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Remote monitored Aqua Garbage Collecting Robot

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Abstract: Clean water is a basic requirement for all living things. It is impossible to survive on Earth without water. Water covers around 70% of the Earth's surface, but just 3% of it is pure water. The wastes created by humans floating on water are extremely hazardous for the water life. Because most diseases nowadays propagate through water, an aqua waste collection robot is required. This paper illustrates aqua garbage collecting robot and collect many types of floating wastes and collect more amount of waste. It is easy for the user operation and environmental friendly. In our approach, conveyor belt mechanism is used to replace a traditional way of collecting a garbage from river. Conveyor Belt Mechanism is monitored remotely for collecting wastes from river. The sensor senses the garbage level in the collector bin and shares the information by message. Based on the obtained information the robot is being controlled. The trash is pushed into a bin located just behind the conveyor. This will be used to clear surface garbage from rivers, ponds, lakes, and other water bodies. Thus it reduces water pollution and aquatic animal deaths. This also lessens the problems faced by humans as it removes the surface garbage like plastic bottles.

Keywords: Garbage collection, Arduino controller, Conveyor belt mechanism, remote monitoring.

I. INTRODUCTION

In India, lakes have a unique significance. Lakes play a crucial role in the Earth's ecosystem. They are incredibly valuable ecosystems that give us with a variety of commodities and services. Water is one of the most essential elements for survival of lives.[1-5] Water covers more than two-thirds of the Earth's surface, whereas land occupies less than a third. People are putting increasing pressure on the planet's water supplies as the world's population continues to expand. Water is an essential natural resource for all types of life on Earth. [6-9] Despite having abundant water resources, water contamination is a severe problem in many countries. Industries produce garbage and pollutants that are extremely damaging to humans and the environment.[10-12] Most of the people around the world lack behind drinkable water. These problems can be reduced by collecting the debris on water surface. As most of the diseases these days spread through water there is a need for aqua garbage collecting robot. The system consists of conveyor belt which collect the garbage from water surface. The robot uses ultrasonic sensor to detect objects on the water surface. The methods used for collecting garbage wastes involve moving around the water and collecting the waste from various locations. The garbage collection system is designed to gather plastic wastes, plastic bottles, organic wastes, and any other sort of floating waste. The trash is pushed into a bin located just behind the conveyor. This will be very useful in rivers, ponds, lakes, and other bodies of water to remove surface water debris. The main objective of our work is to develop and evaluate a floating robot with conveyor belt mechanism for collecting garbage wastes from rivers, ponds, lakes and other water bodies.

II. LITERATURE SURVEY

Shrutika et al. [1] developed a work on gathering of wastes floating within the water. It helps to scale back the pollution of water on floating bodies. But the robot will not capture water debris, garbage, plastic, and any other contaminants floating in bodies of water. It is used for disposing the contaminant near the banks of river. Miao et al. [2] has created a multi robot coverage path planning algorithm for cleaning robots. The cleaning robot considered in their work is a room cleaning robot. They applied their path planning methods for different environments of varying size and shape. They focussed on reducing the cleaning time than that of the previous approaches utilising multi robot for cleaning with different environments. It is observed from their work that when numerous robots are employed to clear a large area, the cleaning time is reduced. But if there is frequent collisions between the multiple robots working in the environment, then the cleaning time will be increased. Raghavi et al. [3] published their work on a radio frequency-controlled robot that collects garbage that floats in the water surface. Their work focussed on maintaining the pH of the water body. As the pH level of the water body is crucial in sustaining the life in the water body, the pollutants on the water surface may

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change the pH to acidic which is not suitable for the water creatures. In their work, they developed a robot controlled using RF transmitter and receiver. The robot is equipped with pH sensor and bucket collector. The pH sensor is used to monitor the pH level of water. The bucket collector is used for collecting the wastes on the surface. Since they used RF transmitter and receiver in their work, it needed line of sight control for operating the robot. Swapnil et al. [4] proposed their work to get rid of the waste debris, plastic waste and garbage from water bodies, which causes harm to aquatic & human life. They developed a machine to collect the surface wastes floating in water. The machine can be fixed at specific location along the flow of water and used to collect the floating garbage. The machine needs to be moved manually by humans to a new location. It does not have motors for moving the machine to different location. In our approach, we aim to develop a robot which can move along the water surface on its own. It communicates to the monitoring person at the shore if any surface waste is detected. Then it uses the conveyor mechanism to collect the garbage floating on the water surface. Once the garbage bin is filled, it gives notification in the monitor and then returns the garbage to the shore.

