Vol. 1 - No. 1
November 2021 E-ISSN:

Design and Implementation of a Voice Controlled Multifaceted Robot

P. Revathi, R. Rachana, K.M. Supriya and R. Suhas Raghavendra
Department of Electronics and Communication Engineering,
East West Institute of Technology, Bangalore, Karnataka, India

Abstract
In the modern world, the Robots play a vital role in replacing manual works especially in assisting handicapped people. In the traditional method the Robots were considered to perform solitary task assigned to it. The proposed work is designed to operate in multifaceted modes, such as RF Transmitter-Receiver mode (remote mode), Hand Gesture mode, Voice Controller mode, Line Follower mode using a micro controller Arduino Mega 2560 board. In addition to this Wireless Camera, APR module, Temperature sensor, Obstacle detection and Medicine dispensing feature made this Robot versatile which can be used in various application.
Keywords
Gesture Control, Voice Control, Medicine Dispensing

I. INTRODUCTION

Innovation and development in technology is to provide comfort and ease to human life. The Robots have the potential to be deployed for disinfection, delivering medications and food, and in which the proposed Robot can assist handicapped people. The proposed work is to solve the issues encountered in assisting handicapped people and senior citizens. This work enables the physically disabled people to return to their normal life, by multifaceted controlling modes, as this Robot can be modeled as wheel chair.

By Voice control mode, one can operate the Robot by giving Wireless command from the application using the functions already programmed in the app, when the Bluetooth application is turned on and is connected with the current system via Bluetooth. The vehicle will have motion in four directions: Forward, Backward, Right and Left. During Forward movement, all four motors will movement in same direction, which is the reverse case in the backward direction. Where as in case of Left and Right motion two motors direction will be inversely proportional to other two motors anti-clockwise and clockwise respectively. Instructions are given to the motors through the Bluetooth app of Android Smartphone by the user.

Gesture recognition technologies are much younger in the world of today. At this time there is much active research in the field and little in the way of publicly available implementations. Several approaches have been developed for sensing gestures and controlling robots. Glove based technique is a well-known means of recognizing hand gestures. It utilizes a sensor attached to a glove that directly measures hand movements.

The proposed robot identifies and tracks a black line on white surface area works as a Line following robot which is able to detect a specified line and maintain track on it and does the assigned job. This work can be modified quite easily to include a camera well that can stream the videos to the user over Wi-Fi using Wi-Fi module.

II. LITERATURE REVIEW

In the traditional method the Robots were considered to perform solitary task assigned to it. The proposed method is designed in such a way that the robot can be operated in multiple modes, as the unique features in isolated Robots are integrated. Hasan U. Zaman, et al., designed and implemented a line following robot that follows a line which specifically is black line on white surface that travels on a designated path, in addition to identifying obstacles in 3 ways.

Aravindan, B., et al., designed Multi – Way Controlled Robot can be operated under hand gesture mode, mobile and voice-controlled modes. In hand gesture mode; robot can be controlled by tilt made by hand. The purpose of this work is to implement a wheel chair for disabled people to navigate themselves using different modes of operation.

Jain, M. et al., presents a four – wheel robot with gesture controlled arm manipulator system. The robot detects the object from its surrounding environment and gesture controller is developed to control the motion of arm that also operates pick and place operation.

Anh, Phung Quang, et al., work aims to design and implement an obstacle avoidance mobile controlled robot operated by controlling android-based mobile device via Bluetooth. User launches android controller interface on his mobile that is connected to Bluetooth and has to select the options to make robot move in any four directions by choosing unblocked path when facing the obstacles.

Ghosh, Shomitro Kumar, et al., presents a line following robot that detects visual line on smooth surface area embedded on the floor and follows it on a path of black on white or white on black using IR sensor and Ultrasonic sensor for obstacle detection.

Chaudhry, Adithya, et al., proposes a system which focuses on the concept of a robot that can be controlled by human voice. An android app is used as a medium for the transmission of human commands to microcontroller. The basic movements such as moving forward, backward, turning to left and right can be controlled by human voice commands.

