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Intelligent Energy Efficient Street Lighting System - A Review

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Abstract: Now days of advancing technology, street lights are the most needed requirement for a common man to commute. Street lights provide safety while a person is walking on the road. While they help a person to safely reach the destination the lights will be ON and it can be turned OFF in a smart way when there are nobody using it Currently, in the whole world, enormous electric energy is consumed by the street lights .Monitoring of street lights and controlling is of utmost importance in developing country like India to reduce the power consumption. This paper presents a street light control system which combines various technologies: a timer, Liquid Crystal Display (LCD), a statistics of traffic flow magnitude, a photosensitive detector (LDR), infrared photoelectric control, Light Emitting Diodes (LED), power transistors, dual relays, and wireless communication, (ZigBee). intelligent streetlight energy-saving system based on power line communication technology with RTOS. Automatic Street Light Control System Using Microcontroller, Intelligent Management of Street Lights using Internet of Things and Power Management.

Keywords: LED, Street Light Microcontroller, IOT, Zigbee)

I. INTRODUCTION

The World's population has been increasing rapidly in the cities over the past few decades. Intelligent and sustainable development therefore plays an important role in the development of a city and towns. The Street lighting system is available in all public roads and streets as a conventional service. If the street lamp posts are furnished with sensors and communication technologies, various services are enabled and it makes them IoT-based. Installation of an IoT based system to all Lamp posts is though costly, the paybacks of them are often not clear and they have to be quantified completely. Therefore, an IoT augmented Lamp Posts are very highly necessary in municipalities, townships, and cities for the development of new Smart cities and towns in this new era [4]. Automation, Power consumption and Cost Effectiveness are the important considerations in the present field of electronics and electrical related technologies. Industry of street lighting systems are growing rapidly and going to complex with rapid growth of industry and cities. To control and maintain complex street lighting system more economically, various street light control systems are developed. These systems are developed to control and reduce energy consumption of a town's public lighting system using different technologies. These range from controlling a circuit of street lights and/or individual lights with specific ballasts and network operating protocols. They may include sending and receiving instructions via separate data networks, at high frequency over the top of the low voltage supply or wireless. Various protocols have been developed as well as compatible hardware for most types of lighting. A multi-functional street light control system, which is more electricity conserving and convenient [1]. One more system is the intelligent streetlight energy saving system based on PLC (Power Line Communication) Technology and RTOS [2]. From PC, controlling the Street Lights through microcontroller via PLC. Microcontroller will be placed in each street light. ON & OFF signal for each Street light will be given from PC. The street lights has been successfully controlled by microcontroller. With commands from the controller the lights will be ON in the places of the movement when it's dark. furthermore, the drawback of the street light system using timer controller has been overcome, where the system depends on photoelectric sensor. Finally, this control circuit can be used in a long roadway between the cities [3].

II TRAFFIC FLOW BASED STREET LIGHT CONTROL SYSTEM

A street light control system which combines various technologies: a timer, Liquid Crystal Display (LCD), a statistics of traffic flow magnitude, a photosensitive detector (LDR), infrared photoelectric control, Light Emitting Diodes (LED), power transistors, dual relays and wireless communication (ZigBee). This system contains light sensor to observe the day and night detection to turn lamps on, merely during night time. It also includes infrared detectors to turn light on automatically when vehicles, pedestrians pass by, later turn off after a certain predefined delay for even more energy conserving. This system also includes fault detection and feedback circuit to indicate the present state of the control system. The intact information regarding these various aspects is transferred to nearby control terminal (base station) by

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using ZigBee communication to visualize the state of the system by creation of Graphical User Interface (GUI) there. It allows substantial energy savings with increased performance and maintainability.

This proposed system utilizes the latest technology for the sources of light as LED Lamps instead of generally used street lamps such as High-pressure Sodium Lamps, etc. The LED technology is preferred as it offers several advantages over other traditional technologies like energy saving due to high current luminous efficiency, low maintenance cost, high color rendering index, rapid startup speed, long working life etc. This proposed system makes use of infrared photoelectric sensor (G12-3C3PA) for vehicle detection. [1]

Street Light Automatic Control Methodology

The street light control system adopts a dynamic control methodology. According to this, the initial state of the lights is set as off. Street light schematic is shown in Figure 1 and control flow in Figure 2. When the signal is detected at the point S, the state of lamp A switched (On to Off or Off to On), when the signal gets detected at the point B, the states of lamp A and lamp C are switched on or off simultaneously, while point D detects the signal, lamp C and lamp E are switched on or off simultaneously, while S' detects the signal, lamp E is switched on or off. Figure 4: Streetlights schematic Figure 5: The control flow chart [1]

