SOLAR POWERED WATER BODY CLEANING ROBOT

Simi P Thomas
Assistant Professor
Department of Electronics And Communication Engineering
St. Joseph Engineering College,Manglore

Aswathi T
Assistant Professor
Department of Electronics And Communication Engineering
St. Joseph Engineering College, Manglore

ABSTRACT

Water acts as a great essential life source. It is a well-known fact that life began with water and the water cleanliness is a very important aspect of life to survive on earth.But, the by-products of science laid their monstrous footsteps as pollutants. Most of these pollutants are toxic and are affecting adversely the water resources like lakes, rivers etc,living organisms in the water, and all dependent organisms. Also due to carelessness in the use and maintenance of water bodies, millions of tons of plastics and other floating wastes are dumped into the water daily. So, we aim to design an IOT enabled waterbody cleaning robot which will help in efficient waste management in waterbodies. Thus, our intension is to remove waste that are created by public using the public itself.

KEYWORDS: Aquatic Waste Management, Raspberry Pi 3 Model B, Solar Charger, Digital Voltmeter Reader

I. Introduction

Water sources are contaminated by garbage, weeds and plastic wastes. Effective waste removal in the water sources such as lakes, ponds and rivers are essential for waste management and control. In Indian setting, Aquatic waste management and control is of main concern for implementing smart city and achieving clean India mission. Therefore, the proposed work, aims at developing intelligent solution towards waste removal in waterbodies. Waterbody cleaning robot system for removing the surface wastes is experimented in this work. This waterbody cleaning system uses Raspberry Pi along with IR sensor for detection of trash bin capacity and DC motors for movement. Raspberry pi controls the movement of the robot along with motors, and IR sensor. The working prototype model of the proposed system exhibits good accuracy with reduced computational time. Also, there is a provision for the public to interfere in the cleaning process like an entertainment. Henceforth, the developed waterbody cleaning robot could be used towards reducing water pollution through efficient waste removal for implementing smart city environment.

The issue of water logging due to plastic, thermocol and metal is prompting bother development and it favour's ailments like intestinal sickness, typhoid and so on. Cleaning the wastes by utilizing manual procedures would be insufficient as it regularly covers immense territory of works and endeavours with plausibility to getting influenced by different sicknesses from the irresistible microorganisms present in the sewage while cleaning manually. To overcome those issues, this project aims to design and simulate a rubbish collecting system that is expected to further develop experimentally for the application in the real world. Hence, it will be able to getting a wide assortment of debris,including gliding litter, trash, logs, disposed tires and others. Thus, it is expected to enhance the demand and need for a design of a river cleaning machine that is able for tidying up waste from rivers, channels and lakes and overcome the current issues. The integrated system incorporates the usage of IoT technology that has the ability to monitor and control the entire process.

II.LITERATURE REVIEW

In (2019), D. Willems researched on Irrawaddy River Dolphins.In this paper he researched to learn

about dolphin mortality, population and ecology, WWF teaches local communities about river dolphins and environmental conservation. They have developed community fishery management zones to help sustainably manage fish and prevent dolphins from accidental capture in nets and other equipment. WWF has long-term river dolphin conservation experience, but we know that we cannot bend the curve alone. Their solution is to mobilize a powerful global community of partners to secure the future of river dolphins and the communities that depend on healthy and productive freshwater ecosystems.

In (2017), M. N. Azwad in his paper Threats To River researches that the dirty water may contain rubbishes or chemical materials, which will reduce the water quality. Therefore, this dirtying of water is called pollution. With the advent of development and industrialization, more and more areas become vulnerable to contamination (Zaki Zainudin, 2017) Many factories want to save on cleaning costs. They just threw toxic substances into the river without cleaning them. Besides this, for convenience, some people treat the river as a dump. For this reason,the main reason for river pollution is regional development and residents' awareness. If the pollutants are not treated, they will be discharged directly or indirectly into the water. Undoubtedly this situation will cause river pollution. For this reason, this situation also will cause environmental degradation, which can affect the entire ecosystem, including animals and plants in the river. When the animals and plants use the rivers, they may get diseases which can kill them. At the same time, river pollution will also endanger human health and cause many diseases In this report, we will analyse and summarize this environmental issue in Malaysia.

