SHRI RAMDEOBABA COLLEGE OF ENGINEERING AND MANAGEMENT, NAGPUR.

ELECTRONICS WORKSHOP LAB MINI PROJECT REPORT

(6^{TH} SEM, SESSION 2022-2023, ECP358)

"Smart Street Light System with Automatic Intensity Control and Automatic Fault Detection"

Submitted By

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1. Introduction

The model ‘Smart Street Light Systems’ proposed by us offer a more efficient and cost-effective way to light up the streets.

Automatic brightness management is a crucial element of our project. This function allows the lights to vary their intensity dependent on the ambient light levels in the surrounding surroundings. The device may automatically dim or brighten the lights based on the light conditions it is continually monitoring. This dynamic management saves energy by minimizing unneeded lighting during daylight or in well-lit regions. It also decreases light pollution, improves visibility in low-light settings, and makes the area safer for pedestrians and automobiles [1].

Our smart street light system also incorporates automatic failure detection, which is an important feature. Traditional street lighting systems frequently have problems such as bulb failures or wiring concerns. Identifying and correcting these flaws can be time-consuming and expensive. Our system incorporates automatic fault detection, enabling timely identification and rectification of faults [1].

By implementing these advanced features, our project aims to create a more sustainable, efficient, and reliable street lighting infrastructure for the benefit of the community.

Literature Survey:

When it comes to metropolitan cities the night also plays an important role and the consumption of power the streetlights are of 8-10% of the total consumption. The operating of this streetlight plays an important role, manual operation is one the most common operation used. In our proposed system we introduced automatic street lightening based on the intensity of sunlight [2].

The objective of the project is to provide automatic control and fault detection on streetlamps. The lighting system which targets energy and automatic operation on economical affordable for the streets and immediate information response about the streetlamp fault. Moreover, errors which occur due to manual operation can also be eliminated. The streetlight switched ON/OFF through an Internet of Things (IOT). The street light system is checking the weather for streetlamp ON/OFF condition. The weather is noted through an LDR sensor, If the weather is bright, the system will OFF. If the weather is dark, the light system will be ON. After the light is ON the light condition also check through LDR sensor for glow or not glow status. If light is not glowing, the sensor sends the value to the street light system. The street light system will generate message and send SMS to ward member and ward serviceman mobile number [2].

2. Impact of Project on society and the environment

The introduction of smart street lights with automatic ambient brightness control and automatic fault detection can have a significant impact on both society and the environment. Here are some possible impacts:

1. Energy Efficiency: Smart Street lights can help reduce energy consumption by automatically adjusting the brightness level based on the ambient light. This reduces the energy wasted on lighting empty streets during the day or excessively brightening the streets at night, leading to lower carbon emissions and less strain on the energy grid [2].

2. Cost Savings: By reducing energy consumption and minimizing maintenance costs, smart street lights can save money for local governments and taxpayers. Automatic fault detection can also help identify and address issues quickly, reducing the time and cost required to repair them [3].

3. Improved Safety: Smart Street lights can help increase safety on roads by providing better visibility for drivers, pedestrians, and cyclists. Automatic brightness control can ensure that the lighting is optimal for different weather conditions, and automatic fault detection can help ensure that any malfunctioning lights are fixed promptly.

4. Reduced Light Pollution: Smart Street lights can help minimize light pollution, which can disrupt ecosystems and affect wildlife. By automatically adjusting the brightness levels and reducing the amount of light emitted, smart street lights can help preserve the natural environment.

5. Improved Quality of Life: Smart Street lights can contribute to a better quality of life for residents by creating more pleasant and safer public spaces. Better lighting can help increase feelings of safety and security, encourage outdoor activities, and improve the overall aesthetic of the urban environment [3].

Overall, the implementation of smart street lights with automatic ambient brightness control and automatic fault detection can have a positive impact on both society and the environment, leading to increased energy efficiency, cost savings, improved safety, reduced light pollution, and a better quality of life.

