UNIVERSITY COLLEGE OF ENGINEERING, DINDIGUL - 624622

AUTOMATIC FAULT DETECTION IN STREET LIGHTS

BE. ELECTRONICS AND COMMUNICATION ENGINEERING

PROJECT GUIDE
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ABSTRACT

- Solar energy is the energy that comes from the sun in the form of light and heat. It can be converted into electricity or other useful forms of energy.
- It reduces the energy consumption and costs of the street lighting system.
- The project "**Automatic Fault Detection in Street Lights**", focuses on creating a system to quickly find problems with street lights and making public spaces safer and more reliable.
- Old methods of checking street lights are slow and need a lot of manual work. The solution aims to make this process faster and easier.
- Used components like an Arduino UNO board, LCD display, LED lights, LDR sensor, Ultrasonic sensor, Solar panel, and Battery are used.
- The Arduino UNO board acts as the main brain of our system.
- An LDR sensor is a device that used to detect the intensity of the light whether the solar light is working or not working.
- Ultrasonic sensor is a device that used to sense the movement of vehicles, pedestrians, or animals on the road, if there is any object comes near the ultrasonic Sensor, the light will ON. Otherwise, the light will OFF.
- If any fault is detected in the system, it will shows the error message on the LCD screen.

INTRODUCTION

- In the past, turning street lights ON and OFF needed people to do it, which was not very efficient. Sometimes, lights stayed on for too long, wasting electricity, and if something went wrong with a light, it could take a while to fix. This could be dangerous if roads were not well-lit. To fix these problems, automatic systems were made, but they didn't always work well because they couldn't adjust to changes in when the sun rises or sets. So, we need a new system that can do this better.

- The Automatic fault detection in street lights without IoT is a project that aims to automate the control of street lights and detect faults, thereby eliminating the need for manual on-site work.

- This system operates in two modes. In one mode, it uses a Light Dependent Resistor (LDR) to sense the level of sunlight. It automatically switches the street lights ON when the sunlight becomes invisible to our eyes, and OFF when the sunlight is visible.

- In the other mode, the lights are automatically switched ON only when motion is detected. If there is no motion, lights intensity automatically reduced.

- A status checking LDR sensor is placed in each street light. If any particular street light is not working, then the corresponding LDR sensor will send the faulty light status information to the LCD Display.

- This system is a simple yet powerful energy-efficient concept. By using this system, manual on-site works are reduced. It is a great solution for energy saving, especially in public street lighting management.

OBJECTIVES

To sense the movement of vehicles, pedestrians, or animals on the road and adjust the brightness of the lamps accordingly the Ultrasonic Sensor is used. By using an Ultrasonic sensor, the street light system can save energy and cost.

To measure the intensity of the solar light to detect whether the solar light is working properly or not, for this LDR Sensor is used.

LITERATURE SURVEY

SI.NO	TITLE	AUTHOR	YEAR	REVIEW	MERITS	DEMERITS
(1)	**National Highway Street Light Faulty Detection and Monitoring System.**	G. Praveen, B. Ravi Teja, M.Madhu Venkat, G.Sai Anvesh	2019	A simple yet powerful energy-efficient concept for street light fault detection and monitoring. It eliminates manual on-site work and can be controlled remotely via the internet (IoT). By using NodeMCU ESP8266 microcontroller.	➢ Energy efficient solution. ➢ Remote control via IoT- Fault detection capability.	➢ NodeMCU ESP8266 is a complex design. ➢ Internet connectivity dependency.
(2)	**IoT Based Automatic Damaged Street Light Fault Detection Management System.**	Ashok Kumar Nanduri, Siva Kumar Kotamraju, G L Sravanthi, Sadhu Ratna Babu	2020	Aims to save power by controlling street lights automatically using a PLC XD26 microcontroller.	➢ Energy saving potential. ➢ Remote monitoring.	➢ High Cost ➢ Complexity ➢ Dependence on Internet Connectivity.
(3)	**Automatic Street Light Control And Fault Detection System With Cloud Storage.**	Mr.T.Gowdhaman, Mr. Dr.D.Surendran	2017	Provides automatic control and fault detection for street lamps. Aims for economical and affordable operation. Eliminates errors due to manual operation using Arduino board.	➢ Automatic operation. ➢ Immediate fault information response.	➢ Dependence on Internet Connectivity. ➢ Complexity of Implementation.

PROPOSED SYSTEM

- The street light system uses solar panels installed at each lamp post, the energy makes the street lights work, so the system doesn’t need electricity from the grid.

- Light Dependent Resistor (LDR) and Ultrasonic sensors control the operation of the lights based on sunlight visibility and motion detection. Each street light has a status checking LDR sensor for fault detection, sending data to the LCD display.

- This efficient, modern solution aims to eliminate manual work, increase energy efficiency, reduce costs, and provide immediate fault information. By using solar energy, the system not only becomes more environmentally friendly but also more cost effective in the long run, as the recurring cost of electricity is significantly reduced.

- One of the key advantages of this approach is its cost-effectiveness and scalability. By eliminating the need for internet connectivity and centralized servers, the system reduces infrastructure requirements and operational costs significantly.

- Overall, the system enhances operational efficiency and ensures reliable urban lighting, essential for smarter, livable cities.

