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### ARM BASED SOLAR STREET LIGHT SYSTEM

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#### ABSTRACT

This paper deals with the auto intensity control of solar street light and provides the information about the amount of energy utilized by the particular street light during peak hours using GSM. As there is enormous growth in the utilization of solar energy which is best for opting solar street light system. The present standalone solar LED street light consists of Photovoltaic panel, LED lamp, storage system, controller, power conditioning system and GSM module. A solar panel converts the sunlight into electricity when the panel is exposed to sun, the charges are collected and stored in battery, and releases to a load when it is required. The amount of energy utilized by the light is provided by GSM.

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#### INTRODUCTION

The sun is considered as the primary source of light. Solar power uses a renewable source of energy, which has become more popular in modern times. This has advantages over non-renewable energy sources. While it also provides more advantage among other renewable energy sources. As the solar power is generated using solar panel, there is no requirement of any mechanical parts such as turbines, which may cause break down, noisy and maintenance issues. According to this solar energy is a clean energy source which emits a very small amount of carbon gases and sulfur oxides, hence it is nonpolluting, reliable and infinite.

Light plays a vital role in human activities, not only living organisms require light. Nothing seems to be exists without light, hence sunlight offers solar power, which is converted into electricity and used for various applications.

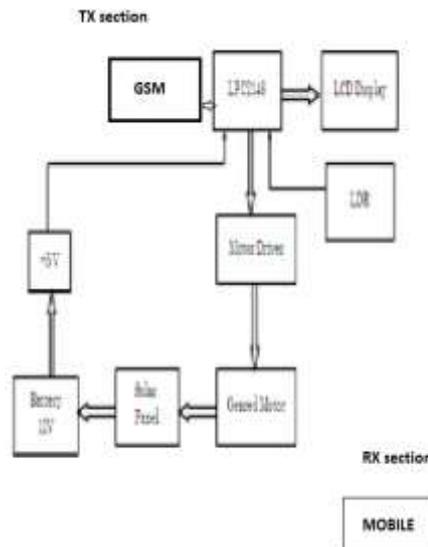
In recent years there is a rapid growth in the energy efficient technologies which results in reducing consumption of energy may increase the demand for saving the electricity. A street light is a illumination source, uses HID lamps, LEDs as light source. HID Lamps consumes a large amount of power, which releases huge amount of CO<sub>2</sub> due to this, LED illumination considered as the energy reducing source of light. HID light life time is 3 times less than LED. LED presents more advantage over HID lamps including smaller size, faster switching, lower energy consumption, longer lifetime, improved robustness, greater durability and reliability. Due to this, LEDs are more suitable for use on isolated island or high mountain regions. LED provides good visual quality, high efficiency, long operating life and low voltage operation which is ideal for solar. Thus solar street light are used to provide illumination on roads during night hours to ensure security and accidents by effective utilization of energy required.

#### SYSTEM DESIGN

The system is designed by mounting a solar panel on pole of street light according to the requirement, battery storage is provided on pole in order to collect the charges, based on the absorption of sunlight hitting the solar panel and stored. If required based on the sensor consideration of movement by vehicle or climatic condition the battery releases charges then LED turns ON. Otherwise the intensity of light decreases gradually gets OFF ARM cortex controls the required operations accordingly.

Here the solar panel will be used to detect the sun in order to charge the battery source. The charged battery source will be used to light the devices accordingly and the unused power will be stored in the battery. Here the data regarding the charge that is collected for a day will be sent as message to the person whose mobile number will be dumped into the controller so that the person can have a track of the number of units that the battery has charged and the person can perform the switching operation of the devices through his mobile

The block diagram regarding the project is as shown below



*Figure 1 Block diagram.*

## HARDWARE DESCRIPTION

### Solar panel

Solar panel converts sunlight into electricity which is made of photovoltaic cells cable to capture solar energy. As the solar cells are made of semiconductors, when sunlight falls on panel, gets heat up and produces two types of electrons which are negatively charged and positively charged. Positively charged electrons gathered around P type and negatively charged electrons are gathered around N type. As the load is connected across two electrodes current flows, it depends on the intensity of in solation and size of cells. Conversion efficiency is given as

$$\text{Conversion efficiency} = \frac{\text{electric energy output}}{\text{Energy of insolation on cell}} * 100\%$$

Generally solar panels are inefficient. The silicon based solar panel provides maximum efficiency of 24.5%. To enhance the performance of solar panel the intensity of light falling on the panel should be increased unless high efficiency solar panels are brought up. To increase the efficiency, Maximum Peak Power Tracker (MPPT) compensates the changing voltage current characteristics of the solar cell. The solar tracking techniques increase the efficiency, where the alignment of panel with sunlight should be proper. As there is enormous importance of nano technology, the panels can be made of nano particles.



