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GREEN ENERGY ENABLED STREET LIGHTING SYSTEM USING IOT

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Abstract: **One of the main objectives of smart cities is to provide an efficient street lighting system. Lighting can account for 10% to 38% of the total energy bill in typically cities worldwide. Every year, a lot of money is wasted on inefficient lighting, and bad lighting also makes things unsafe. Every engineer who works in this field is interested in the idea of creating a new system for streetlights that illuminates large areas with the highest intensity of light while consuming little electricity. So we propose a next generation street lighting system using green energy to control and monitor the lighting infrastructure based on the traffic in order to ensure the efficient usage of conventional energy. The proposed system is also equipped with surveillance cameras to increase the security of people and also reduce the risk of accidents by ensuring that vehicles do not exceed the speed limit.**

***Index Terms*-Internet of Things, LDR Sensor, Infrared Sensor, ESP-32 cam module, Green energy.**

I. INTRODUCTION

Providing pedestrians and commuters with a safer nighttime environment, street lighting is an essential public service. The use of street lighting in the right way can be thought of as a safety measure that has economic and social benefits for the people. These benefits include the reduction of nighttime accidents and economic loss, support for police protection and an improved sense of personal security, smoother traffic flow, promotion of business activities, and the use of public interactions at night.

Although this service is frequently available in developed nations, a lack of financial resources causes many developing nations to lack adequate street lighting. Street crimes and other mishaps are commonplace as a result of poor living conditions caused by inadequate nighttime lighting.

II. LITERATURE SURVEY

[1] This paper proposes a system based on IoT that emphasizes the importance of automatic switching of street lights in order to conserve conventional energy. IR sensors have been used for the detection of traffic in order to determine the switching of the lights. The movement of traffic is being recorded in the cloud server for future references. This paper was published on IEEE Explore, 2019.

[2] This paper proposed and implemented an intelligent street lighting system using IoT and Raspberry Pi. The LDR and IR sensors are powered using solar energy by installing solar panels on the top of the street lights. The use of conventional energies is totally eliminated in this system. This paper was published in ICRAEM 2020.

[3] In this proposed system, the wind turbine installed on top of the street lights generate wind energy and this energy is converted and used for lighting the street lights based on the requirement. This paper was published in (IJACSA) International Journal of Advanced Computer Science and Applications,2018

[4] This paper consists of automatic switching of street lights based on the intensity of sunlight in the environment and the flow of traffic. The real time traffic is monitored using the readings of the IR sensor which is displayed to the authorities. This paper was published in International Journal of Engineering and Advanced Technology (IJEAT) April2021.

III. PROPOSED SYSTEM

The proposed system is to design a smart street lighting system for the society, to achieve sustainable development, powering the street lights using green energies and elimination of light pollution without compromising the safety of the citizens.

OBJECTIVES:

The main objectives of the proposed system:

- To create a smart street lighting system.
- To promote sustainable development.
- To enhance the security of citizens.
- To eradicate manual inefficiencies.

WORKING PRINCIPLE:

In this model of street lighting system, we use the arduino board to connect all the peripheral components and a Wifi module to get connected with an IoT based cloud server. The wind turbine connected to the arduino board converts wind energy into electrical energy. The use of green energies such as solar and wind energy helps promote the nation towards sustainable development and decrease global warming. Automatic switching of street lights is achieved by the following mechanisms: LDR (Light dependent resistor) sensors that switch on and off lamps according to the intensity of sunlight. And IR (Infrared) sensors are used to control the switching of lights based on the real time traffic. This method helps us to eliminate light pollution, save conventional energies and also eradicate all manual inefficiencies and significantly reduces the cost of labour.

The surveillance cameras installed in the street light enhances the security of the public and helps in better vigilance and to decrease the crime rate in the nation. All the data received from various sensors are sent to the cloud server using the Wifi module ESP8266. We would be able to draw various conclusions from the stored data in the cloud servers such as identifying the areas with heavy and low footfall, accident prone zones etc. A suitable mobile application is developed to record the grievances and also to maintain the lighting infrastructure. Authorities can monitor the street lighting and also interpret the shortcomings of the system easily using the mobile application. In future, data analytics can be performed on the collected data to predict weather conditions, traffic flow statistics, pedestrian flow etc. Further, the surplus green energy generated by the system can be stored in the smart grid and can later be used when the need arises.

