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Cabin detector with counter in binary representation

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Abstract -- This project represents a Human Presence Detection System designed for cabins, classroom, office environments, using a combination of electronic components to monitor and display the number of people entering a designated area. The components of the system include a Passive Infrared (PIR) sensor, a timer IC, a counter IC, a transistor, a voltage supply, and a set of four Light Emitting Diodes (LEDs) serving as a binary display. The PIR sensor serves as the primary input device, detecting infrared radiation emitted by human bodies. Upon detecting a presence, the PIR sensor gives out a signal to the transistor, the NPN transistor amplifies the signal and gives out a LOW signal to the timer IC, initiating a sequence of electronic processes. The system utilizes a counter to keep track of the number of people entering the office space. A combination of capacitors and resistors is employed to fine-tune the timing parameters and ensure a reliable operation. To visually communicate the occupancy status, four LEDs are utilized as a binary display.

Keywords: Human Presence Detection, PIR Sensor, Counter

INTRODUCTION

In the realm of human presence/cabin management , the significance of human presence detection cannot be overstated. Existing technologies often rely on systems with varying degrees of complexity. However, this project is established using components such as the Passive Infrared (PIR) sensor, timer IC, counter, and LEDs, providing a cost-effective solution for monitoring human presence in office spaces. While the individual components are known entities, the novel aspect lies in their integration to form a system tailored for human presence detection. The specific calibration and interaction of the timer IC, counter, and binary display LEDs to optimize accuracy and user-friendliness are areas that require exploration. Aligning these components to achieve real-time monitoring of people entering an office remains a challenge. The integration process involves usage of the PIR sensor as the primary input device, to detect infrared radiation emitted by human bodies. The timer IC is added along with a combination of resistors and capacitors to increase the duration of the LEDs in HIGH state and to generate a rectangular

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wave which is provided to the counter . The counter, utilizing the rising edge of the rectangular wave provided by the timer IC, ensures precise counting and reliable operation, while a transistor enhances the system's sensitivity to human presence. The choice of a binary display using four LEDs serves a dual purpose: simplicity and efficiency. The binary representation of the count allows for a clear and concise visual representation, facilitating quick interpretation.

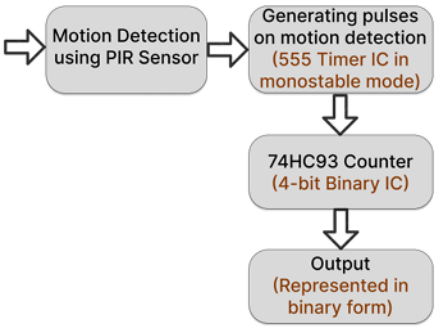

Figure 1 Block Diagram of Cabin Detector with counter

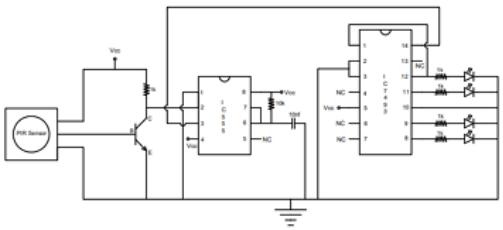

Figure 2 Circuit Diagram of Cabin Detector with counter

RESULTS AND DISCUSSION

Our office entrance monitoring system, powered by a PIR sensor and augmented with LEDs in binary form, delivers precise and immediate feedback on occupancy. The integration of two ICs and one BJT ensures a hardware foundation. The real-time binary LED display not only efficiently communicates the number of people entering but also adds a visually sophisticated touch to the system. This project represents a cost-effective and scalable solution, successfully merging technology and practicality for effective office occupancy monitoring. The outcome for increase in time by using combination of 10nF capacitor and 10k resistor was calculated by using formula of monostable multi vibrator.

$T = 1.1*R*C$

- The display in binary form was calculated by using LEDs that are connected to the counter. The right most LED represents LSB and left most LED represents MSB.

- When the PIR sensor's output goes high and turns on the transistor, it triggers the IC 555 timer by briefly pulling the trigger input low. This initiates the timing operation of the IC 555 timer.

- By using the IC 555 timer in monostable Mode we can increase the time delay as well as start the working of the counter due to the rectangular wave signal that is generated when the IC 555 timer works in monostable Mode.

- The counter works by taking the rising edge of the rectangular wave as an input and adds count to the display. The below figure contains diagram of a rectangular wave showing rising edge:

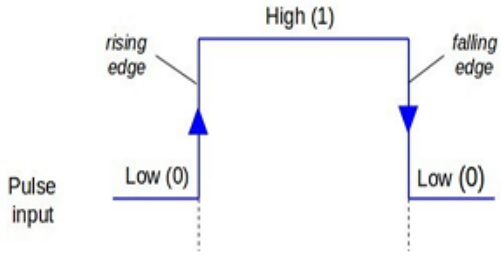

Figure 3 Rectangular Wave of Counter

- One of the challenges faced was adding the 7-segment display.

- Also one of the drawbacks of this circuit is that the person leaving the designated area is added as a count.

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FORMULA & CALCULATION

Formula to calculate the time delay adjusted by adding capacitors and resistor to IC555 :

$T=1.1*R*C$

$T=1.1*10*10\ 3\ *10*10\ -9$

$T=110*10^{-6}$ i.e. $T=110\ ms$

CONCLUSION

The PIR sensor-driven Cabin Detector with counter circuit, complemented by LEDs displaying the entry count in binary form, successfully captures and presents real-time occupancy. The integration of two ICs, one BJT, and resistors ensures a hardware foundation. This cost-effective solution provides an efficient and effective tool for person counting. Further scalability options make this project a practical and adaptable solution for diverse environments like cabins, classrooms and workplaces

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