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Autonomous Vehicle for Supervision Based on Voice and Gesture Control

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Abstract - *In recent times, there has been a dire need to reduce human contact and provide ease of working. They are used to doing work that humans cannot perform. Hand gestures and voice are two of the most powerful communication techniques. There are many such areas where robots can be used to reduce human interaction, make work easier and safer. Defense, industrial robotics, vehicle part assembling industries in the civil side and medical field for surgery are the major fields that prefer hand gesture/voice recognition robots. Robot devices are tougher to control with the help of buttons and switches. The use of remote controls, buttons will make it tedious and complex. Our project deals with the interface of robots through voice and gesture control. The purpose of this gesture recognition and voice recognition method is to capture human hand gestures, voice and perform applications and move in a specific direction depending on the need of the user. This project aims to use these two methods to control a robotic car from a long distance without using any physical contact.*

Key Words: **Arduino UNO, Gesture Control, Voice Control, Robot Car, Gesture Recognition**

1.INTRODUCTION

Robotics, automation has become one of the most researched and worked upon areas in recent times. It is becoming one of the most advanced in the field of technology. The majority of industrial robots are autonomous as they are required to operate at high speed and with great accuracy. They play a very important role in the functioning of our society. They reduce manpower, human interaction. In our project, the reason we are using hand gestures and voice controls is that it provides an easier and natural way to control the robot. Without any contact, it is easy to interact with the robots in an efficient and friendly way. The greatest advantage of using a mobile phone to recognize voice commands to remotely control a robot car is location independent. Smartphones are a powerful platform for robotic automated remote control. For gesture control, the objective is achieved with the help of an accelerometer and Arduino. Robots have evolved so much that they are capable of mimicking humans that they seem to have a mind of their own.

1.1 Proposed Method

Robots are known to be helping and assisting humans daily. Here, we will be discussing the reduction of human interaction in the present pandemic situation. We aim to integrate two systems, namely- gesture and voice control, and implement them in a single robotic vehicle, this can be applied widely in many fields like health care, quarantine facilities, and construction. Hand movements are recognized from the transmitter, signals are passed on to the receiver, and the vehicle moves in that specific direction. In the same way, voice commands are recorded with the help of an android application and converted to signal form, then communicated to the robotic car over Bluetooth. In addition to this, an ESP32 camera module is installed to help in surveillance purposes and advanced areas like face recognition and image processing.

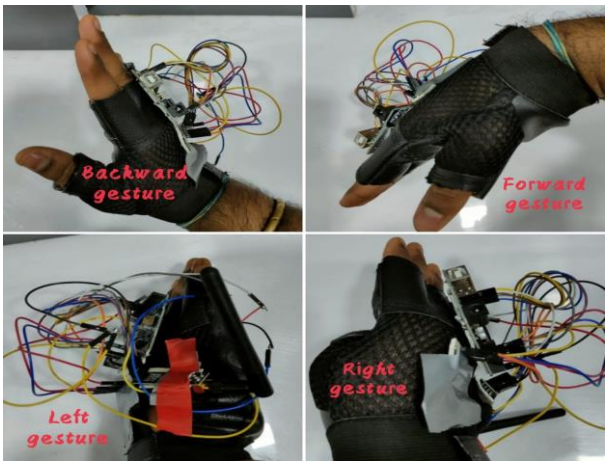

Fig 1 : Hand Gesture Controls

2. Working

SYSTEM ARCHITECTURE AND MODULE DESCRIPTION FOR GESTURE CONTROL ROBOT:

The gesture control robot mainly consists of two divisions

TRANSMITTER:

The transmitter part of the circuit will be transmitting the command signals to the receiver part of the circuit. This whole process is done using the help of Radio Frequency, or RF in short. RF Modules are used widely in many consumer related applications such as garage door

openers, wireless alarm systems, industrial remote controls, smart sensor applications, and wireless home automation systems. This transmitted RF signal is then received by the receiver module, from where it is forwarded to the motor drivers, which in turn relay the commands to the motors attached, making the wheels move according to the commands. The module description for the Transmitter circuit is given below:

MPU6050

The MPU6050 is a Micro-Electro-Mechanical System (MEMS) which comprises a 3-axis Accelerometer and 3-axis Gyroscope within it. This helps us to measure acceleration, velocity, orientation, displacement and many other motion-related parameters of an object. In our project, it is used to detect the hand gesture and then send the command signals acquired from the gestures to the microcontroller.

