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EFFICIENT LIGHT CONTROLLING SYSTEM

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Major Project-II

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ABSTRACT

This study presents the design and implementation of an efficient light-controlling system leveraging the combined capabilities of a Passive Infrared (PIR) sensor and a Light Dependent Resistor (LDR). The integration of these sensors aims to create an intelligent lighting solution capable of dynamically adjusting light levels based on human presence and ambient light conditions. The system addresses the need for energy-efficient lighting by activating or modifying illumination only when required, thus minimizing unnecessary energy consumption.

The PIR sensor detects human motion, enabling the system to activate or adjust lighting in response to occupancy. Complementing this, the LDR measures ambient light levels, allowing the system to optimize illumination according to the natural lighting available. The synergy between these sensors results in a smart, adaptive lighting system that not only enhances energy savings but also provides a comfortable and convenient user experience.

Key features include customizable settings to accommodate individual preferences, potential integration with broader smart home or building automation systems, and enhanced security through motion-triggered lighting. The study evaluates the system's performance in terms of energy savings, user satisfaction, and adaptability to various environments.

Results indicate a promising reduction in energy consumption, contributing to sustainability

goals and cost efficiency. The system's adaptability and potential for integration with modern technologies underscore its applicability in diverse settings, ranging from residential to commercial and industrial environments. The findings suggest that the efficient light-controlling system using PIR sensor and LDR offers a practical and user-friendly solution for achieving intelligent and sustainable lighting in today's dynamic and energy-conscious world.

CHAPTER 1
INTRODUCTION

1.1 Introduction

Power saving have become a necessary thing in our day to day life. Many conventional power saving methods such as using electrical devices which consumes very less energy or cutting off the entire power supply for a scheduled time for a particular area are not efficient and there will be a lot of discomforts to the users and cost may also increase to use a low power electrical device. Buildings are responsible for up to 40% of energy usage. Most part of this energy is used mainly for maintaining good lighting such that the workers feel comfortable.

Nowadays the newly constructed modernized or automated buildings may have lighting system to improve the comfort of occupants and to save the energy. But there are large number of old buildings which contains the traditional lighting system. To reduce the energy consumption in those types of buildings and to help the owners of that building in terms of saving electricity bill an intelligent and an effective method is discussed in this paper. Because of advancement in Sensor technology a very cheap and portable methods to measure our surroundings are available. The amounts of light required to for a good environment to work comfortably in various areas are which is recommended by CIBSE lighting guides.

1.2 Objective of the project

The most commonly used lighting systems are explained below.

1.2.1 A Switch operated manually: In this method a user has to switch ON and OFF the required lights. Since the user can switch on and off the lights as per their preferences there is a chance of keeping the lights in on state even though it was not need during that time. This may occur because of carelessness of user and a large amount of power is wasted. This approach 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 won't switch on the light otherwise it switches on the light.

1.2 By Detecting Occupants: The lighting system with occupant detection uses passive infrared sensor (PIR). This PIR sensor detects any movement is present in that particular area. If any movement is there meaning then this system automatically switches ON the lights. If timers are not used in this type of system means then the lights will be kept in ON state even after the user left the place. Because of this fault also a large amount of energy can be wasted. Then another drawback about this type of system is, it will switch ON the lights when there is an occupant is present in that area. But there is a possibility of enough lighting will be there at that particular time. This system is not going to check the intensity of light before switching on the lights.

Because of this also a large amount of energy can be lost.

The proposed system overcomes all the drawbacks of existing system. This system takes two things into account before taking any action, namely (1) human presence and (2) intensity of light. The system consists of a PIR sensor (Parallax 555- 28027) and an LDR (NORP 12). The PIR sensor is used to detect whether any occupants are there in that room and LDR is used to detect the intensity of light in that room.

CHAPTER 2
LITERATURE REVIEW

Efficient light controlling systems play a crucial role in optimizing energy consumption and creating comfortable and sustainable environments. Below is a literature review summarizing key research findings and trends in this field.

1. **Smart Lighting Systems:**
- Smart lighting systems integrate sensors, actuators, and communication technologies to create adaptive lighting environments. They respond to occupancy, ambient light levels, and user preferences.
- Studies (e.g., Chen et al., 2018) have shown that smart lighting systems can significantly reduce energy consumption by dynamically adjusting light levels based on real-time conditions.

2. **Occupancy and Motion Sensors:**
- Presence detection through occupancy sensors is a common strategy for energy-efficient lighting. Sensors can detect the presence of occupants in a room and adjust lighting levels accordingly.
- Research by Yao et al. (2016) suggests that occupancy-based lighting control systems can lead to substantial energy savings in commercial buildings.

3. **Daylight Harvesting:**
- Daylight harvesting involves utilizing natural daylight to supplement artificial lighting. This is achieved through sensors that measure ambient light levels and adjust artificial lighting accordingly.
- Studies (e.g., Kim et al., 2017) have demonstrated the effectiveness of daylight harvesting in reducing energy consumption while maintaining adequate illumination levels.

4. **Wireless Communication Technologies:**
- Wireless communication technologies, such as Zigbee and Bluetooth, play a crucial role in enabling communication between different components of a light control system.
- Research (e.g., Patel et al., 2019) highlights the benefits of wireless systems, including flexibility in installation and scalability.