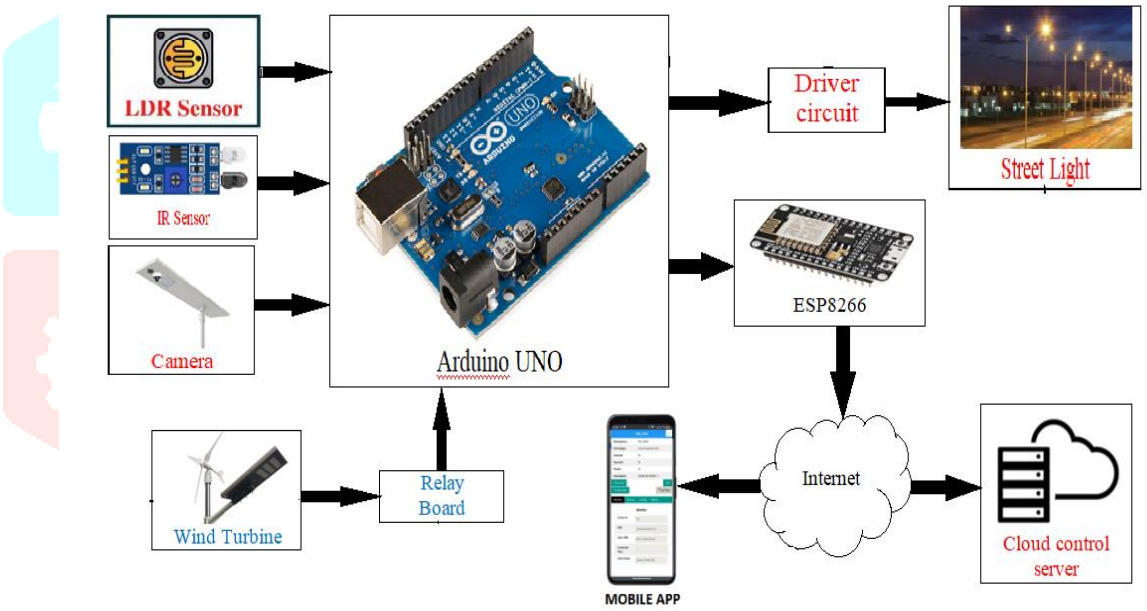

Fig.1-Block Diagram of Proposed System

ADVANTAGES:

- Conservation of conventional energy
- Eliminates light pollution
- Improves Efficiency
- Data can be monitored
- Enhances security
- Cost effective

IV. SYSTEM DESIGN AND IMPLEMENTATION

HARDWARE REQUIRED:

- **Arduino UNO**

  The Arduino UNO is a microcontroller board based on the ATmega328P. It has 14 computerized input/yield pins, six simple information sources, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. Six of these pins can be used as PWM yields.

- **LDR Sensor**

  LDR sensors or light dependent sensors are used to detect the amount of sunlight present in the environment. It exhibits the property of photoconductivity.

- **IR Sensor**

  IR Sensor stands for Infrared sensors. It is used to detect the movement of objects in the environment. It detects the heat radiation to determine the flow of traffic.

- **ESP8266 Module**

  ESP8266 is a Wifi SOC (framework on a chip) created by Espressif Frameworks. It's a highly integrated chip made to fit in a small package and offer complete internet connectivity. The module enables communication between the components.

- **Driver Circuit**

  The driver circuit is used to interface the wind turbine with the Arduino UNO. The driver circuit helps in powering and rotating the wind turbine to generate green energy.

SOFTWARES REQUIRED:

- **Python**

  Python programming language is used to develop the concept of machine learning in order to detect the flow of traffic in the future.

- **C++**

  C++ programming language is used to interface the components such as IR sensor, LDR sensor, IP camera, Wifi module with the Arduino UNO.

