DESIGN OF A STREET LIGHT SYSTEM IN A SMART CITY IMPLEMENTING IOT CONCEPT

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ABSTRACT

In the present field technologies, the main considerations are automation, power consumption and cost effectiveness. Automation is intended to reduce man power with the help of intelligent systems. Power saving is the main consideration forever as the source of the power is getting diminished due to various reasons. This paper illustrates the designing of a smart street light scheme with IoT based monitoring and thus executing the advanced development in embedded systems. A smart street lighting infrastructure includes Internet Protocol connectivity via gateways, which enables remote management of individual lights by monitoring environmental conditions, such as light, fault and pollution level. By means of monitoring each and every street light such as power failure, bulb damage and circuitry problems can be detected by monitoring whether the light is working or not and check the status of the sunlight and the artificial lamp (street lamp) by using LDR as light sensor. More than 50 percentages of energy and maintenance cost can save by adding some intelligence to lights. Also, a demonstration with a real-time prototype model involving costs and implementation procedure has been developed using Internet of Things to visualize the real time updates of street processing and notifying the changes occur.

Keyword – *Street light, Microcontroller (AT89S52), IoT, ESP8266, LDR, Op-Amp (LM358), Transformer*

1. INTRODUCTION

The street light system is one of the major elements in every cities and small towns. There is nothing to explain the importance of street light, but the present system is having number of drawbacks. Primarily, most of the street light systems are manually operated which have to be activated by human being either locally or from a centralized point. At the same time, they do not have any feedback system through which it could be identify the functioning and non-functioning street light unit.

A system will be highly beneficial if the street light can be controlled from a centralized location remotely without wire connectivity. The wireless connectivity is again distinctly useful if the street lights are powered by battery back-up and solar energy. In case of street lights in many places conventional street lights are replaced by automatic street light which is based on light intensity sensor. This is a noble way to minimize the wastage of power, manpower as well as increase the life of the light unit (indirectly). But these systems are not having in built monitoring system i.e. whether the light is actually working or not. It is a very common phenomenon where we have found that street light is installed but many of the units are not in working condition, it is due to lack of proper maintenance and ignorance about the faulty system. A system with self-monitoring system and remote controlling can be improved a street light system up to an extent.

2. INTERNET OF THINGS (IoT):

The IoT allows objects to be sensed or controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency, accuracy and economic benefit in addition to reduced human intervention. When IoT is

augmented with sensors and actuators, the technology becomes an instance of the more general class of cyber-physical systems, which also encompasses technologies such as smart grids, virtual power plants, smart homes, intelligent transportation and smart cities.

"Things", in the IoT sense, can refer to a wide variety of devices such as heart monitoring implants, biochip transponders on farm animals, cameras streaming live feeds of wild animals in coastal waters, automobiles with built-in sensors, DNA analysis devices for environmental/food/pathogen monitoring, or field operation devices that assist firefighters in search and rescue operations. Legal scholars suggest regarding "things" as an "inextricable mixture of hardware, software, data and service".

3. SMART STREET LIGHT

Smart street light refers to public street lighting that adapts to movement by pedestrians, cyclists and cars. Intelligent street lighting also referred to as adaptive street lighting, dims when no activity is detected, but brightens when movement is detected. This type of lighting is different from traditional, stationary illumination, or dimmable street lighting that dims at pre-determined times. Smart street light system tries to find solution for the faster depletion of energy resources due to the inefficient usage and wastage of these resources. Increasing electricity bill is something that can be witnessed by these practices. This paper helps to decrease the wastage of electricity by controlling the working of street light system that attributes to a good amount of electricity. Street lights can be made intelligent by placing cameras or other sensors on them, which enables them to detect. The other advantage of LED is that the intensity can be controlled easily.

