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Arduino Based Solar Street Lighting

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ABSTRACT

`This work is about automation of street lighting systems and efficient application of street lights. A critical issue nowadays is the energy crisis taking place in India. Energy loss takes place due to street lights which consume enormous electric energy. In the present study, smart street lighting systems are developed to ensure efficient street lighting and reduce consumption of electric energy. Auto intensity light control helps in dimming the street lights when no movement is detected using light dependent sensors. Design of such systems which have efficient applications do not only achieve energy saving but also extends the service life of street lighting equipment. Energy savings in public systems are discussed from different viewpoints here. The system is mainly going to focus on efficient use for solar energy for street lights.

Keyword: ***-Brightness Control, Street Light, Solar Light.***

1. INTRODUCTION

We need to save or conserve energy because of most of the energy sources we depend on, like coal and natural gas can't be replaced. In today's world we all are well acquainted with our nation's energy scenario. We are well aware of fact that not only available power is less than wasted on large scale. The wastage is in form of unnecessary usage of lighting, low power factor and similar other factors.

There are three possible solutions for the problems mentioned above. First possibility is use of Renewable energy source in the place of the conventional source. The second is utilization of the latest possible LED technology which offers many benefits like, environment friendliness, energy efficiency and about a 50% saving in power consumption. The third is the Remote- Control system which involves as the nomenclature suggests energy to produce electricity is hydroelectricity energy i.e. energy is generated using water force which is converted into potential energy which ultimately leads to increase the cost required to produce energy, instead if we use solar energy it would be cost efficient. So it is necessary for efficient and renewable energy system that has greater advantages. Most of time we see street lights are ON even after sunrise thus by having an smart system which turns ON and OFF street lights of given time or when ambient light falls below a specific intensity. In our project we are using Light Dependent Sensors i.e. LDR sensors which detect the environment light, using analog output from this sensor we are going to control the intensity of LED light by using PWM technique. Solar energy is the main renewable source utilized from biomass and solar collectors to provide ventilation specifically driven by solar power. To achieve the various concepts have been considered in order to optimize zero carbon emissions with regard to fossils fuel, over the life of a commercial sized building.

1.1 Review of Related Literature

Street lights in the beginning were manually controlled; latter they were controlled via time control and optical control manner. These methods are very costly and noted for difficulty in monitoring. They involve high power consumption. The universal observation is that about 20% power consumption occurs through street lighting system due to their designs as per old standards which do not incorporate the latest technology features like remote control and monitoring which simplify problems of management and maintenance problem. The main theme of this paper is to define street lighting in a smart way by using a microcontroller to control the intensity of light and using a renewable energy source instead of a conventional one. The process of dimming the lights automatically brings about environment benefits. There is less wastage of power. Here we are using an LDR sensor to detent the light. Therefore, it is possible to go one step further and turn lighting system more intelligent with this prototype that we

are trying to develop. The prerequisite for this kind of smart system is that the luminaries be featured by high efficiency, low environmental impact, flexibility to control the intensity of light and more advance functionalities.

1.2 Process Description.

In this proposed work we are going to interface Light Dependent Resistor to the analog pin of Arduino mini-pro, Arduino mini-pro is the small Arduino board with all the features available it is also fabricated using ATmega 328 Controller. We have also interface LED/ Relay driver IC ULN2003AGP which will be able to handle a current of 400mA, that means for demo purpose we can connect (400/20)=20 LEDs.

The system will first check an output from the LDR Sensor and then convert it in to digital format obvious conversion will be done by Arduino board itself as it have in-build analog to digital converters, after converting data to digital format it will be compared to threshold values for given LED brightness and accordingly the brightness of LED will get set.

