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Arduino Obstacle Avoiding + Voice Control + Bluetooth Control Robot

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Abstract: *The project is design to build an obstacle avoidance robotic vehicle using ultrasonic sensors for its movement. A microcontroller (ATmega328) is used to achieve the desired operation. A robot is a machine that can perform task automatically or with guidance. The project proposes robotic vehicle that has an intelligence built in it such that it directs itself whenever an obstacle comes in its path. This robotic vehicle is built, using a micro-controller of AT mega 328family. An ultrasonic sensor is used to detect any obstacle ahead of it and sends a command to the micro-controller. Depending on the input signal received, the micro-controller redirects the robot to move in an alternate direction by actuating the motors which are interfaced to it through a motor driver. Some of the project is built with the IR sensors has its own application so in our project those application is not compactable so we are using ultrasonic sensor.*

Keywords: Arduino UNO, motor shield L293d, ultrasonic sensor HC-SR04, DC Motor, servo motor

I. INTRODUCTION

Obstacle avoidance Robot is designed in order to navigate the robot in unknown environment by avoiding collisions. Obstacle avoiding robot senses obstacles in the path, avoid it and resumes its running. There are some very popular methods for robot navigation like wall-following, edge detection, line following and many more. A more general and commonly employed method for obstacle avoidance is based on edge detection. A disadvantage with obstacle avoidance based on edge detecting is the need of the robot to stop in front of an obstacle in order to provide a more accurate measurement. All mobile robots feature some kind of collision avoidance, ranging from primitive algorithms that detect an obstacle and stop the robot in order to avoid a collision, using some sophisticated algorithms that enable the robot to detour obstacles. The latter algorithms are more complex, since they involve detection of an obstacle as well as some kind of quantitative measurements concerning the obstacle's dimensions.

Once these have been determined, the obstacle avoidance algorithm needs to steer the robot around the obstacle and resume motion toward the original target. The steering algorithm ensures that the robot does not have to stop in front of an obstacle during its navigation. An ultrasonic sensor is used to detect any obstacle ahead of it and sends a command to the micro-controller [10] Hence the robots may overcome some of the problems during navigation, which are discussed above and it can navigate smoothly during its operation avoiding the collisions. if we were use the IR sensor Infrared sensors detect the object's distance with infrared radiation. When the beam detects an object, the light beam returns to the receiver with an angle after reflection there is a limitations in sensor those limitations are Performance of IR sensors has been limited by their poor tolerance to light reflections such as ambient light or bright object colors.

No object recognition at the dead zone area, for example Sharp GP2D12 IR distance sensor dead zone between 0 to 4cm. IR sensors also give inaccurate detection result with transparent or bright color materials. Detection results also depend on the weather conditions and the sensing reliability of IR sensors decreases with moisture and humidity. Furthermore, IR sensors can sense IR radiation from the sunlight, which can cause correctable or non-correctable errors at output. Besides that, if analogue IR sensor is used, signal losses will occur at the amplifier circuit. Meanwhile, PIR

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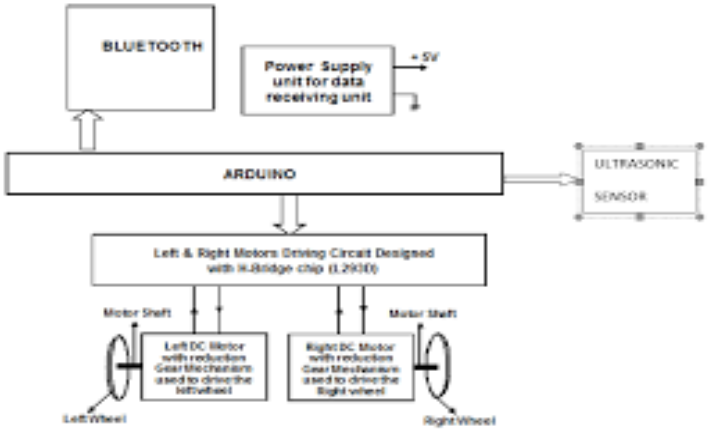
motion sensor needs a long calibration time and is sensitive to thermal radiation. Besides that, PIR sensor is insensitive to very slow motions or to objects in standing mode [2].

