VOICE CONTROL ROBOT ASSISTANCE FOR VISUALLY CHALLENGED PEOPLE WITH REAL TIME OBSTACLE DETECTION AND WARNING

A.Shankar Ganesh[#1],Ba.Anandh [#2], R.Sakthivel [#3],A.Mangalambigai [#4]
[#1, #2, #3]Department of Electronics, PSG college of Arts and Science, Coimbatore-14.
[#4]Department of Education, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore-43.

Abstract: **In the recent era, everything is being automated and controlled via Smartphone's. In this system, the robot is designed and controlled by the voice control which detects obstacle found inside the home and warns the users if any obstacles are found. The ultrasonic sensor is used to detect the obstacles and the Nodemcu controller is used to process the signal and alert the VC people via Arduino Uno & Smartphone using wifi control. This system is mainly designed for blind people to roam inside the homes by simply using their Smartphones without any human assistance. This type of system with some modifications can also be used in an industrial hazards area to avoid the risk of human lives.**

Keywords – Robots, Ultrasonic sensor, NodeMcu, Arduino Uno, Voice Control, Wi-fi, Smartphone.

INTRODUCTION:

The Robot is electro-mechanical device which has mechanical, electrical, electronics and computing units with required sensors. Nowadays robots module is widely used in industrial automation purposes and also autonomous robots with AI can perform desired tasks in an unstructured environment without continuous human guidance. The robots can also perform more functions which are out of human reach in many industrial applications. In this system the robot is designed with detecting the obstacle using ultrasonic sensors and its movement can be controlled by the voice commands given by the user. This voice-controlled robot with automatic obstacle detections is to support people with visually challenged peoples [1]. It is a self-operating robot that moves along with a user input and also features with detecting obstacles and warns the user about the obstacles present in its moving path. Today the sixth finger of the human being is the Smartphone. This system brings the outcome of the robot based on the voice input given through their smartphones and that can be controlled over Wi-Fi network i.e. the user inputs for the direction of the movement of the robot are provided through the Wi-Fi. Here the voice is sent to the Google assistant and that voice will be converted to the text via supporting applications and it will be processed by the NodeMcu controller. This controller controls the robot's wheel according to the voice commands given by the user using a Smartphone. The ultrasonic sensor attached to the robot automatically detects the obstacles in its path and warns the user. This system can be used by blind people to detect the obstacle around their surroundings and also finds another suitable alternative way to reach their destination without any human interaction. [2]

Hardware Description:

NodeMcu ESP8266 : It is a open source community with an operating system of XTOS. It has a CPU (Esp8266), memory of 128k bytes and storage of 4Mbytes. This MCU boards are based on non-AVR processor and the software component is required by the Board manager and the Arduino IDE to compile an Arduino C/C++ source file for the target MCU's machine language. It has 13 General purpose input output pins and one Analog pin, which plays a major role in this system. The ESP8266 module is mounted inside the system is used to communicate with the internet. This helps to communicate with the Google assistant for voice controlled purposes. The voice input signal is encoded and it can be directly accessed via Wi-Fi control [3].

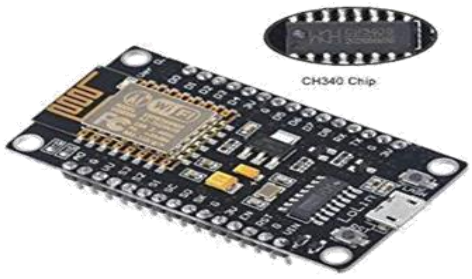

Fig. 1 NodeMcu ESP8266

Arduino Uno Board: Arduino Uno is the open source microcontroller board based on ATmega328p. It has 14 digital I/O pins of which 6 can be used as PWM outputs, 6 analog inputs, a 16 MHz Crystal oscillator, a USB connection, a power jack, a reset button. 32Kb ISP FLASH memory with read while write capabilities, 1Kb EEPROM, 2Kb SRAM, 32 general purpose register, 3 flexi able

timers/counters. Its operating voltage is 5v. It consists of a simple hardware platform as well as a free source code editor which has a one click compile or upload feature in it. The operating voltage is from 7v to 12V. [4]

Fig. 2 Arduino Uno Board

L293D H-Bridge Serial Motor Driver: L293D is a motor driver IC which allows DC motor to drive on either direction. The output current from the microcontroller is not sufficient to drive the motors, so L293D driver is used to drive the motors. L293D is a 16pin IC which can control a set of 2 to 4 DC motor simultaneously in any direction. Its supply voltage range is 4.5V to 36V. Its output current capability is 600-mA per driver. Its features are separate current logic supply, 1.2 amps pulsed current, thermal shutdown and high noise immunity inputs. The PWM signals are send from arduino to drive the motors [5].