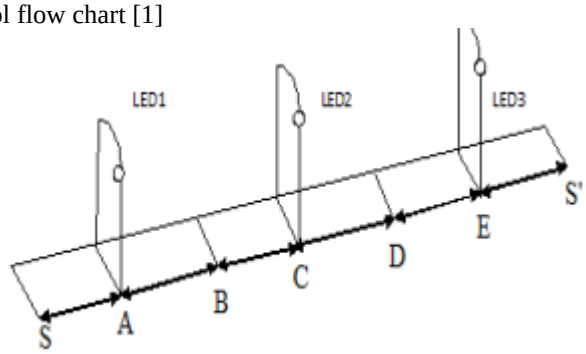

Fig:1 Street light schematic [1]

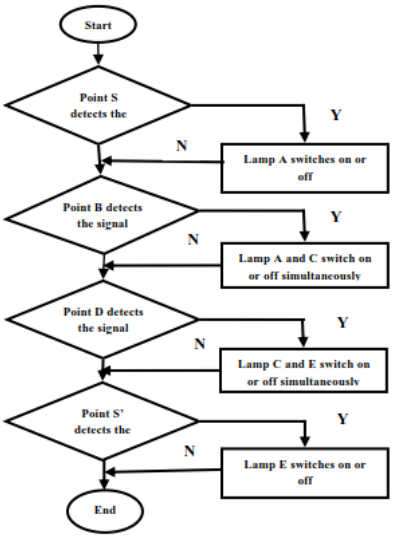

Fig:2 The control flow chart [1]

III INTELLIGENT STREETLIGHT ENERGY-SAVING SYSTEM BASED ON POWER LINE COMMUNICATION TECHNOLOGY WITH RTOS

Lighting systems, especially in the public sector, are still designed according to the old standards of reliability and they often do not take advantage of the latest technological developments. The proposed remote control systems can optimize management and efficiency of street lighting. It uses power line Communication device which enable more efficient street lamp-system management..

The system compromises of server, GUI to display and nodes which are micro controlled processed with embedded sensors measuring different parameters. Each node in the network is linked to the main server via a protocol. The analog data sensed by the sensor is converted in digital form, processed by microcontroller and then sent to the server.

The master controls all the slaves .The other nodes sends the data to master and the master collects the data and further sends to concentrator and ser ver where the data is monitored and on necessary alterations process it to switch On/Off the nodes devices. This scenario increases life of streetlights, reduces power consumption, ease of monitoring and controlling and less installation cost are the various
advantages achieved.[2]

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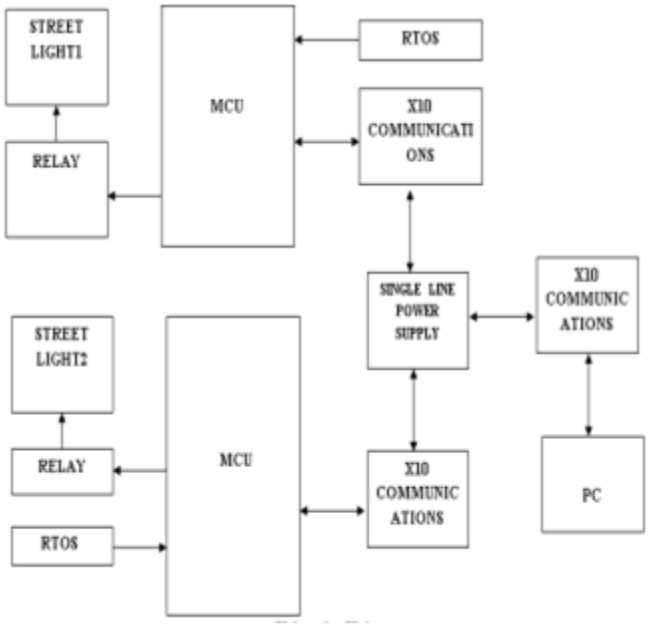

Fig:3 Block Diagram [2]

IV AUTOMATIC STREET LIGHT CONTROL SYSTEM USING MICROCONTROLLER

The present system is like, the street 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 roads. this paper gives the best solution for electrical power wastage. Also the manual operation of the lighting system is completely eliminated. In this paper the two sensors are used which are Light Dependent Resistor LDR sensor to indicate a day/night time and the photoelectric sensors to detect the movement on the street. the microcontroller PIC16F877A is used as brain to control the street light system, where the programming language used for developing the software to the microcontroller is C-language. Finally, the system has been successfully designed and implemented as prototype system.

In this paper two kinds of sensors will be used which are light sensor and photoelectric sensor. The light sensor will detect darkness to activate the ON/OFF switch, so the streetlights will be ready to turn on and the photoelectric sensor will detect movement to activate the streetlights. LDR, which varies according to the amount of light falling on its surface, this gives an inductions for whether it is a day-night time, the photoelectric sensors are placed on the side of the road, which can be controlled by microcontroller PIC16f877A. The photoelectric will be activated only on the night time. 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.