BLOCK DIAGRAM

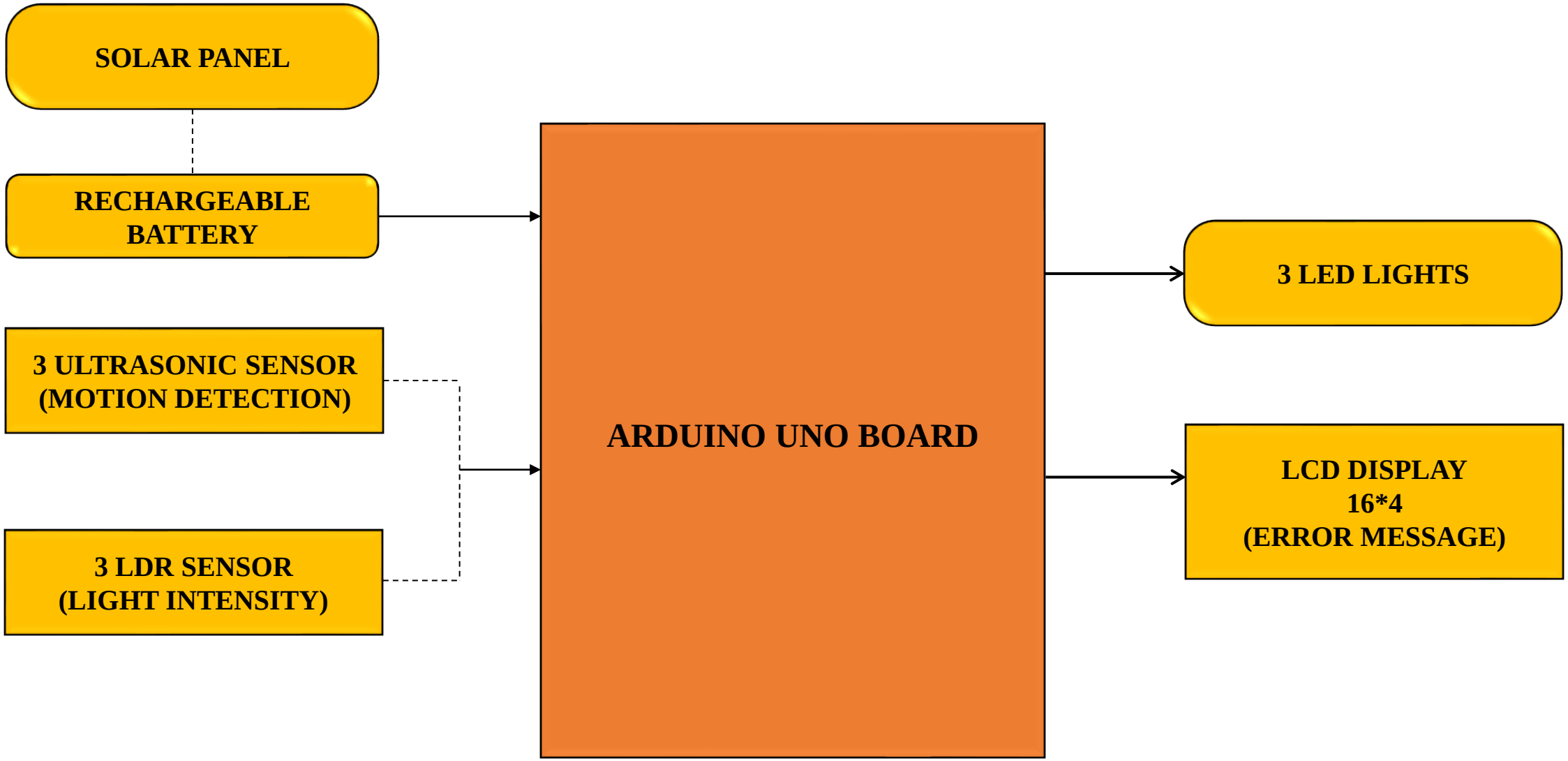

Figure 1: BLOCK DIAGRAM

HARDWARE SETUP

- The overall block diagram, consisting of four key components: Light Dependent Resistor (LDR) sensors, Ultrasonic sensors, an LCD display, and a microcontroller (Arduino UNO Board). The system aims to optimize energy efficiency and ensure reliable street lighting system.

- Firstly, Connect three LDR sensors to the Arduino Uno board. These sensors will detect ambient light levels, serving to monitor the functionality of solar lights.

- Secondly, Connect three ultrasonic sensors to the Arduino Uno. These sensors will detect the movement of an object, if an object comes within range of an ultrasonic sensor, the corresponding LED light switches ON; otherwise, it remains OFF.

- Connect three LED lights to the Arduino Uno board. These lights represent street lights and will be controlled based on the input from the ultrasonic sensors, activation according to movement.

- Integrate an LCD screen into the system to display the output and status. If any faults are detected within the system, an error message will be displayed on the LCD screen for prompt identification and resolution.

- The entire system is energy-efficient, powered by solar panels, aligning with sustainability goals. Overall, the automatic fault detection system represents a significant advancement in street lighting technology, enhancing performance, saving energy, and improving public space safety.

ARDUINO UNO BOARD

- Arduino UNO is a low-cost, flexible, and easy-to-use programmable open-source microcontroller board that can be integrated into a variety of electronic projects.

- The Arduino UNO board serves as the central processing unit in the “Automated fault detection in street lights”, facilitating sensor interfacing, processing, communication, control logic implementation, power management, and system customization.

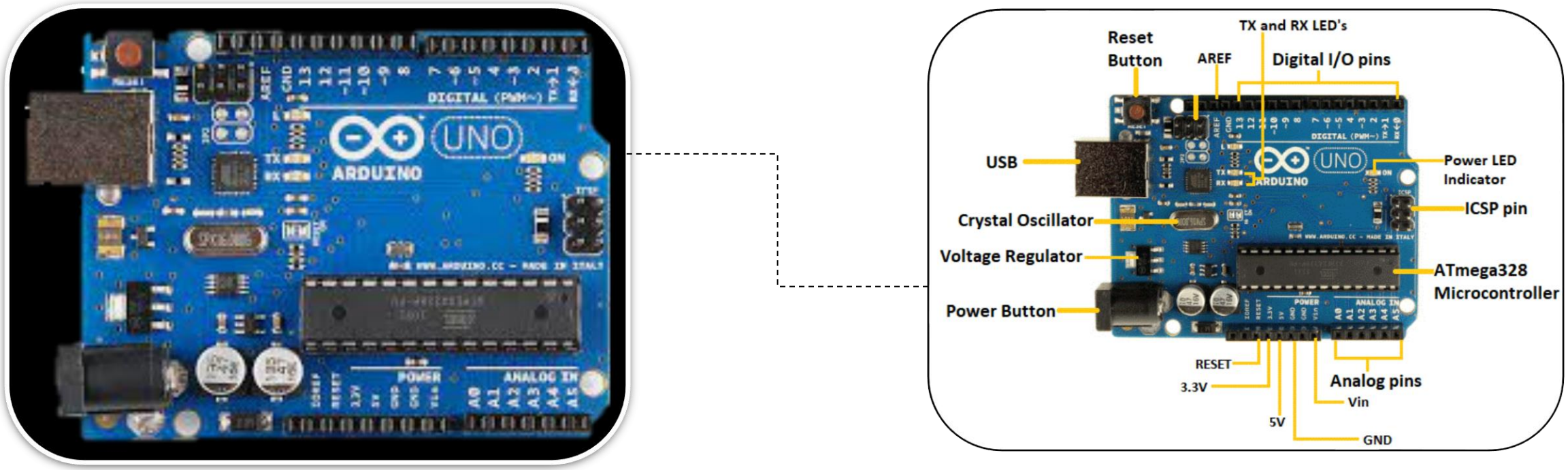

Figure 2: Arduino UNO Board

SENSORS

LDR Sensor: An LDR sensor is a device that used to detect the intensity of the light whether the solar light is working or not working.

- The LDR sensor turns street lights on and off based on the ambient light levels, adjusting for sunrise and sunset, it helps save energy by only turning the lights on when needed.

- Ensures proper lighting during dark hours, improving visibility and public safety.

Ultrasonic sensor: An Ultrasonic sensor is a device that used to sense the movement of vehicles, pedestrians, or animals on the road.

- When an object comes within a threshold distance detected by the ultrasonic sensor, the light will turn ON. If there is no object within the threshold distance, the light will turn OFF.

- This way, the sensor controls the light based on the presence of objects in its distance, allowing for efficient use of lighting.

Figure 3: LDR Sensor

Figure 4: Ultrasonic Sensor


SOFTWARE RESULT

- If the ultrasonic sensor detects a distance of 170cm, it triggers the condition for activating "light 1." This means that when the sensor measures an object or obstruction at this distance, the programmed response is to turn ON "light 1."