Arduino Uno

Arduino Uno is a microcontroller device that is based on the ATmega328P microchip. Here this microcontroller is used to receive the input gesture signals from the MPU6050 module and then relay them to the Trans-receiver module.

nRF24L01 Wireless Trans-receiver module:

The nRF24L01+ transceiver module is designed to operate in a 2.4 GHz worldwide ISM frequency band and uses GFSK modulation for data transmission. In addition to the module, we will also be using a mountable antenna which we can attach to the module for range improvement. This PA/LNA antenna boasts a range of up to 1000m. This whole trans-receiver circuit is the one that transmits the command signals to the receiver part in the form of RF signals. This module receives the input signals from the microcontroller and sends it to its counterpart in the receiver section of the project.

RECEIVER

The receiver part of the circuit will be receiving the gesture signal commands from the transmitter part of the circuit. The RF receiver is specially designed to receive the signal from the rf transmitter to demodulate or decode the original signal. The module description for the Transmitter circuit is given below:

nRF24L01 Wireless Trans-receiver module:

Just like in the transmitter circuit, we will be using another one of these trans-receiver modules to receive the RF signals sent from its counterpart in the transmitter circuit. These received signals are then passed onto the microcontroller.

Arduino Nano:

Arduino Nano is quite similar to the Arduino Uno and has the same ATmega328P microchip. The only difference is that the Arduino Nano can be considered as a smaller version of the Arduino Uno. Here, in our project, this microcontroller will be used to relay the signals acquired from the receiver module mentioned above.

L298N H-Bridge Motor Driver:

This L298N Motor Driver Module is a high-power motor driver module used for driving DC and Stepper Motors. This module consists of an L298 motor driver IC and a 78M05 5V regulator. Up to 4 DC motors can be controlled with directional and speed controls In our project, this module will be receiving the commands that are relayed to it from the microcontroller, and then are conveyed to the motors, which move according to the gesture instructions received.

DC Motors:

Electrical energy is converted to mechanical energy by a DC motor.

In our project, these DC motors are controlled by the motor driver module mentioned above.

The DC input power for these motors to work is provided by batteries that are directly connected to the motor driver.

SYSTEM ARCHITECTURE AND MODULE DESCRIPTION FOR VOICE CONTROL ROBOT:

The working of the Voice Controlled Robot is divided into two parts:

Smartphone:

This smartphone will act as the microphone to input the voice commands to be transmitted through Bluetooth to the HC-05 Bluetooth module. This smartphone needs to have the AMR_Voice Application installed and paired to the HC-05 Bluetooth module.

Robot Car:

The whole robot car can be considered as the receiver part of the project. It has many components, which are described as below:

HC 05 Bluetooth Module:

The HC-05 is a Bluetooth module that can act as a wireless trans-receiver via Bluetooth in between any Arduino microcontrollers and any Bluetooth supported device like a laptop or a smartphone. Here, the HC-05 receives voice commands from the smartphone. These instructions are then sent to the microcontroller.

Arduino Uno:

Arduino Uno is a microcontroller device that is based on the ATmega328P microchip. Here this microcontroller is used to take the voice commands which were relayed to the Bluetooth module and then these commands are conveyed to the L298N motor shield.

L298N H-Bridge Motor Driver:

This L298N Motor Driver Module is a high-power motor driver module used for driving DC and Stepper Motors. This module comprises an L298 motor driver IC along with a 78M05 5V voltage regulator. This module can control up to 4 DC motors with directional and speed control. In our project, we will be using this module to

operate the DC Motors with the help of the commands received from the microcontroller.

DC Motors:

A DC motor converts electrical energy to mechanical energy.

. In our project, these DC motors are controlled by the motor driver module mentioned above. The DC input power for these motors to work is provided by batteries that are directly connected to the motor driver.

Voice Recognition:

The Voice controlled sections of the Robotic vehicle can be controlled by any of the users by just giving their voice commands. Then the speech given by the user is received and detected by the microphone and simultaneously processed by the voice module. When a command given to the robot is recognized then the voice module sends its respective command messages to the microcontroller of the robot. Then the microcontroller in turn analyzes the command messages received by it and does the appropriate actions. When the voice commands are given on the transmitter side then these commands are taken by the mobile module and then converted to the form of digital signals. Then these digital signals are transmitted to the robotic vehicle through the HC-05 Bluetooth module. These commands are then sent to the Motor shield, which is placed on Arduino Uno, and then finally to the DC motors, thus making the car move according to those commands.

