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GESTURE CONTROLLED ROBOT USING ARDUINO

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ABSTRACT

Car is also consider under robot even automobiles (electromechanical) are consider as robot because robot is a device which can be used as tool for making work easier and effortless. Today Robots plays a vital role in industries like line tracker. We cannot introduce the new technology and create new enhancement. We just made project with low cost and use of less components. It's always a challenge for engineers to make the things simpler and cheaper the way they were before. We tried to emphasize on those concepts and that's why we built a wireless gesture control robot. This project is about design and fabrication of a wireless gesture controlled Robot using ARDUINO ATMEGA32 processor and an Android operated application to control the gestures through HC-05 Bluetooth module with less, and cheap hardware requirements. My work is to implement in automobile such as car, buses and trolley without the use of manpower we simply control these is our Smartphone. Using a smart phone the robot directions can be controlled through android app. These robots can be reprogrammable and can be interchanged to provide multiple applications.

Keywords: automobiles, Robots, ARDUINO (ATMEGA328), Bluetooth Module (HC05), Smartphone.

1. INTRODUCTION

Nowadays smart phones are becoming more powerful with reinforced processors, larger storage capacities, richer entertainment function and more communication methods. Bluetooth is mainly used for data exchange; add new features to smart phones.

ARDUINO is a prototype platform (open-source) based on an easy-to-use hardware and software. It consists of a circuit board, which can be programmed (microcontroller) and ready-made software

called ARDUINO IDE (Integrated Development Environment), which is used to write and upload the computer code to the physical board.

Researchers have shown interest in gesture recognitions and have built several robots and devices that are controlled by human gestures. There is a constant development in the field of gesture controlled devices. Apart from hand gesture recognition, emotional gesture recognition from face is also done in some cases. There are two types of gestures used in gesture recognition: Online gestures and Offline gestures. In Online gestures, direct manipulations like rotation and scaling are done. In Offline gestures, the processing is done only after the user interacts with the object. Gesture technologies are applied in several fields like in Augmented Reality, Socially assistive Robots, recognition of sign languages, emotion detection from facial expressions, Virtual mouse or keyboard, recognition of sign languages, remote control, etc.

There are various modes of communication between the microcontroller of the robot and the Smartphone. However, the popularly used means of communication is done via RF, Bluetooth or Wi-Fi. Using RF limits the distance from which the robot can be controlled.

2. PROPOSED SYSTEM

The purpose of our research is to provide simpler robot's hardware architecture but with powerful computational platforms so that robot's designer can focus on their research and tests instead of Bluetooth connection infrastructure. This simple architecture is also useful for educational robotics, because students can build their own robots with low cost and use them as platform for experiments in several courses. The following components can be used .They are

2.1. ARDUINO

ARDUINO is an open-source computer hard ware and software company, project and user community that designs and manufactures microcontroller-based kits for building digital devices and interactive objects that can sense and control objects in the physical world. ARDUINO had used the ATMEGA328.

2.2. BLUETOOTH

A HC-05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. Serial port Bluetooth module is fully qualified BluetoothV2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. It uses CSR Blue core 04-Externalsingle chip Bluetooth system with CMOS technology and with AFH (Adaptive Frequency Hopping Feature).It has the footprint as small as 12.7mmx27mm.

2.3. ANDROID PHONE

In this project we will control the robot using Android Phone by using an application which we will get from Android Play store. By installing the application we can move the robot in four directions i.e., is front, reverse, left and right directions.

2.4. BLUETOOTH RECEIVER

Bluetooth Receiver consists of Bluetooth serial interface module and Bluetooth adapter. Bluetooth serial module is used for converting serial port to Bluetooth. This module has two modes: master and slaver device.

2.5. ARDUINO UNO

The ARDUINO Uno is a 8 bit microcontroller board based on the ATmega328.It has 14 digital pins and 6analog pins and other power pins such as, GND, VCC, It has 14 digital input/output pins (of which6can be used as PWM outputs), 6 analog inputs, a 16MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It has SRAM 2kb and flash memory 32kb EEPROM with 1KB. ARDUINO is open source hardware board with many open source libraries to interface it on board microcontroller with many other external components like LED, motors, IR sensors and

many other things one want to interface with ARDUINO board. ARDUINO is a complete board which includes all things to connect with external peripheral and to program through computer. It contains everything needed to support the microcontroller. We either need to connect it to a computer using a USB cable or power it with an AC-to-DC (7-12v) adapter. The ARDUINO circuit acts as an interface between the software part and the hardware part of the project.