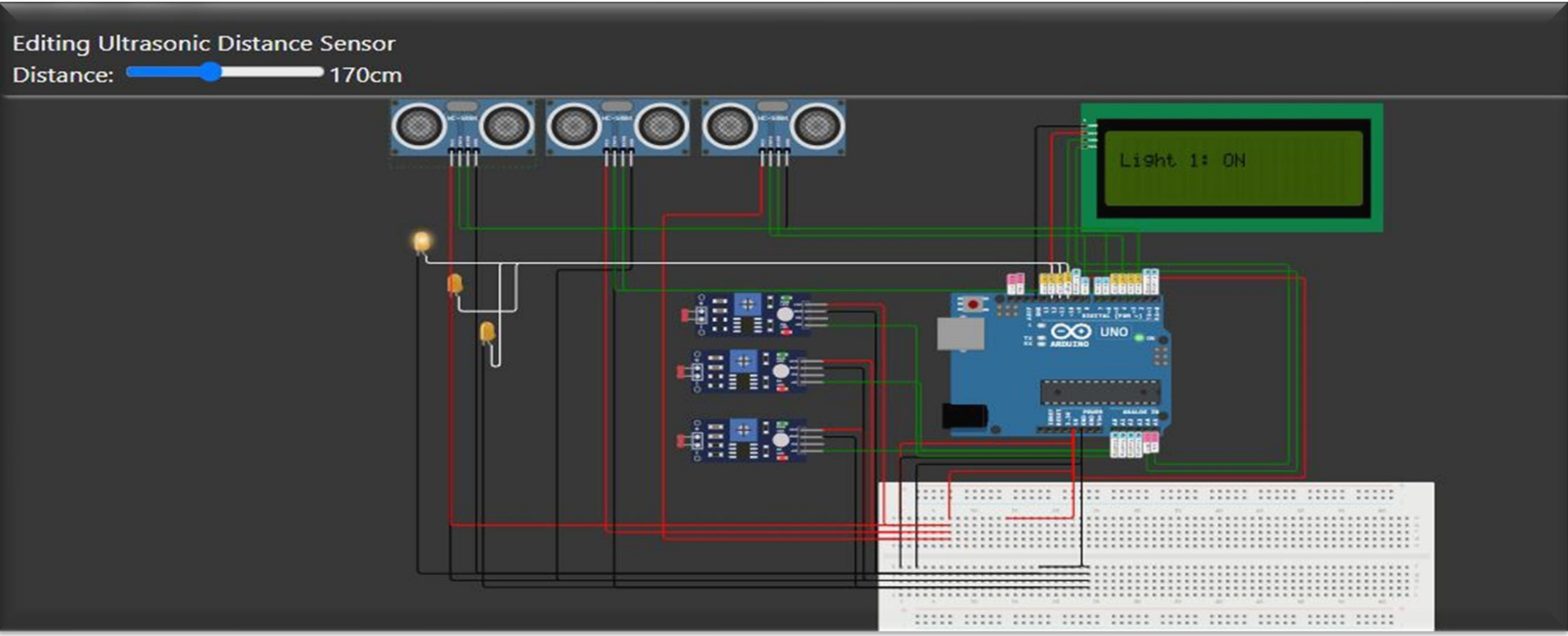

Figure 5 LED LIGHT 1: ON CONDITION

- If the ultrasonic sensor measures a distance of 201 cm, then "light 2" will be turned OFF "light 2" should be turned OFF according to the programmed conditions or logic.

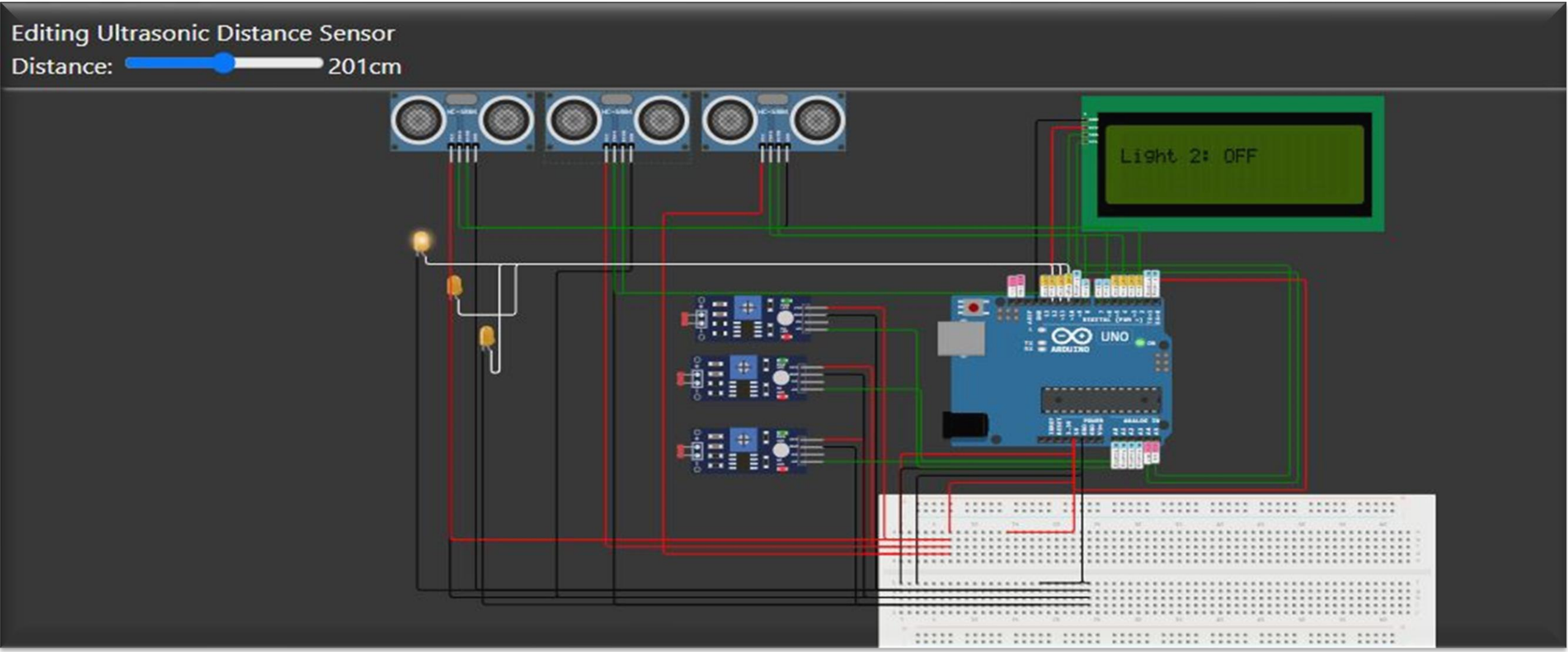

Figure 6 LED LIGHT 2: OFF CONDITION

- If the ultrasonic sensor measures a distance of 200 cm, then the condition for turning **ON** "light 3" is met

