Internet Of Things Based Intelligent Street Lighting System for Smart City

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Internet of Things Based Intelligent Street Lighting System for Smart City

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ABSTRACT: This project aims for designing and executing the advanced development in embedded systems for energy saving of street lights. Currently we have a manual system where the street lights will be switched ON in the evening before the sunsets and they are switched OFF in the next day morning after there is sufficient light on the outside[1]. But the actual timing for these lights to be switched ON is when there is absolute darkness. With this, the power will be wasted up to some extent. This project gives solution for electrical power wastage [2]. Also the manual operation of the lighting system is completely eliminated. The proposed system provide a solution for energy saving. This is achieved by sensing and approaching a vehicle using an IR transmitter and IR Receiver couple. Upon sensing the movement the sensor transmit the data to the microcontroller which furthermore the Light to switch ON [4]. Similarly as soon as the vehicle or an obstacle goes away the Light gets switched OFF as the sensor sense any object at the same time the status(ON/OFF) of the street light can be accessed from anywhere and anytime through internet. This project is 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 real time information of the street light(ON/OFF Status) can be accessed from anytime, anywhere through internet.

KEYWORDS: PIC Microcontroller, IR Sensor, Current Sensor, LDR, Intel Galileo Gen2.

I. INTRODUCTION

The street lighting is one of the largest energy expenses for a city. An intelligent street lighting system can cut municipal street lighting costs as much as 50% - 70%. An intelligent street lighting system is a system that adjusts light output based on usage and occupancy, i.e., automating classification of pedestrian versus cyclist, versus automotive. An intelligent street light management proposes the installation of the wireless based system to remotely track and control the actual energy consumption of the street lights and take appropriate energy consumption reduction measures through power conditioning and control [3].

The street light controller should be installed on the pole lights which consist of microcontroller along with various sensor and wireless module. The street light controller installed on the street light pole will control LED street lighting depending on traffic flow, communicate data between each street light. The data from the street light controller can be transferred to base station using wireless technology to monitor the system [5]. The mode of operation of the system can be conducted using auto mode and manual mode. The control system will switch on-off the lights at required timings and can also vary the intensity of the street light according to requirement.

II. RELETED WORK

In [1] the paper describes about the circuit that switches the street light ON detecting the vehicle movement and remains OFF after the fixed time. In this system the street light automatically ON/OFF during the night and the day time. In this

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system the GSM technology has been used in which the manual switching OFF/ON of the street light using GSM. Here the system controls the intensity of the street light by dimming and brightness the intensity on the detection of any object using PIR sensor.
In [2] this paper is focused on the necessity of the automated street light system and the peculiar way of implementation with embedded system tools. In this system the piezo electric sensor is used to detect the movement of the object on the street instead of using IR sensor. A microcontroller msp430 as a brain to control the process involved. This paper gives a solution to the controlling the intensity of the light considering the movement on the road.
In [3] this project is designed to detect the vehicle movement on the highways to switch ON only a block of the street light ahead of it and switch OFF the trailing light to save energy. During the night all the lights on the highways remain ON for the vehicle, but lot of energy is wasted when there is no vehicle movement on the highways. In this paper two kind of sensors has been used which are light sensor, photo electric sensor.
In [4] Automatic Street Light Control System is not only easiest but also the powerful technique. Relay uses as a automatic switch in this system. It releases the manual work atmostupto 100% . 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 which actually does this work and senses the light as our eyes does. As soon as the sunlight comes, visible to our eyes it automatically switches OFF lights. Such type of system is also useful for reducing energy consumption.
In [5] this system the system with LDR sensor, PIR sensor, Zigbee is used to intimate the status of humans use, light intensity and street light ON/OFF status to the EB section to avoid wastage of energy by glowing street lights in unwanted areas. The whole system is operated by using artificial energy source called solar and with battery backup. 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. 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 remote urban and rural areas where the traffic is low at times.

III. PROBLEM DEFINATION

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.

