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Intelligent Conference Hall Automation System

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***Abstract*— Automation system plays an ever-increasing role in human life, whose central aim is to develop control strategies that improve performance when they are applied to a system. Electricity is one of the most important resources indispensable for human life. In general, electricity is wasted due to negligence of people to turn off lights, fans, air conditioner and other electrical devices when they leave the room. Thus, conference hall automation system is an important technology required for conserving electricity. This paper presents the design and development of PIC16F877A microcontroller based intelligent conference hall automation system, which is useful to control and integrate all electrical devices in a room automatically. The proposed system consists of an Infra-Red sensor, which acts as a bidirectional person counter to count the number of people inside the conference hall. Based on this count, the microcontroller automatically controls the electrical devices inside the hall. The system also provides a user interactive menu to set the required count value to turn on the devices, to meet the needs of the user.**

***Index Terms*— Automation system, electricity, PIC 16F877A microcontroller, bidirectional person counter, user-interactive menu.**

I. INTRODUCTION

Electricity is one of the most important resources, which plays a part and parcel of everyday life. With the growing human population, there is a much increase in the consumption of electrical energy. Thus, it is essential to conserve electricity. In general, electricity is wasted due to negligence of people to turn off lights, fans, air conditioner and other electrical devices when they leave the room.

Automation system is a technology developed to meet the necessity for conserving electricity. It reduces the manual effort to control and operate on any equipment. The benefit of introducing an automation system is to save energy, labour and materials for improving quality, accuracy and precision. In general, humans are more prone to errors. However, an automated system can work with diligence, versatility and almost with zero error, thus are preferred over manual systems.

In the recent past, various automated systems have been employed to conserve electricity in working environments. Among them, conference hall automation system is used to control and integrate all electrical equipments inside the hall. Several conference hall automation systems have been developed based on various technologies which include RFID, Bluetooth, Wi-Fi, Zigbee and GSM [4]. The use of Zigbee and other wireless protocols increases the cost of the system.

This paper presents the design and development of microcontroller based intelligent conference hall automation system which overcomes the drawbacks of above mentioned technologies. The microcontroller used in this system is PIC16F877A. The proposed system comprises of a bidirectional visitor counter developed using Infra-Red sensor. The IR sensor detects people entering or leaving the hall and updates the number of people present inside the conference hall. Depending on this count value, various electrical equipments inside the hall such as lights, fans and air conditioners are automatically controlled. In this work, a Liquid Crystal Display (LCD) is used to display the number of persons inside the hall and the status of the electrical equipments (ON/OFF). These information are stored in EEPROM, so that they are non-volatile. The system also provides a user interactive menu to set the required count value to turn on the devices, to meet the needs of the user.

The remaining sections of the paper are organized as follows. Section II specifies the literature review of the existing systems. Section III describes the design of the proposed system. Section IV explains the hardware specifications of the proposed system with block diagram. Section V presents the results of the system. Section VI concludes the paper.

II. LITERATURE REVIEW

Conference hall automation system is a technology developed to meet the increasing demands to conserve electricity and to improve the quality and comfort of living by reducing the man power involved in the operation of electrical devices. This section presents the several conference hall automation systems developed and are analysed based on the technology or controller used.

Alex Joy et. al., [1] have proposed a microcontroller based room automation system using ATMEGA328 microcontroller. This system consists of an automatic room light and temperature controller, which operates lights and fans inside the room depending on the intensity of light and temperature inside the room. The disadvantage of this system is that the initial cost of establishment is high [1] and the operation of an air conditioner has not been automated. N.B. Bhawarkar et. al., [2] have developed an ARM based room light controller using Zigbee technology and PIR sensor. This work is proposed using ARM 7-LPC 2138 controller interfaced with a Zigbee modem and Passive Infrared Sensors to detect presence of humans inside the room and

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operate lights and fans accordingly in an educational institution. Ying-Wen Bai and Yi-Te Ku [6] have proposed an automated home light control module using microprocessor, PIR sensor and an RF module.