Aakash Sinha; Prashant Bhardwaj; Bipul Vaibhav; Noor Mohommad in their paper Research And Development Of Ro-Boat: An Autonomous River Cleaning Robot presents the research of Ro-boat. Ro-Boat is an autonomous river cleaning intelligent robot incorporating mechanical design and computer vision algorithm to achieve autonomous river cleaning and provide a sustainable environment. Ro-boat is designed in a modularfashion with design details such as mechanical structural design, hydrodynamic design and vibrational analysis. It is incorporated with a stable mechanical system with air and water propulsion, robotic arms and solar energy source and it is proceeded to become autonomous by using computer vision. Both "HSV Color Space" and "SURF" are proposed to use for measurements in Kalman Filter resulting in extremely robust pollutant tracking. The system has been tested with successful results in the Yamuna River in New Delhi. We foresee that a system of Ro-boats working autonomously 24x7 can clean a major river in a city on about six months' time, which is unmatched by alternative methods of river cleaning.

Ganesh U L, Vinod V Rampur in their research paper Semi-Automatic Drain For Sewage Water Treatment Of Floating Materials proposed concept to replace the manual work in drainage cleaning by mechanical drain cleaner. Now-a-days even though mechanical drainage plays a vital role in all industrial applications in the proper disposal of sewages from industries and commercials are still a challenging task.Drainage pipes are using for the disposal and unfortunately sometimes there may be loss of human life while cleaning the blockages in the drainage system. To overcome this problem and to save human life we implement a design "mechanical semi-automatic drainage water cleaner" and we designed our project to use this in efficient way to control the disposal of wastages and with regular filtration of wastages.

Mr.G.G. Rathod, Suraj Varpe, Sanket Pawase, Vikas Sahane in their paper River Cleaning Machine present theory on "river cleaning Mechanism". The system is successfully able to clean the floating solid waste over the river surface more efficiently. This system works towards its social aim of cleaning the rivers & other water bodies. It simulates the conventionallyused mechanisms of using conveyors in its working principles but have an intimidating modification of

Air Tube Piping Guider mechanism for improving its efficiency. This innovation is easy and less costly and has lot of room to grow more economical. This project "River water Cleaning Machine" is designed with the hope that it is very much economical and helpful to river and Pond cleaning. Its design, estimating cost and availability can be seen that it is cheap and very useful for the society.

TMr.Abhijeet.M. Ballade, Mr. Vishal.S. Garde, Mr.Akash.S. Lahane and Mr.Pranav.V.Boob, in their paper Design & Fabrication Of River Cleaning System discuss the water pollution is very important problem in rivers, ponds and water bodies. Due to increase in water pollution in the form to waste debris. It will affect the life of aquatic life. sometimes the aquatic animal tends to eats surface waste debris considering it as a food; which ultimately cause the death of animals. Polluted water may cause skin diseases to human kind. It is a non-conventional river clean-up system. It's initial & maintenance cost is low. Skill Worker not required to drive the system self-propel.Proper timing of mechanical control operations can improve control and reduce the spread of propagates. Environment friendly system.

