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IoT Based Smart Street Light System

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ABSTRACT

Today, street lighting commonly uses high-intensity discharge lamps, often HPS (High Pressure Sodium lamps).Globally 70% of all electricity is generated by burning fossil fuels, a source of air pollution and greenhouse gases, and also globally there are approximately 300 million street lights using that electricity. Almost all of those lights are controlled manually. The cost spent is so huge that all the sodium vapour lamps consume more power. The street light is one of the huge expenses in a city. Currently a manual system is used where the light will be made to switched ON/OFF i.e. the light will made to be switched ON in the evening and switched OFF in the morning. Hence there is a lot of energy wastage between the ON/OFF. Existing street light system suffers from the problems like inefficiency, power wastage and other cumbersome maintenance issues facility. Faulty street lights can also be reason for crimes on roads and highways. The substantial scope of this new system provides dimming and on-site status check system is a perfect solution for total global electricity conservation. Intelligent Street light control system can switch lights reasonably, regulates voltage according to degrees of shine and runs in lower voltage in night .As a result, it saves electricity costs largely, prolongs the service life of street lamps and equipments, and saves labour costs of maintenance and materials significantly. Street light control and management system is made up of the network systems to report the status of the system.

Keywords: Fossil Fuels, Electricity Conservation, Inefficiency, Street Light, Power Wastage and IoT.

1. INTRODUCTION

We use intelligent instruments in every part of our lives. This project is on IoT Based Intelligent Street light Monitoring System. The street light is one of the huge expenses in a city. Currently a manual system is used where the light will be made to switched ON/OFF i.e., the light will made to be switched ON in the evening and switched OFF in the morning. Hence there is a lot of energy wastage between the ON/OFF. The main purpose of designing this project is to prevent loss of energy unnecessarily and to reduce maintenance costs.

Today, road lighting ordinarily utilizes high-force release lights, regularly HPS (High Pressure Sodium lamps).Globally 70% of all power is produced by consuming non-renewable energy sources, a wellspring of air contamination and ozone depleting substances, and furthermore comprehensively there are around 300 million road lights utilizing that electricity. Almost those lights are controlled manually. The taken a toll spent is huge to the point that all the sodium vapor lights devour more power..

The inspiration for this project was obtained from the shortage of power in an ever increasing power demand scenario in India. Relevant questions such as, “What can be done in order to reduce the deficit of power?” “Is setting up of more power plants the only solution for the problem?” “Do DSM and other power management techniques provide lasting results?” “Or is it sensible and feasible to set up an autonomous system that can manage its own power consumption?” cropped up. Though there are several power management techniques such as smart grid technology, home automation technology, that are in place to reduce wastage of power, it was intriguing to find out that there is no such system in place for street lights which are switched on for almost 12hrs or more daily.

Though there is an automatic switching facility to switch on the street lights at dusk and switch off at dawn, it is more of a convenience than an effort to reduce power wastage.

The substantial scope of this new system provides dimming and on-site status check system is a perfect solution for total global electricity conservation. Intelligent Street light control system can switch lights reasonably, regulates voltage according to degrees of shine and runs in lower voltage in night .As a result, it saves electricity costs largely, prolongs the service life of street lamps and equipments, and saves labour costs of maintenance and materials significantly. Street light control and management system is made up of the network systems to report the status of the system.

2. LITERATURE REVIEW

The base paper of this project is 'IoT based smart and adaptive lighting in street lights' published by IEEE journal in 2017[1]. Their system is mainly used for smart and weather adaptive lighting in street lights. The project is implemented with smart embedded system that controls the street light based on detection of sunlight. During the night time the street light gets automatically OFF. The ON/OFF can be accessed anywhere anytime through internet. A camera is placed on top of the street light to track the actions performed on the road where the foot-ages are stored in a server. In addition to this, a panic button is placed on the pole, in-case of any emergency or danger, the person in danger can press this button which raises an alarm at the nearby police station. Whenever the panic button is pressed, the footage at that time recorded by the camera is sent directly to the cloud account. The access of the account is given to the particular police station by which they can view the incident's spot. Each area's street lights are connected to the particular area's police station and each of them has a cloud accessible account. The manual operation using GSM technology is completely eliminated. Thus the system is mainly designed to ensure safety and to prevent energy wastage.

