: The Visitor Counter initiates the counting process.

Update Count: The Counting Module receives visitor count updates from the counting process and communicates with other modules.

Control Lights/Fans: The Device Automation module controls lights and fans based on the visitor count received from the Counting Module.

Read Sensor: The Environmental Monitoring module reads sensor data, such as temperature and humidity, from the sensors.

Buzzer: The Buzzer module activates the buzzer if the number of people in the room exceeds a certain threshold.

Each module represents a distinct functionality or system component involved in the IoT-based bi-directional visitor counter. The use case diagram illustrates the interactions between these modules and provides an overview of the system's key functionalities and actors involved.

3.2.1 Hardware Requirements:

1. Arduino UNO as the control unit
2. Infrared sensor module
3. Liquid Crystal Display
4. Digital Humidity and Temperature Sensor (DHT11)
5. Relay Switch
6. Buzzer
7. Electronic Devices 8. Hardware Platform

1. Arduino UNO as the control unit

The most common version of Arduino is the Arduino Uno. This board is what most people are talking about when they refer to an Arduino. The Uno is one of the more popular boards in the Arduino family and a great choice for beginners. There are different revisions of Arduino Uno, below detail is the most recent revision (Rev3 or R3).

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Features

Microcontroller : ATmega328

Operating Voltage : 5V

Input Voltage (recommended) : 7-12V

Input Voltage (limits) : 6-20V

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

Length : 68.6 mm

Width : 53.4 mm

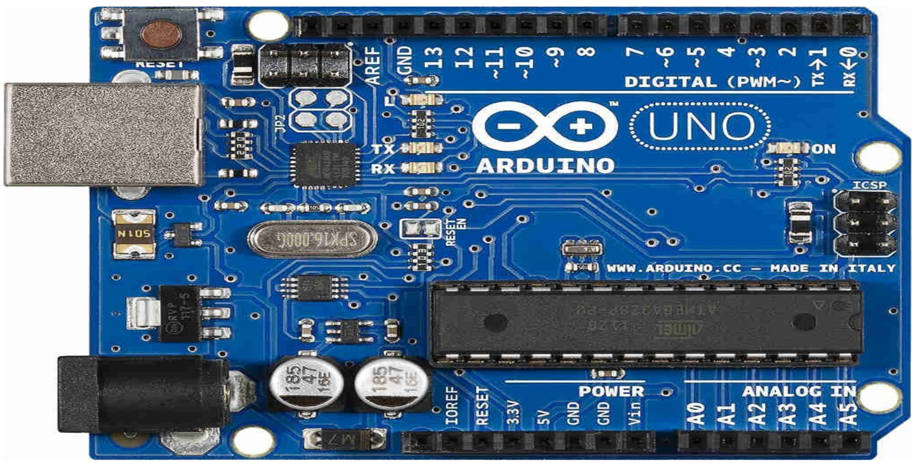

Figure 3.2.1.1: Arduino UNO

USB Plug External Power Supply Plug

Every Arduino board needs a way to be connected to a power source. The Arduino Uno can be powered from a USB cable coming from your computer or a wall power supply that is terminated in a barrel jack. The power source is selected automatically. The USB connection is also how you will load code onto your Arduino board. The board can operate on an external supply of 6 to 20 volts.

If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may be unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts.

Voltage Regulator

The voltage regulator is not actually something you can (or should) interact with on the Arduino. But it is potentially useful to know that it is there and what it's for. The voltage regulator does exactly what it says – it controls the amount of voltage that is let into the Arduino board. Think of it as a kind of gatekeeper; it will turn away an extra voltage that might harm the circuit. Of course, it has its limits, so don't hook up your Arduino to anything greater than 20 volts.

Power Pins

Voltage In Pin – The input voltage to the Arduino board when it's using an external power source(as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.

5V Pin – This pin outputs a regulated 5V from the regulator on the board. The board can be supplied with power either from the DC power jack (7 – 12V), the USB connector (5V), or the VIN pin of the board (7-12V). Supplying voltage via the 5V or 3.3V pins bypasses the regulator, and can damage your board. It's not recommended.

3.3V Pin – A 3.3 volt supply generated by the on-board regulator. Maximum current draw is 50 mA.

Ground Pins

There are several GND pins on the Arduino, any of which can be used to ground your circuit.

IOREF Pin

This pin on the Arduino board provides the voltage reference with which the microcontroller operates. A properly configured shield can read the IOREF pin voltage and select the appropriate power source or enable voltage translators on the outputs for working with the 5V or 3.3V.

Input and Output Pins

Each of the 14 digital pins on the Uno can be used as an input or output. They operate at 5 volts. These pins can be used for both digital input (like telling if a button is pushed) and digital output (like powering an LED). Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20-5k Ohms. In addition, some pins have specialized functions.

Serial Out (TX) Serial In (RX)

Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL Serial chip.

External Interrupts

Pins 2 and 3 can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value.

PWM – You may have noticed the tilde ( ) next to some of the digital pins (3, 5, 6, 9, 10, and 11). These pins act as normal digital pins, but can also be used for something called Pulse-Width Modulation (PWM). Think of these pins as being able to simulate analog output (like fading an LED in and out).

SPI – Pins 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). SPI stands for Serial Peripheral Interface. These pins support SPI communication using the SPI library.

Analog Input Pins – Labeled A0 through A5, each of which provide 10 bits of resolution (i.e. 1024 different values). These pins can read the signal from an analog sensor (like a temperature sensor) and convert it into a digital value that we can read. By default they measure from ground to 5 volts, though is it possible to change the upper end of their range using the AREF Pin (Stands for Analog Reference. Most of the time you can leave this pin alone). Additionally, some pins have specialized functionality:

TWI – Pins A4 or SDA pin and A5 or SCL pin. Support TWI communication using the Wire library.

Reset Pin

Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board.

LED Indicators

Power LED Indicator – Just beneath and to the right of the word “UNO” on your circuit board, there’s a tiny LED next to the word ‘ON’. This LED should light up whenever you plug your Arduino into a power source. If this light doesn’t turn on, there’s a good chance something is wrong. Time to re-check your circuit!

On-Board LED – There is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it’s off. This useful to quickly check if the board has no problem as some boards has a pre-loaded simple blinking LED program in it.

TX RX LEDs – These LEDs will give us some nice visual indications whenever our Arduino is receiving or transmitting data (like when we’re loading a new program on to the board).

Reset Button

Pushing the reset button temporarily connect the reset pin to ground and restart any code that is loaded on the Arduino. This can be very useful if your code doesn’t repeat, but you want to test it multiple times.

2. INFRARED SENSOR MODULE

An infrared sensor emits infra rays in order to detect any object of its surroundings. An IR sensor can both detect the heat and motion of an object. The rays are not being seen by our eyes and can be identified by an IR. The emitter is a LED (Light Emitting Diode) and the detector is a photodiode.

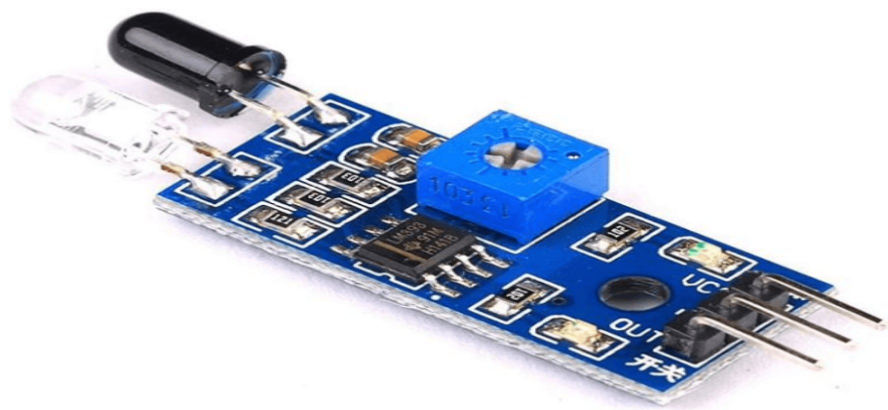

Figure 3.2.1.2: IR Sensor

3. LIQUID CRYSTAL DISPLAY

LCD (Liquid Crystal Display) Shown in fig. is an electronic display module. A 16x2 LCD display is very basic module and is very commonly used in different types of devices and circuits. These modules are preferred over seven segment and other multi segment LEDs.