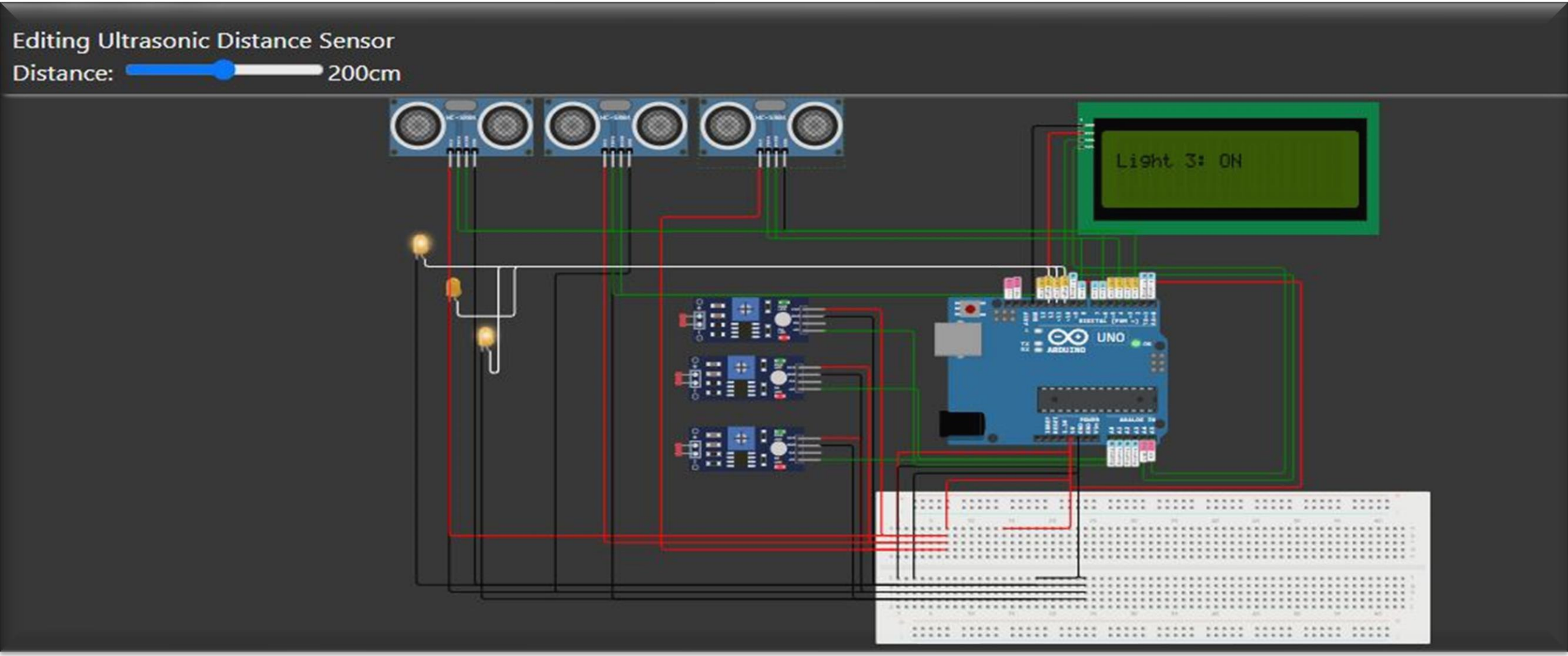

Figure 7 LED LIGHT 3: ON CONDITION

HARDWARE RESULT

- The hardware prototype of the project, demonstrates how the various components, such as the Arduino, LDR sensors, Ultrasonic sensor, solar panel and LED Lights, are integrated and work together.
- This prototype serves as a physical representation of the project is design and functionality.

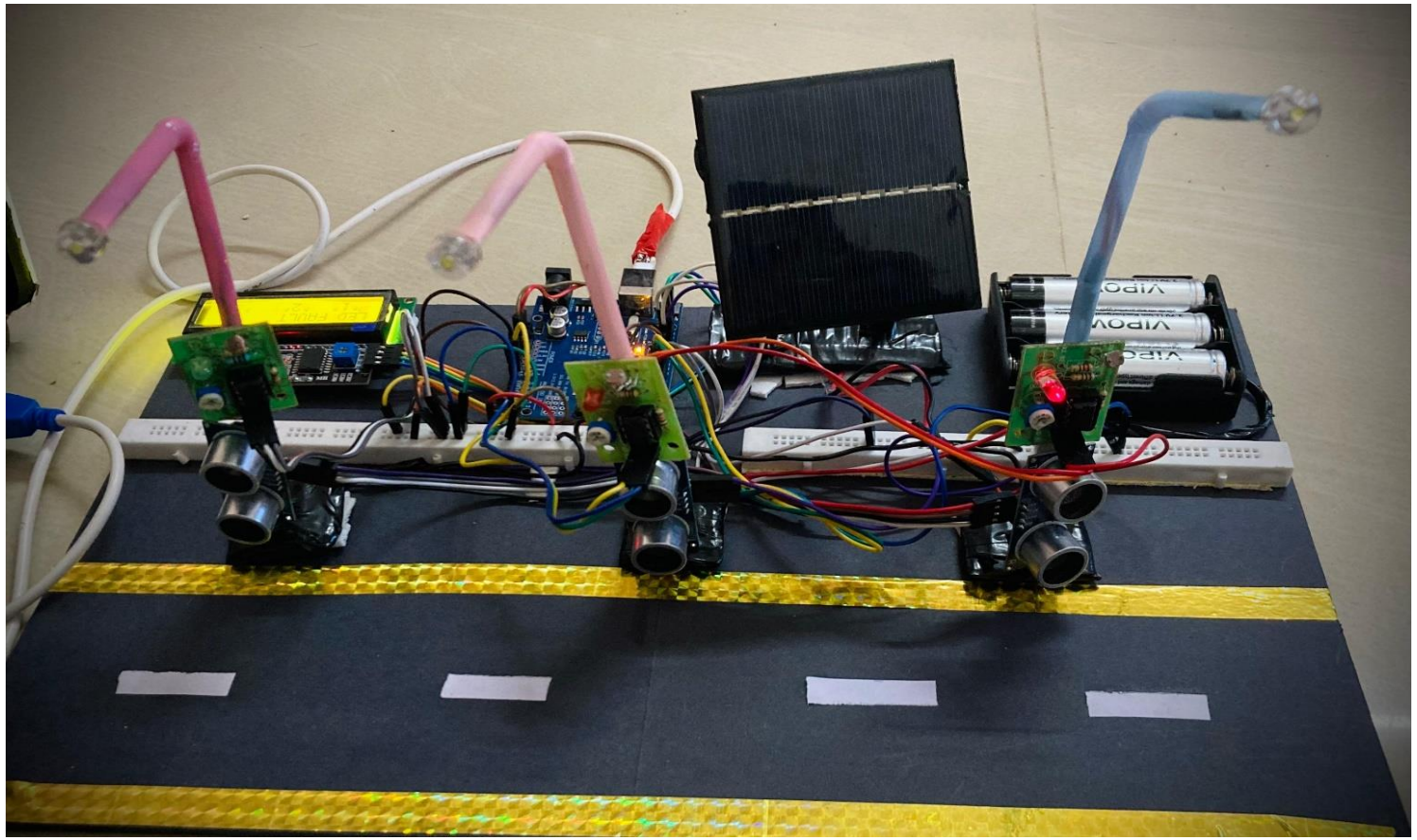

Figure 8 HARDWARE PROTOTYPE

- The LED light functions properly, so no 'LED fault' message is displayed. This setup ensures the light operates effectively when a person or object approaches, improving safety and visibility in the area.
- Since no object is detect within a threshold distance the LED lights 1 and 3, they remain OFF.

