Project Report On

Solar Power Water Trash Collector

SUBMITTED BY :

THOTA KOUSHIK SAI

K.kaushik

Kushal Kalyan

R.Pavan Kumar

S.Yugender

D.Shivani

P.Bhavya sri

T.Sathwik Reddy

CH.Sri Pranav Teja

P.Sanjay

G.Varish Teja

Supraja

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Abstract

A solar-powered water trash collector is an innovative solution to combat water pollution. These devices utilize solar energy to power their operations, making them environmentally sustainable. Typically deployed in rivers, lakes, or oceans, these collectors employ floating barriers or nets to trap debris and waste materials. As water flows through the collector, trash gets caught, preventing it from further polluting the water body or harming aquatic life. The solar panels integrated into the collector harness sunlight to generate electricity, powering the system without relying on conventional energy sources. This not only reduces operational costs but also minimizes the environmental footprint of the device. Solar-powered water trash collectors play a crucial role in preserving aquatic ecosystems and protecting marine life by effectively removing pollutants from water bodies, contributing to cleaner and healthier environments for both humans and wildlife.The efficiency of solar-powered water trash collectors hinges on addressing the disparity between charging and discharging times. Prolonged charging, caused by factors like solar panel misalignment or inadequate maintenance, impedes energy absorption. Conversely, abbreviated discharge periods may result from insufficient battery capacity or inefficient energy management, compromising system effectiveness. To tackle this, a holistic approach is necessary. Optimizing solar panel efficiency through maintenance and proper alignment, alongside upgrades to battery capacity and the use of advanced charge controllers, can rectify these issues. Load management tactics and backup power systems like generators further enhance resilience, especially during low-light periods. Continuous monitoring and innovation ensure ongoing improvements, creating a reliable and impactful solution for waterbody clean-up while minimizing environmental impact. Addressing these challenges ensures the sustained operation ofsolar-powered water trash collectors, crucial for preservingaquatic ecosystems and protecting marine life.

Chapter 1

INTRODUCTION

The solar-powered water trash collector represents a significant advancement in cleaning and maintaining our waterways. This innovative device operates by harnessing the power of the sun to remove floating debris from lakes, rivers, and other water bodies. Its core components include solar panels, which capture sunlight and convert it into electricity, powering the entire system. A floating platform provides buoyancy and houses the collection mechanism, which is responsible for gathering the trash. Collected debris is then stored in onboard bins until they are full and require emptying. More sophisticated models of these trash collectors incorporate sensors and sometimes even autonomous navigation systems. Sensors can detect the presence of trash, water levels, and other environmental factors, allowing the device to operate efficiently and target areas with the highest concentration of debris. Autonomous navigation systems enable the collector to navigate the water body without human intervention, further improving its efficiency and coverage. By utilizing solar energy, these devices are environmentally friendly, reducing reliance on fossil fuels and minimizing their carbon footprint. Ultimately, the solar-powered water trash collector offers a sustainable and effective solution to combat water pollution, protect aquatic ecosystems, and promote responsible waste management practices.

1.1 EXISTING SYSTEM

Current water trash collection methods often rely on outdated and inefficient practices. Manual cleanup, using workers in boats with nets, is labor-intensive, slow, and covers limited areas. Fuel-powered boats with skimmers, while more efficient than manual labor, contribute to water and air pollution through fuel consumption and emissions, undermining the very goal of cleaning the water. Stationary methods like booms and nets trap floating debris but require frequent manual maintenance and emptying, which can be costly and time-consuming. Although some autonomous or semi-autonomous devices exist, they often lack the sophisticated navigation and collection capabilities needed for effective large-scale deployment. These limitations highlight the need for more advanced, sustainable, and efficient solutions for water trash collection, such as solar-powered autonomous devices with intelligent navigation and collection systems. Such advancements would minimize human labor, reduce pollution, and improve the overall effectiveness of keeping our waterways clean.