A 16x2 LCD means it display 16 characters per line and there are 2 lines. By this LCD each character is displayed in 5x7 pixel matrix. This LCD contain two registers, thats are Command and Data. The command register stores the command instructions which is given to the LCD. A command is an instruction which is given to LCD to do a predefined task like initializing it, clearing its screen,

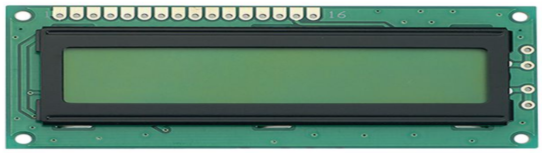

Figure 3.2.1.3: LCD

setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is in the form of ASCII value of the character to be displayed on the LCD.

The most commonly used Character based LCDs are based on Hitachi's HD44780 controller or other which are compatible with HD44580.

A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.

The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD.

Pin Description of LCD

Most LCDs with 1 controller has 14 Pins and LCDs with 2 controller has 16 Pins (two pins are extra in both for back-light LED connections). Pin description is shown in the table below. Pin Configuration table for a 16X2 LCD character display:-

Pin No.	Symbol	Function.
1	Vcc	Positive Supply
2	Vdd	Contrast adjustment
3	RS	Register Select; 0 - Instruction Register,1 - Data Register
4	R/W	Read/Write Signal; 1 - Read, 0 - Write
5	E	Enable; Falling Edge
6	DB	Bidirectional data bus, data transfer is performed once, thru DB0 to DB7 ,in the case of interface data length is 8 bits; and twice,through DB4 to DB7 in the case of interface data length is 4 bits. Upper four bits first then lower four bits.

Table 1 : LCD Pin Configuration

Data/Signals/Execution of LCD

LCD accepts two types of signals, one is data, and another is control. These signals are recognized by the LCD module from status of the RS pin. Now data can be read also from the LCD display, by pulling the R/W pin high. As soon as the E pin is pulsed, LCD display reads data at the falling edge of the pulse and executes it, same for the case of transmission.

LCD display takes a time of 39-43μS to place a character or execute a command. Except for clearing display and to seek cursor to home position it takes 1.53ms to 1.64ms. Any attempt to send any data before this interval may lead to failure to read data or execution of the current data in some devices. Some devices compensate the speed by storing the incoming data to some temporary registers.

Commands and Instruction set

Only the instruction register (IR) and the data register (DR) of the LCD can be controlled by the MCU. Before starting the internal operation of the LCD, control information is temporarily stored into these registers to allow interfacing with various MCUs, which operate at different speeds, or various peripheral control devices. The internal operation of the LCD is determined by signals sent from the MCU. These signals, which include register selection signal (RS), read/write signal (R/W), and the data bus (DB0 to DB7), make up the LCD instructions.

There are four categories of instructions that:

Designate LCD functions, such as display format, data length, etc.

Set internal RAM addresses.

Perform data transfer with internal RAM.

Perform miscellaneous functions.

Although looking at the table you can make your own commands and test them. Below is a brief list of useful commands which are used frequently while working on the LCD.

Command	Code										Description	Execution Time
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		
Clear Display	0	0	0	0	0	0	0	0	0	1	Clears the display and returns the cursor to the home position (address 0).	82μs~1.64ms
Return Home	0	0	0	0	0	0	0	0	1	*	Returns the cursor to the home position (address 0). Also returns a shifted display to the home position. DD RAM contents remain unchanged.	40μs~1.64ms
Entry Mode Set	0	0	0	0	0	0	0	1	I/D	S	Sets the cursor move direction and enables/disables the display.	40μs
Display ON/OFF Control	0	0	0	0	0	0	1	D	C	B	Turns the display ON/OFF (D), or the cursor ON/OFF (C), and blink of the character at the cursor position (B).	40μs
Cursor & Display Shift	0	0	0	0	0	1	S/C	R/L	*	*	Moves the cursor and shifts the display without changing the DD RAM contents.	40μs
Function Set	0	0	0	0	1	DL	N$	F	*	#	Sets the data width (DL), the number of lines in the display (L), and the character font (F).	40μs
Set CG RAM Address	0	0	0	1	A_{CG}						Sets the CG RAM address. CG RAM data can be read or altered after making this setting.	40μs
Set DD RAM Address	0	0	1	A_{DD}							Sets the DD RAM address. Data may be written or read after making this setting.	40μs
Read Busy Flag & Address	0	1	BF	AC							Reads the BUSY flag (BF) indicating that an internal operation is being performed and reads the address counter contents.	1μs
Write Data to CG or DD RAM	1	0	Write Data								Writes data into DD RAM or CG RAM.	46μs
Read Data from CG or DD RAM	1	1	Read Data								Reads data from DD RAM or CG RAM.	46μs
	I/D = 1: Increment I/D = 0: Decrement S = 1: Accompanies display shift. S/C= 1: Display shift S/C = 0: cursor move R/L= 1: Shift to the right. R/L= 0: Shift to the left. DL = 1: 8 bits DL = 0: 4 bits N = 1: 2 lines N = 0: 1 line F = 1: 5x10 dots F = 0: 5 x 7 dots BF = 1: Busy BF = 0: Can accept data *# Set to 1 on 24x4 modules* *$ With KS0072 is Address Mode.*										DD RAM: Display data RAM CG RAM: Character generator RAM A_{CG}: CG RAM Address A_{DD}: DD RAM Address Corresponds to cursor address. AC: Address counter Used for both DD and CG RAM address.	Execution times are typical. If transfers are timed by software and the busy flag is not used, add 10% to the above times.

Figure 3.2.1.4: Showing various LCD Command Description

Liquid crystal displays interfacing with Controller

The LCD standard requires 3 control lines and 8 I/O lines for the data bus.

8 data pins D7:D0

Bi-directional data/command pins Alphanumeric characters are sent in ASCII

RS: Register Select

RS = 0 - Command Register is selected

RS = 1 - Data Register is selected

R/W: Read or Write

0 - Write,   1 - Read

E: Enable (Latch data)

Used to latch the data present on the data pins. A high-to-low edge is needed to latch the data.

4. Digital Humidity and Temperature Sensor (DHT11):

The DHT11 sensor is an ultralow-cost temperature and humidity sensor. It uses a capacitance dampness sensor and a thermostat to calculate nearby surrounding, and throws out an output signal on the data pin. It can be used very easily, but needs correct timing to achieve data.

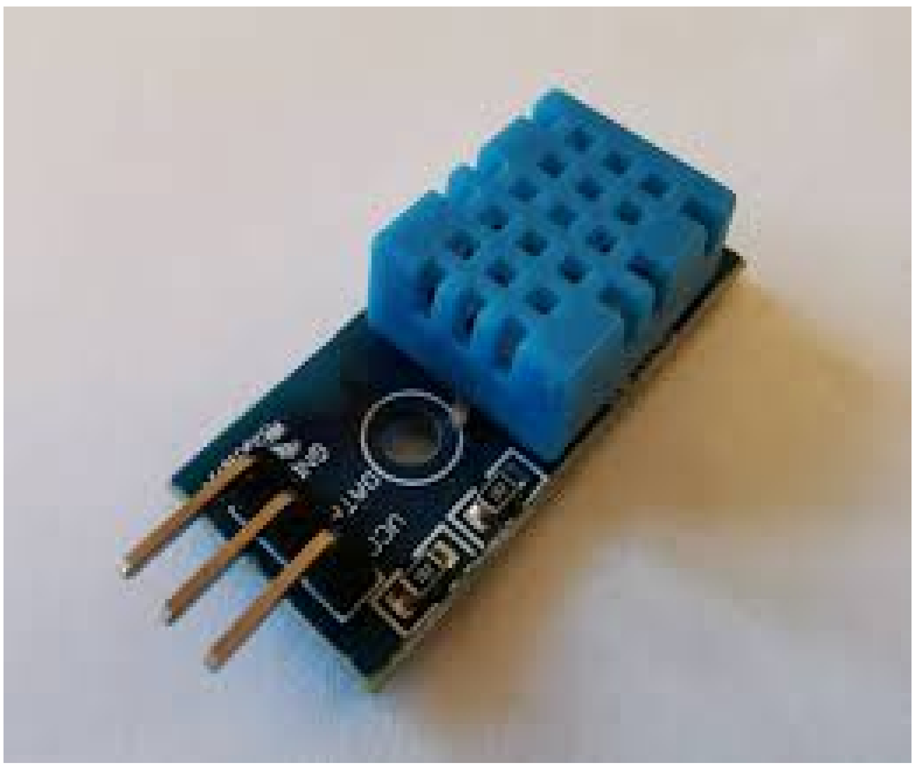

Figure 3.2.1.5: DHT11 Sensor

5. Relay Switch:

A relay is an electrically operated switch. Many relays are used to control various electrical appliances safely. Relays are used in a circuit controls by a separate less power signal and also many circuits can be controlled by only one signal.