Vaibhav Bhatia and Gavish Bhatia [5] have developed an automated fan speed control system based on room temperature using Pulse Width Modulation technique. The temperature of the room is measured using a temperature sensor.

P.P. Chitte et.al., [3] have introduced an automated audio tracking and video recording system to capture the location of current speaker inside the conference room. The system also controls the temperature and light intensity of the room. This work uses a Raspberry pi controller to regulate the video conferencing system and an AVR microcontroller along with temperature sensor and LDR. However, the cost and complexity of the system is more.

Most of the developed systems presented in the above literature have only introduced automation of individual components in a home/conference room. However the design and development of an intelligent conference hall automation system, to integrate and control all electrical devices in a room is indispensable in today's increasing demands to conserve electricity.

III. DESIGN OF THE PROPOSED SYSTEM

The proposed system consists of PIC16F877A microcontroller, which integrates and controls all electrical devices in the hall such as lights, fans and air conditioner depending upon the input from the Infra-Red sensors. The flowchart of the proposed system design is shown in Figure 1.

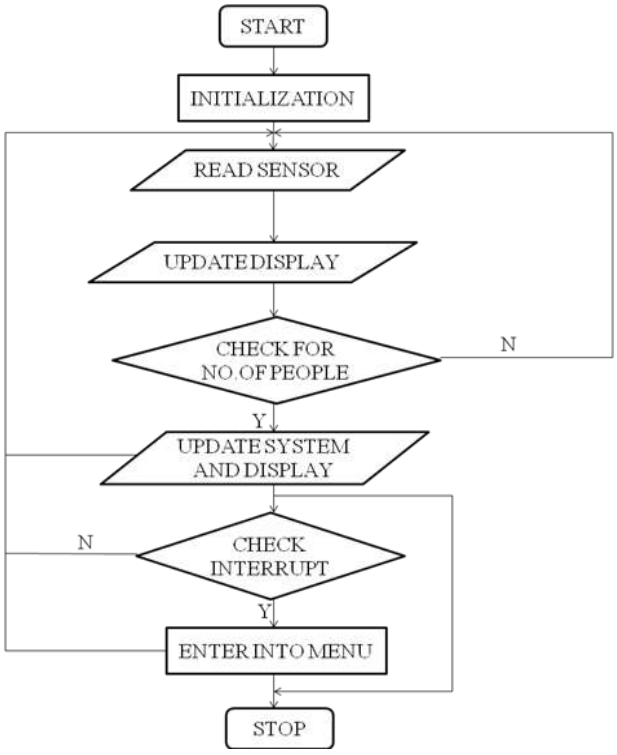

Figure 1. Proposed system design

A system comprising of two IR sensors, forms the bidirectional visitor counter. An IR sensor consists of an Infra-Red transmitter and a receiver. The Infra-Red rays are continuously emitted by the transmitter. The two IR sensors are placed in the entrance of the conference hall. When a person enters or leaves the hall, the IR rays get reflected and dispersed by the person and fall on the receiver thus detecting the person. When a person is detected by the two IR sensors in a particular sequence, it indicates the entry of the person inside the hall. When the person is detected in the opposite sequence by the two IR sensors, then it indicates that the person is leaving from the hall. Therefore this setup is used to count the number of people inside the hall. When a person enters the hall, the count gets incremented by one. When a person leaves the hall, then the count gets decremented by one. Depending on this count value, various electrical equipments inside the hall are automatically controlled by the microcontroller.

The proposed system has been designed such that when there is at least one person inside the hall, the controller turns on the lights inside the hall. When the number of people inside the hall reaches a particular user-defined count value, then the controller automatically turns on the fans inside the hall. Also the maximum capacity of the hall can be defined by the user. Initially, the fans run at a minimum speed. When more people enter into the hall, the speed of the fans gets increased in terms of one step for every particular count, which is decided by the maximum hall capacity. In the proposed system, the speed of the fan is controlled in five regulated steps. Thus, the number of people for the speed of the fan to be increased by one step is given by the maximum hall capacity divided by 5. The speed of the fan is regulated by Pulse Width Modulation (PWM) technique. The fans are controlled in the similar way when people leave the hall.

