

# Solar Powered Smart Street Light Using PIR & LDR

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**Abstract-** *The aim for this project is to design a solar powered smart lighting system which targets the energy saving and autonomous operation on economical affordable for residential and commercial During night all the lights on the highway remain ON for the living beings and vehicles, but lot of energy is wasted when there is no movement of any living being. Controlling of street light is of almost importance in developing country like India to reduce the power consumption. Saving of this energy is a very important factor these days as energy resources are getting reduced day by day. This project describes about the circuit that switches the street lights on detecting movement of motion and remains off after fixed time. It automatically controls the street light i.e., off during day time and on during night time using LDR sensor. It controls the street light by detection of any object using PIR sensor. We can operate it manually or on sensor mode.*

**Keywords-** ( Atmega 328 P microcontroller, LDR ( Light dependent resistor ), RIR ( Passive infrared sensor ).

## I. INTRODUCTION

In solar powered smart street light system the street light is designed in such a way that street light automatically switches off and on based on the sunlight and at day time solar power will save in 12 Volt lead acid battery. The LDR (light dependent resistor) is used for this feature. Next feature of the Smart street light system is to turn off the street light when nobody else is on road or near street light. This feature can be implemented by interfacing PIR motion sensor to the microcontroller. These systems are developed to control and reduce energy consumption of a town's public lighting system using different technologies. The Proposed work is to control switching of street light automatically according to light intensity to develop flow based dynamic control statistics using infrared detection technology. The proposed system utilizes the latest technology for the sources of light as LED Lamps instead of generally used street lamps such as High Pressure Sodium Lamps, etc. The LED technology is preferred as it offers several advantages over other traditional technologies like energy saving due to high current luminous efficiency, low maintenance cost, high colour rendering index, rapid start up speed, long working life etc.

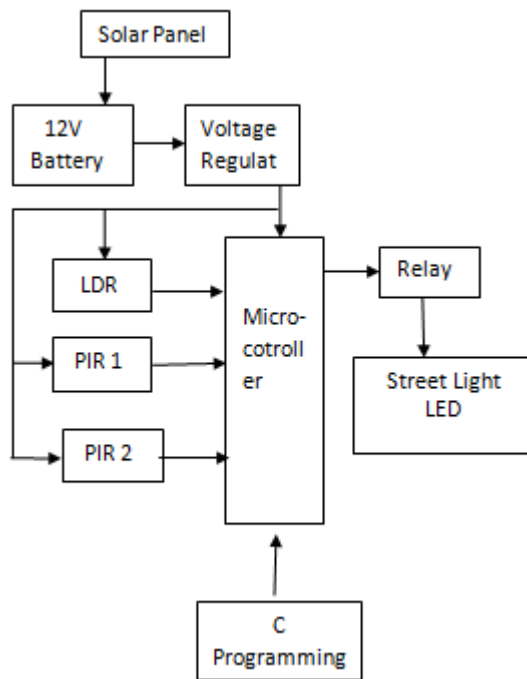
## II. SYSTEM ARCHITECTUR

The proposed Smart Street Light System consists of Solar Panel, 12 Volt 8Ah lead acid battery, PIR (Passive Infrared) Sensor, LDR (Light Dependent Resistor) and Atmega 328P microcontroller. At day time power from solar panel will use for charging of 12 V battery, The PIR sensor senses the moving body in its specific range and generates a output signal High and Low logic which is given to the microcontroller. The second sensor is LDR which detects it is day or night. At night the resistance of LDR is infinite and at day the resistance is very low or negligible. Output of LDR is connected to the microcontroller. The relay is controlled by the microcontroller using code written in it. When there is night and any motion is occurred then relay circuit will be activated otherwise deactivated. Hence the street light will be ON when there is night and any motion occurred.