1.2 PROPOSED SYSTEM

The proposed solar-powered water trash collector offers a substantial improvement over current water cleanup methods. By utilizing solar panels, the system harnesses renewable energy, eliminating the reliance on fossil fuels and significantly reducing its environmental impact. This eco-friendly approach minimizes pollution and promotes sustainability. A key advancement is the integration of advanced sensors, GPS, and artificial intelligence. These technologies enable the device to autonomously navigate waterways, intelligently targeting areas with high concentrations of floating debris. This targeted approach maximizes collection efficiency and minimizes wasted energy. The system is also equipped with obstacle avoidance capabilities, ensuring safe and uninterrupted operation. Collected trash is stored in onboard bins, which are designed for periodic emptying. This autonomous operation reduces the need for constant human intervention, making the system more efficient and cost-effective. Overall, this proposed system offers a sustainable, efficient, and environmentally responsible solution for keeping our water bodies clean.

Chapter 2

ARCHITECTURE

2.1 HARDWARE

2.1.1 AURDINO UNO

The Arduino UNO is a popular microcontroller board based on the ATmega328P chip. It features 14 digital input/output pins, 6 analog inputs, a 16 MHz quartz crystal,a USB connection, a power jack, an ICSP header, and a reset button. The UNO is designed for ease of use, making it a great choice for beginners and experienced users alike. It can be powered via USB or an external power supply, allowing for flexibility in various projects. The open-source Arduino software (IDE) enables users to write and upload code to the board, facilitating the development of a wide range of applications from simple LED blinkers to complex robotics and automation systems.

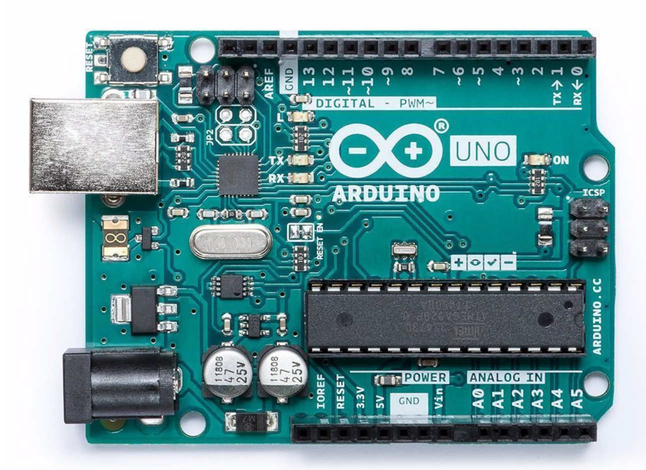

Figure 2.1: AURDINO UNO

2.1.2 Servo Motor

A servo motor is a self-contained electrical device that moves parts of a machine with high efficiency and great precision. In simpler terms, a servo motor is a BLDC motor with a sensor for positional feedback. This allows the output shaft to be moved to a particular angle, position, and velocity that a regular motor cannot do. Fig. 8. Servo Motor SG90 A servo motor is controlled by controlling its position using Pulse Width Modulation Technique. The width of the pulse applied to the motor is varied and sent for a fixed amount of time. Servo Motor generally requires a DC supply of 4.8V to 6V.

Figure 2.2: Servo Motor

2.1.3 UltraSonic Sensors

Ultrasonic sensors, such as the HC-SR04, measure distance by emitting ultrasonic sound waves and timing their echo return. They consist of a transmitter and receiver, where the transmitter emits sound waves that bounce back from objects, and the receiver captures the echoes. The sensor calculates the distance based on the time interval between sending and receiving the pulse. These sensors are widely used for obstacle avoidance in robots, level detection, and various distance measuring applications due to their accuracy and non-contact measurement capability

Figure 2.3: UltraSonic Sensors

2.1.4 RS 555 Motor

RS 555 motor: The RS-555 motor is a widely used type of DC motor prized for its reliability and performance acrossdiverse applications. With a robust construction featuring a metal housing and durable components, it operates efficiently on DC voltages ranging from 6V to 24V. Known for its moderate speed and high torque output, the RS-555 motor is particularly suited for applications requiring substantial rotational force, such as in robotics, electric vehicles, and industrial machinery.

