International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 06 | June 2020 www.irjet.net p-ISSN: 2395-0072

Voice Controlled Pick and Place Robot using Raspberry pi

Manjunath yadav S[1], Gireesh M R[2], Suhas G[3]

[1,2,3]*Student, Dept. of E&C Engineering, RVCE, Karnataka, India.*

Abstract—*In the field of electronics and electrical engineering Robotics has been an important feature. This is due to the high Robots potential that reduces human effort and performs tasks accurately and efficiently. This paper designed and built voice controlled pick and place Robot using Raspberry pi. Python which is open source and which simplified version of other programming languages in terms of functions, used to program the architecture of Robot of Raspberry pi commands. The Robots performs the action due to voice commands via voice input. The system performs the pick and place the object through input voice commands to lift maximum of 100 grams and distance upto 20m with high precision. This robot uses the Tensorflow USB Coral accelerator to increase the Raspberry pi object detection.*

Keywords—Robot, Raspberry pi, python, accurate, efficient, Tensorflow, USB.

1. INTRODUCTION

A robot is an important part of automating versatile production systems which are highly in demand these days. Robots are now more than machines, robots are the solution for the future, as labor costs and customer demands continue to increase. For many manufacturing industries robots are indispensable, as the cost per hour of running a robot is a fraction of the cost of human labor needed to perform the same task. However, once programmed, robots execute tasks repeatedly with a high precision that surpasses that of the most experienced human operator. This paper is aimed at designing and developing a pick and place robot with a Raspberry pi and Roboclaw motor controller, and the common Rover 5 robot platform to pick and place the object.

Day to day life has so many dangerous circumstances. There are so many occasions when the human can not function. In such situations, work is impossible without a considerable amount of safety precautions, such as hazardous waste disposal, radioactive substances, remote handling of explosive devices, and lighting and hostage situations among others. Such robots can operate safely on unsafe environments maintaining human health and replacing large human workforce. It are often also applied in medical sciences, surgeries, defense, AI, super markets, and also in manufacturing.

2. OBJECTIVES

The main objective of this project is to firstly, the system has to recognize the voice command of the user, in which it has to detect the voice command. Secondly, the system has to identify the specific object and move towards the object on its own. Finally, the robot has to pick the object and return back to its original position and place the object which is specified in the voice command.

3. METHODOLOGY

The design methodology consists of two main components; Hardware (That describes the system's physical components) and Software (Which instructions are encoded on the computer). The block diagram of the system is shown in **Figure 1.**

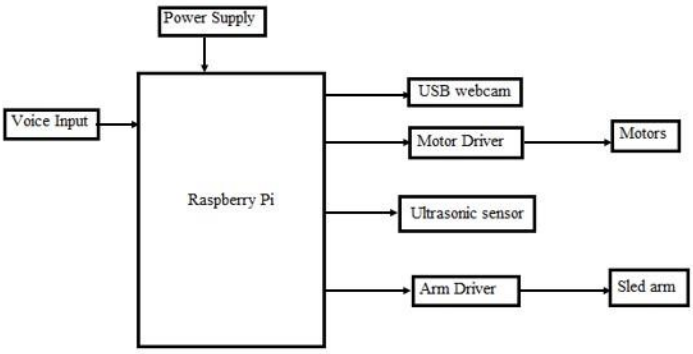

Figure 1: Block diagram of the system.

3.1 Hardware

The hardware components are

- Raspberry Pi 3
- Roboclaw 2x7A
- USB Webcam
- Ultrasonic Sensor (HC-SR04)
- Sled arms

3.1.1 Raspberry Pi 3: It is the brain of the robot. It performs the all the computation for where the robot should move and what task it perform. It is the hub for all the sensors and electronics and allows them all to work together.