IV.PROPOSED SYSTEM

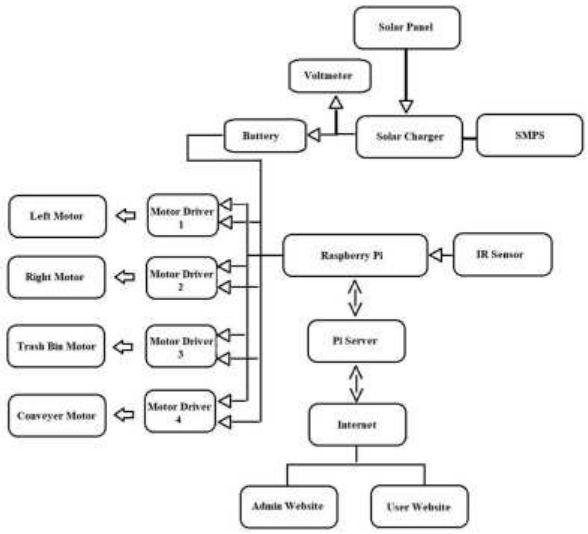

Fig.1. Block Diagram of Proposed System

Water body cleaning robot controlled through a website can be implemented in tourist spots will be an entertaining purpose with cleanliness. We have used python,Django, PyCharm language at Raspberry Pi. we effectively make use of the system by providing public interference. Hence, we were able to get all time users from the tourist spots and make use of it. This technology can replace the direct contact with the water bodies thus preventing infections from the microbes. Also, power consumption is less, that is here we used solar energy as a resource. The area covered and the waste collection will totally get depending on the user's eyesight.

V.HARDWARE REQUIREMENTS

Raspberry Pi 3 Model B

The Raspberry Pi 3 Model B is the third generation Raspberry Pi. This powerful credit - card sized single board computer can be used for many applications and supersedes the original Raspberry Pi Model B+ and Raspberry Pi 2 Model B.Whilst maintaining the popular board format the Raspberry Pi 3 Model B brings you a more powerful processor ,10X faster than the first generation Raspberry Pi .Additionally it adds wireless LAN and Bluetooth connectivity making it the ideal solution for powerful connected designs. Raspberry pi 3 is a Quad core 64-bit ARM Cortex A53 clocked at 1.2 GHz. It has an internal memory of 1 GB and 4 USB ports.

Fig.2 Raspberry Pi 3 B

DC Motors

DC motors are devices designed to convert direct current electrical energy to mechanical energy. Here

we are using four 12V DC motors with three different types. Two high-speed motors with 2800rpm are used to drive the system. The conveyor motor runs the conveyor belt with 10rpm. The bin motor with 4.7rpm lift the bin.

Fig.3 Drive Motor

Fig.4 Bin Motor

Fig.5 Conveyor Motor

Solar Panel

The energy from the solar panel is used to run the system. It uses PV module to convert sunlight into electricity. Here we are using a 10W, 14V solar panel.

Fig.6 Solar Panel

SMPS (Switched Mode Power Supply)

It is used as a secondary charging device when solar energy is not sufficient. We can charge SMPS externally to meet the energy requirement. So that we can use the system even if solar energy is insufficient.

Fig.7 SMPS

Solar Charger Control Circuit

This solar charge control combines multiple features into a single design: 3A current rating, low dropout voltage (LDO), range of voltage adjustment, reverse polarity protection, low parts cost and low parts count. High performance is attributed to the application of the common LM358 op amp and TL431 regulator. R1 biases D1, the voltage reference diode. The 2.5V reference from D1 is compared with voltage feedback from the resistor divider. The ratio of R3/R2 control the proportional gain, and C1 is a compensation capacitor that blocks DC feedback, but responds to changes in output signal thus maintaining stability. Zener D2 prevents overvoltage at the gate of Q1-R4 limits op amp output current when D2 is conducting .C1 is the positive rail bypass capacitor. D3 prevents battery discharge when the solar cells are not generating power. When the feedback voltage from

the wiper of R6 drops below 2.5V, the output of U1A moves in the negative direction thus turning Q1 on. The increased current out of Q1 causes the battery voltage to increase and increases the voltage at the wiper of R6 until it is equal to the reference voltage. 14 It may seem like a waste to use a dual op amp when only a single is required, but the LM358 remains the least expensive and most available device. It also has an undocumented feature that provides reverse battery connection. When the battery voltage is reverse, the non-inverting input of U1 is driven below the negative rail, when this happens, the output of the op amp swings to the positive rail thus turning off Q1 and protecting the circuit against this potentially damaging condition. While this malfunction is perhaps well known in the engineering community, the application of this as a circuit trick is new to the world.

Digital Voltmeter Reader

This is tiny and compact digital voltmeter with LED Display. The DC 4.5-30V 2 wire LED Display Digital Voltage Voltmeter Panel requires only a few minutes of configuration and is as simple as directly connecting wires to the source we want to measure. This voltmeter can be used to measure the storage battery's voltage in our system.Digital Voltmeter Reader and also can grasp the storage battery's status. It also can be used to measure other voltage. 30V is the voltmeter's maximum operating limited voltage.