Vishaal, M., et al., work presents a prototype robotic system that automatically dispenses medicines to patients in the hospital. The robot uses the line follower method to deliver the pills to patient resided in the room. The robot uses a GSM module to send message to check whether the patient has taken their medicines to the caretaker's mobile. Similar work is adopted in the proposed method where the Robot can dispense the medicine with the authentication of the patients and assist them.

Lim, Jongil, et al., work presents the design of a network robotic framework using a Smartphone based robotic platform. The implementation uses a Smartphone as a network bridge between mobile robot and the computer to distribute complex task into multiple networked computational resources, as well as, a sensor package that allows the mobile robot to navigate with low power consumption. This work is intended for a single robot that has a network connection through a smart-phone communicating with the sensing and motion data with Arduino Mega through the Bluetooth module. Similarly, in the proposed work the single Robot is integrated with multiple tasks.

Srivastava, Shubh, and Rajanish Singh work aims to build a voice controlled robot car based on arduino microcontroller using Bluetooth. The control unit is coordinated with

Bluetooth gadget that transmits the control signals on receiving the voice commands. Instructions are provided via smart android device with Bluetooth application.

Mišeikis, Justinas, et al., work presents the robot named Lio as the mobile robot platform with a multifunctional arm explicitly designed for human robot interactions and personal care assistant tasks. The robot has a compliant motion controller and the combination of visual, audio, laser, ultrasound and mechanical sensors used for safe navigation and environment understanding. Similar work is adopted in the proposed method where the Robot assists the disabled people. Using the above literature papers as a base, a design is proposed which fulfills the drawbacks of all the systems and was implemented.

III. SYSTEM DESIGN

Methodology gives the systematic, theoretical analysis applied to design the block diagrams as shown in Fig 1 and Fig 2 for the transmission and reception of the signals for the Robot operation. The block diagram shown in Fig 1 is the Gesture control using Arduino Uno microcontroller that cooperates to act as the transmitter for controlling the robot through Gesture controlling mode of operation. The block diagram of Gesture Control Transmitter consists of microcontroller Arduino Uno board which is interconnected to a RF Transmitter and an Accelerometer with an input Power supply is as shown in Fig 1. The signals are transmitted with respect to the angle of tilt made by the hand through the transmitter which is then received by the Receiver which is connected to the Robot and act accordingly. The block diagram shown in Fig 2 consists of a microcontroller unit Arduino Mega board which is interconnected to Ultrasonic Sensor 1, Ultrasonic Sensor 2, IR sensor 1, IR sensor 2, Four-Channel switch, Temperature sensor, LCD, power supply module, Bluetooth module, esp8266 module, Motor driver 1, Motor driver 2, Motor driver 3, RF Receiver, Finger print scanner and Speaker which is connected to APR Voice Recorder. The input to the microcontroller unit is given by the 12V Power Supply and the expected output from the block diagram is as follows:

- Instructions are given to the motors through Bluetooth app of Android Smart phones by the user.
- Voice control mode can be achieved through Bluetooth module which is connected to Arduino Mega Board through which Robot movements in four directions: Forward, Backward, Left and Right can be achieved.
- Object detection can be achieved by Ultrasonic sensors.
- Line follower can be accessed by IR sensors.
- Human body temperature can be detected through Temperature sensor.
- The transmitted signals are received through RF module in the Receiver as per the instructions given by the user which tends to drive the wheels through Motor driver 1 and Motor driver 2.
- The stored commands are recorded in the APR Voice Recorder and the feedback is received through the speaker.
- Medicine dispensing application can be achieved by Motor driver 3 accessing finger print scanner.

