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SOLAR HIGHWAY LIGHTING SYSTEM WITH AUTO TURN OFF ON DAY TIME

[1]P AMEENU,[2]K HONNOR SAHEB,[3]B SRUTHI,[4]JANGAM SUSHMITHA
[123]Assistant Professor,[4]Student
Department Of EEE
Bheema Institute of Technology and Science, Adoni

ABSTRACT:
The Automatic Street Light Control System is a simple yet efficient concept that uses a transistor as a switch. This process completely removes physical labour. The lights switch on automatically when sunlight reaches below the visible region of human eyesight. A Light Dependant Resistor (LDR) sensor, which senses light in a manner akin to that of human eyes, is used to do this. Lights are switched off automatically as soon as sunlight appears.
The IR transistor and the LDR are the two main components of the project. The resistance of a light-dependent resistor (LDR) varies with the quantity of light it receives. As a biassing resistor, this LDR is fastened to the transistor. Depending on how much light hits the LDR, the transistor operates in the cutoff and saturation areas. This transistor turns the relay to turn on or off the light.
The importance of street lighting for traffic safety is growing. The primary problem with modern street lights, however, is that they depend on solar panels and cells, which leaves them open to theft and other illegal behaviour. For this reason, sensor-equipped solar street lighting are essential. Furthermore, led theft or malfunction is one of the main problems influencing the functioning of the current electrical infrastructure. As a consequence, many of these systems are no longer operational. The idea provides a mechanism for detecting theft or malfunctions in order to protect the solar street lighting infrastructure. To solve this problem, it is essential to regularly monitor the battery and solar voltages. This information may be retrieved from the server over WiFi. If someone attempts to take out the lead, it will be visible on the app. By implementing this task, the developed mobile telnet app will enable the service department to get preventative alerts. The main controller for the system is an Arduino Uno module. A relay is used to switch on and off the LED. The prototype was made, and the results were excellent.

I.INTRODUCTION

It is widespread nowadays to see the solar photovoltaic cell based street lighting system. Peoples became aware about moving from conventional recourses to renewable energy. We as a whole realize that non-renewable energy source assets are getting diminished step by step. Following quite a while from now there will be no non-renewable energy sources.. Living society without power is difficult. So it is required to maximize the usage of renewable resources to save conventional sources. Ordinary solar powered PV based street lighting system needs automation. The overall energy consumption in street lighting system is quite more because usage of low efficiency lamps and continuous operation of lamps. It will be reduced by using energy efficient LED lamps and solar power which is highlighted in [1]-[2].Automatic control (ON/OFF) of street lights only during vehicle movement also helps to save energy which is highlighted in [3]. Another way to reduce the energy consumption is by using array of street lights and adjusting the brightness of the lamps based on the vehicle movement which is suggested in[4]-[5]. The existing street light system has manual control that is the street lights will be turned ON manually during night time and turned OFF manually during day time. This type of system leads increased energy consumption because the street lights are always in ON condition throughout the night time even if there is no vehicle movement on the road. In this paper, we propose a new technique which will automate the entire street lighting system. The special feature of the proposed method is adjusting the intensity of light based on movement of vehicles and automatic switching of states from ON/OFF during non vehicle movement. Further, the energy consumption and hence, the human intervention are reduced. IR sensor is utilized to identify the movement of people or vehicles and afterward it gets turned on consequently and adjusts the intensity of the light. The IR sensor will be activated only on the night time. If any object crosses the infrared beam, a particular light will be automatically ON. By utilizing this as a basic guideline, the energy efficient street lighting system can be designed for the ideal use of streetlights in any place. The proposed system is more suitable for implementation in hardware and software which results in a reduced cost.

