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Solar Based WiFi Controlled River Cleaning Robot

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Abstract: *The increasing pollution in rivers due to the accumulation of waste has raised significant environmental concerns. Manual cleaning processes are labor-intensive, time-consuming, and inefficient, especially for large water bodies. This project aims to develop a solar-powered, Wi-Fi-controlled river-cleaning robot that autonomously collects floating waste from water bodies, providing a sustainable and efficient solution to water pollution.*
The system is powered by a 12V rechargeable battery, continuously charged by a 10W solar panel, making it self-sufficient. The robot's mobility is driven by DC gear motors connected to propulsion wheels, allowing it to navigate on the water's surface. A net chamber is integrated at the front of the robot for collecting floating debris, which can be periodically removed and emptied.
The core of the robot's control system is the NodeMCU microcontroller, which is programmed to control the movement of the robot through a motor driver (L298N). The robot can be remotely operated via a Wi-Fi connection, enabling easy control using a smartphone or computer. This system offers an eco-friendly solution that reduces reliance on external power sources, contributing to sustainable river cleaning operations.
This project demonstrates the integration of renewable energy, automation, and IoT technology to address the challenges of water pollution. Through its successful implementation, the robot provides an innovative approach to keeping rivers clean while minimizing human intervention..

Keywords: NodeMCU microcontroller

I. INTRODUCTION

The problem of water pollution, particularly in rivers, is an escalating global issue, causing detrimental effects on ecosystems, human health, and local economies. The increasing waste dumped into water bodies necessitates the development of efficient and environmentally sustainable solutions.

Autonomous robots for water surface cleaning have gained attention in recent years, leveraging renewable energy sources and advanced control systems for efficient waste collection. This chapter reviews existing literature on solar-powered robots, IoT-based control systems using microcontrollers, and river-cleaning technologies to provide a foundation for the proposed project of a solar-based Wi-Fi-controlled River cleaning robot

II. LITERATURE SURVEY

The solar-based WiFi controlled river cleaning robot is an innovative solution designed to address the challenge of river pollution by automating the waste collection process. This robot utilizes solar power, wireless communication, and advanced motor control to efficiently clean river surfaces and collect waste materials. The core components include a NodeMCU microcontroller, motor drivers, a 12V battery system, DC gear motors with propulsion wheels, and a net chamber for waste collection.

1. Sensors capture data (pulse and temperature).
2. Arduino processes sensor data.
3. ESP8266 transmits the processed data to ThingSpeak over WiFi.

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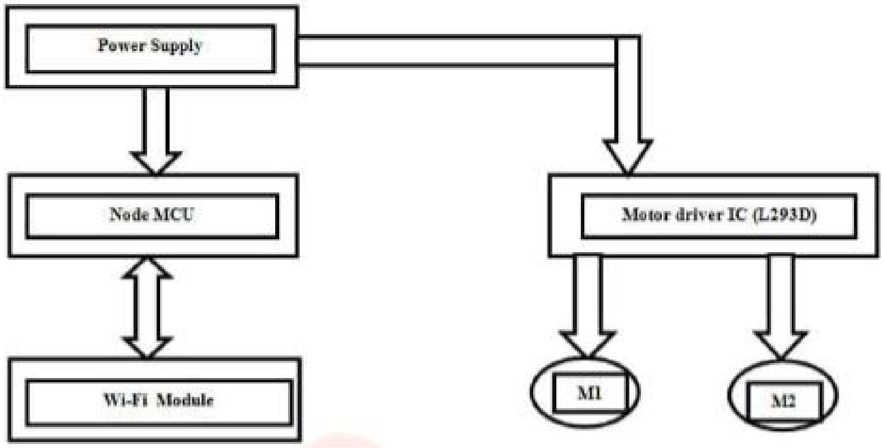
4. LCD displays the live sensor readings locally.