Figure 2.4: RS 555 Motor

2.1.5 BTS 7960 Motor driver

The BTS7960B motor driver module is an advanced H bridge circuit designed for high power DC motor control applications. Featuring robust con struction and efficient operation, it supports bidirectional control of DC motors with a voltage range from 5V to 27V. Capable of handling continuous currents up to 43A and peak currents up to 46A (depending on cooling con ditions), the BTS7960B ensures reliable performance even under demanding conditions.

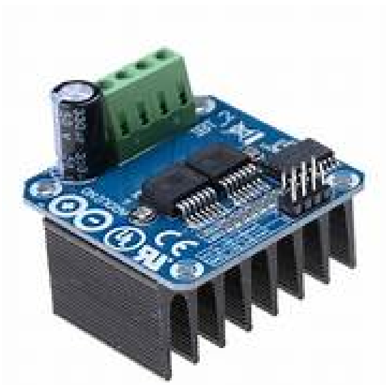

Figure 2.5: BTS 7960 Motor driver

2.1.6 Solar Panel

Solar panels are devices designed to convert sunlight into electricity. They are made up of many solar cells, typically composed of silicon, that absorb photons from sunlight and release electrons. This process, known as the photovoltaic effect, generates direct current (DC) electricity. Solar panels are widely used in residential, commercial, and industrial settings to provide a renewable, sustainable source of energy, reducing reliance on fossil fuels and decreasing green house gas emissions.

Figure 2.6: Solar Panel

2.1.7 Lithium Ion battery

Lithium-ion batteries are widely used for their high energy density and rechargeable capabilities, making them ideal for portable electronic devices like smartphones, laptops, and electric vehicles. They operate by transferring lithium ions between electrodes during charging and discharging cycles, enabling efficient energy storage and release. Despite their advantages, safety considerations are crucial due to potential risks like overheating. Proper recycling practices are also essential to manage their environmental impact responsibly.

Figure 2.7: Lithium Ion battery

2.1.8 Flysky Receiver

The Flysky FX-16X is a 16-channel radio transmitter designed for RC enthusiasts, offering precise control over drones, airplanes, and other RC vehicles. Operating on the 2.4GHz frequency band, it provides reliable communication with a sufficient range for most RC applications. Its ergonomic design ensures comfort during extended use, featuring an intuitive layout of switches, knobs, and sticks.Compatible with various Flysky receivers, it supports programming options for customization of endpoints, servo reversing, dual rates, and expo settings.

Figure 2.8: Flysky Receiver

2.1.9 Motor Driver - L298N

The L298N is a dual H-bridge motor driver integrated circuit (IC) commonly used to control and drive DC motors,particularly in robotics and mechanics applications. It provides a straightforward way to manage motor direction and speed using control signals from micro-controllers like Arduino. The L298N motor driver has a supply range of 5v to 35v and is capable of 2A continuous current per channel, so it works well with most of the DC motors.

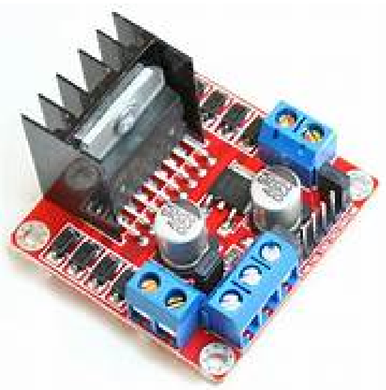

Figure 2.9: Motor Driver L298N

2.1.10 PVC Pipes

PVC (Polyvinyl Chloride) pipes are used extensively in various applications due to their durability, lightweight, and cost-effectiveness. In robotics, these pipes are commonly utilized to construct frameworks or chassis. They can be easily cut, drilled, and assembled, making them a versatile material for building project structures. PVC pipes are also resistant to corrosion and chemical damage, adding to their longevity and reliability in different environments.

Figure 2.10: PVC Pipes

2.1.11 Relay

A relay is an electrically operated switch. It uses a small amount of electricity to control a larger amount of electricity. It's like a remote control for turning things on and off without touching them directlyLithium-ion batteries are preferred because they are lightweight, have a high energy density (meaning they can store a lot of energy for their size), and can be recharged hundreds to thousands of times.They provide longer-lasting power compared to traditional batteries and are commonly used in portable devices where long battery life is important.