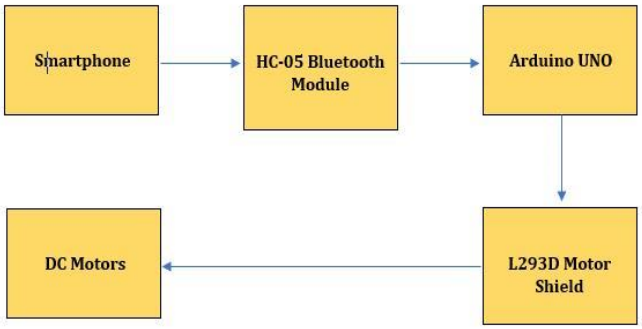

Fig.2 - Block Diagram for Voice Control

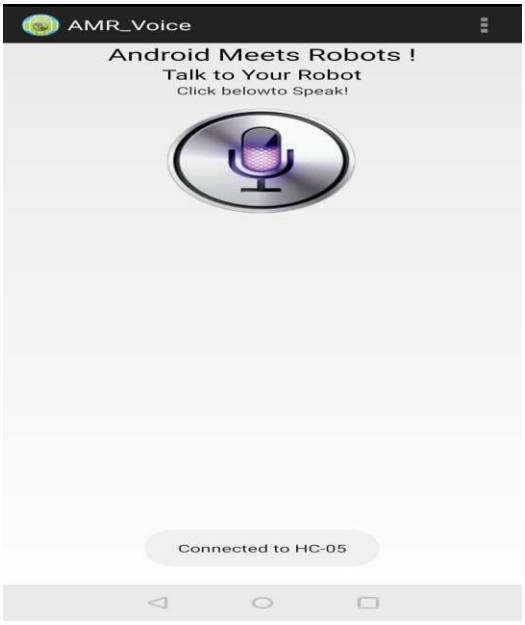

Fig -3: User Interface for Voice Control Application

Gesture Controlled:

The gesture-controlled robotic vehicle moves according to the hand movements of the user because we place the transmitter on the hand glove. The transmitter on the hand glove also contains an accelerometer sensor and it gives an analogue output which is further converted to digital, and the signal is received by the receiver and further these instructions are sent to the motors using the motor drivers which finally makes the robotic vehicle move. When the user tilts the hand to the front side the robotic vehicle moves forward and continues to move in the same direction until the next command is given by the user. When the hand is tilted backward the robotic vehicle changes its present state and it starts moving in the backward direction until the next command is given. In the same way when the user turns the hand right side the robotic vehicle turns right till the next command. When the user tilts the hand to the left side the robotic vehicle turns left. And the robotic vehicle stops when the user's hand is stable. This way the robotic vehicle can be controlled.

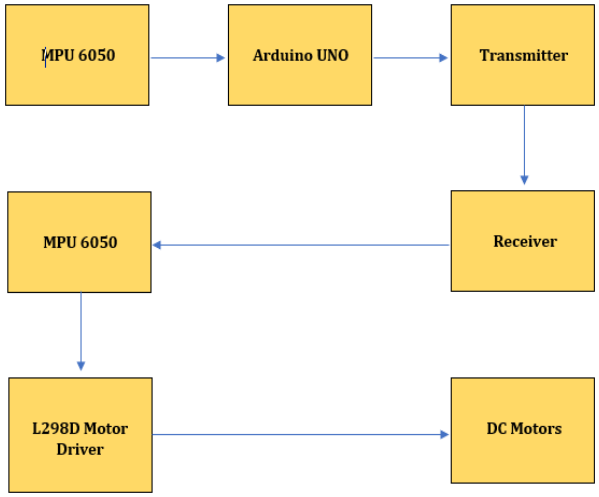

Fig -4: Block Diagram for Gesture Control

Table -1: Functions of Pins

Pin Number	Symbol	Function
1	VCC	Input power for the module can be from +3V to +5V, but generally, +5V is used
2	GND	The ground of the system
3	SCL	Provides clock pulse for I2C Communication
4	SDA	Data Transfer through I2C Communication
5	XDA	The Auxiliary Serial The data pin is used to connect I2C compatible sensors from SDA pin to MPU6050
6	XCL	The Auxiliary Serial Clock pin is used to connect I2C compatible sensors from SCL pin to MPU6050
7	AD0	The I2C Slave Address LSB pin, if connected to VCC, then it is read as logic one and slave address changes