- **Arduino IDE**

  It is open-source software that is used to code the Arduino UNO microcontroller and upload it. Multiple operating systems, including Linux, MacOS X, and Windows, are compatible with the IDE application.

- **Ubidots Application**

  The Ubidots application is used to analyze the readings of the street light systems and to draw graphs based on the usage of street lights at various times.

HIGH LEVEL DIAGRAM

High Level Design (HLD)of the proposed system shown in Fig 2 This architecture diagram provides an overview of the proposed system and interfacing of various sensors that we have used for system This HLD aids in ensuring the compatibility of supporting components with one another.

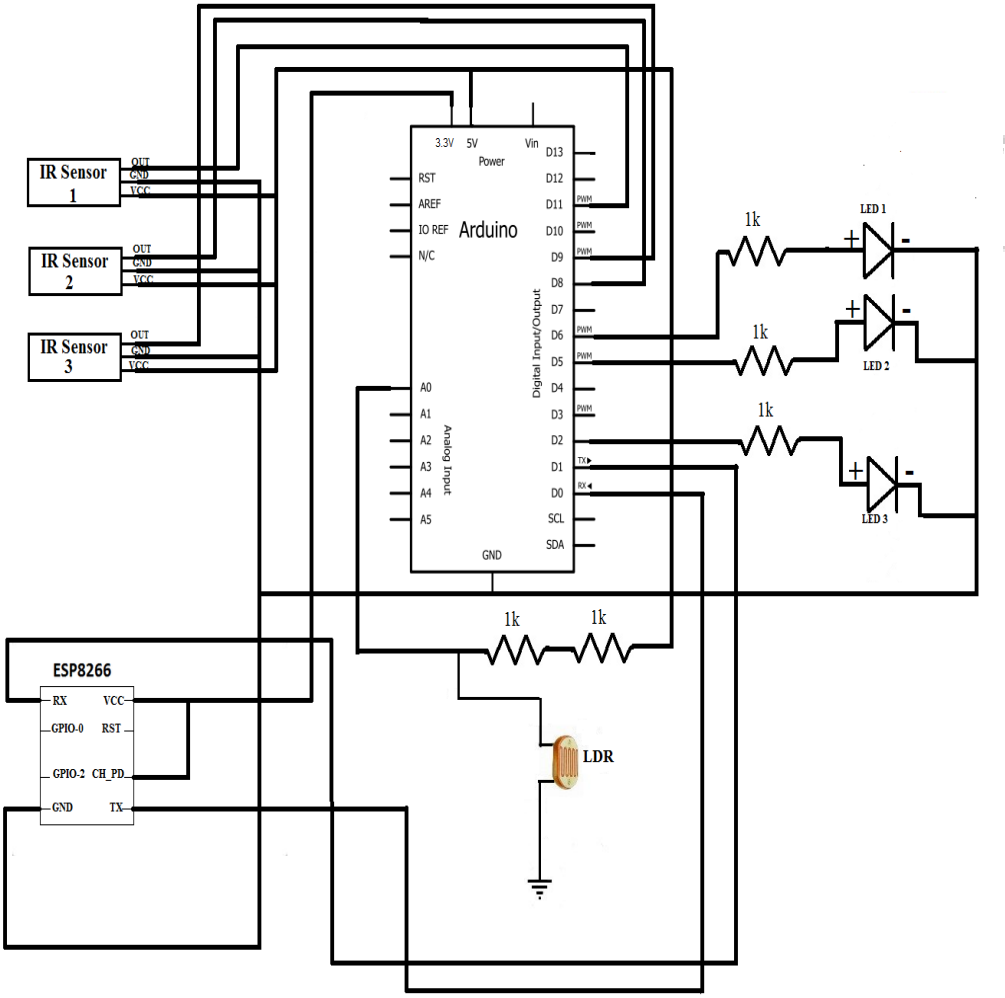

Fig.2-HLD Diagram

INTERFACING IR SENSOR TO ARDUINO UNO

STEP 1: Connect the Infrared Sensor **Vcc** to **5V** Power Supply on Arduino UNO.

STEP 2: Connect the Infrared Sensor **OUT** to **D2** Pin on Arduino UNO.

