IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

MODULAR GARBAGE COLLECTOR ROBOT

[1]Bhavita Bhoir, [2]Shivani Birwadkar, [3]Siddhesh Chavan, Nemisha Vikamsey, [5]Anushree Prabhu

[1,2,3,4]*Student*,[5]*Professor*,

Department of Electronics Engineering,

Vivekanand Education Society's Institute of Technology, Mumbai, Maharashtra, India

Abstract: Nowadays due to the fast increase in population as well as physical resources, collecting and disposing of garbage has turned into a challenging task and solid waste management has become a crucial challenge for the community. Focusing on human health and hygiene, as well as the cleanliness of the environment, the effectiveness of garbage disposal has become very significant. So we have come up with a 'Modular Garbage Collector Robot'. This is a WiFi controlled garbage collector robotic vehicle. Its main objective is to reduce manual labour and contact of humans with the toxic or hazardous waste like syringes, broken glass, etc. It is an app controlled robotic vehicle and it has four motor driven wheels for locomotion. This robot is designed keeping the perspective of automatic cleaning in our mind.

Index Terms **- IoT, Raspberry Pi, Modular garbage collector.**

I. INTRODUCTION

Now-a-days efficient waste collection is very important considering the fact that cleaning large areas is a tedious task. The robots which are available in the market are very expensive as they are designed to clean a large amount of area in a single stroke. This Modular Garbage Collector Robot is comparatively a lot cheaper than that version and being equipped with four wheels for locomotion helps this robot to move around freely in distant areas to collect garbage. This robot is supported with a Raspberry Pi camera which acts as the eyes of the user and makes it easier for the robot to identify and detect the garbage. The action of sweeping the garbage into the bin attached to the robot will be done by the robot as and when instructed to do so by the user through the app. With the help of a collection mechanism, the robot will be able to lift the garbage using the pulley system attached to motors. The user will also be able to control the robot from anywhere in the world with the help of a user-friendly app and the Raspberry Pi camera attached to it. This design is very flexible and it can be used for multiple cleaning purposes like household chores, cleaning areas after concerts, cleaning open grounds, hospitals, malls, schools, restaurants, beaches, offices, hotels, etc. This will be possible with the help of the Internet of Things (IoT). It helps in creating and streamlining productive, responsive, and affordable system architecture and thus it plays a key role in the automation industry.

II. LITERATURE SURVEY

In order to get the concrete idea of a scaled system and architecture of our proposed model we went through similar research papers . There have been a great number of various working designs of waste management systems, solar power based garbage collector machines and waste segregators . In this part, the first technical paper we referred is *Garbage Collection Robot on the beach using wireless communications* in which the garbage collection robot is controlled by the user via Bluetooth with the help of images from an IP wireless camera whose purpose is to collect garbage from the beach. The next paper which we came across is *Autonomous Garbage Collector Robot* in which the operation of the robot includes motion control of the robot, garbage collection and disposal of garbage to overcome the major issue of waste collection.

A. Garbage Collection Robot on the beach using wireless communications**[1]*:*** Sirichai Watanasophon and Sarinee Ouitrakul present this article of garbage collection robot on the beach using wireless communications. The main objective of this robot is to clean up waste materials on the beach. The garbage collection robot uses bluetooth and the movement of the robot is controlled by the user by looking at the images captured from the IP wireless camera. The controller used is a basic picture microcontroller. The bot is completely controlled by the user(not self-ruled), with buttons being made for COM transport connection, the four translational 5 directions, as well as the upright motion of the tray. It can collect huge amounts of waste like plastic bottles, small parcels, and so on. The robot chassis is built with tank wheels which makes it right not only for use in the sand, but also in other

hard and rough conditions. It is WiFi-controlled and nature-friendly. The mechanical aspects of the robot helps it complete tasks in the environment for which it is designed.

B.Autonomous Garbage Collector Robot*[2]*: This design of garbage collector robot uses engineering method. The Autonomous Garbage Collection robot is developed to overcome the major problem of waste collection. Its main goal is to provide automatic control for collecting garbage. It distinguishes between static and dynamic obstacles and moves accordingly as it is programmed. It basically consists of sensors at different levels for detection of dynamic obstacles. The garbage collection poses a serious threat to workers if the waste is hazardous. This project helps to collect the garbage if detected and throw it in a designated place which reduces labor as well as avoids human contact with harmful substances.