In conclusion, the literature on efficient light controlling systems underscores the importance of embracing advanced technologies and strategies to create lighting environments that are both energy-efficient and tailored to human needs. Ongoing research is likely to contribute further to the development and implementation of intelligent lighting solutions in various contexts.

CHAPTER 3
PROBLEM FORMULATION

To reduce the energy consumption in various buildings and to help the owners of that building in terms of saving electricity bill an intelligent and an effective method is discussed in this paper. After this we get the answers to the following questions.

1. What are the most effective algorithms for optimizing light levels based on real-time occupancy and ambient light conditions?

2. How can emerging technologies, such as smart sensors and adaptive controls, be integrated into light-control systems to enhance efficiency?

3. How do different light-control strategies impact energy consumption in residential, commercial, and industrial settings?

4. How do user preferences and behaviors influence the design and acceptance of automated light-control systems?

5. What factors contribute to user satisfaction and comfort in environments where light levels are controlled automatically?

6. What is the cost-effectiveness of implementing advanced light-control systems compared to traditional lighting solutions?

7. How do the initial costs and long-term savings vary across different types of buildings and use cases?

8. How can light-control systems comply with existing regulations and standards related to energy efficiency?

9. What regulatory challenges exist for the implementation of emerging light-control technologies?

10. How can light-control systems be seamlessly integrated into building management systems to create a more comprehensive and efficient approach to energy management?

These research questions can serve as a starting point for investigating various aspects of efficient light-control systems.

CHAPTER 4
PROPOSED METHODOLOGY

PROPOSED SYSTEM: This system takes two things into account before taking any action, namely (1) human presence and (2) intensity of light. The system consists of a PIR sensor (Parallax 555- 28027) and an LDR (NORP 12). The PIR sensor is used to detect whether any occupants are there in that room and LDR is used to detect the intensity of light in that room. Apart from this an algorithm can be implemented in our system which uses both the LDR and PIR sensor to decide whether to switch on the light or not.

SYSTEM DESIGN: This system can be implemented using a PIC 16F877A, a LDR, A PIR sensor and the lights can be controlled by relays. The LDR sensor will keep on sensing the intensity of light and sends it to the microcontroller. The PIR sensor will send a signal to the microcontroller if there is any occupant in the room. If anybody is present in the room then the microcontroller compares the sensed value of intensity in the room with the value already stored in the microcontroller. If the sensed value is less than the value stored in the microcontroller then the light will be switched on by connecting the relay.