2.6. DC MOTOR

Almost every mechanical movement that we see around us is accomplished by an electric motor. Electric machines are means of converting energy. Motors take electrical energy and produce mechanical energy. Electric motor is used to power hundreds of devices we use in everyday life. An example of small motor applications includes motors used in automobiles, robot, hand power tools and food blenders. Micro-machines are electric machines with parts the size of red blood cells and find many applications in the medicine.

3. REQUIRED COMPONENTS

3.1 ARDUINO

The key features are:

- ARDUINO boards [2](K. Ashokkumar et al.)are able to read analog or digital input signals from different sensors and turn it into an output such as activating a motor, turning LED on/off, connect to the cloud and many other actions.
- You can control your board functions by sending a set of instructions to the microcontroller on the board via ARDUINO IDE (referred to as uploading software).
- Unlike most previous programmable circuit boards, ARDUINO does not need an extra piece of hardware (called a programmer) in order to load a new code onto the board. You can simply use a USB cable.
- Finally, ARDUINO provides a standard form factor that breaks the functions of the micro-controller into a more accessible package.

3.2 SELECTION OF BOARD

The selection of ARDUINO board is important, because all the boards are not seems to be used .But ARDUINO is generally a microcontroller. so we have select the board depend on characteristics and properties.

3.2.1 BOARD TYPES

Various kinds of ARDUINO boards are available depending on different microcontrollers used. However, all ARDUINO boards have one thing in common: they are programmed through the ARDUINO IDE.

The differences are based on the number of inputs and outputs [1](John Weissmann) (the number of sensors, LEDs, and buttons you can use on a single board), speed, operating voltage, form factor etc. Some boards are designed to be embedded and have no programming interface (hardware), which you would need to buy separately. Some can run directly from a 3.7V battery, others need at least 5V.The ARDUINO Uno is a microcontroller board based on the ATmega328 It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button.

3.3 ARDUINO BOARD

In this chapter, we will learn about the different components on the ARDUINO board as shown in Figure 1. We will study the ARDUINO UNO board because it is the most popular board in the ARDUINO board family. In addition, it is the best board to get started with electronics and coding. Some boards look a bit different from the one given below, but most ARDUINO have majority of these components in common.

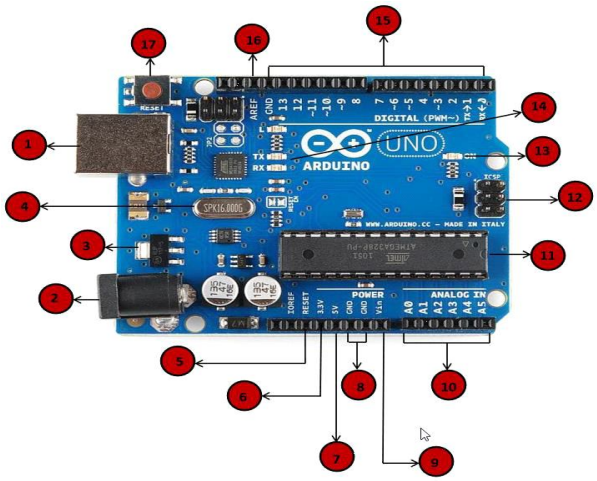

Figure 1: ARDUINO Board

3.3.1 POWER USB

ARDUINO board can be powered by using the USB cable from your computer. All you need to do is connect the USB cable to the USB connection (1).

3.3.2 POWER BARREL JACK

ARDUINO boards can be powered directly from the AC mains power supply by connecting it to the Barrel Jack (2).

3.3.3 VOLTAGE REGULATOR

The function of the voltage regulator is to control the voltage given to the ARDUINO board and stabilize the DC voltages used by the processor and other elements.

3.3.4 CRYSTAL OSCILLATOR

The crystal oscillator helps ARDUINO in dealing with time issues. The number printed on top of the ARDUINO crystal is 16.000H9H. It tells us that the frequency is 16,000,000 Hertz or 16 MHz

3.3.5 ARDUINO REST

You can reset your ARDUINO board, i.e., starts your program from the beginning. You can reset the UNO board in two ways. Initially using the reset button (17) in the board. Second, you can connect an external reset button to the ARDUINO pin labeled RESET (5).