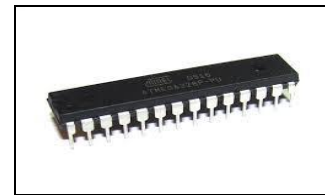
## III. WORKING OF PROJECT

The main components in the circuit are PIR sensor, LDR and Atmega328P microcontroller. In this project the PIR sensor is used to check motion of body in street light area. If any movement detected then PIR sensor generates output as High and if no movement occur then output is logic Low. The solar panel is used to charge the 12 Volt lead acid battery at day time and at night time the stored power in battery will use for street light. The LDR is used here to detect dark. In circuit LDR is in series with 1k resistor and output is taken in between point. In this system the LDR output is connected to A5 pin (28 pin) of microcontroller. Output of PIR sensor is connected to A4 and A3 pin of microcontroller. The code written in microcontroller continuously reads the outputs of LDR and PIR sensor. When output of LDR is high and output of PIR is high then relay circuit activated. The relay is connected at pin number D9 of microcontroller. The relay is activated through transistor BC547 which acts as a digital switch. When small current applied to it.

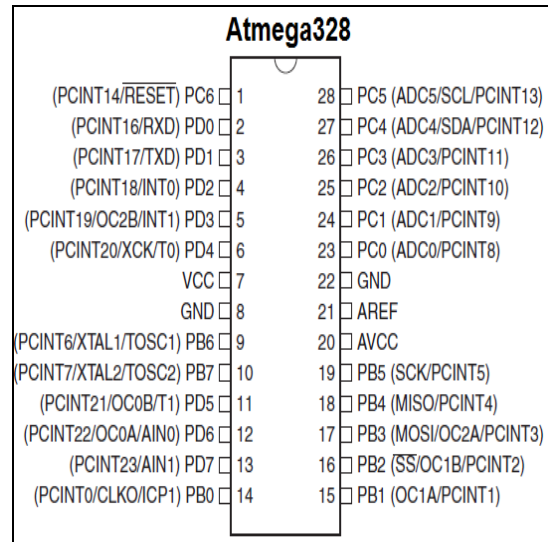
## IV. BLOCK DIAGRAM



device achieves throughputs approaching 1 MIPS per MHz, balancing power consumption and processing speed.



Pin Diagram :



## V. COMPONENTS REQUIREMENT

### 5.1 Atmega328P Microcontroller

### 5.2 Capacitors 100uF/25V

### 5.3 Resistors 10K, 1K, 220E

### 5.4 Transistor BC 547

### 5.5 Arduino IDE and Development Board

### 5.6 Crystal 16MHz

### 5.7 PIR Sensor

### 5.8 LDR (Light Dependent Resistor)

### 5.9 Solar Panel 15 Watt

### 5.10 Relay 12Volt (SPDT)

### 5.11 12 V LED Panel

### 5.12 Toggle switch

### 5.1 Atmega 328P Microcontroller:-

The high-performance Atmel 8-bit AVR RISC-based microcontroller combines 32KB ISP flash memory with read-while-write capabilities, 1KB EEPROM, 2KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and five software selectable power saving modes. The device operates between 1.8-5.5 volts. By executing powerful instructions in a single clock cycle, the

### Pin Description :

As stated before, 20 of the pins function as I/O ports. This means they can function as an input to the circuit or as output. Whether they are input or output is set in the software. 14 of the pins are digital pins, of which 6 can function to give PWM output. 6 of the pins are for analog input/output. 2 of the pins are for the crystal oscillator. This is to provide a clock pulse for the Atmega chip. A clock pulse is needed for synchronization so that communication can occur in synchrony between the Atmega chip and a device that it is connected to. The chip needs power so 2 of the pins, Vcc and GND, provide it power so that it can operate. The Atmega328 is a low-power chip, so it only needs between 1.8-5.5V of power to operate. The Atmega328 chip has an analog-to-digital converter (ADC) inside of it. This must be or else the Atmega328 wouldn't be capable of interpreting analog signals. Because there is an ADC, the chip can interpret analog input, which is why the chip has 6 pins for analog input. The ADC has 3 pins set aside for it to function- AVCC, AREF, and GND. AVCC is the power supply, positive voltage, that for the ADC. The ADC needs its own power supply in order to work. GND is the power supply ground. AREF is the reference voltage that the ADC uses to convert an analog

signal to its corresponding digital value. Analog voltages higher than the reference voltage will be assigned to a digital value of 1, while analog voltages below the reference voltage will be assigned the digital value of 0. Since the ADC for the Atmega328 is a 10-bit ADC, meaning it produces a 10-bit digital value, it converts an analog signal to its digital value, with the

