Designing of Automatic Room Lights Controller by Using Arduino

Dinesh Dhakla[1] Balvinder Singh[2] Arshdeep Singh[3] Nooman Abdallah Talib[4] Harpreet Kaur Channi[5]

[1,2,3,4,5]Department of Electrical Engineering

[1,2,3,4,5]University Institute of Engineering, Chandigarh University Gharuan, Mohali, Punjab, India

Abstract— Lighting Control System for the Room By sensing the presence of a human, an Arduino and an ultrasonic sensor can be used to turn on and off the illumination system of a home or office on a regular basis. Such Automatic Room Lights systems can be implemented in classrooms, faculty cabins, garages, staircases, bathrooms, and other areas where we do not require constant light but only when people are present. Also, with the help of this system, we can save money on energy bills because power will be consumed only when a human is present, i.e. when necessary lights will be turned on or off on their own. An automatic room light controller using Arduino and ultrasonic sensor and relay module is described in this paper. The ultrasonic sensor will detect human activity and the PIR sensor unit will control the switching action based on the response. The strategy proposed can assist us in lowering our electricity consumption.

Keywords: Arduino, Ultrasonic Sensor, Illumination System, PIR Sensor

I. INTRODUCTION

Scientific discoveries delivered us luxury and comforts. Technology has become vital and essential part of our lives. Tremendous advancement in technology is succeeded in last few years. Electrical energy has become a crucial part of human life. In recent years the people are looking forward for the automation in their day to day life, and even now the people are excited to save energy consumed to reduce the expenditures. People are becoming lazy to switch off the lights while leaving the room, so the large amount of energy is wasted if the light is remaining ON in the absence of human being. Generally, in public and private sector companies, offices, school and colleges most of the people are not interested to switch OFF the electronic machines like fan, light, etc., while going out of the room.

As more and more consumer electronic and home appliances are used, the size of them is becoming large; power consumption in home area tends to grow. Moreover, unusable power consumption occurs in the absence of human being in public and private sectors. Using the automation in switching the home or office lighting system, the consumption of electricity can be comprehensively reduce which will in turn save the money of the owner. Now the people are looking forward for automation in their daily life. The people are trying to reduce human efforts. By using suggested system wastage of electricity can be reduced as electrical appliance will be automatically turned ON or OFF based on the presence of the human being with the help of PIR sensor, while departure no need to turn off the appliances or while arriving in your cabin no need to turn on the electrical appliances. This is the main enhancement of the projected system.

The main parts of the proposed system are Arduino, PIR Sensor and the Relay Module. This system can be considered as a major application of PIR sensors. The remaining paper is ordered as: section II is about basic details of various modules and components used for the system. Section III Proposed system description. Section IV gives working of the system using Ardiuno and PIR sensor. Section V is the upcoming scope and section VI is the result and conclusion. on about hardware and software design.

II. LITERATURE SURVEY

Literature survey is the study of already established systems and collection of information which helps in doing new tasks.

Vibhuti et al [1] proposed a system which operates with control of relays and with the use of WAGO PLC (Programmable Logic Controller) and Arduino Uno. Switching operation of devices such as tube light, fan, AC, etc. can be operated spontaneously by using PIR sensor and on the basis of environmental conditions. In real-time implementation, automatic control is done by sensor data and manual control is done by android application. But, difficulty in this paper is the controlling and monitoring of devices done by WAGO PLC and Arduino Uno both. These operations can be done by using only ArduinoUno.

Maslekar et al [2] proposed a smart lighting system in which Raspberry Pi has used. Raspberry Pi is monitoring lights and fans simultaneously. In the absence of person room lights and fans will automatically turns OFF. Energy is preserved by using this smart lighting system. The experimental results of this system have shown that 50% energy is conserved. But the difficulty is Raspberry Pi is more expensive than Arduino Uno.

Aleskar [3] Automatic Lighting and Control System for Classroom in which electrical light is controlled by Bluetooth, PIR sensor and relay. To switch ON or OFF the light Bluetooth module is connected to Arduino Uno which sends voice command from Arduino Uno by using the mobile android application. The experimental results have shown the 50% energy is conserved. But this paper can be implemented by removing the Bluetooth module as well.

In [4], the disquisitions speak about automatic room light system by using visitor counters operation. Depending upon the human presence, the room lights ON or OFF. There is no need of manual operation for switching. The PIR sensor is used to the human presence which is at the entrance of room. As visitor counter is used, there is increment in the counter when person enters in the room and this leads to turn ON the room light which is controlled by microcontroller program. If person exits the room, the counter decremented and this leads to turn OFF the lights. When all persons left the room then only lights in the room switched OFF. The difficulty in this system is that the door of room should not allow more than one person at a time.