III. REQUIREMENT ANALYSIS

The implementation detail is given in this section.

3.1 Software

A. MIT App Inventor: MIT App Inventor is an open source web application integrated development environment which is used to create an android application that can run on mobile devices. It features a drag and drop programming interface that allows anybody to create mobile applications for Android devices. Here, it is used for creating an application to control the robot.

B. Firebase: The Firebase Realtime Database is an open source cloud hosted database. It is a Backend-as-a-Service (Baas). It stores realtime data as JSON. In our project, Firebase acts as an interface between the application and Raspberry pi.

C. Python IDE: Thonny is a Python IDE which has in-built Python 3. It is mainly for beginners. Here, python programming language is used because Raspberry Pi supports Python by default and it is easy to use.

3.2 Hardware

A. RaspberryPi 4: The most important step for implementation of our project was finding the microcontroller. We have chosen RaspberryPi 4 which is more like a micro computer mainly because it has a built-in WiFi module.
B. PI Camera Module: Raspberry Pi 5MP camera module is small and lightweight. It is capable of capturing 2592 x 1944 pixel still pictures and records high quality video of 1080p30, 720p60 and 640x480p60/90 .

C. L298N Motor Drivers: L298N Motor Driver module is used for driving DC motors. It consists of a motor driver IC L298 and a voltage regulator IC 78M05 5V. It basically converts low current control signal to high current control signals for driving the motors.

D. Johnson Motor: Johnson geared 100RPM 12V DC motors are mainly used for providing a massive torque of 6Kgcm in robotic applications. It is responsible for rotating the wheels of the robot.

E. DC Motor: DC motor converts electrical energy into mechanical energy. Its operating voltage is from 4.5 to 9V. DC motors are used to lift up the garbage collection bin.

IV. DESIGN

4.1 Block Diagram

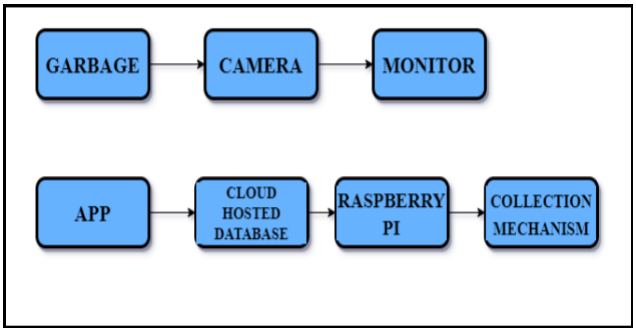

Fig.1 Block diagram of the proposed system

4.2 Methodology

In our project, we have opted for RaspberryPi as the microcontroller, it is more like a microcomputer. It is a very powerful device and enables the possibility of huge modifications in the future, like automating the detection of garbage using machine learning. It also supports IoT because it has an on board wifi module, which makes it easier, and reduces the space occupied by the components on the robot. The robot being IoT enabled, makes it possible for the user to operate it from a distance also. All it requires is a stable internet connection. Below mentioned is the in detail working of each block of the block diagram shown in fig.1:

A. Camera: Live video streaming is done with the help of Raspberry Pi camera to detect the garbage. The camera is responsible for collecting real time data about the environment around the robot. It will send this data to the user continuously.

B. App: An app is created using MIT App Inventor to control the motion of the robot. This app has FORWARD, BACKWARD, STOP, LEFT, RIGHT buttons to move the robot in a particular direction, PUSHER UP and PUSHER DOWN buttons to push the garbage in the lifter which has a bin attached to it, LIFTER UP and LIFTER DOWN buttons for the motion of the lifter and System Shutdown button to shut the entire system down.

C. Firebase: Firebase Realtime Database is a cloud hosted database which is used to store the data. It is connected to MIT App Inventor. The following variables are created in Firebase: Direction, Lift, Collect and System. When a particular button is clicked on the app, the variable associated with it will contain the respective value which was assigned to it. Direction, Lift, Collect and System variables are associated with the following buttons and are assigned the values: STOP: Direction=0, FORWARD: Direction=1, LEFT: Direction=2, RIGHT: Direction=3, REVERSE: Direction=4, LIFTER UP: Lift=1, LIFTER DOWN: Lift=2, PUSHER UP: Collect=1, PUSHER DOWN: Collect=2, SYSTEM SHUTDOWN: System=1.The value for that respective variable will be stored in Firebase and is forwarded to Raspberry Pi in real time. It has been used so that the range of controlling the robot can be increased.