II. LITERATURE REVIEW

The robot intelligently detects the obstacle that is in its path and navigates and moves around as given in the code. So, this system provides an alternate way to the existing system to replace a skilled labour with robotic machinery which can handle more complex tasks in less time increasing the accuracy with less cost with economic growth. With combination of Bluetooth module and motor driver shield we can control this by our android phone app. This technology is not used in many fields due to limitation of communications overhead. We use Bluetooth module for the communication between the app and the device. the android mobile phone is free resource and easily available, that can be used by decreasing the cost of the robot. All the commands are available in the app thus the car can be easily controlled by just touching the buttons on the android-based app.

III. METHODOLOGY

Install any Bluetooth Application for Arduino. Pair HC-05 Bluetooth module with the mobile Default password is "1234" or "0000".Click on the "MIC" icon and speak/instruct the robot .On speaking our speech gets recognized and converted into text. That text is transferred using Bluetooth .The Bluetooth Module receives the string, decodes it and compares it with the Instructions that are described in the program and moves the robot in direction given by the user using mobile application.



IV. SYSTEM DESIGN

The overall design of the system is explained through the block diagram shown below. It describes all the components needed to implement a system. Figure 1 shows the block diagram of Obstacle avoiding Voice controlled system.

The Arduino Uno is a microcontroller board built on the ATmega328. It has 14 digital I/O pins (6 can be used a s PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and can be connected to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Uno does not use FRDI USB-to -serial driver chip unlike other boards. Figure 2 below shows the pin diagram of Arduino Uno R3.

HC-05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module. It is intended for transparent wireless serial connection setup. The HC-05 Bluetooth Module can be used in a Master or Slave configuration in wireless communication. This serial port Bluetooth module has a fully capable Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. It uses CSR Blue core 04-External single chip Bluetooth system with CMOS technology and Adaptive Frequency Hopping Feature. The Bluetooth module HC-05 is a MASTER/SLAVE module.

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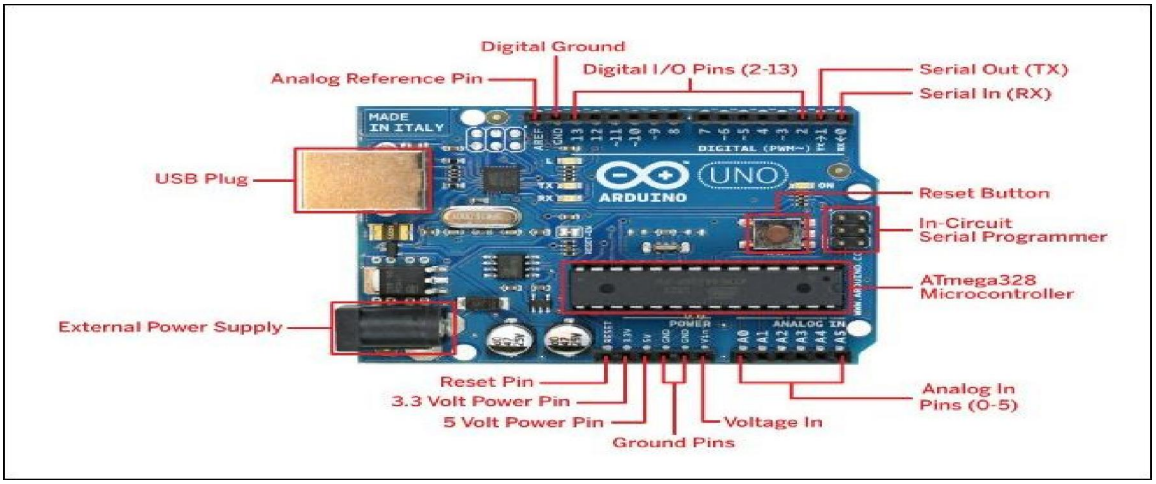
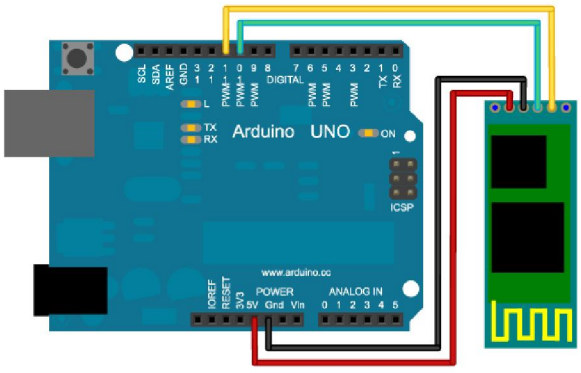