Figure 2.11: Relay

2.1.12 Rainbow Wires

Rainbow wires refer to cables or wires that are color-coded using a spectrum of colors, typically following a specific pattern or standard. These colors help distinguish different conductors or functions within the wiring system, aiding in easier identification during installation, maintenance, and troubleshooting. For instance, in electrical wiring, eachcolor may represent a different voltage level or signal type, ensuring safety and accuracy in handling electricity. Rainbow wires are commonly used in various industries, including electronics, telecommunications, and computer networking.

Figure 2.12: Rainbow Wires

2.1.13 Jumper Wires

A jumper wire is an electrical wire or group of wires used to connect circuits without soldering. They have connectors or pins at their ends. Depending upon the configuration of end connectors, they are classified into three types: male-to-male, male-to-female and female-to-female.

Figure 2.13: Jumper wires

2.1.14 Bread Board

A breadboard is a crucial tool for electronics prototyping. It's a solderless platform with rows of interconnected holes, allowing you to easily build temporary circuits. Components are simply pushed into the holes, creating connections without any soldering. This makes breadboards ideal for testing circuit ideas, making changes, and experimenting with different designs. They're widely used by hobbyists, students, and engineers alike due to their ease of use and reusability.

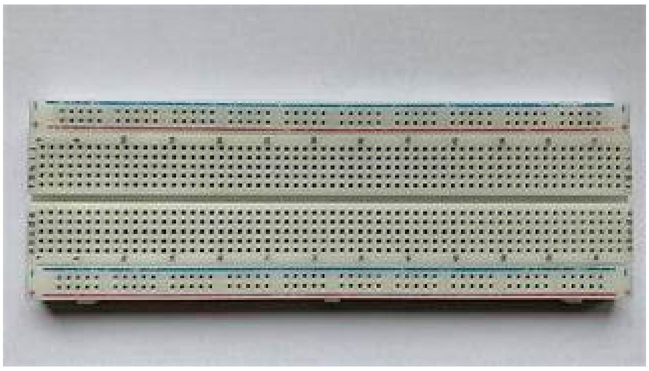

Figure 2.14: Breadboard

2.2 SOFTWARE

2.2.1 Arduino IDE

Arduino Integrated Development Environment is an open source application software created by Arduino. It is used to write and upload code on to the Arduino boards. It supports C and C++ programming languages, and has a built-in compiler. You can compile your code within the IDE to check for errors and then upload the compiled program (known as a sketch) to the connected Arduino board. The IDE handles the compilation and uploading process seamlessly.

Figure 2.15: Arduino IDE

2.2.2 Fusion 360

Fusion 360 is a computer-aided designing (CAD) software application for 3-D modelling and simulation. It's other functions include computer-aided manufacturing (CAM) and computer-aided engineering (CAE), as well as designing printed circuit boards.Fusion 360 provides powerful 3D modeling tools that allow users to create complex 3D models of products and components. It supports parametric modeling, direct modeling, and sculpting.

Figure 2.16: Fusion 360

2.2.3 Easy EDA

EasyEDA is a free, web-based EDA (Electronic Design Automation) tool suite. It simplifies PCB (Printed Circuit Board) design with an intuitive interface, schematic capture, and PCB layout capabilities. EasyEDA also offers a large library of components, simulation tools, and even ordering services for manufactured PCBs. Its cloud-based nature allows for easy sharing and collaboration on projects. While it may not have all the advanced features of professional software, EasyEDA is a great option for hobbyists, students, and makers looking for a user-friendly and accessible PCB design solution.