Fig. 3 L293D H-Bridge Serial Motor Driver

Ulrasonic sensor (HC-SR04) : The ultrasonic sensor is used to measure the distances based on transmitting and receiving ultrasonic waves. The features of the sensor are Power Supply :+5V DC, Quiescent Current : <2mA,Working Current: 15mA,Effectual Angle: <15°,Ranging Distance : 2cm – 400 cm/1″ – 13ft, Resolution : 0.3 cm, Measuring Angle: 30 degree, Trigger Input Pulse width: 10uS, Dimension: 45mm x 20mm x 15mm. Whenever any obstacle is ahead of the ultrasonic sensor, the sound waves will reflect back in the form of echo and generate an electric pulse. It has a positive TTL pulse communication. It has divided into three broad categories: transmitters, receivers and transceivers. [5]

Software Description:

Arduino Software IDE: The open source Arduino software (IDE) makes it easy to write coding and upload it to the Arduino board. It supports all Windows, Mac and Linux operating systems. It is a cross-platform application that is written in the programming language Java. This can be used with any Arduino board. In this system, Arduino IDE software is used to upload the code to the Arduino board [6].

Fig.4 Ultrasonic Sensor- HCSR04

Fig.5 Arduino Software IDE

Google Assistance: Google Assistant is a man-made consciousness fuelled menial helper created by Google that is primarily available on mobile and smart home devices. Google engaged with the future of two-way conversations. In this system, we use the mobile application for giving input voice to the controller. Google assistance won't directly communicate with the Arduino Uno board.[7]. The webhooks are used to monitor and control for the voice over from the google assistance to the controller. In special arrangement function we use Blynk with IFTTT as an intermediate application for google assistance and controller and using this we can create custom voice commands.[8]

Blynk App: Blynk is a platform with iOS and android used to control Arduino, Raspberry Pi, and NodeMcu and moreover the internet. It is used for the internet of things. It has separate cloud storage. It can able to control the hardware remotely and also used to store and visualize the data's which was used in the blynk application. The message or data here used in this application will travel through the Blynk cloud and this storage will be used to find its to the system hardware. We create the toggle buttons for each motor associated with the microcontroller through the motor drive which is done by Blynk app. This will send a token to your registered email-id in this application. This token should be noted and saved for its use while programming the NodeMCU and setting up the IFTTT application. [9],[10]

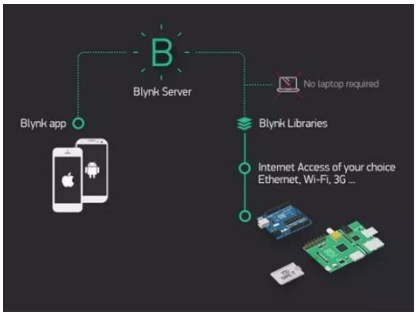

Fig. 6 Bylnk Application

IFTTT Application: IFTTT is both a web and a mobile app. IFTTT has its abbreviation from the programming conditional statement. "If this then that" is an online service that smart devices can connect to it and it can ready to impart between them.. Generally, it is like a messenger between two services and knows how to communicate with both. It essentially automates daily workflow, whether its ability to manage smart home devices also well as robot-like devices or apps and websites. At first, create a free ("Maker") account then connect google assistant to the Blynk which allow to control the robot with voice commands. IFTTT platform is used, which allows hundreds of different services to trigger actions in a variety of other services [11].