This system is centred on the need of the robotized road light framework and the exceptional method for usage with installed framework devices. A microcontroller is utilized as a core element to control the procedure included. Solar panel is used for street lighting because of increased benefits of power saving, conservation of precious natural resources. Solar street lights save cost are long lasting and maintenance free. In this framework, the road light is automated to TURN ON/OFF utilizing relays. For sensing the light during night / day time Light Dependent Resistor (LDR) is employed. IR sensor controls the intensity of light in view of the recognition of any movement of vehicle. These sensors are connected to the ports of the microcontroller for control purpose. Rectifiers are used for AC/DC supply conversion. Voltage regulators ensures regulated DC output. Sotware Compiler is used to obtain the simulation result of the proposed system.

PROPOSED SYSTEM

This proposed work focus on the necessity of the automated street light system and the peculiar way of implementation with embedded system. It is designed to detect the vehicle movement on the highways to switch ON only a block of the street light ahead of it and switch OFF the trailing light to save energy. The main idea behind the system is that the LED array will be in off position at day time. IR sensor will detect the presence of any humans or cars. When IR sensor detects the vehicle movement the brightness of the LED will be high when there is no vehicle, the brightness will be decreased. LEDs are controlled to glow only when it is needed. During night time sometimes roads will be empty and hence there is no use of illuminating all the lamps. At such instances the intensity of LEDs are controlled to conserve the energy. The power will be taken from solar power or external power supply based on the availability of renewable resource. For switching action relay circuits are used.

Street lights are the elemental part of any city since it facilitates better night visions, secure roads, and exposure to public areas but it consumes a quite large proportion of electricity. Also now a days, there is a risk that the led may get damaged or stolen. Due to this, the street light remains OFF for particular time period till the maintenance team comes and repair or restores the fault. Also, in manual streetlight system lights are powered from sunset to sunrise with maximum intensity even when there is sufficient light available. This energy wastage can be avoided by switching off lights automatically [1,2]. The saved energy can be efficiently utilized for other purposes like residential, commercial, transportation etc. In case of led panel fault, the service department is unable to recognize the fault or steal due to lack of information and unawareness,so the particular street light remains off for very long time [5]. Because of this, due to darkness accidents may occur [1]. IoT is the network of physical devices that allows the devices to communicate with each other. These system allows greater transparency, control and good performance. Automation simplifies various problems in the world economy as well as in daily life. It uses the latest technology in LED as the light source to restore conventional street lamps. The LED lights are adapted because of its various advantages over existing technologies like power saving due to increased current luminous efficiency, reduced maintainance cost, high colour rendering index, and durability [8]. Nowadays flexibility of street lights system is being highly challenged. Handling remote area location is the greatest dilemma. Here, relay is used as the automatic switch and reduce almost 100% of manual work [2,6]. The main issue of existing electric system is the connectivity problem as most of the connections handled by different contractor are done manually. It supports client server mechanism where a single user can control the overall system [5]. Arduino is an open source microcontroller which is used with other communication technologies

II.LITERATURE SURVEY

Automation plays an increasingly very important role in the world economy and in daily life. Automatic systems are being preferred over any kind of manual system. We can also call it an "SMART STREET LIGHT SENSING". Intelligent light sensing refers to public street lighting that adapts to movement by pedestrians, cyclists and cars. Intelligent street lighting, also referred to as adaptive street lighting, offs when no activity is detected, but brightens when movement is detected. This type of lighting is different from traditional, stationary and illumination, or dimmable street lighting that offs at pre-determined times. The research work shows automatic control of streetlights as a result of which power is saved to some extent. In the scope of industrialization, automation is a step beyond mechanization. Whereas mechanization provided human operators with machinery to assist the users with muscular requirements of work, automation greatly decreases the need for human sensory and mental