BLUETOOTH MODULE - HC-05 Module

HC-05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. The HC-05 Bluetooth Module can be used in a Master or Slave configuration, making it a great solution for wireless communication. This serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. It uses CSR Blue core 04-External single chip Bluetooth system with CMOS technology and with AFH (Adaptive Frequency Hopping Feature). The Bluetooth module HC-05 is a MASTER/SLAVE module. By default the factory setting is SLAVE.

INTERFACING HC-05 WITH ARDUINO

Vcc and GND of the module is connected to the Vcc and GND of Arduino. The TXD pin is connected to RXD pin of Arduino and RXD pin connects to TXD pin of Arduino i.e. digital pin 0 and 1. The user can use the on board LED. But here, LED is connected to digital pin 12 externally for betterment of the process. Figure 4 below shows the Interfacing of HC-05 Module with Arduino.



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ULTRA SONIC – the ultra-sonic sensor HC-SR04 uses SONAR (sound navigation and ranging) technology. To determine distance of the object. The device measures the distance of an object by emitting ultra-sonic waves and converts the reflected wave into electrical signal. the ultra-sonic sensor travels more than the speed of sound human can hear. The ultra-sonic sensors have two main components first one is a transmitter that emits sound using piezoelectric crystals and second one is receiver which encounters sound waves after the reflection from the object.

SERVO MOTOR- this servo motor is tiny and lightweight with high output power. It rotates 180 degrees, 90 degrees to the right and 90 degrees to the left. This servo is designed to work with control systems. It provides good torque, holding power and faster updates with response to external force. However, these are dead cheap and serve the purpose.

GEAR MOTOR -gear motor is a component that adjusts to the speed mechanism of the motor, thus leading them to operate at a certain speed. These motors deliver high torque at low speeds, as gear head functions as a torque multiplier and can allow small motors to generate higher speeds. This has a combination of gear box and electric motor.

JUMPER WIRES- jumper is an electric cable with connector end. This is normally used to connect the components on bread board, test circuits, and connecting the components on embedded chip. Each end is fitted according to the requirements. By using them we can avoid soldering as these come with several types of endings and colors.

Obstacle Avoiding

An Obstacle Avoidance Robot is an intelligent robot, which can automatically sense and overcome obstacles on its path. It contains a Arduino to process the data, and Ultrasonic sensors to detect the obstacles on its path. Obstacle avoidance is one of the most important aspects of mobile robotics. Without it, robot movement would be very restrictive and fragile. This project also presents a dynamic steering algorithm that ensures that the robot doesn't have to stop in front of an obstacle which allows the robot to navigate smoothly in an unknown environment, avoiding collisions. Almost all navigation robot demands some sort of obstacle detection, hence obstacle avoidance strategy is of most importance. Obstacle Avoidance Robot has a vast field of application. They can be used as services robots, for the purpose of household work and so many other indoor applications. Equally, they have great importance in scientific exploration and emergency rescue, there may be places that are dangerous for humans or even impossible for humans to reach directly, then we should use robots to help us. In those challenging environments, the robots need to gather information about their surroundings to avoid obstacles. Nowadays, even in ordinary environments, people require that robots to detect and avoid obstacles. For example, an industrial robot in a factory is expected to avoid workers so that it won't hurt them. In conclusion, obstacle avoidance is widely researched and applied in the world, and it is probable that most robots in the future should have an obstacle avoidance function. Thanks for reading my idea.

Voice Control

A Bluetooth module is used to create a communication link between the car and human voice commands via Android Application. The RF transmitter of the module can take human voice commands through the application which will then be converted into encoded digital data up to an adequate range of 100 meters from the robot. The receiver of the

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module decodes the input data before feeding it to the microcontroller to drive DC motors via motor driver L298D for necessary movements. An Arduino UNO which is the brain of our system is programmed to read voice commands and respond accordingly. Obstacle detection can be done by ultrasonic sensors interfaced with the Arduino UNO. Considering this feature, in the future it might prove a milestone in vehicle automation. Further the project can be developed using the Internet of Things, Artificial Intelligence technology where a user can control the car from any corner of the world.