Figure 3.2.1.6: Relay Switch

6. Buzzer:

A buzzer or alarm is an audio device, which may be of the following types, mechanical, electromechanical, or piezoelectric (piezo for short). Typical uses of buzzers include alarm devices and safety. It will notify the user if there is some kind of overload.

Figure 3.2.1.7: Buzzer

7. Electronic Devices:

Each of the 14 digital pins on the Uno can be used as an input or output. They operate at 5 volts. These pins can be used for both digital input (like telling if a button is pushed) and digital output (like powering an LED). Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20-5k Ohms. In addition, some pins have specialized functions.

Figure 3.2.1.8: LED

Figure 3.2.1.9: DC Fan

8. HARDWARE PLATFORM

In this model our main intension is to propose a model that consists a guest counter which will automatically switch on the electrical devices and also, the temperature and dampness will be measured inside an industry. The Proposed system's architecture diagram is given in Figure. An IR beam is used as the source of a light beam. Bidirectional Guest Counter, which helps in the automatic electrical devices controller and Arduino as the main control unit has two sections. DHT11 sensor is used for detecting room temperature and a buzzer will notify if there is highly increase of both people and temperature.

Monitoring Arduino Reading:

Arduino helps clients to screen different sorts of sensors, for example, IR sensor and motion sensors. The GPIO pins inbuilt on Arduino board can help as universal use I/P and O/P pins (GPIO). The ATmega328 micro-controller on the Arduino board carries out the analog-to-digital conversion, which changes the I/P signal from 0 to 1023.

Controller:

The activating is at last done by the Arduino door. The Arduino makes a move continuously to operate the on/off of the LED and controlling the buzzer. In this model it has two parts, one the transmitter section where the light output is given. The other is the receiver end where light is taken as input and applied on entry sensor circuit and exit sensor circuit.

System Protection:

Often random power supply may lead to damaging the components of the circuit. When the arduino cable is fed with the I/P power source then it sends the output of components. It provides a regular and static power supply and also protects from any type of power surges.

Infrared Sensing System

The IR module holds IR diodes and LEDs. Potentiometer is utilized for setting similar voltage at comparator’s one terminal and IR sensor detects any individual and give an adjustment in voltage at comparator’s second terminal. At that point comparator looks at other two voltages and a digital signal at output one is send for entry sensor and second for an exit sensor circuit.

Counter Display:

In this segment we have utilized LCD to show the number of guests in the room. The framework is outlined utilizing the Arduino(IDE) stage. At the point when Arduino check for zero condition (Zero condition implies nobody in the room) and discovers it is genuine then the Arduino kills the globule by deactivating the transfer through a transistor. Here there are two capacities for in and out. This addition or decrement is executed in LCD.

3.2.2 Software Requirements

3.2.2.1 Ardino IDE

The Arduino IDE is an open-source software, which is used to write and upload code to the Arduino boards. The IDE application is suitable for different operating systems such as Windows, Mac OS X, and Linux. It supports the programming languages C and C++. Here, IDE stands for Integrated Development Environment. The program or code written in the Arduino IDE is often called as sket- ching. We need to connect the Genuino and Arduino board with the IDE to upload the sketch written in the Arduino IDE software. The sketch is saved with the extension “.ino.”. The Upload button com- piles and runs our code written on the screen. It further uploads the code to the connected board. Before uploading the sketch, we need to make sure that the correct board and ports are selected.We also need a USB connection to connect the board and the computer. Once all the above measures are done, click on the Upload button present on the toolbar.The latest Arduino boards can be reset automatically before beginning with Upload. In the older boards, we need to press the Reset button present on it. As soon as the uploading is done successfully, we can notice the blink of the Tx and Rx LED. If the uploading is failed, it will display the message in the error window. We do not require any additional hardware to upload our sketch using the Arduino Bootloader. A Bootloader is defined as a small program, which is loaded in the microcontroller present on the board. The LED will blink on PIN 13.

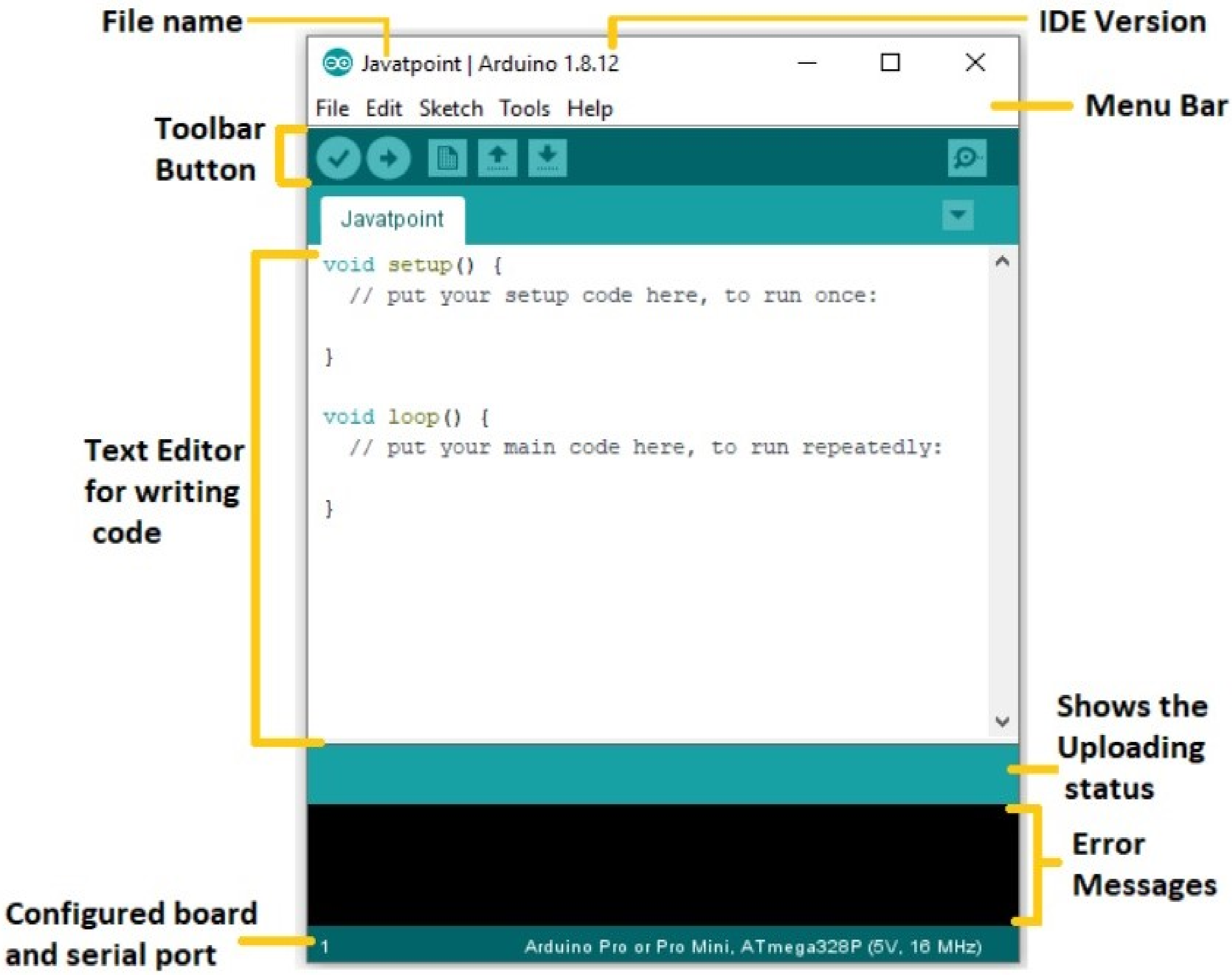

Figure 3.2.2.1.1: Arduino IDE

3.2.2.2 Software Libraries

i).DHT11.h:

The “DHT11.h”library is a software library that provides functions and methods for interfacing with the DHT11 sensor. The DHT11 is a commonly used sensor for measuring temperature and humidity.