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requirements as well. Basically, street lighting is one of the important parts. Therefore, the street lamps are relatively simple but with the development of urbanization, the number of streets increases rapidly with high traffic density. There are several factors need to be considered in order to design a good street lighting system such as night-time safety for community members and road users, provide public lighting at cost effective, the reduction of crime and minimizing it is effect on the environment[1]. At the beginning, street lamps were controlled by manual control where a control switch is set in each of the street lamps which is called the first generation of the original street light. After that, another method that has been used was optical control method done using high pressure sodium lamp in their system. Nowadays, it is seen that the method is widely used in the country. Automation systems are being preferred over the manual mode because it reduces the use of energy to saves energy. These automation systems play an essential role in making our daily life more comfortable and facilitate users from ceiling fans to washing machines and in other applications. Among all exciting applications, street lights play a vital role in our environment and also plays a critical role in providing light for safety during night-time travel. In this scenario, when the street lights are in working functionality over the whole night that consumes a lot of energy and reduces the lifetime of the electrical equipment such as electric bulb etc. Especially in cities' streetlights, it is a severe power consuming factor and also the most significant energy expenses for a city[2]. In this regard, an intelligent lighting control system can decrease street lighting costs up to 70% and increase the durability of the equipment. The traditional lighting system has been limited to two options ON and OFF only, and it is not efficient because this kind of operations meant power loss due to continuing working on maximum voltage. Hence, wastage of power from street lights is one of the noticeable power loss, but with the use of automation, it leads to many new methods of energy and money saving. In this regard, controlling lighting system using Light Dependent Resistor (LDR), and Arduino together is proposed. In the meanwhile, the importance of smart light system has motivated a lot of studies and the series of research work has been done [4]. Street lighting provides a number of important benefits. It can be used to promote security in urban areas and to increase the quality of life by artificially extending the hours in which it is light so that activity can take place. Street lighting also improves safety for drivers, riders, and pedestrians. Driving outside of daylight hours is more dangerous – only a quarter of all travel by car drivers is between the hours of 7pm and 8am, yet this period accounts for 40% of fatal and serious injuries to the same group1 . Pedestrians and vulnerable road users suffer from decreased visibility in the dark too[5]. For these reasons, ways of reducing the risk to all road users during the hours of darkness must be found. A study for the Department for Transport2 in 2003 found that road safety was perceived as a key benefit for street lighting improvement [6]. Automation, Power consumption and Cost Effectiveness are the important considerations in the present field of electronics and electrical related technologies. Industry of street lighting systems are growing rapidly and going to complex with rapid growth of industry and cities. To control and maintain complex street lighting system more economically, various street light control systems are developed. This proposed system utilizes the renewable technology (Solar) for the sources of light as LED Lamps instead of generally used street lamps such as High Pressure Sodium Lamps, etc[7]. 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. This proposed system makes use of Ultrasonic Sensor for movement detection [8]n. Here Arduino is used to dump the code. LDR senses the light intensity and ultra sonic sensor detect the object and when LDR senses that there is no light present and when there is an object present then street light will be turned ON and vice versa.

III. DESIGN OF HARDWARE

This chapter briefly explains about the Hardware. It discusses the circuit diagram of each module in detail.

ARDUINO UNO

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 a 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

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USB-to-serial converter. Uno board has a resistor pulling the 8U2 HWB line to ground, making it easier to put into DFU mode. Arduino board has the following new features:

- 1.0 pin out: 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.
- Atmega 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: ARDUINO UNO

POWER SUPPLY:

The power supplies are designed to convert high voltage AC mains electricity to a suitable low voltage supply for electronic circuits and other devices. A power supply can by broken down into a series of blocks, each of which performs a particular function. A d.c power supply which maintains the output voltage constant irrespective of a.c mains fluctuations or load variations is known as "Regulated D.C Power Supply".

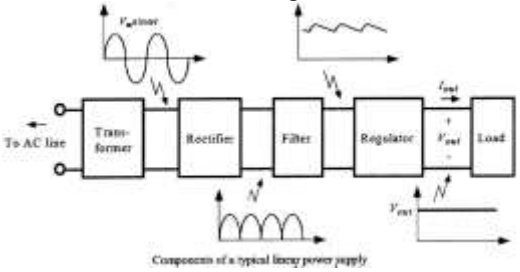

Fig: Block Diagram of Power Supply

LCD DISPLAY

A model described here is for its low price and great possibilities most frequently used in practice. It is based on the HD44780 microcontroller (Hitachi) and can display messages in two lines with 16 characters each. It displays all the alphabets, Greek letters, punctuation marks, mathematical symbols etc. In addition, it is possible to display symbols that user makes up on its own. Automatic shifting message on display (shift left and right), appearance of the pointer, backlight etc. are considered as useful characteristics.

