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Automatic Street Light Control using Arduino

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Abstract:
The objective of the project is to provide automatic control and fault detection of street lamps. The lighting system which targets the energy and automatic operation on economical affordable for the streets and send information about the street lamp fault to the control room. Moreover, errors which occur due to manual operation can also eliminate. The street light system is checking the weather for street lamp ON/OFF condition. The weather is bright or dark, are sense through a LDR sensor. If the weather is bright, the system will be OFF otherwise system will be ON. The light condition is also used to check the lamp glowing status through LDR sensor. If light glows then the sensor sends the value to street light system through the Wi-Fi module. Here, also the PIR sensor is used to measure the motion of vehicle or any other object. According to the program, whenever there is no vehicle cross as the PIR sensor, the light will glow as dim. Otherwise the light will glow as bright.

Keywords: Arduino UNO, PIR Sensor, LDR Sensor, ESP8266, IoT.

1. INTRODUCTION

In our country, the corporation street light consumes more power when roads are desolate. However with the increasing importance for saving power and proper maintenance are leads to save the natural resources for the future. A smart street light system can reduce the power of Corporation Street light for desolate roads.

In our project gives the solution to those problems. An automatic street light system using sensors and wireless modules for implement a system. The LDR (Light Dependent Resistor) sensing the weather condition.

The system can identify the bright or dark environment using LDR. The weather is dark the system allows to ON the street lights. The weather is bright the system allows to OFF the street lights. Same this LDR operation is used to find the light fault detection and send to the control room using ESP8266 Wi-Fi module.

Here the intensity of the street light to be controlled by the controller. Whenever PIR sense the motion of vehicle, the street light will glow as bright or normal. Otherwise the street light will glow as dim.

2. PROPOSED SYSTEM

The street light control and fault detection system is implemented through an arduino. Nowadays, the street lamps are operate manually.
But the cloud storage system operates the street lamps ON/OFF and find the fault in the street lamps automatically. Same this LDR operation is used to find the light fault detection and send to the control room using ESP8266 Wi-Fi module.

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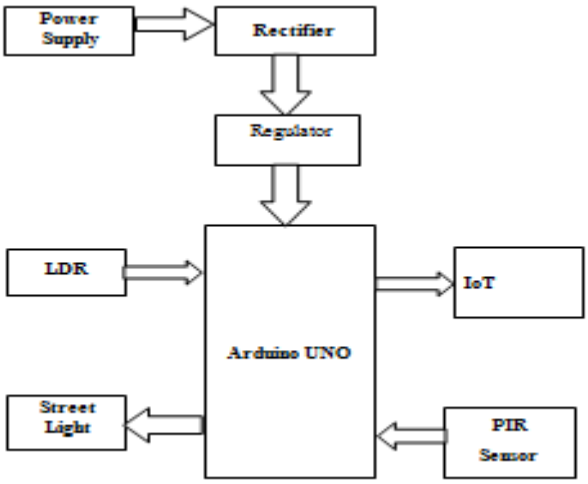
3. BLOCK DIAGRAM AND DESCRIPTION



Block Diagram
As described in the introduction two parameters are to be considered in this project. One, the intensity of the street light controlled for the vehicle movement and another one fault light identification.

Power supply
Power supply is require for every component in the block diagram. Two kind of power supply is given to the components

- External power supply
- Internal power supply(from the controller)

The controller is driven by the external power supply. Here, the AC power is converted in to DC power using transformer, rectifier and regulator. The operating voltage of the sensors are taken from the controller. In other words the controller provide the internal power supply to the sensors. The controller provide two separate constant DC power supply of 3.3V and 5V. The constant DC power supply is to drive the sensors.

Sensors
Sensors are used to measure the various parameters considered.

The Passive Infrared Sensor (PIR) sensor module is used for motion detection of the people, animals, or other objects. The PIR sensor provide analog output when the object motion detection. Light dependent resistance(LDR) is used to measure the intensity of the light by resistance change. LDR is a resistor, whose value of resistance is altered according to the intensity of the light falling on them. As per the flow of in the above block diagram the intensity of the street light vary by the controller when PIR detect motion of the object and send information about light fault.

ESP8266 WiFi Module:
The ESP8266 WiFi Module is a self-contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your WiFi network. The ESP8266 is capable of either hosting an application or offloading all WiFi networking functions from another application processor.

Controller
The sensor values are given to the controller and produce control signal according to designed program for the project. Controller consist of ALU, memory unit, processing unit. According to the program written in the memory, the controller produce the control signals. These control signals are given to the street light. The controller used in this project is ARDUINO UNO type controller.