4.1 BLOCK DIAGRAM:

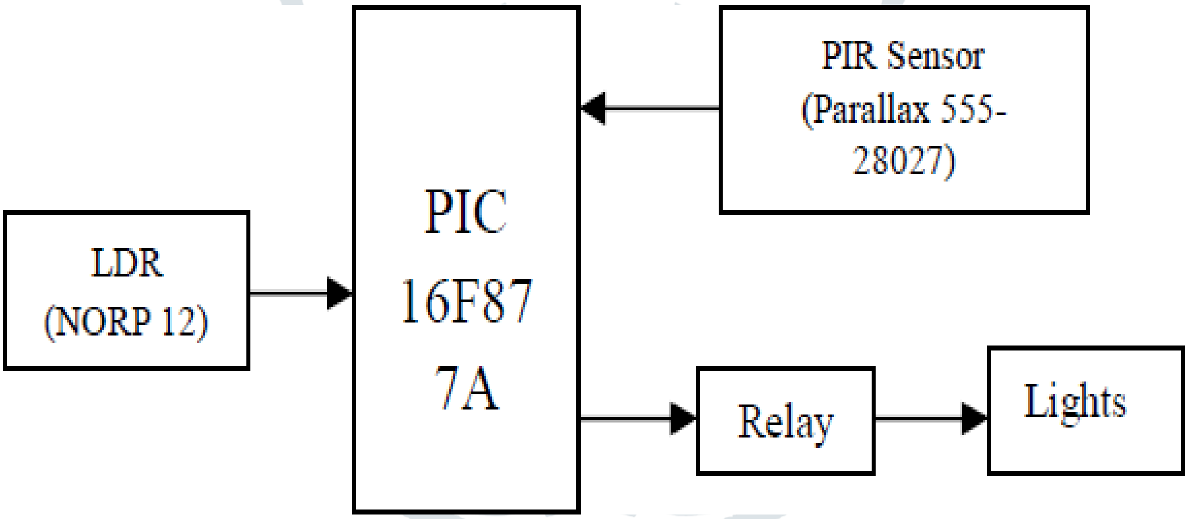


FIG:1 BLOCK DIAGRAM FOR THE PROPOSED SYSTEM

4.2 CIRCUIT DIAGRAM:

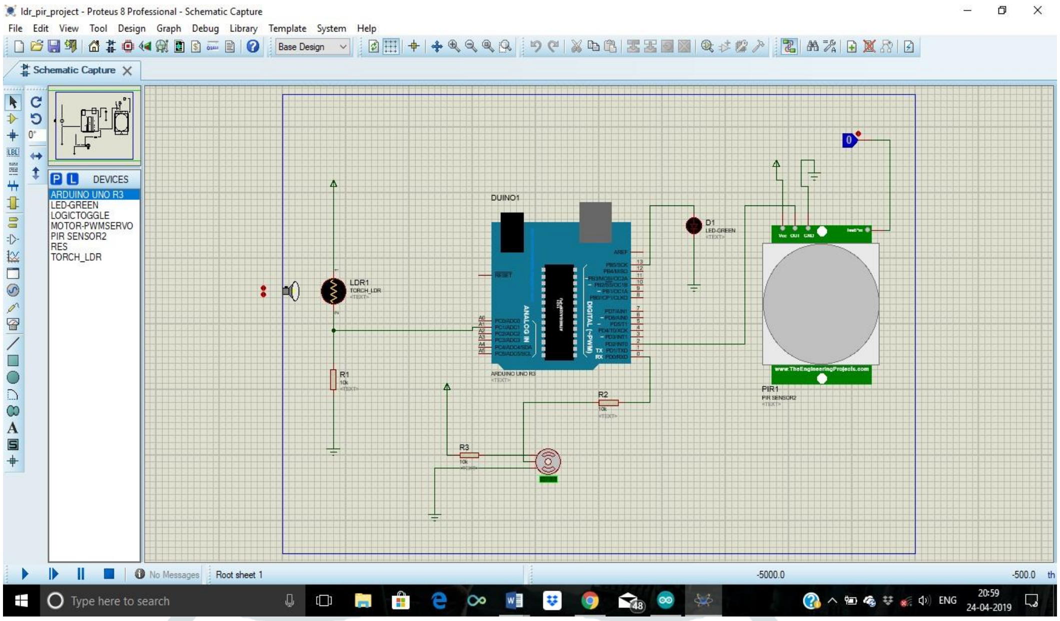


FIG:2 CIRCUIT DIAGRAM ON PROTEUS

4.3 FLOWCHART:

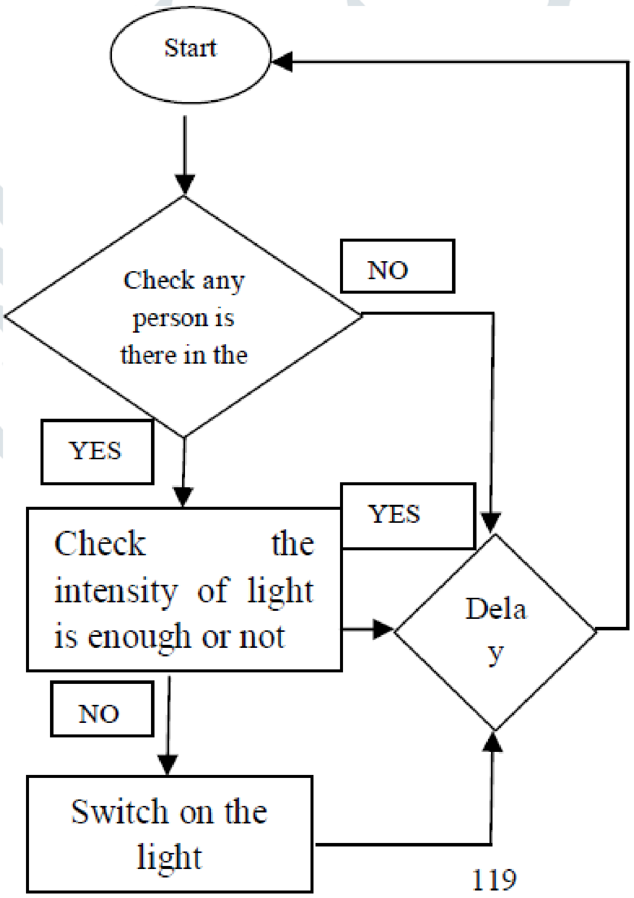


FIG:3 FLOWCHART FOR THE SYSTEM

CHAPTER 5
SYSTEM COMPONENTS AND ALGORITHM

5.1COMPONENTS DISCRIPTION:

5.1.1. ARDUINO UNO:

Overview

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.

The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter. Revision 2 of the Uno board has a resistor pulling the 8U2 HWB line to ground, making it easier to put into DFU mode. Revision 3 of the board has the following new features:

- 1.0 pinout: added SDA and SCL pins that are near to the AREF pin and two other new pins placed near to the RESET pin, the IOREF that allow the shields to adapt to the voltage provided from the board. In future, shields will be compatible both with the board that use the AVR, which operate with 5V and with the Arduino Due that operate with 3.3V. The second one is a not connected pin, that is reserved for future purposes.

- Stronger RESET circuit.

- At mega 16U2 replace the 8U2.

"Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform; for a comparison with previous versions, see the index of Arduino boards.

