SOLAR POWERED AQUA RO-BOAT

[1]Ajisha S, [2]Akhila A, [3]Cereena S Jackson, [4]Rahul R Krishnan and [5]Vighnesh Manoj

dept of EEE, College of Engineering Perumon
APJ Abdul Kalam Technological University
Kollam, India

Abstract: Water is an essential need, so it is important to maintain the cleanliness and hygiene of water. The widespread problem of water pollution is jeopardizing our health. Water bodies get polluted due to many reasons such as waste from industry, sewage etc. thus creating an unhygienic condition in the nearby surroundings. We are incorporating a technology for cleaning the water bodies effectively and efficiently. This project emphasis on the design and fabrication of a fully automated aquatic trash collector. The proposed system aims at detecting floating wastes in water using an action camera. A solar based charging unit is implemented for effective power consumption .The prime objective of the project is to minimize water pollution to a greater extent thereby safe-guarding the sanity of the water body and its dependent living things.

Keywords— Raspberry pi , Camera module, Pollution, GSM/GPS module.

I. INTRODUCTION

We have all witnessed in recent times that the pollution of water bodies is one of the major problems. The quality of water in major rivers has deteriorated to a greater extent. Disposal of plastic waste has emerged as an important environmental challenge in this world where plastics make up as much as one-tenth of the solid waste stream. Majority of the items found on beaches across the region contain plastic which pose a serious danger to marine life. Plastic waste disposal is a major challenge due to non-biodegradable nature of plastics and such wastes are visibly present in landfill sites for a long time. The floating bodies in the water cut off the oxygen exchange between atmosphere and water, thereby affecting the marine life. These floating bodies are responsible for carrying the harmful pathogens from one area to another area, by creating the pathogenic colonies causing the problems like diarrhoea, cholera and other health diseases. So above criterion are responsible for unbalancing the ecological conditions of the nature. As industrialization has spread around the globe, so the problem of pollution has spread with it.

In order to overcome these problems, our project aims at detecting floating waste and cleaning them in an efficient way. In current scenario, we have different methods for cleaning the water bodies. Some of them use an arm like structure to collect the waste. Remote control strategy is used for controlling such systems. But these methods require more human interference and are costly and time consuming.A fully automated system for the waste removal is not common. By taking the above factors into consideration Solar Powered Aqua Ro-boat has been designed to clean water body surfaces.



Fig 1: Floating wastes on a water body.

II. PROPOSED SYSTEM

The proposed system is turned on by supplying power to the components. The system consists of a Raspberry Pi camera which captures images of surrounding water body and the captured image is processed by the Raspberry Pi controller. The movement of the body is controlled by the controller through two motors. The system navigates itself to the floating trashes. It consists of a conveyor belt attached to the shaft of a 12V, 100W motor. Using a relay this motor is turned on and due to the rotation of the

motor, the conveyor starts rotating. As the conveyor moves it collects the floating wastes on the water body in the upward direction .When it reaches the upper extreme position it will get dropped onto the tray provided on the system. A load cell is used for checking the weight limit of the collected trash. When the limit exceeds it sends a warning alert to the user with the help of a GSM module and the system then returns to its initial point with the help of GSM/GPS module.A solar based charging unit is implemented for effective power consumption.This is a fully automated machine. This strategy is developed mainly to find a solution for severe problem faced by aquatic environment, which is a threat for future, and thereby restoring the balance of ecological conditions in water bodies.

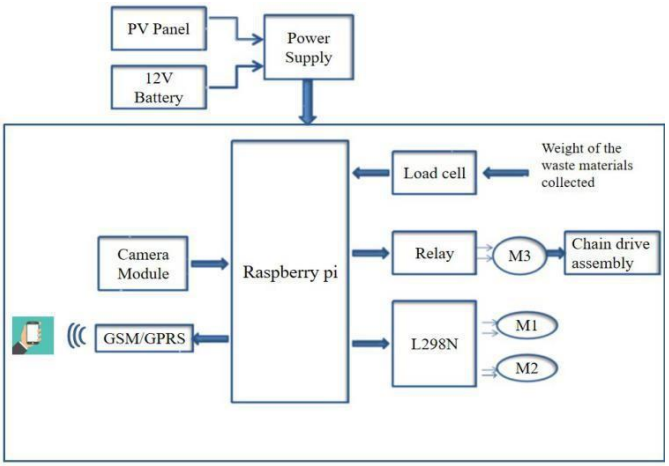


Fig.2. Proposed block diagram

III. HARDWARE AND SOFTWARE IMPLEMENTATION

3.1 Raspberry pi

Raspberry Pi is a series of small single based computers. The model used in this project is the Raspberry Pi 3B+ with Broadcom BCM2837 SoC having a 64-bit quad core processor running at 1.4GHz, dual-band 2.4GHz and 5GHz wireless LAN, Bluetooth 4.2/BLE, faster Ethernet, and PoE capability via a separate PoE HAT. The dual-band wireless LAN comes with modular compliance certification, allowing the board to be designed into end products with significantly reduced wireless LAN compliance testing.Raspberry pi can run computer vision libraries like Open CV. In this project, Raspberry pi with Open CV is used for image processing and to run the algorithm for system operation.