Another venture done in view of this subject is 'Shrewd Street Light System in light of Image Processing' distributed by 2016 International Conference on Circuit, Power and Computing Technologies [ICCPCT][2].Their article presents road light framework, the idea to support vitality effectiveness of a city. These days, individuals are excessively occupied, and unfit, making it impossible to discover time even to turn OFF the lights at whatever point not required. The framework works like, the road lights are changed to ON state in the night prior to the sun sets and they are turned OFF following day morning after there is sufficient light on the streets. This paper gives a standout amongst other answer for diminishing the vitality utilization. This framework identify vehicle development/human nearness on express ways to switch ON just a piece of road lights in front of it and to turn OFF the trailing lights keeping in mind the end goal to diminish utilization of vitality. This is accomplished by handling the picture of moving toward question and after that sending control message to the road light piece. Extra appealing highlights of the framework utilizing reasonable sensors for identifying the fizzled road light and afterward sending a SMS to the control expert by means of GSM modem for suitable activity are likewise included. Smart road light is actualized such that it enlightens vehicle when there is a nearness of human or vehicle. Camera which is set in the main road

light will catch the picture from the road and process the picture. At the point when there is any vehicle or human is discovered, the light which is closer to that protest will gleam and the remaining will be off. Sensors additionally actualized to check the ecological conditions there will be gas sensor, temperature sensor, and LDR sensor. On the off chance that the sensor esteem is genuine message will be send to the comparing control station.

Another paper related to this project was 'Low Power Consumption of LED Street Light Based on Smart Control System' published IEEE journal 2016 for 2016 International Conference on Global Trends in Signal Processing, Information Computing and Communication[3].In this paper, they have proposed low power consumption LED Street light based on smart control system. In this system we used sensor to measure sun light intensity, day / night condition and traffic on a road. The intensity of LED Street light varies with these parameters. We have used two sensors that are LDR (light depending resistor) sensor and motion sensor. LDR sensor is used to control the switching action of LED street lights depending on sunlight condition. Motion sensor is used to change the intensity of LED light, when there is no motion of object at mid night on street then all the street lights are dimmed, to reduce the power consumption. In this paper proposed state of art system which consists of PIC 18F4550 micro controller, LDR sensor, motion sensor, LED driver and Computer. The switching action of system is depending on sun light intensity. It is controlled by using LDR, i.e. when there is sufficient sunshine in atmosphere then LDR resistance minimum and when there is dark, the LDR resistance will be maximum. The threshold value of resistance can be set any value as per user requirement. This value sends to micro controller to switching LED lights on/off. At mid night, there is very less traffic on road so there is no need of LED lights with full intensity light. To detect motion of the object on a road, we have used motion sensor. It will sense the motion of object within the range of seven meters. If there is no motion of object on a road within user defined time then light intensity will decrease to minimum value using PWM (Pulse width Modulation) pulse. If any motion of an object detected on a road then it will sends a signal to the micro controller and micro controller generate PWM pulse to give LED lights with full intensity. Besides the automation, this paper also provides a secondary control by PC through UART. By a PC, user can control the switching as well as control the intensity of LED street lights. In this system, user can provide intensity level at which LED light will be glow. As per intensity level provided by user this signals received by micro controller, micro controller generates the PWM of desired duty cycle and gives the output to LED driver circuit. This driver circuit has four output channels. As per PWM signal received from micro controller, driver circuit adjusts the current of all the four output channels simultaneously.

The paper 'ZigBee Wireless Communication for Monitoring Renewable Street Light System' published in 2014 IEEE journal gives more information that are needed while designing this project [4]. The proposal here is to design a smart street light system (SSL) which uses solar power supply to operate the controller, the communication module and to charge storage battery during day time. The charged battery will be used to operate at night. Therefore the system is independent from electric power source. An automation control is required to establish the functions of this system. The software at remote server is used for logging the light intensity obtained from the lamppost via the ZigBee module. The bidirectional communication established between the remote server and the

lamppost enables the maintenance effectiveness of the smart street light. The RMI will ease the maintenance process of the smart street light over remote monitoring. The system can be improved with employing an image processing method to extract image for evaluation purposes.