Fig: LCD

WIFI MODULE:

The **ESP8266** is a low-cost Wi-Fi microchip with full TCP/IP stack and microcontroller capability produced by Shanghai-based Chinese manufacturer, Espressif Systems.[1]

The chip first came to the attention of western makers in August 2014 with the **ESP-01** module, made by a third-party manufacturer, Ai-Thinker. This small module allows microcontrollers to connect to a Wi-Fi network and make simple TCP/IP connections using Hayes-style commands. However, at the time there was almost no English-language documentation on the chip and the commands it accepted.[2] The very low price and the fact that there were very few external components on the module which suggested that it could eventually be very inexpensive in volume, attracted many hackers to explore the module, chip, and the software on it, as well as to translate the Chinese documentation.[3]

The **ESP8285** is an ESP8266 with 1 MiB of built-in flash, allowing for single-chip devices capable of connecting to Wi-Fi.[4]

The successor to these microcontroller chips is the ESP32.

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PHOTOVOLTAIC INVERTER

3.1 Introduction to PV system

The basic block diagram of grid connected PV power generation system is shown in Fig. 3.1. The PV power generation system consists of following major blocks:

1. PV unit
2. Inverter
3. Grid
4. MPPT

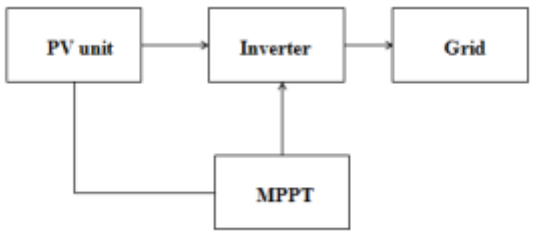

Fig. Schematic diagram of PV system

Photovoltaic cell and array modeling

A PV cell is a simple p-n junction diode that converts the irradiation into electricity. Fig.3.2 illustrates a simple equivalent circuit diagram of a PV cell. This model consists of a current source which represents the generated current from PV cell, a diode in parallel with the current source, a shunt resistance, and a series resistance.

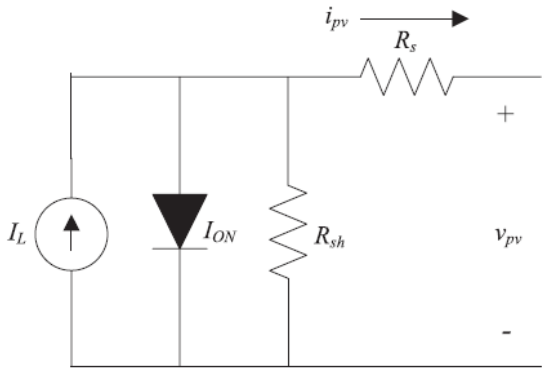

Fig. Equivalent circuit diagram of the PV cell

LED:

A light-emitting diode (LED) is a two-lead semiconductor light source. It is a p–n junction diode that emits light when activated.[5] When a suitable voltage is applied to the leads, electrons are able to recombine with electron holes within the device, releasing energy in the form of photons. This effect is called electroluminescence, and the color of the light (corresponding to the energy of the photon) is determined by the energy band gap of the semiconductor. LEDs are typically small (less than 1 mm^2) and integrated optical components may be used to shape the radiation pattern.