## 5.2 Capacitors 100uF/25V:-



**5.13 Lead acid battery** It is connected to the solar panel and used to store energy. It is rechargeable battery and have long life.

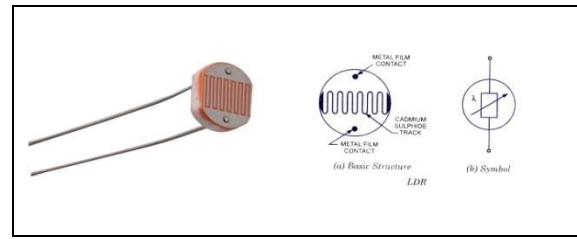
**5.14 Voltage regulator** : Here the two types of voltage regulators are used i.e. 7805 and 7812 the 05 indicates that the regulator operates on +05 v. it gives supply to microcontroller. And the 12 indicates that in 7812 that indicates on +12 v because we use a 12 v. battery. to store energy. The purpose of use voltage regulators is to give a constant and steady power supply to the circuit.

## 5.7 PIR Sensor:-



Any of the object in the world radiates IR rays and these IR rays are sensed by these sensor. The living being which passes to the street light is detected by PIR sensor. The PIR sensor itself has two slots in it, each slot is made of a special material that is sensitive to IR. The lens used here is not really doing much and so we see that the two slots can 'see' out past some distance (basically the sensitivity of the sensor). When the sensor is idle, both slots detect the same amount of IR, the ambient amount radiated from the room or walls or outdoors. When a warm body like a human or animal passes by, it first intercepts one half of the PIR sensor, which causes a positive differential change between the two halves. When the warm body leaves the sensing area, the reverse happens, whereby the sensor generates a negative differential change. These change pulses are what is detected.

## 5.8 LDR (Light Dependent Resistor):-



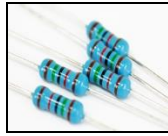
A light dependent resistor works on the principle of photo conductivity. Photo conductivity is an optical phenomenon in which the materials conductivity is increased when light is absorb by the material. When light falls i.e. when the photons fall on the device, the electrons in the valence band of the semiconductor material are excited to the conduction band. These photons in the incident light should have energy greater than the band gap of the semiconductor material to make the electrons jump from the valence band to the conduction band. Hence when light having enough energy strikes on the device, more and more electrons are excited to the conduction band which results in large number of charge carriers. The result of this process is more and more current starts flowing through the device when the circuit is closed and hence it is said that the resistance of the device has been decreased. This is the most common working principle of LDR.

## 5.9 Solar Panel 15 Watt:-

A solar panel is a set of solar photovoltaic module electrically connected. A photovoltaic module is packaged, connected assembly of solar cells. The solar panel can be used as component of a larger photovoltaic system to generate and supply electricity in commercial and residential applications. Each module is rated by its dc output power under standard test conditions (etc) and typically ranges from 100 to 320 watts. The efficiency of a module determines the area of a module. A single solar module can produce only a limited amount of power, most installations contain multiple modules. A photovoltaic system typically includes a panel or an array of solar modules, an inverter, and sometimes a battery and/or solar track and sometimes a battery and/ or solar tracked and interconnection wiring.

A *capacitor* (originally known as a condenser) is a passive two-terminal electrical component used to store electrical energy temporarily in an electric field.

## 5.3 Resistors 10K, 1K, 220E:-



A **resistor** is a passive two-terminal electrical component that implements electrical resistance as a circuit element. **Resistors** may be used to reduce current flow, and, at the same time, may act to lower voltage levels within circuits.

