AUTOMATIC ROBOVAC

Alphin A J
Department of Mechatronics
Malabar College of Engineering
And Technology, Kerala, India
alphinaj290@gmail.com

Aswin V Babu
Department of Mechatronics
Malabar College of Engineering
And Technology, Kerala, India
aswin.vb.27@gmail.com

Shahabas Aman PK
Department of Mechatronics
Malabar College of
Engineering
And Technology, Kerala, India
Shahabasaman20@gmail.com

Shebin KS
Department of Mechatronics
Malabar College of Engineering
And Technology, Kerala, India

Ujjwal Babu
Department of Mechatronics
Malabar College of Engineering
And Technology, Kerala, India
Ujjwalbabu333@gmail.com

ABSTRACT

"Robotics" - the word has a deep meaning. Robotics in turn takes the scale of development by employing various branches, tools, and mechanisms and performs a wide variety of functions for the benefit of mankind. Robot is an electromechanical device which automates the work in many areas like industrial power plants, military applications, Domestic works, agricultural applications etc. Robots are reliable means to bring objects, do settings, clean area etc. at places where human intervention is rather impossible or can cause hazardous effect on human health i.e., at nuclear power plants, chemical factories. From this whole ocean of robotics, it is intended to build a basic PC controlled vacuum cleaner robot.

The instrumental work is about making a robot capable of vacuuming and collecting waste materials like plastic bottles, covers etc. in the floor of a room or areas like parks and the road path ways without any human interaction other than just starting and stopping the unit thus saving valuable human time. In the robot a robotic arm, a vacuum cleaner and obstacle detector sensors has been integrated and the instrument controlled by a PC, which is useful in cleaning our Home, Industries, and Parks, path ways etc.

1.0 : INTRODUCTION

In the current situation, India is facing various challenges in the environment by the improper waste collection, treatment, transport, disposal. By making advancement in the present robotic vacuum cleaner ,it allows to be used in the public areas. The robot allows proper cleaning of wastes without any human intervention. Mainly used for the removal of garbage and other waste materials from the public places such as parks , malls and pathways, parking areas and auditorium etc,.. It uses vacuum cleaning mechanism and a waste collecting mechaninsm with a robotic arm for waste removal and collection . Sensors used for

the detection and provide pathways. Basic functions are path planning, obstacle avoidance, smart waste monitoring etc…

2.0: LITERATURE SURVEY

The main aim of this work is to control the robot for collecting the scrap from different areas or surfaces automatically by monitoring and regulating the direction of a dc-motor with PIC16F72 Microcontroller remotely using mobile phone techniques and DTMF (Dual Tone Multi Frequency) signaling. Different functions of moving robot are controlled like moving forward, backward, left and right.

The aspect of the project is to build an actual robot that subjects wireless operation from a PC or a smartphone. The requirement of simplicity was set in order to focus on operability and functionality. The cleanup is time consuming, and represents a potentially significant source of untapped recyclable materials. By developing an autonomous robot that can locate, sort, and separately store the different containers, the manpower needed for cleaning can be significantly reduced.

Vacuum cleaning system used in this robot is Cyclonic type filtration system which works under the principle of forced vortex flow same as in case of centrifugal pump. Centrifugal force will be created and all types of debris will be sucked in through pipe. The advantage of using this robot is saving in time, it will be very much useful for people with mobility issues to clean the house without any difficulties. The development of Autonomous Robot is divided into two main sections, the electronics design and mechanical design. The main component is PIC16F72microcontroller. The PIC16F72 can be programmed using the Pic Basic Pro compiler. The motor used is the Tamiya Twin-Motor Gearbox. The robot is equipped with the obstacle-avoidance ability which uses the infrared sensors. Then the robot can play pre-recorded messages. Those pre-recorded messages are stored in the Winbond ISD 2560 Chipcorder.

Mobile robotics is a relatively new research area that deals with the control of autonomous and semiautonomous vehicles. There are some important differences between the requirements of traditional fixed robotic installations and the requirements of mobile robotic systems. One of it is the environmental uncertainty in which the vehicle might operate in. For fixed robotic systems, a small workspace can usually be engineered to facilitate the task being undertaken. For mobile robotic systems, it is difficult to engineer the environment where the system needs to operate in because the world is dynamic and unpredictable. This required improved sensor technology and the ability for the system to cope with uncertainty. The design of mobile robotic systems considers the ability to carry all necessary resources such as power sources and all of the sensing and processing hardware within the mobile itself.