4. HARDWARE IMPLEMENTATION

The hardware implementation of street light control is divided into various modules such as **PIR Module; LDR Module; ESP8266 WiFi Module.**

PIR Module
A PIR-based motion detector is used to sense movement of people, animals, or other objects. An individual PIR sensor detects changes in the amount of infrared radiation impinging upon it, which varies depending on the temperature and surface characteristics of the objects in front of the sensor. When an object, such as a human, passes in front of the background, such as a wall, the temperature at that point in the sensor's field of view will rise from room temperature to body temperature, and then back again. The sensor converts the resulting change in the incoming infrared radiation into a change in the output voltage, and this triggers the detection.

Figure.1. PIR Sensor

LDR Module:
LDR uses the light dependent change of resistance according to intensity of light. Two resistance are connected in parallel one is standard resistance and the other is LDR. According to the voltage divider rule the intensity is measured as change of output voltage this is analog signal. LDR the resistance of this device increases as the intensity of light decreases they have inverse relation with each other.The resistance of the LDR is maximum at darkest and minimum as brightness increases.
Two cadmium sulphide (cds) photoconductive cells with spectral responses similar to that of the human eye. The cell resistance falls with increasing light intensity. Application include smoke detection, automatic lighting control, batch counting and burglar alarm systems.

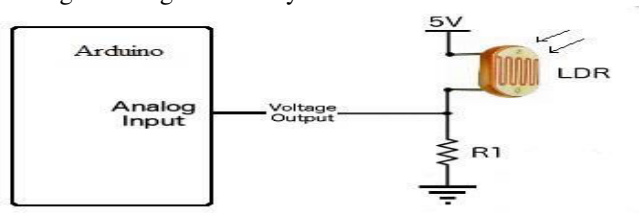


Figure.2. LDR Sensor

ESP8266 WiFi Module
The ESP8266 WiFi Module is a self-contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your WiFi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor.