Appearing as practical electronic components in 1962, the earliest LEDs emitted low-intensity infrared light.[7] Infrared LEDs are still frequently used as transmitting elements in remote-control circuits, such as those in remote controls for a wide variety of consumer electronics. The first visible-light LEDs were also of low intensity and limited to red. Modern LEDs are available across the visible, ultraviolet, and infrared wavelengths, with very high brightness.

Early LEDs were often used as indicator lamps for electronic devices, replacing small incandescent bulbs. They were soon packaged into numeric readouts in the form of seven-segment displays and were commonly seen in digital clocks. Recent developments have produced LEDs suitable for environmental and task lighting. LEDs have led to new displays and sensors, while their high switching rates are useful in advanced communications technology.

WORKING:

A P-N junction can convert absorbed light energy into a proportional electric current. The same process is reversed here (i.e. the P-N junction emits light when electrical energy is applied to it). This phenomenon is generally

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called electroluminescence, which can be defined as the emission of light from a semiconductor under the influence of an electric field. The charge carriers recombine in a forward-biased P-N junction as the electrons cross from the N-region and recombine with the holes existing in the P-region. Free electrons are in the conduction band of energy levels, while holes are in the valence energy band. Thus the energy level of the holes is less than the energy levels of the electrons. Some portion of the energy must be dissipated to recombine the electrons and the holes. This energy is emitted in the form of heat and light.

The electrons dissipate energy in the form of heat for silicon and germanium diodes but in gallium arsenide phosphide(GaAsP) and gallium phosphide (GaP) semiconductors, the electrons dissipate energy by emitting photons. If the semiconductor is translucent, the junction becomes the source of light as it is emitted, thus becoming a light-emitting diode. However, when the junction is reverse biased, the LED produces no light and—if the potential is great enough, the device is damaged.

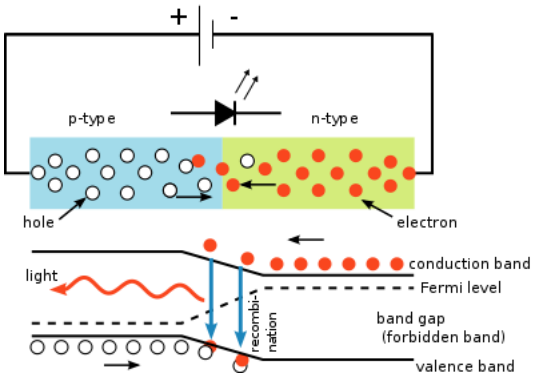
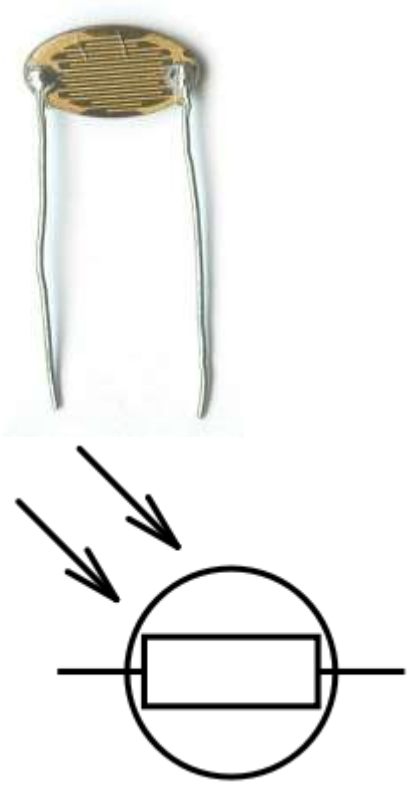


Fig: WORKING OF LED

LIGHT DEPENDENT RESISTOR

A photo resistor or light dependent resistor (LDR) is a resistor whose resistance decreases with increasing incident light intensity; in other words, it exhibits photoconductivity. It can also be referred to as a photoconductor or CdS device, from "cadmium sulfide," which is the material from which the device is made and that actually exhibits the variation in resistance with light level. Note that CdS is not a semiconductor in the usual sense of the word (not doped silicon).