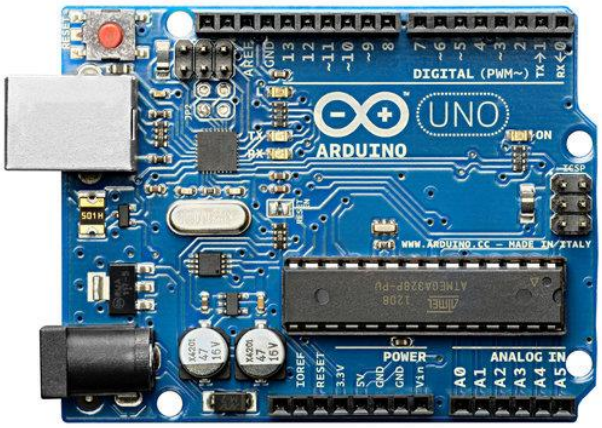


FIG:4 ARDUINO UNO

Input Voltage (limits)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
Analog Input Pins	6
DC Current per I/O Pin	40 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328) of which 0.5 KBused by bootloader
SRAM	2 KB (ATmega328)
EEPROM	1 KB (ATmega328)
Clock Speed	16 MHz

Table:1 Specification Of Arduino Uno

Power

The Arduino Uno can be powered via the USB connection or with an external power supply. The power source is selected automatically.

External (non-USB) power can come either from an AC-to-DC adapter (wall-wart) or battery. The adapter can be connected by plugging a 2.1mm center-positive plug into the board's power jack. Leads from a battery can be inserted in the GND and Vin pin headers of the POWER connector.

The board can operate on an external supply of 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may be unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts.
The power pins are as follows:

- **VIN.** The input voltage to the Arduino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.

- **5V.** This pin outputs a regulated 5V from the regulator on the board. The board can be supplied with power either from the DC power jack (7 - 12V), the USB connector (5V), or the VIN pin ofthe board (7-12V). Supplying voltage via the 5V or 3.3V pins bypasses the regulator, and can damage your board. We don't advise it.

- **3V3.** A 3.3-volt supply generated by the on-board regulator. Maximum current draw is 50 mA.

- **GND.** Ground pins.

Memory

SRAM The ATmega328 has 32 KB (with 0.5 KB used for the bootloader). It also has 2 KB of and 1 KB of EEPROM (which can be read and written with the EEPROM library).

Input and Output

Each of the 14 digital pins on the Uno can be used as an input or output, using pin Mode (), digitalWrite(), and digital Read() functions. They operate at 5 volts. Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20-50 kOhms. In addition, some pins have specialized functions:

- **Serial: 0 (RX) and 1 (TX).** Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL Serial chip.
- **External Interrupts: 2 and 3.** These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the attach Interrupt() function for details.
- **PWM: 3, 5, 6, 9, 10, and 11.** Provide 8-bit PWM output with the analogWrite() function
- **SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK).** These pins support SPI communication using the SPI library.
- **LED: 13.** There is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.
- The Uno has 6 analog inputs, labeled A0 through A5, each of which provide 10 bits of resolution (i.e. 1024 different values). By default they measure from ground to 5 volts, though is it possible to change the upper end of their range using the AREF pin and the analogReference() function.

Additionally, some pins have specialized functionality:

- **TWI: A4 or SDA pin and A5 or SCL pin.** Support TWI communication using the Wire library.

There are a couple of other pins on the board:

- **AREF.** Reference voltage for the analog inputs. Used with analogReference().
- **Reset.** Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board.

Communication

The Arduino Uno has a number of facilities for communicating with a computer, another Arduino, or other microcontrollers. The ATmega328 provides UART TTL (5V) serial communication, which is available on digital pins 0 (RX) and 1 (TX). The RX and TX LEDs on the board will flash when data is being transmitted via the USB-to-serial chip and USB connection to the computer (but not for serial communication on pins 0 and 1.

Programming

The Arduino Uno can be programmed with the Arduino software (download). Select "Arduino Uno from the **Tools > Board** menu (according to the microcontroller on your board). For details, see the reference and tutorials.

The ATmega328 on the Arduino Uno comes preburned with a bootloader that allows you to upload new code to it without the use of an external hardware programmer. It communicates using the original STK500 protocol (reference, C header files).

You can also bypass the bootloader and program the microcontroller through the ICSP (In-Circuit Serial Programming) header; see these instructions for details.

5.1.2. PIR SENSOR:

Product Description:
HC-SR501 is based on infrared technology, automatic control module, using Germany imported LHI778 probe design, high sensitivity, high reliability, ultra-low-voltage operating mode, widely used in various auto-sensing electrical equipment, especially for battery-powered automatic controlled products.

Specification:

- Voltage: 5V – 20V
- Power Consumption: 65Ma
- TTL output: 3.3V, 0V
- Delay time: Adjustable (.3->5min)
- Lock time: 0.2 sec
- Trigger methods: L – disable repeat trigger, H enable repeat trigger
- Sensing range: less than 120 degree, within 7 meters
- Temperature: – 15 ~ +70
- Dimension: 32*24 mm, distance between screw 28mm, M2, Lens dimension in diameter: 23mm

Application:
Automatically sensing light for Floor, bathroom, basement, porch, warehouse, Garage, etc, ventilator, alarm, etc.

Features:

- Automatic induction: to enter the sensing range of the output is high, the person leaves the sensing range of the automatic delay off high, output low.
- Photosensitive control (optional, not factory-set) can be set photosensitive control, day or light intensity without induction.
- Temperature compensation (optional, factory reset): In the summer when the ambient temperature rises to 30 ° C to 32 ° C, the detection distance is slightly shorter, temperature compensation can be used for performance compensation

- Triggered in two ways: (jumper selectable)
  - Non-repeatable trigger: the sensor output high, the delay time is over, the output is automatically changed from high level to low level.
  - Repeatable trigger: the sensor output high, the delay period, if there is human activity in its sensing range, the output will always remain high until the people left after the delay will be high level goes low (sensor module detects a time delay period will be automatically extended every human activity, and the starting point for the delay time to the last event of the time).
- Wide operating voltage range: default voltage DC4.5V-20V.
- Micropower consumption: static current
- Output high signal: easy to achieve docking with the various types of circuit.