III. COMPONENT SPECIFICATION

The working and operation of the components employed in the designed system are as follows:

A. Arduino Uno board

The ATmega328P is used in the Arduino Uno board. The ATmega328 belongs to the member of the megaAVR microcontroller family. Modified Harvard architecture with 8-bit RISC CPU core is used in it. It consists of 28-pin IC with 32KB of code capacity. The ATmega328 features 32KB of non-volatile memory, 1KB of EEPROM, 2KB of SRAM, 23 GPIO lines, USART module, SPI module, 10-bit ADC module, watchdog timer module. It also supports 5 sleep modes for varying level of power management. The supported operating voltage range is 1.8V to 5.5V based on the sleep mode. There are six analog pins on Analog Port C. Each of Digital Port B and D has seven pins. The ATmega328 has 14 digital pins as a result. RX and TX pins are used for serial communication. With the ATmega328, an external quartz oscillator of 16MHz is used. The ATmega328 is a low-cost, low-power device. A programming lock and a genuine timer counter with a custom oscillator are also included.

B. Ultrasonic sensor

An ultrasonic sensor is used to detect the garbage and calculate the distance. The ultrasonic sensor is connected to the Arduino microcontroller. It also measures the distance of the surface debris and helps to move the robot. A single ultrasonic element is employed for both transmission and reception in this sensor. The ultrasonic sensor triggers the Camera Module. Camera module captures the garbage and sends the video to the human operator.

C. ESP32 CAM module

The ESP32 CAM module support Wi-Fi communication of video stream captured by a 2 MP camera. This module is used for transmitting the camera feed to the human operator. It is a system on chip module with integrated TCP/IP protocol stack. It runs a video streaming web server which can be connected by the human user in the network to view the feed. The ESP32 module is a cost-effective board and can be easily interfaced with other controllers.

D. Motors

The robot uses a 60 RPM Single Shaft Motor. The major advantage is that it produces good rpm and torque. It also operates in lower voltage range of 3-12V. Two motors are mounted on the body of the robot. It also has a light weight design. It is used together with the plastic propeller to move in the water surface. The propellers are designed with a diameter of 69 mm. The motor and propeller system is affordable, compact, and simple to install. The motor driver is used to drive the robot in both the forward as well as the reverse direction. The motor driver L298N is used in the robot. It operates utilizing the H-Bridge principle, allowing it to drive the robot in any direction. The motor driver supports pulse width modulated speed control of the motors.

E. Conveyor belt

A conveyer belt is employed to move the waste to the bin in an elevation manner. It is made from polyurethane material. It is waterproof in nature and has a non-adhesive surface. It provides the perfect skid surface for light-duty applications. The working of the conveyer belt is achieved by using two separate motors that loop over an extended stretch of thick, durable polyurethane material. When the motor within the pulleys operates and spin in the same direction at an equivalent speed, the belt moves between the two. Acrylic sheet is employed for creating a robot. It uses thickness of 3mm inches. It is a PVC material with stiffness and strength. This sheet is straightforward to bonds well with adhesives and fabricate. It has good dimensional stability and exhibits glass-like qualities clarity. It also provides water proofing of the system components mounted inside it.

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IV. WORKING

The robot operates in a semi-autonomous mode of collecting garbage. The overall block diagram of the robot is shown in Fig. 1. The arduino microcontroller board is interfaced with the ESP32 cam module. The robot can be controlled manually or autonomously collect the garbage. In the manual control operation, the robot is controlled through the ESP32 cam module. Through the server running in the ESP32 module, the user can send commands to the arduino board to operate the propeller motors. In the autonomous mode, the robot floats around the surrounding area and collects the garbage. The arduino board is connected to the ultrasonic sensor which senses the obstacle and garbage in the water surface. The conveyor belt is controlled by two dc motors. The dc motors are interfaced with the L298N motor driver IC. The motor driver is controlled by the arduino board. The speed control of the motors is achieved through the arduino board. The conveyor is operated near the garbage to collect it and place it in the dust tray attached at the end. The conveyor is designed such that its one end is touching the water surface so that garbage can be easily collected. As the conveyor rolls across the water surface, it collects various types of floating objects like floating cans, floating leaves, debris, bottles, and any other floating items. As soon as the robot is placed in water, it can start its operation of garbage collection.

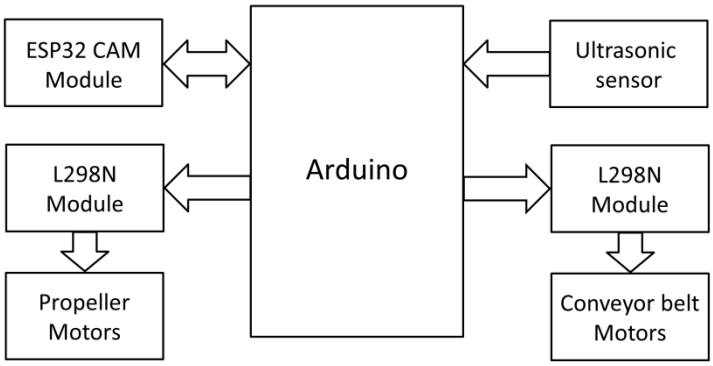

Fig. 1 Block diagram of aqua robot

The garbage is collected in the trash bin. When the bin is filled, it is indicated to the human user through the ESP32 module. The user can operate the robot to the shore through the manual control operation. The trash collected in the bin is cleaned. And then the robot is ready to collect the garbage again.