The block diagram of street light system as shown in Fig. 4 consists of microcontroller, LDR, and photoelectric sensor. By using the LDR we can operate the lights, i.e. when the light is available then it will be in the OFF state and when it is dark the light will be in ON state, it means LDR is inversely proportional to light. When the light falls on the LDR it sends the commands to the microcontroller that it should be in the OFF state then it switch OFF the light, the photoelectric sensor will be used to turn ON or OFF the light according to the presence or absent of the object. All these commands are sent to the controller then according to that the device operates. We use a relay to act as an ON/OFF switch. [3]

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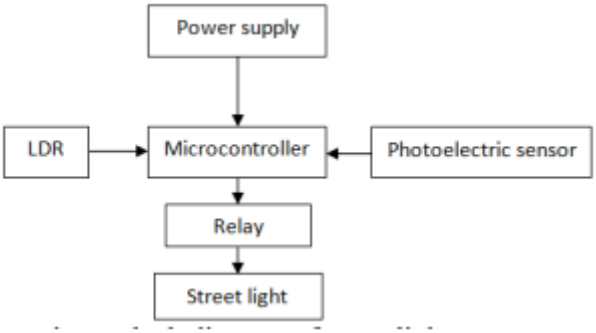

Fig:4 Block diagram of Street light system [3]

V Intelligent Management of Street Lights using Internet of Things and Power Management

Street lights serve as an important light source for a person to reach the destination mainly while walking . To increase the efficiency of these street lights, they can be turned OFF when they are not being us ed. This is the best way to save energy. When energy is saved, cos t will be automatically reduced. Since the street lights are under control of local municipal or corporation authorities , there is necessity for them to track the activities in real time. Whenever there are any suspicious activities , the governing authorities can be immediately informed s o that necessary actions can be taken. Also, at any point of time if a device has a defect or is not functioning as expected, then the governing body will immediately be informed so that it can be fixed soon.

Proposed methodology

The proposed methodology introduces the concept of central station and sub stations within them. A street might have approximately 6-7 street lights. All these lights will be linked to a substation. Similarly, several substations will be linked to the main station. The number of lights to be linked to a substation and number of sub stations to be linked to a main station is purely dependent on the amount of load each can handle and frequency of us age. The proposed concept here is that the solar energy that is tapped from each solar panel will be sent to the central station where the energy gets stored. Hence, the central station acts as the main storage area from where power will be supplied to each substation when required. This helps save energy since power will be supplied only when needed thereby ensuring equal and proportionate distribution of power. [4]

Figure 5 shows the conceptual block diagram of power distribution setup that is proposed. As shown, the solar energy that is captured by the street lights will be directly sent to the
main station through the substation. The required power for the lights and substations to operate will directly come from the main station.[4]

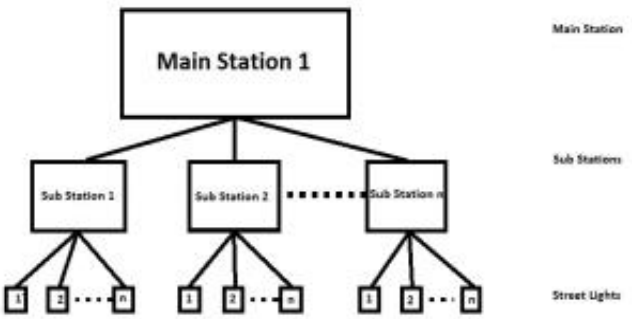

Figure:5 Conceptual Block Diagram for Power Distribution[4]

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VI CONCLUSION

In this paper discussed about various Intelligent Energy Efficient Street Lighting System. In first method the Traffic Flow based Street Light Control System is power saving mechanism for street lights by using LED lamps as replacement of normal lamps and using special power savings mechanism for microcontroller and ZigBee modules. It turns out most reliable and time efficient way to switch ON/OFF street-lights. It provides an effective measure to save energy by preventing unnecessary wastage of electricity, caused due to manual switching or lighting of street-lights when it is not required. In second method describes a new intelligent street lighting system which integrates new technologies available on the market to offer higher efficiency and considerable savings. The result of the project is to develop Intelligent street light energy saving system at street light using power line communication and RTOS through microcontroller via PLC. The street lights has been successfully controlled by microcontroller discussed in third method. With commands from the controller the lights will be ON in the places of the movement when it's dark. furthermore, the drawback of the street light system using timer controller has been overcome, where the system depends on photoelectric sensor. Finally, this control circuit can be used in a long roadway between the cities. In last method the introduction of GSM shield to provide real time defect or s tatus change notification to the governing bodies not only helps in bug tracking and fast resolution of the issue but also helps to develop a safe maintenance for the members of the society. Street-lights are a large consumer of energy for cities, using up to 50 percent of a city's energy budget. If every city installs the proposed system then a lot of power can be saved.

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