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Intelligent Street Lighting System

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Abstract: **The current research work is carried out for designing and executing the advanced development in embedded systems for energy saving of street lights. In India at many places manual street lighting system is installed and taken cared by municipality. Evening before the sunset's street lights are switched ON and switched OFF in the next day morning. Another scenario is automated time setting is also used for street lighting. At few places after midnight all street lights are switched off. These all scenarios ultimately wasted up power.But the actual timing for these lights to be switched ON is when there is absolute darkness and glow only when there is a movement of vehicles or humans. To avoid the problems associated with street lighting system, the fully automated energy efficient system is proposed to perform the ON and OFF operations only when needed. Also the system is intelligent enough to communicate with the municipality office if any maintenance is needed. The proposed system is designed by using Arduino UNO and Bluetooth devices. Light Dependence Resistance (LDR) and Motion Sensors are used for designing the system. The proposed system is successfully fulfilled the designing purpose.**

Keywords **--- Arduino UNO, PIR Sensor, LDR Sensor, Bluetooth.**

I. INTRODUCTION

One challenge that will continue to concern the nation is the rising demand for power. The gap between demand and supply of power will determine the extent to which the government will be able to meet its development objective. The objective of government is investing in more efficient power distribution and optimizes power consumption through use of efficient technology. Debu C [1] published in his article that street lighting is one of the major component of power consumption in India also. He also stated that 18 to 38% of total energy bill goes towards street lighting.

In most cities, the street lights are installed and maintained by municipalities. Most urban and semi-urban cities and towns are still using a combination of fluorescent, CFL, high pressure sodium lamps or metal halide bulbs, which are not designed to meet area-wise lighting needs. Very little study or planning has gone into the illuminance required in different areas of streets, to address the needs of pedestrians and vehicular traffic alike. For instance, the lighting needs of vehicular traffic in high speed zones are different from low-speed high traffic zones. Likewise, lighting needs in road crossings are different from secondary roads. Then again, the lighting requirements of an area with vehicular traffic will vary from that of an area with high pedestrian traffic.

A one-size-fits-all approach to street lighting results in inefficient deployment of power resources and ends up in wasteful use of electricity that could have been better utilized elsewhere. Street light planning is not just about luminosity but also the 'height' of the lighting mast, which in turn varies based on the requirements of that particular area. Due to a lack of 'area-wise' study, standard tenders are issued on a 'city-wise' basis, leading to high operational cost incurred on street lighting. Very often, one notices that the street lights stay on well past sunrise. This is because the lights are switched off based on a predecided time rather than lighting needs, which vary based on season and location of the city. There is a need for devising a well thought out way to prevent wastage of electricity. Perhaps, the government can think of implementing Automatic Street Light Control System using LDR (Light Dependent Resistor), which automatically switches off lights when sunlight fall on it.

In order to keep operational costs down, one sector that needs to be efficiently designed is the electricity generation, distribution and monitoring. In the context of street lighting, the government needs to give special focus on solar power generation (on grid and off grid), use of LED bulbs in street lighting and smart grid monitoring.

To regulate street lighting system and minimize energy consumption the automated street lighting system is needed.

In a 1999 article for the RFID Journal Ashton wrote:

"If we had computers that knew everything there was to know about things—using data they gathered without any help from us -- we would be able to track and count everything, and greatly reduce waste, loss and cost. We would know when things needed replacing, repairing or recalling, and whether they were fresh or past their best. We need to empower computers with their own means of gathering information, so they can see, hear and smell the world for themselves, in all its random glory. RFID and sensor technology enable computers to observe identify and understand the world—without the limitations of human-entered data [3]."

To achieve the above stated objective Internet of Things is the one of the technology

"The Internet of things (IoT) is the network of physical devices, vehicles, and other items embedded with electronics, software, sensors, actuators, and network connectivity which enable these objects to collect and exchange data [2]"

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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.

