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IoT- Based Smart Streetlight Monitoring System with Fault Detection using GSM

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ABSTRACT

The motto of a smart street light monitoring system using IoT is to conserve electricity wastage as well as to reduce the manpower. This system enables the devices to communicate with each other and entitles the street light to glow with maximum intensity in the presence of darkness and during the movement of obstacles and glows with less intensity during darkness and in no movement of obstacles and the lights will be OFF during day time. If any of the lights fails due to any reason, a message will be sent to the registered mobile number using GSM technology. All the data will be posted in an IoT application Thing Speak via Cloud which provides the analytics of the system.

KEYWORDS:Arduino UNO, IR Sensor, ESP8266 Wi-fi Module,LDR, GSM Module, LCD display.

1. INTRODUCTION

The internet of things (IoT) is a popular term that refers to physical items made up of sensors, actuators, software, and other components that connect and exchange data with other devices through the internet, cloud, or other communication networks. Because the IoT is made up of web-enabled smart devices that employ embedded systems like processors, sensors, and communication gear to gather, deliver, and act on data, the gadgets in this system mainly perform without human intervention. Connectivity, intelligence, scalability, a dynamic and self-adapting nature that analyses data on the cloud or locally are all features of the Internet of Things. It helps to utilize them since it has many advantages such as improved communication, ease of operation, good data transmission, and the ability to access information from anywhere at any time.

2. PROBLEM DEFINITION

The current street lighting system consumes a significant amount of energy. It's because the current system keeps the lamps on throughout the night, from sunset to daybreak, unless and until the operator manually turns them off. People will suffer if the operator forgets to turn on the streetlights, and if he forgets to turn them off, more energy will be spent. It is quite difficult to recognize if any of the lights' health is bad or fails in the manual method, which also requires a lot of manpower.

Existing System Disadvantages:

- Consumption of more energy
- Manually turning off and on street lights
- Increased manpower.

3. PROPOSED SYSTEM

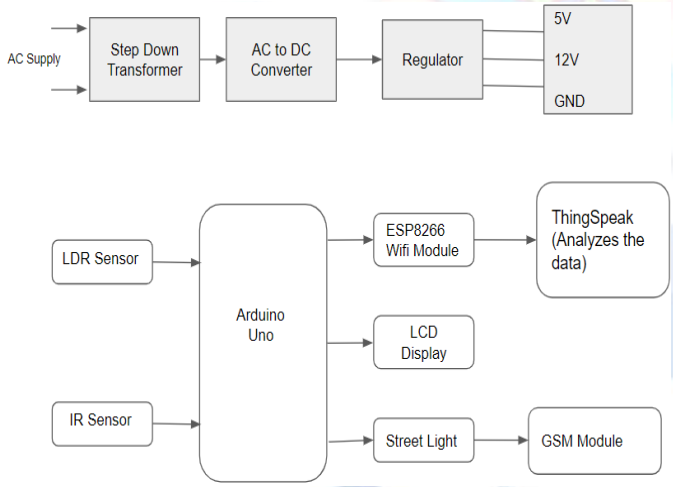
The proposed streetlight system allows devices to interact via the internet, allowing the streetlights to glow at their highest intensity only during darkness and in the presence of moving obstacles, and to glow at a lower intensity (dim) during darkness when moving obstacles are not present. During the day, the streetlight will be switched off. All of this activity can be tracked using an IoT application called Thing Speak, which provides analytics for the light statues. And if the light fails for some reason, the proposed system's GSM technology would send a message to the registered mobile phone number informing them that the light has failed. As a result, this technology aids in the conservation of electricity and manpower.

Benefits of the Proposed System:

- Automatically turning off and on street lights
- Wireless communication
- Energy conservation
- Manpower reduction
- Light pollution reduction.

4. SYSTEM DESCRIPTION

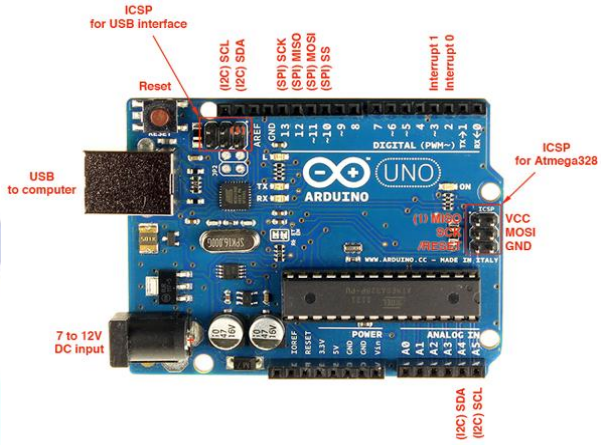
A. Block Diagram:



The proposed system includes a step-down transfer that transforms the 230V ac supply to 12V DC via an AC to DC converter; and then converts that 12V DC to 5V DC via a voltage regulator. This 5V DC supply will be connected to the Arduino's power port.

