Smart Autonomous Street Light Control System

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Abstract

In olden days, Street lights are controlled manually. Nowadays automation of street light has emerged. This project is about how to control the power consumptions at the streets and eliminating manpower. It includes controlling a circuit of street lights with specific Sensors, LDR and Microcontrollers during day and night time. One can observed that there is no need of high intensity of light in peak hours, when no traffic and even in early morning by reducing the intensity in this time. Energy can be saving up to some extent. Solar energy is collected with the aid of solar cell and battery is charged during day time and this energy is used for power street lights during night time. In addition, if a solar tracker system is used we can attain maximum energy from the sun. This project explains the system that automatically control the intensity of street light which is design using microcontroller and LEDs.

Keywords: Auto dimming, Auto grid power switching, Fault detection using sms alert, Sun tracking, auto day and night tracking

I. INTRODUCTION

A light is a converter which produces light energy when electric current passes through it. The main purpose of road lighting is to make people, vehicles and objects on the road visible. In engineering field, environment related issue has been raised where many researchers and engineers are involving themselves to find the techniques and tricks which is used to reduce energy consumption, environment friendly equipment and to increase product efficiency.

The solution is the smart system when it is applied in many areas like industrial, residential and commercial, etc. Smarts system is having an autonomous operation which detects the change in environment with the help of sensors and other electronic components and act to correct the offset cause of the environment. The systems perform continually to reach the optimal solution. Advantage of using street light is, to better the quality of human life for the dark period of the day.

The latest technology, which is used nowadays, is light emitting diode(LED) based system, it is worked as energy efficient and reliable lighting technology, which reduced the lighting cost as well as energy consumption up to 75%and also responsible for the reduction of carbon dioxide emissions and other dangerous gases. This paper presents the design and evaluation of a street light controlling system using sun tracking solar system.

II. LITERATURE REVIEW

A. From IEEE Reference:

1) An Intelligent Driver for Light Emitting Diode Street Lighting:

The demand for developing LED street lighting is growing constant because light emitting diode has performed better. The advantage of LED performances has taken to search for electronic driver. The intelligent driver is based on our patented LED modules. This is derived from thermal, photometric, power electronics techniques. The intelligent driver consists an AC/DC converter which is designed in a quasi-resonant operation flyback topology to maintain high efficiency and constant current output of 800mA/31 V with variable voltage output at wide input voltage range of 100-250 V/AC. The intelligent controller does function of soft start up, full ON, half ON and OFF. A 50 W LED pole head design by setting this driver we can save 72% more energy compared with conventional street lighting after some time.
2) Design of New Intelligent Street Light Control System:
The methods of time-control, optical-control and time-optical-control are in commonly used to control street lamp particularly in small and medium-sized cities of China. We find bed precision and poor work there due to poor administrative method. The new intelligent system we can control many kinds of sensor combination, multi-sensor exhibition and environment’s change with the help of pre-installing time in this system street light can be controlled automatically sunshine which may act according to the actual determination of the sunlight degree of illumination. A smart controller is designed with dual functions including timing control and automatic photo-electric control. It allows street lamp automatically lit in the evening: lighting the road for adjustable time when few vehicles go past it turn off automatically. When the vehicles are going through street light will be waken up by terminal controller. This system is for achieving energy-saving, extending life of equipment easy maintaining.

3) Integrated System for Intelligent Street Lighting:
Hardware implementation at dimmable electronic ballast for high pressure sodium lamps and a microprocessor based system for control and energy measurement for this ballast is studied. These ballasts are connected in topology of a logic network, one at them being defined as the master of the sub circuit and others as slaves. The master unit distinguishes from the slaves by the additional communications system. It is enabled the wireless connection to a PC-based central supervisory system. It can control entire main lighting system and obtain more accurate data about energy billing. It is resulted in financial and energetic economy.

B. Company Working On Similar Technology:

1) IoTcomm Technologies, China:
IoTcomm has developed an intelligent street lighting control system. This system provides least expensive and the most reliable solution to significantly reduce power consumption, operating costs and environment impacts. Its power line communication modules and wireless communication modules are integrated into smart automation systems of lighting, heating and cooling, security, fire detection, access control or energy monitoring equipments for both commercial and residential buildings.

C. Other References:
In a street lighting implementation based on photovoltaic panels uses solar energy as primary source and batteries as secondary source. Light emitting diodes are employed as lighting source for an alternative for remote area [2]. The paper [12] focused on implementing a lighting control system that made street lighting to be an autonomous and efficient part of the urban environment. The paper presented an efficient street lighting system with reduced power consumption in comparison to classical lighting systems.

The common drawbacks of the most light control systems are uneasiness of handling and difficulty of maintenance. To reduce these weaknesses in operating light control system the system is using Zigbee communication devices.

III. SYSTEM DESIGN

A. System Description:
The system consists of four modules, solar tracking system, auto dimming, fault detection and auto power supply switching. Solar tracking system is used to convert solar power into electrical power. Auto dimming is used for the dimming of LED at night time and day time at day time dimming of LED is low and night time dimming of LED is high. Any fault related to wire connection is occurred at that time GSM is sent the message to the control room. Auto switching power supply is used to switching the power supply to the government power supply when the power level in battery is low.

