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Street Light Automation System Using Arduino Uno

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ABSTRACT: Street light automation system, most prominently reduces the human effort of manually switching OFF/ON of street lights time to time. The Street light Automation system helps in reducing the energy consumption. It also reduces maintenance costs. It is economical hence better than older ones .Also helps to reduce crime activities and accidents up to certain limit. The Internet of Things (IoT) is the network of physical objects or "things" embedded with electronics, software, sensors, and network connectivity, which enables these objects to collect and exchange data. Arduino is an open-source hardware kit with 8-bit Atmet AVR pre-programmed on-board microcontroller kit, with boot loader that uploads programs into microcontroller memory. In this work, two kinds of sensors namely, PIR, which is a motion sensor, used to identify passage of vehicles or pedestrians and LDR is a light sensor which will detect intensity of sun light. Wifi module is a wireless communication medium, used to send/receive information from/to street lights and control unit.

KEYWORDS: IoT, Arduino, Street light automation

I. INTRODUCTION

Street lights play a vital role in our municipal service delivery sector and also plays a critical role in providing light for safety during night time travel on our roads. Maintenance and service for millions of street lights become a nearly impossible task. Intelligent Street Lighting is all about fully automated control of street lights across your street based on daylight. This design eliminates the need for any manual intervention of switching street lights ON/OFF. This is so possible with the help of an LDR (Light Dependent Resistor) module which is interfaced to Arduino board. Depending on the intensity of light falling onto LDR Street lights are turned on and off. Also, High Intensity Discharge street lamps has been replaced with LEDs, so that the power consumption is reduced. This paper proposes the use of a smart street lighting system which provides an intelligent method of conserving energy and monitoring street light faults with the use of communication over the power line.

Street Light Automation system based on IOT consists of smart lights which mainly have four features,

- Automatic ON/OFF bulbs according to surrounding Light intensity.
- Adjusting the brightness when the motion is detected.
- Controlling the lights remotely.
- Detecting the faulty lights.

Street light automation system is smart and provides a safe night time environment for all road users including pedestrians. It discusses an intelligent system that takes automatic decisions for ON/OFF/DIMMING considering movement of vehicle or pedestrian and surrounding light intensity. The Street light Automation system helps in reducing the energy consumption and maintenance costs and also helps to reduce crime activities and accidents up to certain limit. The Street light Automation system also detects the faulty lights and controls it. Using these smart lights, one can also control the ON/OFF remotely using android sets or WIFI connected to system. These smart street lights are designed with the help of PIR and LDR sensors.

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II. RELATED WORK& OBJECTIVES

Manual operation using electricity: Switching ON/OFF of street lights MANUALLY which consumes energy and more cost along with human errors. No fault detection in this method. High cost for repair as well as replacement. Manual operation using solar energy: Switching ON/OFF of street lights using the solar energy. Solar panels are of high cost and needs regular servicing and it is also tedious to maintain during rainy seasons. Current techniques used for saving power involves sensors which detect movement and lights are switched between different stages of light intensities. Most of the Intelligent street light control systems in use today, use the latest international intelligent street light energy-saving control technology. This is accomplished by using multi-sensor array. The goal is to achieve energy saving and environmental protection providing adequate lighting to even late night travellers. Adding the ability of communicating to and from street lights add more control and more effective monitoring of street lights by introducing automation to the process. Our objectives are:

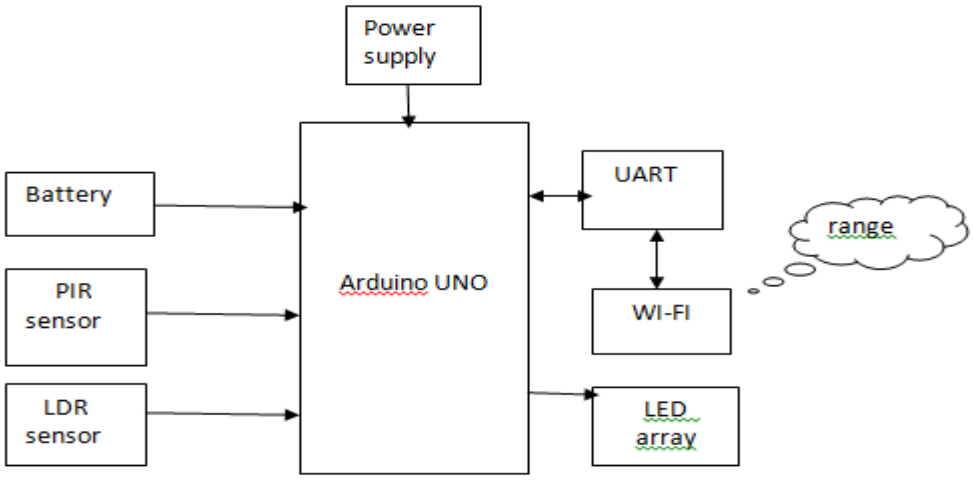
1. Renew LED based street-lighting solutions with improved/extended communications (detection of human presence, improved adaptation to ambient conditions) especially dedicated to small rural communities, where improved safety and significantly reduced operating costs are key factors to justify investment into new street-lighting installations. Due to the limited resources of smaller communities the option of gradual introduction of new features in new lighting installations is also an important aspect.
2. Introduce the self-diagnostics and intelligent LED control functions for street-lighting.
3. Develop a central control unit for the luminaires with a sensor interface and communications interface with an architecture inspired by the principles of the OSI model, allowing high degree of independence of the physical medium available for data transmission and providing flexibility in the actual communications protocol being used; allowing street-lighting operators to tailor the smart LED luminaires to their existing infrastructure or re-configuring (updating) the luminaires when the infrastructure is upgraded.

III. PROPOSED METHODOLOGY

Here we overcome the disadvantages of the existing system using street light automation system based on IOT. Automation of street lights where the street lights are automatically controlled which increases energy efficiency and cost savings of things. This also detects defective street lights and they can be controlled remotely and TIMER set too. In traditional systems there is no option of dimming of lights depending upon the objects present on the road where as in our project we have tried to provide this system which will help to save energy as well as cost.

System model:

Transmission Side



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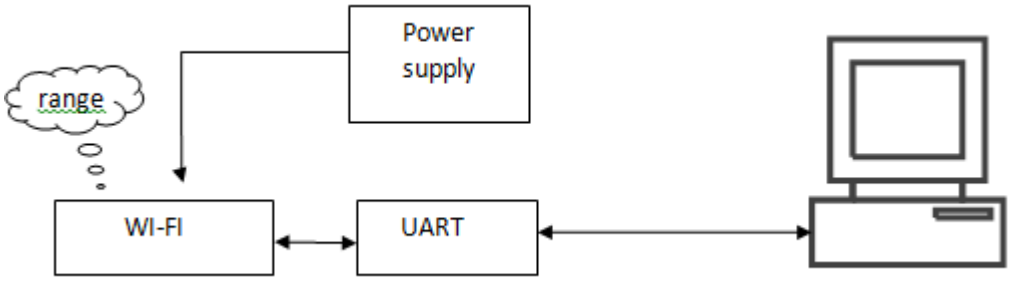
Receiver Side



Working: This is a system diagram of the Street light Automation system it has battery in the transmission side, it also has PIR LDR sensors Arduino UNO board with a Wi-Fi modem of range 2.4 gigahertz and in its receiver side it has another modem connected to a system with a same range. It has electrical power supply and the Arduino kit is directly connected to the street light arrays.

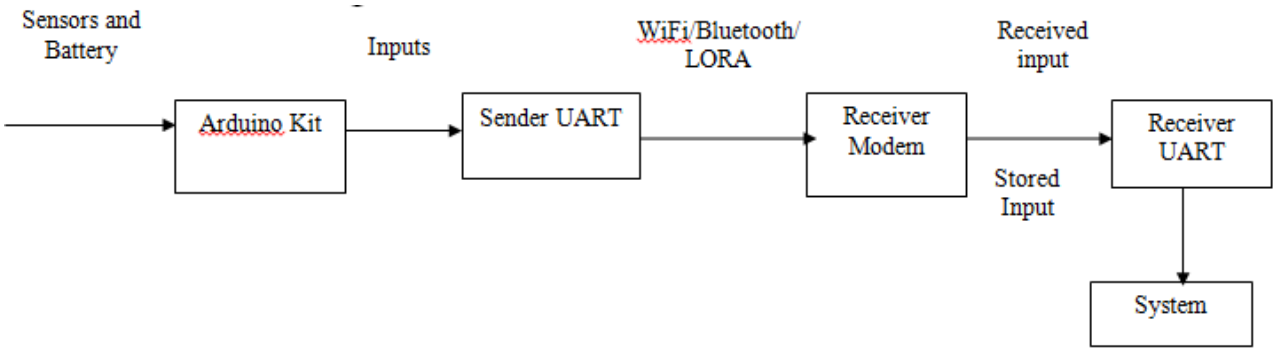
1. **Hardware arrangements:** First connect the required equipments(LDR PIR WIFI and other resistors) to the bread board.