B. Components:

Arduino UNO:



Description:

Microcontroller	ATmega328
Operating Voltage	5V
Input Voltage	7-12V
Input Voltage (limits)	6-20V
I/O Pins (Digital)	14 (6 provide PWM output)
Analog Input Pins	6
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328)
SRAM	2 KB (ATmega328)
EEPROM	1 KB (ATmega328)
Clock Speed	16 MHz
Length	68.6 mm
Width	53.4 mm
Weight	25 g

A USB port, a power jack (connector), an ICSP header, and a reset button are all present on the microcontroller. The suggested system's Arduino is one of the most crucial components, to which other components are linked and get power. With an ATmega328 processor, it also contains software, which is vital for the components' efficient working. The Arduino IDE is free, open-source software that works with any Arduino board and makes writing and uploading code simple. It consists of different libraries that supports alignment of several hardware components to function in a desires manner.

IR Proximity Sensor:

An infrared proximity sensor is an electrical component that detects the presence or motion of objects. It is composed of an emitter that emits infrared rays, which are collected by a receiver positioned beside the transmitter.

When the infrared transmitter transmits radiation, it hits the object, and depending on the intensity of the response, some of the radiation emitted will reflect back to the Infrared receiver sensor.

WIFI module ESP8266:

The ESP8266 WIFI Module is a self-contained SOC with integrated TCP/IP protocol that can provide access to your WIFI network to any microcontroller. An AT command set firmware is pre-programmed into each ESP8266 module. The ESP8266 module is a very budget-friendly board.

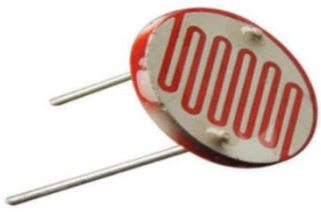
Microcontrollers may connect to the internet through Wi-Fi using the ESP8266 module. Using the Arduino to configure the wi-fi modem is also a crucial step. In order for the wi-fi module to be included, we must first install the ESP8266 serial library in our IDE.

SIM900A GSM Modem:

It's powered by a dual-band GSM/GPRS SIM900A. And it mostly operates at 900/1800 MHz, which may be changed via AT Commands. The GSM module is intended for short-messaging service (SMS) wireless transmission (SMS). The serial data from radiation monitoring equipment can be received by this module. Data can be transferred and configurations can be built up in both directions. The firmware of the module is in charge of tasks involving communication between the device and the host server. GSM is mostly utilized in this system to elevate information concerning streetlight malfunction incidents.

LDR Sensor:

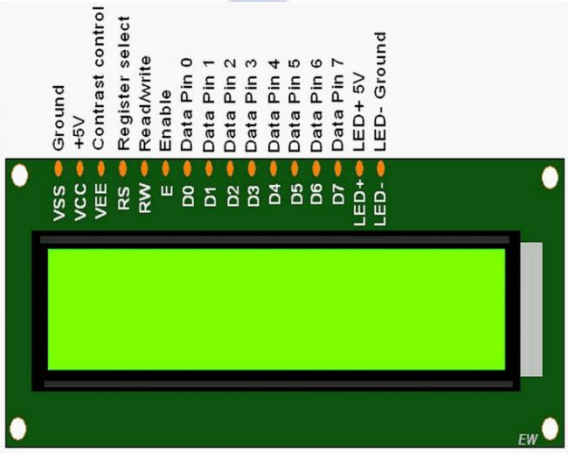
Light-dependent resistance is a sensor that can detect the existence or illuminance. This is extremely light-sensitive; Resistance lowers while light intensity raises and vice versa. In the proposed system, LDR plays a critical function in recognizing ambient light as well as determining the illuminance of each street light.



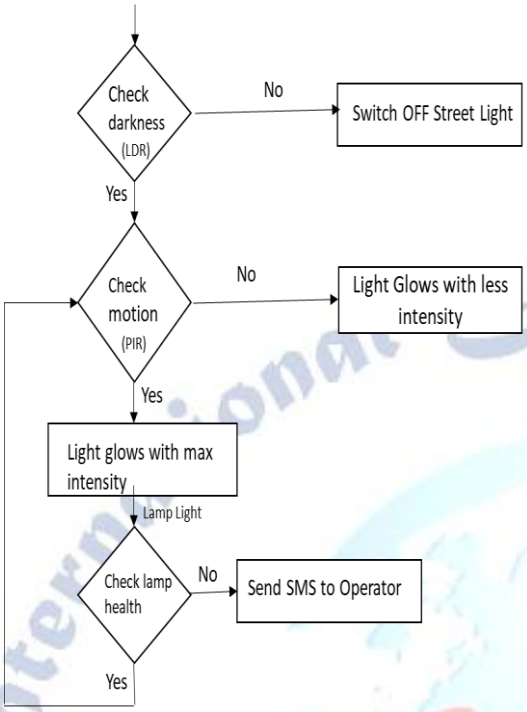
Light Dependent Resistor

LCD Display:

Liquid Crystal Display is a type of electrical appliance that displays data and messages (LCD). As the name implies, it has 16 columns and 2 rows, allowing it to show a total of 32 characters (162=32). It shows project information and light illuminance levels, as well as a notification regarding any faults that have occurred.

