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DESIGN AND IMPLEMENTATION OF ENERGY SAVER FOR AUTOMATIC ROOM LIGHT CONTROLLER WITH VISITOR COUNTER

UMAR MOHAMMED; BASHIR SADIQ USMAN; & IDRISS MOHAMMED GODOWOLI
Department of Electrical and Electronic Engineering Technology, Federal Polytechnic Damaturu Yobe State

ABSTRACT
This paper titled design and implementation of Energy Saver for Automatic Room Light Controller with Visitor Counter. With limited energy resources, it is the need of time to revolutionize the traditional methods of counting visitors to control the electrical appliances. This paper describes the development and implementation of visitor counter along with automatic room light controller. As a visitor enters the room, the count is incremented by one and the lights are switched on, while the counting is decremented if a person leaves the room. Microcontroller is used in this design due to suitability and accessibility of the component and other components. This project design also helps to reduce human efforts. Also it is very useful to conserve resources. In nowadays world, there is a continuous need for automatic appliances. With the increase in standard of living, there is a sense of urgency for developing circuits that would ease the complexity of life. Also if at all one wants to know the number of people present in room so as not to have congestion. The concept of an automatic room light controller counter can be built upon not just for household usage but tor such settings as hotels, schools, hospitals, industrial purpose or businesses. In conclusion, this project is successfully designed and implemented and it should be encouraged and put into large scale manufacturing because of its various advantages.

***Keywords**-- Energy saver, visitor counter. Microcontroller.*

INTRODUCTION
The advent of microelectronics in 1959 by Jack Kilby, gave rise to the birth of both linear and digital circuits like Operational Amplifiers, Voltage Regulators, IC Timers, Combinational Logic, Structural and Sequential Logic ICs among a host of other digital system components. The control and automation of human counters for hotel rooms, Cinemas, Schools, and conference halls processes can be realized

using a microcontroller integrated with an infrared sensor, which senses the passage of human beings and detects them and counts (Boylestad, 1996).

The discovery of the microcontroller in 1972 marked the beginning of micro program control in electronics. Microprocessors like 8080, 8086, 8088; Pentium, etc., were employed for program control of batch counters in the 20th century but microcontrollers became more preferable for such embedded .applications for control systems in contrast to the microprocessors which are better for general purpose applications. Other devices which may be similarly used for such control operations are programmable logic devices (PLDS) Such as Complex Programmable Logic Devices (CPLDs), Field Programmable Gate Array (FPGA) among a host of other devices, This automatic room light controller with visitor counter contains Sensors (Infrared Sensor) formed with a combination of infrared LEDs, while the digital readout was formed with 16x2 Liquid crystal display (LCD) (Edje et al., 2015). The control mechanism of this ARLFC with BVC is realized through a micro program control. The micro program which is the driving software is written in Ct+ language and flashed into the PIC16F876 microcontroller. By using the sensors and its related circuit diagram the system can count the persons in a given area, put ON/OFF lights automatically.

Due to the present day geometric increase in population of people in schools, seminar halls and places of learning and research, they become highly patronized. Hence, inability of knowing the exact number of people going in and out becomes a problem which may result to over population, temperature increase inside and people time wastage in searching seat before they can sit, and also courses electric power wastage, these are a few among numerous disadvantages this problem may cause.

Aim and Objectives of this Design

The aim is to Design and Construct energy saver for automatic room light controller with visitor counter.

The objectives are as follows:

i. To minimize wastage of electricity in our homes, schools, colleges etc by provide an energy saving room light controller.
ii. To provide a means of counting number of people in a particular room hence saves time and labour.

To automatically switch ON and OFF a light in a particular room rather than manual switching.

PROJECT DESIGN CONCEPT

The main aim of this project is to design and implement of energy saver with automatic room light controller with visitor counter and display system. Therefore,

the heart of this project is microcontroller which include the hardware and software parts. The hardware
Which is the circuit design of the device, with the aid of a circuit design simulator called *proteus-VSM*. This makes the circuit design easier and allows one to simulate the system, detect problems and make appropriate corrections before the actual construction. Writing source code for the microcontroller would be the next stage.
The circuit consists the following units;

i. Regulated Power Supply
ii. Processing unit (PIC16F1877A)
iii. PIR Proximity Sensor
iv. Display Unit.
v. Switching Circuit Unit

In designing this project the block diagram shown in Fig.1, shows the above mention sections of each unit, which explain the project design methodology that will be used.