A photoresistor is made of a high resistance semiconductor. If light falling on the device is of high enough frequency, photons absorbed by the semiconductor give bound electrons enough energy to jump into the conduction band. The resulting free electron (and its hole partner) conduct electricity, thereby lowering resistance.

A photoelectric device can be either intrinsic or extrinsic. An intrinsic semiconductor has its own charge carriers and is not an efficient semiconductor, e.g. silicon. In intrinsic devices the only available electrons are in the valence band, and hence the photon must have enough energy to excite the electron across the entire bandgap. Extrinsic devices have impurities, also called dopants, added whose ground state energy is closer to the conduction band; since the electrons do not have as far to jump, lower energy photons (i.e., longer wavelengths and lower frequencies) are sufficient to trigger the device. If a sample of silicon has some of its atoms replaced by phosphorus atoms (impurities), there will be extra electrons available for conduction. This is an example of an extrinsic semiconductor. Photo resistors are basically photocells.

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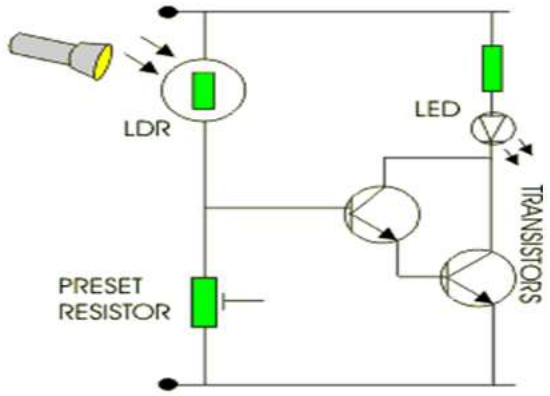
LDRs or Light Dependent Resistors are very useful especially in light/dark sensor circuits. Normally the resistance of an LDR is very high, sometimes as high as 1000 000 ohms, but when they are illuminated with light resistance drops dramatically.



IR SENSOR

Infrared is a energy radiation with a frequency below our eyes sensitivity, so we cannot see it Even that we can not "see" sound frequencies, we know that it exist, we can listen them.

Even that we can not see or hear infrared, we can feel it at our skin temperature sensors. When you approach your hand to fire or warm element, you will "feel" the heat, but you can't see it. You can see the fire because it emits other types of radiation, visible to your eyes, but it also emits lots of infrared that you can only feel in your skin.

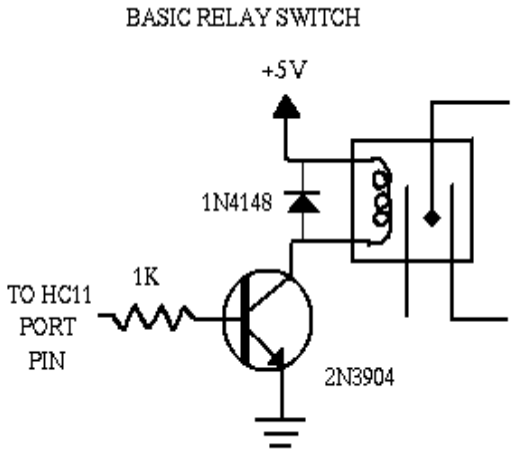
INFRARED IN ELECTRONICS

Infra-Red is interesting, because it is easily generated and doesn't suffer electromagnetic interference, so it is nicely used to communication and control, but it is not perfect, some other light emissions could contains infrared as well, and that can interfere in this communication. The sun is an example, since it emits a wide spectrum or radiation.

The adventure of using lots of infra-red in TV/VCR remote controls and other applications, brought infra-red diodes (emitter and receivers) at very low cost at the market.

From now on you should think as infrared as just a "red" light. This light can means something to the receiver, the "on or off" radiation can transmit different meanings.Lots of things can generate infrared, anything that radiate heat do it, including out body, lamps, stove, oven, friction your hands together, even the hot water at the faucet.

RELAY



The following schematic shows the basic circuit.