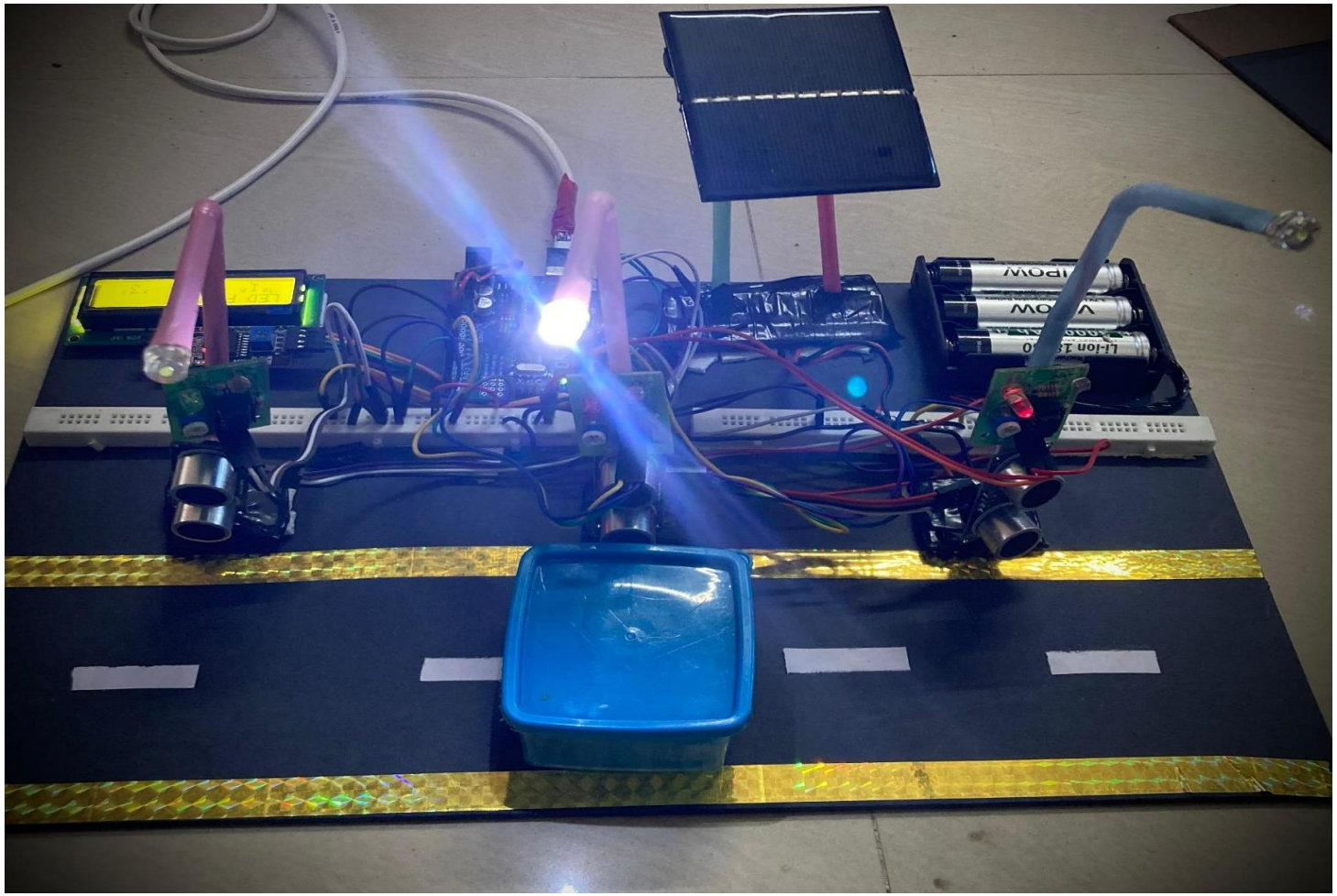

Figure 9 LED LIGHT 2: ON CONDITION

- If the ultrasonic sensor senses movement (such as a person, vehicle, or animal), within a threshold distance, it triggers LED 3 to light up. LED light 3 is turned ON, this action can help improve visibility and safety by providing light when movement is detected, as shown in Figure 10.

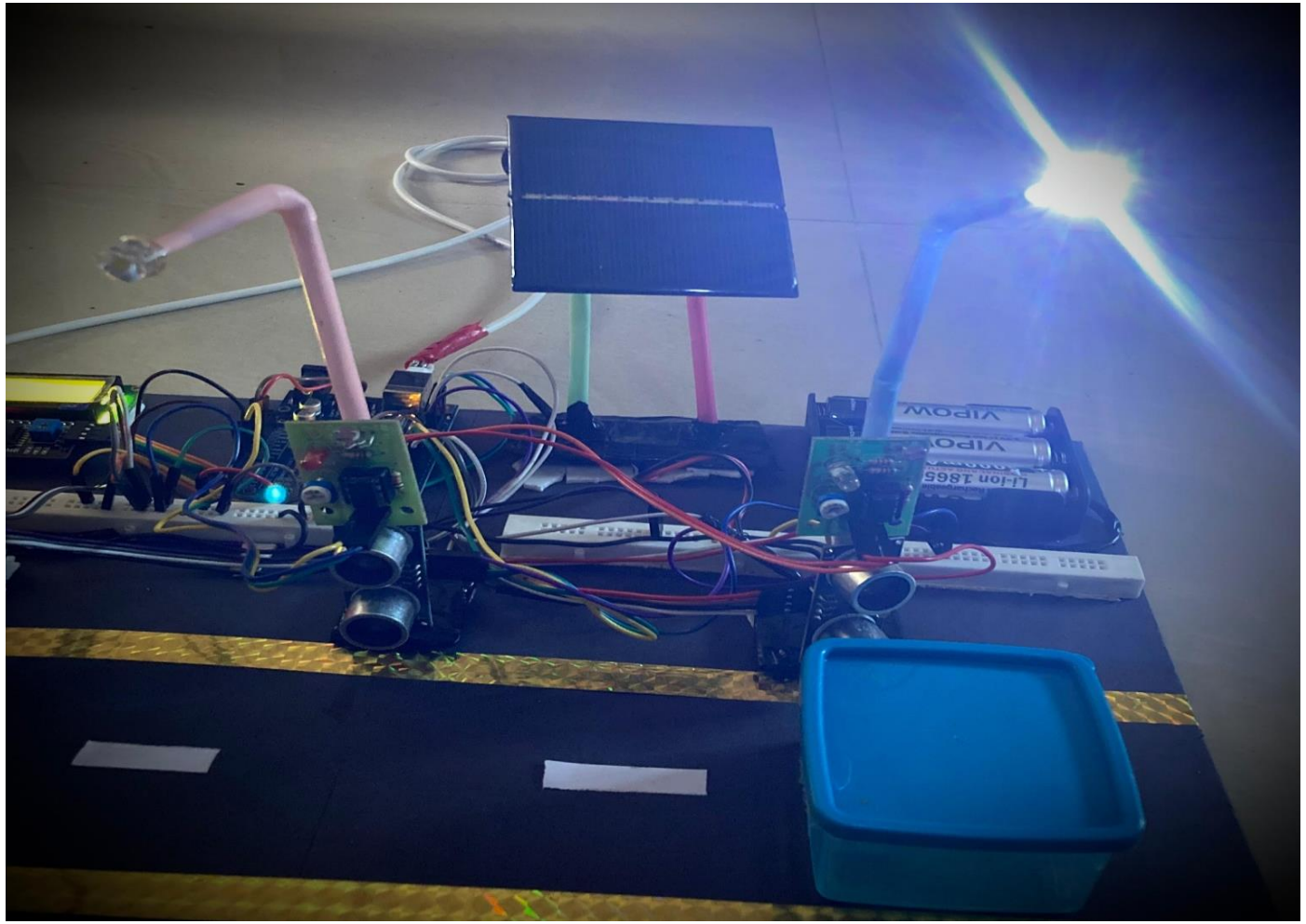

Figure 10 LED LIGHT 3: ON CONDITION

- If the ultrasonic sensor detects movement at a threshold distance and it sends the sensor to turn ON LED 1, but LED 1 is faulty and not working properly. An error message about the LED fault is displayed on the LCD screen, as shown in Figure 12.