Vahid et al [5] proposed a system whose control is depend on Arduino microcontroller, network communications and Modbus industrial protocol. Arduino

Ethernet shield and a wireless router device is used to built the network communication. The specific Android application is used to load the Modbus program into mobile or Windows software named "mypro" and on Arduino board, Arduino code loaded through USB (Universal Serial Bus) cable. There is interconnection between Arduino Ethernet Shield and mobile through Ethernet cable and router. By connecting to router, user can control and monitor the appliances easily.

III. PROBLEM FORMULATION

Problem Formulation is like the foundation of a building to be constructed. To solve a problem someone has to know about the problem. So, the problem identification and formulation is very crucial for the researcher before conducting a research, and this is perhaps one of the most difficult aspects of any research undertaking. Arduino is the main part of this project and it will be used to read from ultrasonic sensor HC-SR04 and calculate the distance. This distance will tell us if any vehicle is near the signal or not and according to that the traffic signals will be controlled. The main task was to avoid use of delay because we have to continuously read from the ultrasonic sensors and also at the same time, we have to control signals which requires the use of delay function.

IV. METHODOLOGY

We proposed how supported that Automatic Street Lighting System on/off depends upon the vehicle or objects. It depends upon the vehicle if the vehicle or object isn't present on the road then the road light is going to be dim because it's necessary to seek out the road for the thing. It'll save the consumption power of electricity. during a previous paper, the LDR sensor is connected meaning is that it'll provide permanent electricity to the Arduino board but in our research paper, we using the ultrasonic sensor to seek out the thing and produce the road light on when the object is passing through the nearer to the road light. So, we will say that it'll depend on the motion of the thing or vehicle.

V. DETAILS OF PROPOSED SYSTEM MODULES

A. Aurdino UNO

The Arduino Uno as shown in Fig 1 is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various development boards (shields) and other circuits. The board has 14 digital I/0 pins (six capable of PWM output), 6 analog I/0 pins, and is programmable with the Arduino IDE (Integrated Development Environment), via a type B USBcable. It can be powered by the USB cable or by an external 9-volt battery. It also has 16 MHz ceramic resonators, a USB connection jack, an external power supply jack, an ICSP (incircuit serial programmer) header and a reset button. Its operating voltage is 5v, input voltage 7 to 12v (limit up to 20v).

Fig. 1: Aurdino Uno

B. Specifications of Arduino:

- Microcontroller: MicrochipATmega328P
- Operating Voltage: 5volts
- Input Voltage: 7 to 20volts
- Digital I/O Pins: 14 (of which 6 can provide PWMoutput)
- Analog Input Pins:6
- DC Current per I/O Pin: 20mA
- DC Current for 3.3V Pin: 50mA
- Flash Memory: 32 KB of which 0.5 KB used by boot loader
- SRAM: 2 KB

C. Ultrasonic Sensor:

An ultrasonic sensor as shown in Fig 2 is an electronic device that measures the distance of a target object by emitting ultrasonic sound waves, and converts the reflected sound into an electrical signal. Ultrasonic waves travel faster than the speed of audible sound (i.e. the sound that humans can hear). Ultrasonic sensors have two main components: the transmitter (which emits the sound using piezoelectric crystals) and the receiver (which encounters the sound after it has travelled to and from the target).In order to calculate the distance between the sensor and the object, the sensor measures the time it takes between the emission of the sound by the transmitter to its contact with the receiver. The formula for this calculation is D = ½ T x C (where D is the distance, T is the time, and C is the speed of sound ~ 343 meters/second). For example, if a scientist set up an ultrasonic sensor aimed at a box and it took 0.025 seconds for the sound to bounce back, the distance between the ultrasonic sensor and the box would be:

$$D = 0.5 \times 0.025 \times 343$$

or about 4.2875 meters.