STEP 3: Connect the Infrared Sensor **GND** to **GND** on Arduino UNO.

INTERFACING LDR SENSOR TO ARDUINO UNO

STEP 1: Connect the LDR Sensor **Vcc** to **5V** Power Supply on Arduino UNO.

STEP 2: Connect the LDR Sensor **Digital Out** to **D2** Pin on Arduino UNO.

STEP 3: Connect the LDR Sensor **Digital Out** to GND on Arduino UNO.

INTERFACING ESP-32 CAM TO ARDUINO UNO

STEP 1: Connect the ESP-32 cam **U0R** to **RX0** on Arduino UNO.

STEP 2: Connect the ESP-32 cam **U0T** to **TX0** Pin on Arduino UNO.

STEP 3: Connect the ESP-32 cam **GND** to **GND** on Arduino UNO.

STEP 4: Connect the ESP-32 cam **Vcc** to **5V** on Arduino UNO.

INTERFACING ESP 8266 TO ARDUINO UNO

STEP 1: Connect the ESP 8266 **RX** Pin to **RX** Pin on Arduino UNO.

STEP 2: Connect the ESP 8266 **TX** to **TX** Pin on Arduino UNO.

STEP 3: Connect the ESP 8266 **Vcc** to **3.5V** Power Supply on Arduino UNO.

STEP 4: Connect the ESP 8266 **GND** to **GND** on Arduino UNO.

DATA FLOW DIAGRAM:

A data-flow diagram (DFD) of the proposed system represents a flow of data through a processor a system. The following data flow diagram also provides information about the outputs and inputs of each entity and the process itself.

