IJIREEICE ISSN (O) 2321-2004, ISSN (P) 2321-5526

International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering

Impact Factor 8.021 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 12, Issue 3, March 2024

DOI: 10.17148/IJIREEICE.2024.12311

Solar-powered debris collector designed for water bodies

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Abstract: The paper focuses on the creation of a prototype for an Internet of Things (IoT) based Water Surface rubbish Collector. The aim behind this project is to educate individuals about the importance of monitoring the health of our rivers. The prototype allows people to collect rubbish from the water surface using a mobile robot. The trash collector is specifically engineered for the purpose of cleaning small-scale lakes, narrow rivers, land, and sewers. The robot's navigation is governed by IOT communication facilitated through a Smartphone application. A comprehensive assessment was conducted to evaluate the control efficiency and garbage collecting load capacity of the water garbage collector. According to the empirical findings obtained from a swimming pool, the device has the capability to function across a considerable distance and gather recyclable waste of small to medium dimensions, including food packaging, water bottles, and plastics. The device successfully maintained buoyancy and maneuvered on the River while remaining within the range of the Bluetooth network. It is advisable to utilize a robust and lightweight material for the construction of this water waste collector. An ultrasonic sensor is used to determine the level of waste in a collection of trash particles. This sensor is being integrated in future plans to enable a fully autonomous control system.

Keywords: Internet of Things, ESP32, Arduino IDE, Photo Voltaic Cell.

I. INTRODUCTION

Water covers more than two thirds of Earth's surface, whereas land occupies less than one third. People are putting a greater and greater strain on the world's water supplies as the global population rises. Our rivers, oceans, and other inland bodies of water are being "squeezed" by human activity, leaving them less potable. Water contamination occurs when water quality drops. The skimmer boats, which are used to collect and dispose of floating solid waste in waterways and harbors, are the subject of this innovation. The invention is mainly focused on small, easily-manoeuvrable boats that can catch floating trash, keep it on board, and then send it to a designated area—the beach, another boat, or even another trash boat—for later disposal. The gathering of floating solid trash and other debris has been suggested by numerous work boats and vessels. One common configuration is a monohull with an operator station and either a paddle wheel or screw driver for propulsion, while another is a catamaran-type hull with two pontoons or sponsors. The pontoons of a catamaran-type twin-hull vessel often house one or more open mesh conveyors that are operated by hydraulics in a trash skimmer configuration. As a result of current environmental trends, the flooding and climate change problem has grown into an alarming one. The world, particularly emerging nations, are really worried about this now. In addition to contributing to flooding and global warming, the majority of the trash that makes its way through a water drainage system is not biodegradable. When one end of the drainage system becomes clogged, the water has to go somewhere else, beyond the planned drainage system. This means that the water is forced to spill over the drainage system's horizontal height and spread to areas adjacent to it. This can lead to issues like water logging of agricultural land and residential buildings, etc. Contaminants in water can make it unhealthy and even deadly. To collect, convey, and dispose of water through an outfall or outlet is the primary purpose of the main drainage system, as long as the draining system is taken into consideration. Empty bottles, plastic bags, papers, and other similar objects are the only acceptable contaminants in drainage water. This is a functional prototype of a solar-powered water cleaning mechanism that can autonomously gather litter and other solid waste off the water's surface and deposit it in a floating container. It is remote-operable, programmable, and capable of scaling to any size. As a tactic for river cleaning, the system is both native and effective.

Goals

This research tries to decrease human intervention while simultaneously collecting various waste types from water bodies. The equipment's gathered garbage is easily disposed of. An eco-friendly and user-safe water rubbish collector powered by solar energy. will be utilized in the smart water city area in the future.

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II. CELL PRINCIPLE

Upon absorption of the sunlight that strikes the PV cells. Particles with + or – charges (holes and electrons) are generated by the energy of the absorbed light and are capable of unrestricted motion in every direction within the cell.

Electrons (-) have a tendency to accumulate in N-type semiconductors, whereas holes (+) accumulate in P-type semiconductors. An electric current flows through the cell when an external burden is connected between the two electrodes.

III. ACTIVITIES

We utilize twin hull construction for floating purposes in this system. The primary objective is to gather debris from the water's surface utilizing solar panels as an unconventional energy source. The voltage produced by the solar sheet is stored in a lithium-ion battery. Maintaining voltage fluctuations between the battery and components requires a stationary voltage regulator.

