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BIDIRECTIONAL VISITOR COUNTER WITH AUTOMATIC ROOM LOAD CONTROLLER

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ABSTRACT

This paper displays the circuit of automation system used for industrial purpose. This system counts the number of persons into the specific halls or rooms bi-directionally. This counting will be very accurate. The system consist of two IR sensor at the entry point and exit point which detect the entering and exiting person using the infrared ray. This system also helps for automatic control of load inside the hall or room. When the first person entering the room, detected by the sensor count 1 will display on LCD and it leads to turn on automatically lights and fans inside the room and it will automatically turned off after the room become vacant. The System not only display the entering and exiting person count but also Provides the count of people inside the room. This approach minimizes the level of manual intervention, enhanced energy saving, and maintains comfort inside the room.

Keywords: Arduino, Bidirectional Visitor Counter, Room Load Control, Infrared, LCD Interface.

I. INTRODUCTION

In today's world of automation, Industries require a large number of work force and maintenance. At many places, we need to monitor the people entering or exiting from the areas such as shopping malls and Seminar halls. Over a year ago, manpower was essential to monitor the visitor count in these locations. There is a need of developing an automation system to ease the complexity, reduce manpower, labor cost and reduce the consumption of electricity. To provide a solution for this we are going to implement a device called a Bidirectional visitor counter with an Automatic Room load control feature within it. The major concept behind the project is to Count and display the number of people entering and exiting the room. This project operates in two primary functions it increases the count when an individual enters the room and decreases the count when someone exits. Additionally, it assists in managing the electrical loads within the room.by turning on the room lights and fan automatically when the person enters the room and also turn off automatically when the whole room becomes empty. The initial method for counting the visiting peoples in such areas is to hiring a individual person who manually stands and calculate number of guests enters or exits the room. This method could be unreliable and comes at great cost. It may be confusing for a person to tally the number of individuals entering and exiting simultaneously. Additionally, hired personnel occasionally forget to turn off the lights, fans and air conditioner after the ending of seminar and closing of malls which leads to caused electrical wastage. Our intension is to design and develop a device which manage human traffic in a large sectors and reduce the efforts of Turning lights and fans on and off also conserve the usage of electricity. This tracking of attendees also aids in evaluating the feedback from the seminars. Our main aims in paper is constructing a bidirectional visitor counter with load controller using arduino microcontroller and calculate number of people in a hall or building at a same time and turn the lights on and off when people enters or leaves the hall.

II. LITERATURE REVIEW

The system will automatically activate room lighting and fans upon detecting an entry, and turn them off when the last person exits. This feature not only enhances user comfort but also contributes to energy conservation (Jones & Lee, 2020).

By automating the counting process, businesses can significantly reduce the need for manual labor, thereby lowering operational expenses associated with staffing (Brown et al., 2019).

The reliance on automated sensors minimizes the risk of counting errors that are common with manual tallying (Williams, 2022).

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The collected data can be utilized for analyzing visitor trends during seminars or events, providing valuable insights for future planning (Taylor & Nguyen, 2021)

III. MATERIALS AND METHODS

A. System Overview:

The system consists of three main parts.

Bi-directional Visitor Counter: With sensors, it tallies the entering and exiting people in the room.

Room Environmental Control: Controls lighting and fans upon the number of people occupying the room.

Arduino Controller: It is where counting and the control operations will be synchronized with sensor inputs.

B. Hardware Description:

1. Arduino UNO: The Arduino UNO is a microcontroller board built around the ATmega328P chip. It features 14 digital input/output pins, of which 6 can be utilized for Pulse Width Modulation (PWM), and 6 analog input pins. Additionally, the board includes a 16 MHz crystal oscillator, a USB interface for connectivity, a power jack for external power supply, and a reset button for easy reinitialization. This comprehensive setup allows users to easily connect to a computer or power source, making it ideal for various electronic projects.