3.1.2 RoboClaw 2X7A. The 2 RoboClaws are the muscle of the system. These are the motor controllers that actually allow movement of the robot and performs tasks that it needs to do. The first RoboClaw controls both the tank-tread motors, and the next RoboClaw controls the singular robotic sled motor that used to picking up the object.

3.1.3 USB Webcam: We can use the Raspberry Pi Camera or any other generic USB webcam. In our case we used the

separate USB Microphone for voice recognition commands since the Raspberry Pi camera doesn't have a mic.

3.1.4 Ultrasonic Sensor: We used simple HC-SR04 ultrasonic distance sensor to find the distance between the robot to detected object.

3.1.5 Sled arms: we can use any geared brushed DC motor with a built-in encoder and appropriate torque.

3.1.6 Battery: We can use Li-Po battery with two-cell 7 volt 1400 mah capacity.

3.2 Software Section

The software components consists of the

- Tensor flow
- Snowboy
- Python 3.0

4. WORKING OF THE SYSTEM

The Working of the system explained in various steps:

4.1 Detection of Voice

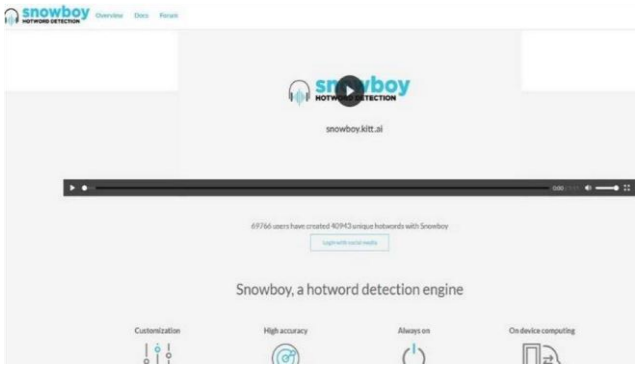

Figure 2: Voice command using Snowboy

The robot voice detection works via the SnowBoy voice detection program. Snowboy is an software tool which is light weight, offline voice wake-up word detector. The SnowBoy barely uses any CPU power to detect voice which runs device locally, which means your voice is processed on the Raspberry Pi itself and not server. It means our voice data is private and there aren't any privacy concerns. Since

Snowboy uses multiple voice commands, we must use wakeup voice command, in our case we use “hey robot”. After 10 second internal timer starts and the LED light turns on. Further we can give voice command to detect, pick and place object at original position. e.g, In our case, we use command “tea cup”, in which this command asks the robot to find a cup and bring it to original position.The **figure2** and **figure4** shows the representation of working of the Snowboy using voice commands.

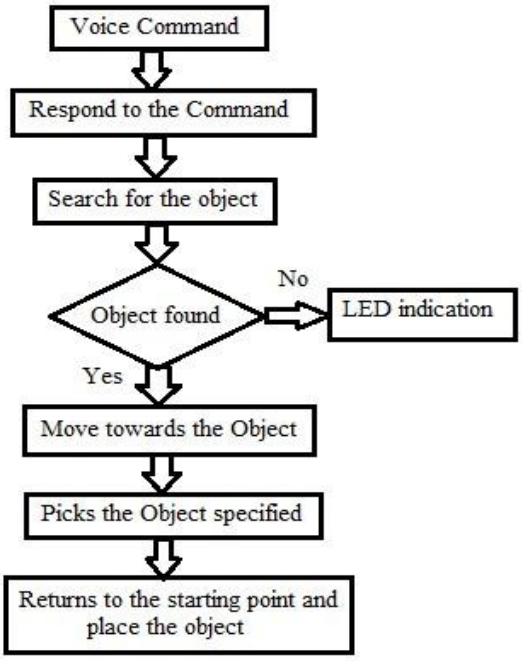

Figure 3: Flowchart of overall process.