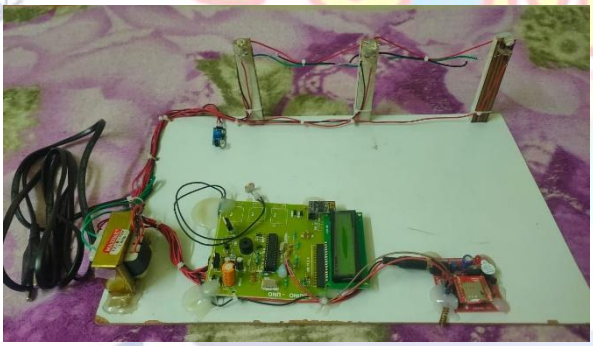


C. Flow chart:



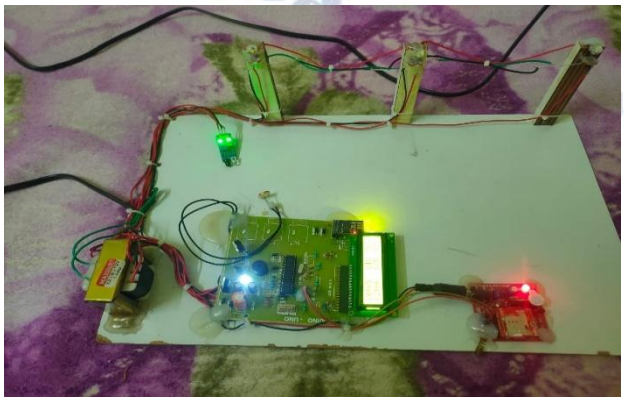
5. RESULTS AND DISCUSSION

The prototype of the proposed system is shown below:

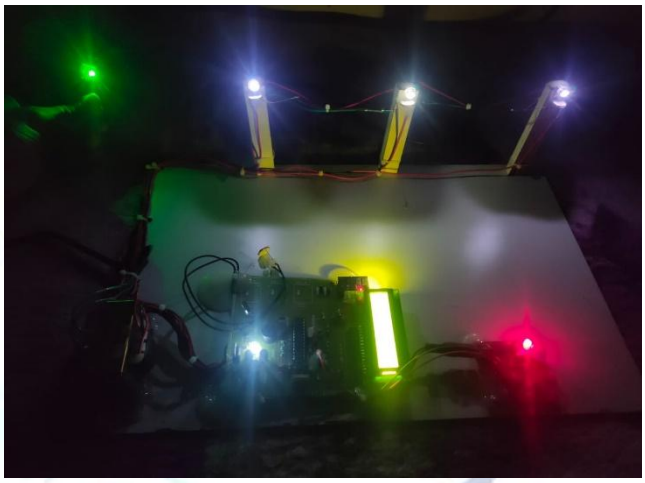


The Proposed Prototype gives the following results:

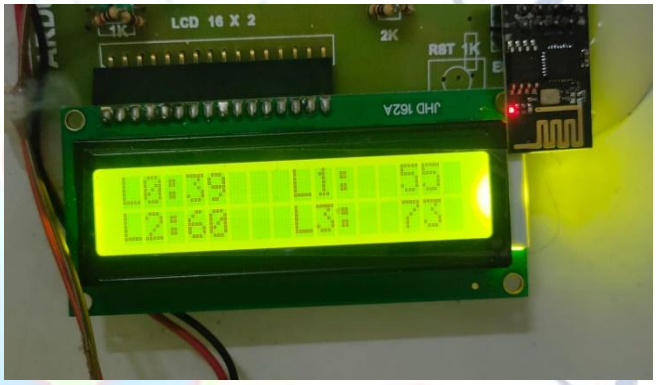
- **Case 1**: During day-time: -Status of lights is **OFF**.



