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Design and Implementation of an Automated Solar Street Light System

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Abstract: Most of the street lights in Bangladesh use high-pressure sodium vapor lamps and energy saving bulbs running from the national grid electricity to light the street. Due to improper maintenance, most of the street lights are under the fault condition and roads are under dark condition. In this paper, an arduino based low-cost solar street light system has been designed. The objective of this work is to design an automatic control and fault and obstacle detection system for street lamps. The lighting system is based on renewable energy which is low cost. With the development of urbanization, the number of streets increases rapidly with high traffic density. This work includes three features: the sunlight sensing and control on/off of the street lights, the traffic sensing and fault reporting system. The microcontroller used is arduino mega 2560 which has to be programmed for these three tasks. This could be applicable in Bangladesh, which might provide a low-cost alternative to the existing street lighting system.

Keywords: *Automatic Control, Use of Solar Energy, Fault Detection, Energy Saving*

I. Introduction

Street lighting system is an important issue should be designed well to allow users for traveling at night with good visibility in respect of safety and comfort. An efficient system ensure comfort tracking and reduces the accident during late night. On the other hand, poorly designed lighting systems can lead to poor visibility which may not be helpful for pedestrians who are passing through that street. Street Lighting can cost about 10–38% of the total energy bill in typical cities worldwide (D. A. Devi, 2012). Street lighting is a particularly critical concern for public authorities in developing countries because of its strategic importance for economic and social stability (L. Prasad Naik, 2013). Inefficient lighting wastes significant financial resources every year, and poor lighting creates unsafe conditions (L. Prasad Naik, 2013). Energy efficient technologies and design mechanism can reduce cost of the street lighting drastically (L. Prasad Naik, 2013). Manual control is prone to errors and leads to energy wastages as manually dimming of lights during mid night is impracticable. Also, dynamically tracking the Obstacle or vehicle are imposed by manual control. The current trend is the introduction of automation and remote management solutions to control street lighting (J. Mohelnikova, 2008).

In this paper, two kinds of sensor are used which are light sensor and photoelectric sensor. The light sensor is used to detect darkness and to activate the ON/OFF switch, thus the streetlights will be ready to turn on. On the other hand, the photoelectric sensor is used to detect vehicle movement to activate the streetlights. LDR, which varies according to the amount of light falling on its surface (K. S. Sudhakar, 2013), gives an indications for whether it is a day-night time, the photoelectric sensors are placed on the side of the road, which can be controlled by Arduino Mega 2560. At the photoelectric sensor will be activated generally during the night time. Moreover, if any object crosses the photoelectric beam, a particular light will be automatically ON. By using this as a basic principle, the intelligent system can be designed for the perfect usage of streetlights in any place.

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II. Existing System

Street light are poorly designed and not regularly maintained. The switches of street lights are switched ON/OFF manually by the workman in the entire zone. This requires man power and time. As it is human operation, it leads to many possible errors. There is a complaint register in every zonal office street light section (R. Sathish Kumar, 2016).

The maintenance of street light is done by the line technician. The complaint received from public and corporation officials either over phone, or direct work hour recorded in the complaint register. The complaints which are entered are stored by the technician (T. Gowdhaman, 2017).

III. Proposed System

The proposed system is based on Photovoltaic panel which is one of the convenient and abundant renewable energy.

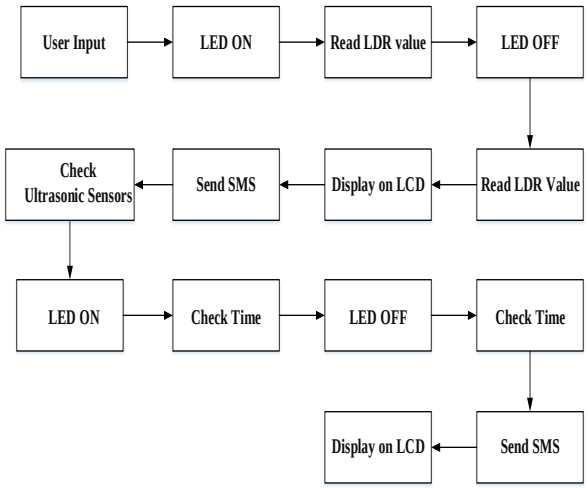

Figure 1: Block diagram of Automated Solar Street Light System for Highway Application