Advantages of the Proposed System

- Automatic Switching of Street lights.
- Maintenance Cost Reduction.
- Reduction in CO_2 emission.
- Reduction of light pollution.
- Wireless Communication.
- Energy Saving.
- Reduction of manpower.

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IV. METHODOLOGY

i. MPLAB IDE:

MPLAB IDE is a free, integrated toolset for the development of embedded applications on Microchip's PIC and ds PIC microcontrollers. It is called an Integrated Development Environment, or IDE, because it provides a single integrated environment to develop code for embedded microcontrollers. MPLAB IDE runs as a 32-bit application on MS Windows, is easy to use and includes a host of free software components for fast application development and super-charged debugging. MPLAB IDE also serves as a single, unified graphical user interface for additional Microchip and third party software and hardware development tools. Moving between tools is a snap, and upgrading from the free software simulator to hardware debug and programming tools is done in a flash because MPLAB IDE has the same user interface for all tools.

ii. Arduino IDE:

The Arduino Software (IDE) is an open source software and it makes easy to the code and upload it to the board. I t runs on the different plant from Windows, MAC OS, Linux. The environment is written in Java and before running the IDE Java software to be installed on the machine this software can be used with any Arduino board.

iii. OrCAD

OrCAD is a blessing when it comes to PCB design and the subsequent manufacture. This utility helps from designing the schematic to implementing the routes of the electrical connections and further mounting diagrams of the components. In general it offers a total solution for core design schematic and PCB layout. The Capture program includes a project wizard that provides an easy method for creating a project, complete with library and simulation resources. Creating a project does not create a design within the project. A new design inherits characteristics from the settings in the design template dialog box, so we should always check those settings before we create adesign.After creating a schematic folder we can move existing pages into it and we can create new pages in it.

V. MATERIAL

i. PIC16F877A MICROCONTROLLER

High-Performance RISC CPU its having 35 single word instructions to learn ,all instructions are single cycle (1µs) except for program branches and the operating speed: DC - 20MHz clock input . Its having 8 k Bytes Flash Program Memory, 368 Byte RAM Data Memory and 256 Byte EEPROM Data Memory. Two 8-bit timer/counter(TMR0, TMR2) with 8-bit programmable prescalar, One 16 bit timer/counter (TMR1).

ii. Intel Galileo Gen2

Intel is committed to providing the ultimate processors, boards, and tools to its community. The first initiative by Intel is the introduction of Intel Galileo and Intel Galileo Gen 2 boards, which are compatible with the Arduino headers and reference APIs. Intel Galileo boards are open source and open hardware; in other words, all the source code and hardware schematics are available online, which you can download, use, and modify.

The Intel Quark X1000 SoC was preserved on Intel Galileo Gen 2 as the memory's capacity. It also has the same clock frequency, the same analog and power headers(except for a small improvement in the digital header to allow redirection of UART1 to thepins IO2 and IO3), and the same I2C and SPI speeds. The next section discusses the newchanges and improvements in details. In terms of Arduino headers, Intel Galileo Gen 2 provides the same set with major improvements, such as PWM. Figure shows its major components.

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Fig 5.1: Intel Galileo Gen2 Board

iii. LDR

A Light Dependent Resistor (LDR) or a photo resistor is a device whose resistivity is a function of the incident electromagnetic radiation. Hence, they are light sensitive devices. They are also called as photo conductors, photo conductive cells or simply photocells. They are made up of semiconductor materials having high resistance.

A light dependent resistor works on the principle of photo conductivity. Photo conductivity is an optical phenomenon in which the materials conductivity (Hence resistivity) reduces when light is absorbed by the material.