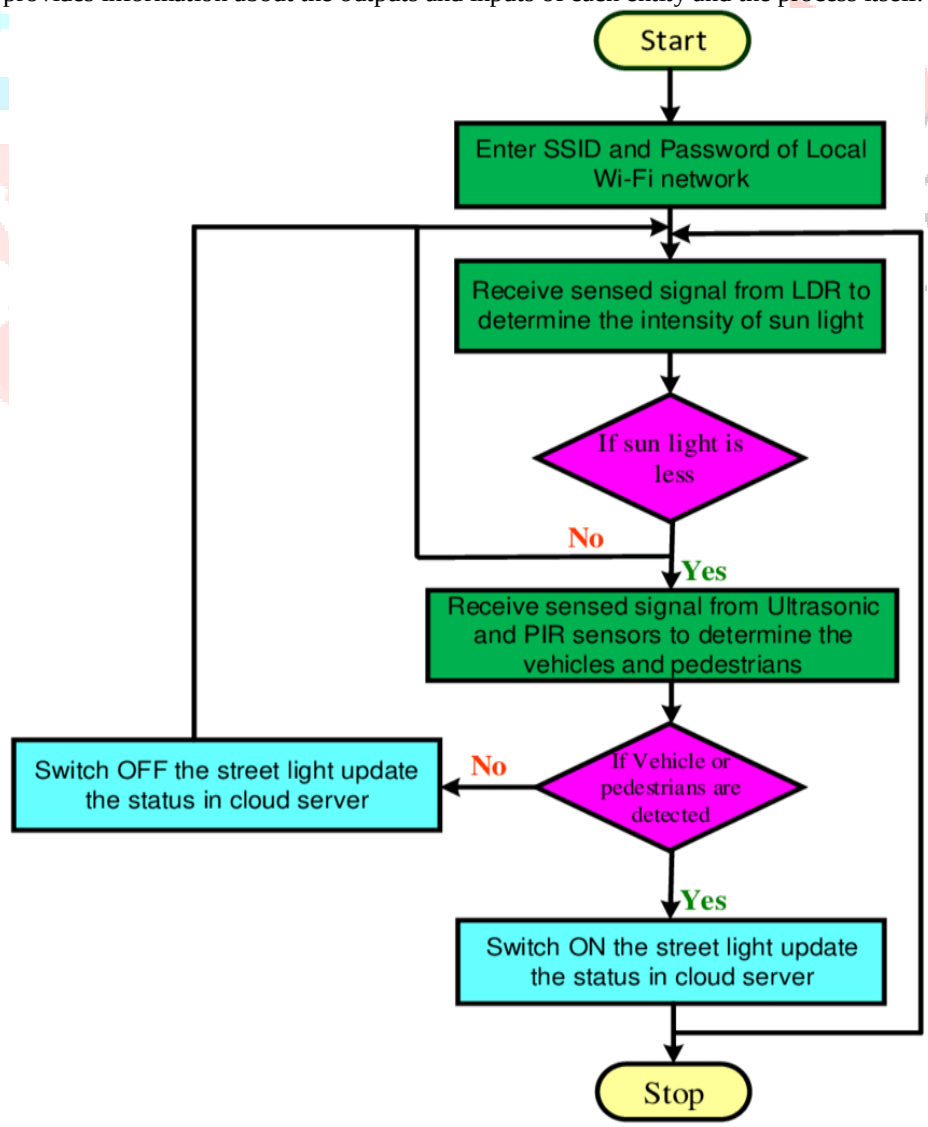

Fig.3-DataFlowdiagram

UBIDOTS:

Students, makers, and researchers can build IoT solutions with ease and security thanks to Ubidots. It is used to visualize data, send it to the cloud from any device with an Internet connection, and then trigger actions and alerts based on that data. Ubidots is an Internet of Things (IoT) platform that enables industries and innovators to prototype and scale IoT projects to production. Using visual tools, actions and alerts can be set up based on real-time data and unlocking data values. Ubidots provides a REST Programming interface that enables customers to browse and write information about the available resources, such as data sources, factors, values, events, and experiences. The API supports both HTTP and HTTPS and an API Key B-friendly APIs, analytics, reports and alerts.

V. RESULT

STEP 1:

The prototype of the proposed system is shown in Fig.4. The Arduino UNO board is interfaced with LDR Sensor, Infrared Sensor, ESP 8266 and ESP-32 camera module.

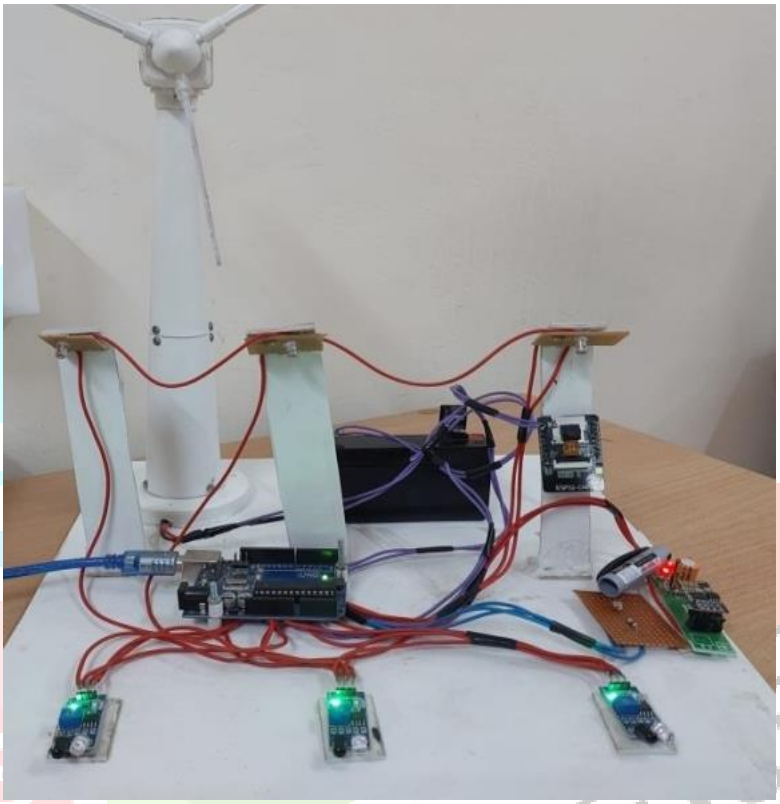

Fig.4 Arduino with Sensors

STEP 2:

The Fig.5 shows the login page of ubidots website where we enter the user credentials.