Instructions for use:

- Sensor module is powered up after a minute, in this initialization time intervals during this module will output 0-3 times, a minute later enters the standby state.
- Should try to avoid the lights and other sources of interference close direct module surface of the lens, in order to avoid the introduction of interference signal malfunction; environment should avoid the wind flow, the wind will cause interference on the sensor.
- Sensor module with dual probe, the probe window is rectangular, dual (A B) in both ends of the longitudinal direction
- When the human body from the front to the probe or from top to bottom or from bottom to top on the direction travelled, double detects changes in the distance of less than infrared spectroscopy, no difference value the sensor insensitive or does not work.
- The dual direction of sensor should be installed parallel as far as possible in in line with human movement. In order to increase the sensor angle range, the module using a circular lens also makes the probe surrounded induction, but the left and right sides still up and down in both directions sensing range, sensitivity, still need to try to install the above requirements.

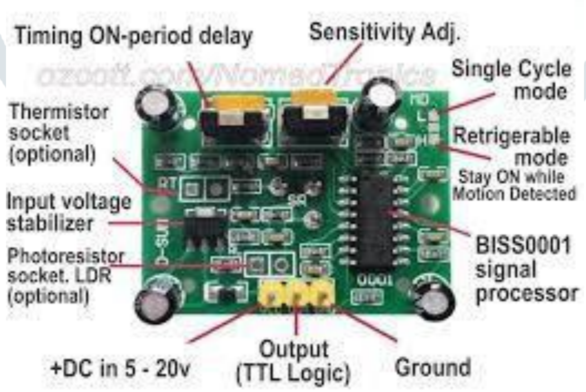


FIG:5 PIR SENSOR

5.1.3. LDR (light dependent resistor)

A photoresistor or light dependent resistor is a component that is sensitive to light. When light falls upon it then the resistance changes. Values of the resistance of the LDR may change over many orders of magnitude the value of the resistance falling as the level of light increases.

It is not uncommon for the values of resistance of an LDR or photoresistor to be several megohms in darkness and then to fall to a few hundred ohms in bright light. With such a wide variation in resistance,
LDRs are easy to use and there are many LDR circuits available. The sensitivity of light dependent resistors or photoresistors also varies with the wavelength of the incident light.

LDRs are made from semiconductor materials to enable them to have their light sensitive properties. Many materials can be used, but one popular material for these photoresistors is cadmium sulphide (CdS).

How an LDR work ?

It is relatively easy to understand the basics of how an LDR works without delving into complicated explanations. It is first necessary to understand that an electrical current consists of the movement of electrons within a material. Good conductors have a large number of free electrons that can drift in a given direction under the action of a potential difference. Insulators with a high resistance have very few free electrons, and therefore it is hard to make the them move and hence a current to flow.

An LDR or photoresistor is made any semiconductor material with a high resistance. It has a high resistance because there are very few electrons that are free and able to move - the vast majority of the electrons are locked into the crystal lattice and unable to move. Therefore, in this state there is a high LDR resistance.

As light falls on the semiconductor, the light photons are absorbed by the semiconductor lattice and some of their energy is transferred to the electrons. This gives some of them sufficient energy to break free from the crystal lattice so that they can then conduct electricity. This results in a lowering of the resistance of the semiconductor and hence the overall LDR resistance.

Types of photoresistor

Light dependent resistors, LDRs or photoresistors fall into one of two types or categories:

- ***Intrinsic photoresistors:*** Intrinsic photoresistors use un-doped semiconductor materials including silicon or germanium. Photons fall on the LDR excite electrons moving them from the valence band to the conduction band. As a result, these electrons are free to conduct electricity. The more light that falls on the device, the more electrons are liberated and the greater the level of conductivity, and this results in a lower level of resistance.

- ***Extrinsic photoresistors:*** Extrinsic photoresistors are manufactured from semiconductor of materials doped with impurities. These impurities or dopants create a new energy band above the existing valence band. As a result, electrons need less energy to transfer to the conduction band because of the smaller energy gap.

Regardless of the type of light dependent resistor or photoresistor, both types exhibit an increase in conductivity or fall in resistance with increasing levels of incident light.

LDR symbol

The LDR symbol used in circuits is based around the resistor circuit symbol, but shows the light, in the form of arrows shining on it. In this way it follows the same convention used for photodiode and phototransistor circuit symbols where arrows are used to show the light falling on these components.

Fig. 6 LDR Sensor

Circuit symbols used for the light dependent resistor / photoresistor

The light dependent resistor / photoresistor circuit symbols are shown for both the newer style resistor symbol, i.e. a rectangular box and the older zig-zag line resistor circuit symbols.