The block diagram in Fig. 1 shows the overall operation of the project. This system will start by manual input of the user and directly it will start to check the LED lights on the street. This operation will be done by the readings of LDR and if there is any fault in the line and light, an error message will be sent automatically to the control room which also will be shown on the display. When there is any vehicle or person is passing by the ultrasonic sensor, the LED linked with that sensor will be turned on for a certain time i.e. 1 min. If there is any obstacle in front of that sensor for a long time i.e. 2 minutes (set in this program), a message will be sent to the nearest traffic control room also will be displayed on the LCD display.

IV. Working Principle

Flowchart of automated solar street light system for highway application is shown in Fig. 2. The system works absolutely in the darkness, avoiding waste of energy during sunny day when the solar panel recharges the battery. The sensors enable the system to operate absolutely when necessary. The system used highly economical LEDs to ensure correct illumination and assure energy savings. The system is proposed to be low power consumption, minimizing the battery capacity and also the energy supplied from the solar panel.

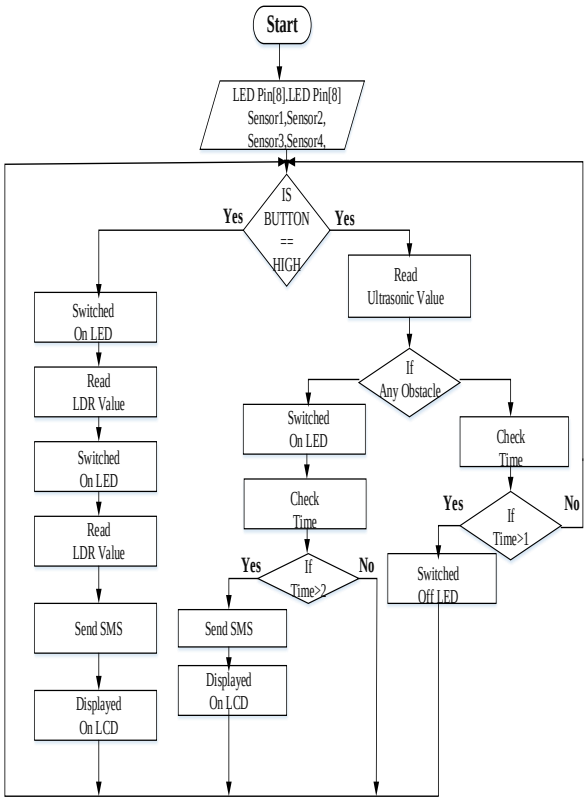

Figure 2: Flowchart of Automated Solar Street Light System for Highway Application

Hence, the condition of the street lamp status is monitored by this system. This feature allows great energy conservation. In addition, any faulty

LED will be automatically turned OFF which would reduce more energy wastage caused by these faulty LEDs. If any fault occurs on street lights, a GSM module send will SMS to the control room. The maintenance will be easier by this method. If heavy traffic on the road, a SMS will send in the police control room which will help traffic control.

At first, the system will check whether the push button is pressed or not. If the push button is pressed, it will turn On the all LEDs one by one and will take the LDR readings. After taking all LDR readings, it will turn OFF each LEDs and will take the readings of each LDR again. By comparing those two values, the faulty LED will be determined.

If there is any fault in the connection or LED, a massage with specific LED number will be sent to control room. If the push button is not pressed, it will check the current time and if the time is in between 6:00 pm to 11:00 pm all LEDs will be switched ON. If the time is not in between 6:00 pm to 11:00 pm it will check each ultrasonic sensor. If any vehicle is detected by any ultrasonic sensor it will switch on two LEDs near by the respective sensor. If there is no vehicle, LEDs will be switched OFF automatically after a certain time. If any vehicle is on the road for a certain time a massage with the coordination of the location will be sent to the police control room. Then the PIR sensor will check for the movement of the people. If any motion is detected, the yellow LED will be switched on. After a certain time, the red LED will be switched on. When all the pedestrians are passed, the green LED will be switched on.