2. IR Sensor: An IR sensor, or infrared sensor, is an electronic device designed to measure and detect infrared radiation. These sensors commonly utilize a photodiode or phototransistor to sense the infrared radiation and convert it into an electrical signal. This capability allows them to be used in various applications, including motion detection and temperature measurement.

3. Two Channel relay; The two channel module is used to control two high power devices. It can switch 2 loads independently.

4. 12C LCD display: An 12C LCD display is a liquid crystal display that uses the 12C protocol to communicate with other devices. It is used as the interface of the system.

5. 5V 5A SMPS: SMPS stands for switch mode power supply it is an electronic power supply device which converts the AC Power into the DC. Here it convert 220V alternating current into 5V 5A direct current.

C. Software Description.

1. Arduino IDE 2.3.3 : This IDE is used for programming arduino microcontroller. This integrated development environment (IDE) accommodates both C and C++ programming languages by implementing specific coding structure guidelines.

D. Visitor Counting:

The system maintains the count of IR sensors installed at entry and exit points of the room. The count goes up by one, meaning there is an entry of a person in that room, in case the entry sensor is activated first .In case the exit sensor is activated first, the count goes down by one, thus there is an exit of the room by someone .The LCD displays the real-time count for easier monitoring purposes.

E. Room Environmental Control:

Light and Fan Control: It should automatically turn the lights and Fans on if people count becomes 1 inside. Otherwise, it should automatically switch off the loads when the count become 0 to conserve energy.

F. Test Cases:

Case 1: Empty Room: Light and fan remained switched off since no one was there.

Scenario 2: Occupied room: When count become 1, lights and Fans are ON.

Scenario 3: Exitting People: In the people counting, the system turned off the fan and light when the counted people had gone 0.

IV. WORKING PRINCIPLE

The Bidirectional visitor counter with load controller operates in such a way first we need to position IR Sensor A at the entry point and IR Sensor B at the exit point. The sensors are connected to the digital pins of Arduino UNO. When someone enters the room the (IR sensor-A) will get Triggered and sends the output value to the arduino. Then arduino read the value and count +1 as it programmed also sends the signal to the relay module connected to its another digital pins which will get triggered and leads to turning on lights and fans inside the

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room. Likewise, when IR Sensor A detects an additional visitor, the Arduino increases the count by one. This process continues, with the Arduino adding one to the total each time a visitor enters the room, thereby calculating the number of incoming visitors.

Similarly when the visitors leaves the room from the exit gate, equipped with IR Sensor B, detects any obstacles get triggered and sends the output to arduino. Then the arduino increment the number of exiting visitors count from this gate by +1. Each time a visitor exits the room, the Arduino increases the count by one and calculates the total number of occupants by subtracting the number of exiting visitors from the total number of entering visitors. When the count of individuals inside the room reaches zero, the Arduino sends a signal to a relay, which then turns off the lights and fan in the room.

All the counted and calculated data regarding visitors in the room is transmitted to an LCD display. The LCD shows the total number of individuals entering the room, those exiting, and the current number of visitors present. The entire system is powered by a switched-mode power supply (SMPS), which converts 230V AC into a 5V, 5A DC supply.