The library encapsulates the necessary code and logic to communicate with the sensor, retrieve data, and handle any errors or anomalies that may occur during the communication process.

Some of the functions and capabilities typically provided by the “DHT11.h”library are:

1. Initialization: The library may include an initialization function that sets up the necessary configurations and parameters for communication with the DHT11 sensor. This function usually needs to be called before any data retrieval operations.

2. Data Retrieval: The library provides functions to retrieve temperature and humidity readings from the DHT11 sensor. These functions handle the low-level communication protocols required to receive the data from the sensor.

3. Error Handling: The library may include error handling mechanisms to detect and handle errors that can occur during communication with the DHT11 sensor. This could involve checking for checksum errors, timing issues, or sensor malfunction.

4. Conversion and Scaling: The library may include functions to convert the raw sensor data into meaningful temperature and humidity values. It may also provide options to scale the values to different units (e.g., Celsius or Fahrenheit for temperature).

5. Time Sensitivity: The DHT11 sensor has specific timing requirements for communication. The library may include timing functions or mechanisms to ensure that the sensor’s timing constraints are met during data retrieval.

6. Platform Compatibility: The library is typically designed to be compatible with specific microcontroller platforms or development environments, such as Arduino, ESP8266, or Raspberry Pi. It provides functions and interfaces that are tailored to work seamlessly with these platforms.

By using the “DHT11.h”library in our project, it can simplify the process of interfacing with the DHT11 sensor. The library abstracts away the low-level communication details and provides higher-level functions and error handling mechanisms, making it easier for developers to retrieve temperature and humidity data from the DHT11 sensor in their code.

ii) Liquid Crystal Display:

The “LiquidCrystal.h”library is a software library that provides functions and methods for interfacing with liquid crystal displays (LCDs). In your project, it is used to display the temperature and humidity readings retrieved from the DHT11 sensor on an LCD screen.

Some of the functions and capabilities typically provided by the “LiquidCrystal.h”library are:

1. Initialization: The library includes functions to initialize and configure the LCD display. These functions typically set up the necessary parameters such as the number of columns and rows of the LCD, the communication protocol (e.g., 4-bit or 8-bit), and the pin assignments for data and control signals.

2. Display Control: The library provides functions to control the display behavior, including turning it on or off, setting the cursor position, scrolling, and controlling the backlight (if supported by the LCD module).

3. Text and Character Output: The library includes functions to display text or characters on the LCD screen. These functions allow you to set the position of the text or characters and specify the content to be displayed. You can write individual characters, strings, or formatted data on the LCD.

4. Custom Characters: Some LCD modules support custom character creation. The library may provide functions to define and display custom characters on the LCD, allowing you to create custom symbols or icons for specific purposes.

5. Backlight Control (if applicable): If the LCD module has a backlight, the library may include functions to control the backlight brightness, turn it on or off, or adjust its intensity.

6. Special Functions: The library may also provide additional functions for special LCD features, such as controlling contrast (if supported), shifting the display, or creating graphical elements.

By using the “LiquidCrystal.h”library in our project, it can easily control and display the temperature and humidity readings from the DHT11 sensor on an LCD screen. The library abstracts away the low-level details of communicating with the LCD module and provides higher-level functions to initialize, control, and write data to the LCD, making it more convenient for developers to interact with the display in their code.

4. METHODOLOGY

The methodology of a bidirectional visitor counter involves several key steps to accurately track and count visitors in both directions. Here's a general methodology that can be followed:

Sensor Placement: Determine the appropriate locations to place the sensors or cameras. Typically, these sensors are installed at entry points or designated areas where visitors pass through.

Sensor Calibration: Calibrate the sensors to ensure accurate detection and counting of visitors. This involves adjusting parameters such as sensitivity, detection range, and angle to optimize performance.

Data Collection: Set up a mechanism to collect data from the sensors. This can be achieved through wired or wireless connections, depending on the specific implementation. Ensure that the data collected includes timestamps and the direction of movement (inward or outward).

Data Processing: Receive the data from the sensors and process it to extract visitor count information. Analyze the timestamps and direction of movement to differentiate between incoming and outgoing visitors. Apply filtering techniques to eliminate false readings or noise.

Count Calculation: Use algorithms or rules to calculate the visitor count based on the processed data. For bidirectional counting, increment the count when a visitor enters and decrement it when a visitor exits.

Storage and Persistence: Store the visitor count data in a suitable database or storage system. This allows for historical analysis and retrieval of visitor count information over time.

Reporting and Visualization: Develop a user interface or dashboard to display real-time visitor counts and historical data. Provide visualizations, charts, and graphs to present the data in a meaningful and accessible manner.

Error Handling and Maintenance: Implement error handling mechanisms to handle exceptional cases such as sensor malfunction, power outages, or connectivity issues. Regularly maintain and calibrate the sensors to ensure accurate and reliable counting.

It's important to note that the specific implementation and choice of technologies may vary based on the project requirements and available resources. For example, some systems may use infrared sensors, laser sensors, or computer vision-based cameras for visitor detection. The methodology should be tailored to the specific hardware and software components used in your bidirectional visitor counter project.

4.1 Architecture Design

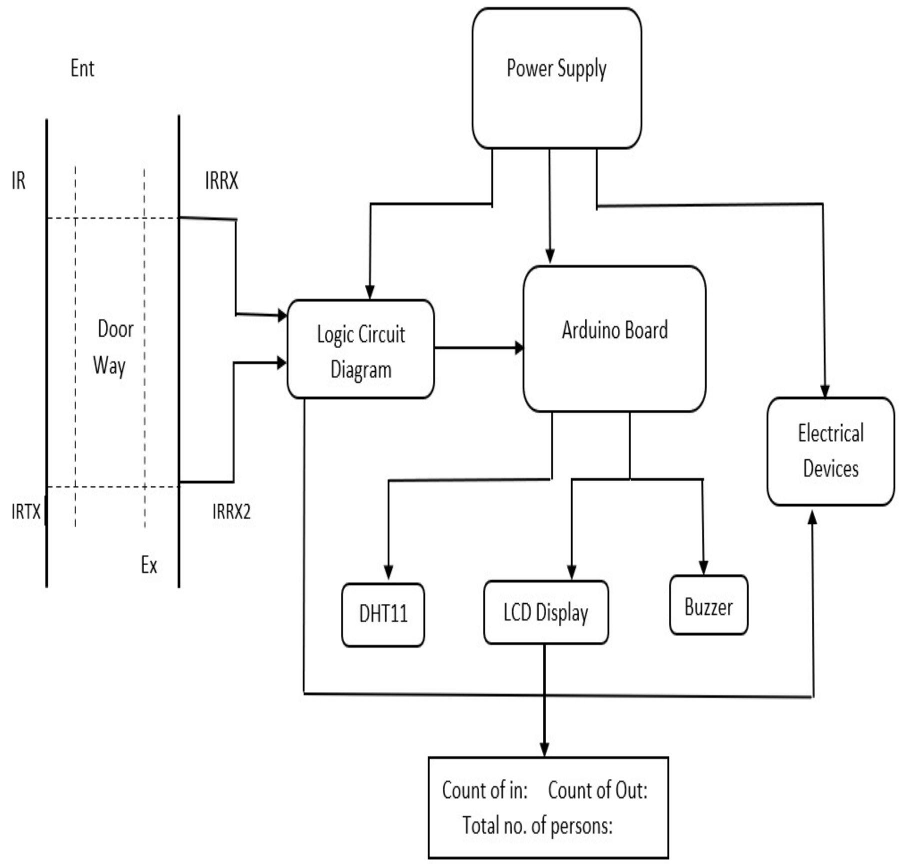

Figure 4.1.1: Block Diagram

First of all, we need to set one IR sensor (IR sensor-1) at the entry gate and another one (IR sensor-2) set at the exit gate. Normally when IR sensors do not detect any obstacle, it produces a HIGH (1) output value from the Output Pin.