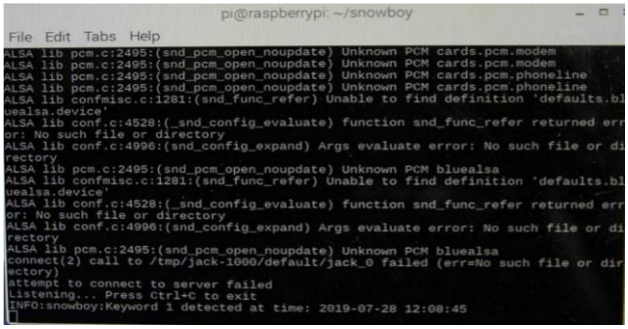

Figure4: Programming commands for Snowboy

4.2 Detection of Object

The object detection model algorithm uses COCO model which can detect up to 90 objects listed. If the object being detected is to the right of the camera frame, the robot moves right to center the object, and if the object is to the left of the camera frame, the robot moves left to center the object. Further the filtering of the input data has been done to remove the jumpy data and also smooth out any noise in the data. For these purpose averaging function that takes the last 3 coordinates and averages them to give you the current coordinate used for the robot's movement calculation. These 3 coordinates are stored in an array and the oldest of the 3 data points gets replaced as soon as a new coordinate data point is returned from the computer vision model. This method theoretically makes the robot slower to respond to fast movements, but with a high enough frame rate from the object detection models. The **figure5** below shows the detection of the tea cup and other computer components.

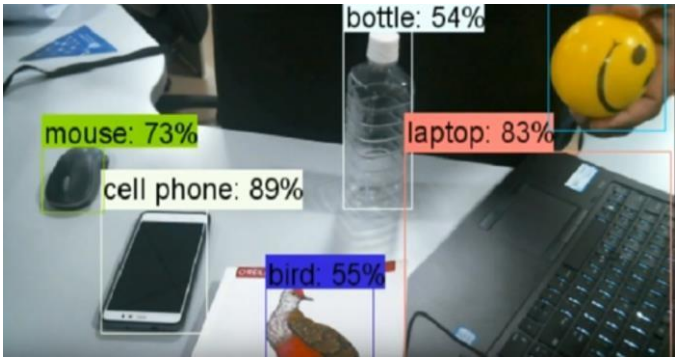

Figure5: Detection of object

4.3 Pick and place of Object

The robot can find and detect objects using computer vision & machine learning. The pick and place step is performed when the robot has successfully move towards the object and it is looking for and has also reached a certain minimum distance (in our code it was 30cm) from the object it is trying to pick up.

The actual steps required for the picking up the object detailed below:

- The robot will first open its sled.
- Next the robot will move forward up to certain distance(in our case it is up to 25cm) .
- Next the robot will close its sled and picks up the object of appropriate mass.

The sled itself is manufactured and powered using Brushed DC motors. The reasoning for this is multifaceted. Firstly geared brushed DC motors are very small and easy to source. Next it is very easy to do precise positional control through the Robot Claw motor controller and encoders. Next brushed DC motors have incredible torque due to such high gear ratios. This is especially useful for when the robot sled is picking up a larger, heavier object. The **figure6** below shows that robot picking up of the tea cup using sled arms.

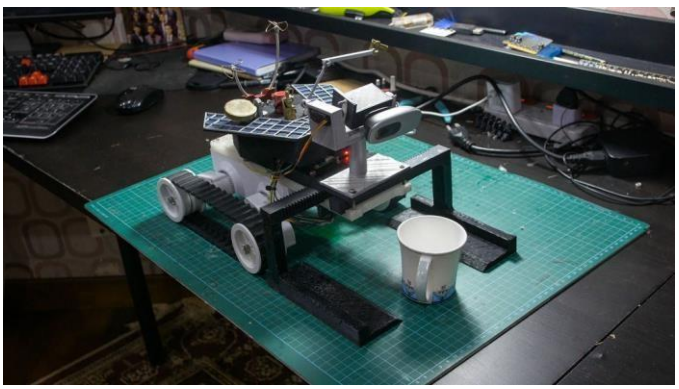

Figure 6: Picking up of teacup by robot.