Setting the IFTTT applications, first create an applet and select Google assistant and apply the commands to through Google assistant to control the robot. Then the reply from the Google assistant will be same as applied. After the configuring process select Webhooks, which will allow to send commands to the Blynk server. Now, in the URL apply the IP address of the Blynk server. This URL will be followed by the Authentication token which was sent by the Blynk server. To connect the microcontroller it is needed to add the pin number to this server which was just added the authentication token address to access the controller. Then we add some content type in the application, in the body we add some values to access the controller, like "on" and "off". This will create the actions for the trigger which where given earlier. This action was done by simply sending a message to the Blynk app to connect the concerned devices. Communicate with the Blynk and the microcontroller via the Internet to control.

BLOCK DIAGRAM:

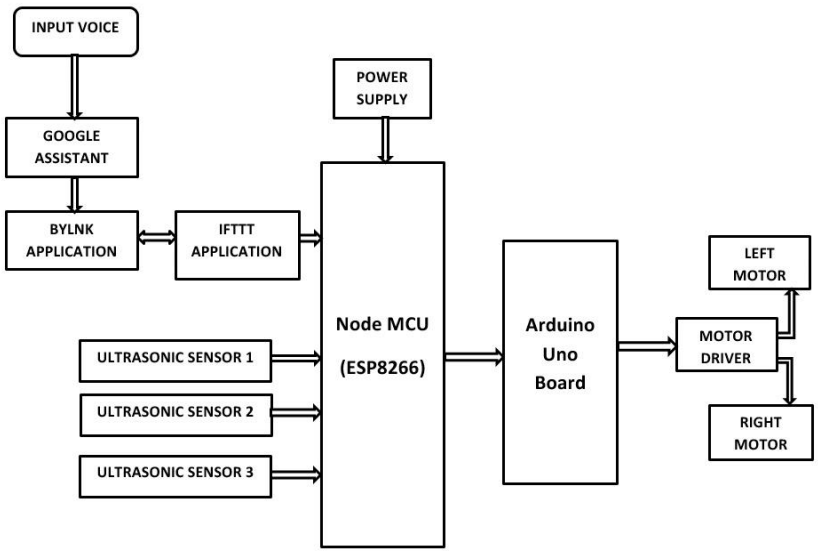

Fig. 7 Block Diagram

CONTROLLING THE ROBOT:

The robot will receive the commands in text form. This text form will feed to the microcontroller of the robot; this robot will function as per the command. The text will be sent to the Arduino microcontroller, this checks the pre-programmed instructions which were already built in to the program as follows:

1) Move Forward: Activates both the motor and moves forward
2) Turn Right: Activates left motor and makes a 90 degree wide turn, and right motor
3) Turn Left: Activates Right motor and makes a 90 degree wide turn
4) Move Backward: Both the motor stops, and moves backward
5) Stop: Deactivates both motors. [12]

The motor moves along with the controls with the master's input, when the obstacle is placed nearby the surroundings, the ultrasonic sensor continuously calculate the distance between the robot and the obstacle around with the following functions. Here three ultrasonic sensors are used in this module.

Ultrasonic sensor 1*:* It is a middle sensor connected in front of the robot module. When the sensor1 is detected it sends the signal to the microcontroller, it checks the pre-programmed function which was already written in the controller. When it detects the robot stops and produces the sound through buzzer, it indicates there is no way of moving so we want to use another command for motor moving.

Ultrasonic sensor 2: It is a top left placed sensor on the robot module. When the sensor 2 is detected, the robot performs the zig-zag movement along with right 90^0 rotation.

Ultrasonic sensor 3: It is a top right placed sensor on the robot module. When the sensor3 is detected, the robot performs the zig-zag movement along with left 90^0 rotations.

When the both sensor are detected, then both the motor stops rotating and moves forward to avoid the obstacle and moves along the desired path. [13]