4. BLOCK DIAGRAM

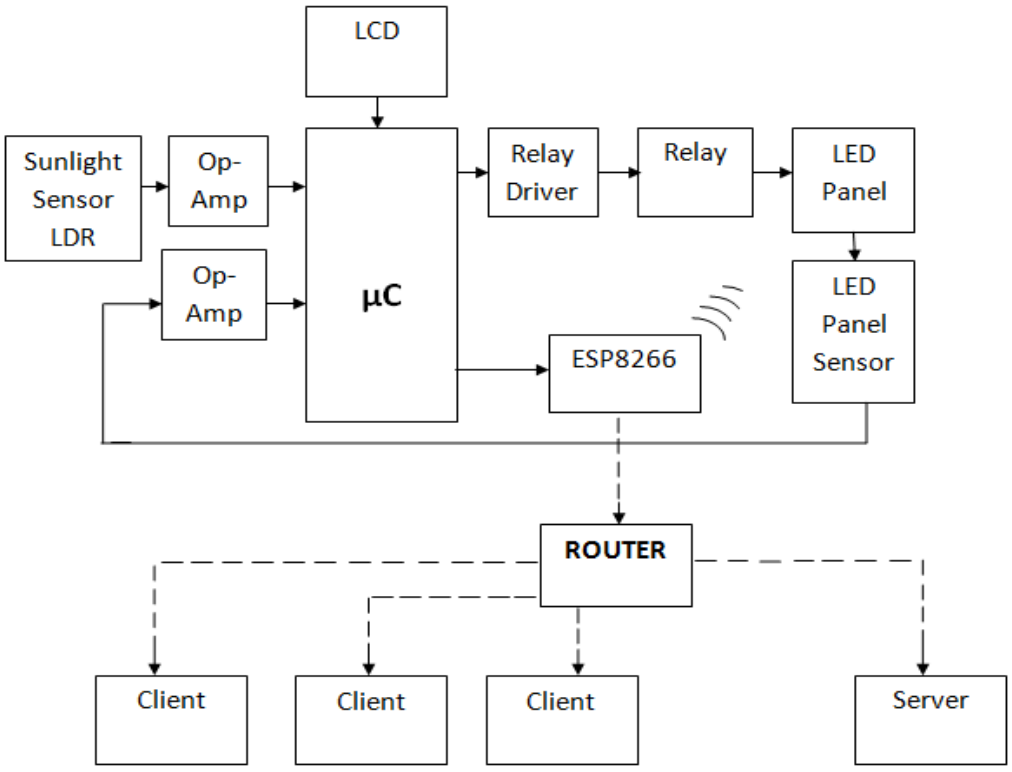

Fig 1. Block diagram of the designed model

5. WORKING PRINCIPLE

The working principle of the work "Design of a street light system in a smart city implementing IoT concept" is primarily divided into 6 units. The 1st unit is a sensor circuit that detects the environmental light to assume whether it is day or night (or evening). This unit is having two sensors. The 1st sensor to detect sunlight and the 2nd sensor to identify the LED panel is working or not. The 2nd and the primary unit is an 8-bit microcontroller which is responsible for monitoring the status of the 1st LDR i.e. whether the environment is having enough sunlight or not. If it has enough sunlight it will do nothing but if the sunlight is low the microcontroller triggers the third unit. The 3rd unit is nothing but a relay driver circuit and the relay which is controlled by designated IO pin of the microcontroller. If there is no sunlight, it activates the relay driver circuit designed with NPN transistor 2N2222. The transistor's collector is connected to 1st terminal of relay and the other terminal of the relay is connected to +12v. When the relay is energized, the mechanical switch in the relay allows to pass current to the 4th unit. The 4th unit is an LED panel made of 6×8 matrix. The size of the panel can be increased by n adding more LEDs. Instead of electromagnetic relay, the panel can be controlled by solid state relay also.

When the microcontroller activates the LED panel, the second LDR detect the light from the panel if the second LDR is getting enough panel if the second LDR is getting enough light the system assumes that panel is working properly but if the panel is not working (2nd LDR is not getting enough light). The microcontroller transmits information to the web server through the 5th unit. The 5th unit is a WIFI modem based on ESP 8266. THE microcontroller is communicating ESP 8266 through the serial communication. We are using the ESP8266 AT command mode i.e., the microcontroller is transmitting and controlling theESP8266 through AT commands.