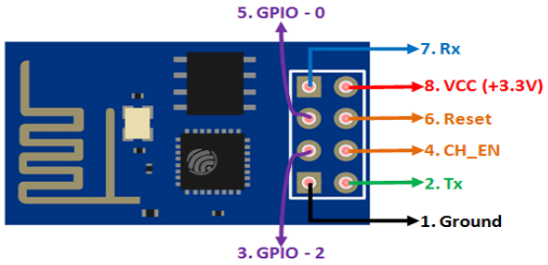


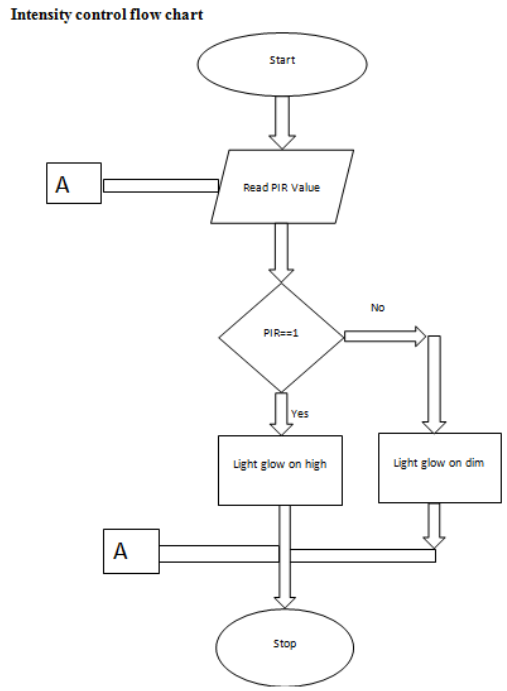
Figure.3. ESP8266 WiFi Module

5. SOFTWARE IMPLEMENTATION

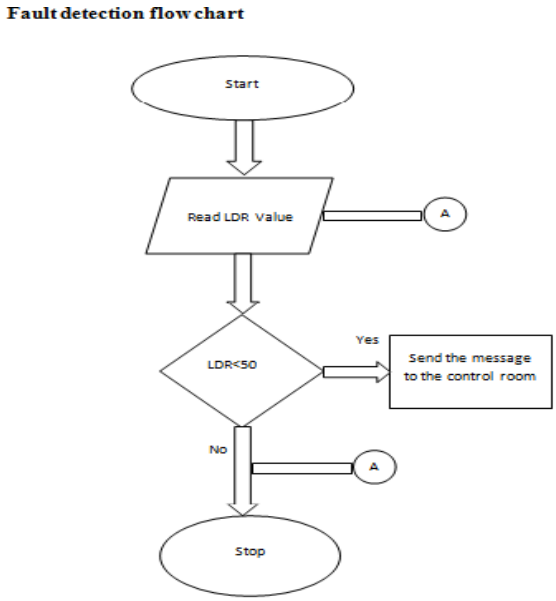
Arduino UNO
Arduino is common term for a software company, project and user community that designs and manufactures computer open-source hardware, open-source software and microcontroller-based kits for building digital devices and interactive objects that can sense and control physical devices. The project is based on microcontroller board designs, produced by several vendors, using various microcontrollers.These systems provide sets of digital and analog I/O pins that can interface to various expansion board (termed shield) and other circuits. The board feature serial communication interfaces, including Universal Serial Bus (USB) on some models, for loading programs from personal computers. For programming the microcontrollers, the Arduino project provides an integrated development environment (IDE) based on a programming language named processing, which also supports the languages, C and C++. The UNO is a microcontroller board based on the ATmega228P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button.

Figure.4.Arduino UNO

Flow Chart



Intensity Control



Fault Detection

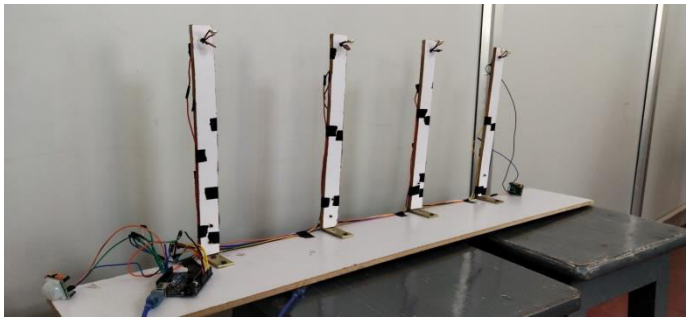
Flow Chart Description:

Intensity Control:
Initially, the process is started. Then read the PIR value. If the PIR value is equal to one then the light glow bright. If the PIR value is not equal to one then the light glow dim. Finally the process is stop.

Fault Detection:
Initially, the process is started. Then read the LDR value. If the LDR value is less than fifty then the message send to the control room through the WiFi module. Finally, the process is stop.

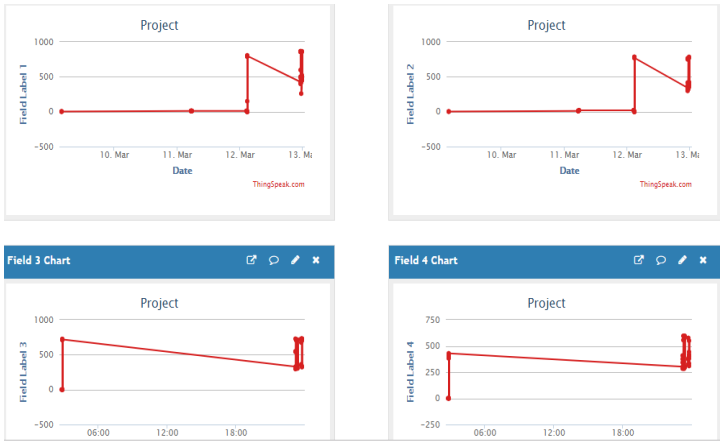
6. RESULT AND DESCRIPTION

The complete module of implemented Automatic Street Light Control hardware module



This figure refers the street light glows on dim, if PIR not detect the motion of any object.

This figure refers the street light glows on bright, if PIR detect the motion of any object.



This graph shows the output of LDR sensor through IoT.

7. CONCLUSION

By referring all the results, it can be concluded that both hardware and software development of this project meet the objective of design. A working prototype of street lighting automation system was successfully built using Arduino Uno. Usage of PIR sensor as the input gives energy saving to the system since LED turn on only when there is movement from vehicles, thus, the usage of power consumption by LED decreases. An automatic street light control and fault detection system with cloud storage in this project, control the street light ON/OFF automatically depends on the weather situation and we can easily identify the light faults in this system easily and also the system sends alert message to the system room. About 16.67 % energy can be saved when compared LED for street lighting automation system with LED used for public street lighting. However, 58.33 % energy can be saved when compared LED for street lighting automation system with HPS used for public street lighting. For future development, this

system can be upgraded for two ways road especially in highways, traffic routes and urban areas.

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