These devices collect useful data with the help of various existing technologies and then autonomously flow the data between other devices. The quick expansion of Internet-connected objects is also expected to generate large amounts of data from diverse locations, with the consequent necessity for quick aggregation of the data, and an increase in the need to index, store, and process such data more effectively [2].

IoT systems allow users to achieve deeper automation, analysis, and integration within a system. They improve the reach of these areas and their accuracy. IoT utilizes existing and emerging technology for sensing, networking, and robotics [4].

II. LITERATURE REVIEW

Earlier researchers proposed few approaches for the same problems studied as follows. Prof. K. Y. Rajput et. al [5] presented a approach using GSM for intelligent street lighting system which targets energy saving and autonomous operation on economical affordable for street. This system is designed using two LDR sensors one for monitoring day/night status and other monitors the lamp health status. The status data collected on their server through GSM module. Roxana Alexandru et. al [6] studies different approaches of Smart lighting like Variable Lighting, Part Night Lighting and Light Trimming and come up with solution using Motion Detection and Dimming, Wireless communication. Dimming involves adjusting the lighting levels of LEDs such that lower lighting levels are used when there are no pedestrian or cars on the streets. Sindhu. A.M et. al [7] proposed Smart Street light system to reduce the power consumption when there are no vehicle movements on the road using motion detection.

Reinhard Mu¨ llner et. al [8] proposed an energy efficient pedestrian aware Smart Street Lighting (SSL) system for dynamic switching of street lamps. This system able to track pedestrian's location via his/her smart phone and desired safety zones. CO2 emission will be reduced by such systems. The limitation identified about this system is trees like objects interrupt wireless communication between lampposts and another is inaccuracy of global positioning system position detection. Chetna Badgaiyan et. al[9] presented smart street lighting system by using wireless sensor network , pyroelectric infrared sensor(PIR) and Zigbee. PIR is used to detect movement of pedestrian's and vehicle and according to that the intensity of light is adjusted. Street Lights remained less bright if there is no movement. Parkash et. al[10] implemented with smart embedded system which controls the street lights based on detection of vehicles or any other obstacles on the street .Whenever the obstacle is detected on the street within the specified time the light will get automatically ON/OFF according to the obstacle detection and the same information can be accessed through internet. The PIR and LDR sensors sense the persons and light intensity of a particular place and transmits the data in wireless to the EB section with Zigbee. Deepak Kumar Rath [11] proposed LDR based smart street lighting system to automatic On/Off and adjustment of light intensity. Sayali Arkade et. al. [12] proposed the control system consists of a GSM Modem, and control circuitry and the electrical devices. Base server can control the whole city's street lights by just sending an SMS to GSM network. Soledad Escolar et. al [13] presents an intelligent street light control system that enables multiphase light sources to adapt their intensity to the environment conditions. They designed an adaptive behavior for the control devices attached to the lampposts in smart cities scenarios; as a result the lampposts dynamically adapt to the presence (or absence) of obstacles and environment light in their vicinity. They compared the estimate of their system with nonadaptive systems and found that their system saves above 35% energy. Samir A. Elsagheer Mohamed [14] proposed a energy saving and Vehicular Ad-Hoc Networks (VANET) make it possible to propose such system. VANET enables the possibility to know the presence of vehicles, their locations, their directions and their speeds in real time.

The review of literature suggested few gaps in the earlier system like only motion detection or day/night light conditions are used to solve the problem alone. Only movement detection not works because movement's detection is possible in day light also. Similarly only nature light detection also not sufficient because the lights may ON for whole night. The current problem needs multiple conditions to take in account. The street lights must be ON only when there is Dark (night) and when the movements are detected on road. Hence the new solution is proposed here to make the system more capable.