A tele remote is a remote control system which enables switching 'on' and 'off' of appliances through telephone lines. It can be used to switch appliances from any distance by just making a phone call. This system is designed to overcome the limitation of the range offered by infrared or wireless technology, by making use of the already available telephone lines, all over the world. The DTMF signals on telephone instrument are used as control signals. It decodes the DTMF tone from the keypad of telephone into its respective BCD code after the system receives the call. This BCD code is passed through a decoder which selects a particular D-flip flop. This activates a switching transistor, which in turn triggers the relay connected to the appliance.

3.0: PROBLEM STATEMENT

Collection of waste from any surface or anywhere is being handled with human intervention in many places and companies throughout the world over past years which may be very time consuming and speculative job for the mankind. As known, demand for automation is rising rapidly in recent times using the modern technologies, which also reduces the man power and risk-taking activities directly or indirectly. Complete automation is very complex; hence it can be performed using remote controls and network connections.

The current project is to reduce the time consumption and human risk while collecting the waste from a particular surface using a four wheeled robot with L293D driver controlled DC motors. The system is equipped with a vaccum setup, rotating brush type setup and a robotic arm which works together for waste collection

4.0: METHODOLOGY

In our proposed method, Raspberry PI and Node MCU is used as a core controller. The ultrasonic sensor is used for the proper pathway of the system. System consist of 4 DC motors for the rotation of 4 wheels, L293D motor driver IC is an integrated circuit chip which is usually used to control motors in autonomous robots. As the vehicle moves in zig zag manner, the ultrasonic sensor detects any obstacle present infront Then using web cam in real time, object detection (plastic bottle) takes place using machine learning via YOLO algorithm. When the plastic bottle is detected, a signal (HIGH) is sent from raspberry pi to Node MCU and the robotic arm picks up the detected bottle by moving at certain angles System also include a vacuum setup which works all the time for the collection of dirt which is collected by a dustbag for later disposal. It also consists of a brush type setup powered by a dc motor to collect plastic covers, and other kind of wastes. It can use in both automatic (Raspberry pi) or manual control(mobile control using Blynk). Manual control: As the object gets detected by machine learning, a notification sent to blynk app. The blynk app consists of joystick, slider to control the vehicle

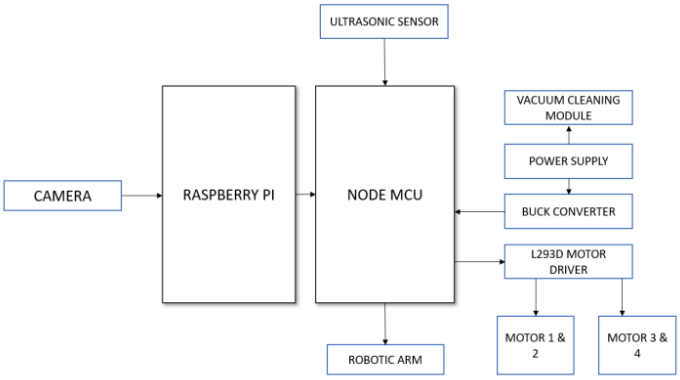

Figure 1: Block diagram of the system

5.0: HARDWARE REQUIREMENTS

5.1: L293D MOTOR DRIVER

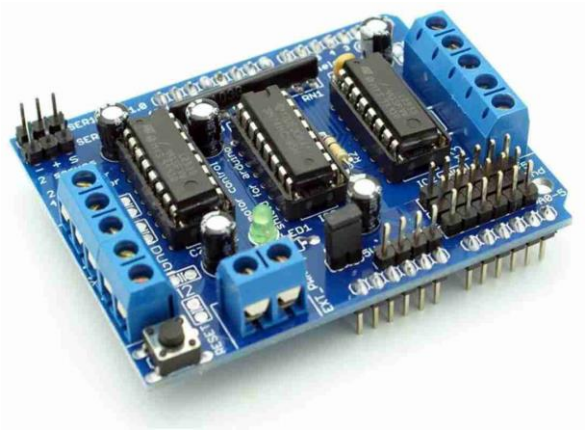

Figure 5.1: L293d Motor Driver

A motor driver IC is an integrated circuit chip which is usually used to control motors in autonomous robots. Motor driver ICs act as an

interface between microprocessors in robots and the motors in the robot. The most commonly used motor driver IC's are from the L293 series such as L293D, L293NE, etc. These ICs are designed to control 2 DC motors simultaneously. L293D consist of two H-bridge. H-bridge is the simplest circuit for controlling a low current rated motor. For this tutorial we will be referring the motor driver IC as L293D only. L293D has 16 pins, they are comprised as follows:

Ground Pins- 4

Input Pins - 4

Output Pins -4

Enable pins - 2

Voltage Pins – 2

5.2: ULTRASONIC SENSOR

Figure 5.2: Ultrasonic sensor

This is the HC-SR04 ultrasonic distance sensor. This economical sensor provides 2cm to 400cm of non-contact measurement functionality with a ranging accuracy that can reach up to 3mm. Each HC-SR04 module includes an ultrasonic transmitter, a receiver and a control circuit. There are only four pins that you need to worry about on the HC-SR04: VCC (Power), Trig (Trigger), Echo (Receive), and GND (Ground)

5.3: RASPBERRY PI 3 MODEL B+

Figure 5.3: Raspberry PI 3 model b+

Raspberry Pi 3 Model B brings you a more powerful processer, 10x faster than the first generation Raspberry Pi. Additionally it adds wireless LAN & Bluetooth connectivity making it the ideal solution for powerful connected designs. Raspberry Pi 3 Model B comes with 64 bit quad core processor, on board WiFi and Bluetooth and USB features. It has a processing speed ranging from 700 MHz to 1.4 GHz where RAM memory ranges from 256 to 1GB.

5.4: ESP 8266

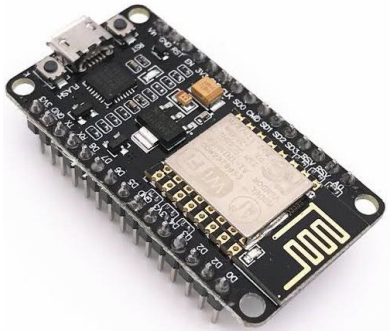

Figure 5.4: ESP8266

The ESP8266 WiFi Module is a self contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your WiFi network. The ESP8266 is capable of either hosting an application or offloading all WiFi networking functions from another application processor. Each ESP8266 module

comes pre-programmed with an AT command set firmware, meaning, you can simply hook this up to your Arduino device and get about as much WiFi-ability as a WiFi Shield offers (and that's just out of the box)! The ESP8266 module is an extremely cost effective board with a huge, and ever growing, community.

5.5: WEB CAM

Figure 5.5: Web cam

A webcam is a camera that connects to a computer. It captures either still pictures or motion video, and with the aid of software, can transmit its video on the Internet in real-time. Webcams are typically small cameras that sit on a desk, attach to a user's monitor, or are built into the hardware.

5.6: BUCK CONVERTER

5.6: Buck converter

DC – DC power converter which steps down voltage (while drawing less average current) from its input (supply) to its output (load).It contains at least two semiconductors (a diode and a transistor, although modern buck converters frequently replace the diode with a second transistor used for synchronous rectification) and at least one energy storage element, a capacitor, inductor, or the two in combination.

6.0: SOFTWARE REQUIREMENTS

6.1: YOLO ALGORITHM

YOLO is an algorithm that uses neural networks to provide real-time object detection. This algorithm is popular because of its speed and accuracy. It has been used in various applications to detect traffic signals, people, parking meters, and animals, and some specified objects

Figure 6.1: Yolo symbol

Object detection is a phenomenon in computer vision that involves the detection of various objects in digital images or videos. Some of the objects detected include people, cars, chairs, stones, buildings, and animals etc..

This phenomenon seeks to answer two basic questions:

1. *What is the object?* This question seeks to identify the object in a specific image.
2. *Where is it?* This question seeks to establish the exact location of the object within the image.

Object detection consists of various approaches such as fast R-CNN, Retina-Net, and Single-

Shot Multi Box Detector (SSD). Although these approaches have solved the challenges of data limitation and modeling in object detection, they are not able to detect objects in a single algorithm run. **YOLO algorithm** has gained popularity because of its superior performance over the aforementioned object detection techniques

- YOLO is an abbreviation for the term 'You Only Look Once'. This is an algorithm that detects and recognizes various objects in a picture (in real-time). Object detection in YOLO is done as a regression problem and provides the class probabilities of the detected images.
- YOLO algorithm employs convolutional neural networks (CNN) to detect objects in real-time. As the name suggests, the algorithm requires only a single forward propagation through a neural network to detect objects.