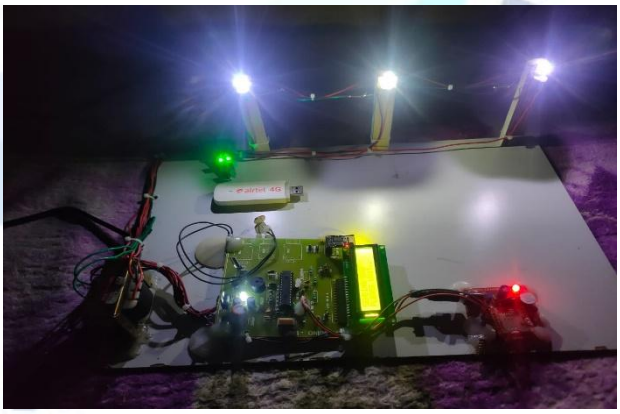
- **Case 2:** During Night time in the absence of movement: - Status of lights is ON (dimmed).



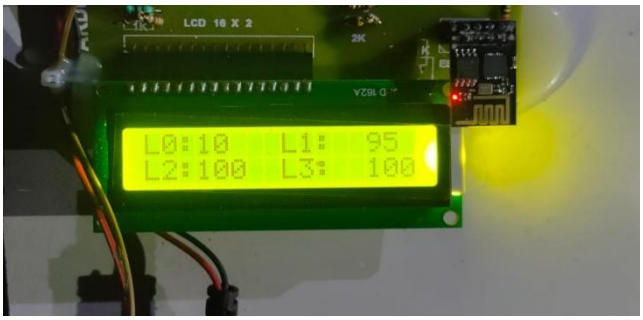
The intensity values of the light during night time in the absence of light:



- **Case 3:** During night time in the presence of movement- Status of lights is ON (glows with Max intensity).

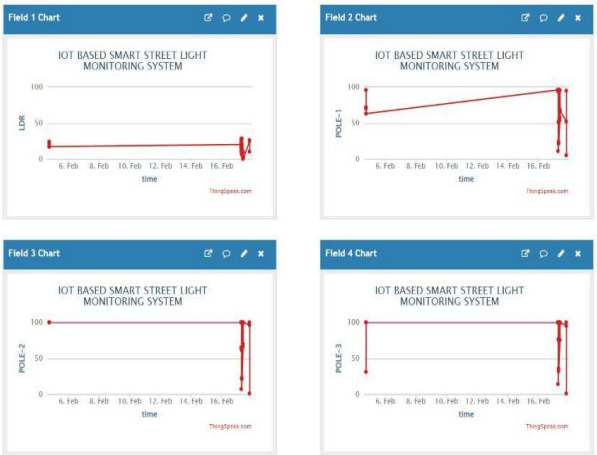


- The intensity values of light during night time in the presence of movement:



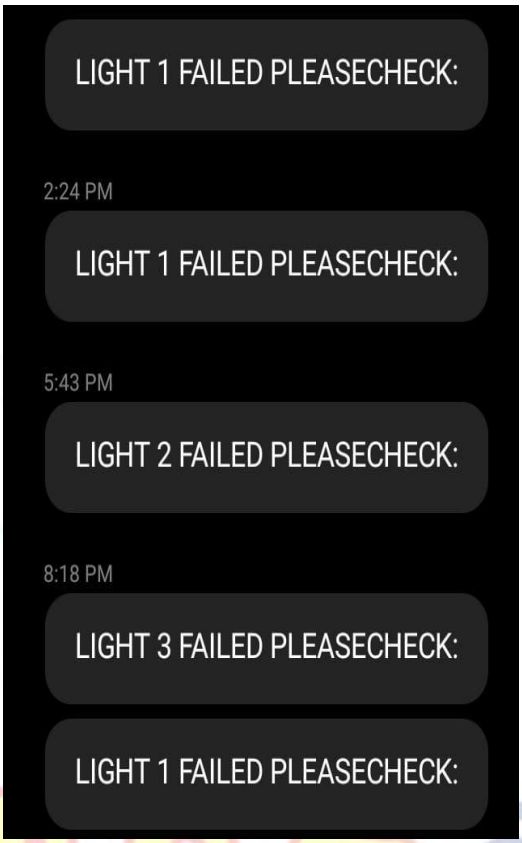
Thing Speak:

Thing Speak is a cloud-based IoT analytics software that lets you gather, view, and analyze live data streams. By simply setting the devices using Thing Speak, one may undertake online data analysis and processing. Collect, analyze, and act are the three main aspects. Each light's analytics may be shown as illuminance Vs time in the proposed system.



And the values also stored in an excel sheet as CSV (comma separated values) file which is can be downloadable. We can also export data entries for visualization.

- **Case 4:** During fault occurrence – message will be sent to the registered mobile number.



Messages will be sent to registered mobile number and the messages will be sent to that as shown in the above picture. As each and every light has a number associated, it's easy to identify that a light got failed and also easy to identify which light got failed to resolve the problem as early as possible.

Hence the proposed system satisfies the requirement as it conserves power and reduces manpower.

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

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