2. **Software and hardware connection:** connect the breadboard to the arduino Uno which is further connected to the systemhaving arduino Uno IDE to upload the source code.

3. **Testing:** compile the source code and then run it.

4. **Connection to Internet:** Connect the internet of the system to the Blynk an android platform which helps in controlling the lights remotely. Note that both the android device and the system should have internet connections.

Data Design:



1. Firstly Arduino Kit receives input from the sensors (LDR, PIR) and the battery connected to the board.
2. IT sends the further inputs to the UART of transmitter side.
3. With the help of Wi-Fi/Bluetooth/LORA, we can transmit the input to the receiver's UART.
4. It then sends it to the system which has Aurdino IDE which will manipulate the code.

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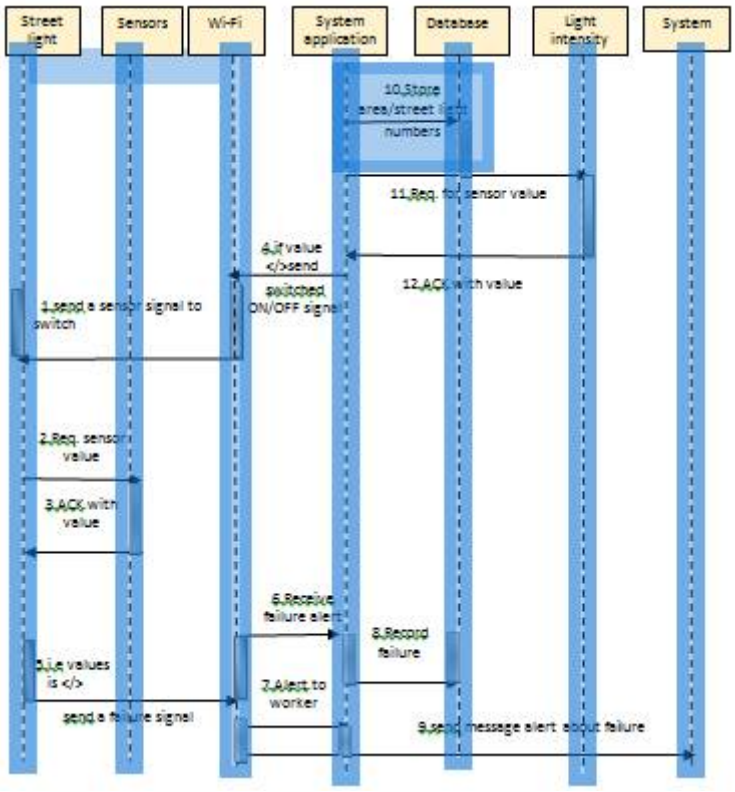
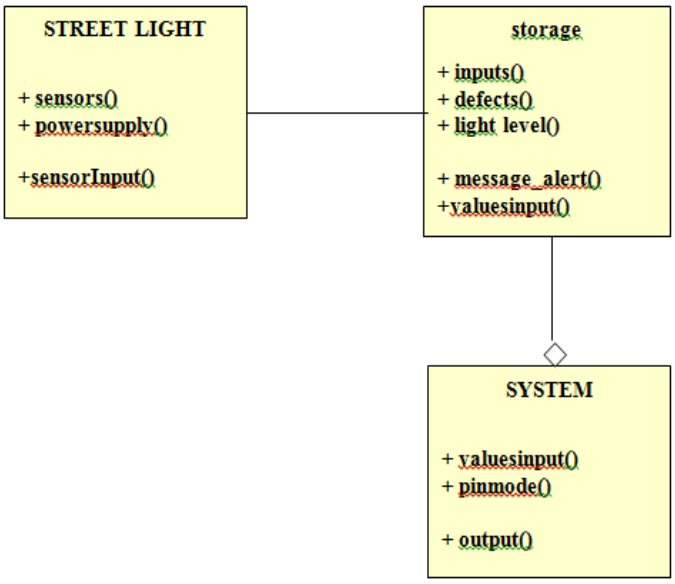
Component level design:



Class Diagram:



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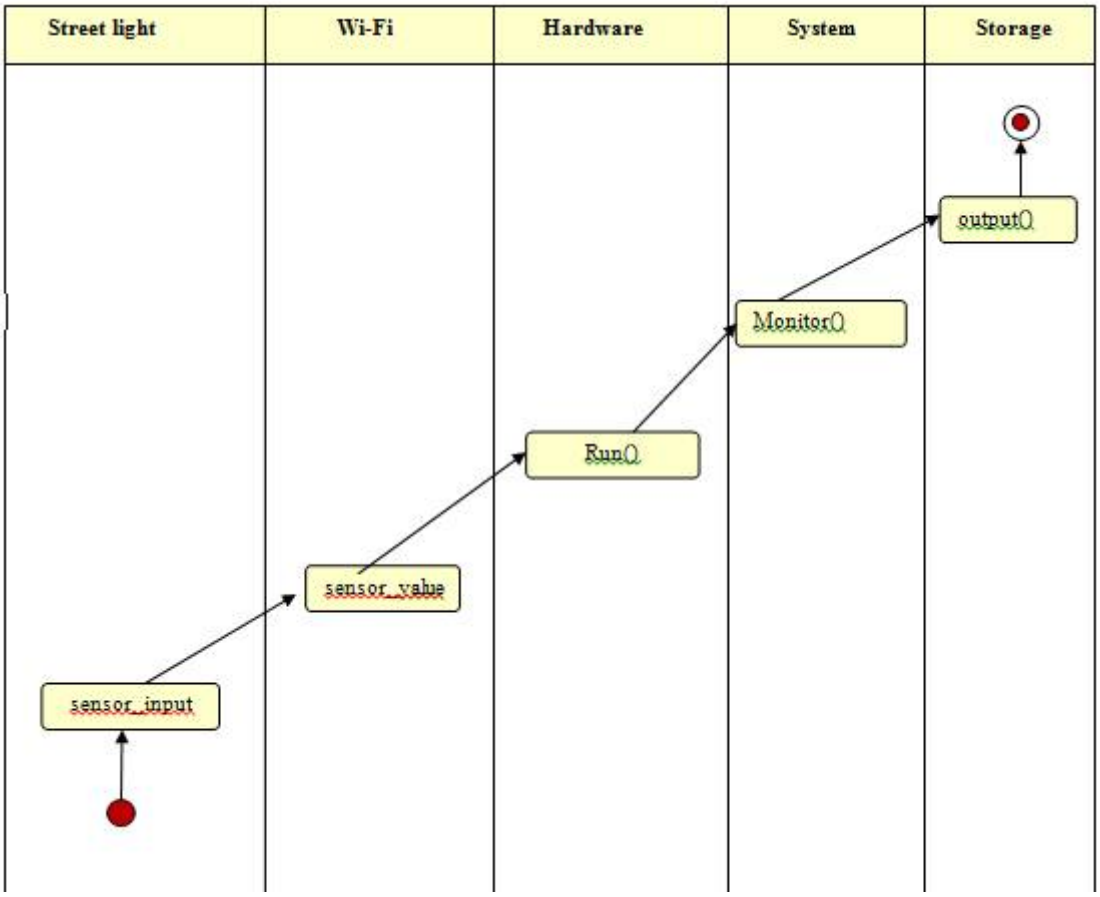
Activity Diagram



IV. PSEUDO CODE

Step 1: Installing Arduino IDE software on the System.
Step 2: Switching ON/OFF of LED using LDR Sensors.
Step 3: Adjusting Brightness of the LED using PIR sensors
Step 4: Controlling the Lights using Blynk Android Application
Step 5: Detection Of faulty lights and sending the alert message to the device.
Step 6: Combining all the above modules and presenting the whole system as STREET LIGHT AUTOMATION SYSTEM.

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V. SIMULATION RESULTS

Test case specification

Module Name	Input data	Expected results	Actual results	Remarks
Testing Arduino Board	Digital Signal	Toggle LED at regular interval.	LED got switched ON and OFF at regular interval	Hardware correctness
Testing Light Dependent Resistor(LDR) sensors	Outside light values	Intensity of the light noted on the serial monitor and LED glows accordingly	LED glows according to the intensity of the outside light noted on the serial monitor	Hardware correctness
Testing Passive Infrared (PIR) sensors	Motion detected from the surroundings	LED glows whenever motion is detected	LED glows whenever motion is detected	Hardware correctness
Detecting faulty Lights	Faulty LED	Faulty lights detected and mail sent	Mail received about the replacement, remarks error handling	Hardware correctness

Module 1: Installing Arduino IDE software on the System.

1. Download and install the Arduino Software from the open source www.arduino.cc.
2. Connect Arduino – UNO to the computer using USB cable.
3. Install the Arduino UNO device driver software.