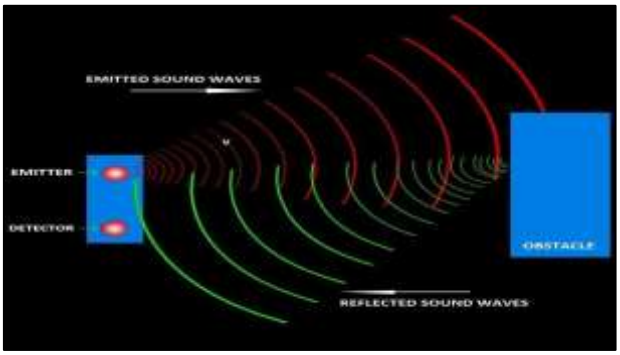

Fig. 2: Ultrasonic Sensor

D. How does ultrasonic sensor work?

Ultrasonic sensors work by sending out a sound wave at a frequency above the range of human hearing. The transducer of the sensor acts as a microphone to receive and send the ultrasonic sound. Our ultrasonic sensors, like many others, use a single transducer to send a pulse and to receive the echo. The sensor determines the distance to a target by measuring time lapses between the sending and receiving of the ultrasonic pulse.

E. Uses of ultrasonic sensor

Ultrasonic sensors are used primarily as proximity sensors. They can be found in automobile self-parking technology and anti-collision safety systems. Ultrasonic sensors are also used in robotic obstacle detection systems, as well as manufacturing technology. In comparison to infrared (IR) sensors in proximity sensing applications, ultrasonic sensors are not as susceptible to interference of smoke, gas, and other airborne particles (though the physical components are still affected by variables such as heat).Ultrasonic sensors are also used as level sensors to detect, monitor, and regulate liquid levels in closed containers (such as vats in chemical factories). Most notably, ultrasonic technology has enabled the medical industry to produce images of internal organs, identify tumors, and ensure the health of babies in the womb.

VI. RELAY MODULE

The Relay module as shown in Fig. 3 is a distinct hardware device used for remote switching. The Relay module houses two SPDT relays and one wide voltage range, optically isolated input.(As shown in figure) These are brought out to screw-type terminal blocks for easy field wiring. Relays are switches that open and close circuits electromechanically or electronically.

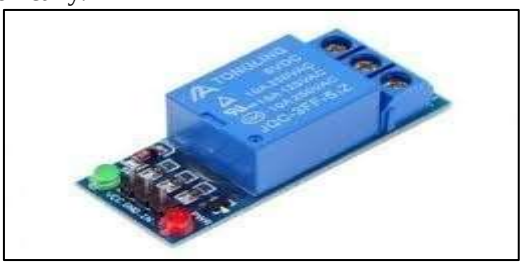

Fig. 3: Relay Module

Relays control one electrical circuit by opening and closing contacts in another circuit. As relay diagram show, when a relay contact is normally open (NO), there is an open contact when the relay is not energized.

VII. PROPOSED SYSTEM DESCRIPTION

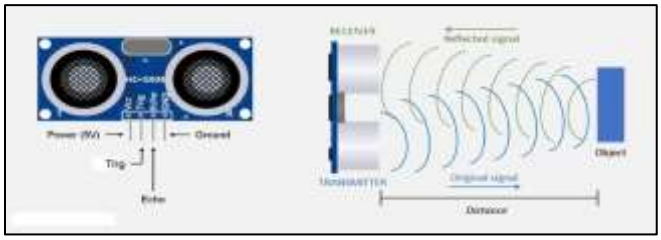

Fig. 4: Ultrasonic Sensor Working

The proposed system design is divided into 3 parts, Arduino consisting microcontroller circuit for controlling the entire system, PIR sensor which detect the presence of human and the Relay module for automatic switching.

VIII. WORKING OF THE SYSTEM

Ultrasonic Sensor HC-SR04 is a sensor that can measure distance. It emits an ultrasound at 40 000 Hz (40kHz) which travels through the air and if there is an object or obstacle on its path It will bounce back to the module. Considering the travel time and the speed of the sound you can calculate the distance. In order to generate the ultrasound we need to set the Trigger Pin on a High State for 10 µs. That will send out an 8 cycle sonic burst which will travel at the speed sound and it will be received in the Echo Pin. The Echo Pin will output the time in microseconds the sound wave traveled. For example, if the object is 20 cm away from the sensor, and the speed of the sound is 340 m/s or 0.034 cm/µs the sound wave will need to travel about 588 microseconds. But what you will get from the Echo pin will be double that number because the sound wave needs to travel forward and bounce backward. So in order to get the distance in cm we need to multiply the received travel time value from the echo pin by 0.034 and divide it by 2.

For the programming code, first we need to define the Trigger Pin and Echo Pin that connected to Arduino board. In this project EchoPin is attached to D2 and TrigPin to D3. Then define variables for the distance (int) and duration (long).