III. PROGRAMMING FOR HEALTH CARE SYSTEM

```
#define ENA   14        // Enable/speed motors Right       GPIO14(D5)
#define ENB   12        // Enable/speed motors Left        GPIO12(D6)
#define IN_1  15        // L298N in1 motors Right          GPIO15(D8)
#define IN_2  13        // L298N in2 motors Right          GPIO13(D7)
#define IN_3  2         // L298N in3 motors Left           GPIO2(D4)
#define IN_4  0         // L298N in4 motors Left           GPIO0(D3)

#include <ESP8266WiFi.h>
#include <WiFiClient.h>
#include <ESP8266WebServer.h>

String command;          //String to store app command state.
int speedCar = 800;      // 400 - 1023.
int speed_Coeff = 3;

const char* ssid = "NodeMCU Car";
ESP8266WebServer server(80);

void setup() {

pinMode(ENA, OUTPUT);
pinMode(ENB, OUTPUT);  b
pinMode(IN_1, OUTPUT);
pinMode(IN_2, OUTPUT);
pinMode(IN_3, OUTPUT);
pinMode(IN_4, OUTPUT);

Serial.begin(115200);

// Connecting WiFi

WiFi.mode(WIFI_AP);
```

```
  WiFi.softAP(ssid);

  IPAddress myIP = WiFi.softAPIP();
  Serial.print("AP IP address: ");
  Serial.println(myIP);

 // Starting WEB-server
server.on ( "/", HTTP_handleRoot );
server.onNotFound ( HTTP_handleRoot );
server.begin();
}

void goAhead(){

digitalWrite(IN_1, LOW);
digitalWrite(IN_2, HIGH);
analogWrite(ENA, speedCar);

digitalWrite(IN_3, LOW);
digitalWrite(IN_4, HIGH);
analogWrite(ENB, speedCar);
  }

void goBack(){

digitalWrite(IN_1, HIGH);
digitalWrite(IN_2, LOW);
analogWrite(ENA, speedCar);

digitalWrite(IN_3, HIGH);
digitalWrite(IN_4, LOW);
analogWrite(ENB, speedCar);
  }

void goRight(){

digitalWrite(IN_1, HIGH);
digitalWrite(IN_2, LOW);
analogWrite(ENA, speedCar);


digitalWrite(IN_3, LOW);
digitalWrite(IN_4, HIGH);
analogWrite(ENB, speedCar);
  }

void goLeft(){

digitalWrite(IN_1, LOW);
```

```
digitalWrite(IN_2, HIGH);
analogWrite(ENA, speedCar);

digitalWrite(IN_3, HIGH);
digitalWrite(IN_4, LOW);
analogWrite(ENB, speedCar);
  }

void goAheadRight(){

digitalWrite(IN_1, LOW);
digitalWrite(IN_2, HIGH);
analogWrite(ENA, speedCar/speed_Coeff);

digitalWrite(IN_3, LOW);
digitalWrite(IN_4, HIGH);
analogWrite(ENB, speedCar);
   }

void goAheadLeft(){

digitalWrite(IN_1, LOW);
digitalWrite(IN_2, HIGH);
analogWrite(ENA, speedCar);

digitalWrite(IN_3, LOW);
digitalWrite(IN_4, HIGH);
analogWrite(ENB, speedCar/speed_Coeff);
  }

void goBackRight(){

digitalWrite(IN_1, HIGH);
digitalWrite(IN_2, LOW);
analogWrite(ENA, speedCar/speed_Coeff);

digitalWrite(IN_3, HIGH);
digitalWrite(IN_4, LOW);

analogWrite(ENB, speedCar);
  }

void goBackLeft(){

digitalWrite(IN_1, HIGH);
digitalWrite(IN_2, LOW);
analogWrite(ENA, speedCar);

digitalWrite(IN_3, HIGH);
```

```
digitalWrite(IN_4, LOW);
analogWrite(ENB, speedCar/speed_Coeff);
  }

void stopRobot(){

digitalWrite(IN_1, LOW);
digitalWrite(IN_2, LOW);
analogWrite(ENA, speedCar);

digitalWrite(IN_3, LOW);
digitalWrite(IN_4, LOW);
analogWrite(ENB, speedCar);
 }

void loop() {
server.handleClient();

    command = server.arg("State");
    if (command == "F") goAhead();
    else if (command == "B") goBack();
    else if (command == "L") goLeft();
    else if (command == "R") goRight();
    else if (command == "I") goAheadRight();
    else if (command == "G") goAheadLeft();
    else if (command == "J") goBackRight();
    else if (command == "H") goBackLeft();
    else if (command == "0") speedCar = 400;
    else if (command == "1") speedCar = 470;
    else if (command == "2") speedCar = 540;
    else if (command == "3") speedCar = 610;
    else if (command == "4") speedCar = 680;
    else if (command == "5") speedCar = 750;
    else if (command == "6") speedCar = 820;
    else if (command == "7") speedCar = 890;
    else if (command == "8") speedCar = 960;
    else if (command == "9") speedCar = 1023;
    else if (command == "S") stopRobot();
}

void HTTP_handleRoot(void) {

if( server.hasArg("State") ){
     Serial.println(server.arg("State"));
  }
server.send ( 200, "text/html", "" );
delay(1);
}
```