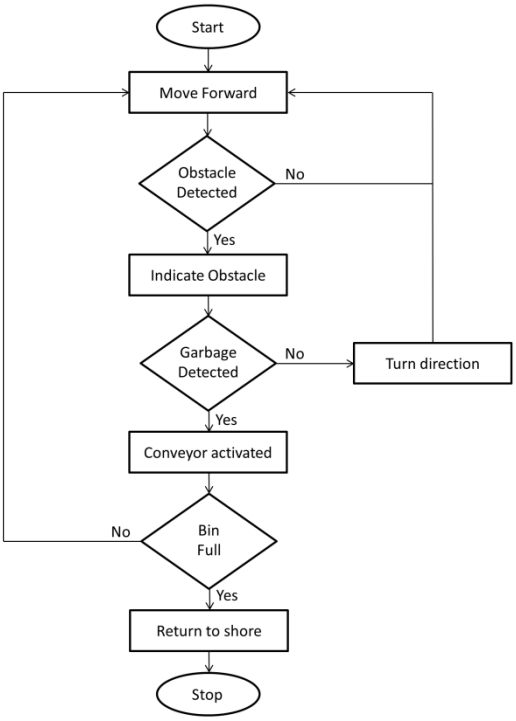

Fig. 2 Flowchart of robot operation

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The flowchart depicting the robot operation is given in Fig. 2. The robot when placed on the water surface starts moving around and it detects any object in front of it using ultrasonic sensor. Then the object must be decided whether as an obstacle or garbage. This is done with the help of remote user through the camera module. Based on the input from user, if the object is an obstacle, then the robot changes its direction and search for garbage in water surface. If the detected object is a garbage, then the conveyor belt is activated using the motors. The conveyor collects the trash in the bin. Then it is checked if the bin is full. If the bin is full, it is informed to the user on the shore through message. If the garbage is far away from the conveyor, then it is viewed through the camera feed by the human user. Then the user can manually control the robot. The process is repeated until the level of the waste is filled. The collection mechanism is made up of the conveyor that is mounted on the shaft. The conveyor system that is mounted on the motor shaft moves to collect the trash. When the machine is submerged in water, debris in the water is raised and moved upward, eventually falling into the tray. This leads to safe collection of wastes and cleaning of water surfaces.

In the manual operation, the human user can control the operation of the robot remotely. Using the camera feed, the user can move the robot to any position. It will be able to travel around the water body on its own in the autonomous mode. But detection of the garbage or obstacle is done with the help of remote user only. The robot can be switched between manual mode and autonomous search operation mode.

Fig. 3 shows the prototype of the proposed robot developed. The robot is tested in a test water tank with floating garbage. The robot successfully moves along the water surface and gathers the trash. The camera feed is viewed in the WiFi network through the server running in the ESP32 cam module. The control commands are also sent through the server running in ESP32 to the arduino board. The robot can be developed with cost effective materials. It is very useful for reducing pollution in water bodies. It can be used to minimise water debris, pollutants, and other sorts of contaminants that float on the surface of the water or in a water tank or in a swimming pool. It is beneficial in improving the quality of aquatic life in rivers and lakes.

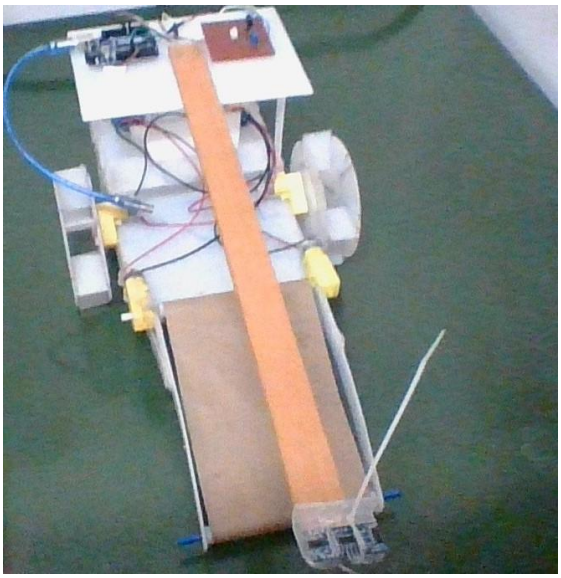

Fig. 3 A Complete Setup of robot

V. CONCLUSION

The aqua garbage collecting robot is primarily intended to remove water contaminants such as plastics and water debris that float on river and pond surfaces. The robot is able to successfully collect the debris floating on the water surface. The robot operates in manual mode and autonomous search mode. The camera feed is used to take decisions by the human user. The sensor present in the robot detects the obstacles and garbage. The garbage is collected through the conveyor belt mechanism. The trash is collected in the bin attached with the robot. Once the bin is full, the robot indicates it to the human user through messages. The robot is then emptied of the trash and used again to collect the garbage. The robot requires the WiFi network for its operation. A local WiFi network can be hosted on the area of operation of the robot. The robot can be improved to work in full autonomous operation without human intervention in future. The robot helps to clean the surface of the water body. Hence it is useful for sustaining human and animal life.

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