A relay is an electrically operated switch. When you turn it on, it switches on way. When it is off, it switches the other way. You can use a relay to switch on and off a high current device. A relay has an electromagnet, called a coil, and a lightweight switch inside it. When you energize the coil, a piece of the switch is attracted by the coil's magnetic field, which switches the switch on or off.

Mechanical relay:

Typical Mechanical Relay connection pin

This is a very important section. The introduction to this electrical control switch, call a Relay. It is basically a device to activate a mechanical switch, by electrical means. This is unlike a switch which is activated manually. In another words it is a device that convert electrical signal to a mechanical energy back to electrical signal again. Similar to mechanical switch, they can be described as 2P2T, single pole double throw, etc...

How it works? A electrical voltage will be applied to activate a coil in the relay. The coil being powered up, will generate a magnetic force that will attract the lever. This lever will be pulled towards the magnetized coil, causing an action that will switch the mechanical contact.

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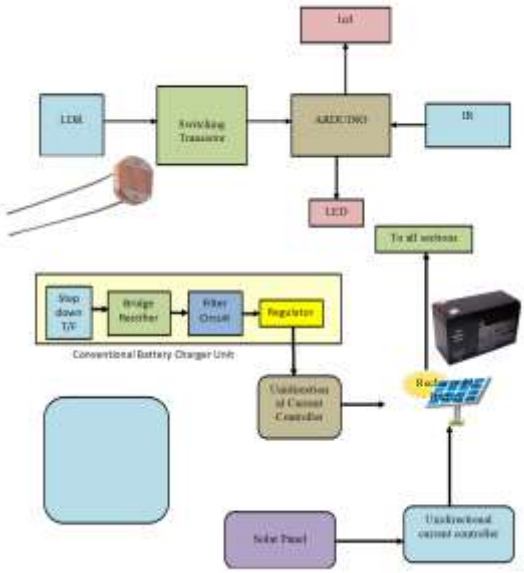
IV.PROJECT DESCRIPTION.

BLOCK DIAGRAM



HARDWARE:

1. ARDUINO
2. Power supply
3. LCD (16*2)
4. LDR sensors
5. Relay
6. Light

SOFTWARE:

1. ARDUINO IDE
2. Proteus
3. Embedded C

Working:

The energy efficient and eco-friendly street lighting system. LDR sensor and the IR sensors are the two main conditions in working the circuit. If the two conditions have been satisfied the circuit will perform the desired work according to defined algorithm. Each sensor controls the turning ON or OFF the lighting column. With commands from the controller the lights will be automatically turned ON in the places of the movement when it's dark and adjust its brightness based on vehicle movement. By implementing this system the drawback of the street lighting system using timer controller has been eliminated. This control strategy can be implemented in Street lighting system in villages, smart cities, Highway roads. The results prove that the system is more efficient when implemented in long roadways between the cities. The advantages of the proposed method include: (1) The simplicity of the structure and its robustness to disturbances. (2) Improved Energy saving and continuity of power (3) Repairing work can be quickly done by instant communication during failure of lamp.

ESP8266 is a low cost Wi-Fi modules with an AT commands library. It allows the arduino to connect to the internet through Wi-Fi connection [7]. Arduino collects all the data uploaded from sensors and transmits it to the cloud server by using Wi-Fi module ESP8266 which is mounted on arduino through on board serial port. The data on the cloud server will be displayed location wise. APP will contain the separate dashboards and news, surveys related to the led[1]. In this project, we will present a system for monitoring led or if in case, it get removed, then an message will be generated and sent to the provided App.

V.CONCLUSION:

The rechargeable battery will be charged by our technology when sunshine is present. The battery will then begin to drain around dusk, causing the LEDs to get brighter. Since the LEDs are dimmable, our system will also include sensors to aid in the identification of approaching automobiles. The lights will be lowered from one to six (A.M.). It will detect an automobile using sensors, and the LEDs will then turn on.

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