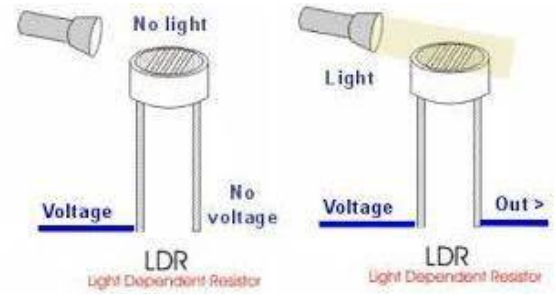

Fig 5.2: Working ofLDR

iv. IR Sensor

An infrared sensor is an electronic instrument that is used to sense certain characteristics of its surroundings by either emitting and/or detecting infrared radiation. It is also capable of measuring heat of an object and detecting motion. Infrared waves are not visible to the human eye. In the electromagnetic spectrum, infrared radiation is the region having wavelengths longer than visible light wavelengths, but shorter than microwaves. The infrared region is approximately demarcated from 0.75 to 1000µm. IR (infrared) sensors detect infrared light. The IR light is transformed into an electric current, and this is detected by a voltage or amperage detector.

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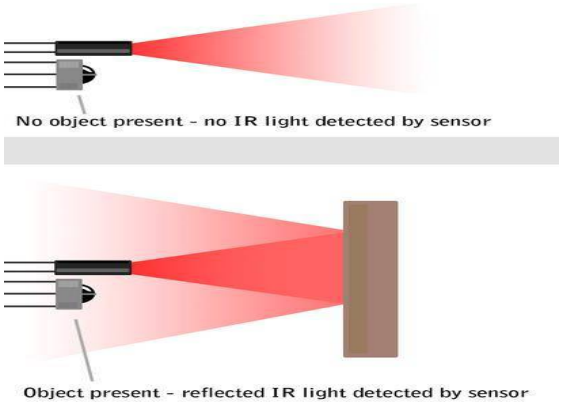

Fig5.3: Working of IR Sensor

v. Current Sensor

A current sensor is a device that detects electric current (AC or DC) in a wire, and generates a signal proportional to it. The generated signal could be analog voltage or current or even digital output. It can be then utilized to display the measured current in an ammeter or can be stored for further analysis in a data acquisition system or can be utilized for control purpose.

vi. Relays

A relay is usually an electromechanical device that is actuated by an electrical current. The current flowing in one circuit causes the opening or closing of another circuit. Relays are like remote control switches and are used in many applications because of their relative simplicity, long life, and proven high reliability. Although relays are generally associated with electrical circuitry, there are many other types, such as pneumatic and hydraulic. Input may be electrical and output directly mechanical, or vice versa. Relays are mainly made for two basic operations. One is low voltage application and the other is high voltage. For low voltage applications, more preference will be given to reduce the noise of the whole circuit. For high voltage applications, they are mainly designed to reduce a phenomenon called arcing

vii. WiFi Module

Espressif Systems ‟Smart Connectivity Platform (ESCP) of high performance wireless SOCs, for mobile platform designers, provides unsurpassed ability to embed Wi-Fi capabilities within other systems, at the lowest cost with the greatest functionality. ESP8266 offers a complete and self-contained Wi-Fi networking solution, allowing it to either host the application or to offload all Wi-Fi networking functions from another application processor. Alternately, serving as a Wi-Fi adapter, wireless internet access can be added to any microcontroller-based design with simple connectivity through UART interface or the CPU AHB bridge interface.

VI. WORKING PRINCIPLE

The system architecture of the intelligent street light system consists of IR sensors, LDR,PIC16F877A microcontroller, Relay, UART and Wifi Module. LDR‟s are light dependent devices whose resistance decreases when light falls on them and increases in the dark. When a light dependent resistor is kept in dark, its resistance is very high. The vehicle which passes by the street light is detected by IR sensor. Relay are used as a switch to switch on/off the street light bulb. A UART (Universal Asynchronous Receiver/Transmitter) is the microchip with programming that controls a computer's interface to its attached street light system