The transmitted data is handled by the 6th unit i.e., a web server. Unlike many ESP8266 based system where the ESP8266 itself is using web server, ESP8266 is used here as client, so that it can transmitted the data to web server and we do not have to number any IP address of the ESP8266.It also communication with the web server which make the system as a centralized moving system i.e., all such devices will communicate with a single web server.

In the web server section, it has a set of web pages through which we can monitor and configure the street light.

6. CIRCUIT DIAGRAM

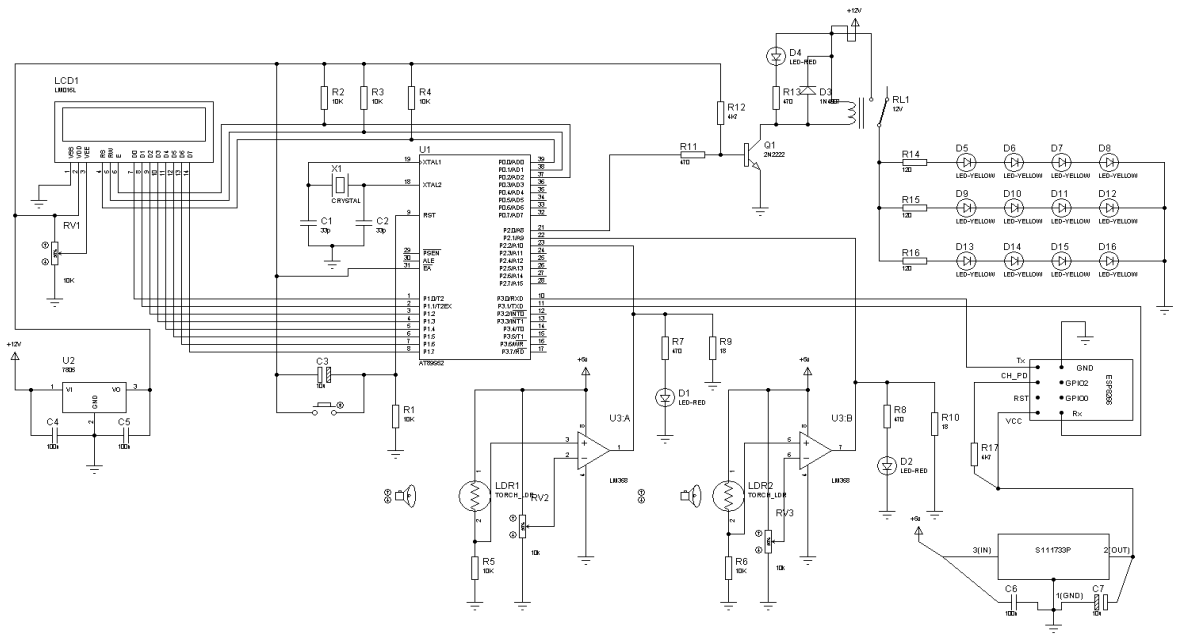

Fig2. Circuit diagram of the model

7. RESULT AND ANALYSIS

The model's aim is to reduce the side effect of the current street lighting system and find a solution to save power. In this paper the first thing to do, is to prepare the inputs and output of the system to control the light of useful and fulfil all the present constraints if implemented at large scale.