3.2 Camera module

The system uses a Raspberry Pi Camera module which has a 5 Mega-pixel sensor and interfaces to the Camera Serial Interface of the Raspberry pi. It is connected using a 15 Pin ribbon cable to the CSI. It is a high definition camera module compatible with the Raspberry Pi model A and B. It provides high sensitivity, low crosstalk and low noise image capture in an ultra-small and light weight design. It has a resolution of 2592 x 1944 pixels. Raspicam library is used to access the camera in software which is used by the system to take images of the water bodies for object detection.

3.3 Main propulsion unit

The main propulsion unit of the system consists of two 12V, 18W, 1100 GPH bilge pumps which facilitate the movement of the body.

3.4 Propulsion motor controller

In this project an L298N motor driver is used for controlling the propulsion system. The L298N is a dual H-Bridge motor driver which allows speed and direction control of two DC motors at the same time. The module can drive DC motors that have voltages between 5V and 35V, with a peak current up to 2A. L298N motor driver has 4 input pins of which Input 1 and Input 2 pins are used for controlling the direction of rotation of the motor 1, and the inputs 3 and 4 for the motor 2.

3.5 Load cell

The system uses a load cell for checking the limit of the collected waste. The electrical signals generated by Load cell is in few millivolts, so they need to be further amplified by some amplifier and hence HX711 Weighing Sensor comes into picture. HX711 Weighing Sensor Module has HX711 chip, which is a 24 high precision A/D converter. Here we are using a load cell which can weigh up to 5 kg.

3.6 GSM/GPS module

In this project the GSM/GPS module used is SIM900A which is a dual-band GSM/GPRS engine that works on frequencies EGSM 900MHz and DCS 1800MHz. It can work on +4.5V regulated power and any higher voltage may damage the module and the power source should be able to deliver a peak current of 2A. It has power saving mode, typical power consumption on SLEEP mode is 1.5mA. It supports UART interface which consist of transmitting and receiving pins for communicating with the processing unit.

3.7 Relay

Relay is an electrically operated switch used to switch ON or switch OFF motor M3, which controls the motion of the conveyor belt. Here a 5V 5 pin relay is used, which has a trigger Voltage (Voltage across coil) of 5V DC, trigger Current (Nominal current) 70mA and Maximum DC load current of 10A at 30V DC.

3.8 Chain drive assembly

The chain and sprocket is used for conveyor movement, which has fitted fork plates to collect the wastes. The rotation of the chain along with the plates will collect the floating wastes and put off the wastes in the bin that is placed at the backside of the system. The chain revolves with the sprocket wheel which is driven by a 12 V, 100W DC Motor is used for driving the assembly. The motor has a speed of 3550 rpm with rated torque of 0.35 N-m.

3.9 Power supply unit

Since the system works fully on solar energy, two 12V PV Panels are used. Fixed type solar panels are used in this project. They are mounted on the surface of the system. The solar energy obtained from the PV Panels are stored in a battery. A 12 V, 7.5Ah sealed lead acid battery is used for this purpose. This is eco-friendly and the sealed construction ensures no leakage of electrolyte from terminal or casing. It has added advantages of easy handling, easy installation and high reliability. The PV array converts the solar energy to electrical energy in the form of DC. The DC current obtained from the solar panel is fluctuating due to the variation in the solar energy and other constraints. Thus this current should be regulated in order to store in the battery. For this a voltage regulator is inbuilt in the power supply circuitboard.

3.10 Open CV

Open Source Computer Vision is a library of programming functions. A cross-platform library using which we can develop real-time computer vision applications. It mainly focuses on image processing, video capture and analysis including features like face detection and object detection. It works with C, C++, Python, Java.

3.11 Image Processing

Image processing is the analysis and manipulation of a digitized image, especially in order to improve its quality.Image processing basically includes the following three steps**:**

1. Importing the image.
2. Analysing and manipulating the image.
3. Output in which result can be altered image or report that is based on image analysis.

3.12 Raspicam

This library allows access to Raspberry Pi camera and provides class RaspiCam for easy and full control of camera.

IV. ELECTRICAL CIRUIT DIAGRAM

Fig 3 shows the electrical circuit diagram for the system.

