

Smart Street Lighting Using Internet of Things

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Abstract— The objective of the project is to provide a dynamic street light control and management which relies on the Internet of Things architecture. Currently, there is manual switching in which street lights will be switched on in the evening before sunset and switched off next day in the morning. The proposed system provides a solution for energy saving by automatic switching as well as obstruction sensor for better energy conservation. This uses Arduino microcontroller coupled with LDR and IR sensor for obstruction detection. Thus, this system ensures smart operability and smart energy consumption of street lights.

Keywords—Smart street lighting, Dynamic street Lighting, Internet of things, Automatic street lighting

I. INTRODUCTION

Nowadays, human has become too busy, and is unable to find time to switch the lights wherever not necessary. The present system is like the lights will be switched on in the evening before the sun sets and they are switched off the next day morning after there is sufficient light on the outside. Therefore the actual timing for these lights to be switched on are when there is limited brightness. With this, the power will be wasted up to some extent. This paper gives the best solution for electrical power wastage. Also the manual operation of the lighting system is completely eliminated. The energy consumption in entire world is increasing at the fastest rates due to population growth and economic development and the availability of energy sources remains woefully constrained. Resource augmentation and growth in energy supply has not kept pace with increasing demand and, therefore, continues to face serious energy shortages. Streetlights are an integral part of any developing locality. They are present on all major roadways and in the suburbs too. Every day, streetlights are powered from sunset to sunrise at full strength, even when there is no one around. Throughout the world, millions of dollars are spent each day on these street lights to provide the required electrical energy. The maintenance and replacement costs of conventional incandescent bulbs are immense. They consume a lot of electric power to function and their heat emissions are also quite high. All of this contributes to greater demand of electricity production and consequently, more carbon dioxide emissions from powerhouses. So, along with unnecessary light pollution, this practice causes damage to our planet too. The scope of the project is to provide a “Smart Street Lighting System using IOT” powered with dynamic switching based on detection. We use the word “smart” because the system not only provide power to the street lights but also helps in detecting the direction of movement of the pedestrian/vehicle and helps him by means of illuminating the path of movement till the

near next street light. By integrating the entire street lights with Smart street light system, it is possible to systematically help the pedestrian to reach the destination in the remote rural areas which are facing serious electric power supply problem. The same system can also be used in metropolitan cities as well.

A simple and effective solution to this would be dimming the lights during off peak hours. Whenever presence is detected, the lights around it will glow at the normal (bright) mode. This would save a lot of energy and also reduce cost of operation of the streetlights. We can check the status of street light on internet using IOT (Internet of things) from anywhere in real time and solve the issues if happen during the processing.

According to the requirements the control system will be made to switch on-off the lights at required timings and it is also used to vary the intensity of the street lights. Upon sensing the movement of the vehicles or obstacles the sensor transmit the data to the microcontroller which makes the light to switch ON and OFF when no obstacle is detected. The main idea of this system is to ensure safety and energy consumption.

II. BACKGROUND/RELATED WORKS

The focus is to implement an automated smart street lighting system in an smart city ecosystem to conserve energy and creating a pathway towards global energy conservation. In this system the IR sensor is used for vehicular/pedestrian detection which dynamically detects their presence and change the intensity of the LED's. This gives a solution to the controlling the intensity of the light considering the movement on the road.

The project is designed in order to detect the vehicular movement on the roads to switch ON only a block of the street light ahead of it and switch OFF the trailing light to reduce power consumption. During the night all the lights on the street remain ON but lot of energy is wasted when there is no vehicle movement on the roads. In this mechanism two types of sensors has been used which are light sensor, IR sensor.

Automated Street Light Control Mechanism is not only efficient but also an intelligent technique. Relay uses as an automatic switch in this system. It releases the manual work almost upto 99%. As soon as the sunlight goes under the visible region of our eyes this system automatically switches ON lights. Light Dependent Resistor (LDR) is a type of sensor that performs the above task and

senses the light as our eyes does. As soon as the sunlight comes, visible to our eyes it automatically switches OFF lights.

The IR and LDR sensors sense the persons and light intensity of a particular place and transmits the data. Depend upon the data received the controller will turn ON/OFF the street light in wireless communication. This system is appropriate for street lighting in urban as well as rural and semi-urban areas.