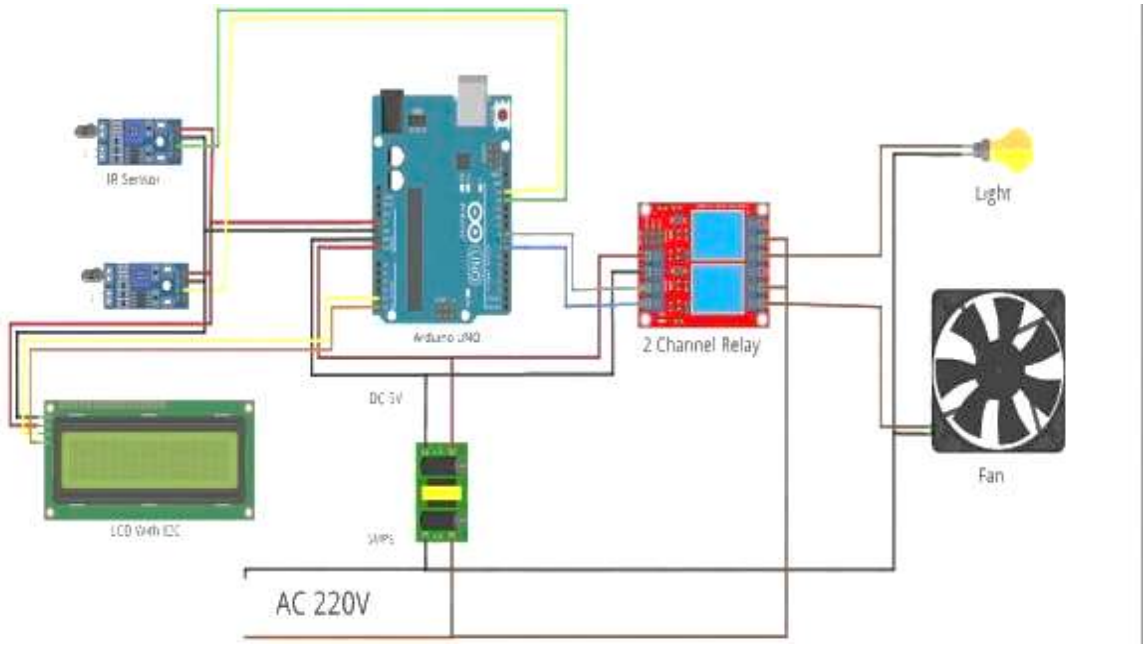

Figure 1: Bidirectional visitor counter with Automatic Room load control

V. ALGORITHM

- Initialization: Initialize the number of visitor to 0, Initialize all the devices such as PIR sensors, light, fan, and LCD.
- Counting logic
- Whenever the entry sensor will be activated then visitor count will get increment
- Whenever the exit sensor will be activated then visitor count will get decremented
- The updated count will be shown on the LCD.
- Control logic
- If Visitor count is greater than 0 then turn ON the light.
- If the visitor count is above a predefined limit (e.g. 3 people), turn on fan
- If visitor count is 0, turn off light and fan