Another paper we referred for this project is 'Measurement and Fault Detection in Intelligent Wireless System using Wireless Devices' published by International Conference on Communication and Signal Processing, April 6-8, 2016, India in IEEE journal 2016 [5]. They proposed method that uses the ZigBee technology for communication and positioning through IOT. The proposed method utilizes the hardware and software, which removes the manual monitoring for FSL system. This system consists of two units. They are, 1. Hitch hiker 2. Fault sensing unit In this implementation fault sensing unit has been installed in one street light and hitch hiker has been implemented in vehicle. The hitch hiker unit receives information about street light intensity and working condition. Simply the fault sensing detects the intensity level of the street light and it detects the fault used to communicate with the hitch hiker which is used to transmit the data with location of faulty street light. The hitch hiker is placed on the common vehicle like taxi or government buses. When the vehicle goes near the street light, the sensed current value, voltage value and the intensity level with address will be sensed by the hitch hiker and it transmits the status to the remote data centre through Wi-Fi. The collected data will be send as a mail to the registered mail id with the regular time interval. The particular person will monitor the mail and send the person to the particular location, when the defect is noticed. This will save the time of detecting the error and the accidents that occurs because of the delay.

3. PROPOSED METHODOLOGY

The reason for this task is to create road lights that will sparkle naturally when human and vehicle developments are detected. Road light are exchanged on relying upon the force of the daylight. It will shine naturally when there is activity. This framework controls the road lights utilizing light ward resistor, PIR sensor and IR sensors. Road lights are exchanged on relying upon the power of the Sun light on LDR. The controller checks top time amid which there is no movement and turn OFF the lights. At the point when there is any vehicle or human out and about, it is identified by the PIR sensor and IR sensors. At whatever point people or vehicles are detected by the PIR sensor inside its range it shows the Raspberry pi 3 to switch the comparing the road light. At that point lights are exchanged on for 2 to 3 minutes and turned off consequently. Additionally, at whatever point people or vehicles cut the infra-red sensors, it demonstrates the Raspberry pi 3 to switch the relating road light. At that point lights are exchanged on for 2 to 3 minutes and turned off automatically. The light will be switches on till the vehicle cuts the following IR sensors.

1.Sensor block
2.Control block
3.Lighting block

3.1 Sensor block

Sensor block is a block consisting of a PIR motion sensor. A PIR-based motion detector is used to sense movement of people, animals, or other objects. They are commonly used in burglar alarms and automatically-activated lighting systems. They are commonly called simply "PIR", or sometimes "PID", for "passive infra red detector".