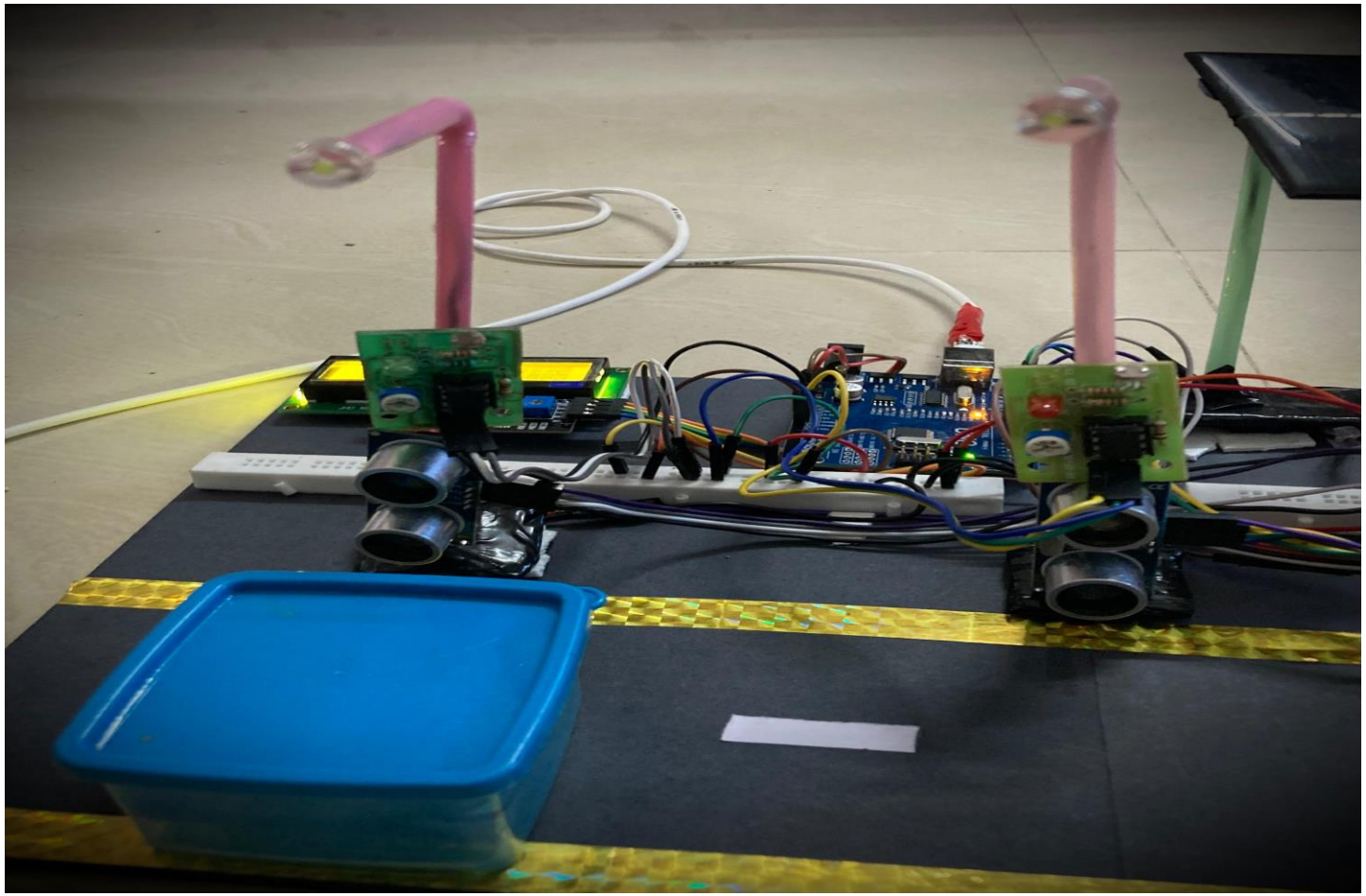

Figure 11 LED LIGHT: 1 NOT WORKING

- The LED 1 is not working properly, as shown in Figure 11. It will show the error message on the LCD display.
- An error message that says "LED FAULT 1" is displayed on the LCD display. This is illustrated in Figure 12.

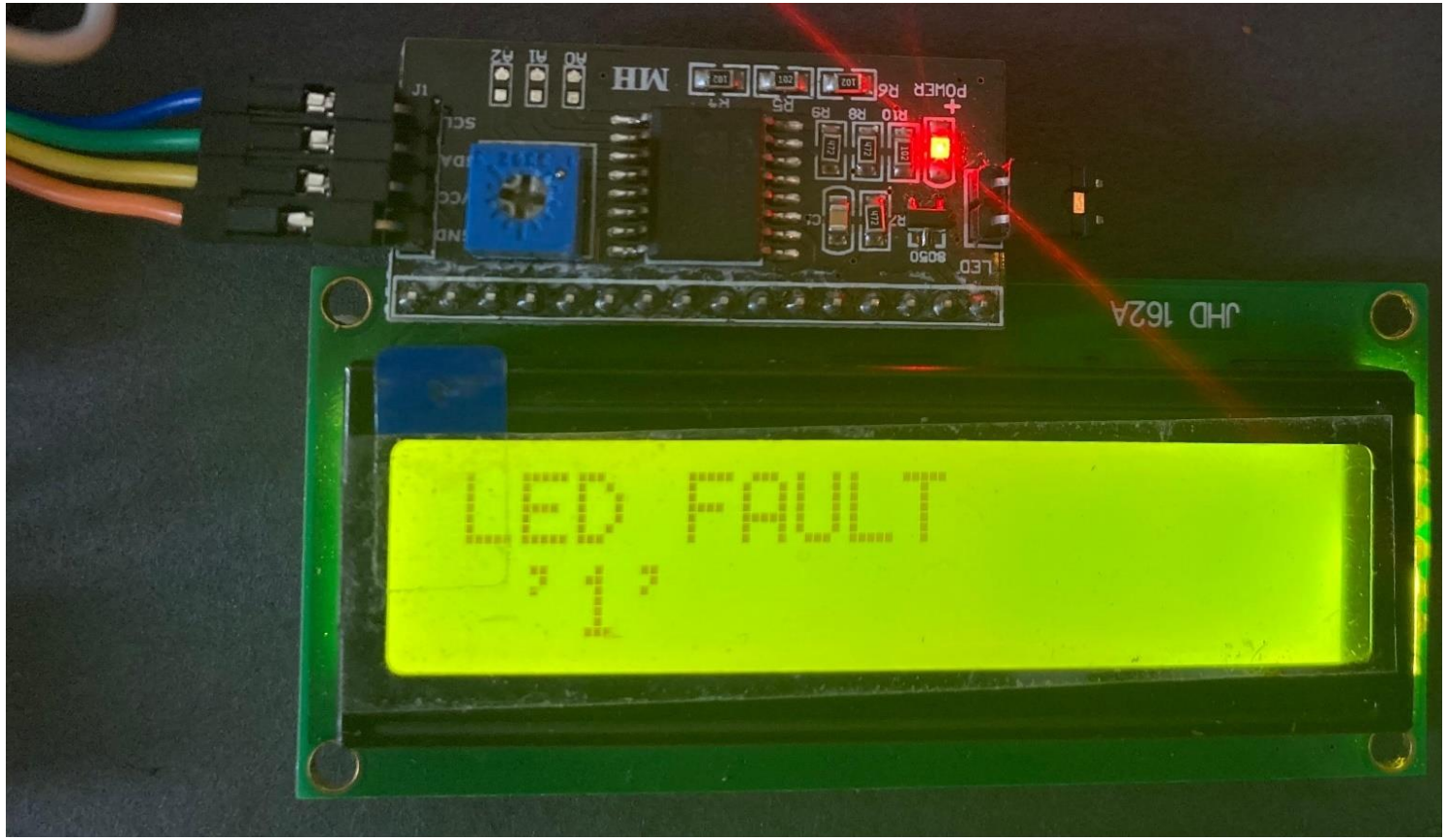

Figure 12 ERROR MESSAGE: LED FAULT 1

- If the ultrasonic sensor detects any movement beyond the threshold distance, it does not detect any object, so the LED light 3 is turn OFF position.