Figure 2.17: Easy EDA

Chapter 3

IMPLEMENTATION AND WORKING

3.1 Circuit Diagram

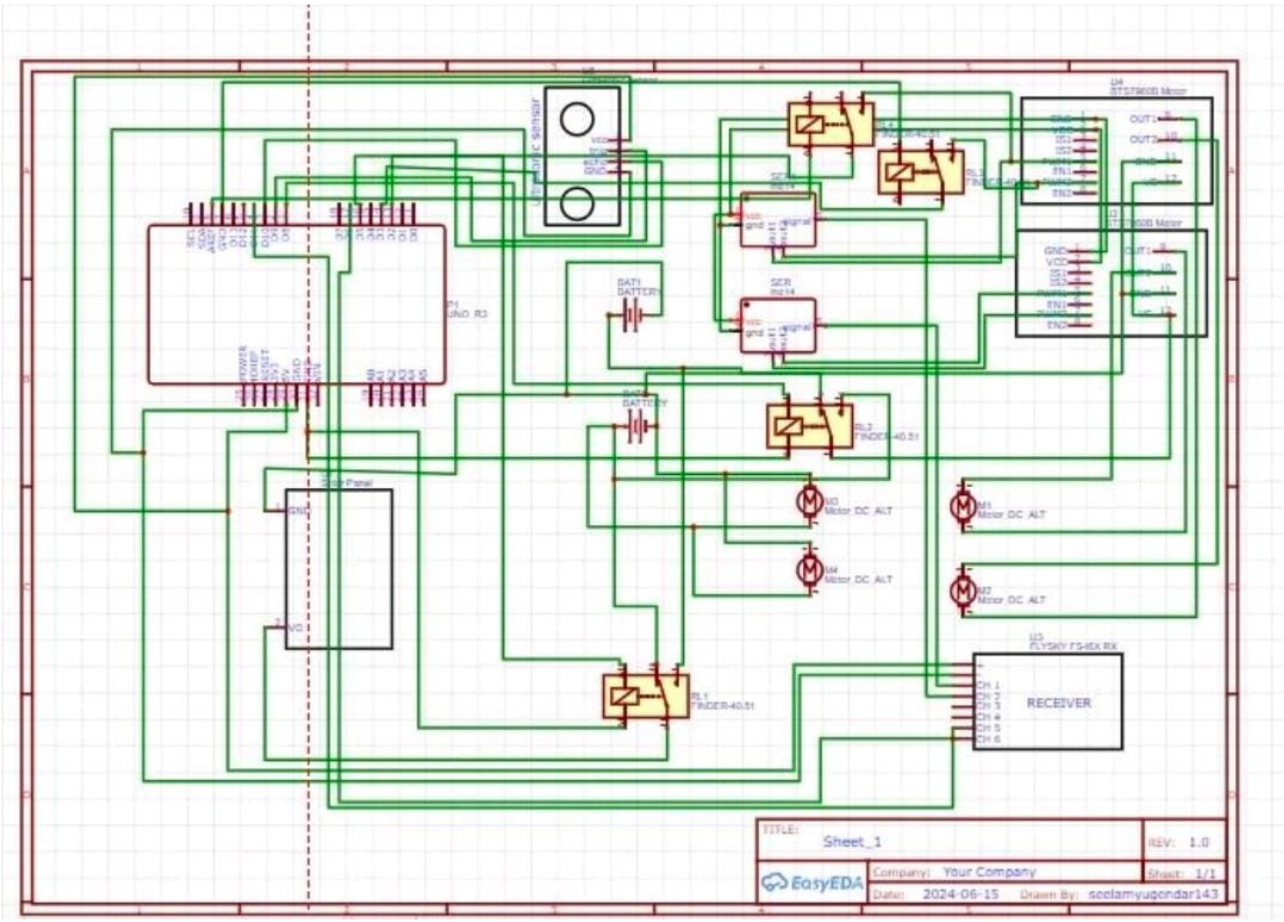

Figure 3.1: Circuit diagram

3.2 Block diagram

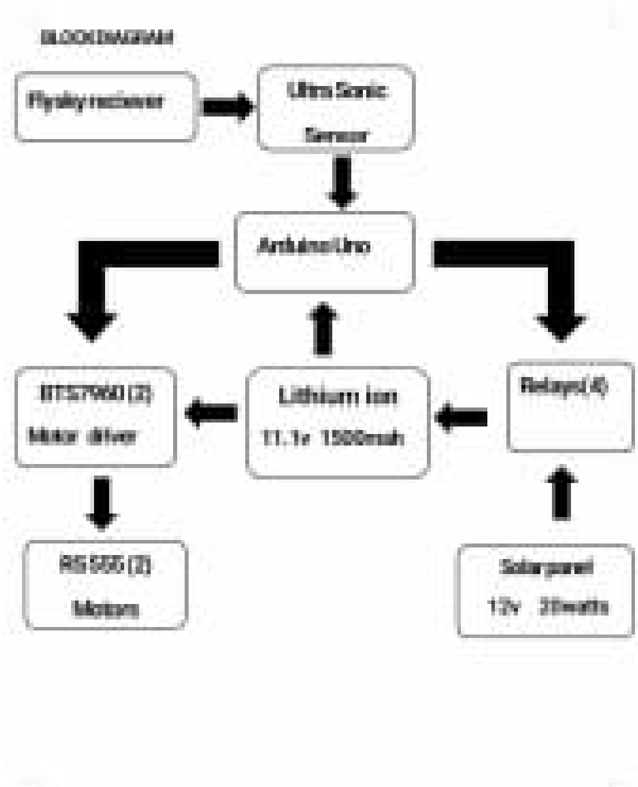

Figure 3.2: Block diagram

3.3 Cad Model

Figure 3.3: Cad Model

3.4 Working

The schematic diagram outlines a system involving an Arduino Uno microcontroller, a solar panel, batteries, relays,motor drivers, DC motors, and a receiver module. The solar panel generates electrical power to charge the batter ies viathe relays, which manage the power distribution to ensure efficient and safe charging. The Arduino Uno mi crocontroller serves as the central control unit, processing inputs and sig nals from the receiver module. The receiver module receives remote control signals, which the microcontroller interprets to generate appropriate control commands for the motor drivers. The motor drivers (BTS7960B) re ceive these commands from the microcontroller to control the DC motors (M1 and M2). The motor drivers regu late the speed and direction of the motors based on PWM (Pulse Width Modulation) signals sent from the microcon troller, allowing precise control over the mechanical opera tions of the motors. The relays (Finder 40.51) switch power between the solar panel and the batteries, ensuring that the system can either charge the batteries or draw power from them as needed In summary, the solar panel charges the batteries, with relays ensuring efficient power manage ment. The Arduino Uno processes remote control inputs received by the receiver module and sends corresponding control signals to the motor drivers, which then drive the DC motors. This setup enables a solar-powered, remote controlled mechanism, such as a robot, with the Arduino Uno coordinating the system's operations

Chapter 4

Experimental Results and Conclusions

4.1 Results