When a visitor enters through the entry gate the IR sensor-1 detects the visitor (obstacle) and produces a Low (0) output value from the Output Pin. Then the Arduino read this value and counts 1+ using the code. Similarly, When the IR sensor-1 detects another visitor (obstacle), the Arduino increment the counting by 1+. In this way every time the Arduino adds +1 in the count when a visitor passes through this gate and calculates the total number of entering visitors.

In the same way, when a visitor leaves through the exit gate the IR sensor-2 detects the visitor (obstacle) and produces a Low (0) output value from the Output Pin. Then the Arduino read this value and counts 1+ using the code. Similarly, When the IR sensor-2 detects another visitor (obstacle), the Arduino increment the counting by 1+. In this way every time the Arduino adds +1 in the count when a visitor passes through this gate and calculates the total number of exiting visitors.

Every time Arduino Subtracts the total number of entering visitors from the total number of exiting visitors to calculate the total number of visitors currently present inside the place.

After counting and calculating all numbers the Arduino sends data to the 16×2 LCD Display. The LCD Display shows the total number of entering visitors, the total number of exiting visitors, and the total number of visitors currently present inside the place. The LED starts glowing when no one is present inside that place.

4.2 Modules

Modules are important to have a precise overview on the development of the project process so that while execution, clarity of the next step is maintained.This project has following modules:

i) Counting the Visitors

ii) Device Automation

iii) Environment Monitoring

iv) Buzzer

i) Counting the Visitors: In this module, we count the number of incoming and outgoing people using two IR sensors and the count will be displayed on LCD screen, if anyone enters or leaves the room the count gets updated.

In an IoT-based bi-directional visitor counter project, the counting of visitors module typically involves capturing and analyzing data from sensors to determine the number of people entering and exiting a particular area. Here are the key components and steps involved in the counting module:

1. Sensors: This project requires sensors to detect the presence of people. Commonly used sensors include infrared sensors, ultrasonic sensors.
2. Data collection: The sensors capture data whenever someone enters or exits the monitored area. The data collected can be in the form of interruptions in the infrared beam, changes in ultrasonic waves.
3. Signal processing: The raw data collected from the sensors needs to be processed to filter out noise and extract meaningful information. Signal processing techniques are used to analyze the sensor data and identify the relevant events, such as a person entering or exiting.
4. Direction determination: To count the number of visitors accurately, the direction of their movement must be determined. This is typically done by analyzing the sequence of sensor events. For example, if a sensor near the entrance detects a person before a sensor near the exit, it can be inferred that the person is entering the area.
5. Counting algorithm: A counting algorithm keeps track of the number of visitors based on

the direction of their movement. It increments the count when a person enters and decrements it when a person exits and the algorithm is account for potential errors or false readings and provide reliable counts.

6. Data storage and communication: The visitor counts can be stored locally on the IoT device or sent to a central server for storage and analysis.

7. Visualization and reporting: The visitor counts can be displayed on a local display,i.e LCD

ii) Device Automation: In this module, Based on the count of people that are inside the room, the lights and fans will automatically switch.

The device automation module in IoT-based bi-directional visitor counter project is responsible for controlling the lights and fans based on the number of visitors to save electricity. Here are the components and steps involved in the device automation module:

1. Actuators: We need actuators to control the lights and fans. we used relay switch to control them.

2. Connectivity: The actuators are connected to the IoT system directly ,This allows you to send commands to turn the lights and fans on or off remotely.

3. Decision logic: The device automation module needs a decision logic algorithm to determine when to turn the lights and fans on or off based on the number of visitors. The algorithm can be programmed to define thresholds, such as turning on the lights and fans when the visitor count exceeds a certain value and turning them off when the count drops below a specific level.

4. Integration with the counting module: The device automation module needs to communicate with the counting module to receive real-time visitor count updates. This could involve establishing a connection between the two modules and exchanging data.

5. Feedback mechanism: To ensure the system operates correctly, a feedback mechanism can be implemented. This could involve confirming that the lights and fans have actually turned on or off by receiving feedback from the actuators or sensors connected to them. If the desired state is not achieved, appropriate actions can be taken, such as re-issuing the control command

or raising an alert.
6. Manual override: It's a good option to include a manual override option to allow users to manually control the lights and fans if needed. This can be implemented through physical switches or a user interface in the IoT system. By combining the counting module and the device automation module, you can effectively control the lights and fans based on the number of visitors, optimizing energy consumption and saving electricity.

iii) Environment Monitoring: In this module, Temperature and Humidity Sensor are added to the model, which keeps the track of the room temperature.

Under environmental monitoring, we are using a DHT sensor to collect readings, and the data will be displayed on an LCD screen. Here are the key components and aspects that come under the environmental monitoring module: 1. Sensor: The DHT sensor is used to measure environmental parameters such as temperature and humidity. It consists of a temperature sensor and a humidity sensor integrated into a single module.
2. Data acquisition: The sensor continuously measures the temperature and humidity values in the environment. The data acquisition process involves reading the analog or digital output from the DHT sensor.
3. Signal conditioning: The raw data from the sensor may need some processing or calibration to ensure accurate measurements. This could involve linearization, filtering, or applying correction factors to compensate for any known sensor biases or environmental factors.
4. Microcontroller: A microcontroller or a similar computing device is used to interface with the DHT sensor, acquire the data, and perform any necessary calculations or data manipulation. The microcontroller typically has input/output (I/O) pins to connect the sensor and output devices like the LCD screen.
5. Display: An LCD screen is used to visually display the temperature and humidity readings. The microcontroller sends the processed data to the LCD screen, which can be a character-based or graphical display. The data is updated periodically to reflect the real-time measurements.

6. User interface: The microcontroller can incorporate a user interface to provide interaction and control over the environmental monitoring system. This interface can include buttons.
7. Power management: The environmental monitoring system needs a power supply to operate. This could involve using batteries, a power adapter techniques depending on the specific requirements and deployment scenario.
8. Optional: Logging and connectivity: In some cases, the environmental monitoring system may include features for data logging and connectivity. This can involve storing the sensor readings in a memory device or transmitting the data to a central server or cloud platform for further analysis and monitoring.

By using the DHT sensor and the LCD screen, we can monitor and display the real-time temperature and humidity values, providing valuable information about the environment's conditions. This module can be extended to include additional sensors or functionalities depending on your specific requirements, such as air quality sensors or data logging capabilities.

iv) Buzzer: In this module, Based on the count of people, if the people in the room exceeds certain limit a beep will be buzzed indicating that the room is overcrowded.

is responsible for producing an audible beep when the number of people in a room exceeds a certain threshold. Here are the key components and aspects that come under the buzzer module:
1. Buzzer: The buzzer itself is an audio output device that emits a sound when activated. It can be a piezoelectric buzzer, an electromagnetic buzzer, or any other type suitable for generating audible alerts.
2. Threshold determination: You need to define the threshold value for the maximum number of people allowed in the room. This threshold can be set based on the room's capacity or any other specific criteria.
3. Connection to counting module: The buzzer module needs to communicate with the counting module to receive real-time updates on the number of people in the room. This can be achieved

through a connection between the two modules, allowing the buzzer module to receive the visitor count data.

4. Comparison and activation logic: The buzzer module contains a comparison logic that compares the current visitor count with the defined threshold. If the count exceeds the threshold, the buzzer is activated to produce a sound. The logic can be implemented using a microcontroller or a similar computing device.

5. Buzzer control: The buzzer control mechanism involves sending a signal to the buzzer to activate it. This can be achieved using a transistor or a relay to provide the necessary power and control signals to the buzzer.

6. Audible alert: When the visitor count exceeds the threshold, the buzzer is activated, emitting an audible sound to alert individuals in the room about the situation

7. Power supply: The buzzer module requires a power supply to operate. This can be provided by the main power source of the IoT system or by using a separate power source if needed.