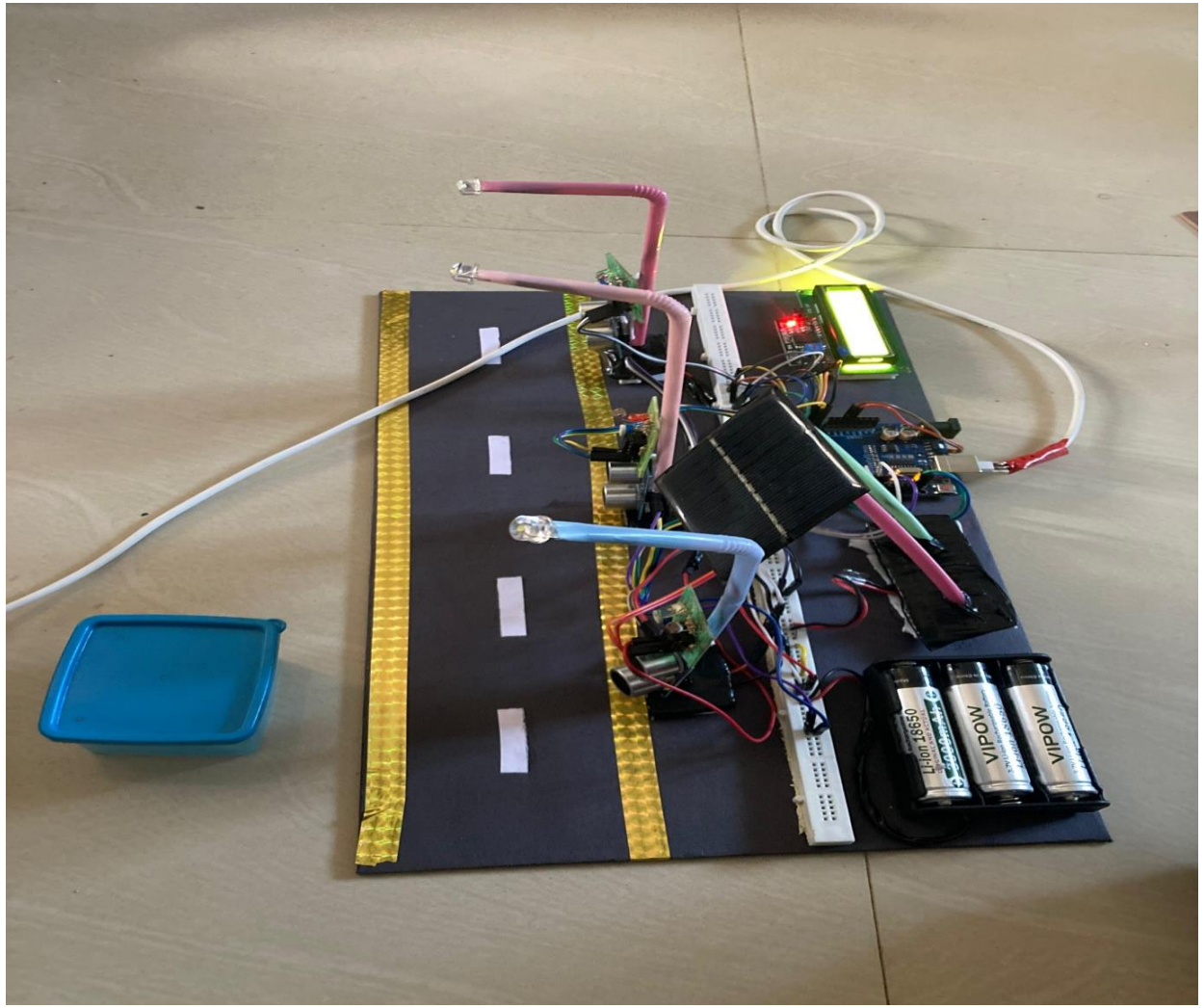

Figure 13 OBJECT OUT OF THRESHOLD DISTANCE

- If the ultrasonic sensor senses movement (such as a person, vehicle, or animal), within a threshold distance, it triggers LED 3 to light up, so the LED light 3 is turn ON position.

