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Dolor Solis : Smart Solar Street Lights

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Abstract - *We are using solar lights which are made up of acid batteries which have very short lifespan. Then, there is problem in street light also, that we can't monitor remotely. So, solution of above problem is discussed. We are going to change batteries of solar lights from acid to Li-Ion batteries which have more lifespan & durability in any weather. By using IoT domain, we are going to install a microcontroller, GPS, Infrared Sensors and other sensors in solar lights itself which will help us to monitor and increase the efficiency of solar lights. By using our street solar lights we not only increase battery life and efficiency of normal street solar lights but also we can monitor status of each and every light in the area with the help of simple android application on our mobile*

Key Words: **Street Light, IR Sensors, LDR sensors, solar panels, GSM Modem**

1. INTRODUCTION

IOT is internet of things and is the network of physical devices, vehicles, home appliances, and other items embedded with electronics, software, sensors, etc. IoT involves extending Internet connectivity beyond standard devices, such as desktops to any range of traditionally dumb or non-internet based physical devices. Embedded with technology, these devices can communicate and interact over the Internet, and they can be remotely monitored and controlled.

Currently Street lights are for lighting every city and every village in India and the world. These street lights currently being used are powered with electricity which results in heavy consumption of electricity. Street lights as a product can be improved in many aspects. Street light can be made on solar power instead of electricity which costs more to government.

Solar powered street lights are best solution for saving electricity. Solar powered street lights are there in market currently but lack lifespan as well as choice of right components. We intend to create smart solar street lights which will be able to communicate with the users or customers who purchased them and at the same time give appropriate feedback regarding status of street light such as ON/OFF status, battery charging status, etc.

Another problem regarding solar street lights is that, they have acid batteries which have less lifespan and poor performance in weather conditions like cold and rain. Hence, we intend to use Li-ion Batteries to increase performance as well as lifespan of batteries. Lights will communicate with the customers using mobile networks via GSM module installed in light itself. Street lights will also communicate their GPS locations to the customers such that customers can monitor the street light. The light will have three working modes according to the condition. Street lights will turn ON/OFF according to ambience, also when no one passes from below the light for certain period of time light will be on 20% intensity. Sensors will be installed on light to detect any activity such that light will glow on full intensity.

As the lights will be on power saving mode, whenever no one passes from below them it will save the battery power. Customer will be able to see location of the lights on the map and their status. Problem regarding solar street lights is that , these street lights are wireless and can be stolen and second problem is that they get damaged very soon hence, We intend to monitor street light location to avoid such problems.

When street lights will leave its original location or configured location it will stop working and Customers will be notified about the incident. If light will get damaged Customers as well as Company will be notified creating a feedback loop. Creating a feedback loop always increases the product quality as customers and manufacturers are also involved in the process.

In this paper studies discusses in second section which is literature survey then in third section we thoroughly go into system requirement specification in which we discussed all aspects of the proposed system

2. LITERATURE SURVEY

1. IoT-enabled Smart Lighting Systems for Smart Cities

In this paper, a generic communication model for an SLS and a brief overview of different IoT protocols that are used in different SLSs is presented. The overview of an SLS in the context of the smart city is given. Some of the existing IoT communication protocols that can be used to implement an SLS focusing on the integration of street and indoor lighting scenarios are discussed. Energy consumption in different SLS scenarios and some advantages of using an SLS are noted. Finally the future scope and identifying existing problems in implementing SLS are also discussed. Conventional lighting approaches

which are proposed to monitor and control the energy consumption of lighting systems have been focused on either manual solutions or arranging on/off duration of the lamps for certain period of a day. While manual solutions suffer from higher implementation cost, timer-based solutions waste the power in less populated regions during uncrowded nights.

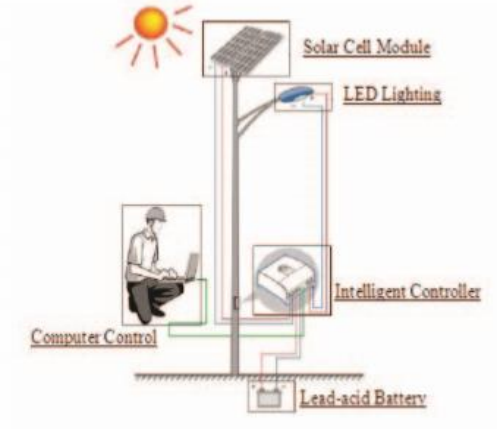

Figure 1: General setup for streetlight solar panel system[1]