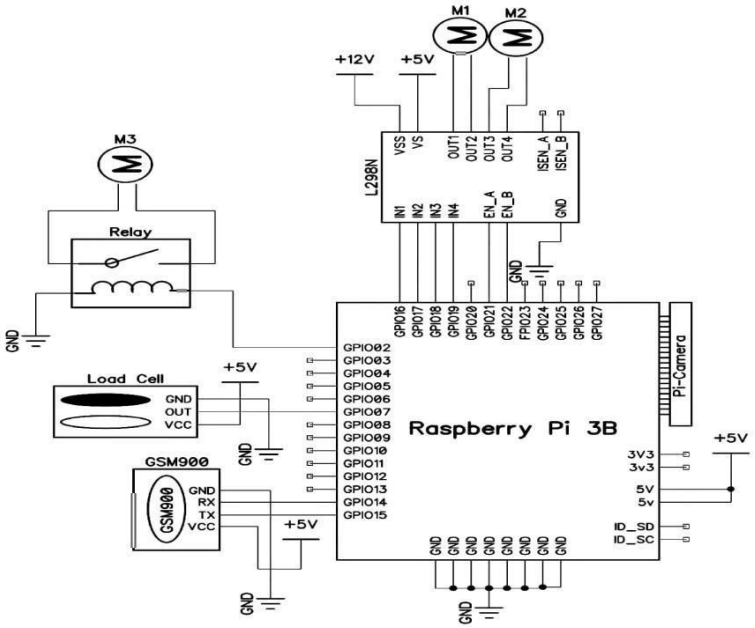


Fig. 3. Electrical circuit diagram

V. ALGORITHM AND FLOWCHART

1) Start.
2) Send “robot started” SMS to user.
3) Set up the Raspberry pi camera module.
4) Capture the image and convert it into blobs.
5) Create a region of interest.
6) Convert the colour space from RGB to grayscale.
7) Load the cascade file having training data to memory.
8) Use Harr cascade classifier to recognize the image from the frame.detect multiscale() is a function used for Harr cascade classification.
9) Identify the co-ordinates of the recognized objects.
10) Navigate to the shortest distance by turning on motors M1 and M2.
11) Start the chain drive assembly by turning on M3.
12) If object is reached collect waste else adjust motor accordingly and go to step 10.
13) If weight is less than limit continue if not go to step 4.
14) Send warning text to user.
15) Return to initial point.
16) Stop.

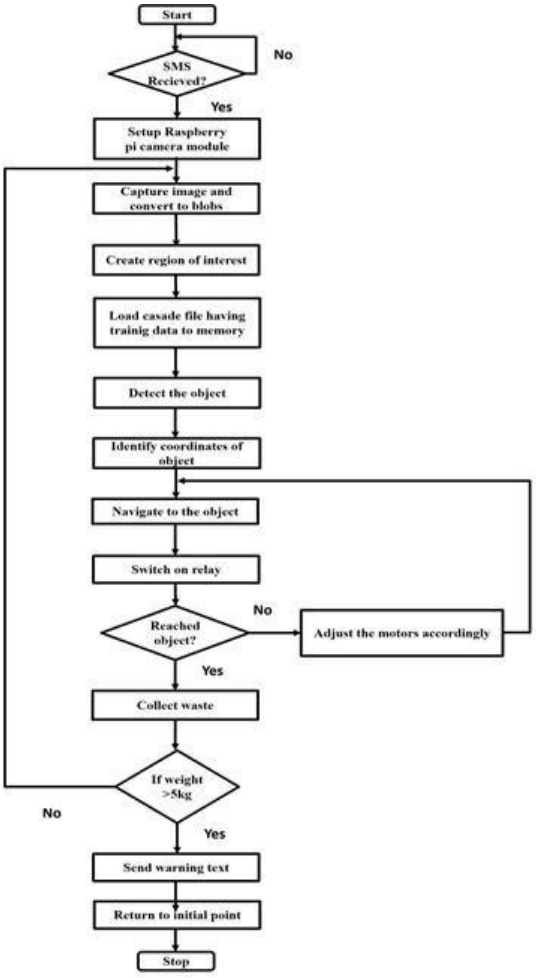


Fig.4 Flowchart of the system.

VI. RESULT AND ANALYSIS

It is estimated that the project can work up to 1 hour 10 minutes on its full capacity, but on real time working as seen the project can work up to 45 minutes after that it is required to charge the battery again. This drawback can be rectified easily by using high power battery and more research can be done in future to overcome with these problems. Fig 5 and Fig 6 shows the text received from the device when the device has started operating and when the weight of trash collected has exceed the limit respectively.