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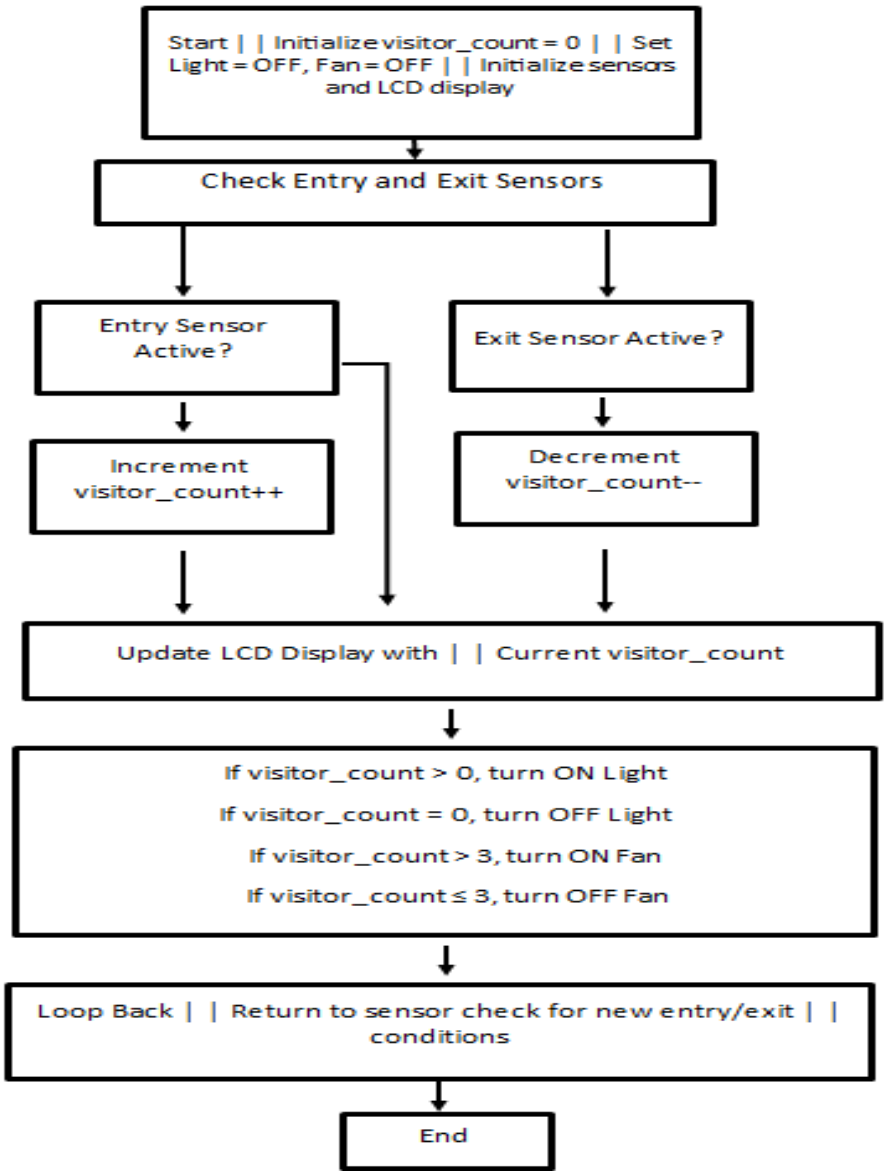
VI. FLOW CHART



VII. APPLICATION

1. The system can be used in classroom to automatically control lights and fans based on the number of student in class room
2. Monitor and manage energy usage in office space.
3. Track visitors traffic while optimizing energy usage in shopping mall.
4. Ensure that devices are only on when visitors are present, saving energy in libraries.

VIII. RESULT

The seamless integration of light and fan controls with visitor counting data represents a significant advancement in smart building technologies. By employing Arduino-based systems, the method enhances energy efficiency and comfort within spaces that experience varying occupancy levels. The data collected by bi-directional visitor counters can be programmatically analyzed to adjust light and fan according to real-time occupancy, thereby optimizing energy use. When visitor counts are low, for instance, lights and fans can be turned off entirely, leading to substantial energy savings and lower operational costs.This dynamic interaction not only elevates user experience but also contributes to sustainable building practices, making it a crucial area for further exploration in environmental resource management.

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Labor Cost Savings

Table 1: Labor Cost Savings

Description	Manual Counting	Automated System	Savings
Daily Cost	₹500	₹2,000 (maintenance)	
Monthly Cost	₹15,000	₹2,000	
Monthly Savings			₹13,000
Annual Savings			₹156,000

Energy Savings Calculation

Table 2: Energy Savings Calculation

Description	Without Automation	With Automation	Savings
Daily Energy Consumption	8.1 kWh	5.4 kWh	
Monthly Energy Consumption	243 kWh (8.1 kWh × 30)	162 kWh (5.4 kWh × 30)	
Monthly Cost (Electricity at ₹7/kWh)	₹1,701	₹1,134	
Monthly Energy Savings			₹567

IX. CONCLUSION

The bidirectional visitor counter with load controller is made using arduino microcontroller which reduce its complexity compared to other systems. This paper describes its circuit which is used for counting the number of people entering or leaving from the room and automatically control room load such as lights and fans. When someone enters the room the counter will be increment accordingly the lights and fans in the room will be turn on and after the room become empty it will automatically turn off. Count of the people will be displayed on LCD display.

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