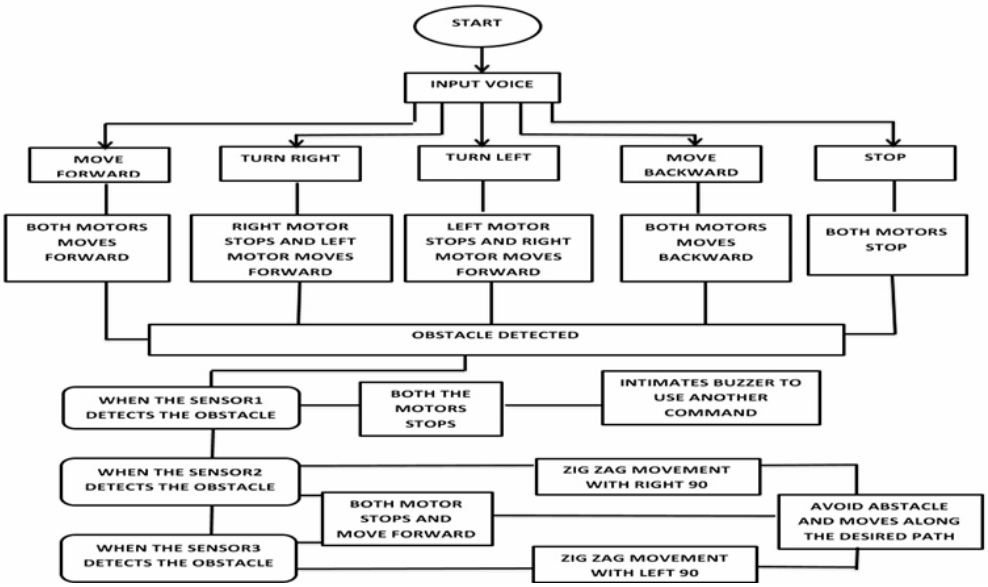

Fig. 8 Flowchart of Controlling the Robot

WORKING PRINCIPLE:

Voice control: In this system, we use android application for voice recognition purposes. Once the voice is recognized, user will be ready to control the robot as per the choice. This voice is converted to text and transmitted to robot through in built Wi-Fi module of ESP8266 **[13]** from the Google assistant. The voice from the Google assistant cannot be transferred directly to the controller, so an intermediate stage to change the voice to text convertor is used via another application, such applications are web hooks and Blynk application.