3. Block diagram and Functional description

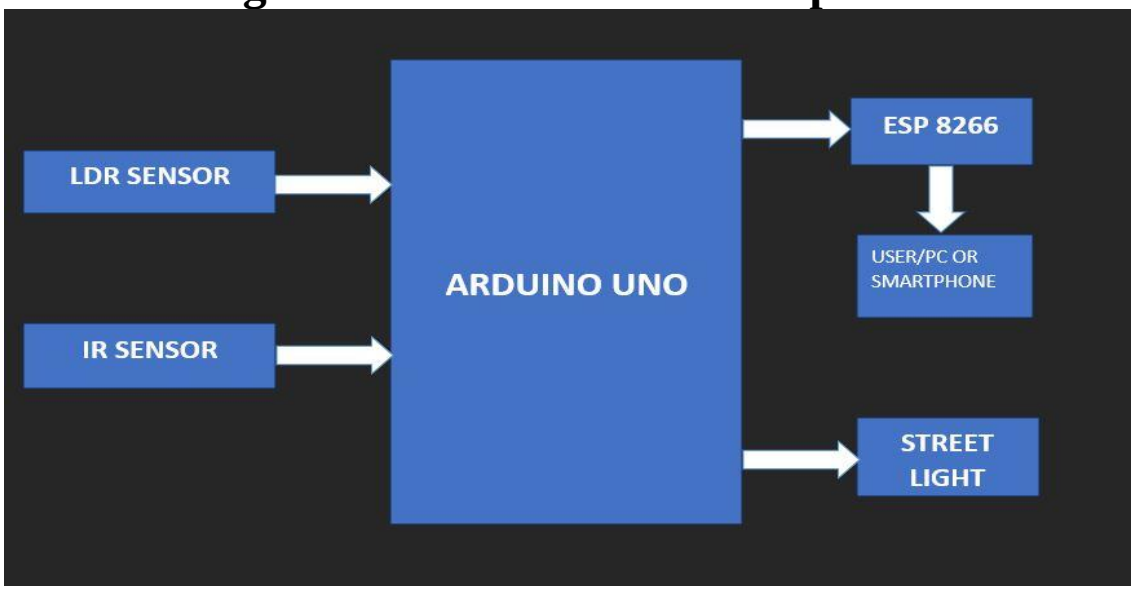

Figure 1

- Arduino Board: The central component of the system is the Arduino board, which serves as the microcontroller unit (MCU). It acts as the brain of the system and controls the overall operation.
- PWM Driver: The PWM (Pulse-Width Modulation) driver receives signals from the Arduino board and controls the intensity of the street light. By adjusting the duty cycle of the PWM signal, the driver can regulate the brightness of the light.
- Fault Detection: The LDR can also be used for fault detection in the street light system. If the LDR consistently reports very low light levels during nighttime when the street lights are expected to be on, it could indicate a fault in the lighting system, such as a burnt-out bulb or a power supply issue. The system can use this information to trigger alerts or notifications for maintenance personnel to address the problem [4].
- A common LDR (Light Dependent Resistor) can be used as a light sensor to detect the ambient light level.
- Motion Detection: An IR sensor can be used to detect the presence of vehicles, pedestrians, or any other objects in the vicinity of the street lights. When the IR sensor detects motion, it sends a signal to the system, indicating that there is activity in the area. This information can be used to activate or increase the brightness of the street lights to ensure proper illumination and safety.
- EP8266: The ESP8266 is a versatile Wi-Fi module that can be utilized in a smart street light system for fault detection and reporting.
- Alert Generation: If a fault is detected, the ESP8266 can generate alerts or notifications to indicate the occurrence of the fault. It can send messages via Wi-Fi or other communication protocols to notify maintenance personnel or a central monitoring system about the specific fault and its location [4].