5. RESULTS AND DISCUSSION

This robot is truly special because it can use Machine Learning models and computer vision to see the object via a camera and perform tasks depending on how the detected object's position is changing in the camera. The above figures show complete voice recognition, object detection, and performs the pick and place operation up to specified mass (in our case it is up to 20-30 grams). The Robot in our case which is specified to detect the tea cup. The Robot recognize the voice command using Snow boy. The Robot given wake up command with “Hey Robot”, then system get rid off multiple voice commands. After 10 sec we give command “tea cup”. The system detects the tea cup using computer vision and machine learning and with ultrasonic sensor it can sense maximum up to 25cm distance and then move it towards the object and pick up the object using sled arms maximum up to 20-30 grams, in case object not found the LED will blink giving command that object not found. The **Figure 6** represents the complete pick and place operation of the object. The Robot can extensively have worked under low temperatures and high pressure which performs operation on drastic condition Human operations are highly difficult. Meanwhile this kind of Robot enhance Human security and reduces the Human effort and drastic conditions.

6. CONCLUSION

The voice controlled pick and place robot has been designed and constructed. The device is fully functional and built from readily available components. It can be used as self-assistant for picking the nearby objects such as tea cups, water bottles. The improvements can be done by Integrating a voice assistant using natural language processing (NLP) to communicate with the user, and take natural sentence commands instead of exact commands. This would be even better if the voice assistant were to be able to tap into Google Now or Amazon Alexa to do more than the robot can do.

7. REFERENCES

[1] Ahmet, V. & Hilmi, K. (2016). Design of Voice Controlled Vehicle”, International Conference on Advances Automotive Technologies 2016, Yildiz Technical University, Instanbul, Turkey, AAT2016 .

[2] Lens. Thomas., Kunz. Jurgen, and Stryk. Oskar Von., “BioRob-Arm: A Quickly Deployable and Intrinsically Safe, Light-Weight Robot Arm for Service Robotics Applications,” 41st International Symposium on Robotics. Germany, pp. 905-910, June 2010.

[3] Ghorabi. Hasan, Maddahi. Yaser., Monsef. Seyyed Mohammad Hosseini., and Maddahi, Ali., “Design and Experimental Tests of a Pick and Place Robot: Theoretical and Experimental Approaches,” 9th

WSEAS international Conferences on Application of Electrical Engineering. Penang, Malaysia, pp. 144-150, March 2010.

[4] Kannan, K. & Selvakumar, J. (2015). Arduino Based Voice Controlled Robot", International Research Journal of Engineering and Technology (IRJET), Vol. 02, p-ISSN: 2395-0072, e-ISSN: 2395-0056.

[5] Muhammed, J. N., Neetha, J, Muhammed, F., Midhun, M., Mithun, S. & Safwan, C. N. (2015). Wireless Control of Pick and Place Robotic Arm Using an Android Application", International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, Vol. 4. (An ISO 3297: 2007 Certified Organization)].

[6] Chung, Mike., Rombokas, Eric., An, Qi., Matsuoka, Yoky., and Bilmes, Jeff. "Continuous Vocalization Control of A Full-Scale Assistive Robot," IEEE International Conference on Biomedical Robotics and Biomechatronics. Rome, Italy, pp. 1464-1469, January 2010.

[7] J.N.K Liu, M. Wang and B. Feng, "iBotguard: an Internet based intelligent robot security system using Face recognition against intruder," IEEE Transactions on system man and Cybernetics part application and review vol.35 pp.97-105, 2005.

[8] Yusoff Kamaril Mohd Ashiq, Samin Reza Ezuan, and Ibrahim Babul Salam Kader. "Wireless Mobile Robotic Arm," International Symposium on Robotics and Intelligent Sensors, pp. 1072 – 1078, 2012.