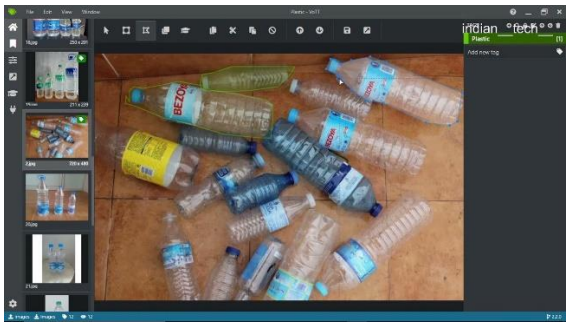

Figure 7.2: Custom data set for bottle detection

- YOLO is an algorithm that uses neural networks to provide real-time object detection. This algorithm is popular because of its speed and accuracy. The YOLO algorithm consists of various variants. Some of the common ones include tiny YOLO, YOLO V1, YOLO V2, YOLO V3.

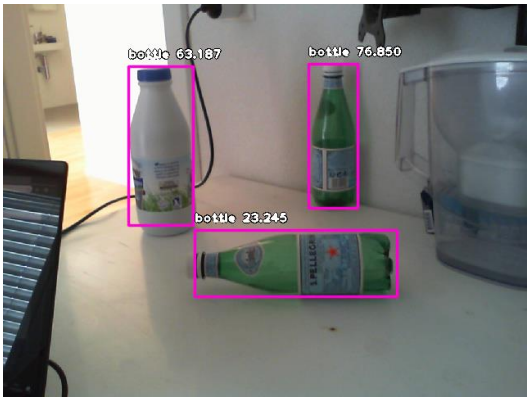

Figure 7.3: Bottle detection using YOLO

The YOLO algoritm already contains pretrained datasets of 80 objects which can be detected using the trained files. Therefore the process of object detection becomes easier using YOLO.

8.0: FLOW CHART OF BOTTLE DETECTION

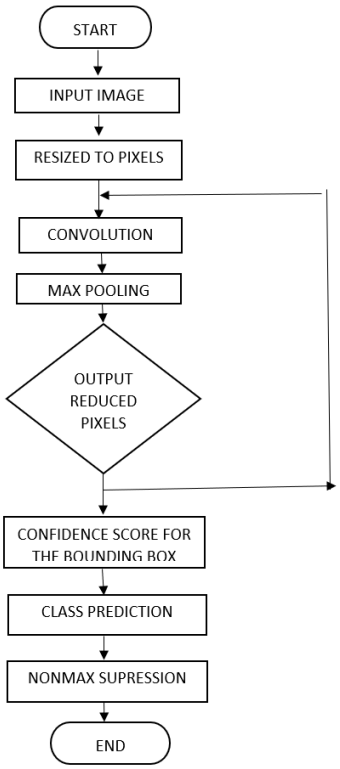

Figure 8.1: Flow chart of bottle detection

9.0: PROJECT DESIGN

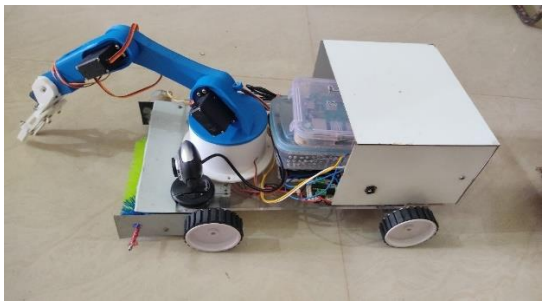

Figure 9.1::Automatic robovac

This is our proposed sytem-Automatic Robovac. The system is mainly used in parks, tourist spots, pathways commonly on plain surfaces for waste collection and management. The proposed system consists of three main configuration setup – vaccum based setup, a robotic arm for bottle pickup and a rotating brush setup infront of the system for collecting other kind of waste materials. The system moves on 4 gear motors controlled by a L293D motor driver. The bottle detection takes place with the help of Raspberry pi and a Node MCU to allow control via Blynk server for object pickup and motion.