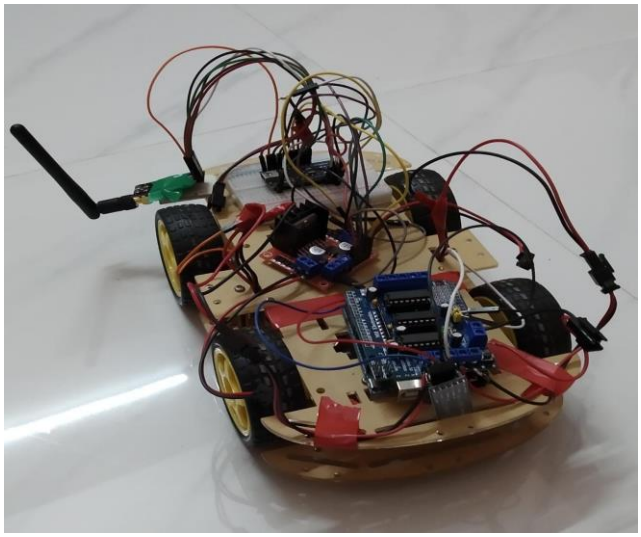

Fig -5: Prototype of Working Model

3. CONCLUSION

The robotic vehicle can hence be controlled by voice and gesture which makes it more useful in this present pandemic situation. This way we can reduce unnecessary human contact wherever possible, and we will also be able to control without any fear of contact. There is also a high risk of spreading the virus by closely following the robotic vehicle so by integrating with the wi-fi will have more range than the previously used Bluetooth module. This would be of great help to reduce human presence in the areas such as health care facilities and quarantine zones.

4. EXPERIMENTAL RESULTS

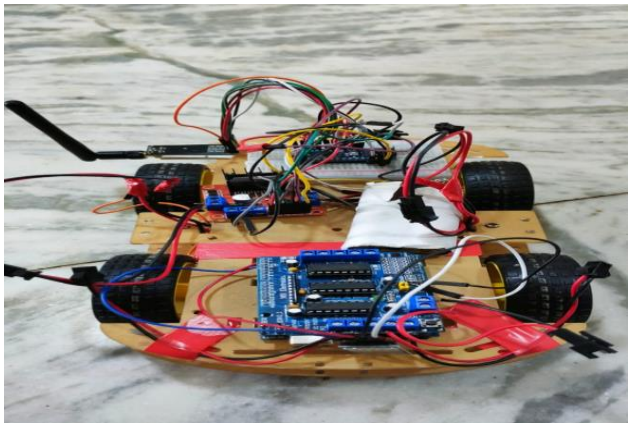

Fig -6: Receiver Circuits for both Gestures and Voice

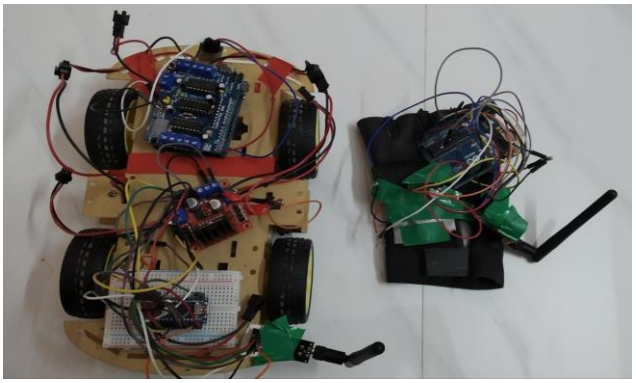

Fig -7: Transmitter and Receiver Circuits

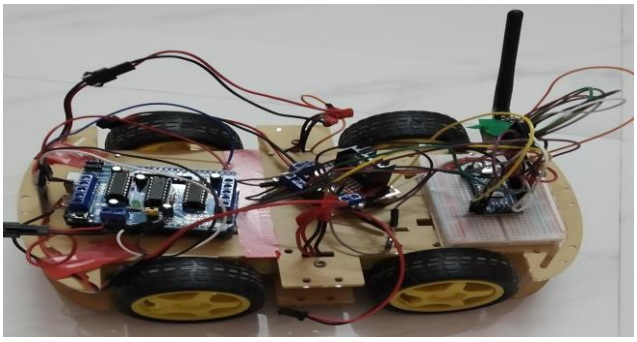

Fig -8: Final Prototype of the Project

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