Fig.7 Digital Voltmeter Reader

IR Sensor

IR sensor is an electronic device, that emits the light in order to sense some object of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. Usually, in the infrared spectrum, all the objects radiate some form of thermal radiation. here we use this IR to take interrupt to limit the weight of the bin in the system.

Fig.8 IR Sensor

Battery

The energy generated from the solar system are in the battery. Here we are using a 12V, 17Ah battery.

Fig.9 Battery

L298N

L298N is known as the duel bidirectional motor driver which is based on dual H bridge motor IC. This circuit allows you to control two DC motors independently in either direction. It also provides an onboard 5V regulator that you can use to Power your 5V circuits very conveniently.

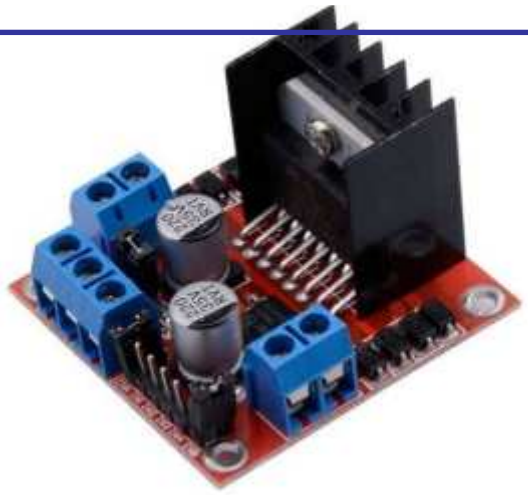

Fig.10 L298N Motor Driver

VI.SOFTWARE REQUIREMENTS

PyCharm

PyCharm is an integrated development environment (IDE) used in computer programming, specifically for the Python language. It provides code analysis, a graphical debugger, an integrated unit tester, integration with version control systems (VCSes), and supports web development with Django as well as data science with Anaconda. 4.3.2 Python Python is a general-purpose, versatile, and powerful programming language. It's a great first language because it's concise and easy to read. Whatever you want to do, Python can do it. From web development to machine learning to data science, Python is the language for you.

Django

Django is a high-level Python Web framework that encourages rapid development and clean, pragmatic design. Built by experienced developers, it takes care of much of the hassle of Web development, so you can focus on writing your app without needing to reinvent the wheel. It's free and open source.

VII.WORKING

RAZE ROBOT water surface cleaning robot is controlled through a website by internet. Here the proposed system is divided into two sections that is charging unit and working unit.

i) **Charging Unit**

Charging unit consists of solar panel, solar charger circuit, voltmeter and a battery. From the solar panel gets an output of 0-18V. The output power is given to the solar 18 charger (13.8 v) with LM358 op-amp to charge the battery. If the solar energy is not sufficient the battery can be externally charged with an SMPS gets an output of +230-13.8) V us given to the solar charger and hence the charge is stored in the battery. Hence the charging section end here.

ii) **Working Unit**

The system is implemented in tourist locations which accompany water bodies we have a base station in which there is a base station operator who monitors the system functions in a real time manner using the admins website. In this system two sites are there; one is for admins and other is for user. Public get access to the user website by scanning a QR code provided at the site. QR code directs the user to install the application which gives the access to control the functions through the website. The admins provide username and password for the user to log into the website. The admins have the provision to delete the user id and password allotted to user for security issues. Waste collection provision is given at the bank of the water body to store the waste collected by the robot. The user can operate the boat from the bank of waterbody.

After user gets access to the website they can control the movements like forward, left, right and stop functions. Also, they have the access to control the conveyor which is used to carry waste from the waterbody to the trash bin. Each user gets a 15minute time limit to run and collect the waste after the successful login. This is the overall website settings.