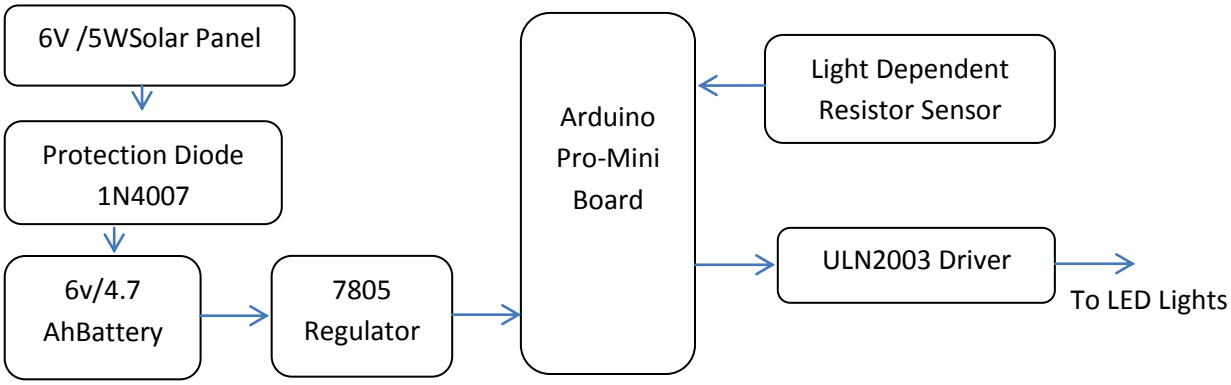

Fig: block Diagram of proposed System

2. HARDWARE EXPLANATION

Hardware point of view the major components used in project is Arduino pro-mini, Solar panel, Light dependent resistor, ULN2003 Driver, LEDs and Rechargeable battery.

2.1 Arduino pro-mini

The Arduino Pro Mini 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, an on-board resonator, a reset button, and holes for mounting pin headers. A six pin header can be connected to an FTDI cable or Spark fun breakout board to provide USB power and communication to the board.

The Arduino Pro Mini is intended for semi-permanent installation in objects or exhibitions. The board comes without pre-mounted headers, allowing the use of various types of connectors or direct soldering of wires. The pin layout is compatible with the Arduino Mini. There are two version of the Pro Mini. One runs at 3.3V and 8 MHz, the other at 5V and 16 MHz. The Arduino Pro Mini was designed and is manufactured by SparkFun Electronics.

2.2 Solar panel/ Photo Voltaic Cell

A solar cell, or photovoltaic cell, is an electrical device that converts the energy of light directly into electricity by the photovoltaic effect, which is a physical and chemical phenomenon. It is a form of photoelectric cell, defined as a device whose electrical characteristics, such as current, voltage, or resistance, vary when exposed to light. Individual solar cell devices can be combined to form modules, otherwise known as solar panels. In basic terms a single junction silicon solar cell can produce a maximum open-circuit voltage of approximately 0.5 to 0.6 volts.

2.3Light Dependent Resistor

A photo resistor (or light-dependent resistor, LDR, or photo-conductive cell) is a light-controlled variable resistor. The resistance of a photo resistor decreases with increasing incident light intensity; in other words, it exhibits photoconductivity. A photo resistor can be applied in light-sensitive detector circuits, and light-activated and dark-activated switching circuits.

A photo resistor is made of a high resistance semiconductor. In the dark, a photo resistor can have a resistance as high as several mega ohms (MΩ), while in the light, a photo resistor can have a resistance as low as a few hundred ohms. If incident light on a photo resistor exceeds a certain frequency, photons absorbed by the semiconductor give bound electrons enough energy to jump into the conduction band. The resulting free electrons (and their whole partners) conduct electricity, thereby lowering resistance. The resistance range and sensitivity of a photo resistor can substantially differ among dissimilar devices. Moreover, unique photo resistors may react substantially differently to photons within certain wavelength bands.

2.4ULN2003 Driver

The ULN2003A is an array of seven NPN Darlington transistors capable of 500 mA, 50 V output. It features common-cathode fly back diodes for switching inductive loads. It can come in PDIP, SOIC, SOP or TSSOP packaging. In the same family are ULN2002A, ULN2004A, as well as ULQ2003A and ULQ2004A, designed for different logic input levels.

2.4Light Emitting Diode (LED)

A light-emitting diode (LED) is a semiconductor light source that emits light when current flows through it. Electrons in the semiconductor recombine with electron holes, releasing energy in the form of photons. This effect is called electroluminescence. The color of the light (corresponding to the energy of the photons) is determined by the energy required for electrons to cross the band gap of the semiconductor. White light is obtained by using multiple semiconductors or a layer of light-emitting phosphor on the semiconductor device.

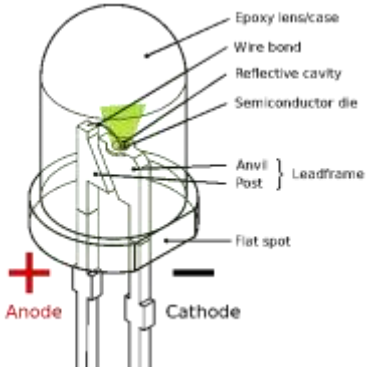

Fig: Construction of LED

2.4 Rechargeable battery

`In proposed system we are using Lead Acid Battery - 6V, 4.5Ah, batter is used to maintain a charge to drive system in night.

4. CONCLUSIONS AND OUTPUT

The paper describes an automatic solar panel based LED street light dimming system; we have successfully implemented and tested the proposed system with resources like Arduino pro-mini, solar panel, light Sensor, LEDs and Rechargeable battery.

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