"To design a self regulatory and energy efficient intelligent lighting system, which is self capable to identify the nature light conditions and moving objects also can communicate about light health status to operator"

III. PROPOSED METHODOLOGY

The proposed system is designed by using two LDR (Light Dependent resistance) one to detect the nature light conditions and another to check lamp health status. One PIR (Motion Sensor) is used to detect the movements of objects (vehicles or

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humans) on road. Bluetooth device is used to communicate the status of the system. Also system is able to send the SMS to the operator about street light maintenance. Components required to designing system are Arduino Board, Bread Board, Jumper Wires, LDR Sensor, PIR(Motion Detection Sensor) and Bluetooth. The system work flow chart is as shown in following Fig 1.

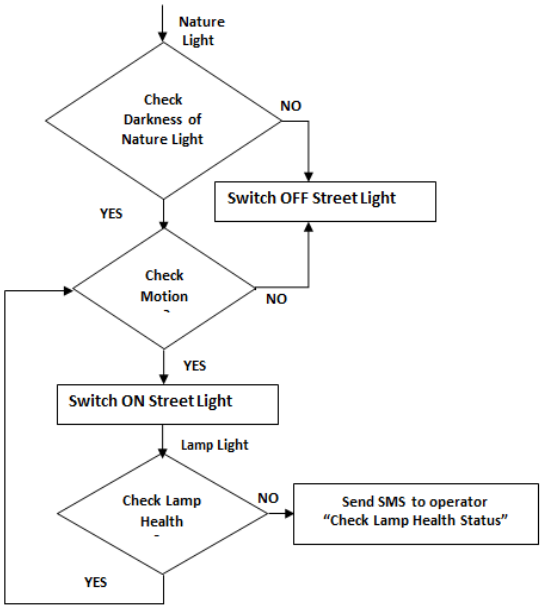


Figure 1: System flowchart

IV. RESULT AND DISCUSSION

In this section the step by step working of project is shown and discussed. By using the above components the circuit is designed. The program is written using Arduino IDE including the conditions shown in system flowchart.

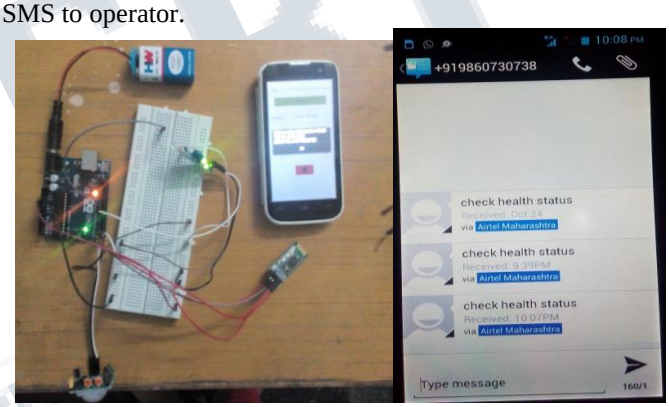
If there is Light and no movement detected or if there is light and movement detected or If there is Dark and no movement detected then LED is in Switched OFF condition. The designed circuit diagram is shown in Fig 2.

Figure 2: The working of system when no dark and no movement or movement

If there is Dark and Movement detected then the LED is in Switched ON condition. As shown in Fig 3.

Figure 3: The working of system when dark and movement

If LED is in Switched ON and No Light Detected then Send SMS to operator.



(a) *(b)*

Figure 4: SMS sent by the system

The proposed system is able to operate the street light automatically in night when there is movement found on road. The proposed system uses Bluetooth to connect with smart phone so that the status of the light can be sent to the operator for maintenance. Using BlueAct app system automatically generates the SMS to the numbers added in app.

V. CONCLUSION AND FUTURE WORK

The current system is able to satisfy the designing goal by verifying nature light conditions and motion detection. The system sends the auto generated text message to operator if the particular street light is not working. The current system does not need to make database storage. Hence no internet connectivity required. This work will be extended to to

measure the amount of energy consumed by each light using network connectivity.

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