If the user wants to perform a function for like, forward movement a command is given to the pi server through internet and corresponding motor pins in the raspberry Pi will give a low signal to the motor driver. Working of each motor can be given in detail. For forward movement both left and right driven motor functions together. Pins GPIO2and GPIO3 are connected to the right motor driver, likewise GPIO17 and GPIO27 pins assigned to left motor driver. For forward movement + ve pins of left and right motor driver that is GPIO2 and GPIO17 sets to 'HIGH' and GPIO3 and GPIO27 sets to 'LOW'. Now the assigned GPIO headers receives low current signals and converts them into high

current signals that can drive the motor. For 20 taking left turn left driver motor turns off and right drive motor turns ON. That is pins GPIO17, GPIO27, GPIO3 pins are set to 'LOW' and GPIO3 to 'HIGH'. For taking right turn right drive turns 'OFF' and left drive motor turns 'ON'. That is GPIO pins 12, 13 and 27 sets to 'LOW' and 17 to 'HIGH'. To stop the motor, we need to set all the driver motor GPIO pins to ' LOW ' i.e., GPIO pins 27,3,17 sets to 'LOW'.

```
import RPi.GPIO as GPIO
import time
GPIO.setwarnings(False)

PumpRPos,PumpRNeg,PumpLPos,PumpLNeg = 2,3,17,27


def BoatForward():
    GPIO.output(PumpRPos, GPIO.HIGH)
    GPIO.output(PumpRNeg, GPIO.LOW)
    GPIO.output(PumpLPos, GPIO.HIGH)
    GPIO.output(PumpLNeg, GPIO.LOW)


def BoatTurnRight():
    GPIO.output(PumpRPos, GPIO.LOW)
    GPIO.output(PumpRNeg, GPIO.LOW)
    GPIO.output(PumpLPos, GPIO.HIGH)
    GPIO.output(PumpLNeg, GPIO.LOW)


def BoatTurnLeft():
    GPIO.output(PumpRPos, GPIO.HIGH)
    GPIO.output(PumpRNeg, GPIO.LOW)
    GPIO.output(PumpLPos, GPIO.LOW)
    GPIO.output(PumpLNeg, GPIO.LOW)


def BoatStop():
    GPIO.output(PumpRPos, GPIO.LOW)
    GPIO.output(PumpRNeg, GPIO.LOW)
    GPIO.output(PumpLPos, GPIO.LOW)
    GPIO.output(PumpLNeg, GPIO.LOW)

```

Fig.11 Code for Driver Motor Working

There is a conveyer Belt to carry the waste from the water to the trash bin. For the working of the conveyor belt, there is a conveyor motor. Conveyor motor runs the conveyor belt. PIO pin 23 and GPIO 24 are pins assigned for the conveyor motor. To run the conveyor motor by, GPIO 23 pin sets to 'HIGH' and GPIO24 pin sets to 'LOW'. To stop the conveyor motor, both the pins are set to 'LOW'.

```
ConveyorPos,ConveyorNeg = 23,24

def ConveyorRun():
    GPIO.output(ConveyorPos, GPIO.HIGH)
    GPIO.output(ConveyorNeg, GPIO.LOW)

def ConveyorStop():
    GPIO.output(ConveyorPos, GPIO.LOW)
    GPIO.output(ConveyorNeg, GPIO.LOW)

```

Fig.12 Code for Controlling Conveyor Motor

Trash bin collects the waste carried by the conveyor. The bin has been set to a threshold weight of 3 KG. When threshold weight exceeds, IR sensor sends an interrupt signal to the GPIO pin, which stops the conveyor motor. After the trash bin fills up, we need to clear the waste. For unloading the waste, the trash bin with the help of a motor, moves upwards inclined to the left side of the boat. GPIO 10 and GPIO 9 are the pins assigned for trash bin motor. Four bin up, GPIO110 sets to HIGH and GPIO09 pm sets to LOW. For bin down, GPIO10 sets to LOW and GPIO09 pins sets to HIGH. For bin motor to stop, set both the pins to LOW. As the trash bin reaches its maximum level of upward movement, stopper switch sensor and interrupt signal to the GPIO20 pin, with stop the motor. Likewise, That's how the boat entire function works.

```
import RPi.GPIO as GPIO
from app import ConveyorStop
from time import sleep
GPIO.setmode(GPIO.BCM)
GPIO.setwarnings(False)
IRsCon = 16

GPIO.setup(IRsCon,GPIO.IN,pull_up_down=GPIO.PUD_UP)
while(1):
    if GPIO.input(IRsCon)==GPIO.HIGH:
        print('Motor Stopped')
        ConveyorStop()# Motor Stopped

    else:
        print('Motor running')
```

Fig.13 Code for Conveyor Interrupt

VIIICONCLUSION

This paper proposes a water body cleaning robot which is controlled through a website along with the IOT technology. Also, it can be implemented in tourist places as an entertaining purpose for the tourist coming there to experience new technology.