Light dependent resistor specifications

There are several specifications that are important for light dependent resistors, LDRs / photoresistors. These photoresistor specifications include:

PARAMETER	**KEY LDR / PHOTORESISTOR SPECIFICATIONS**
Max power dissipation	This is the maximum power the device is able to dissipate within a given temperaturerange. Derating may be applicable above a certain temperature.
Maximum operating voltage	Particularly as the device is semiconductor based, the maximum operating voltage mustbe observed. This is typically specified at 0 lux, i.e. darkness.

Peak wavelength	This photoresistor specification details the wavelength of maximum sensitivity. Curves may be provided for the overall response in some instances. The wavelength is specifiedin nm
Resistance when illuminated	The resistance under illumination is a key specification is a key parameter for any photoresistor. Often a minimum and maximum resistance is given under certain light conditions, often 10 lux. A minimum and maximum vale may be given because of the spreads that are likely to be encountered. A 'fully on' condition may also be given underextreme lighting, e.g. 100lux.
Dark resistance	Dark resistance values will be given for the photoresistor. These may be specified after agiven time because it takes a while for the resistance to fall as the charge carrier recombine - photoresistors are noted for their slow response times.

Table 2 Specifications Of LDR

5.1.4. LED (Light emitting diodes)

Light emitting diodes (**LEDs**) are semiconductor light sources. The light emitted from **LED**s varies from visible to infrared and ultraviolet regions. They operate on low voltage and power. LEDs are one of the most common electronic components and are mostly used as indicators in circuits. They are also used for luminance and optoelectronic applications.

Based on semiconductor diode, **LED**s emit photons when electrons recombine with holes on forward biasing. The two terminals of LEDs are anode (+) and cathode (-) and can be identified by their size. The longer leg is the positive terminal or anode and shorter one is negative terminal.

The forward voltage of **LED** (1.7V-2.2V) is lower than the voltage supplied (5V) to drive it in a circuit. Using an LED as such would burn it because a high current would destroy its p-n gate. Therefore, a current limiting resistor is used in series with LED. Without this resistor, either low input voltage (equal to forward voltage) or PWM (pulse width modulation) is used to drive the LED.

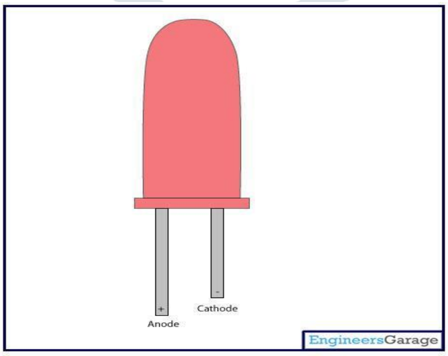


FIG:7 Light Emitting Diode

How do LEDs Emit Light?

LEDs (Light Emitting Diodes) are semiconductor light sources that combine a P-type semiconductor (larger hole concentration) with an N-type semiconductor (larger electron concentration). Applying a sufficient forward voltage will cause the electrons and holes to recombine at the P-N junction, releasing energy in the form of light.

Compared with conventional light sources that first convert electrical energy into heat, and then into light, LEDs (Light Emitting Diodes) convert electrical energy directly into light, delivering efficient light generation with little-wasted electricity.

5.1.5. Resistor

The resistor is a passive electrical component that creates resistance in the flow of electric current. In almost all electrical networks and electronic circuits they can be found. The resistance is measured in ohms (Ω). An ohm is the resistance that occurs when a current of one ampere (A) passes through a resistor with a one volt (V) drop across its terminals. The current is proportional to the voltage across the terminal ends.

Resistors are used for many purposes. A few examples include limiting electric current, voltage division, heat generation, matching and loading circuits, gain control, and setting time constants. They are commercially available with resistance values over a range of more than nine orders of magnitude. They can be used as electric brakes to dissipate kinetic energy from trains, or be smaller than a square millimetre for electronics.

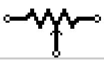
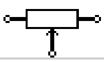
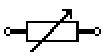
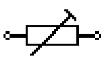
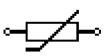
The choice of material technology is specific to the resistor purpose. Often it is a trade-off between cost, precision, power, and other requirements. For example, carbon composition is a very old manufacturing technique that creates a low precision resistor, but is still used for specific applications where high energy pulses occur. Carbon composition resistors have a body made from a mixture of fine carbon particles and a non-conductive ceramic.

FIG:8 RESISTORS

Variable resistor	Variable resistor has an adjustable resistance (2 terminals)
Potentiometer	Potentiometer has an adjustable resistance (3 terminals)
Photo-resistor	Reduces resistance when exposed to light

Power resistor	Power resistor is used for high power circuits and has large dimensions.
Surface mount (SMT/SMD) resistor	SMT/SMD resistors have small dimensions. The resistors are surface mounted on theprinted circuit board (PCB), this method is fast and requires small board area.
Resistor network	Resistor network is a chip that contains several resistors with similar or different values.
Carbon resistor	
Chip resistor	

Table:3 Types of resistors

	Resistor (IEEE)	Resistor reduces the current flow.
	Resistor (IEC)	
	Potentiometer (IEEE)	Adjustable resistor – has 3 terminals.
	Potentiometer (IEC)	
	Variable Resistor / Rheostat (IEEE)	Adjustable resistor – has 2 terminals.
	Variable Resistor / Rheostat (IEC)	
	Trimmer Resistor	Preset resistor
	Thermistor	Thermal resistor – change resistance when temperature changes

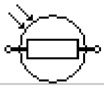
	Photoresistor / Light dependent resistor (LDR)	Changes resistance according to light

Table:4 Resistor symbols

5.1.6. Jumper Wires

Jumper wires are simply wires that have connector pins at each end, allowing them to be used to connect two points to each other without soldering. Jumper wires are typically used with breadboards and other prototyping tools in order to make it easy to change a circuit as needed. Fairly simple. In fact, it doesn't get much more basic than jumper wires.