In this system, once the hall reaches its maximum capacity, the air-conditioner (AC) is turned on. The operation of the AC is controlled by the room temperature preferred by the user. For the AC to function economically, its power is automatically cut-off when the preferred room temperature is reached. If there is any change in the temperature, the AC is turned on again.

Whenever the count of people inside the hall reaches the maximum value, a buzzer is alarmed for 10 seconds, to indicate that the hall is full. During the alarming of buzzer, suppose if the count decreases below the maximum value, the alarm stops.

The system consists of a user-interactive Liquid Crystal Display (LCD), which displays the count of people inside the hall and the status of lights, fans and air conditioner (ON/OFF) inside the hall. The maximum capacity of the hall and the minimum number of people for the operation of each electrical device can be set by the user through an interactive menu displayed in the LCD. If the menu is kept inactive for more than 7 seconds by the user, then the system automatically exits from the menu. All the above information is stored in Electrically Erasable Programmable Read Only Memory (EEPROM) which prevents loss of data due to power failure.

IV. BLOCK DIAGRAM OF THE PROPOSED SYSTEM

The block diagram of the proposed system consists of the following components and is shown in Figure 2.

- PIC16F877A (8-bit microcontroller) with 4-MHz clock
- IR sensors
- Lamp
- Fan
- Air Conditioner
- LCD
- Buzzer

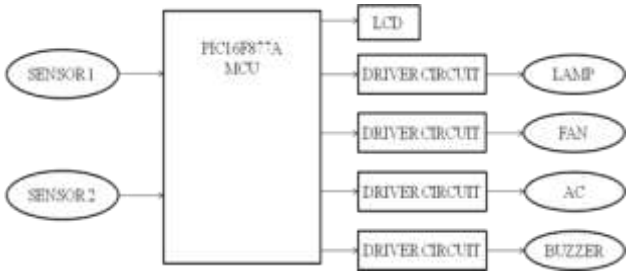

Figure 2. Block Diagram

The various components of the block diagram are described as follows.

A. PIC16F877A Microcontroller

The PIC16F877A Microcontroller is the heart of the system. Based on the input from the Infra-Red sensors, the microcontroller automatically controls and integrates all the electrical components inside the hall such as lights, fans and air conditioner.

The PIC16F877A (Figure 3) is a powerful (200 nanosecond instruction execution) yet easy-to-program (only 35 single word instructions) CMOS FLASH-based 8-bit microcontroller from Microchip and is available in a 40 or 44 pin package. The features of the microcontroller include 256 bytes of EEPROM data memory, an ICD, 2 Comparators, 8 channels of 10-bit Analog-to-Digital (A/D) converter, 2 capture/compare/PWM functions, the synchronous serial port configured as either 3-wire Serial Peripheral Interface (SPI) or the 2-wire Inter-Integrated Circuit (I^2C) bus and a Universal Asynchronous Receiver Transmitter (USART).

Figure 3. PIC16F877A Microcontroller

B. IR SENSOR

A system comprising of a pair of IR sensors, forms the bidirectional visitor counter. This setup is used to count the number of people inside the conference hall. Based on this count value, various electrical devices inside the room are automatically controlled.

Infra-Red sensors consist of two elements: an Infra-Red source or transmitter and an Infra-Red detector or receiver as shown in Figure 4. Infra-Red sources include LEDs or Infra-Red laser diodes. Infra-Red detectors include photodiodes or phototransistors. The IR beam which is invisible to human eyes, is emitted by the Infra-Red source. It is reflected by an object and falls on the Infra-Red detector, thus detecting the object.

Figure 4. IR transmitter and receiver

C. LCD

A Liquid Crystal Display is used to display the count value of people inside the conference room and the status of electrical equipments (ON/OFF) inside the hall. A user interactive menu is also displayed in the LCD to meet the requirements of the user.