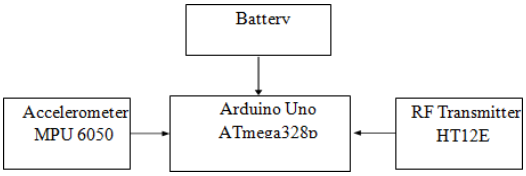

Figure 1: Block Diagram of Gesture Controlusing Arduino Uno Transmitter

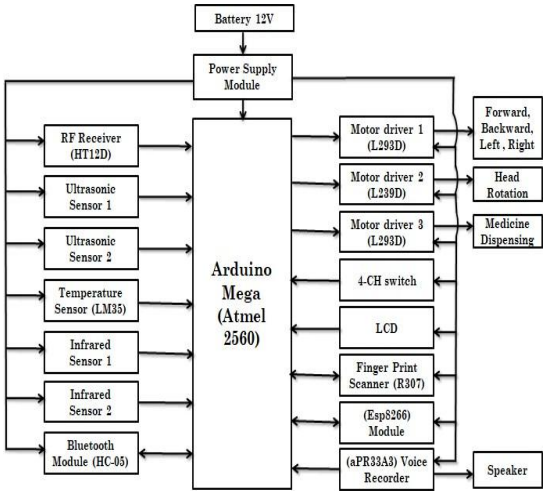

Figure 2: Block Diagram of Design and Implementation of a Voice Controlled Multifaceted Robot Receiver

IV. IMPLEMENTATION

In the Traditional method the Robots were considered to perform solitary task assigned to it. The proposed method is designed in such a way that the Robot can operate in multiple modes, as the unique features in isolated Robots are integrated. The dependency on a caretaker for patients can be prevented. The proposed work is designed to operate in multifaceted modes, in which the Gesture Control mode of operation can be achieved from the circuit built as shown in Fig 3.

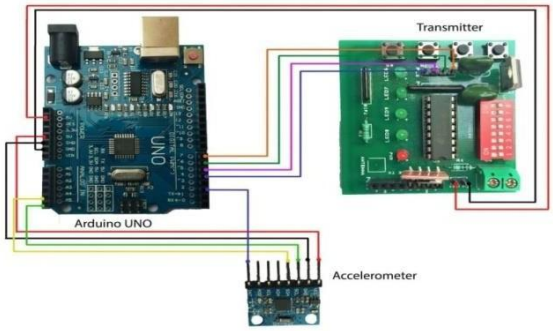

Figure 3: Circuit Diagram of Gesture Control using Arduino Transmitter

The proposed work is designed to operate in multifaceted modes, in which the Gesture Control mode of operation can be achieved from the circuit built as shown in Fig 3. The circuit diagram shown in Fig 3 is the Gesture Control using Arduino UNO microcontroller that combines to act as the transmitter for supervising the Robot through Gesture Control mode of operation. The MPU 6050 communicates with the Arduino through

the I2C protocol. The program will be running in the Arduino Board taking advantage of Arduino's Interrupt Pin by connecting to Digital Pin 2 (Interrupt Pin 0) of Arduino UNO to the INT Pin on MPU 6050.

To set up the I2C lines, SDA (Serial Data) Pin on MPU 6050 is connected to the Analog Pin 4 of Arduino UNO and Serial Clock (SCL) Pin on MPU 6050 to Analog Pin 5 of Arduino UNO. The MPU 6050 is a six DOF (degrees of freedom) or six axis IMU (Inertia Measurement Unit) sensor, which means that it gives six values of output: three values from the accelerometer and three from the gyroscope. An accelerometer works on the principle of piezoelectric effect, the current is produced from the collision on the Piezoelectric walls determining the direction of inclination and its magnitude. Gyroscope works on the principle of Coriolis acceleration that is the acceleration due to the rotation experienced by particles moving along the surface. The 433MHz Wireless RF Transmitter is interfaced with Arduino UNO by connecting its four digital pins to the four switches on the RF Transmitter board (encoder HT12E) for forward (FWD), reverse (REV), left (LEFT), right (RIGHT) motions. The data is transmitted four times in succession. It consists of different lengths of positive going pulses for '1' and '0'. The frequency of these pulses may lie between 1.5 and 7 KHz.