Utilizing the ESP32 IoT device, the conveyor and L293D driver are managed. It is equipped with an integrated Wi-Fi module for navigational purposes. Utilizing the L293D controller, the rotation of a motor in multiple directions is regulated. Water debris is collected by covering the conveyor with a filter sheet. The accumulated garbage is subsequently deposited in the trash collector, where its level is monitored by an ultrasonic sensor. The comprehensive system is managed through the utilization of an Android Studio application on a smartphone.

IV. HARDWARE REQUIREMENTS

- Solar Sheet (20V, 5AH)
- Dc Motor (200 rpm)
- Battery (12V , 4AH)
- L293D
- ESP-32
- Ultra sonic sensor
- Relay
- conveyor

A. Solar Sheet(20 V, 5AH)

The term "solar sheet" denotes a pliable, slender solar panel that transforms solar radiation into electrical energy. Solar sheets, in contrast to conventional inflexible solar panels, are constructed using lightweight and pliable materials like polymers or metals, enabling a wider range of adaptable and handy uses.Solar sheets often comprise several layers, namely an upper transparent layer that facilitates the transmission of sunlight, a layer composed of semiconducting material that captures sunlight and transforms it into electrical energy, and a lower layer that offers structural reinforcement and electrical connectivity.

B. DC motor (200 rpm)

This machine utilizes six TT gear dc motors to regulate the movement of both the model and the conveyor.The motors can be operated using a voltage range of 3V DC to 6V DC, with the motors operating at slightly greater speeds at higher voltages.

C. Battery (12V,4AH)

Our power source is a lithium ion battery. The energy is stored by means of the reversible reduction of lithium ions; it is a form of rechargeable battery. A carbon-based material called graphite is usually used as the negative electrode (anode) in traditional lithium-ion cells. Metal oxides are commonly used as the cathode, or positive electrode. In most cases, an organic solvent containing a lithium salt serves as the electrolyte.

D. L293D

A pair of half-H drivers with four times the current as the L293D. Bidirectional drive currents up to 600 mA are possible at voltages ranging from 4.5 V to 36 V, according to its design. For positive-supply uses, both devices may power inductive loads such relays, solenoids, dc and bipolar stepping motors, and other high-current/high-voltage devices.

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E. ESP-32

From GPIO0 to GPIO19, GPIO21 to GPIO23, GPIO25 to GPIO27, and GPIO32 to GPIO39, the ESP32 chip has 34 physical GPI. You can link each pin to an internal peripheral signal or use it as a general-purpose I/O.There is built-in support for both Wi-Fi and Bluetooth on the ESP32. The ESP32 can operate from 2.2 to 3.6V.

Fig.1 Solar Panel

Fig.2 ESP 32

Fig.3 L293D Driver

Fig.4 Hardware set up

F. Ultra Sonic Sensor

Among its many uses, ultrasonic waves can be measured, detected, and navigated by means of an ultrasonic sensor. It has a transducer, which sends out waves of high frequency, and a receiver, which picks up the waves that reflect off of them. After timing how far and how fast sound waves travel to and from an item, the sensor determines the level.

G. Relay

Switches that are powered by electricity are known as relays. As current flows through the coil of the relay, a magnetic field is produced. This magnetic field attracts a lever, which in turn causes the switch contacts to be altered. It is possible for the coil current to be either on or off, which is why relays have two switch positions and are double throw switches, also known as changeover switches.

H. Conveyor

The conveyor has been utilized in this particular type. Through the utilization of a motor driver circuit, the ESP32 module is responsible for controlling the conveyor. All of the garbage that is floating in the water is collected by this conveyor. For the purpose of filtering the minute particles that are present in the river water, this conveyor also contains filter sheets.