4. Circuit diagram and its description

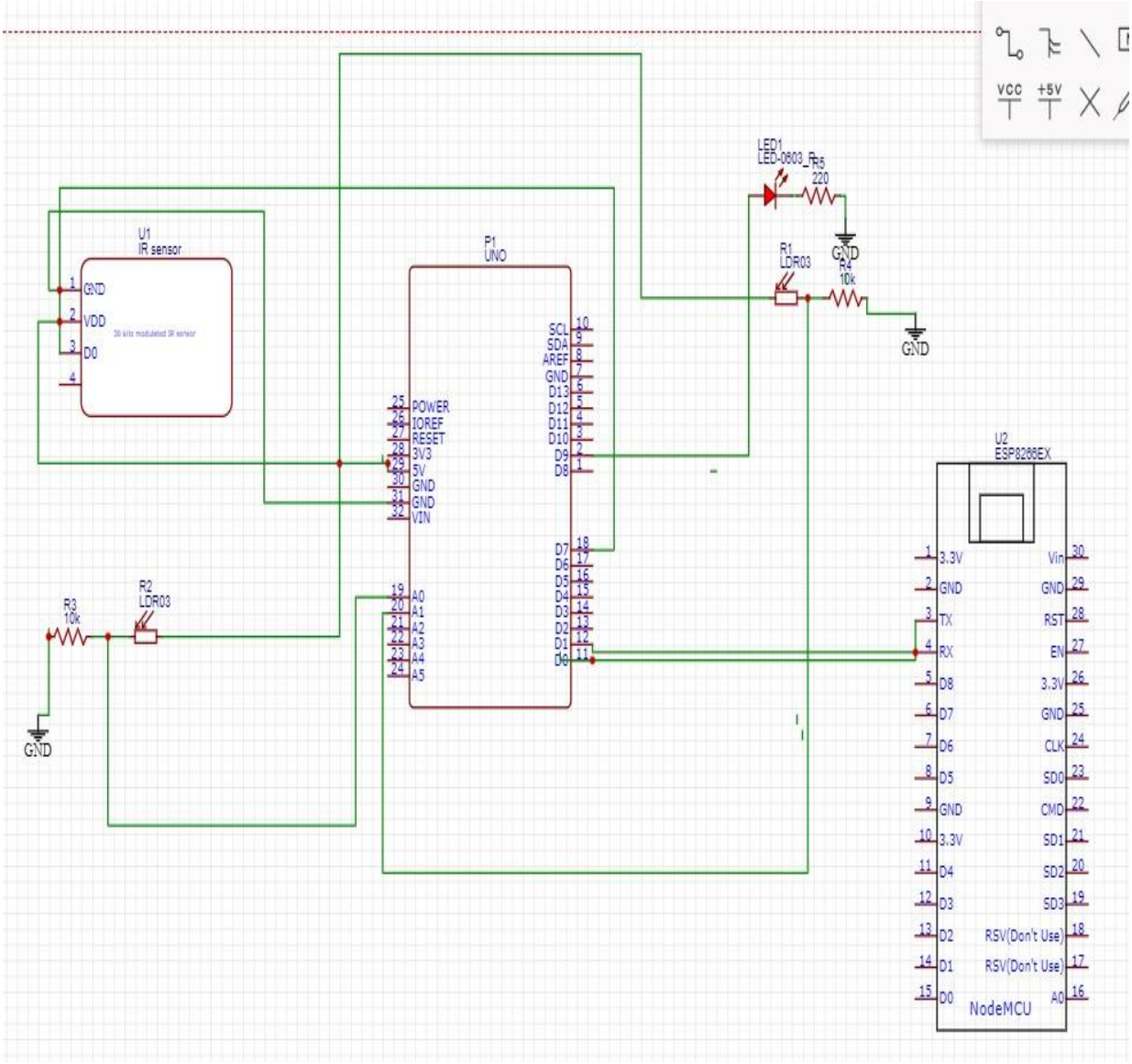

Figure 2

The presented circuit consists of the following components-

- An Arduino UNO board.
- An ESP8266 Wi-Fi module.
- Light Dependent Resistor (LDR).
- Connecting wires.
- Light Emitting Diode.
- Resistors (10k ohms).
- Resistors (220 ohms).
- Infrared sensors (IR).

CONNECTIONS: -

- The RX pin of the ESP8266 is connected to the TX pin of the Arduino UNO.
- The TX pin of the ESP8266 is connected to the RX pin of the Arduino UNO.
- Each LDR and LED are connected to a pull-down resistor for a sufficient supply of current and voltage.
- The IR sensor used for detection of vehicles or pedestrians is connected to the Arduino UNO D7 pin.
- The common LDR, which detects ambient light is connected to the A0 pin of Arduino UNO.
- The LDRs, which we installed under each lamp used for fault detection, are connected to the analog pins (A1, A2, A3, and A4) of the Arduino UNO board.

5. Working of Project

The Arduino Uno can serve as the system's controller. It reads data from the common LDR and adjusts the brightness levels of the streetlights. This LDR is used to measure ambient light levels and change the brightness of the streetlights according to the different ranges of resistance output of this common LDR. As the ambient light level decreases, the resistance of the common LDR goes on decreasing, which in turn increases the brightness of the streetlight accordingly.

The ESP8266 module is used for communication. It is linked to the internet, allowing for remote monitoring and management of the street lighting system. If a defect is identified, the ESP8266 module transmits a message to a central monitoring system.

When the ambient light levels drop below a certain threshold, the streetlights come on at 80% intensity. Here comes the role of the IR sensor. The infrared sensors detect any objects in their path. When it does so, the streetlights now glow with 100% intensity. It drops back to 80% intensity when the object or objects are passed through it.