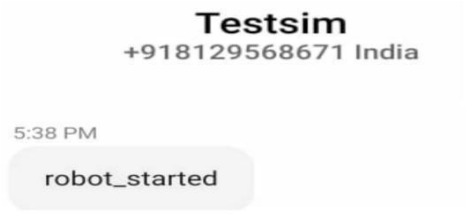


Fig.5. Text sent by GSM when the system started working

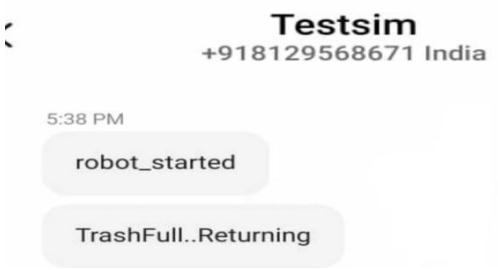


Fig.6. Text sent by GSM when weight exceeded thelimit.



Fig.7. Final hardware set-up

VII. CONCLUSION

By using AQUA RO-BOAT we can collect many floating wastes like plastic bottles, bags without any human interference. We are hoping this system will minimize the manual stress. We implemented the project with a solar panel for power supply, thus reducing the pollution. The camera module installed in the system helps in locating the waste without human interference. The project is helpful since people need not have to go every nook and corner of the water to clean, instead can easily monitored from a control station. This project, Solar Powered Aqua Ro-boat is designed with the hope that it is very much economical and helpful for river and pond cleaning.

VIII. ACKNOWLEDGMENT

Firstly, we would like to thank Almighty GOD, thus we were able to complete this work within the given time. We express our sincere gratitude to Professor, Dr. Z A Zoya, Principal of College Of Engineering Perumon, for providing us with a well-equipped laboratory and all other facilities needed for us to do this work. We also express our gratitude to Dr. Bindu S J Head of EEE Department for her valuable advice and support. We are also very much thankful to Mr. Renjith G and Mrs. Edwina G Rodrigues, our project coordinators for giving us moral support and cooperation. It is our at most pleasure to convey our sincere thanks to Mrs.Ajisha S, our guide, for providing all valuable suggestions and support for this project. We express our gratitude to all the staff members and classmates for their help and motivation. Finally, we express our regards to our parents for their moral support.

REFERENCES

[1] M. Mohamed Idhris, M. Elamparthi, C. Manoj Kumar, Dr.N. Nithyavathy, Mr. K. Suganeswaran,Mr. S. Arun kumar, "Design and fabrication of remote controlled sewage cleaning machine," *International Journal of Engineering Trends and Technology (IJETT),* Volume-45 Number2 -March 2017.

[2] Mr. P. M. Sirsat, Dr. I. A.Khan, Mr. P. V. Jadhav, Mr.P.T. , "Design and fabrication of river waste cleaning machine " *IJSART* - Volume 3 Issue 11–NOVEMBER 2017.

[3] Ms.Aiswarya N A, Ms.Arpitha M, Ms.Chaithra K,Ms. Chira Shankar,Ms.Navyashree D, "Detection and Removal of Floating Wastes on Water bodies" . *International Journal of Research and Scientific Innovation (IJRSI)* | Volume IV, Issue VI, June 2017.

[4] Abhilash R S,Aarathi Madhu,Lekshmi C Senan,Akshay Ajith, "Design and implementation of solar powered AQUA TRAMS" , *Indian Journal of Applied Research (IJAR)* Volume-9, Issue-7, July - 2019.

[5] Shrutika Pawar,Sunita Shinde,Jyoti Fatangare,Suyanka Thorat,Vijaykumar,"Remote Operated Floating River Cleaning Machine" *International Research Journal of Engineering and Technology(IRJET)* Volume :06 Issue :04 April 2019.

[6] Emaad Mohamed H. Zahugi, Mohamed M. Shanta and T. V. Prasad,"Design Of Multi-Robot System For Cleaning Up Marine Oil Spill", *IJAIT* Vol. 2, No.4, August 2012.

[7] Ankita B.Padwal, Monica S. Tambe, Pooja S. Chavare, Reshma K. Manahawar, Mitali S. Mhatre, "Review Paper on Fabrication Of Manually Controlled Drainage Cleaning System", *IJSER*, Volume 8,1ssue 3, March-2017 ISSN 2229-5518.

[8] Cary, Howard B; Helzer, Scott C. (2005),"Modern Welding Technology Upper Saddle River", *New Jersey: Pearson Education*.ISBN 0-13-113029-3.

[9] Kalpakjian, Serope; Steven R. Schmid (2001). "Manufacturing Engineering and Prentice Hall". ISBN 0-201-36131-0.

[10] Prof. N.G.Jogi,Akash Dambhare, Kundan Golekar, Akshay Giri, Shubham Take,"Efficient lake garbage collector by using pedal operated boat".

[11] Murthy S.Trymbaka."Textbook of elements of Mechanical Engineering",*ISBN 9789380578576*