Bluetooth Control

In this project, we will make a wirelessly Bluetooth controlled robot car using Arduino as the microcontroller. It will be an exciting project which is a combination of wireless communication, robotics, and electronics. We can able to control the robot using our smartphone, only we have to just install an App available on Playstore (see later). We are integrating a Bluetooth module for seamless wireless communication between the robot car and Bluetooth-enabled devices.

Software requirements

ARDUINO - Arduino is an open-source software that makes it easy to write code and upload it to the board. This software can be used with any Arduino boards. We write the codes using Arduino software and these are next compiled into the Arduino boards. This ide software is applicable to windows, Linux, mac, os x. The programming languages that are used are c and c++. After writing the code the upload button is used to compile the code into the Arduino board using an usb cable that is connected to your computer and Arduino board. This has many ranges of programmable printed circuit boards(pcb's). These boards can read both analog and digital input signals. The board that we use can be controlled by sending a set of requirements of instructions to the microcontroller on the board via Arduino software.

BLUETOOTH CONTROL-this application is designed to be used with a modified car. This app allows you to control a microcontroller and Bluetooth that is fitted with your Rc car. We control the Rc car with either virtual buttons or phones accelerometer. The slider in the app allows us to control the speed of the car.

V. SOFTWARE DESCRIPTION

- Slave default Baud rate: 9600, Data bits: 8, Stop bit: 1 Parity: No parity.
- Auto-connect to the last device on power as default.
- Permit pairing device to connect as default.
- Auto-pairing PINCODE:"1234" as default.

VI. WORKING

The robot in this project detects obstacles with the help of ultra-sonic sensors. This measures the distance of the surrounding object with the help of ultra-sonic sensors to achieve desired movements. The motors are connected through motor driver IC to Arduino. This robot is designed to detect objects within a specified distance. The object that is found in front of car is termed as an obstacle, after detecting any of those obstacles the robot changes its direction. The sensor is placed above the servo motor facing in front. thus, if any object detected the signal is sent to the uno board. Further Arduino instructs servo motor for the change of direction. Servo changes the direction as per the instruction given by Arduino. The driver will rotate the motors m3 and m4 in forward direction and m1, m2 in reverse direction. The ultra-sonic sensors send ultra-sonic waves at 300 meter (about 984.25 ft) per second. These waves travel in the air, hit the object, and return to the receiver of the ultra-sonic sensor. The distance between object and sensor is calculated. To calculate the distance between object and sensor, the sensor measures the time it takes between emission of waves by the transmitter to its contact with receiver. The formula for calculation of distance is given by D=1\2 T*C

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(where D is distance, T is time, and C is speed of sound I.e., 343 meter per second). Similarly, every time whenever the object is found to be in the path it will detect and move in the direction toward the left or right side.

After the code for Bluetooth is compiled. Connect the Bluetooth of your android to HC-05 and open the app. The android phone gets paired with the app. Once Bluetooth gets connected, the app screen opens on your phone. The button which you press, the car follows the same direction. The program is designed in such a manner that when you press the button front and right it moves diagonally towards the right side, similarly when you press the button back and front it moves diagonally opposite direction to the right side. We have paired with another Arduino uno board to avoid re-uploading the program. The RXD pin of Bluetooth receives commands from android and sends to Arduino and sends signal through the TXD pin for transmitting the information.

VII. CONCLUSION

This project developed an obstacle avoiding robot to detect and avoid obstacles in its path. The robot is built on the Arduino platform for data processing and its software counter part helped to communicate with the robot to send parameters for guiding movement. For obstacle detection, three ultrasonic distance sensors were used that provided a wider field of detection. The robot is fully autonomous and after the initial loading of the code, it requires no user intervention during its operation. When placed in unknown environment with obstacles, it moved while avoiding all obstacles with considerable accuracy. In order to optimize the movement of the robot, we have many considerations for improvement. However, most of these ideas will cost more money and time as well.

VIII. RESULT

The result is obtained for both obstacle avoidance and Bluetooth control. The robot moves forward if any obstacle detected the robot turns 90 degrees left or right, when there Is no obstacle, the robot moves forward direction. The robot follows the instructions as given by the Bluetooth module and goes to the given direction provided by the instructor.

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