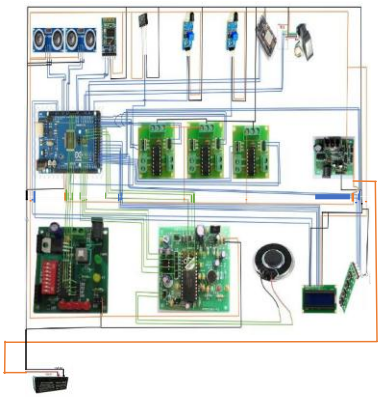

Figure 4: Circuit Diagram of Design and Implementation of a Voice Controlled Multifaceted Robot Receiver

The circuit diagram shown in Fig 4 consists of a microcontroller Arduino Mega board which has fifty-four digital input/output pins and sixteen analog input pins. These digital pins of Arduino Mega are connected by Ultrasonic sensor, Infrared sensor, APR33A3 voice module, Receiver, LCD, four-channel switch, Fingerprint scanner and Motor drivers. The temperature sensor, output pin is connected to analog pin of Arduino Mega board. The Bluetooth module, transmitter pin is connected to Arduino Mega board receiver pin and Bluetooth module, receiver pin is connected to Arduino Mega board transmitter pin. The whole circuit is powered by 12V power supply. The Ultrasonic sensor is used for obstacle detection and avoidance, Infrared sensor is used for line following technique, Temperature sensor is used for detection of human temperature, APR33A3 voice module is used to play voice files for the robot, by the eight pins and can store eight voice/sound. The 433MHz wireless receiver is connected to the Arduino Mega board which can be controlled in two ways: firstly, through Remote control mode that is through wireless transmitter and secondly through Gesture control mode that is through the angle of tilt made by the hand

(Accelerometer connected to the wireless transmitter and Arduino Uno board). The fingerprint scanner is initialized, enrolled and evaluated by four-channel switch and which is displayed through LCD that is for Medicine dispensing feature, it will show whether the patient has taken the medicine or not, and this message is also received through telegram with the help of esp8266 WiFi module. HC05 Bluetooth module is a simple wireless communication device based on the Bluetooth protocol. The Robot performs series operations according to the instructions given through Bluetooth application 'VOICEBOT'. The Bluetooth App receives the voice commands and converts it to text and sends the wireless signal to the Microcontroller Unit (MCU) which is annexed with sensors and modules. The instructions given in the form of voice commands can be listed as follows: A. Audio B. Voice C. Radio D. Line E. Object F. Temperature G. Medicine/Tablet Basically, the Microcontroller and the Robot circuit is powered on by giving 12V power supply. When the Bluetooth app is turned on through the mobile application and is connected with the current system via Bluetooth HC-05. If the connection is secured precisely then the application is ready to connect with Robot or else if the connection is not secured precisely then the application is not ready to connect with Robot as shown in Fig 5. Here, the commands are given through the Bluetooth application called "Voicebot". The commands given to Voicebot are as shown in Table 1.

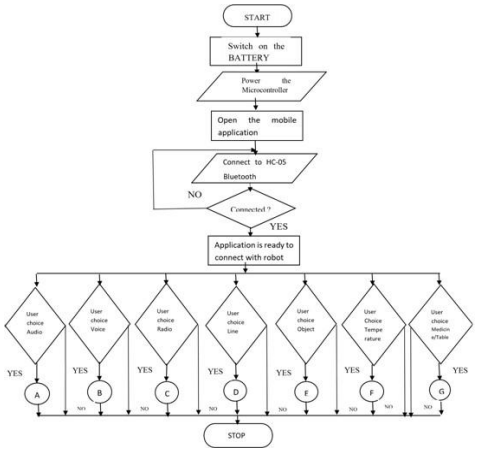

Figure 5: Voice Controlled Multifaceted Robot Flowchart

Table 1: Voice Commands given through Bluetooth

Connector	Commands	Features
A	Audio	Voice feedback
B	Voice	Controlling movements through voice
C	Radio	Remote control and gesture control
D	Line	Line follower
E	Object	Object detection and re-route path
F	Temperature	Temperature detection
G	Medicine/Tablet	Medicine dispensing