#### 5.4 Transistor BC 547:-



**BC547** is an NPN Bi-polar junction transistor (BJT) as shown in figure. A transistor, stands for transfer of resistance, is commonly used to amplify current. A small current at its base controls a larger current at collector & emitter terminals.

#### 5.5 Crystal 16MHz:-



A crystal oscillator is an electronic oscillator circuit that uses the mechanical resonance of a vibrating crystal of piezoelectric material to create an electrical signal with a precise frequency. This frequency is often used to keep track of time, as in quartz wristwatches, to provide a stable clock signal for digital integrated circuits, and to stabilize frequencies for radio transmitters and receivers. The most common type of piezoelectric resonator used is the quartz crystal, so oscillator circuits incorporating them became known as crystal oscillators, but other piezoelectric materials including polycrystalline ceramics are used in similar circuits

#### 5.6 Arduino IDE and Development Board:-



The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, 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 a AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDIUSB-to-serial driver chip. Instead, it features the Atmega8U2 programmed as a USB-to-serial converter."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.

#### 5.9 solar panel :

A solar panel is a set of solar photovoltaic module electrically connected. A photovoltaic module is packed connected assembly of solar cells. A solar panel can be used as component of a larger photovoltaic system to generate and supply electricity and residential applications. Each module is rated by its dc output power under standard stage conditions. The electrical efficiency of module determines the area of module. A single solar module can produce a limited amount of power. Most installations contain multiple modules. It works on a photovoltaic principle. And battery is connected to it to stored energy.



#### 5.10 Relay 12Volt (SPDT):-

The main operation of a relay comes in places where only a low-power signal can be used to control a circuit. It is also used in places where only one signal can be used to control a lot of circuits. The application of relays started during the invention of telephones. They played an important role in switching calls in telephone exchanges. They were also used in long distance telegraphy. They were used to switch the signal coming from one source to another destination. After the invention of computers they were also used to perform Boolean and other logical operations. The high end

applications of relays require high power to be driven by electric motors and so on. Such relays are called contactors

This work includes the study of energy saving system in many applications



**Working of Relay:-**

Relay plays an important role in power circuit. The function of relay is to given a signal to circuit. IN this projectThe code written in microcontroller continuously reads the outputs of LDR and PIR sensor. When output of LDR is high and output of PIR is high then relay circuit activated. The relay is connected at pin number D9 of microcontroller. The relay is activated through transistor BC547 which acts as a digital switch. When small current applied to base terminal current starts flowing from collector to emitter terminal and relay gets activated.We also manually operate street light using toggle switch by sliding it to manual mode.

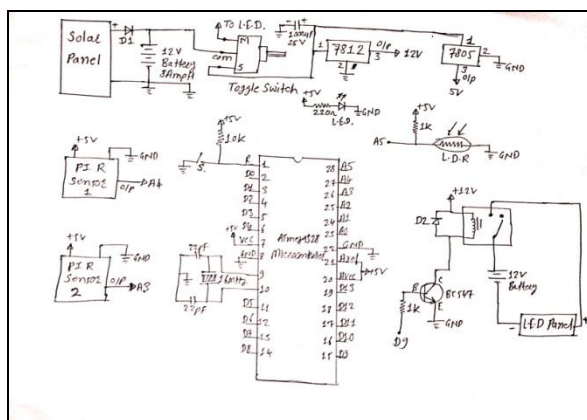
**VIII. FINAL IMPLEMENTATION**



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**VI. CIRCUIT DIAGRAM**



**VII. CONCLUSION**

Solar Powered Smart Street Light Using PIR & LDR is not limited for any particular application, it can be used any where in a process industries with little modifications in software coding according to the requirements. This concept not only ensures that our work will be usable in the future but also provides the flexibility to adapt and extend, as needs change.

In this project work we have studied and implemented a complete working model using a Atmega328P microcontroller. The programming and interfering of microcontroller has been mastered during the implementation.