Figure 9.2: Rotating brush setup

The rotating brush setup infront of the system is driven by a 12v DC Gear motor.The brush used is of hard plastic material used for cleaning bottles.The brush while rotating collects the plastic covers,burnt leaves and other waste materials into a separate box.

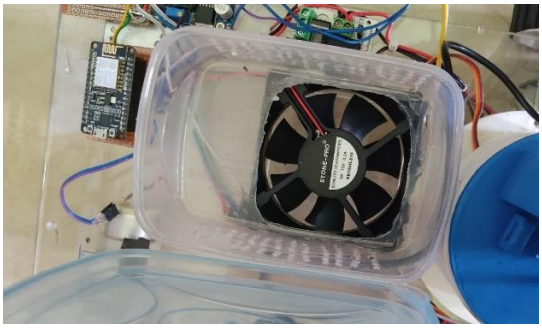

Figure 9.3: Fan for suction

The vaccum based setup on the system sucks small waste particles and collects them on a bin.The setup remains on at all time.

Figure 9.4: Web cam for bottle detection

A Web cam is placed infront of the system which monitors the surroundings in real time.The input video from cam is sent to the raspberry pi @ 8Mb/s.By using YOLO algorithm, frames are extracted from the video and analyze the presence of bottle and sent a notification to Blynk server.

Figure 9.5: Robotic arm for bottle pickup

The robotic arm consists of 6 servomotors including 3 MG servo motors. Each servomotors allow 90, 180 degree of rotation. The arm provide 4 degrees of freedom. After receiving notification from blynk server of bottle detection, the robotic arm can be manually controlled to pick and place the plastic bottles.

10.0: CIRCUIT DIAGRAM

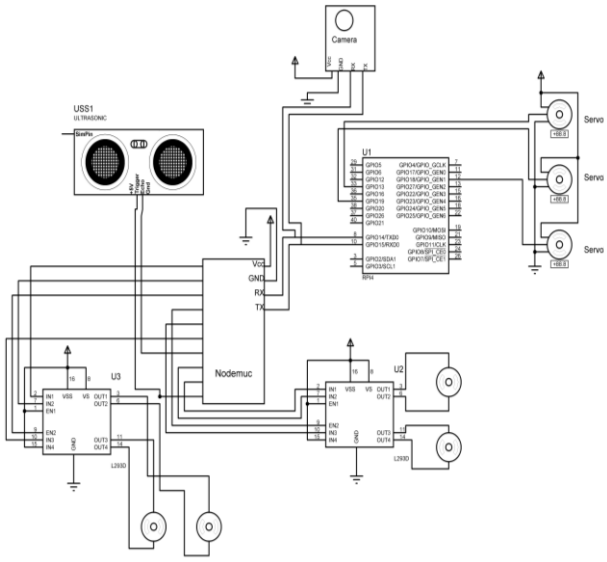

Figure 10.1: Circuit diagram of the proposed system

11.1: ADVANTAGES

• Waste disposal without any human intervention.

• Easily controllable (through android application).

• Efficient.

• Automatic movement of robot with decision making

• Real time Vacuum Cleaner action and waste picking

11.2: DISADVANTAGES

• Continuous power supply.

• Can't differentiate waste materials accurately.

• Waste storing capacity

• Weight

• Not efficient enough

12.0: RESULTS AND DISCUSSION

This project Automatic Robotic Vacuum Cleaner can be used near the parks, tourist spots, roadsides and other areas where waste is dumped. The system is easily portable and small in size to be used even in areas where human intervention is not possible. The waste collection process is accomplished faster and efficient with the implementation of advanced technology of modern era. Moreover , the vacuum cleaner robot can be remotely accessed through cloud network which reduces the human effort to an extent.

13.0: CONCLUSION

The problem of waste management is a major issue. Manual collection of wastes is often complex and time consuming. Availability of labours is also a drastic challenge. Automation represents one of the major trends of the 20th century. The drive to provide increased levels of control to electro-mechanical systems, and with it a corresponding distancing of the human from direct system control, has grown out of the belief that automated systems provide superior reliability, improved performance and reduced costs for the performance of many functions. This project provides a solution to the above problem with the advancement of vacuum cleaning setup and the implementation of machine learning to detect and collect waste materials. This project has some limitations to work practically but with the further modification of the project provides a future asset for waste collection.

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