*Figure 2 Solar panel*

### POWER CONDITIONING SYSTEM

As the solar module produces electricity when exposed to sunlight which charges the battery composed of charge controller and other electronic circuits, which regulates charging input to the battery prevents low discharging and over discharging of the battery and automatic switch ON and OFF of the load. Charge controller and electronic circuit needs to be efficiency, provides maximum benefits. There are different types of charge controllers basically designed to protect the battery from low charge and over charge, which may be capable of preventing reverse current. PWM is one of the techniques, which controls the amount of current charging the battery, results in trickle charge. MPPT which optimize the charges obtained from cell, where the battery charges to optimal capacity. To increase the efficiency, MPPT compensates voltage and current characteristics of solar cells. Due to the non-linearity and variable characteristics of solar panel it is difficult to extract maximum amount of power.

### ARM7 MICROCONTROLLER

In this system we use LPC2148 where LPC represents low power consumption. It contains ARM 7 TDMI processor through which it can support thumb mode. Thumb mode is used for increasing the coding efficiency .it has a flash memory of 128/512KB.it supports 32 bit and 16 bit in the thumb mode.LPC2148 contains 64 pins with two ports port 0 and port 1. The CPU is a real time and ICE logic environment. Regarding the count of the port pins port 0 contains 32 pins whereas the port 1 contains only 16 pins. The pin configuration will be from P0.0 to P0.32,but the pins P0.24,P0.26,P0.27 are not available and for port 1 the pins available are from P1.16 to P1.31.

### STORAGE SYSTEM

Electric storage batteries are one of the simplest means of storage which is required especially when the electric current is produced by the solar cells. The stored energy can be used until it gets discharged .The most commonly used lead batteries are not ideal for this purpose .The alternative is to use the direct current to decompose water into oxygen and hydrogen gases which are stored in a suitable form to generate electricity in a fuel cell.



*Figure 3 Battery*

### SENSORS

A sensor is also called as detector, which means a measurable attributes, converts it a signal. In this system, the light sensors which detects the intensity of light and responds the detected amount of light. LDR is one of the light sensor, which is known as photo resistor made of cadmium sulphide, lead sulphide and semiconductors including Ge, Si and GaAs. As the LDR consists of resistive material sensitive to light.

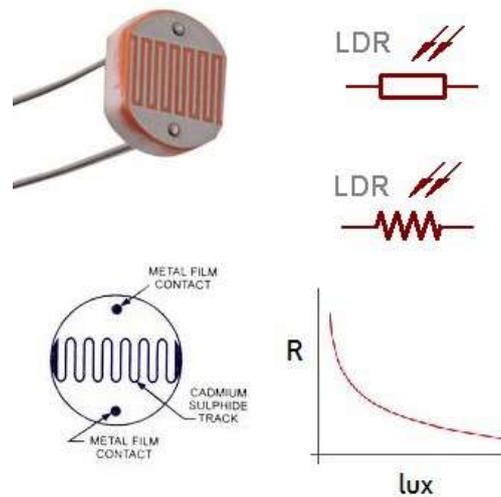


Figure 4 LDR sensor.

### LED

LED is a light source made of semiconductor. LED presents many advantages over HID bulbs such as lower energy consumption, longer lifetime, smaller size, faster switching, greater durability and reliability. Hence these are more preferred. LED operates on DC voltage. HID lamps are based on the gas discharge principle, thus the intensity is not controllable by any voltage reduction method as the discharge path broken.