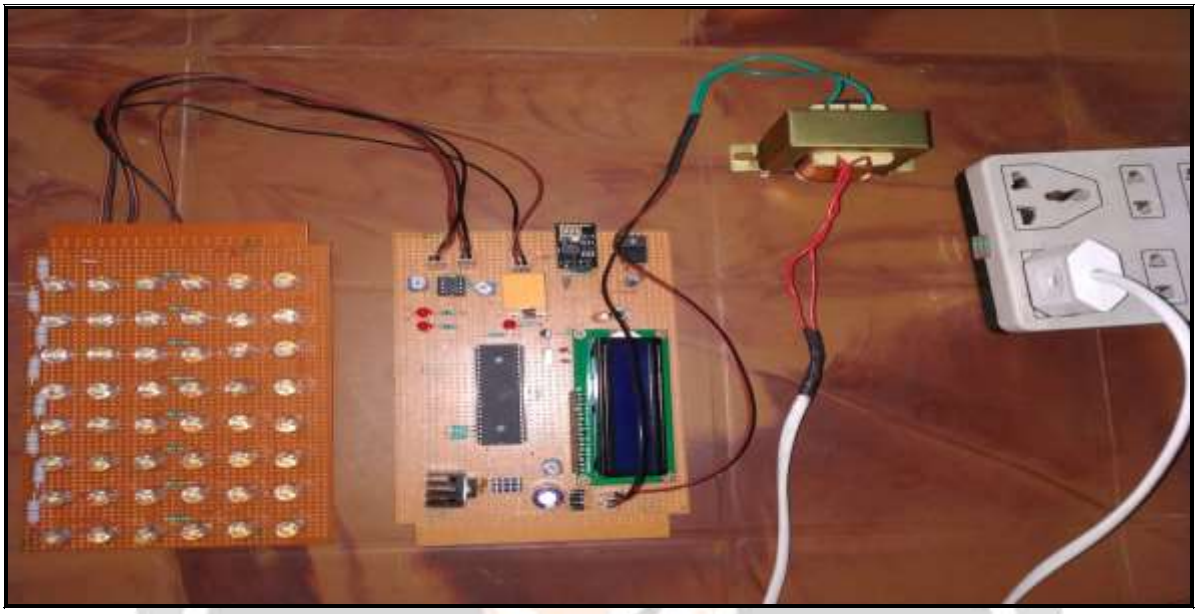

Fig. 3: Prototype of IoT based Smart Street light

Figure 3 shows that the complete working prototype of the IoT Based smart street lighting system for smart city which includes LDR, AT89S52 microcontroller, transformer, relay, resistors, Wi-Fi module, LCD display, LED panel etc.

To provide the connectivity between Wamp Server and the streetlight unit, we are using our mobile hotspot as router but for industrial environment we can connect the server as well as the street lights through a commercial router.

Figure 4 shows the design of the webpage displaying the header named as "IoT Based Street Light Monitoring System". The web pages are set through which we can monitor and configure the street light

Fig. 4: Webpage design of IoT Based Street Light Monitoring System

The working of the IoT based street light system can be explained in both fault and without fault conditions

Condition I Without Fault:

Fig.5: Status of the light in presence of sunlight

Fig. 6: Status of the light in absence of sunlight

Figures 5 and 6 show that the prototype of the system during working condition. The fig. 5 shows the status of the lamp is ON during the presence of sunlight whereas fig.6 shows the status of the lamp is OFF during the absence of sunlight. If the second LDR is getting enough light the system assumes that panel is working properly which is displayed as “WORKING” in the second serial ID in the status of the webpage as shown in fig.7.