1) Solar Tracking System:
This system is the most appropriate technology to enhance the efficiency of the solar cells by tracking the sun. The sun is main source of energy which is the fuel for most renewable system. Photovoltaic renewable system has a great chance to replace solar panel directly converts solar radiation into electrical energy.

Solar panel is mainly made from semiconductor materials. The maximum efficiency at component of solar panels is 24.5%, to increase the intensity of light falling on it, high efficient solar panels should be invented solar trackers get popularized around the world in recent days to harness solar energy in most efficient way.

2) Battery:
A battery is electrical device which stress the electrical energy. It consists of two or more cells connected in series or parallel. It consists of electrolyte and positive electrode and a negative electrode. The electrolyte is an ionic conductor. One of the electrodes will react producing electrons while the other will accept electrons. When the electrodes are connected to a device to be powered called a load, an electric current flow.

3) Switching Circuit and Sensors:
The sensor is used to detect the intensity of light. Light dependent resistor and optocoupler that responds to the amount of light detected. When the light is too low the switching circuit within system ignited by the sensor to activate the flow of electricity. When the sensor detects too much light the sensor will deactivate the light.
4) LED bulbs:
These lamps are made from semiconductor materials. The recent of lamps posses internal circuits that make them operate from standard AC voltage. LED lamps are used for long life and high efficiency. That costs high initially compared to fluorescent light.

5) Relay:
Many relays use an electromagnet to mechanically operate a switch. Relays are used where it is necessary to control a circuit by a low-power signal. Relays contain a sensing unit. The electric coil is powered by AC to DC current. When the applied current exceeds a threshold value, the coil activates the armature. The first circuit is called the load circuit. The basic functions are ON/OFF control, limit control and logic operation.

6) GSM Modem:
GPRS module is a breakout board and minimum system of SIM900 Quad band/SIM900A Dual-band GSM/GPRS module. It can communicate with controllers via AT commands (GSM 07.07, 07.05 and SIMCOM enhanced AT Commands). This module supports software power on and reset.

![Block Diagram of street light control system](image_url)

**Fig. 1: Block Diagram of street light control system**

### B. Hardware Description:

The proposed system consists of solar plate with servo motor, GSM sim 900, Relay, Battery, ICS like 7805, 7812, MAX 232, ULN 2803, TIP 122, LCD, LEDs, Optocoupler, etc. Atmega16 AVR microcontroller is connected with Relay, solar plate, servo motor, GSM sim 900, optocoupler and the other components.

Sun tracking system consists of solar plate with servo motor and battery. By using servo motor, rotate the solar panel according to the sun position and store the power into the battery. In auto dimming, led is dimming using the optocoupler. Whenever the light intensity is high the LED glowing with low power and when the light intensity is low then LED glowing at its maximum level.

Fault detection system consists of GSM sim 900 when the wire connection with street light is break down then GSM is send SMS to the control room. Auto switching power supply module consists of Relay, MAX 232 IC. When the power level of battery is low then automatically power is switched to the grid power. Auto day and night is decided by the intensity of LDR sensor.
Fig. 2: Circuit Diagram of street light control system
IV. CONCLUSION

This project is a cost effective, eco friendly and the safe and smartest way to save energy. It clearly reduces the two problems that world is facing today, saving of energy and also disposal of incandescent lamps, very efficiently. According to statistical data we can save more than 45% of electrical energy that is now consumed by the highways. The main drawback of the project is initial cost and maintenance. With the help of advances in technology and good resource planning the cost of the project can be cut down and also with the use of good equipment the maintenance can also be reduced in terms of periodic checks.

The paper has presented an efficient street lighting system with reduced power consumption as compared to classical lighting systems. The solar-powered street light was designed and constructed such that integrates new technologies provides ease of maintenance and energy savings, a sensor(LDR) to help in the automatic switching which activates and deactivate the system. The system was also built to conserve energy with the use of a light emitting diode (LED) to replace other lamps such as the fluorescent lamp which might reduce the efficiency of the battery, GSM Modem for fault detection, relay as a switch.

The project has scope in various other applications like for providing lighting in industries, campuses and parking lots of huge shopping malls, garden lighting. This can also be used for surveillance in corporate campuses and industries.

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REFERENCES

[7] Nupur, Neha, Sangya gugri, Srishiti mishra ,Gulshan kr. Dube “Advancements in Solar based LED Street light “UG Student, Dept. of EIE, Galgotia”s College of engineering & technology, Uttar Pradesh India and Associate professor, Dept. of EIE, Galgotia”s College of engineering & technology, Uttar Pradesh, India
[8] Prof. K.Y.Rajput[Associate Professor, EXTC dept., TSEC, Mumbai, Maharashtra India,], Gargeyee Khata[Final Year B.E, EXTC dept., TSEC, Mumbai, Maharashtra India,], Monica Pujar[Final Year B.E, EXTC dept., TSEC, Mumbai, Maharashtra India,], Priyanka Yadav[Final Year B.E, EXTC dept., TSEC, Mumbai, Maharashtra India,”Intelligent Street Lighting System Using Gsm”
[12] M. Popa and A. MarcuPolitehnica, “A Solution for Street Lighting in Smart Cities”, University/Faculty of Automation and Computers, Timisoara, Romania