By incorporating the buzzer module into your visitor counting system, you can create an audible alert mechanism that notifies when the number of people in the room exceeds a specific threshold, helping to maintain safety and compliance with occupancy limits.

5. IMPLEMENTATION

The Source Code for Arduino Bidirectional Visitor Counter with Automatic Light Control System is given below.

Source Code:

```
#include< LiquidCrystal.h>
LiquidCrystal lcd(2,3,4,5,6,7);
#define in 8
#define out 9
int count=0;

void IN()
{
count++;
lcd.clear();
lcd.print(”No of Persons:”);
lcd.setCursor(0,1);
lcd.print(count);
delay(1000);
}

void OUT()
{
count–;
lcd.clear();
lcd.print(”No of Persons:”);
lcd.setCursor(0,1);
```

```
lcd.print(count);
delay(1000);
}

void setup()
{
lcd.begin(16,2);
lcd.print(”POWER SAVING”);
delay(2000);
pinMode(in, INPUT);
pinMode(out, INPUT);
lcd.clear();
lcd.print(”No of Persons:”);
lcd.setCursor(0,1);
lcd.print(count);
}
void loop()
{
if(digitalRead(in))
{
IN();
}
if(digitalRead(out))
{
OUT();
}
}
```

6. RESULTS AND DISCUSSION

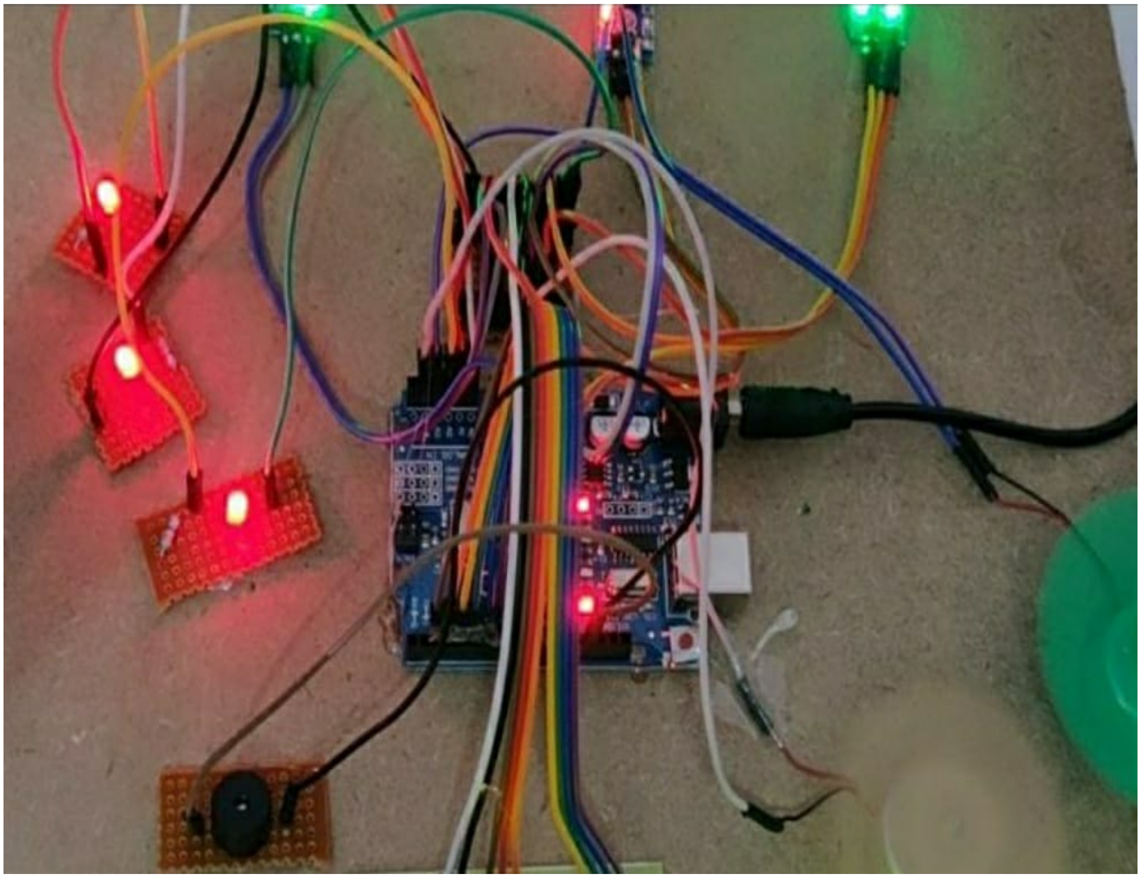

Figure 6.1: System Connections

The Figure 6.1 shows the systems connections where two IR sensors and one LCD display are connected to different pins of an Arduino uno board. Connections are made on bread board,IR sensors are used to sense the number of people incoming and outgoing. LCD display is used to show the number of guests in the room. Lights and fans are automatically switched on and off based on number of incoming people, DHT sensor which is used to sense the temparature and humidity of room temparature is connected and buzzer buzzes if the number of people reached certain limit.

The Figure 6.2 shows the device automation of the system, Initially when first person

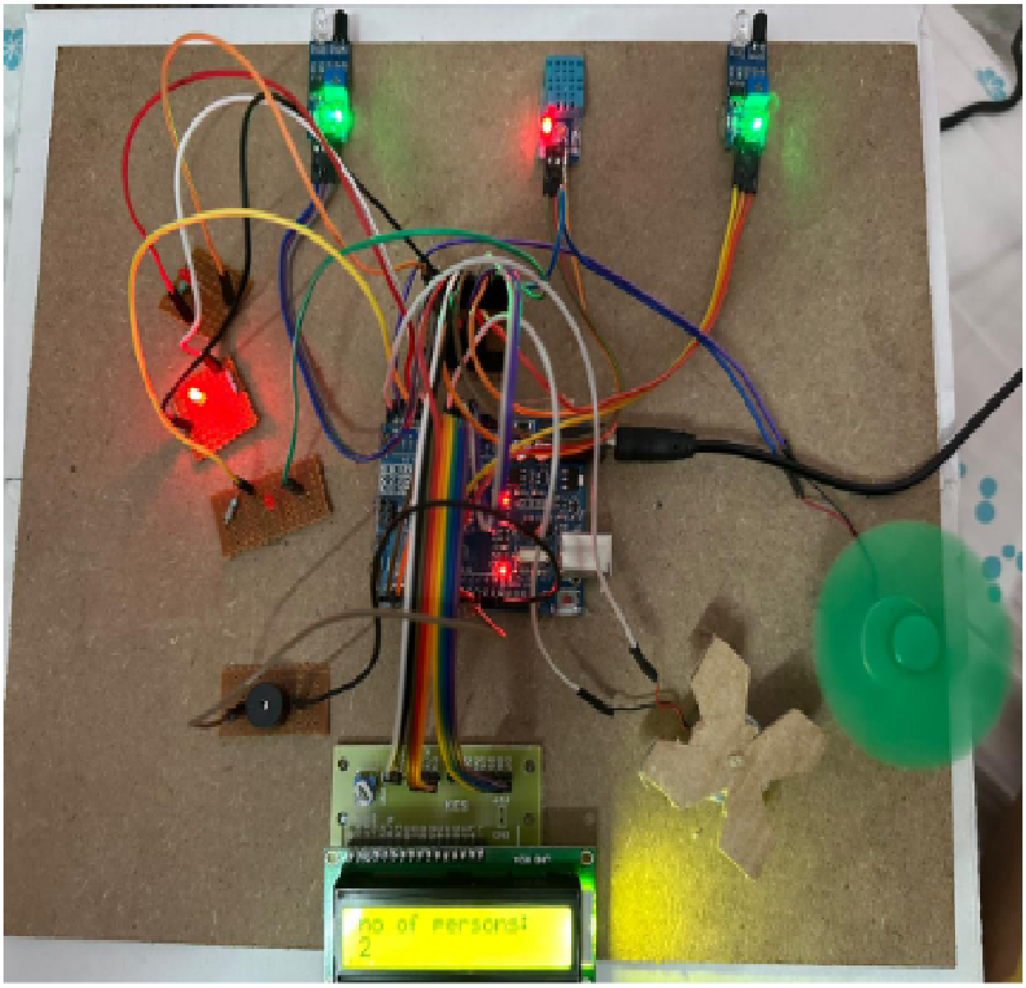

Figure 6.2: Device Automation

enters the room one light and fan are switched on and as the number of people reaches greater than 5 two lights and two fans are switched on as shown in below figure 6.3 .