V. Results and Discussions

All the components those have been used in this project are shown in Fig. 3. It shows both the internal connections and the externals connections. In this project, there are four lamp posts with the solar panel at the top. Ultrasonic sensors are placed at the side of those lamp posts. A PIR sensor is placed at the side of the road. An LCD display shows project results.

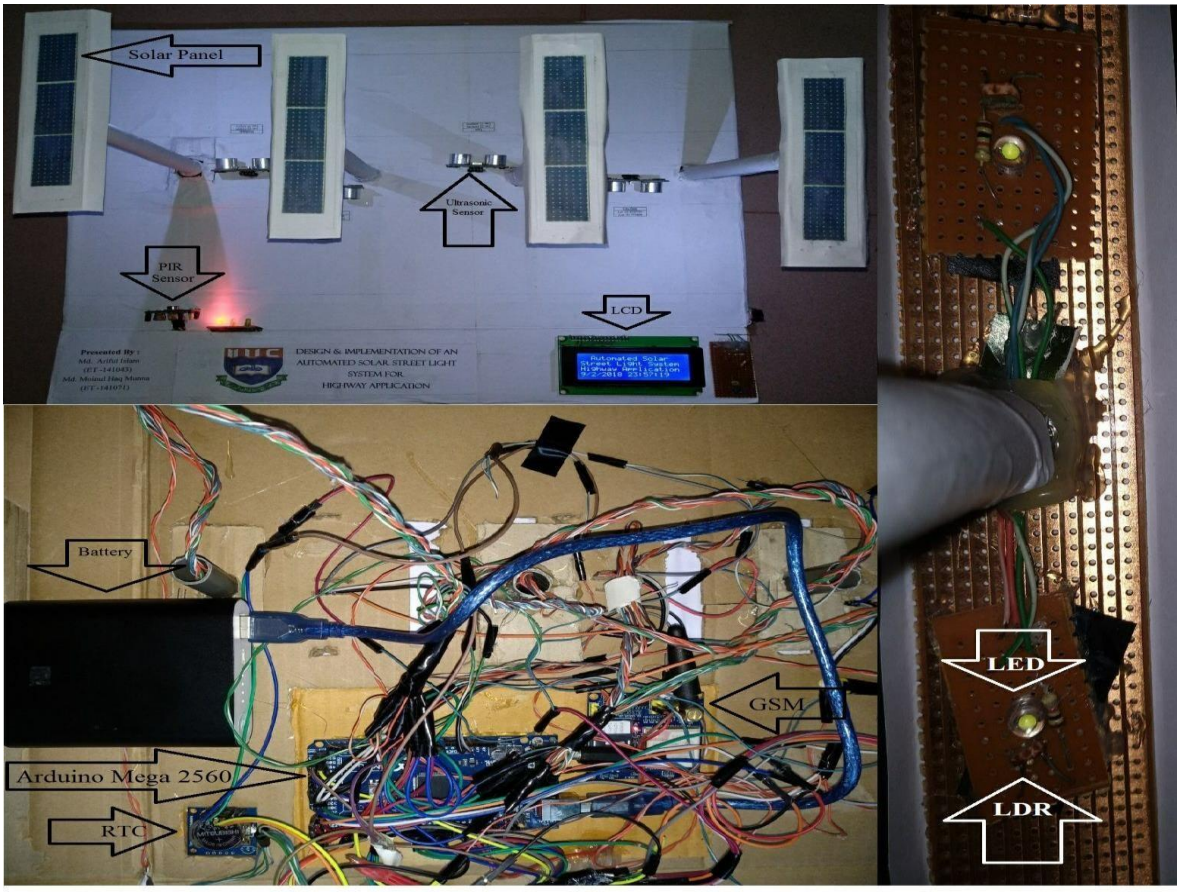

Figure 3: Overview of the Implemented Project

Figure 4 shows the name of the project and After that, by a manual button pressing, all the LEDs of a closed zone will start to find faults in that area. It also shows all the results of the LEDs in the display. Except LED 2 and 5 (Fig. 4), all other LEDs are found OK in this operation. If a fault occurs in a lamp, an SMS will be delivered automatically to the control room, so that they can take necessary steps to solve that problem (Fig. 5).