What Do the Colors Mean?

Though jumper wires come in a variety of colors, the colors don't actually mean anything. This means that a red jumper wire is technically the same as a black one. But the colors can be used to your advantage in order to differentiate between types of connections, such as ground or power.

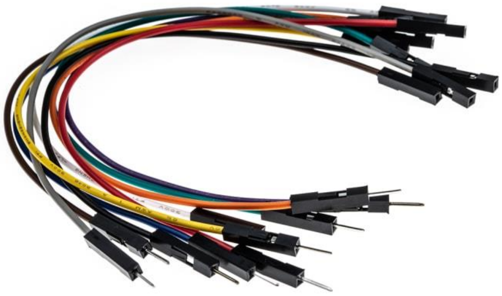


Fig:9 Jumper Wires

5.1.7. Breadboard

An electronics breadboard, or solderless breadboard, is great for making temporary circuits and prototyping. Because breadboards do not require any soldering to create a circuit, they are perfect for creating temporary designs or for testing out ideas quickly. They can also be reused over and over.

How do Breadboards Work?

When you first look at a breadboard, it may not seem that impressive; it's basically just a piece of plastic with a bunch of holes in it. However, the magic lies within where a bunch of metal strips connect the rows of holes. These strips of metal have little clips that match up to the holes in the top of the breadboard and hold wires and components in place — as well as create electrical connections to anything else placed in the same row.

In addition to the horizontal rows, most breadboards feature vertical power rails that allow for easy access to power wherever it is needed within the circuit. Usually, they will be labeled with a '+' and a '-' and have a red stripe and a blue or black stripe to indicate the positive and negative side.

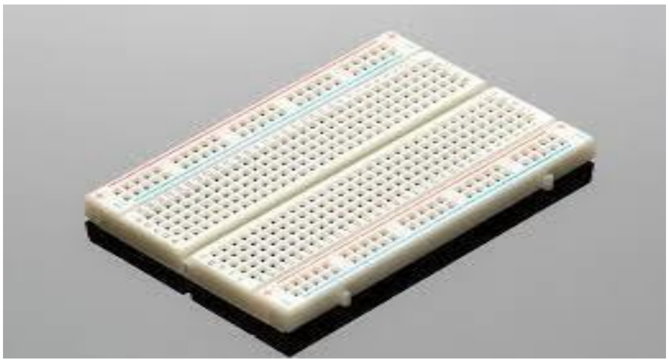


Fig:10 Breadboard

5.2ALGORITHM

Step 1: Start

Step 2: Check whether any occupant is there in the room using PIR sensor.

Step 3: If any Occupants is there, means then compare the intensity of light in the room which was sensed by LDR. If nobody was there, means then after some time delay again go to step 1.

Step 4: If the sensed intensity is less than the required level, then switch on the light or if it was enough mean then after some time delay proceed to step 1.

As per the algorithm our system will first check whether any occupants are there in the room with the help of PIR sensor where the system has been installed. If any occupants are there then it will check the value of light luminance which is sensed through LDR and then the sensed value will be compared with the value stored in the microcontroller, if the value is less than the lights will be switched on or if the sensed value is greater than the stored value then it will wait for some time and again it will from the first.

While checking for occupants if no one is there in the room then the system will wait for some time (delay), which can be programmed in the microcontroller then it will start from the first step.

CHAPTER 6
SIMULATION AND RESULT

The system can automatically adjust light levels depending on the time of day, reducing unnecessary energy consumption during daylight hours. By optimizing lighting based on occupancy and ambient light, the system contributes to energy efficiency and, consequently, reduces the overall environmental impact associated with energy production. By reducing the frequency of unnecessary lighting, the system can contribute to prolonging the lifespan of light fixtures and bulbs, further enhancing cost savings.

The combination of PIR and LDR allows for a more intelligent and adaptive lighting system. Lights can automatically turn on when someone enters a room and adjust brightness based on ambient lighting conditions, providing a comfortable and convenient user experience. Depending on the design of the system, users may have the option to customize settings such as sensitivity levels of the PIR sensor and threshold values for light levels, allowing for a personalized experience. The system's adaptability to different lighting conditions and occupancy patterns makes it suitable for various environments, including residential, commercial, and industrial spaces.

The proposed system has been implemented in a room with four lights each of 40 watts. Since it is normal classroom where evening classes are also conducted the intensity required has been set to **500 lux** which was set as the reference level in microcontroller. Before implementing this system, around **800 watts** of energy was consumed per day. After implementing this system in that room, it has been considerably **reduced to 480 Watts**. Thus, on using this system a large amount of energy can be saved.

It's important to note that the success of such a system depends on the quality of the components, the design of the control algorithms, and the system's ability to adapt to different user preferences and environmental conditions.