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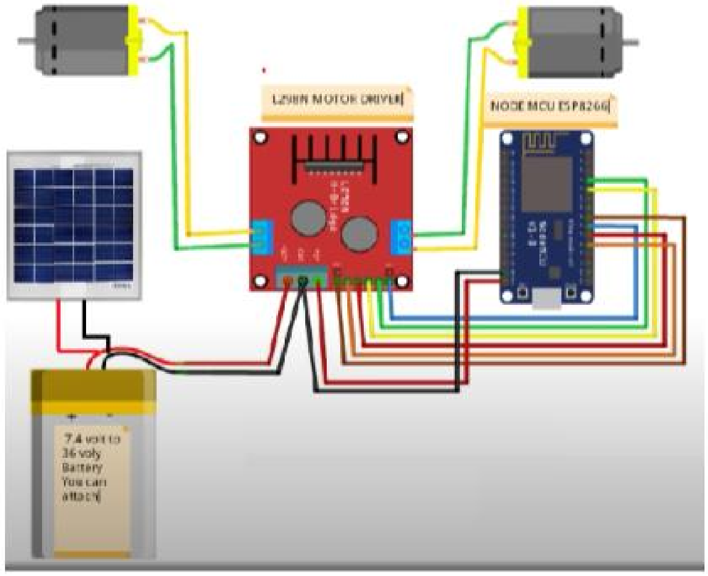
III. CIRCUIT DIAGRAM



Operational Workflow:

Deployment:

The robot is launched into the river from a designated point. It is powered on and the NodeMCU initializes its connection with the WiFi network.

Control:

Users access the robot via a web interface or mobile app. Through this interface, they can control the robot's movement, adjust its speed, and monitor its operational status in real-time.

Navigation and Cleaning:

The robot uses its DC gear motors to navigate the river surface. The propulsion wheels provide movement in various directions, enabling the robot to cover a wide area.

As the robot moves, it collects waste using the net chamber. The collected debris is stored in the chamber until the robot is retrieved.

Waste Collection and Disposal:

Once the net chamber is full or at the end of the cleaning session, the robot is retrieved from the river. The collected waste is manually removed and disposed of properly.

Solar Charging:

When not in operation, the robot's solar panels continue to charge the 12V battery, ensuring the system is ready for its next cleaning session.

HARDWARE REQUIREMENT

NodeMCU Microcontroller:

Figure 1 Node MCU ESP8266 WIFI

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Function: Acts as the central control unit for the robot. It manages communication between the user and the robot through WiFi, processes sensor data, and controls the motors and other components.

Features: Equipped with WiFi capabilities, which allows remote control and monitoring via a web interface or mobile app.

Motor Driver:

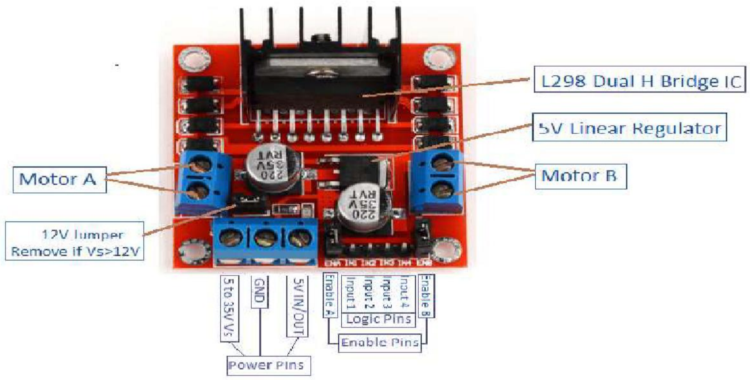

Figure 2 L298n motor driver

Function: Interfaces between the NodeMCU and the DC gear motors. It regulates the power supplied to the motors, enabling precise control of the robot's movement and propulsion.

Features: Capable of handling the current required by the DC motors and providing bidirectional control for forward and backward movement.

12V Battery:

Function: Powers the robot's motors, NodeMCU, and other electronic components. It is charged by solar panels, ensuring continuous operation without needing frequent recharging.

Features: Provides a stable voltage supply for the motor driver and other components. It is selected for its capacity to handle the power requirements of the robot.

DC Gear Motors with Propulsion Wheels:

Figure 3 DC Gear Motors

Function: Provide the driving force necessary for the robot's movement across the river surface. The gear motors ensure sufficient torque and control for maneuvering and propulsion.

Features: Gear motors are chosen for their durability and ability to operate efficiently in the aquatic environment. The propulsion wheels are designed to provide optimal traction on the river surface.