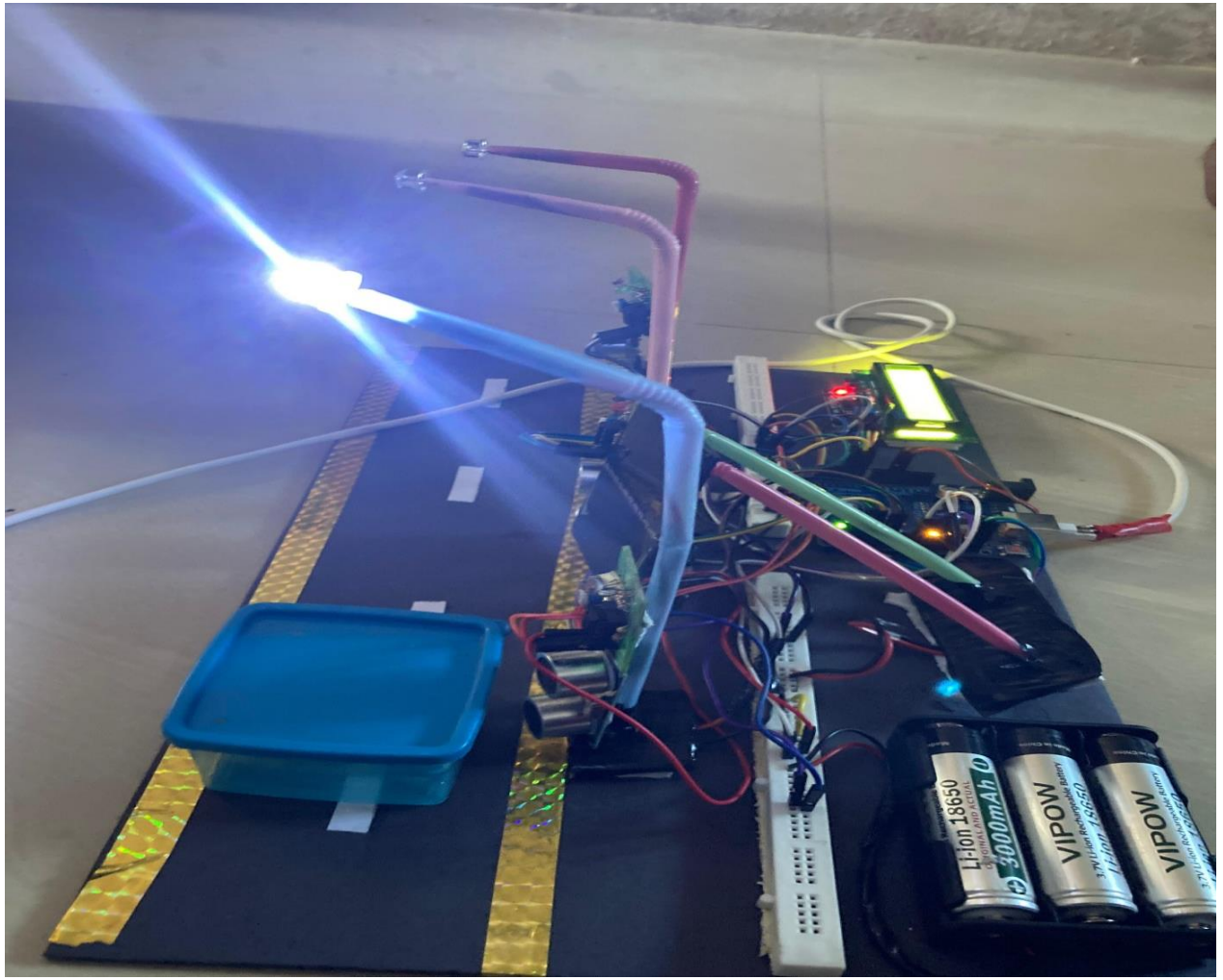

Figure 14 OBJECT IN THE THRESHOLD DISTANCE

- When a vehicle or pedestrian comes within a threshold distance, all ultrasonic sensor detect their movement, triggering all LED lights to turn ON. LED lights 2 and 3 turn ON, but LED light 1 is faulty and not working properly, as shown in Figure 15.

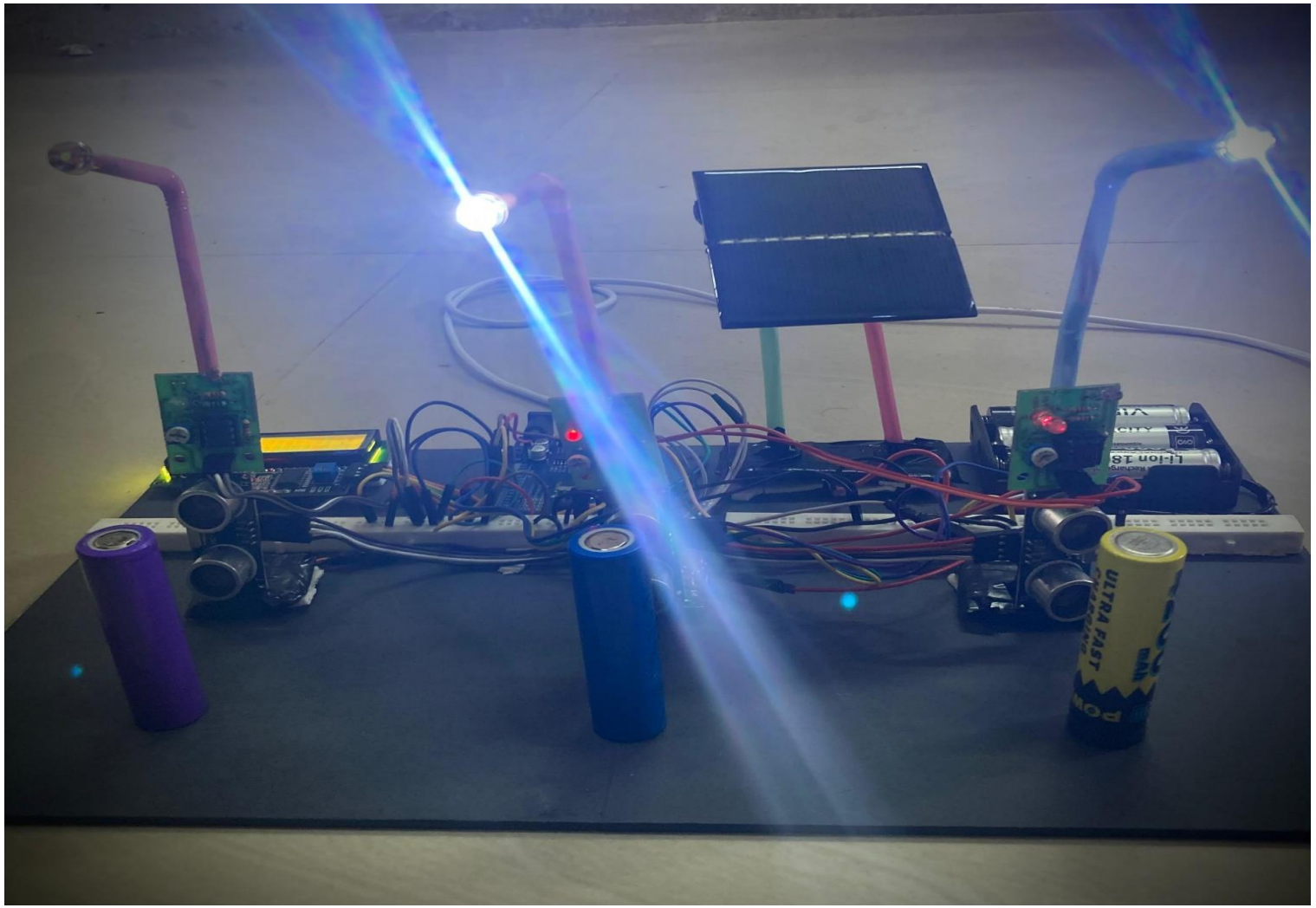

Figure 15 LED LIGHTS: ON CONDITION

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- The ultrasonic sensors are responsible for detecting the movement of vehicles and pedestrians within a range of 200 meters, which triggers the streetlights to become ON. This ensures the safety of pedestrians and drivers while also conserving energy by not lighting up the entire street unnecessarily.
- The LDR sensors, on the other hand, detect the level of ambient light and adjust the streetlight intensity accordingly. During the day when there is ample sunlight, the streetlights are turned OFF completely, saving energy and reducing operational costs.
- In the event of a light failure, the LDR sensors detect the absence of ambient light and send a message to the LCD display. This remote monitoring system reduces the need for manual inspection and maintenance, saving time and reducing manpower.
- Overall, the automatic street light intensity controller using Arduino provides optimal electricity usage, reducing energy consumption and operational costs, while providing better illumination and ensuring pedestrian and driver safety. Additionally, the use of renewable resources such as solar power makes this system environmentally friendly and sustainable in the long run.

CONCLUSION

- In conclusion, the integration of automatic fault detection in street lights effectively utilizes solar energy to generate electricity, ensuring its availability for future generations. This energy can be harnessed for domestic purposes as well. Remote monitoring aids in identifying faulty streetlights, thereby reducing the need for manpower.
- Which helps as to save power compared to traditional systems. Real-time implementation could lead to significant energy savings and increased electricity generation through various techniques.
- Here the solar panel is used in street light system reducing energy consumption and promoting efficiency. The LDR sensor is used to detect the light intensity, by detecting the intensity we can check whether the light is ON or OFF, Ultrasonic sensor is used here to detect the movement, by detecting the movement the lights only turn ON when there is any movement, otherwise the light remains OFF.
- Overall, the automatic street light system, it has the potential to reduce energy consumption, minimize light pollution, and enhance road safety. The project can serve as a valuable reference for future endeavors aimed at developing smart lighting systems for cities.

FUTURE SCOPE

- In the future, this technology is expected to evolve significantly. By incorporating advanced sensors, it can be integrated with other smart city technologies like traffic management systems.

- This advancement will make it easier for maintenance personnel to detect and resolve issues in the system. We are also working on a GSM module, which sends messages to specific people. This means they can check the lights from far away and change things if they need to.

- Overall, the future scope of automatic fault detection in street lights using Arduino looks promising, especially with the integration of advanced sensors and renewable energy sources. This technology has the potential to significantly contribute to the creation of smart and sustainable cities.

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