III. LITERATURE SURVEY

The aim of reviewing the components was so that the devices with ability of wireless communication are able to provide data in accordance with the sensors. [4]

Use of LDR and IR sensors helps the micro controller to work in more efficient manner.[13]

A. Arduino Uno

The network coordinator is the main unit of the WSN. [14]It supports the network operation by wireless communication based on the IEEE 802.15.4 standard and the ZigBee specifications. [2] The network coordinator is also responsible for alerting a network operator or an emergency service using the Ethernet network or sending a SMS using a GSM/GPRS modem.*IR and LDR sensors*. [3]

B. IR and LDR sensors.

This paper proposes on smart wireless street light mechanism integrated with latest technologies, that provides easy maintenance and energy saving. By the use of LDR, it is possible to save some more energy and power. It also monitors and controls the street lights using GUI, which shows the status of the street lights or highway lighting systems. [1]

An infrared sensor(IR) is an electronic instrument which is used to sense the surroundings by either emitting or detecting infrared radiation. It is capable of measuring the heat of an object and detecting motions Infrared waves that are not visible to the normal human eye.

C. Internet of Things – system

ARDUINO IDE is a integrated free set used for the development of embedded based applications that works on a Microchip's PIC and ds PIC microcontrollers. It provides a single integrated environment to provide code for embedded micro controllers hence it is called as Integrated Development Environment or IDE. It runs as a 32-bit application on MS Windows which is very easy to use and includes a host of free software components for faster application development system and super-charged debugging. While traversing between tools and upgrading free software simulator to hardware debugging and programming tools are done very quickly because the IDE has the same user interface for each and every tools present. [5]

The street light's ON/OFF status can be accessed from anywhere, anytime based on the real time system through internet. The street light controller is installed on the pole lights along with a ARDUINO microcontroller [6], sensor and communication between the street lights is based on the controller installed on the next pole of the street light. The controller controls the LED street lights. Using Wireless technology, the data from the controller is sent to the nearby base station.

There are a number of street light control mechanisms that has been developed to control and reduce power consumption of a city's public lighting system. These range from controlling of single circuit of street lights or group of lights with specific network operating protocols within an area. [7] These may include sending or receiving set of protocols via separate data networks over an [8] high frequency using the top of the low voltage supply or wireless type. Various set of instructions have been developed and compatible hardware [9] for most types of lightings respectively.

A city is provided with basic infrastructural mechanism for giving a decent quality of life, a sustainable environment through application of some intelligent solutions. [10] It assures water and electricity supply, sanitation and solid waste management in urban mobility. The availability of electricity is an important determinant of the quality of life in human settlements. As factor of electricity is a growing concern, it needs to be managed tactfully and efficiently. In urban areas, as we see that there are wastage of electricity and keeps on increasing day-by-day. [11] On other hand, in case of rural areas there are few areas which are without electricity supply. It is necessary to make a proper management in order to reduce wastage of electricity in urban areas so that it would be helpful in supplying in rural areas. Thus, it makes us choose electricity as an important factor so that its consumption is done efficiently.

Timer is connected with the digital meter. [12] At each point this connection must be done manually to the feeder, as timer requires 12 hour of continuous power supply to light the street lamps at a particular area. In case if there is load sharing and 12 hours power supply is not enough to light the street light then the whole system comes to halt which leads to delay in timings.

IV. PROBLEM STATEMENT

The existing systems consist of manual controls which need constant monitoring and maintenance. Considering the wastage of energy due to manual control many systems have been introduced. These systems are designed in such a manner that they could reduce their intensity and save as much energy as possible. Systems like these use LEDs (Light Emitting Diode) instead of HID (High Intensity Discharge) lamps due to dimming feature. There is a time slot allotted during which the intensity of the system keeps reducing and turns the lights OFF at morning. The time slot starts when it is specified. Reduction of intensity starts gradually at midnight when it is not much dark and there is not much traffic and is switched OFF at 6 in the morning. Some use IR (Infrared Ray) sensors to detect vehicles. Existing systems do overcome the drawbacks of HID based systems, but do not save enough energy as they are time based also in seasons like monsoon the environment remains dark compared to regular days. Winters bring the fog and if the lights are dim it could result into a great accident or disaster. Therefore still some improvements in systems like these are needed. Time slot based systems consider the time slot as an advantage, but it actually is a drawback as it could not work in all conditions. mentioned above it created problems during seasonal changes, it needs to be customized if it is to be implemented in foreign

countries due to time differences. Also, if any, hardware failure or error occurs, it could be expensive to solve it. Thus, another system is needed which overcomes these drawbacks.