V. RESULTS AND DISCUSSION

Figure 6: Experimental Setup with all the Sensors and Controller Interfaced

Figure 7: Procedures for Bluetooth Connection to Give Commands

Table 2: Voice Commands and their Results

Connector	Command	Feature	Result
A	Hi Name Doing	Voice feedback	Hello RIO Executing commands
B	Forward Backward Left Right	Controlling movements through voice	Forward Backward Left Right
C	Radio	Remote control Gesture control	Forward Backward Left Right Head Rotation
D	Line	Line Follower	Line Follower
E	Object	Obstacle detection and avoidance	Object detected at front or Object detected at back and re-routes path
F	Temperature	Temperature Detection	High temperature Low temperature
G	Medicine / Tablet	Medicine Dispensing	Medicine Dispensing

A. Audio Commands

When the commands Hi, Name and Doing are given through Voicebot application with assistance Bluetooth module the voice feedback such as Hello, RIA and Executing commands respectively are obtained.

B. Voice Commands

When the commands Forward, Backward, Left, Right and Stop are given through Voicebot application with the assistance of Bluetooth module according to the command the Robot works.

C. Remote Control and Gesture Control

Results for the command RADIO can be fetched in two ways such that by Remote control mode shown in Fig 8 and by Gesture Control mode shown in Fig 9.

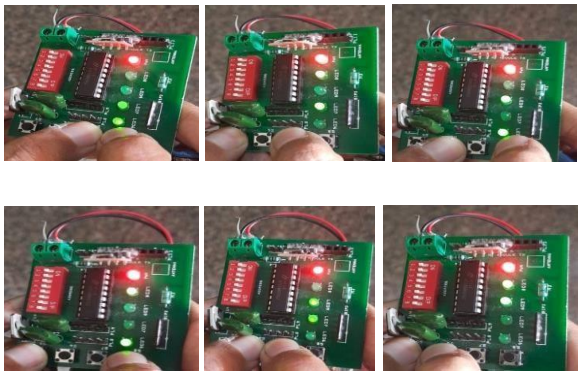

Figure 8: Controlling Robot through Remote Control (RF Transmitter Module)

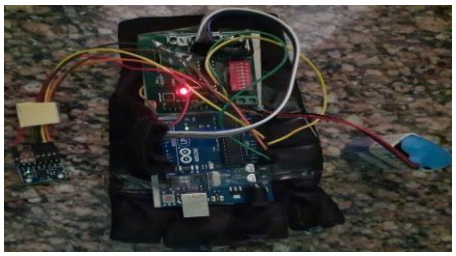

Figure 9: Controlling Robot through Gesture Control

D. Line Follower

Fig 10 represents that the Robots follows the black line on the white surface area acting as the Line Follower Robot.

Figure 10: Line Follower

E. Obstacle Detection and Avoidance

When the Object command is given through the Voicebot application with the assistance of Bluetooth module the Robot speaks as “object detected at front” and re-routes path if it detects the object at front and speaks as “object detected at back” and re-routes path if the object is detected at back.

F. Temperature Detection

Temperature detection is achieved through voice feedback and by LCD after sensing the sensor. Robot detects human body temperature as “high temperature” or “low temperature” as per the limits given while coding as shown in Fig 11.

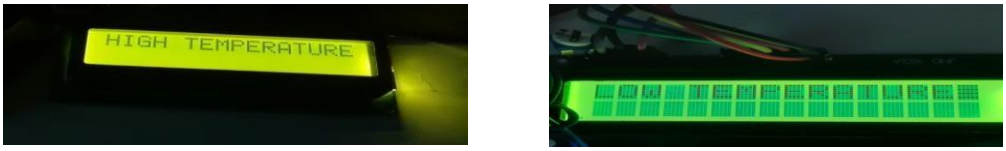

Figure 11: Results of temperature Detection

G. Medicine/Tablet Dispensing

The command MEDICINE or TABLET that includes the sub-features such as locating the patient residing in the room, identifying the patient through fingerprint authentication as shown in Fig 12. The medicines are dispensed soon after the authentication, notifying the caretaker through the Telegram application as shown in Fig 13 the same is shown in Fig 14 through the LCD.