A Liquid Crystal Display (LCD) is a flat - panel display or other electronic visual display that uses the light-modulating properties of liquid crystals. A 16x2 LCD display (Figure 5) is a basic module and is very commonly used in various devices and circuits. It can display 16 characters per line and there are 2 such lines. In this LCD, each character is displayed in 5x7 pixel matrix. These modules are preferred over seven segments and other multi segment LEDs for which LCDs are economical, easily programmable, have no limitation of displaying special characters and animations.

Figure 5. LCD

D. BUZZER

Once the hall reaches its maximum capacity, a buzzer is alarmed to indicate that the hall is full. A buzzer (Figure 6) is an audio signalling device, which may be mechanical, electromechanical, or piezoelectric and is used for timers, alarms, warnings etc.

Figure 6. Buzzer

V. RESULT AND ANALYSIS

The performance analysis of the proposed system has been made and the following results are obtained. When there is at least one person inside the hall, the controller turns on the lights inside the hall. The minimum count value to turn on the fans and the maximum capacity of the hall are set as per the requirements of the user. In this system, the fan is operated in five regulated steps using PWM technique. By varying the duty cycle, the speed of the fan is varied from low to high in steps as shown in Figure 8, depending on the number of people inside the hall. The operation of the fan is given as follows.

- When the number of people is less than the minimum required count value to turn on the fans, then the fans are OFF.
- When the number of people is between the minimum required value and two-fifth of the maximum hall capacity, then the fans are operated in step 1 (very slow).
- When the count value is from two-fifth to three-fifth of the maximum capacity, then the fans are operated in step 2 (slow).
- When the count value is from three-fifth to four-fifth of the maximum capacity, then the fans are operated in step 3 (medium).
- When the count value is between four-fifth of the maximum capacity and the full hall capacity, then the fans are operated in step 4 (fast).
- Once the hall has reached the maximum capacity, the fans are operated in step 5 (very fast).

Also, when the hall reaches its maximum capacity, the controller turns on the air conditioners inside the hall and a buzzer is alarmed to indicate that the hall is full. The proposed system has been experimented by taking the maximum hall capacity as 50 people and the minimum number of people to turn on the fans as 10. Table 1 shows the status of various electrical equipments for different count value of people inside the room. The operation of the fan is depicted in Figure 7.

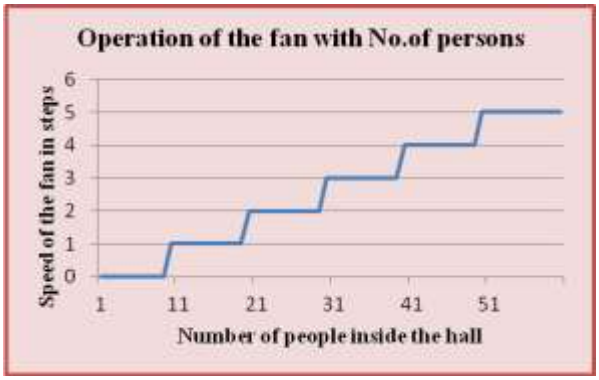

Figure 7. Operation of the fan with number of persons

Table 1. Status of electrical equipments with count value

S.No	Count value of people	Status of Lights	Status of Fans	Status of Air Conditioner	Status of Buzzer
1.	0	OFF	OFF	OFF	OFF
2.	1 to 9	ON	OFF	OFF	OFF
3.	10 to 49	ON	ON	OFF	OFF
4.	>=50	ON	ON	ON	ON

Figure 8. Step Vs Duty cycle of Fan

VI. CONCLUSION

The design of conference hall automation system plays an important role to meet the increasing demands for conserving electricity. In this paper, PIC16F877A microcontroller based intelligent conference hall automation system has been designed and developed to control and integrate all electrical devices in a room automatically depending on the number of people inside the room. The provision of user interactive menu makes the system to be suitable for varying hall capacity. The proposed system

reduces manual effort to operate on electrical devices, thus saving energy, labour and improves the quality, accuracy and performance of the system.

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