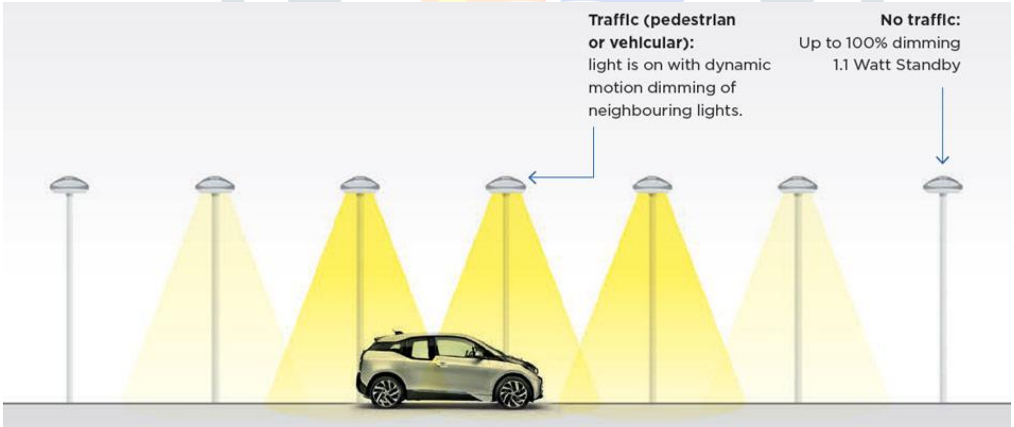


FIG:11 Street light implementation of the same system

CHAPTER 7
CONCLUSION AND FUTURE SCOPE

7.1 CONCLUSION

In conclusion, the implementation of an efficient light-controlling system utilizing a combination of PIR (Passive Infrared) sensors and LDR (Light Dependent Resistor) technology offers a range of benefits. The integration of these sensors in a lighting system provides an intelligent and adaptive solution that optimizes energy consumption, enhances user comfort, and contributes to overall sustainability.

The combined use of PIR sensors and LDRs enables the system to respond dynamically to both occupancy and ambient light levels. This results in substantial energy savings by ensuring lights are only active when needed, and their intensity is adjusted according to the natural light available.

An efficient light-controlling system utilizing PIR sensors and LDRs not only addresses energy efficiency but also enhances user experience, promotes sustainability, and aligns with the broader goals of smart and green building technologies. Real-world testing and ongoing optimization are crucial for ensuring the system's effectiveness and continued user satisfaction.

7.2 FUTURE SCOPE

The future scope of an efficient light-controlling system using PIR sensors and LDRs is promising, with opportunities for advancements in technology, user experience, and sustainability. Here are some potential future developments and areas of exploration:

- **Advanced Sensor Integration:**
  Future systems may incorporate more advanced sensor technologies, such as multispectral sensors or cameras with computer vision capabilities. This could enhance the system's ability to detect occupancy, recognize specific gestures, and respond to more nuanced environmental conditions.

- **Machine Learning and AI Algorithms:**
  Integration of machine learning and artificial intelligence algorithms could enable the system to learn and adapt to user preferences over time. This could result in a more personalized and intuitive lighting experience, optimizing energy efficiency based on historical data and user behavior.

- **Flexible and Adaptive Lighting Solutions:**
  The development of flexible and adaptive lighting solutions, such as tunable LED lighting, could provide users with greater control over colour temperature and intensity. This could have benefits for circadian rhythm regulation, mood enhancement, and overall well-being.

- **Enhanced Security Features:**
  Integration with advanced security features, such as facial recognition or occupancy pattern analysis, could enhance the security aspect of these systems. This could be particularly relevant in both residential and commercial settings.

- **Integration with IoT and Smart Building Systems:**
  Future systems may become integral components of larger Internet of Things (IoT) ecosystems and smart building management systems. This integration could enable seamless communication with other devices and systems, allowing for more comprehensive energy management and automation.

- **User-Centric Design and Accessibility:**
  Continued emphasis on user-centric design and accessibility features could make these systems

more inclusive and user-friendly. This may include voice control, mobile app interfaces, and interfaces designed for individuals with diverse abilities.

REFERENCES

1. Microchip Technology Inc. PIC16F877A Datasheet
2. http://www.parallax.com/detail.asp?prod uctid=555-28027
3. Datasheet of NORP 12 LDR
4. Google

ANNEXURE-I

Source Code

```
#include<Servo.h>

Servo servomain;

int ledPin = 13;

int value = 0;

void setup(){

   servomain.attach(0);

   pinMode(ledPin,OUTPUT);

   Serial.begin(9600); }

void loop(){

  int ldr=analogRead(A1);

  int pirState=digitalRead(2);

  Serial.print(ldr,pirState);

  if(pirState == HIGH){

    if(ldr <=500) {

      value = constrain(value,400,500);

      value = map(value,400,500,255,0);

      Serial.println(value);
```

```
      digitalWrite(ledPin,value);
      delay(10);
    }
    else {
      digitalWrite(ledPin,LOW);
    }
  }
     else if (pirState ==LOW && ldr <=500){
    digitalWrite(ledPin,LOW);
  }
  else{
    analogWrite(ledPin,LOW);
    servomain.write(360);
  }
  delay(10);
}
```