3.3.6 PINS (3.3, 5, GND, VIN)

- 3.3V (6): Supply 3.3 output volt
- 5V (7): Supply 5 output volt
- Most of the components used with ARDUINO board works fine with 3.3 volt and 5 volt.
- GND (8) (Ground): There are several GND pins on the ARDUINO, any of which can be used to ground your circuit.
- VIN (9): This pin also can be used to power the ARDUINO board from an external power source, like AC mains power supply.

3.3.7 ANALOG PIN

The ARDUINOUNO board has five analog input pins A0 through A5. These pins can read the signal from an analog sensor like the humidity sensor or temperature sensor and convert it into a digital value that can be read by the microprocessor.

3.3.8 MAIN CONTROLLER

Each ARDUINO board has its own microcontroller (11). You can assume it as the brain of your board. The main IC (integrated circuit) on the ARDUINO is slightly different from board to board.

The microcontrollers are usually of the ATMEL Company. You must know what IC your board has before loading up a new program from the ARDUINO IDE. This information is available on the top of the IC.

3.3.9 ICSP PIN

Mostly, ICSP (12) is an AVR, a tiny programming header for the ARDUINO consisting of MOSI, MISO, SCK, RESET, VCC, and GND. It is often referred to as an SPI (Serial Peripheral Interface), which could be considered as an "expansion" of the output. Actually, you are saving the output device to the master of the SPI bus.

3.3.10 POWER LED INDICATOR

This LED should light up when you plug your ARDUINO into a power source to indicate that your board is powered up correctly. If this light does not turn on, then there is something wrong with the connection.

3.3.11TX and RX LEDs

On your board, you will find two labels: TX (transmit) and RX (receive). They appear in two places on the ARDUINO UNO board. First, at the digital pins 0 and 1, to indicate the pins responsible for serial communication. Second, the TX and RX led (13). The TX led flashes with different speed while sending the serial data. The speed of flashing depends on the baud rate used by the board. RX flashes during the receiving process.

3.3.12DIGITAL I \O

The ARDUINO UNO board has 14 digital I/O pins (15) (of which 6 provide PWM (Pulse Width Modulation) output. These pins can be configured to work as input digital pins to read logic values (0 or 1) or as digital output pins to drive different modules like LEDs, relays, etc. The pins labeled “~” can be used to generate PWM.

3.3.13AREF

AREF stands for Analog Reference. It is sometimes, used to set an external reference voltage (between 0 and 5 Volts) as the upper limit for the analog input pins.

3.3.14. SPECIFICATIONS

Microcontroller ATmega328

- Operating Voltage 5V
- Input Voltage (recommended) 7-12V
- Input Voltage (limits) 6-20V
- Digital I/O Pins 14 (of which 6 provide PWM output)
- Analog Input Pins 6
- Flash Memory 32 KB of which 0.5 KB used

3.4 BLUETOOTH HC-05

HC-05 Bluetooth Module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. Its communication is via serial communication which makes an easy way to interface with controller or PC. HC-05 Bluetooth module provides switching mode between master and slave mode which means it able to use neither receiving nor transmitting data.

3.4.1 SPECIFICATIONS

- Model: HC-05
- Input Voltage: DC 5V
- Communication Method: Serial Communication
- Master and slave mode can be switched

Table1: Specifications

Pin	Description	Function
VCC	+5V	Connect to +5V
GND	Ground	Connect to ground
TXD	UART_TXD, Bluetooth serial signal sending PIN	Connect with the MCU's (Microcontroller and etc) RXD PIN.
RXD	UART_RXD, Bluetooth serial signal receiving PIN	Connect with the MCU's (Microcontroller and etc) TXD PIN.
KEY	Mode switch input	If it is input low level or connect to the air, the module is at paired or communication mode.

3.5 MOTOR DRIVE

L293D [1] (John Weissmann et al.) is quadruple high-current half-H drivers. It can provide bidirectional drive current of up to 600-mA at voltages from 4.5V to 36V. It is also designed to drive inductive loads such as inductive relays, solenoids, dc and bipolar stepping motors, as well as other high current / high voltage loads in positive-supply applications. All inputs are TTL compatible, each output is a complete totem-pole Drive circuit, with a Darlington transistor and a Pseudo Darlington source [6].

3.5.1 Voltage Regulator (L7805)

The voltage regulator is a device which controls the voltage in the electrical equipment's. These devices are also used as current limiting device.