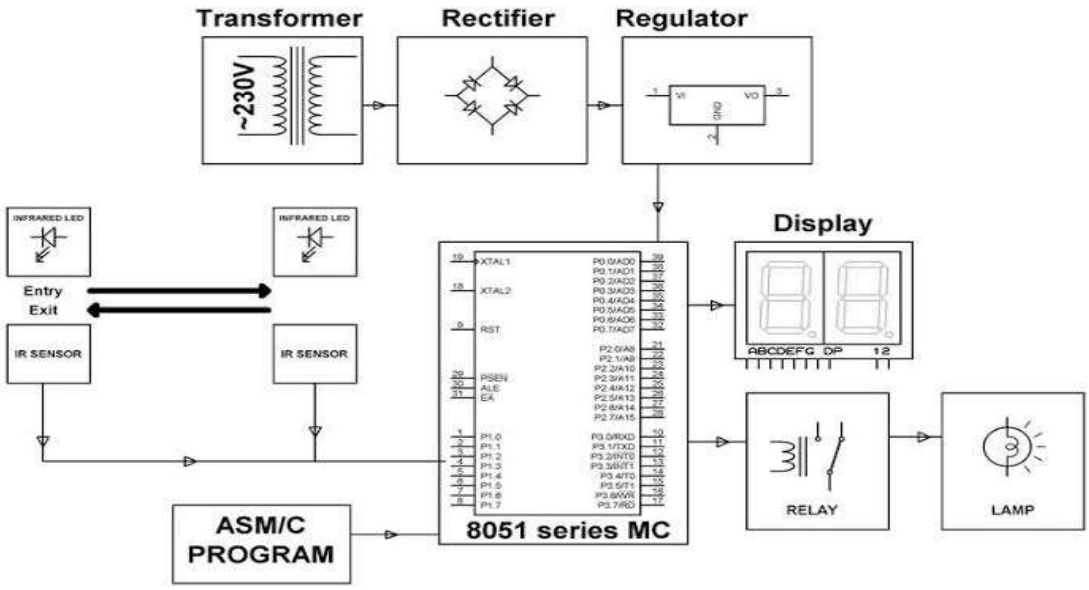

Fig 1: Block Diagram Automatic room light controller with visitor counter

i) Regulated Power Supply

This section contains the regulated power supply for the circuit operation, most electronic devices require dc voltage to operate. The more readily available source of power is the 240AC, 50Hz outlet. Where a de voltage is required, a dc power supply circuit is employed to convert the ac voltage to a de voltage during the

process the sinusoidal ac waveform is converted to a semicircle dc waveform by the rectifier with ripples filtered by the capacitor.
In this project the power used in the circuit is 5volts for the microcontroller with other components, and 12volts for operating the motor and the relays. Hence, the power supply unit consist of a 220/240V, 50Hz, 500mA, DC: 12 x 2 step down transformer, rectifier and regulators.

ii) Processing Unit (PIC16F18 77A)
From the block diagram above, PIC16F877A serves as a heart for the project action that control all the input and output interfacing units. It is a Low-power (operating within 5V and 25mA sink/source current handling capabilities), high-speed Flash type with 256 byte EEPROM.
The PIC16F877A is a low-power, high-performance CMOS 8-bit microcontroller with 4Kbytes of In-system Programmable Flash memory. The device is manufactured using Atmel's high-density nonvolatile memory technology and is Compatible with the industry-standard 16F876 instruction set and pin out. The on-chip flash allows the program, memory to be reprogrammed in-system or by a conventional nonvolatile memory programmer. By combining a versatile8-bit CPU with-In-system programmable flash on monolithic chip, the Atmel AT89S51 is a powerful microcontroller which provides a highly flexible and cost-effective solution to many embedded control applications.

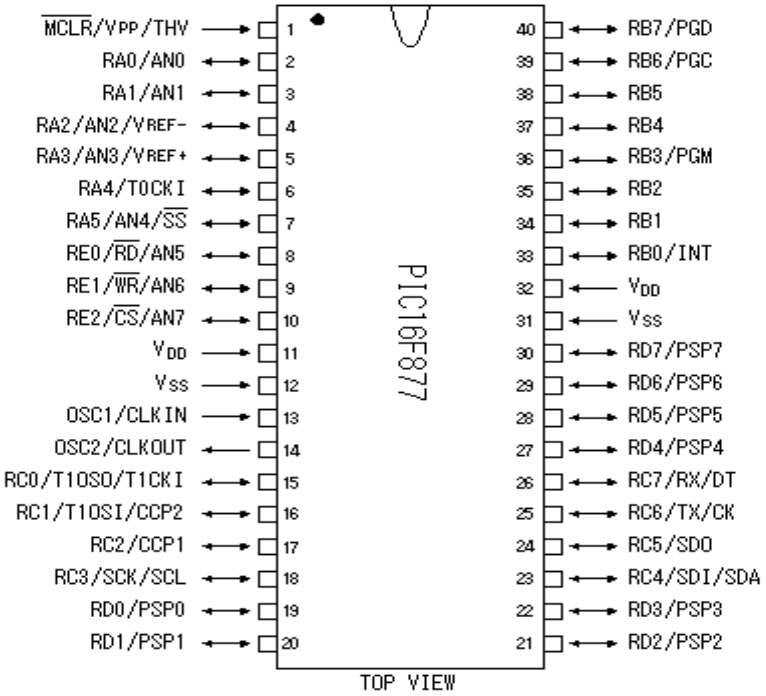

Fig.2. PIN Diagram of PIC16f877A

a. EEPROM

It is a memory used for storing important data that must not be lost if power supply suddenly fails, The PIC16F876A is made up of up to 256 X 8 bytes of EEPROM data memory. For instance the EEPROM stores the personal identification number which is compared with the user input so as to activate the port to which the door relay is connected.