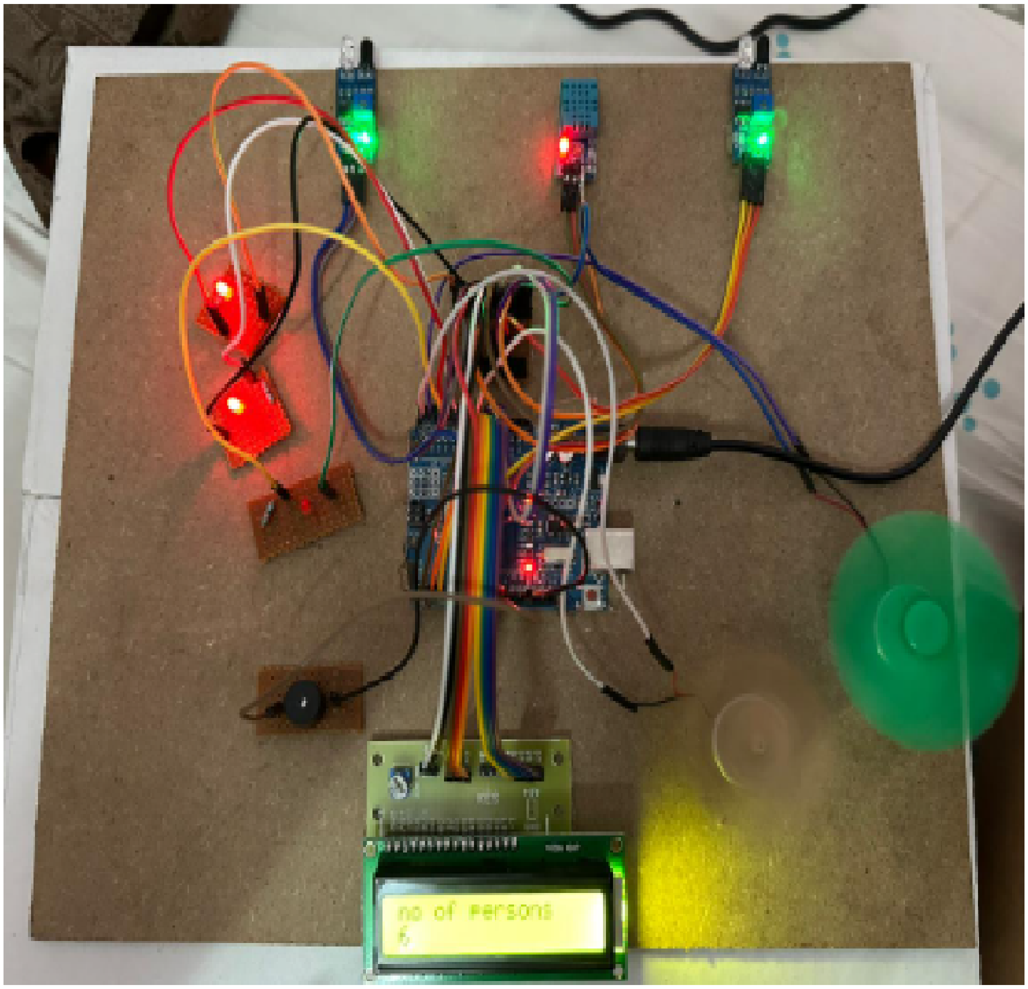

Figure 6.3: Device Automation

The figure 6.4 shows that when the count of people reaches above 10 then the subsequent three lights and two fans are switched on as shown below.

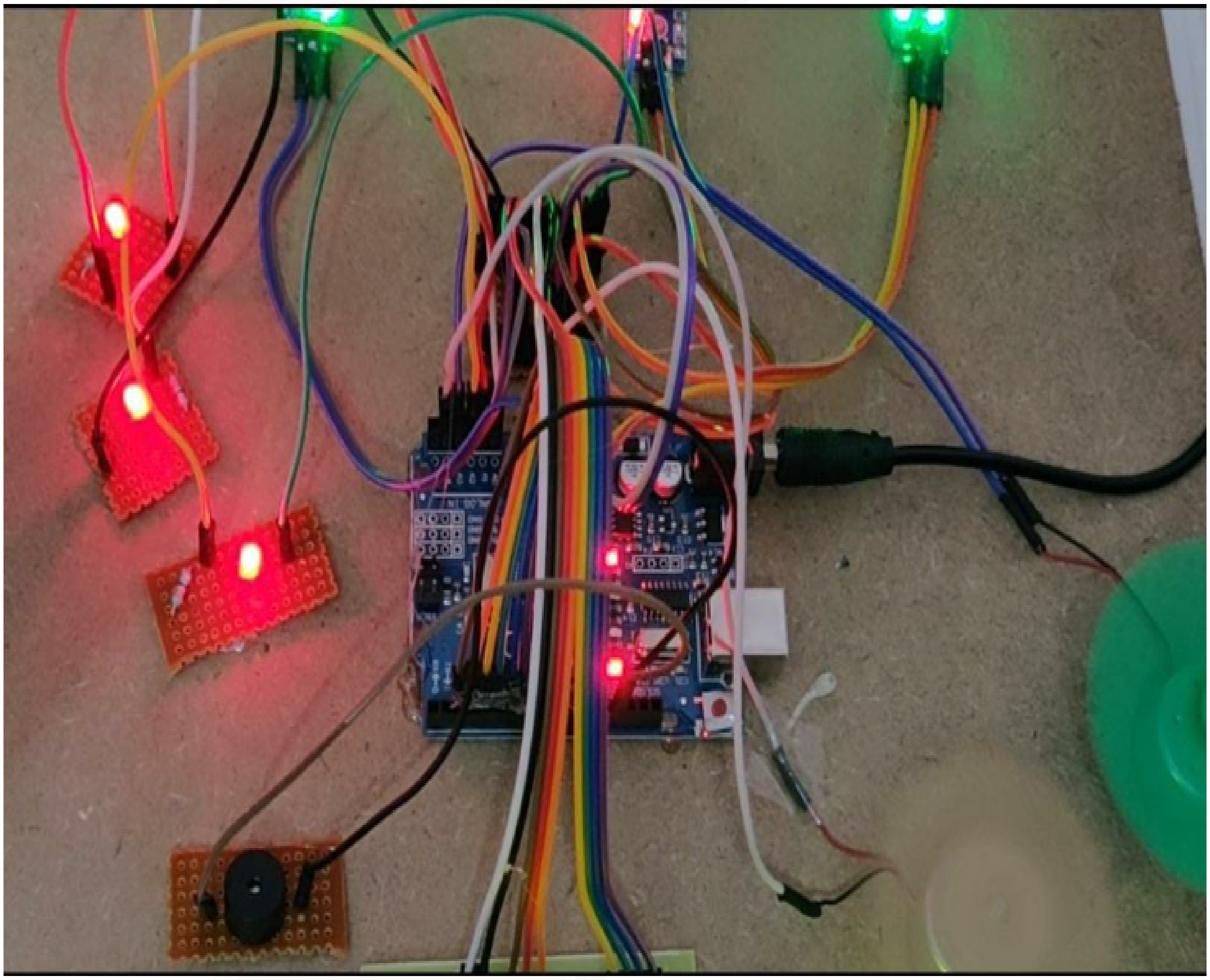

Figure 6.4: Device Automation

Figure 6.5: Environmental Monitoring

Fig shows environmental monitoring of the system which includes a DHT11 Sensor Temperature Humidity Sensor features a temperature humidity sensor complex with a calibrated digital signal output. By using the exclusive digital-signal-acquisition technique we can obtain the readings of temparature and humidity whose display is shown on the LCD.