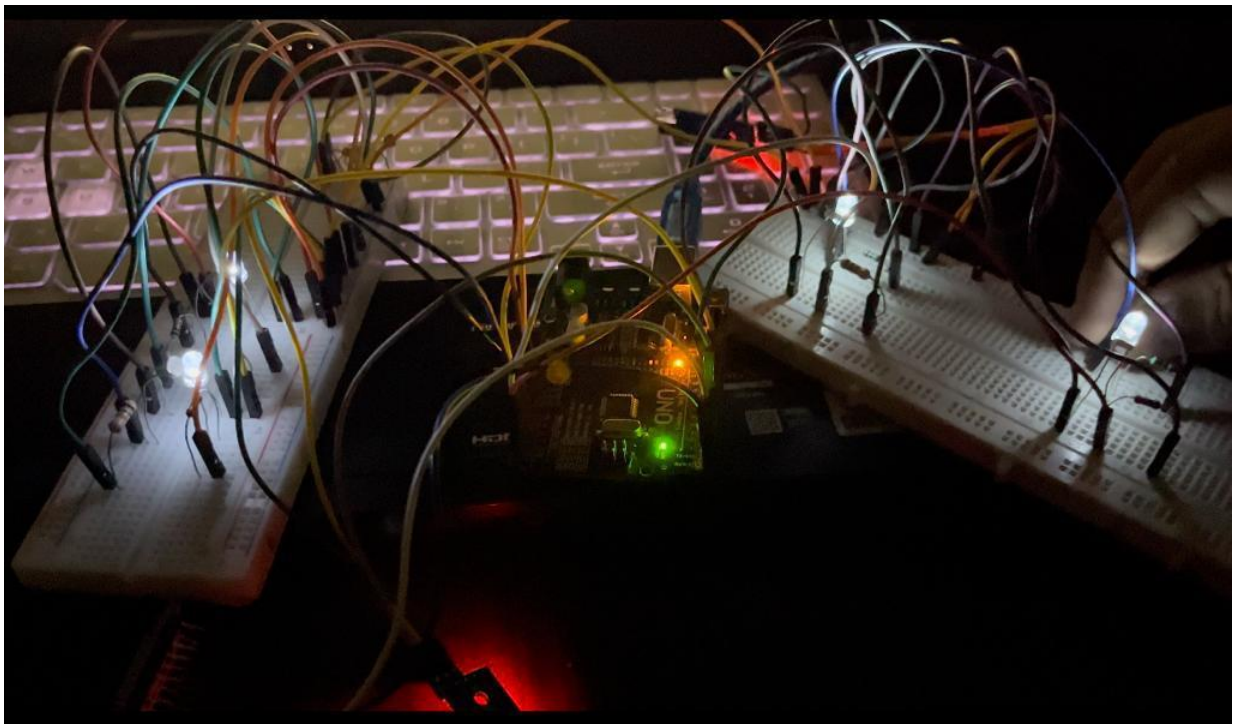

Figure 3

6. Result & Future Scope

At the day time, the light will be in off position. When the environment light is decreasing, the level of intensity of the street light increases. During the night time or when the environment light is below the declared threshold, the street light will be at 80% of its maximum brightness. Now, if there is any movement of vehicle/pedestrian in the range of the IR sensor during the night, the streetlight will be at its highest intensity [5][6].

Whenever there is a light failure, the LDR sensor placed under each lamp will detect it and will display a message on the Blynk app through ESP8266 wi-fi module.

This will help in saving the electricity to a great extent. Also, remote monitoring helps in detecting the failure of light which reduces the manpower. Which results as a great cost-efficient method for the governing bodies to operate these street lights.

Future Scope

The smart street light system with ambient brightness control and fault detection has a vast future scope. Some of the potential advancements that can be made in the future include:

Integration with Smart City Infrastructure: The smart street light system can be integrated with other smart city infrastructure to create a more cohesive and efficient ecosystem. For example, it can be connected to traffic management systems to control the brightness of the streetlights based on the traffic flow [7][8].

Renewable Energy Integration: The street light system can be powered by renewable energy sources such as solar panels and wind turbines. This will reduce the dependency on the grid and make the system more sustainable [9].

Advanced Fault Detection and Maintenance: The fault detection system can be improved by using advanced sensors and machine learning algorithms. This will help in detecting faults accurately and predicting maintenance requirements beforehand, reducing downtime and maintenance costs.

Real-time Monitoring and Control: The system can be designed to provide real-time monitoring and control of the street lights. This will help in adjusting on the fly, based on the changing requirements [10].

Overall, the future scope of the smart street light system is vast, and advancements in technology can make it more efficient, sustainable, and cost-effective

7. References

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