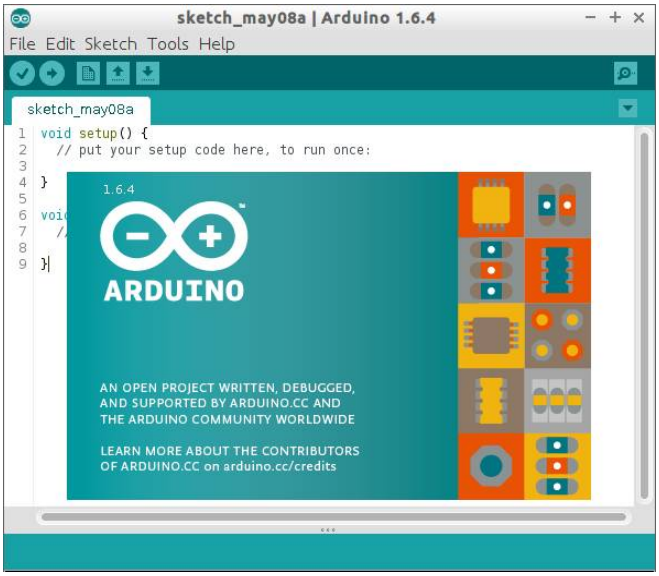

Fig 1: Arduino IDE

Module 2: Switching ON/OFF of LED using LDR Sensors.

1. Design the circuit by connecting all the equipments using jumper wires as per required.
2. Upload the software code on IDE.
3. Compile and Run the source code.

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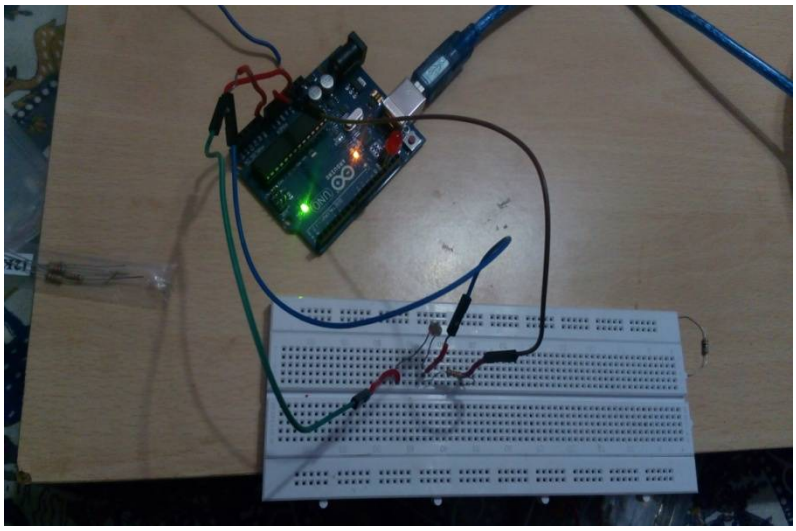

Fig 2: LDR sensors

Module 3: Adjusting Brightness of the LED using PIR sensors.

1. Design the circuit as per required on the bread board.
2. Upload the source code onto the software.
3. Connect Arduino to the laptop with the help of USB cable.
4. Compile and Run the code.