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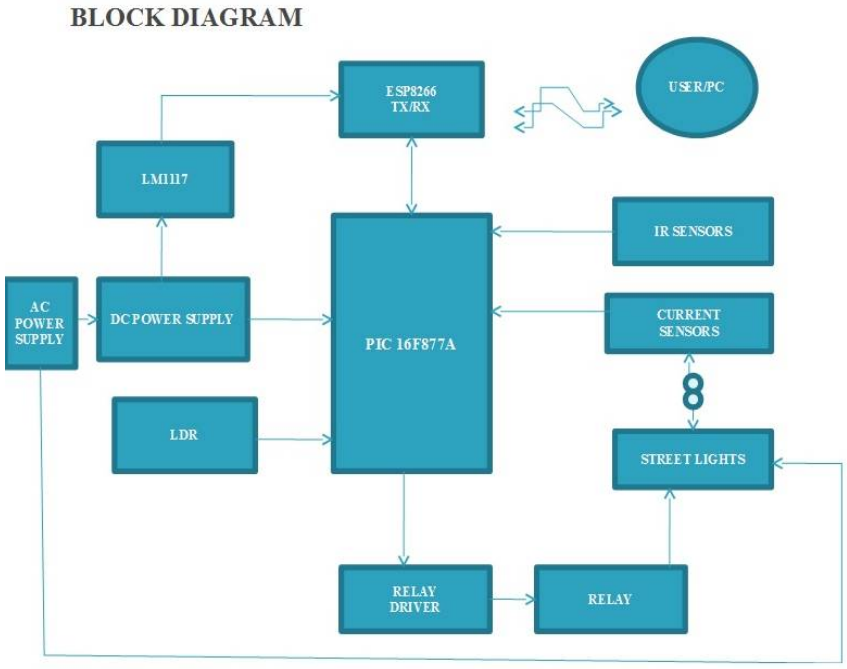

Fig 6.1: Block Diagram of System

VII. RESULT AND DISCUSSION

The project aims were to reduce the side effects of the current street lighting system, and find a solution to save power. In this project the first thing to do, is to prepare the inputs and outputs of the system to control the lights of the street. The prototype as shown in Fig..has been implemented and works as expected and will prove to be very useful and will fulfil all the present constraints if implemented on a large scale**.**

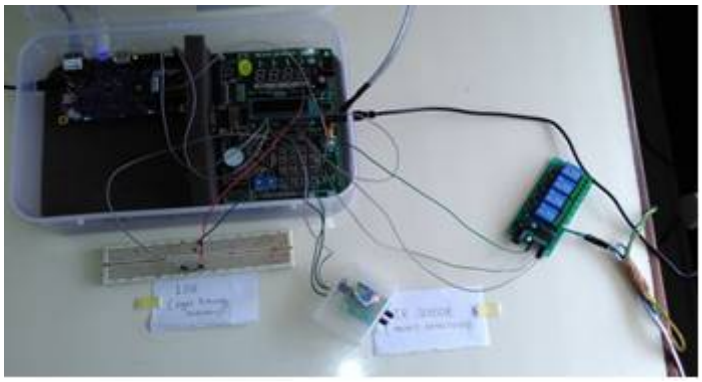

Fig 7.1: Prototype of Smart Intelligent Lighting System

Fig 7.2: Status of the Light is OFF System

Here the above Fig7.1 shows that the complete working prototype of the IoT Based smart intelligent lighting system for smart city which includes LDR, IR Sensor, Current Sensor, PIC microcontroller, Intel Galileo Gen2 Board, Wifi Module, Relays. The Fig 7.2 shows that a smart intelligent light initially in OFF condition.