The purposed design is going to be an effective, user friendly, entertaining purpose to boost up the directly waste collecting process with high quality, reduced time taken and it has the potential to replace the Manuel labour that is, it can prevent the human from the direct contact and risk of injuries with infectious microbes during manual process. Moreover, people going to such places will be getting a great experience and new technology to make their time more sufficient.

REFERENCES

[1] D. Willems, "Irrawaddy River Dolphins," WWF-Myanmar, p. 2, 2019.
[2] M. N. Azwad, "Threats to River," WWF-Malaysia, p. 1, 2017.
[3] A. Sinha, P. Bhardwaj, B. Vaibhav, and N. Mohammad, "Research and Development of Ro-Boat – An Autonomous River Cleaning Robot, in Intelligent Robots and Computer Vision XXXI: Algorithms and Techniques, 2014", vol. 9025, pp. 1–8.
[4] S. S. Rafique and A. Langde, "Design And Fabrication Of River Cleaning Machine," Int. J. Sci. Res. Dev., vol. 3, no. 11, pp. 8–18, 2017.
[5] Ganesh U L and Vinod V Rampur "Semi-Automatic Drain For Sewage Water Treatment Of Floating Materials International Journal of Research in Engineering and Technology, 2016", vol.5,7, pp.1-4.
[6] M. Mohamed Idhris, M.Elamparthi,C. Manoj Kumar, Dr.N.Nithyavathy, Mr. K. Suganeswaran, Mr. S. Arunkumar, "Design and fabrication of remote controlled sewage cleaning Machine", IJETT – Volume-45 Number2 -March 2017.
[7] Mr. P. M. Sirsat, Dr. I. A. Khan, Mr. P. V. Jadhav, Mr. P. T. Date, "Design and fabrication of River Waste Cleaning Machine", IJCMES 2017 Special Issue-1 ISSN: 2455-5304. [8] T. Thomas, S. Lukose, J. George, and A. B. Thundathil, "River Cleaning Robot," J. Adv. Electr. Devices, vol. 3, no. 2, pp. 1–3, 2018.
[9] S. L. Fong, D. Wui Yung Chin, R. A. Abbas, A. Jamal and F. Y. H. Ahmed, "Smart City Bus Application with QR Code: A Review," 2019 IEEE International Conference on Automatic Control and Intelligent Systems (I2CACIS), Selangor, Malaysia, 2019, pp. 34- 39. 27
[10] Sim Liew Fong, David Chin Wui Yung, Falah YH Ahmed, Arshad Jamal, "Smart City Bus" Application with Quick Response (QR) Code Payment, ICSCA '19 Proceedings of the 2019 8th International Conference on Software and Computer Applications, Pages 248-252, Penang, Malaysia — February 19 - 21, 2019
[11] M. N. Mohammed, Heayma Raj Hamid, S. Al-Zubaidi, Nur Shazwany Zamani, Muhammad Irsyad Abdullah, "A New Design of Batik Production Machine Using IOT Technology, 2019 IEEE 7th Conference on Systems, Process and Control (ICSPC)," 13– 14 December 2019, Melaka, Malaysia
[12] Zainuddin, N.F., Mohammed, M.N., Al-Zubaidi, S., Khogali, S.I., "Design and Development of Smart Self-Cleaning Solar Panel System, 2019 IEEE International Conference on Automatic Control and Intelligent Systems, I2CACIS 2019" – Proceedings 8825056, pp. 40-43
[13] A. Jamal, D. D. AL Narayanasamy, N. Q. Mohd Zaki and R. A. Abbas Helmi, "Large Hall Temperature Monitoring Portal," 2019 IEEE International Conference on Automatic Control and Intelligent Systems (I2CACIS), Selangor, Malaysia, 2019, pp. 62- 67.