The final result of implementing a solar-powered trash collector is a fully autonomous, sustainable system that efficiently collects waste using renewable energy. High-efficiency solar panels and battery storage ensure continuous operation, even during cloudy days or at night. Equipped with sensors and a microcontroller, the trash collector can detect and navigate to waste without human intervention.A robotic arm or conveyor system gathers trash and deposits it into an onboard container. Designed to withstand various weather conditions, the system is durable and reliable. By utilizing solar energy, the trash collector reduces the carbon footprint and contributes to cleaner public spaces, offering an innovative solution for waste management.

4.2 Future Enhancements

Future advancements in solar-powered trash collectors promise to significantly enhance their capabilities. Integrating AI and machine learning algorithms will enable the device to recognize different types of waste, optimizing collection strategies and potentially sorting recyclables. Enhanced sensor technology, including cameras and LiDAR, will provide a more detailed understanding of the surrounding environment, improving navigation, obstacle avoidance, and targeted waste collection.
IoT connectivity will revolutionize remote monitoring and control. Real-time data on waste levels, system performance, and even location will be accessible, allowing for proactive maintenance and optimized deployment. Improvements in energy efficiency, through the use of high-performance solar

panels and battery systems, will extend operational time and minimize maintenance requirements. A modular design approach will further enhance the system's longevity. This modularity will allow for easy upgrades and replacements of individual components, ensuring the trash collector can readily incorporate the latest technological advancements. These combined improvements will create a more intelligent, efficient, and sustainable solution for combating water pollution.