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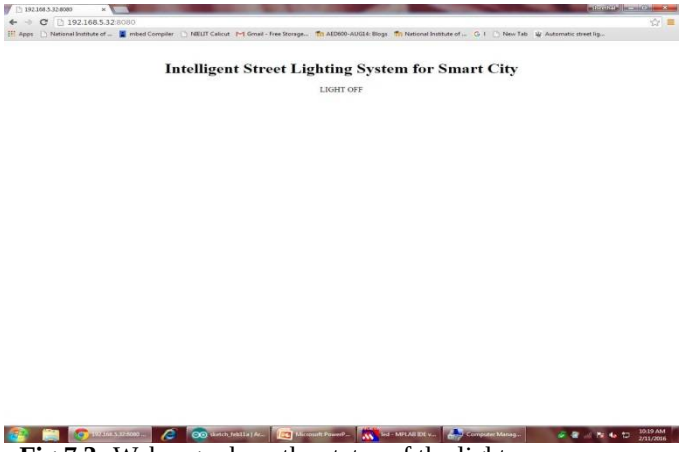

Fig 7.3: Webpage show the status of the light

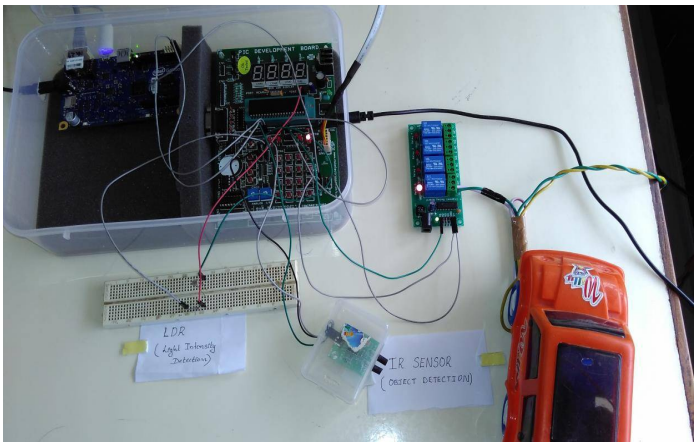

Fig 7.4: Obstacle detection through IR

The Fig 7.3 shows that the webpage displaying the real time information of the status of the light on the webpage. It displaying the status of the Light is OFF on the webpage. Here the real time information can be accessed from anytime anywhere through internet and the Fig 7.4 shows that the prototype of the system with obstacle detection on the street through IR sensor where the IR Sensor detects the obstacle and switch ON the Lights.

Fig 7.5: Status of the Light is ON after obstacle detection

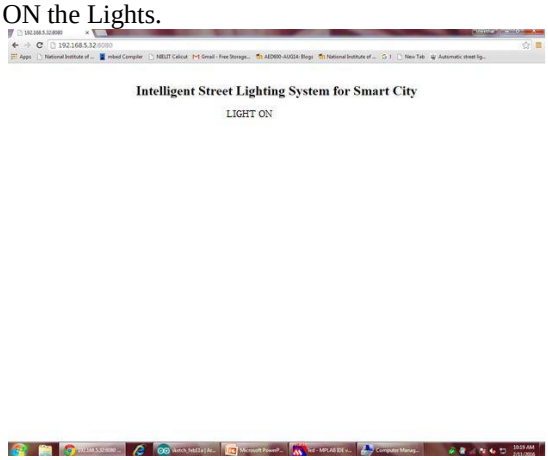

Fig7.6: Webpage displaying the status of Light

The Fig 7.5 show that the smart intelligent light is getting automatically switched on after detection of the obstacle on the street as well checking the LDR status and Fig 7.6 show that the webpage which displaying the real time data of the smart intelligent light on the webpage through internet.

VIII. CONCLUSION AND FUTURE WORK

This project "IoT Based Smart Intelligent Lighting System for Smart City " is a cost effective, practical, eco-friendly and the safest way to save energy and this system the light status information can be accessed from anytime and anywhere. It clearly tackles the two problems that world is facing today, saving of energy and also disposal of incandescent lamps, very efficiently. Initial cost and maintenance can be the draw backs of this project.

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With the advances in technology and good resource 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 these reasons our project presents far more advantages which can over shadow the present limitations. Keeping in view the long term benefits and the initial cost would never be a problem as the investment return time is very less. The project 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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BIOGRAPHY

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