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V. TECHNOLOGY IMPLEMENTED

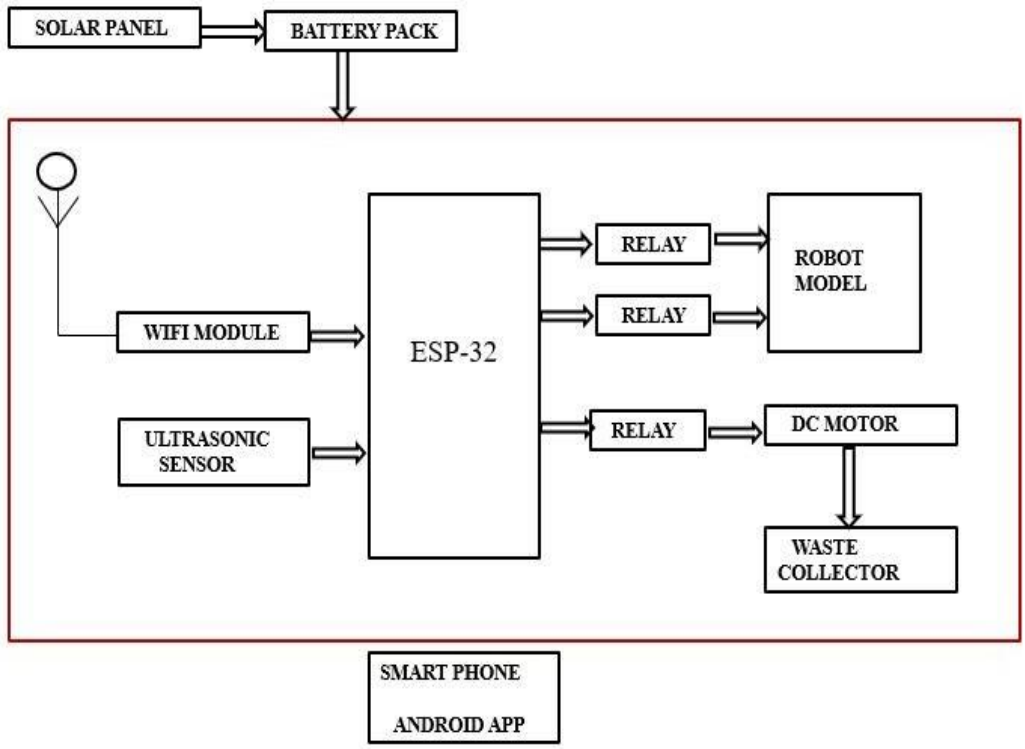

Fig.5 Block Diagram of Proposed system

A. Arduino IDE

For programming Arduino UNO, the Arduino IDE (Integrated Development Environment) is utilized. Use of the C programming language for program development. Arduino UNO is coupled to the Wi-Fi module microcontroller ESP32. The Wi-Fi module facilitated Internet-based communication with the Android studio (i.e., the mobile application). By establishing a connection to an ESP32 and enabling mobile hotspot, the link was established. The ESP32-transmitted data was exhibited by the mobile application. This information was utilized for real-time and online parameter monitoring.

B Android Studio

This Android application is installed on mobile devices in order to automatically manage the configuration via Wi-Fi.

Fig.6 Android Studio

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VI. METHODOLGY

In order to function, solar-powered garbage collectors on bodies of water collect floating debris. The apparatus extracts refuse from the water, including plastic bottles, froth, and other debris, and subsequently supplies it to a conveyor system.

The garbage is then transferred to a storage container via conveyance. Solar energy is utilized to power the device through the utilization of photovoltaic panels. Batteries contain the energy that drives the electric motors that are accountable for the rotation of the conveyor belts and wheels.

The ESP 32 module is utilized by mobile phones to regulate the motion of motors. Large containers or bags are used to store the collected refuse until it can be retrieved and disposed of at a designated recycling center or landfill. The volume of waste in the body of water and the dimensions of the device will determine whether the collection system operates continuously for hours or the entire day.

VII. MERITS

- Simple and hand efficient
- Less expensive
- Reduced man power
- Low power consumption
- This project is used to monitor the soil water etc.

VIII. APPLICATIONS

• This pertains to water contamination in ponds and rivers.

• It is beneficial to eliminate any sediments that may be present in order to maintain the cleanliness of the water bodies.

• It is preferable to avoid contact with patients during pandemic; therefore, this system can be modified and implemented in hospitals to collect medical refuse.

• These are frequently employed to ensure proper effluent treatment and prevent drain blockages.

IX. POSSIBLE FUTURE SCOPE

• Solar-powered trash collectors are gaining popularity because they reduce human labor and expenses while providing an environmentally favorable solution for waste collection on bodies of water.

• The device further contributes to the enhancement of water quality through the elimination of contaminants and perils that endanger marine life and wreak havoc in aquatic ecosystems.

• In response to the growing need for sustainable waste management, cutting-edge technology and inventive approaches are driving the development of cleaner and more effective measures to safeguard the environment.

X. CONCLUSION

This study demonstrated the capability of an Internet of Things (IoT)-enabled water refuse collector prototype to gather debris that is floating and partially submerged in the water's surface. The efficacy of utilizing a smart phone application to remotely control the forward, reverse, left, and right rotation of the water waste collector was validated through the implementation of multiple experimental configurations.

Garbage was successfully collected in the pool area. Future iterations of water garbage collectors may be equipped with garbage detection systems and the ability to navigate autonomously without human intervention.

The prototype's functionality can be enhanced to effectively mitigate the danger of flooding through the incorporation of high-strength materials in the collector body. Additionally, self-sustaining solar panels have the capability to power DC motors with increased speed and torque.

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