iii. PIR Proximity Sensors

For visitor detection, two Passive Infra-Red (PIR) proximity motion sensor HC-SR501 were used. Operating voltage range of sensor is from 4.5V to 20V and the power is provided through the supply unit described in first section. Delay time and block time of the sensors are adjustable. The sensing range of HC-SRSOI is about 120 degrees up to the distance of seven meters. Though the linear range is useful for most practical scenarios, we found out experimentally that the angle is too wide for satisfactory operation of visitor counting in real world scenarios. The solution of this problem is also discussed in order to improve efficiency. PIR sensors sense an object by comparing the heat emitted by the moving object and the background. So, such sensors must be installed only for stationary backgrounds.

a. Sensory Unit

The sensory unit of this project consist of 4 squares D16 LMS1 - 1AB pressure switches. Two are used in the IN-Gate detection and the other two are used for OUT-Gate detection. These pressure switches serve as the sensors to the microcontroller; Pin 3,5 and Pin 4,5 are utilized for this purpose respectively. These pressure switches are connected to 10KΩ resistor each by data sheet Specification. Hence $R_9 = R_{10} = R_4 = R_3 = 10k\Omega$ and have a 5V dc supply each. The reset buttons are meant for OFF and ON function and are connected with 10kΩ resistor each by data -sheet specification. Therefore, R_1 and R_2 are both 10kΩ each and supplied with 5V dc through pin 1 and pin 2

iv. Display Unit

In order to display the increment or decrement of students into and out of the room, an LMO16L LCD display is used. LMO16L is of 16 x 2 lines capacity with an in-built LSI FID44780 controller and a display color of gray. The character size is 5 x 7 dots and requires an input voltage of +5V. The internal pin connection of the EMO16L LCD display can he given as follows:

Table 3.1: Internal pin connection of LMO16L LCD

PIN NO	***SYMBOL***	***LEVEL***	***FUNCTION***
1	V ss	-	OV
2	V_{DD}	-	+5V
3	V_{EE}	-	Contrast
4	R S	H/L	L: instruction code input H: Data input
5	R/W	H/L	H: Data read (LCD Module - MPU) L: Data write (LCD Module – MPU)
6	E	H, H-L	Enable signal
7	DBO	H/L	Data Bus line
8	DB1	H/L	Data Bus line
9	DB2	H/L	Data Bus line
10	DB3	H/L	Data Bus line
11	DB4	H/L	Data Bus line
12	DB5	H/L	Data Bus line
13	DB6	H/L	Data Bus line
14	DB7	H/L	Data Bus line

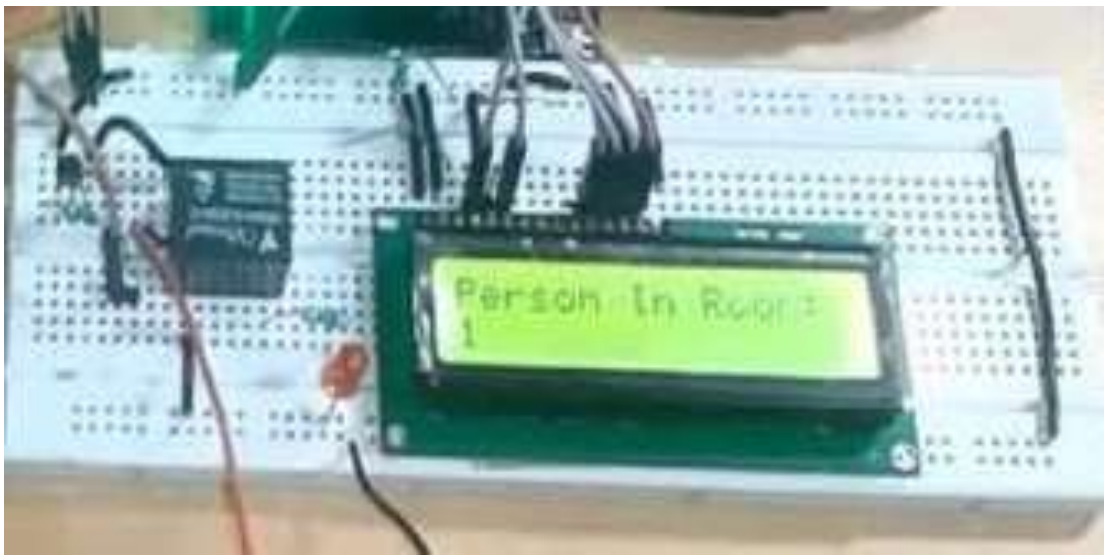

Fig 3: Breadboard Layout

Fig 4. System Assembling and Casing of Automatic Room light Controller with Visitor counter