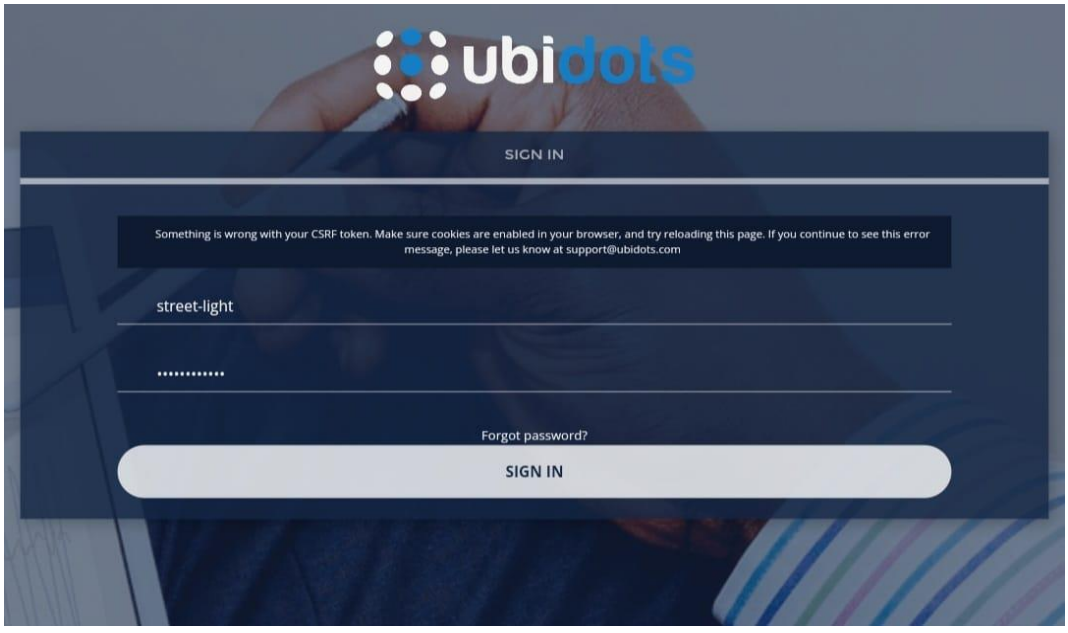

Fig.5 Login page of Ubidots website

STEP 3:

Fig.6 is the ubidots dashboard which shows the readings of the street light system.