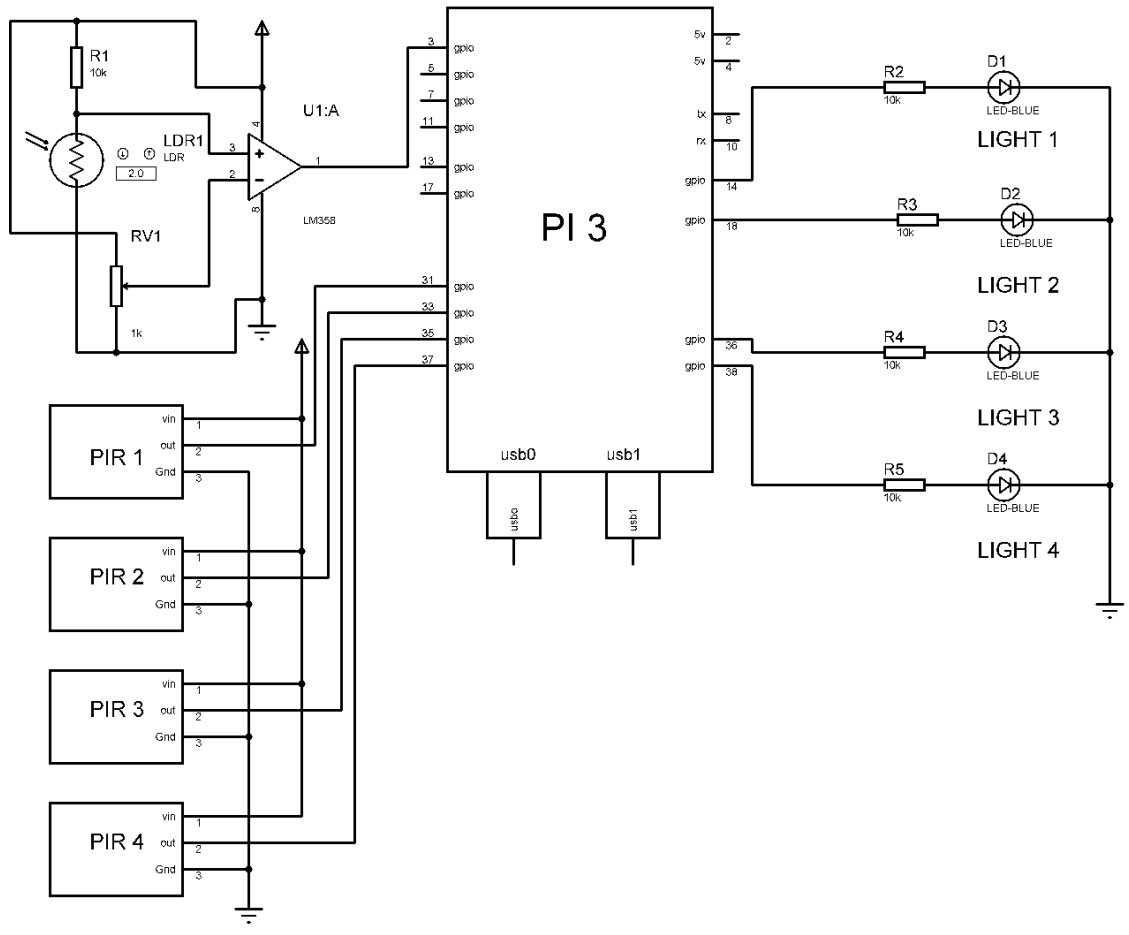
3.2 Control block

The control block consists of Raspberry pi 3 unit. Raspberry pi 3 interprets the inputs from the sensor and sends out control signals to the LED driver in the Lighting Block.

3.3 Lighting block

Lighting piece comprises of a variety of LEDs for lighting, and a LED driver. A light-transmitting diode (LED) is a two-lead semiconductor light source. It is a p– n intersection diode, which discharges light when actuated. At the point when a reasonable voltage is connected to the leads, electrons can recombine with electron openings inside the gadget, discharging vitality as photons. This impact is called electro iridescence, and the shade of the light (comparing to the vitality of the photon) is controlled by the vitality band hole of the semiconductor.

3.4 Circuit Diagram



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The LDR circuit checks for if it is dark or not. The circuit for the lights is turned on when it is dark and turned off when there is enough light. During the dark hours if the power consumption goes over a maximum unit of power i.e, if the lights are in ON state for more than a certain period of time a warning message is sent to the control station over internet to turn the power saving mode on. The control station then sends a signal to the control unit to turn ON the power saving mode. The PIR sensors controls the light from here on. All the lights are turned OFF until a PIR sensor detects a movement. The output of the PIR sensor is given to the Raspberry pi 3 board along with the output of LDR and output of IR receiver. When light is absent, the street light is expected to be turned off. When the PIR sensor detects a movement of either a person or a vehicle, it sends a signal to the Raspberry pi 3unit.When vehicles cut the IR rays, it is sensed by the IR sensors and the signal sent to the Raspberry pi 3 through the IR receivers. Thus the signal is sent from the board to the light controlling system. As a result, the lights will be turned on whenever there is a movement and keeps glowing for certain fixed time and then turned off until another movement is being detected. At the same time reports on all usage data are sent to the server located at control rooms over IoT to ensure the efficiency of the system and to rectify faults immediately.

4. HARDWARE SPECIFICATION

4.1 Raspberry pi 3

The Raspberry Pi is a progression of little single-board PCs created in the United Kingdom by the Raspberry Pi Foundation to advance the educating of essential software engineering in schools and in creating nations. The first model wound up much more famous than expected, offering outside of its objective market for utilizations, for example, mechanical technology. Peripherals (counting consoles, mice and cases) are excluded with the Raspberry Pi. A few embellishments however have been incorporated into a few official and informal bundles.All models highlight a Broadcom framework on a chip (SoC), which incorporates an ARM perfect focal preparing unit (CPU) and an on-chip illustrations handling unit (GPU, a Video Core IV). CPU speed ranges from 700 MHz to 1.2 GHz for the Pi 3 and on board memory go from 256 MB to 1 GB RAM. Secure Digital (SD) cards are utilized to store the working framework and program memory in either the SDHC or Micro SDHC sizes. Most sheets have in the vicinity of one and four USB openings, HDMI and composite video yield, and a 3.5 mm phono jack for sound. Lower level yield is given by various GPIO pins which bolster regular conventions like I²C. The B-models have a 8P8C Ethernet port and the Pi 3 and Pi Zero W have on board Wi-Fi 802.11n and Bluetooth.