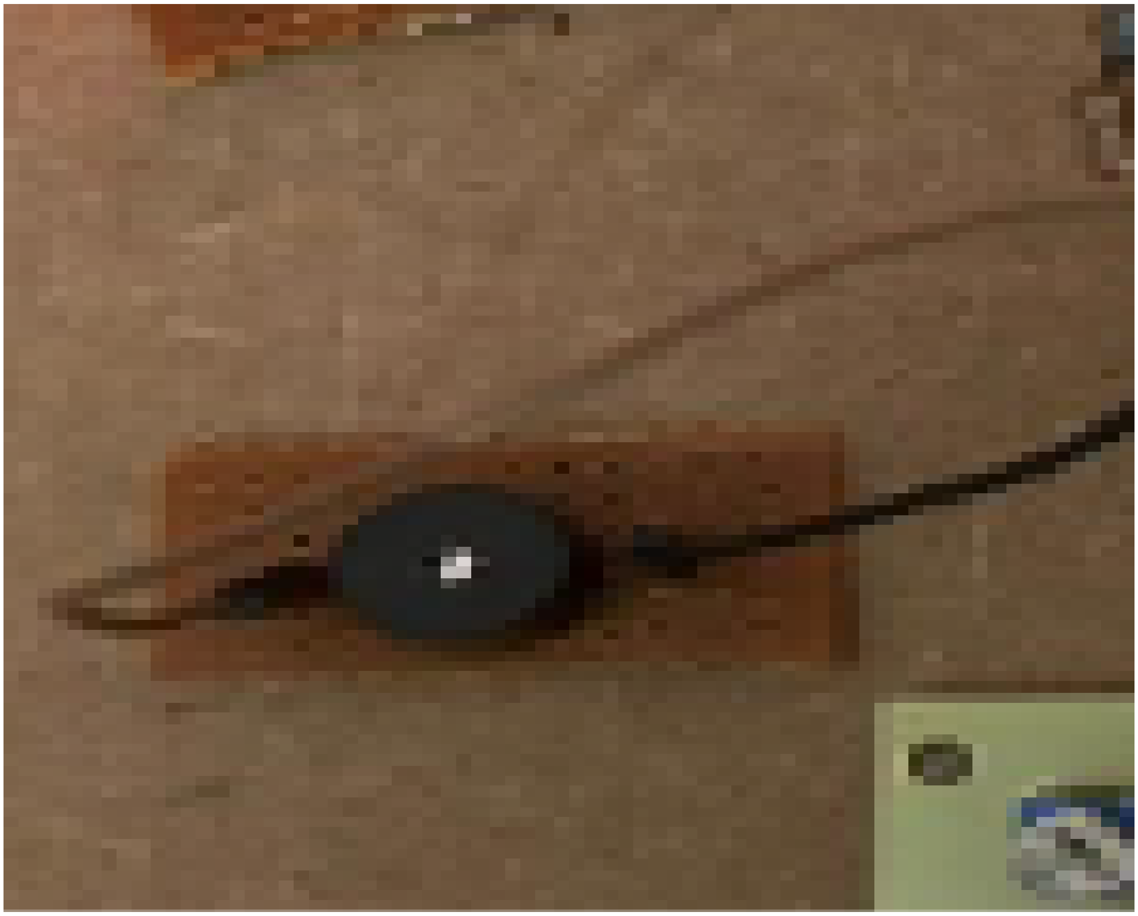

Figure 6.6: Buzzer

The above Figure 6.6 shows Buzzer connected to the Arduino UNO board,which is an audio signaling device,it may be mechanical, electromechanical, or piezoelectric which helps us in warning or alarming necessary situations in this case the buzzer beeps when the number of people are more than 15.

6.1 Analysis of Power Comsumption

The Bi directional visitor counter is used to save the power consumption in many aspects of life.

The formula to calculate power consumption is as follows

Power Consumed = Wattage x Duration

Power Consumed in units = (Wattage x Duration)/1000

We have tested it against a class room for 8 hours where there are 3 tubelights and 2 fans(the wattage of the tubelights is 40 watts and the fan is 100 watts, the count of maximum number of people that this counter permits is 15. Initially 13 people entered into the room which means all the three lights and two fans turned on.

Later after 3 hours 4 people left the room leaving 9 people in the room due to which tubelight-3 turned off as the counter is set to turn off tubelight-3 when count is less than or equal to 10. So, the amount of time tubelight-3 was turned on is 3 hours.

So, Power consumed by tubelight-3 per a day = wattage x duration

= 40 x 3

= 120

Power consumed by tubelight-3 per a day in units = (wattage x duration)/1000

= 120/1000

= 0.12 units/day

Later after 2 more hours 5 people left the room leaving 4 people in the room due to which tubelight-2 and fan-2 turned off as the counter is set to turn off tubelight-2 and fan-2 when count is less than or equal to 5. So, the amount of time tubelight-2 and fan-2 were turned on is 5 hours.

So, Power consumed by tubelight-2 per a day = wattage x duration = 40 x 5

= 200

Power consumed by tubelight-2 per a day in units = (wattage x duration)/1000

= 200/1000

= 0.20 units/day

Power consumed by fan-2 per a day = wattage x duration

= 100 x 5

= 500

Power consumed by fan-2 per a day in units = (wattage x duration)/1000

= 500/1000

=0.5units/day

Later after 3 more hours 4 people left the room leaving the room empty due to which tubelight-1 and fan-1 turned off as the counter is set to turn off tubelight-1 and fan-1 when count is less than 1. So, the amount of time tubelight-1 and fan-1 were turned on is 8 hours.

So, Power consumed by tubelight-1 per a day = wattage x duration

= 40 x 8

= 320

Power consumed by tubelight-1 per a day in units = (wattage x duration)/1000

=320/1000

= 0.32 units/day

Power consumed by fan-1 per a day = wattage x duration

= 100 x 8

= 800

Power consumed by fan-1 per a day in units = (wattage x duration)/1000

= 800/1000

= 0.80 units/day

Total power consumed by all the electronic devices with using visitor counter

= 0.12+0.20+0.32+0.80+0.50

= 1.94 units/day

Therefore, Annual consumption of total power consumed by all electronic devices using visitor counter = 1.94 x 365 = 708.1 units

Observing the same class room for 8 hours without using this visitor counter we observed that at the beginning of the day when 13 people entered the room they have turned on all the three tube lights and 2 fans leaving them turned on for all the 8 hours irrespective of the people that left the room.

Due to this we can say that the power consumed by the electronic devices in a class room per a day without using visitor counter is as follows

Power consumed by tubelight-1, tubelight-2, tubelight-3 per a day in units = (40 x 8)/1000

= 0.32 units/day

Power consumed by fan-1 and fan-2 per a day in units = (100 x 8)/1000

= 0.80 units/day

Total power consumed by all the electronic devices with using visitor counter

= 0.32+0.32+0.32+0.80 +0.80

= 2.56 units/day

Therefore, Annual consumption of total power consumed by all electronic devices using visitor counter = 2.56 x 365 = 934.4 units

So, Annually a total of 226.3 units of power will be saved using this visitor counter

Below is the tabular representation of the analysis of power consumption.

Devices	Power Consumed with using visitor counter	Power Consumed without using visitor counter
Tubelight-1	0.32 units	0.32 units
Tubelight-2	0.20 units	0.32 units
Tubelight-3	0.12 units	0.32 units
Fan-1	0.80 units	0.80 units
Fan-2	0.50 units	0.80 units
Total Power Consumed	1.94 units/day	2.56 units/day
Annual Consumption	708.1 units	934.4 units

Table 2: Analysis table

7. CONCLUSION & FUTURE SCOPE

The IoT-based bi-directional visitor counter project offers an efficient and automated solution for counting and monitoring visitors in a space. By combining various modules such as counting, device automation, environmental monitoring, and a buzzer, the system accurately counts visitors, optimizes energy usage, monitors environmental conditions, and alerts when visitor thresholds are exceeded.

This project provides several benefits, including improved visitor management, enhanced energy efficiency, and the ability to maintain safe and comfortable conditions within a space. It offers real-time data collection and analysis, enabling better decision-making for resource allocation and facility management.

In Future we will be trying to implement this model in real time scenarios such as classrooms and malls since it helps in saving power and maybe integrating with cloud platforms can enhance scalability, data storage, and remote management capabilities. Cloud integration allows for real-time monitoring, data backup, and analytics.

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