Fig 5. Complete System Layout of Automatic Room light Controller with Visitor counter

System Operational Principle

The implementation of this project's design is done strategically (section by section) to analyze extensively in order to prove the functionality to a satisfactory level. This electronic device is set up in such a way that whenever a person walk through the sensor on the entry door of a hall, the sensor circuit becomes active and give the LCD command which displays the number of present people in the room and the light inside the hall will be switched ON. The LCD will keep counting the number of people present in the hall, the light in hall will be switched OFF automatically when the last person present in the hall walk out through the exit door.

v. Switching Unit

The switching unit comprises of two relays with two transistors (BC547) energizing them. More current is transferred to the first transistor which quickly performs the. Switching action. The current reaching the base of the transistor is 0.48mA and by datasheet specification of the opto-coupler Rg = Rg = R14 = R7= 1kM. Also, R16 = R13 F R7 = Rs2200 is connected to Pin 5 of the opto-coupler to protect the opto-coupler from back emf from the coil of the relay. Diode, D, and Da are protective diodes (free-wheeling diodes). In this project IN4007 is used where $D_1 = D_3$.

Also two pieces of LED's are used to indicate the proper action (switching, action) of the switching unit. Light emitting diode D = Da are used as indicators. These indicators are connected to the microcontroller through Pin 11 and 12, respectively. A limiting resistor of 1000 is connected to each of the aforementioned light emitting diodes. Hence, by, specification of the LED's, R12 R21= 1000Ω.

CONCLUSION

The automated state of the system gives the product certain flexibility and the potential to be integrated with some of the other household systems into a universal household and industrial eventually, one simple system like this has the capability to control air appliance conditioners, televisions, CCT, lighten system, sockets, washing machine, and other home appliances. This design began the framework for a more complex and more functional product. The concept of an automatic

room light controller counter can be built upon not just for household usage but tor such settings as hotels, schools, hospitals, industrial purpose or businesses.

Eventually this designed product can be built using less expensive components thus making it affordable alternative for consumers, it is a simple upgrade to an existing standard product and it has endless expansion possibilities.

In conclusion, this project is a design which should be encouraged and put into large scale manufacturing because of its various advantages.

This project is a viable one in the sense that it will go a long way in making it more convenient easier for users to easily control their appliances, lighting points and even sockets because of its automatically in their homes, hotel, conference rooms, and classrooms importance as a household need, efforts must be geared towards designing a viable project like this one strongly recommend that the department should see this project as a priceless possession and should endeavor to provide financial assistance and more research, works relating to this project to support and encourage students embarking on this type of project so as to be used to be used not only in homes but also in offices, schools etc.

REFERENCES

Boylestad, R.L. and Nashelsky, L. (1996): Electronic Devices and Cirocuit Theory Prentice Hall London.

Caccavale, Michael. (2019). "The Impact Of The Digital Revolution On The Smart Home Industry. Forbes.

CEE Residential Lighting Controls Market Characterization". Consortium for Energy Efficiency. Retrieved 2014-08-11.

DiLouie, Craig (2008). Lighting controls handbook. Lilburn, Ga. [u.a.]: Fairmont Press [u.a.] p. 239. ISBN 1-4200-6921-7

Edje E. Abel, Ureigho Roy Joel, (2015)."Information Systems:-The prospects of bidirectional counter system in the hotel industry'", Found. Comp. Sci. FCS.2 (9).

Forrest, M. MIMS, III (1994); Getting Started in Electronics, United State of America.

Galasiu, A.D.; Newsham, G.R., (2009). Energy savings due to occupancy sensors and personal controls: a pilot fleld study, Lux Europa, 11th European Lighting Conference Istanbul, Turkey, September 9-11, 2009, pp. 745-752

Home Automation & Wiring (1 ed.) (1999). New York: McGraw-Hill/TAB Electronics. 1999-03-31. ISBN 9780070246744

Rye, Dave (1999). "My Life at X10".AV and Automation Industry eMagazine.AV and Automation Industry eMagazine.Archived from the original on September 30, 2014. Retrieved October 8, 2014.

Smart Home - United States Statista Market Forecast" Staţista. Retrieved 2019-11-07.
Theraja, A.K. and Theraja B.L. (2005); A Textbook of Electrical Technology, S. Chand and Company Limited New Delhi.