4.3 Conclusion

In summary, the solar-powered trash collector marks a significant leap forward in sustainable waste management practices. By harnessing the power of the sun, these devices offer an environmentally friendly alternative to traditional cleaning methods, minimizing reliance on fossil fuels and reducing carbon emissions. The integration of advanced sensor technology and autonomous operation enables efficient and targeted waste collection, ensuring public spaces remain clean and litter-free. Looking ahead, the future of these devices is bright, with several key enhancements on the horizon. The continued development and integration of artificial intelligence will enable more intelligent waste recognition and sorting, potentially facilitating recycling efforts. Further advancements in sensor technology, including higher-resolution cameras and more precise LiDAR, will enhance navigation and obstacle avoidance capabilities. The incorporation of Internet of Things (IoT) connectivity will provide real-time data on system performance, waste levels, and location, enabling remote monitoring and optimization of operations. Improvements in energy efficiency, through more efficient solar panels and battery storage, will extend operational time and reduce maintenance needs. Finally, a modular design approach will allow for easy upgrades and replacements of components, ensuring the system remains adaptable and incorporates the latest technological advancements. This innovative approach not only minimizes environmental impact but also establishes a new paradigm for integrating renewable energy with automated systems in urban environments, paving the way for smarter and more sustainable cities.

4.4 References

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Chapter 5

SOURCE CODE

```
define sensorPin 6 // select the input pin for the potentiometer
    define relay1 7
    define relay2 8
    define relay3 9
    define relay4 10
    //define sensorvalue 0
    const int trigPin = 9;
    const int echoPin = 10;
    // defines variables
    long duration;
    int distance;
    void setup()
    pinMode(2,OUTPUT);
    pinMode(3,OUTPUT);
    pinMode(4,OUTPUT);
    pinMode(5,OUTPUT);
    pinMode(6,INPUT);
    pinMode(11,INPUT);
    pinMode(relay1,OUTPUT);
    pinMode(relay2,OUTPUT);
```

```
pinMode(relay3,OUTPUT);
pinMode(relay4,OUTPUT);
pinMode(trigPin, OUTPUT);
pinMode(echoPin, INPUT);
Serial.begin(9600);
void loop()
int sensorvalue = pulseIn(6,HIGH,40000);//For battery charge and decharge
Serial.print(”sensorValue = ”);
Serial.println(sensorvalue);
delay(500);
if(sensorvalue ¿ 1600)
digitalWrite(relay1,HIGH);
digitalWrite(relay2,HIGH);
else
digitalWrite(relay1,LOW);
digitalWrite(relay2,LOW);
int sensorvalue2 = pulseIn(11,HIGH,40000);//For auto mode of bot
Serial.print(”sensorValue2 = ”);
Serial.println(sensorvalue2);
delay(500);
if(sensorvalue2 ¿ 1600)
digitalWrite(relay3,HIGH);
digitalWrite(relay4,HIGH);
else
digitalWrite(relay3,LOW);
digitalWrite(relay4,LOW);
// Clears the trigPin
digitalWrite(trigPin, LOW);
delayMicroseconds(2);
// Sets the trigPin on HIGH state for 10 micro seconds
```

```
digitalWrite(trigPin, HIGH);
delayMicroseconds(10);
digitalWrite(trigPin, LOW);
// Reads the echoPin, returns the sound wave travel time in microseconds
duration = pulseIn(echoPin, HIGH);
// Calculating the distance
distance = duration * 0.034 / 2;
// Prints the distance on the Serial Monitor
Serial.print(”Distance: ”);
Serial.println(distance);
if(distance ¿ 140)
digitalWrite(2,HIGH);
digitalWrite(3,LOW);
digitalWrite(4,HIGH);
digitalWrite(5,LOW);
else if(distance ¡140)
digitalWrite(2,HIGH);
digitalWrite(3,LOW);
digitalWrite(4,LOW);
digitalWrite(5,HIGH);
```