V. PROPOSED SYSTEM

We have seen in the number of cities where the street lights is the one of the huge energy expense for a city. Currently we have manual system where the light will be switched ON in the evening before the sunset and they are switched OFF next day morning after there is sufficient light outside. So there is lot of energy waste between ON and OFF timing.

Disadvantages of Existing System

- Manual Switching off/on of Street Lights
- More Energy Consumption.
- High expense.
- More manpower.

Street Light Monitoring & control is an automated system designed to increase the efficiency and accuracy of an industry by automatically timed controlled switching of street lights. This project describes a new economical solution of street light control systems. The control system consists of internet, and control circuitry and the electrical devices. This also includes client server mechanism where user can directly interact with web based application to control the Street light of any place from any where in the world.

Advantages of the Proposed System

- Automatic Switching of Street lights.
- Maintenance Cost Reduction.
- Reduction in CO₂ emission.
- Reduction of light pollution.
- Wireless Communication.
- Energy Saving.
- Reduction of manpower

The system is designed exclusively these purposes.

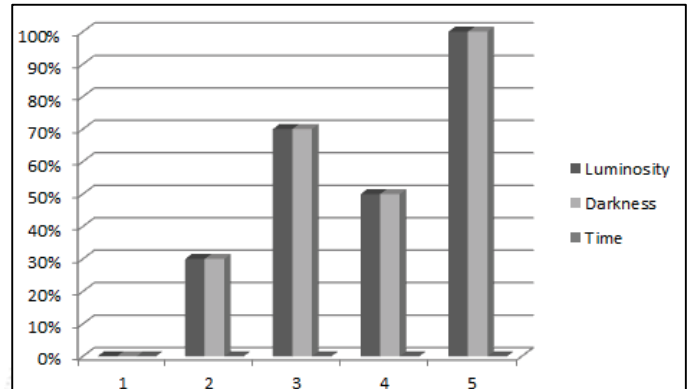
- To provide energy consumption.
- To prevent energy wastage.
- To ensure security to the people, especially to prevent women harassment.
- The above three purposes are implemented by Automatic switching ON and OFF of street lights.
- Panic button is provided at the reachable height of humans.

As soon as the sunlight goes away from the visible region, LDR sensors will trigger the light to switch ON. Street lights communicate with each other through network.

Panic button is fixed at the street light to trigger the

system by raising an alarm signal at the nearby police station.

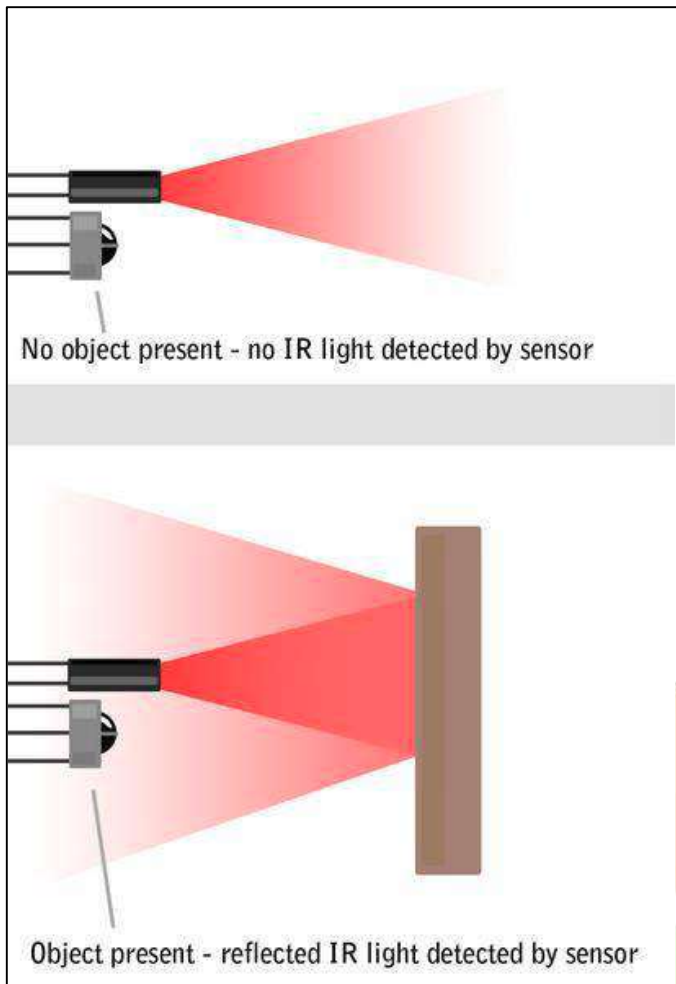
Ip65 camera is installed to capture the entire movements of people moving on the particular street. A Cloud account is maintained to store the footages of camera whenever the panic button is pressed by the people.