Figure 4: Testing operation of LED

Figure 5 : Results of testing LEDs

After that in Figs. 6-7 show the traffic control monitoring when a vehicle stopped in the road in front of an ultrasonic sensor. At that time, with the help of GPS, we know the current position of that vehicle with latitude and longitude position of that place (Figs 6-7). Finally, the crossing system on road shows in Fig. 8. When PIR sensor detects a person at that movement the Red light will be illuminated and all the vehicles will stop at this time. Then, when the Yellow light illuminates, the person cross the road.

At last, when the Green light illuminates the vehicle will move. In our work, we calculate the effective cost It will be near about 11410/= BDT, which is without the maintenance and foundation cost. This system is totally pollution free. It saves energy and reduces the dependency on human resource. Moreover, it gives security for us.

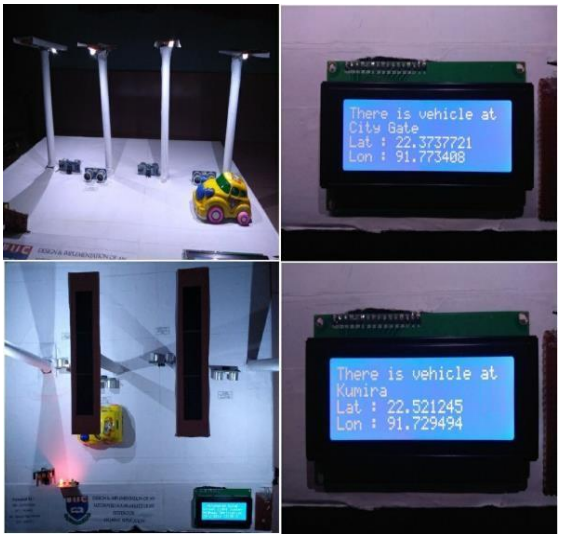

Figure 6: Traffic control monitoring at City Gate and Kumira

Figure 7: Traffic control monitoring at Mirsharai and Feni

Figure 8: Crossing system on road

VI. Conclusions

The proposed system is a perfect solution for energy saving, especially in public lighting management. In remote as well as the urban area where the traffic is low, this proposed system is perfect for street lighting. Independence of the power network permits to implement it in remote areas where the classical systems are badly expensive. Along with energy saving, it also tackles with the problem of power theft. It is capable of taking corrective actions in case of the unprecedented event of climate change. Furthermore, the drawbacks of the street light system are that PIR sensors do not operate above the temperature of 35^{o}C and also this kind of sensors work in LOS (Line of Sight) and do not work in non-LOS regions. Finally after having implemented this Intelligent System, what remains is the scope for improvements. Firstly, we could directly go for Wireless Power Transmission which would further reduce the maintenance costs and power thefts of the system, as cable breaking is one of the problems faced today. Moreover, attempts can be made to ensure that the complete system is self-sufficient on nonconventional energy resources like solar power, windmills, piezo-electric crystals, etc. We hope that these advancements can make this system completely robust and totally reliable in all respects.

References

D. A. Devi and A. Kumar, Design and Implementation of CPLD based Solar Power Saving System for Street Lights and Automatic Traffic Controller, *International Journal of Scientific and Research Publications*, Vol. 2, Issue11, November 2012.

D. Asha Devi and L. Prasad Naik, Prototype Implementation of Power Saver Street Lighting and Automatic Traffic Management System, *International Journal of Computer Science and Mobile Computing*, Vol.2 Issue. 11, November 2013.

J. Mohelnikova,"Electric energy savings and light guides." *Proceedings of the 3rd IASME/WSEAS international conference on Energy & environment*. World Scientific and Engineering Academy and Society (WSEAS), 2008.

K. S. Sudhakar, A. A. Anil, K. C. Ashok and S. S. Bhaskar, Automatic Street Light Control System, *International Journal of Emerging Technology and Advanced Engineering*, Vol. 3, May 2013.

R. Sathish Kumar, Intelligent Street Light Monitoring and Control using Micro Controller, *International Journal of Engineering Computational Research and Technology*, Vol.1, Issue.1, December 2016.

T. Gowdhaman, P. Scholar, D.Surendran, "Automatic Street Light Control and Fault Detection System with Cloud Storage", *International Journal of Scientific & Engineering Research*, Volume 8, Issue 5, May 2017.