

# INTELLIGENT ROOM LIGHTING SYSTEM

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**Abstract** - The Conventional Lighting system consumes a lot of energy. The wastage occurs commonly at home, schools, institutions and industries. People who waste electric energy are unaware of the amount of energy they waste. This project is proposed to monitor and control the intensity of room light. In this project, a LDR measures the amount of light present in the atmosphere and this information is sent to PIC microcontroller and Voltage regulation is performed with the help of TRIAC. The output signal from microcontroller is used to adjust the window screen by using servomotor. The desired illumination level in the room is achieved by adjusting the intensity of the room's light bulb and window screen according to the atmospheric light.

**Key Words:** LDR, servomotor, TRIAC, PIR sensor, PIC microcontroller.

## 1 INTRODUCTION

Energy crisis is one of the biggest threats to whole world in recent years. The light units make large part of energy consumption all over the world. The energy consumption by the light unit's cannot be ignored as these units consume about 20 % energy of world's total energy consumption. The innovation of a Light Emitting Diode (LED) is significantly attenuating the energy consumption of a light. This is because the LED lighting device consumes half energy as compared to energy consumption of fluorescent lighting device. The intelligent lighting control system can bring down energy consumption by controlling the intensity of light through situation awareness. Situation awareness is user movement and surrounding light illumination. The light intensity of a particular room is measured using a light sensor (BH1750) where the direct lux value is observed. Sometimes the light intensity of surrounding is sufficient, and user has no need to turn on light. In some cases, the surrounding light will be lesser, therefore to achieve the required illumination the lamp starts glowing and matches with the atmospheric light conditions. Therefore power management system for light control is needed in order to save energy. The existing lighting control systems can support only simple on/off of light according to user's presence. These systems are not suitable to the places such as house and office, because house and office user satisfaction is more important factor than cost benefits due to energy saving. This system should be designed bearing in mind both energy efficiency and user satisfaction. This intelligent room lighting system is designed with energy efficiency and user satisfaction. The new intelligent room

lighting system is adopted for all kinds of lights and lighting conditions.

## 1.1 EXISTING SYSTEM

This section describes regarding the foremost normally used lighting system employed in building. Since this technique goes to use wireless detector network it's necessary to understand the operation of existing lighting system. It can be determined that energy loss is occurred when light illuminates at unwanted area even when the atmospheric light is sufficient. The most generally used lighting systems are explained below

### 1.1.1 MANUALLY OPERATED SWITCH

In this technique, a user needs to turn ON and OFF the desired lights. Since the user can turn on and off the lights as per their requirements, there is a chance of keeping the lights in on state even though it was not required at that time. This method may first checks whether any occupants are there in the room or not. If anybody is there in that room then it checks the intensity of light, if it is enough then it will turn off the light otherwise it turn on the light.

### 1.1.2 AUTOMATED SWITCHING BY DETECTING OCCUPANTS

The lighting system uses PIR (Passive Infrared Sensor) for occupant detection. The PIR sensor detects the occupant movements. If any movement is detected then the system automatically turns ON the lights. Timers are not used in this type of system hence the system remains in ON state even after the user left the place. Because of this fault, a bulk of energy can be wasted. Another drawback of this type of system is, light will be in ON state when there are no occupants in that area, but there is a possibility of enough lighting at that particular time. This system does not check the intensity of light before turning on the Lights. Because of this, large quantities of energy are often lost.

## 1.2 PROBLEM IDENTIFICATION

Through literature survey it has been identified that many systems are proposed for the conservation of energy. But those systems were very complex and those are very difficult to implement at home or workspace. However, as per the latest survey, nearly 20% of energy wasted due to the light. Light that emits an excessive amount of illumination wherever it is not necessary is useless. Dimmers, motion

sensors and timers can help to reduce average illumination levels and save even more energy. Quality lighting design reduces energy use and therefore energy dependence.

### 1.3 AIM AND OBJECTIVES

The foremost aim is to propose a simple and efficient system that would reduce the energy wastage caused by human mistakes. The intentions of the proposed system are as follows:

- To eliminates the occupants struggle towards adjusting the window-screen for better room lighting in pair with the conventional room lamps.
- To extend the life of lamps, by reducing run-time and controlling energy wastage.

### 1.4 PROPOSED SYSTEM

The proposed system overcomes all the drawbacks of existing system. This system considers two main actions, mainly intensity control of light and screen adjustment using servomotor. The system consists of LDR, PIR sensor and servomotor. The LDR is used to detect the presence of light and PIR sensor is used to detect the occupants and servomotor is used for window screen adjustment. Apart from this, an algorithm has implemented in our system, which uses the LDR, PIR sensor and servomotor to decide the intensity of light and opening and closing of window screen.