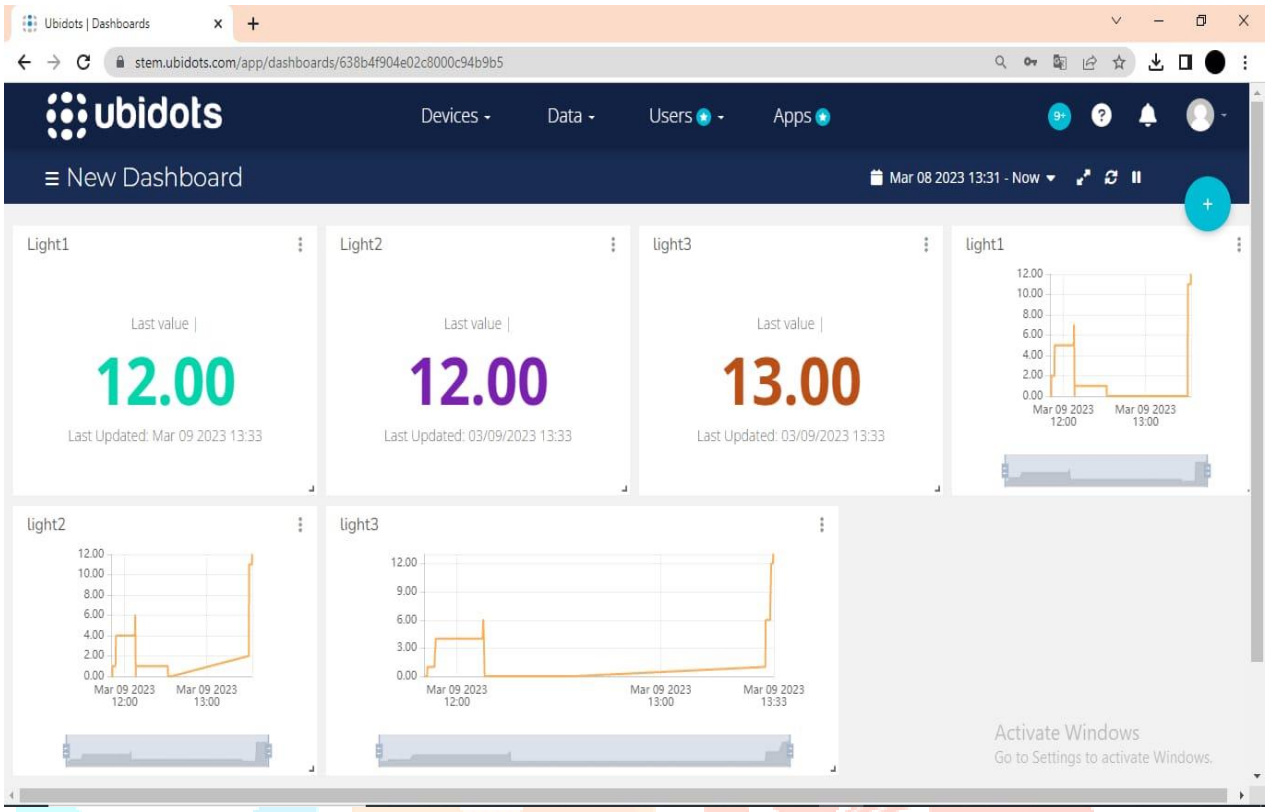

Fig.6 IR sensor data with graph

STEP 4:

An android application is created to view the readings of the street light using a mobile device.

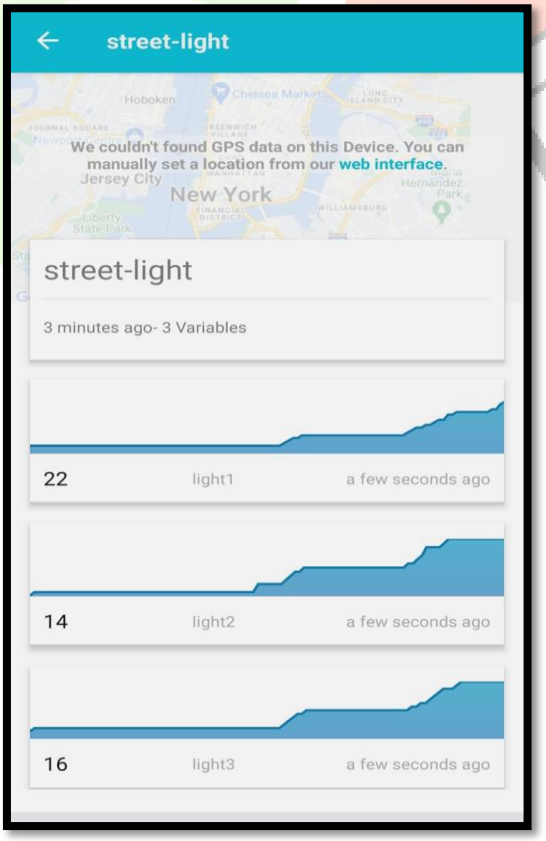

Fig.7 Application UI

VI. ACKNOWLEDGEMENT

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VII.CONCLUSION

Green energy enabled street light monitoring system is developed with suitable sensors and software applications to optimize the power consumption and increase the safety of citizens by monitoring and analyzing the objects crossing the street lights. It can be extended to monitor multiple locations at the same time and website or application must be able to display the info based on the selection done by the authority. In future, data analytics can be performed on the real-time data collected from Arduino UNO micro controller, using ML (Machine Learning) algorithm to predict weather conditions, traffic flow statistics, pedestrian flow etc. Further, the surplus green energy generated by the system can be stored in the smart grid and can later be used when the need arises.

VIII.REFERENCES

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