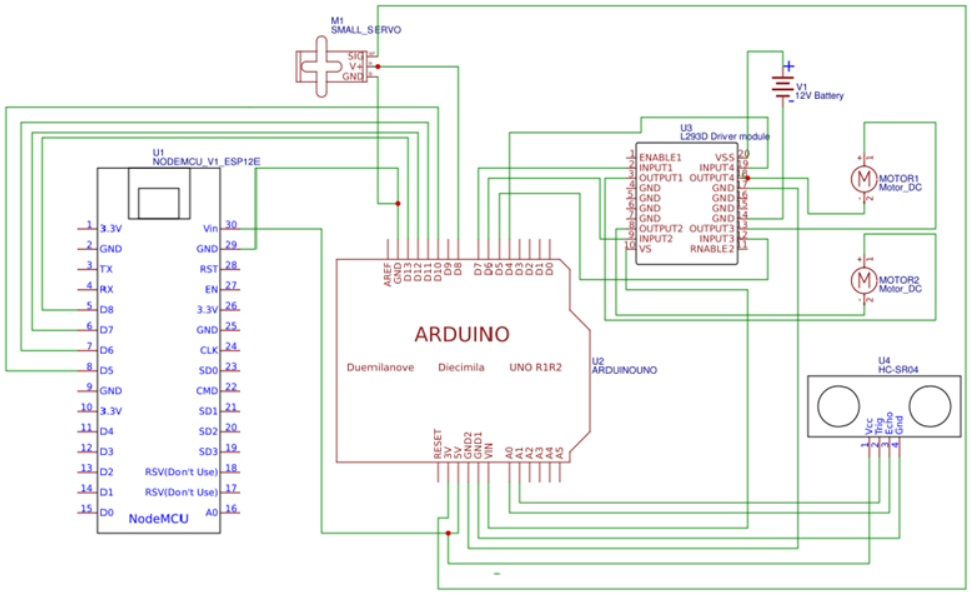

Fig. 9 Circuit Diagram

Obstacle detection and avoidance: The obstacle detection was done by using the three ultrasonic sensors for more accuracy. The single sensor is enough to detect the obstacle around the surrounding but to sense the total right and left surrounding we add an additional two sensor in the robot to avoid a collision. The multiple ultrasonic are added for moving without collision. This type of obstacle detection helps to detect the presence of an object at a certain distance. Three sensors are placed in the robots frontal and also the right, middle and left section of the robot. The every desired time limit ultrasonic sensor emits ultrasonic pulses. When one of the sensors detects the obstacle nearby the distance, the robot changes its direction. When the sensors detect more obstacles in the surroundings, it will avoid the entire obstacle with the help of all the three sensors. After some movement in the one direction sensor again sends the pulse to the controller to intimate whether there are any obstacles is present or not. Both the left and right sends detect the obstacle then the robot will stops and automatically moves along in the forward direction. For a complex situation, the robot will compare both the right and left sensor and move in the direction where the distance much larger than another one. When there is no space for moving the robot, then the buzzer will intimate the sound it means there is no space for moving so the user wants to use another possible command.[14]

APPLICATIONS:

- Obstacle avoiding robots can be used in all mobile robot navigation system
- They can be converted and used as fire fighting robots with modifications.
- They can be utilized in dangerous and hazardous industrial environment.
- They can be used in defence sector with modifications in sensors.
- They can be used as 3D laser vision robots with some modifications.
- It is useful for visually challenged people whom they can control the system through voice control.[2]

CONCLUSION:

This voice-controlled robot with automatic obstacle detection and avoidance is mainly focused for the visually challenged people move from one place to another without any human assistance or help in their surroundings. It prevents many accidents in their day-to-day life activities and makes them physically fit. The accuracy of the robot depends upon the sensors used. This system is helpful in industrial areas where the human power can be reduced using the voice control with obstacle avoidance facility available in the robot. It can also be used in a dangerous and hazardous industrial environment where human's health and life are at risk. The major advantage of the system is that, the robot can be controlled at anywhere by configuring the Google assistance application as and when required.

REFERENCES

[1]. A. Shankar Ganesh, A. Mangalambigai, V. Swarna, Ba. Anandh, R. Sakthivel, A. Ranisangeetha, "OCR based Image Processing with Audio Output for Visually Challenged People", International Journal for Research in Applied Science and Engineering Technology, Volume 7, Issue III, March 2019.

[2]. R.Vairavan, S. Ajith kumar, L. Shabin Ashiff, C.Godwin Jose, "Obstacle Avoidance Robotic Vehicle using ultrasonic sensor, Arduino controller", Volume 5, Issue 02, February 2018.

[3]. https://en.m.wikipedia.org/wiki/ESP8266

[4]. https://en.m.wikipedia.org/wiki/Arduino_Uno

[5]. Omkar Bhalekar, Alka Aacharya, Shony Banjan, Vishruti Gharat, " An Intelligent Speech Recognition and Obstacle Detection Robot", International Journal of Advanced Research in Computer Engineering & Technology, Volume 5, Issue 9, September 2016.

[6]. https://en.m.wikipedia.org/wiki/Arduino_IDE

[7]. https://en.m.wikipedia.org/wiki/Google_Assistant

[8]. https://www.google.com/amp/s/www.androidcentral.com/google-home-setting-ifttt-assistant%3famp

[9]. Manish Prakash Gupta, "Google Assistant Controlled Home Automation", International Research Journal Of Engineering and Technology, Volume 5, May 2018.

[10]. https://makezine.com/2015/07/06/control-arduino-your-smartphone-via-blynk/

[11]. https://ifttt.com/discover

[12]. Yasir Ali Memon, Imaaduddin Motan, Muhammad Ali Akbar, Sarmad Hameed, Moez Ul Hasan, "Speech Recognition system for a voice controlled robot with real time obstacle detection and Avoidance", International Journal Of Electrical, Electronics And Data Communication, Volume 4, Issue 9, September 2016.

[13]. Ba. Anandh, A. Ranisangeetha, Aravindan. K, A. Shankar Ganesh, R. Sakthivel, "IOT based Automated Object Colour Sorting and Counting System", International Journal for Research in Applied Science and Engineering Technology, Volume 7, Issue III March 2019.

[14]. Faiza Tabassum, Susmita Lopa, Muhammad Masud Tarek, Dr.Bilkis jamal Ferdosi, "Obstacle Avoiding Robot ", Global Journal Of Researches In Engineering H Robotics & Nano-Tech, Volume 17, Issue 1, 2017.