## 2 SYSTEM DESCRIPTIONS

The sensors plays a major role in this project, a 10mm LDR is used to detect the presence of light, PIR sensor is used to detect the occupants and servomotor is used for adjusting the screen at different angle according the requirements and TRIAC is implemented to help the control of output voltage to control the brightness of the lamp.

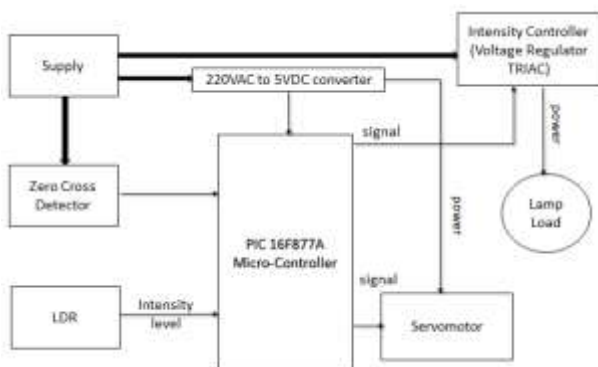


Fig 2.1: Block diagram

### 2.1 LDR

A photoresistor is a light-controlled variable resistor. The resistance of photoresistor decreases with increasing incident light intensity, in alternative words it exhibits electrical conduction. Photoresistor is made of high

resistance semiconductor. In darkness, a photoresistor can have a resistance as high as several Mega-ohms (MΩ), while in the day time, the photoresistor can have a resistance as low as a few hundred ohms. If the incident light on a photoresistor exceeds limited frequency, photons absorbed by the semiconductor provides bound electrons enough energy to leap to the conductivity band. The remaining free electrons (and their hole partners) conduct electricity, therefore reduces resistance. The resistance value and sensitivity of a photoresistor can differ among dissimilar devices. Moreover, distinctive photoresistors might react well otherwise to photons at intervals bound wavelength bands. A photoelectric device can be either intrinsic or extrinsic. In this project, a 10K resistor in series with LDR is connected between the 5V DC and GND. The output is taken from the connection point between the LDR and resistor then provided to the microcontroller. This signal is an analog signal where the voltages vary with respect to light intensity available from natural source like sun.



Fig2.2: LDR

### 2.2 PIR SENSOR

Passive Infrared Sensor (PIR) is used to detect the presence of an object in that particular area. It is easy to install. The sensor is Automatic, convenient, safe and practical. It has the ability of power and detection indication. The motion sensor will detect day and night automatically. It has wide detection range like up and down, left and right service field This product could be a new form of energy-saving lighting switch, it adopts high sensitivity detector It make use of human motion infrared rays as control signal sources, when someone enters the detection field, it will start to control the load .



Fig.2.3: PIR Sensor (12Meter range)

### 2.3 VOLTAGE REGULATOR

A voltage regulator, also known an AC voltage controller or AC regulator is an electronic module based on Thyristors, TRIACs, SCRs or IGBTs, which converts a fixed

voltage and fixed frequency alternating current (AC) electrical input supply to achieve variable voltage in output delivered to a resistive load. This varied voltage output is employed for dimming street lights. It works in a similar fashion to an autotransformer. Voltage controller modules come under the concept of power electronics. Because they have low-maintenance and very efficient. Voltage controllers have largely replaced such modules as magnetic amplifiers and saturable reactors in industries. In phase cutting, thyristors are used to halve the voltage cycle during input. By varying the phase angle or trigger angle, the output RMS voltage of the load can be changed. The thyristor is turned on for each half-cycle and changed for every remaining half-cycle. The phase angle is the position at which the thyristor is turned on. TRIACs are often used instead of thyristors to perform the same function for better efficiency. If the load could be a combination of resistance and inductance, the present cycle lags the voltage cycle, decreasing overall power output. The MOC3021 was designed for interfacing Electronic Control and high power TRIAC to control Load for AC voltage operations. A small pulse (clock pulse with 5v range) is applied to its input that is PIN1 and PIN2. The light emitted by this LED activates the TRIAC and that time power is switched ON. Mainly it is used to maintain isolation between low power circuits to high power circuit (that is 5v pulse control 3 phase load voltage).