However, to consider these drawbacks, an SLS uses multiple sensors. These sensors are used to adjust the on/off time according to human presence and light intensity. In an SLS, there are three basic components of the system architecture: 1) Lamp Unit (LU): LUs are comprised of necessary and sufficient sensors to provide automatic control to the overall system. 2) Local Control Unit (LCU): Local control unit collects the data from an array of LUs through a short range communication protocol transmit the data to the Control Center. 3) Control Center (CC): The Control Center collects all types of data from LCUs and stores it on a server. This paper is focused on IoT-enabled Smart Indoor and Outdoor Lighting Systems (SiLS, SoLS) in a smart city, which can effectively reduce the power consumption and provide more intelligent operations. Different usage scenarios for SiLS and SoLS are analyzed and power consumption analysis is provided.

2. Design and implementation of solar based smart street light solution

The Smart Street Lights are the one that detects the vehicle from a certain radius and glows till the vehicle crosses a particular radius. Moreover these smart lights are charged by solar panels at day time so they will be functioning at night by solar energy. This proposed system is extended by using suitable sensors for detecting the street light failure, and then sending an SMS to the control department through a GSM modem for suitable action. By using this proposed system a lot of energy can be saved. The system comprises of four main components i.e. solar panels, LDR sensors, motion sensors, GSM modem. A smart street light is a type of street light which runs on consumption of solar energy and hence helps in saving lots of electricity. The word smart refers to the vehicular detection by the sensors and glowing of street light on detecting the same. A LDR (Light Dependent Resistor) makes it even smarter by not glowing the street lights in the morning to evening time. A GSM MODEM is also connected which will eventually reduce the man power by sending a message to the control station that which street light is not working, so that the person don't need to locate the faulty light by themselves. Moreover it is seen that the proposed system is completely solar based and the batteries will be charged by sunlight. If due to some reason the sun doesn't appear for several days then the batteries can also be charged by the AC supply as backup. The lights will only glow when there is lack of sunlight i.e. during night and cloudy times and for that an LDR sensor is used.

3. An Intelligent System for Monitoring and Controlling of Street Light using GSM Technology

In this designed system, lights control is based on 1) Intensity & 2) Time. In the intensity, control method is related to light intensity. When the light intensity is low, lamp will glow and will be turned off automatically when the light intensity becomes more. The drawback of this method is, during cloudy days, the intensity of light is very low all over the day. This will make the lamp to glow for the entire day which leads to power loss. In time based method which uses RTC (Real Time Clock) is combined with intensity control method (LDR). In time based control method, light should be ON/OFF for the fixed time duration. However, this method also have some disadvantages as, in summer, days are of long duration and vice a versa in winter. So, the lights should be turned off earlier during summer than in winter. But the time duration is already set and it cannot be changed. To overcome these drawbacks, microcontroller is introduced which considers both parameters LDR and RTC at the same time. This makes the system easy to operate in any environmental condition. Another parameter needed to consider is that, the street lights are installed on highways with vast range of kilometers which make it difficult to monitor and control the performance of each and every street lamp causes the problem for highway services. Solution to this problem is to make use of various wireless technologies such as Bluetooth, Wi-Fi, ZigBee. But, in Bluetooth, Wi-Fi & ZigBee, there is need to build several number of small servers in every few hundred meters of range which becomes hectic to observe and control. Here GSM communication system as a method of wireless communication for the monitoring and controlling the performance of street lights is used. The developed system includes Light Emitting Diode (LED) as a lighting source, solar panel which uses renewable energy source, various sensors like presence sensor to detect the presence of

vehicle or pedestrian, current sensor for the measurement of power consumption, and for the detection of faulty lamps. The system is designed such that lights sensors (LDR), RTC and Presence sensor placed in all the street lights circuit will turn lamps ON and OFF automatically. When the lights are turn ON every light pole having current sensor informs about fault to the centralized system by using GSM module attached to circuit via Short Message Service (SMS).