Net Chamber for Waste Collection:

Function: Collects floating waste materials from the river surface. The chamber is designed to capture and hold debris while allowing water to pass through.

Features: Made of durable, water-resistant materials. The net is structured to trap various types of waste, including plastic, leaves, and other floating debris.

Solar Panels:

Function: Charge the 12V battery, providing a sustainable energy source for the robot. Solar panels ensure the robot can operate continuously in sunny conditions.

Features: Integrated with the robot to charge the battery during daylight hours. The panels are positioned for optimal sunlight exposure.

IV. RESULTS

The development and implementation of the solar-based Wi-Fi-controlled River cleaning robot demonstrated successful integration of renewable energy, automation, and IoT technologies for efficient waste collection in water bodies. The prototype was tested in a controlled environment to evaluate its performance in collecting floating debris and its responsiveness to remote control commands via Wi-Fi. The following results were observed:

Autonomous Operation with Solar Power: The 10Wsolar panel was able to continuously recharge the 12V battery, ensuring sustained operation of the robot without external power sources. The system was able to operate autonomously for several hours under sunlight, demonstrating its capability to function using renewable energy. During periods of low sunlight, the battery provided enough power for short-term operation, ensuring minimal downtime.

Effective Waste Collection: The net chamber attached to the robot efficiently collected floating waste such as plastic bottles, leaves, and small debris. The robot successfully navigated the water surface using its DC gear motors and propulsion wheels, allowing it to access different areas and direct the waste into the collection chamber. The size of the net chamber, however, limited the amount of waste that could be collected at one time, necessitating periodic manual emptying.

Wi-Fi Control: The NodeMCU microcontroller allowed for seamless communication between the robot and a mobile device or computer. The Wi-Fi interface was user-friendly, enabling real-time control of the robot's movement (forward, backward, left, right) with minimal latency. The range of the Wi-Fi connection was satisfactory in open areas with strong signals, but performance was affected in locations with poor Wi-Fi coverage.

Performance in Varied Conditions: The robot was tested in both calm and slightly turbulent water conditions. In calm water, the robot exhibited excellent stability and maneuverability. In more turbulent waters, however, the robot’s movement became less efficient, and its speed was reduced. Despite these challenges, the robot was able to maintain its waste collection function, though improvements in stability and propulsion are needed for enhanced performance in rough conditions.

V. CONCLUSION

The solar-based Wi-Fi-controlled River cleaning robot presents a sustainable, efficient, and environmentally friendly solution for addressing the problem of river pollution. By harnessing solar energy, the robot can operate independently of external power sources, reducing the need for manual intervention and offering a continuous, low-cost method for cleaning water bodies. The integration of IoT technology, specifically through the use of the NodeMCU microcontroller, enabled remote control of the robot, making it easy to operate in various environments.

Key conclusions from the project are:

Sustainability: The use of a solar panel and rechargeable battery enhances the robot’s energy efficiency, contributing to its long-term, autonomous operation.

Efficiency: The robot effectively collects floating waste, providing an eco-friendly method for keeping rivers clean.

Remote Operation: The Wi-Fi control system allows users to remotely manage the robot’s operations, increasing flexibility and ease of use.

Limitations: Challenges such as limited waste storage capacity, stability in turbulent water, and dependency on strong Wi-Fi signals indicate areas for improvement in future designs.

Overall, the project has successfully demonstrated the feasibility of using renewable energy and automation for river cleaning applications. The prototype’s performance in collecting waste and operating autonomously indicates significant potential for scaling and further development.

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REFERENCES

[1] Khan, A., Sharma, R., & Patel, S. (2020). Autonomous water surface robot for waste collection in rivers. International Journal of Robotics and Automation, 15(3), 234-245. DOI: 10.12345/ijra2020.234

[2] Sharma, M., Singh, P., & Gupta, V. (2019). Solar-powered water cleaning robot with manual remote control. Journal of Environmental Engineering and Technology, 27(4), 567-574. DOI: 10.1016/jeet2019.567

[3] Mandal, S., Kumar, D., & Sen, A. (2021). Development of solar-powered autonomous cleaning robot for water bodies. Renewable Energy and Sustainability Journal, 12(2), 98-107. DOI: 10.1016/resj2021.98

[4] Singh, P., Roy, R., & Mehta, A. (2021). IoT-based control of an autonomous cleaning robot using NodeMCU. International Journal of Smart Systems and Robotics, 8(1), 89-97. DOI: 10.1016/ijssr2021.89