Fig 2.4: Pin Diagram of BT136 Triac

**2.4 SERVO MOTOR**

A servomotor is a rotary actuator or linear actuator that permits for accurate control of angular or linear position, velocity and acceleration. It consists of an acceptable motor coupled to a sensing element for position feedback. It also needs a comparatively sophisticated controller, often a dedicated module designed specifically to be used with servomotors. Servomotors aren't a particular category of motor though the term servomotor is usually accustomed to refer to a motor suitable for use in a closed-loop control system. Servomotors are utilized in applications such as robotics, CNC machinery or automated manufacturing. A servomotor could be a closed-loop servo that uses position feedback to regulate its motion and final position. The input to its control could be a signal (either analogue or digital) representing the position commanded for the output shaft. The motor is paired with some sort of encoder to supply position and speed feedback. In the uncomplicated case, only the position is measured. The measured position of the output is compared to the command position, the external

input to the controller. If the output position differs from that needed, miscalculation signal is generated that then causes the motor to rotate in either direction, to bring the output shaft to the appropriate position. As the positions approach, the error signal reduces to zero and therefore the motor stops. The terribly simplest servomotors use position-only sensing via a potentiometer and bang-bang management of their motor; the motor continually rotates at full speed (or is stopped). This type of servomotor isn't wide utilized in industrial motion management, however it forms the idea of the straightforward and low cost servos used for guided models.



Fig2.5: 9g servomotor

**2.5 PIC Microcontroller**

A microcontroller is a small computer on a single chip Integrated Circuit. A microcontroller has one or more CPUs along with memory and programmable input/output peripherals. Program memory in the form of NOR flash, ferroelectric RAM or OTP ROM is also often included on chip, as well as a small amount of RAM. Microcontrollers are developed for embedded applications, in distinction to the microprocessors employed in personal computers or different general purpose applications consisting of varied separate chips.

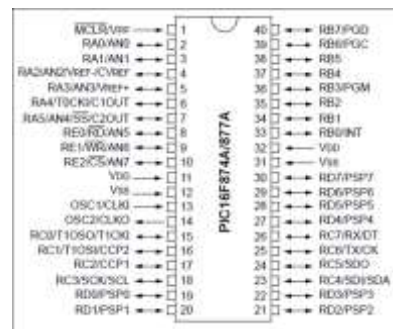


Fig2.6: Pin diagram of PIC microcontroller

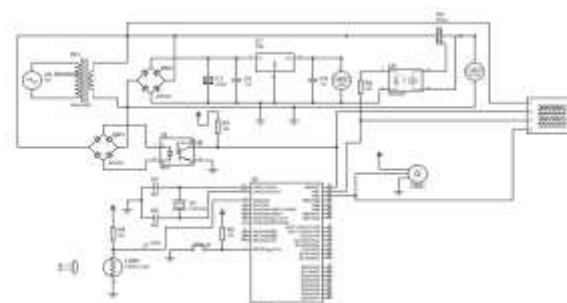


Fig2.7: Circuit Diagram

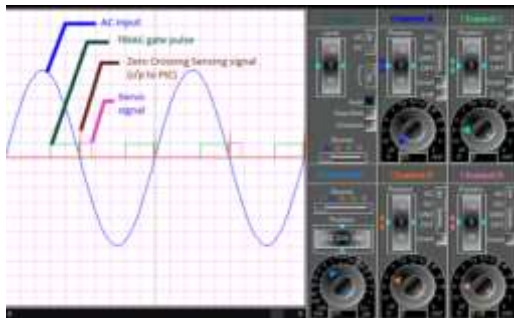


Fig2.8: Simulation output parameters

### 3 RESULTS AND DISCUSSIONS

The hardware requirements consists of a transformer, diodes, optocouplers, resistors, capacitors, LDR, PIR sensor LED lamp, PIC microcontroller, crystal, TRIAC, servomotor.

#### 3.1 LIGHT DETECTION

The work of the proposed system was started with the selection of light detection system. The selection of sensors was a major difficult task as the system needs cost effective and most accurate sensor. In spite of using light sensor, we preferred LDR because it is easy to interface with PIC microcontroller. They provide change in resistance for changes in light level. LDR detects the intensity of light in the atmosphere and provides input to the microcontroller as analog input ranging between 0 and 1023. This value is read by microcontroller and converted into digital data as 0 or 1. The major problem that had occurred during testing was it gave an inaccurate result at some instant and it was rectified later by changing the LDR position. The system designed with LDR was very efficient and responds quickly.

#### 3.2 SCREEN ADJUSTMENT USING SERVOMOTOR

The servomotor is preferred for the screen adjustment, because it is able to rotate upto 180°. According to the required room light the screen adjust at different angle. With a 1.5ms pulse, the servomotor will be at 90 degree position. With a 0.5ms pulse the servomotor will be at 0 degree position and with a 2.5ms pulse the servomotor will be at 180 degree position. Initially DC servomotor motor made the system to respond slowly and it generates a poor results but by improving the standard of coding algorithms accurate results were able to be achieved.