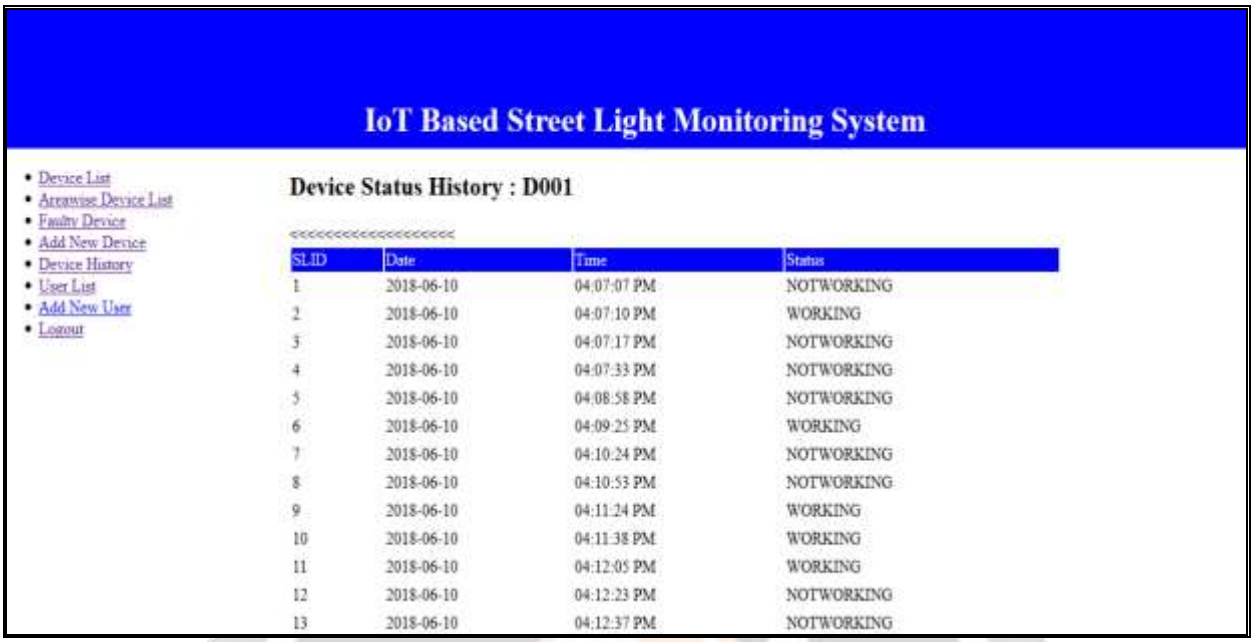

Fig 7: Webpage showing the status of the light without fault

Condition II During Fault

Here the figure 6 shows that the prototype of the system when there is a fault on LED panel. When there is no sunlight, the LED panel should work properly but instead the LED panel is off even in the absence of sunlight which is displayed on the LCD screen.

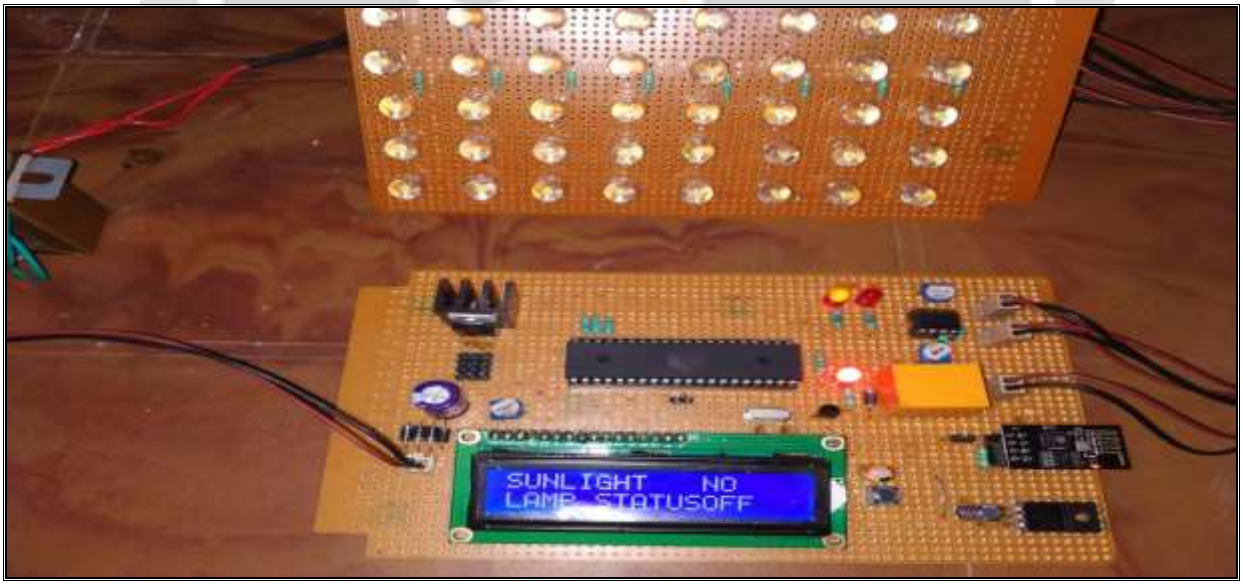

Fig. 8: Status of light during fault condition

In fig.9 it shows that the webpage displaying the real time information of the status of the light on the webpage. It displays the status of the Light is “Not Working” in the first serial ID in the status of the webpage even during the presence of sunlight.