Proposed system observation graph

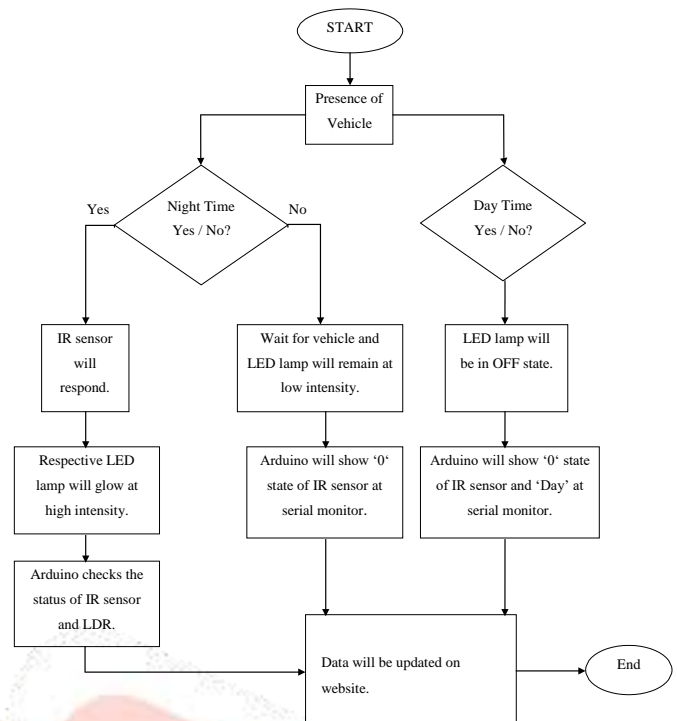
S. No.	Component Name	Price per Component(Rs.)	Quantity	Sub Total
1.	Jumper wires	4.6	50	230
2.	Power LED strip	70	2	140
3.	LM317	10	1	10
4.	LEDs	2	10	20
5.	Resistors	1	20	20
6.	Potentiometer	5	5	25
7.	Diodes	2	3	6
8.	Capacitors	2	2	4
9.	Solar panel	600	1	600
10.	PCB	10	2	20
11.	Male-Female Berg	10	4	40
12.	Arduino Board	600	1	600
13.	ULN2003	15	1	15
14.	ICs Bed	10	4	40
15.	LDR	5	1	5
16.	IR transmitter and Receiver	5	8	40
17.	Op-amp 741	10	4	40
Sub Total				1855

Cost Estimation



Working of IR Sensor

Data flow Diagram



Architecture Diagram



The architecture consist of LED street lights, with IR and LDR sensors which detect vehicles/obstruction and sunlight, based on the conditons of the sunlight, the light will glow in set minimum brightness when there is no sunlight, and as soon as any obstruction such as cars/pedestrians crosses the light will increase its intensity to its maximum luminescence and once the obstruction crosses it will again be back to its minimum luminescence. By this we are achieving the maximum energy conservation by implementing the obstruction detecting smart street lighting system.

VI. FUTURE SCOPE

This system smart street lighting can be further expanded to accommodate digital sign boards, and loudspeakers for the government officials to pass important alerts such as weather updates, severe weather warning, traffic updates, current flash news and other important news. The system can also be used to

identify the speed of vehicles, identification of number plates of the vehicle using image processing techniques.

VII. CONCLUSION

The use of power electronics is increasing exponentially across various sectors of human life. The components used in the project, like Arduino and sensors are slowly becoming an indispensable part of our daily routines. So, it is only fitting that we use them to improve efficiency in every walk of life. Keeping in mind the urgent need for energy conservation, Smart Street Lighting System with IoT is an excellent and effective solution. It combines safe lighting protocols with consumption of minimal amount of power. The energy savings, as discussed before are phenomenal. An additional component which would lead to better functioning of the concept would be the use of LED bulbs. Despite their high initial costs, they are a viable option as they drastically reduce the power consumption. They will aid in further saving of energy and reduction in operational costs. Planned future work will address the performance, the reliability and the security of our network in order to assure a safe operation of the critical infrastructure of street lighting along with the implementation of vehicular detection dynamic street lighting system.

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