Figure 12: Fingerprint Authentication of the Patient

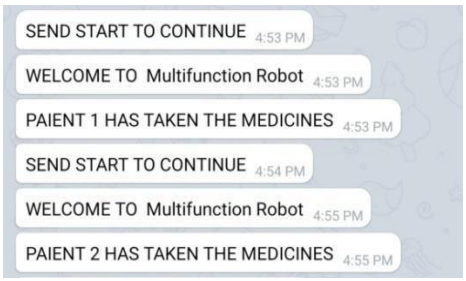

Figure 13: SMS received by the Caretaker through Telegram Application

Figure 14: LCD Display of Medicine / Tablet Dispensing

VI. CONCLUSION

The possibility to migrate features from different individual Robots collectively into a sole Robot with multifaceted (that is to have many different aspects or features), by using a microcontroller reducing the target system. The Robot is designed and implemented using simple technologies rather than complex ones, to achieve maximum efficiency with reduced area and cost. Thus, the Robot has been designed to work effectively at restaurants, office and hospital environment.

VII. FUTURE ENHANCEMENT

Real time clock with GSM module can be implemented for Medicine dispensing application such that at a particular time coded, the Robot would automatically dispense the medicine without giving voice commands.

VIII. REFERENCES

[1] Srivastava, Shubhash, and Rajanish Singh. "Voice Controlled Robot Car using Arduino." *International Research Journal of Engineering and Technology*, vol. 7, no. 5, 2020.

[2] Jain, M., et al. "Object Detection and Gesture Control of Four-Wheel Mobile Robot." *International Conference on Communication and Electronics Systems*, 2019.

[3] Anh, Phung Quang, et al. "Design and Development of an Obstacle Avoidance mobile-controlled robot." *Conference on Research and Development*, 2019.

[4] Gosh, Shomithro Kumar, et al. "A Line Follower Robot with Obstacle Detection by Ultrasonic." 2019.

[5] Chaudhry, Aditya, et al. "Arduino Based Voice Controlled Robot." *International Conference on Computing, Communication, and Intelligent Systems*, 2019.

[6] Vishaal, M., et al. "Automated Medical Dispensing System using Robotics." *IJCESR*, vol. 6, no. 4, 2019.

[7] Aravindan, B., et al. "Multi-way Controlled Robotic Vehicle." *International Journal of Engineering and Management Research*, vol. 7, no. 2, 2017, pp. 171-174.

[8] Zaman, Hasan U., et al. "A Novel Design of Line Following Robot with Multifarious Function Ability." *IEEE International Conference on Microelecronics, Computing and Communication*, 2016.

[9] Lim, Jongli, et al. "Design and Implementation of a Network Robotic Framework using a Smart Phone based Platform." *IEEE Access*, vol. 7, 2019.

[10] Mišeikis, Justinas, et al. "Lio–A Personal Robot Assistant for Human-Robot Interaction and Care Applications." *IEEE Access*, vol. 5, no. 4, 2020.

[11] Jeevan Reddy, K, et al. "Microcontroller Based Assistant System for Dumb People." *International Journal for Research in Applied Science and Engineering Technology*, vol. 7, no. IV, 2019.

[12] Adithya, Narsingoju, and Sridevi Chitti. "Hand Gesture Controlled Robot." *International Journal of Recent Technology and Engineering*, vol. 8, no. 1S4, 2019.

[13] Kamruzzaman, Md., and Md. Tareq. "Design and Implementation of a Robotic Technique Based Waiter." *International Conference on Electrical Information Communication Technology*, 2017.

[14] Tan, YongChai, et al. "A New Automated Food Delivery System Using Autonomous Track Guided Centre - Wheel Drive Robot." *IEEE Conference on Sustainable Utilization and Development in Engineering and Technology*, 2010.

[15] Sriram, K.N.V., and Suja Palaniswamy. "Mobile Robot Assistance for Disabled and Senior Citizens Using Hand Gestures." *International Conference on Power Electronics Applications and Technology in Present Energy Scenario*, 2019.