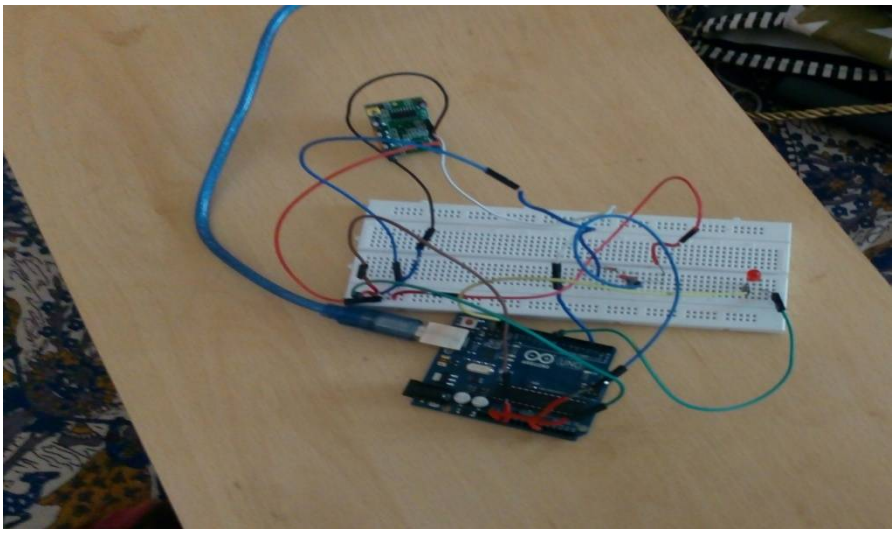

Fig 3: PIR sensors

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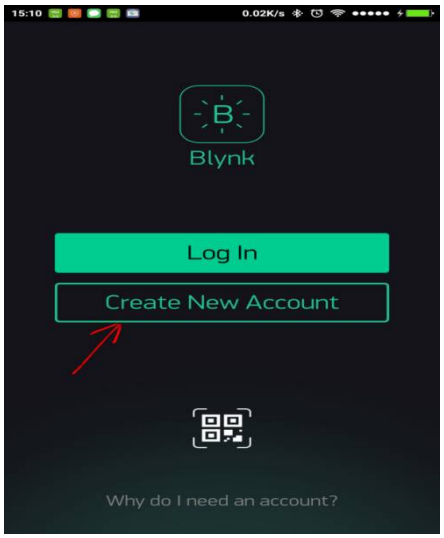
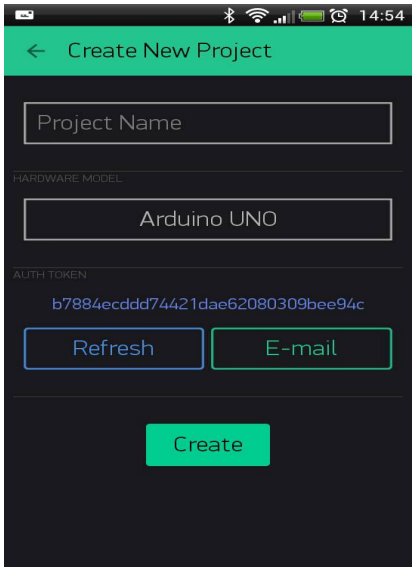
Module 4: Controlling the Lights using Blynk Android Application



Create a Blynk Account



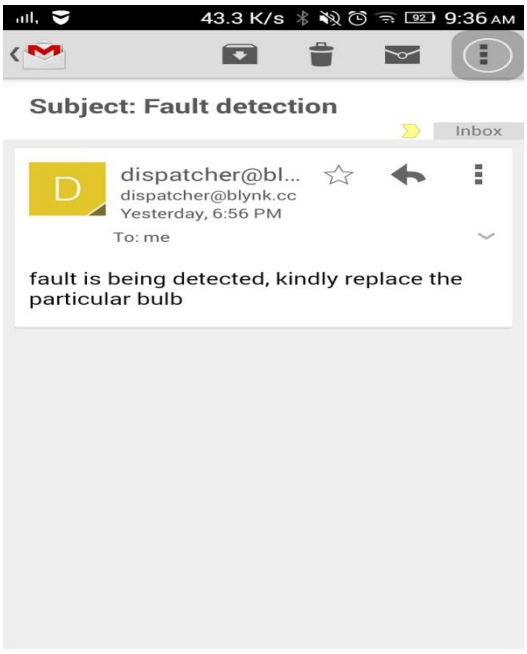
Create a New Project

Module 5: Detection Of faulty lights and sending the alert message to the device.

1. Design the circuit as per required on the bread board.
2. Upload the source code onto the software.
3. Connect Arduino to the laptop with the help of USB cable.
4. Compile and Run the code.

OUTPUT:

A message is sent through an Email about the street light which is detected faulty and the sooner replacement of the same.



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Module 6: Combining all the above modules and presenting the whole system as STREET LIGHT AUTOMATION SYSTEM.

1. Design the circuit as per required on the bread board.
2. Upload the source code onto the software.
3. Connect Arduino to the laptop with the help of USB cable.
4. Compile and Run the code.

OUTPUT:

The street lights glow according to the instructions with the help of sensors as well as interface.

VI. CONCLUSION AND FUTURE WORK

Hence, by using the technologies of IOT, microcontroller this smart street light automation system is developed. This system controls the smart lights automatically which conserves manual power, electricity consumption.Also, the defective street lights tweets to the controller about the fault and replacement. These smart street lights can be controlled from any remote area. Thus fulfilling the requirement criteria and saving the energy.

FUTURISTIC USE:

1. Smart cities
2. Home automation
3. Agriculture field monitoring
4. Timely automated lights
5. Hospitals, Malls, Airport, Industries etc..

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