In the loop first you have to make sure that the trigPin is clear so we have to set that pin on a LOW State for just 2 µs. Now for generating the ultrasound wave we have to set the trigPin on HIGH State for 10 µs. Using the pulseIn()function you have to read the travel time and put that value into the variable "duration". This function has 2 parameters, the first one is the name of the echo pin and for the second one you can write either HIGH or LOW. In this case, HIGH means that the pulseIn() function will wait for the pin to go HIGH caused by the bounced sound wave and it will start timing, then it will wait for the pin to go LOW when the sound wave will end which will stop the timing. At the end the function will return the length of the pulse in microseconds. For getting the distance we will multiply the duration by 0.034 and divide it by 2 as we explained this equation previously. At the end we will print the value of the distance on the Serial Monitor.

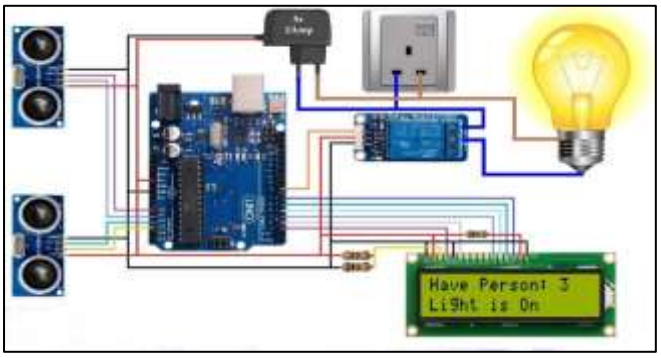

Fig. 5: Circuit Diagram Using Tinkercad

IX. PROGRAM CODE

```
#include <LiquidCrystal.h>// initialize the library with the numbers of the interface pinsLiquidCrystal lcd(2, 3, 4, 5, 6, 7);
#define e_s1 A0 //echo pin#define t_s1 A1 //Trigger pin
#define e_s2 A2 //echo pin#define t_s2 A3 //Trigger pin int relay = 8;
// Out for light long dis_a=0,dis_b=0; int flag1=0, flag2=0;
int person = 0;
//**********ultra_read**********void ultra_read(int pin_t,int pin_e,long &ultra_time)
{
long time;pinMode(pin_t,OUTPUT);
pinMode(pin_e,INPUT); digitalWrite(pin_t,LOW);
delayMicroseconds(2); digitalWrite(pin_t,HIGH);
delayMicroseconds(10); time=pulseIn (pin_e,HIGH);
ultra_time = time / 29 / 2;
}
void setup()
{
Serial.begin(9600);// initialize serial communication at 9600 bits per second: pinMode(relay, OUTPUT);
lcd.begin(16, 2);lcd.setCursor(0, 0); lcd.print(" Welcome ");delay(1000);
// Waiting for a whilelcd.clear();
}
void loop()
{
//**********ultra_read(t_s1,e_s1,dis_a);
delay(30); ultra_read(t_s2,e_s2,dis_b);
delay(30);
//********** Serial.print("da:");
Serial.println(dis_a);
Serial.print("db:"); Serial.println(dis_b); if(dis_a<90 && flag1==0)
{
flag1=1; If(flag2==0)
{
person = person+1;
}
}
if(dis_b<90 && flag2==0)
{
flag2=1;
if(flag1==0){person = person-1;
}}
if(dis_a>90 && dis_b>90 && flag1==1 && flag2==1)
{
flag1=0, flag2=0;delay(1000);
}
lcd.setCursor(0, 0); lcd.print("Have Person: "); lcd.print(person); lcd.print(" "); lcd.setCursor(0,1); lcd.print("Light is "); if(person>0)
{
digitalWrite(relay,HIGH); lcd.print("On ");
}
else{digitalWrite(relay,LOW); lcd.print("Off");
}
}
```

X. APPLICATION

In the proposed system decision are taken based on presence of human but here we can also interface LDR (Light Dependent Resistor) along with ultrasonic sensor for better working of the system. This system can also be interfaced with the Bluetooth module so the whole system can be controlled from the mobile by just single click. Applications of this system are:

1) It can be used in college labs, schools, etc.
2) It can also be used in bathrooms, staircases, etc. in the house.
3) 3 It can be used for the security purposes.

XI. CONCLUSION

From the proposed system we can conclude that an approach is taken to control the room lights using various devices. As nowadays enormous amount of energy is wasted in daily life. With the help of this system the energy wastage can be preserved and can be contribute to large amount of power saving. The total effective cost of system is very less.

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