D. Raspberry Pi 4: Raspberry Pi is basically the brain of the robot. After detecting garbage on the monitor, the app sends a stop command to Raspberry Pi via Firebase. Raspberry Pi will give the signal to the motor driver which will stop the dc motors and the robot stops moving. Raspberry Pi will again give a signal to the motor driver to start the motors which will enable the flap to push the garbage in the lifter which has a bin attached to it.

E. Collection Mechanism: A flap is attached at the front of the robot. When the garbage is detected, the flap will move down with the help of dc motors and will push the garbage inside the bin. If the bin gets completely filled then it is manually removed and the garbage is disposed of.

4.3 Robot Body Architecture

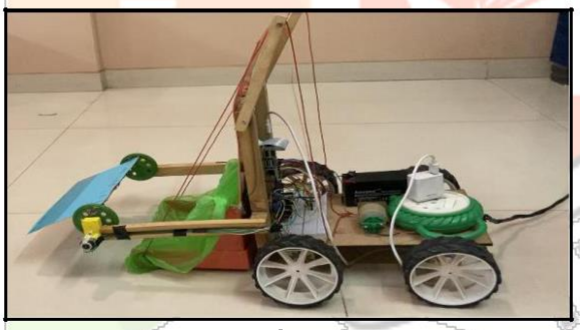

Fig.2 Robot Design

The main body of the robot is wooden. A pulley system has been used to pull the garbage collector bin,which is like a dustpan, upwards. A nylon rope is used in the pulley and rollers that gives strength to lift up the garbage. In the front there is a blue rotating flap attached to the 2 DC motors to push the garbage inside the bin.

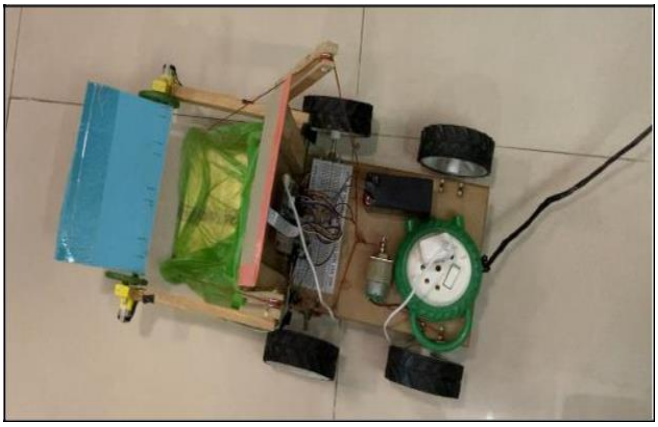

Fig.3 Top view of the robot

This robot is mostly made with recycled material, material that is lying around at home like the flap, pulley, nylon rope, bin (made from cardboard) and even the wooden extension on the chassis is made from the wood that was left over after renovation of the house. Even plastic can be used in this instead of cardboard to recycle it.

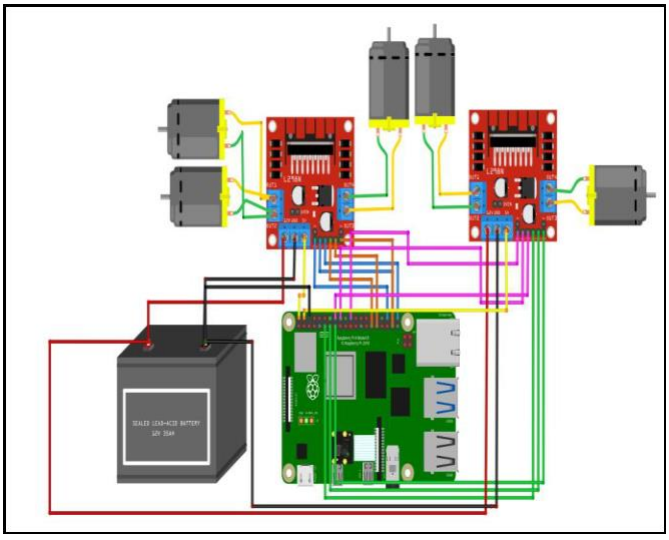

Fig.4 Fritzing Schematic of the robot along with peripherals

V. RESULTS AND DISCUSSION

The robot was successfully tested by controlling it through an application that is designed using the MIT App Inventor. There are 3 aspects in this project viz. the application, realtime database and the robot.