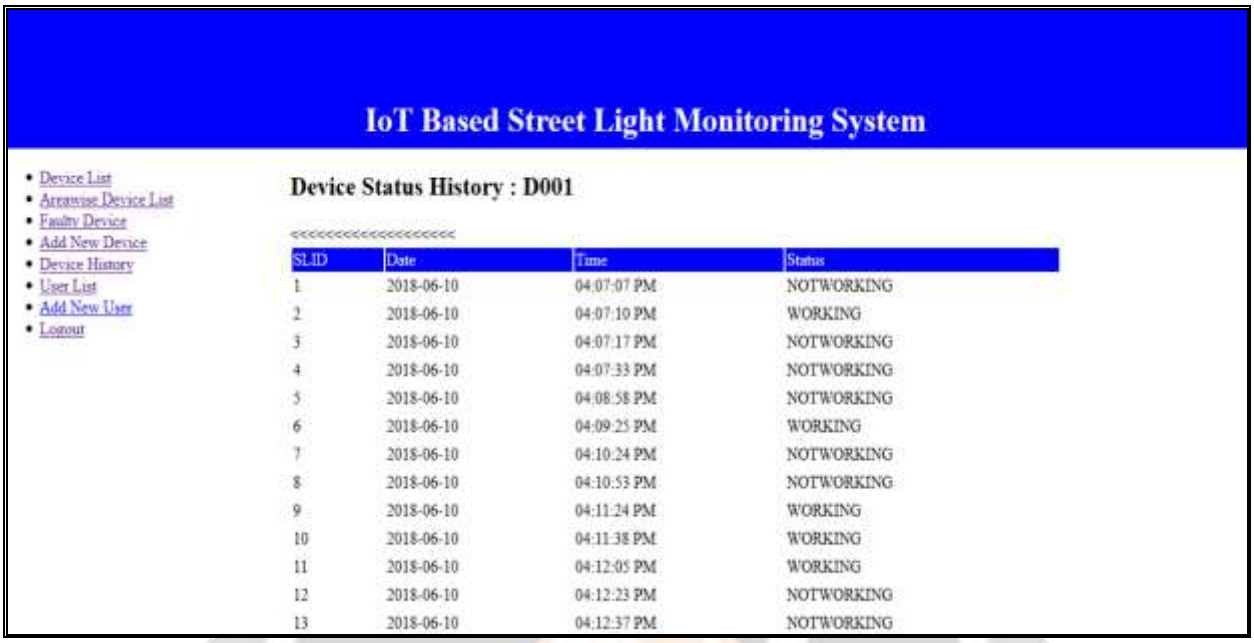

Fig. 9: Webpage showing the status of the light during fault

The system testing under standard condition is working properly as we have decided to design but many other issues can be handled with this system.

During the implementation of connectivity, it was not connecting properly at initial stage but when the ESP8266 is configured with AT+CWJAP with a valid accessory and password it started working without an error.

8. CONCLUSION

This model explained here is a cost effective, practical, eco-friendly and the safest way to save energy and in this system, the light status information can be accessed from anytime and anywhere. It clearly tackles the two problems and the world is facing today, saving of energy and also disposal of incandescent lamps, very efficiently, initial cost and maintenance can be the backs of the model. With the advanced of technology and good resources 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 LEDs have long life, emit cool light, donor have any toxic material and can be used for fast switching. For this reason, it has far more advantages which can over shadow the present limitations. Keeping the view of long term benefits and initial cost would never be a problem as the investment return time is very less. This work has scope in various other applications like for providing lighting in industries, campuses and parking lots of huge shopping malls. This can also be used for surveillance in corporate campuses and industries.

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