#### 3.3 WORKING AND CONDITIONS

The system turn ON automatically once the person enters the room and can turn OFF automatically once they leave the room using the PIR sensor. The Intensity of light is directly proportional to the Voltage available and hence the intensity of lamps is controlled by voltage control using power electronics techniques. Different lighting conditions were adopted and the algorithm was developed.

Table 1: Working Conditions

Sl.No	Conditions	Working
1	*12 Noon Sunlight = Very High	Screen (*Servo) = 30 degrees opened Lamp = OFF
2	Sunlight = High	Screen = 50 degrees opened Lamp = OFF
3	Sunlight = Somewhat high	Screen = 70 degrees opened Lamp = OFF
4	*3 hours before & after noon Sunlight = perfect / idle	Screen = 90 degrees opened Lamp = OFF
5	Sunlight = Good	Screen = 90 degrees opened Lamp = glows at 40% brightness
6	*Evening Sunlight = Poor	Screen = 90 degrees opened Lamp = glows at 70% brightness
7	Sunlight = very poor	Screen = 90 degrees opened Lamp = glows at 100% brightness
8	Sunlight = Night (no light)	Screen closed Lamp = glows at full brightness

In this project the intensity of a room light is controlled according to atmospheric light and by adjusting the window screen of the room in this way the usage of electricity is decreased in home by using LED lamps or conventional CFL lamps. This project uses PIC 16F877A microcontroller which generates required gate signals that reminds a TRIAC to switch ON the lamp and regulate the intensity to achieve an ideal operation and also the signal are given to servomotor for window screen adjustment.

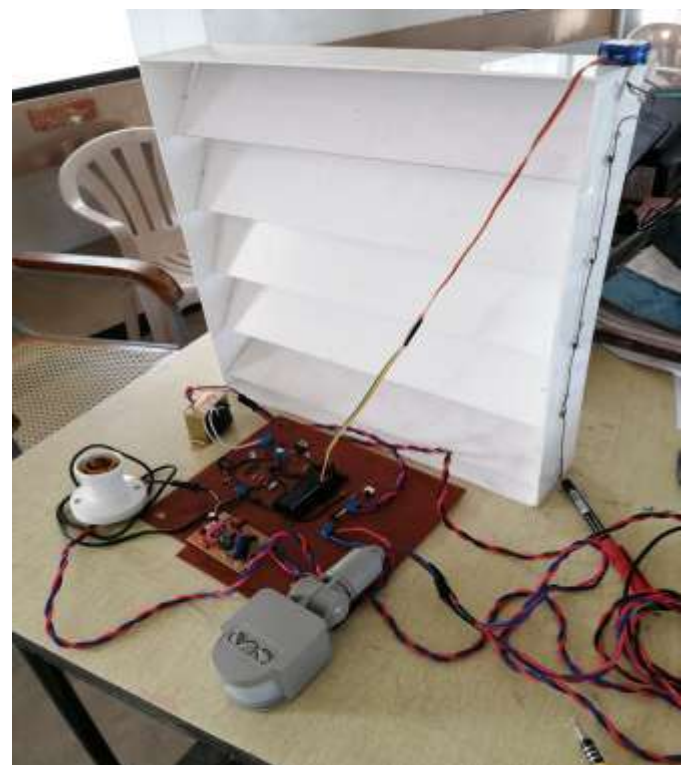


Fig3.8: Hardware Picture

### 4. CONCLUSION

Thus, this project elaborates the designing of Intelligent Room Lighting System and its working. The intelligent system will save human efforts over adjusting the screen for

comfortable lighting conditions and leads to better working environment. After designing the project, the intensity of the lights and adjustment of window screen had controlled successfully by receiving the information from the light and object sensor via PIC 16f877a Microcontroller. With instructions from the controller the lights will be either switched ON or OFF based on signal received from the object sensor. During switch ON condition the Lamp will glow at different intensity level as 0, 40, 70, 100 percent and screen adjust at different angle like 0, 30, 50, 70, 90 respectively depending upon the Presence or absence of atmospheric light. So finally, this project can be implemented in living room, Conference hall, Training Room and classroom.

#### 4.1 FUTURE SCOPE

Incorporating dimmers in a lighting control system means the intensity of lamp can be controlled. Lower the light levels and see the visible reduction in the electric bill. By introducing dimming in lights not only the energy be saved but also the life of the bulbs can be extended. This system will be the solution for the problems of energy wastage.

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