1)The **application** has two parts: designing of user interface and designing of blocks.

Fig.5 Design of User Interface

Fig.6 Design of blocks

2) **Realtime database** was created using Firebase. Data from MIT App Inventor was stored in it and the robot read that data via RaspberryPi.

Fig.7 Variables in Firebase Realtime Database

3) After building the application and connecting it to the database, the **robot** was designed to collect the garbage in the bin in front of its body.
Waste paper cups and a paper ball were used as garbage to
demonstrate the working of the robot. The garbage collected was dumped in the bin at the front side of the robot which is covered with a garbage bag for easy disposal.
As it can be seen in the below images, in the first image the robot is near the garbage, in the second image it has swept the garbage into the bin and in the third image it can be seen that the garbage has been successfully collected in the bin with the help of the collector which is the flap.

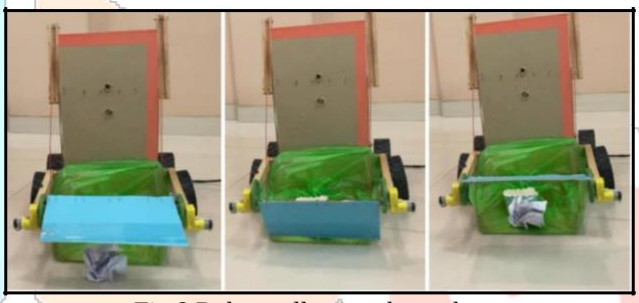

Fig.8 Robot collecting the garbage

In this final image, it can be seen that the robot has successfully collected all the garbage that was supposed to be collected. And now the green garbage bag can simply be disposed of in the nearby dustbin.

Fig.9 All the garbage collected by the robot

The dimensions of the robot are 60cm x 28.2cm x 45cm and dimensions of the bin are 23cm x 17cm x 11cm. The robot will be able to carry a maximum of 2 pounds of garbage in the bin at a time with the current material used for the body.The motors of the robot can move at 100rpm, but given the load, it decreases a little.If 2 batteries are used, one for motors and the other for RaspberryPi, then theoretically, the robot can operate for approximately 1hour. To increase the battery life, more batteries can be used, one for motors of the wheels, one for the motors used to collect the garbage and the other for RaspberryPi, so total 3 batteries. For demonstration, power supply from the wall socket was used to power the RaspberryPi, but a 5V 3Ah battery pack can be used instead.

VI. CONCLUSION

This paper offers the implementation of a low cost yet great solution for garbage collection. The main advantage of our project is that the robot can be operated from anywhere in the world with the help of a user-friendly app. It is mostly made from the materials that are available in the house. It can be used in hospitals to clean the COVID wards without putting the staff at risk keeping the social distancing norms in mind. So, this reduces the requirement of manual help.

REFERENCES

1) Sirichai Watanasophon and Sarinee Ouitrakul, "Garbage Collection Robot on the Beach using Wireless Communications," 2014 3rd International Conference on Informatics, Environment, Energy and Applications IPCBEE vol.66 (2014) © (2014) IACSIT Press, Singapore DOI: 10.7763/IPCBEE. 2014. V66. 19
2) Apoorva S. Chaithanya, Rukuma S.Prabhu, Saiswaroop B. Shetty, Denita D'Souza, "Autonomous Garbage Collector Robot," International Journal of Internet of Things 2017; 6(2): 40-42 doi:10.5923/j.ijit.20170602.06
3) Sayyad, Dr. (2019). Design and Development of Beach Cleaning Machine. International Journal for Research in Applied Science and Engineering Technology.7.1943-1948. 10.22214/ijraset.2019.6327.
4) M. Vanitha, M. Selvalakshmi and R. Selvarasu, "Monitoring and controlling of mobile robot via internet through raspberry Pi board," 2016 Second International Conference on Science Technology Engineering and Management (ICONSTEM), 2016, pp. 462-466, doi: 10.1109/ICONSTEM.2016.7560864.