4. IoT-GSM-Based High-Efficiency LED Street Light Control System (IoT-SLCS)

In this system, an integrated hardware was designed with a GSM-based TCP/IP client socket that communicates with the writing on the cloud. By measuring energy consumption, the transition between the battery and the city network is controlled according to the traffic volume and the light level. In this system, an intelligent battery charging and management structure was designed using a Cortex-M3 processor, a GSM data module and a micro SD. It was designed to be cost effective and feasible since it did not require a PLC or any external hardware. Even when the battery is depleted or there are interruptions in the city network, the electronic components of the system were designed to operate for seven days, reporting the traffic volume and light level to the cloud. The choice of which lamps to employ is determined via the cloud according to the intensity of the traffic and the level of light. The IoT Street Light Controller (IoT-SLC) communicates with the cloud software at 3-minute intervals via GSM. The light poles were equipped with 12-V LED lights with each light source drawing ~ 1.8 A current. In the IoT Street Light Controller hardware, two 12 V/20 Ah batteries were used for each light pole. These batteries were charged wirelessly, using a 5-W solar panel with a full power output voltage of 21 V. Both batteries were charged using a trickle charger unit containing an 8bit processor operating independently of the Cortex-M3 processor in the IoT-SLC-H. This was necessary to save the battery when it dropped below 10.5 V during periods when the entire system was completely de-energized, thus enabling the battery to be monitored with minimal energy consumption. Experimentally, when the voltage drops to 11V, all charging related units enter sleep mode. In this case, however, even if the battery operated for nearly one week, the voltage would not fall below 10.5 V. The main processor controls TCP/IP socket communication, lighting and other traffic-related operations via GSM. The IoT-SLC system was developed with software components that include embedded software and cloud software. Under the embedded software, sensor measurements and GSM operations are carried out. The cloud software sets the entire lighting scenario and sends it to the IoT-SLC-H units.

5. Smart Lighting: Intelligent and Weather adaptive Lighting in Street Lights using IOT

This system works on an arrangement of sensors that transmit information based upon the light level; The Master gadget handles all road lights in its encompassing region through correspondence. It passes the message to screen the status of all the slave gadgets exchanging ON/OFF at the opportune time. What's more, in view of affirmation identifies status of each light. Singular Street light works in view of auto force control, i.e. when it identifies any protest or movement in that specific range it naturally changes to 100% power else it works in low force level. Every road light screens its usefulness, and reports its blame. It helps in fast recuperation. All the light towers are controlled by the gateway. The data sensed by the sensors are given to the web server, and the server takes a decision, at which time the lights will be switched on/off.

3. PROPOSED SYSTEM

A. System Architecture

The user will first register if he hasn't already a registered user, otherwise he will simply login to the system. User will then add lights to his account using an unique lights ID provided with the lights. Once added, user can check the status of lights. Lights will check for location at regular intervals and match it with the value stored in database. If the value does not match, lights will shut down and send status to the user. If the value matches then lights will send its current status to the database.

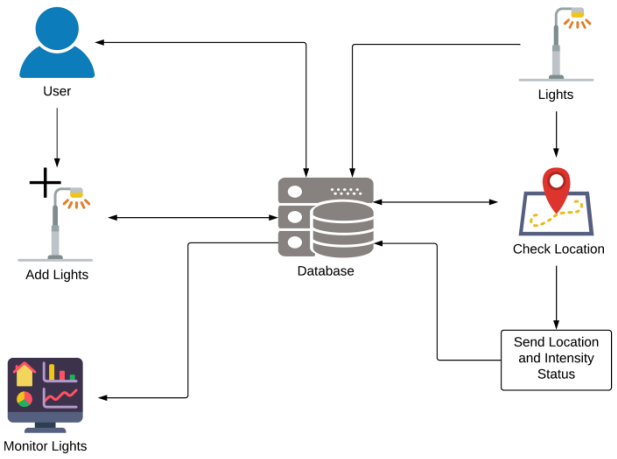

Figure 2: System Architecture

B. Hardware Requirements

Basic Hardware Requirement are 2 GB RAM for client and 4 GB RAM for server. The basic Software Requirement are Android phone with version 4.4 or higher for client

while server will need Windows 7 or higher, NodeJS and MySQL.

C. Communication InterfaceWeb Applications Scanner

In order for the proposed system (product) to be functional, lights as a single unit must be connected to the system (cloud) in order to transmit the information through the mobile communication signal. The user`s android phone must be connected to the internet for street light information viewing. Lights will communicate with the system using the GSM module which will send the data over the network using mobile communication channels

4. CONCLUSIONS

In this paper we are deploying a solar street lights system which has more lifespan than the traditional solar street lights, with a microcontroller to control and monitor the street lights which are registered with an Android app.

We are also deploying an Android app from which we can monitor the solar street lights which will send notifications if location of street lights get changed or the component of street light get damaged. This will help in lowering the maintenance cost of solar street lights.

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