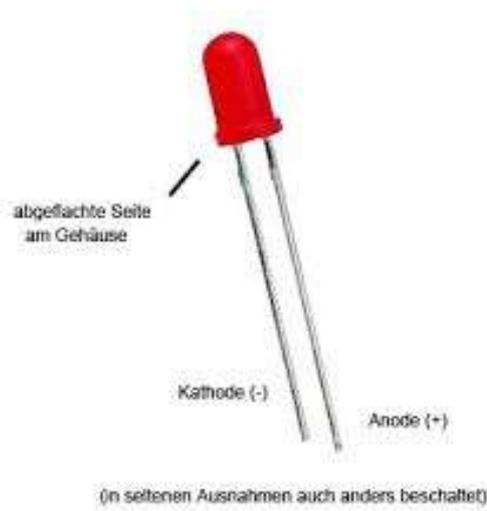


Figure 5 Light emitting diode.

### IMPLEMENTATION

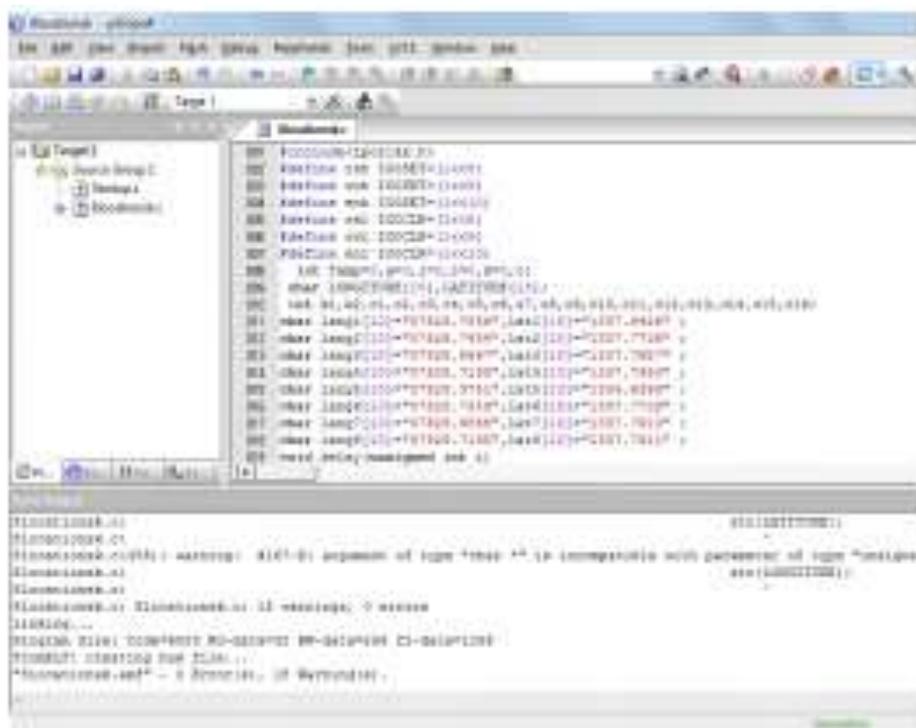
1. The solar panel here is used for the purpose to convert the solar light into electricity by the use of the solar panel.
2. The electric power that is generated by the panel will be collected by the battery.
3. The stored power will be utilized to power the devices when there is a need of the devices like the situation in night time.
4. The GSM that is connected to the controller will be used to know the amount of charge that is collected by panel which is indicated in the form of units .
5. The GSM connected will send the message to the number that is dumped in the controller regarding the units and also the GSM will be used to switch the devices by using the mobile of the respective person

**SOFTWARE DESCRIPTION**

The software tool that is used in developing this project is: Keil uvision IDE.

The keil IDE provides the platform for writing the source code, editing, compiling, debugging as well as to generate the hex file .the hex file that is generated will be copied into the disk drive of the LPC 2148, so that the controller will work according to that hex file. Before copying the hex file we have to clear the existing file just by deleting it. After that we have to copy the desired hex file.

The keil window will be as shown in the figure below:



*In this way we will have the file dumped into the controller and the device will work.*

**RESULT AND CONCLUSION**

The solar street light with auto intensity control and the amount of charge utilized by the street light is provided , which results in saving the energy .As the traffic density on the roads tends to decrease slowly in late night, the intensity gets reduced progressively till morning to save energy. Intensity of street light is required to be kept high during peak hours and poor climatic condition. Thus street light automatically gets switch ON and OFF.

**FUTURESCOPE**

Further this paper may be enhanced by using CAN protocol, where centralized based street lights are controlled effectively.

It may be extended as solar wind street light system, here the system not only able to generate power from solar energy in the daytime, but also can be generated from wind, this is easy to install and according to the environmental condition of installation site, the system will be configured.

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