4.2 PIR Motion Sensor Module

Minimal and finish, simple to utilize Pyroelectric Infrared (PIR) Sensor Module for human body discovery. Consolidating a Fresnel focal point and movement recognition circuit. High affectability and low commotion. Yield is a standard 5V dynamic low yield flag. Module gives an improved circuit that will distinguish movement up to 6 meters away and can be utilized as a part of robber alerts and access control frameworks. Cheap and simple to utilize, it's optimal for alert frameworks, movement actuated lighting, occasion props, and mechanical autonomy applications. The Output can be associated with microcontroller stick straightforwardly to screen flag or an associated with transistor to drive DC loads like a ringer, signal, siren, transfer, opto-coupler (e.g. PC817,

MOC3021), and so forth. The PIR sensor and Fresnel focal point are fitted onto the PCB. This empowers the board to be mounted inside a case with the distinguishing focal point distending outwards.

4.3 LM358

The LM358 is a low power dual operational amplifier integrated circuit originally introduced by National Semiconductor. It is used in detector circuits. The abbreviation LM358 indicates an 8-pin integrated circuit, comprising two operational amplifiers at low power. The LM358 is designed for general use as amplifiers, high-pass filters, low band pass filters, and analog adders.

The LM358 is now an industry-standard part manufactured by several companies. These devices consist of two independent, high-gain, frequency-compensated operational amplifiers designed to operate from a single supply over a wide range of voltages. Operation from split supplies also is possible if the difference between the two supplies is 3 V to 32 V (3 V to 26 V for the LM2904), and VCC is at least 1.5 V more positive than the input common-mode voltage. The low supply-current drain is independent of the magnitude of the supply voltage. Applications include transducer amplifiers, dc amplification blocks, and all the conventional operational amplifier circuits that now can be implemented more easily in single-supply-voltage systems. For example, these devices can be operated directly from the standard 5-V supply used in digital systems and easily can provide the required interface electronics without additional ±5-V supplies.

4.4 LDRs

A photo resistor (or light-dependent resistor, LDR, or photocell) is a light-controlled variable resistor. The resistance of a photo resistor decreases with increasing incident light intensity; in other words, it exhibits photo conductivity. A photo resistor can be applied in light-sensitive detector circuits, and light- and dark-activated switching circuits.

5. SIMULATION RESULTS AND HARDWARE IMPLEMENTATION

This system has been verified with the simulation results, which makes sure the performance of the circuit and components. This method has been implemented in real time. The performance of this system has been measured and analysed. In real time implementation, the control unit can communicate with the control station to intelligently switch between the two power modes available as required to save energy. The total time of running, power consumed, total time in power saving mode, total power consumed, and total power consumed during power saving mode can be calculated using the data collected at the control station.

The project here is to design a smart street light system (SSL).An automation control is required to establish the functions of this system. The software at remote server is used for logging the necessary information about power consumption and other details. The bidirectional communication established between the remote server and the lamppost enables the maintenance effectiveness of the smart street light.

6. CONCLUSION

The project is named as 'IoT Based Smart Street Light System'. Generally, street lights are switched on for whole night and during the day, they are switched off. But during the night time, street lights are not necessary if there is no traffic. Saving of this energy is very important factor these days as energy resources are getting reduced day by day.

The substantial scope of this new system provides dimming and on-site status check system is a perfect solution for total global electricity conservation. Intelligent Street light control system can switch lights reasonably, regulates voltage according to degrees of shine and runs in lower voltage in night .As a result, it saves electricity costs largely, prolongs the service life of street lamps and equipments, and saves labour costs of maintenance and materials significantly. Street light control and management system is made up of the network systems to report the status of the system.

The main aim of this project is to save the power. This can be used in long roadways between cities. Here we are saving lot of power without any wastage by this advanced technology we can design many more systems. This project encourages energy proficiency and use of new and renewable energy source in the transport.

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