3.5.2 Power Supply

It's a hardware which supplies the required voltage to the device. It's usually taken the input as AC and gives DC output to the device as required.

3.5.3 Gear Motor

In a Gear motor, the magnetic current (which can be produced by either permanent magnetic or electromagnets) turns gears that are either in a gear reduction unit or in an integrated box. A second shaft is connected to those gears. The result is that the gears greatly increase the amount of torque the motor is capable of producing while simultaneously slowing down the motors output speed.

4. EXPERIMENTAL SETUP AND EXPERMINATION

4.1 ISTRUCTIONS OF ARDUINO

ARDUINO can sense the environment by receiving input from a variety of sensors and can affect its surroundings by controlling lights, motors, and other actuators. The microcontroller on the board is programmed using the ARDUINO programming language (based on Wiring) and the ARDUINO development environment (based on Processing). ARDUINO projects can be stand-alone or they can communicate with software on running on a computer (e.g. Flash, Processing, Max MSP).

4.1.2 ARDUINO INSTALLATION

After learning about the main parts of the ARDUINO UNO board [1] (John Weissmann et al.), we are ready to learn how to set up the ARDUINO IDE. Once we learn this, we will be ready to upload our program on the ARDUINO board.

In this section, we will learn in easy steps, how to set up the ARDUINO IDE on our computer and prepare the board to receive the program via USB cable.

Step 1: First you must have your ARDUINO board (you can choose your favorite board) and a USB cable. It need a standard USB cable (A plug to B plug), the kind you would connect to a USB printer as shown in the following image.

Step2: Download ARDUINO IDE Software
You can get different versions of ARDUINOIDE from the Download page on the ARDUINO Official website. You must select your software, which is compatible with your operating system (Windows, IOS, or Linux). After your file download is complete, unzip the file.

Step 3: Power up your board.
The ARDUINO Uno, Mega, Duemilanove and ARDUINO Nano automatically draw power from either, the USB connection to the computer or an external power supply. If you are using an ARDUINO Diecimila, you have to make sure that the board is configured to draw power from the USB connection. The power source is selected with a jumper, a small piece of plastic that fits onto two of the three pins between the USB and power jacks. Check that it is on the two pins closest to the USB port.
Connect the ARDUINO board to your computer using the USB cable. The green power LED (labeled PWR) should glow.

Step 4: Launch ARDUINO IDE.
After your ARDUINO IDE software is downloaded, you need to unzip the folder. Inside the folder, you can find the application icon with an infinity label (application.exe). Double-click the icon to start the IDE.

Step 5: Open your first project.
Once the software starts, you have two options:
- Create a new project.
- Open an existing project example.

To create a new project, select File --> New.
To open an existing project example, select File -> Example -> Basics -> Blink.
Here, we are selecting just one of the examples with the name **Blink**. It turns the LED on and off with some time delay. You can select any other example from the list.

Step 6: Select your ARDUINO board.
To avoid any error while uploading your program to the board, you must select the correct ARDUINO board name, which matches with the board connected to your computer.
Go to Tools -> Board and select your board.

4.2 DESIGN OF ANDROID APPLICATION
The Android application [3] (Wang. B et al.) is the key to control the robot using hand gestures. The application reads the accelerometer state and X, Y, and Z values are obtained in the application. There are two threshold values assigned for each movement: one is the MAX_THRESHOLD, and the other is the MIN_THRESHOLD. If the obtained value lies between these thresholds of a certain movement, then the character assigned to denote that movement, which is called the DET or determinant is sent to the robot via Bluetooth. The application continuously sense this until the application is ON. A graphical user interface has been designed for the comfort of the user. The application abstracts the calculations and accelerometer values, but the user interface shows the direction of movement of the hand so that the user is aware of wrong turns in the bot.

4.2.1 ALGORITHM FOR ANDROID APPLICATION
Step 1: Connect to the Bluetooth Module
Step 2: Set THRESHOLD_MAX and THRESHOLD_MIN values for each direction forward, backward, Left and Right
Step 3: Get the state of the accelerometer: I State of the accelerometer
Step 4: VALUE I into X, Y, Z coordinate values
Step 5: If VALUE is in between THRESHOLD_MAX and THRESHOLD_MIN for a direction, then set DATAOUT as the direction of VALUE represented by a Character.
Step 6: Return DATAOUT.

5. RESULT AND DISCUSSION

In this chapter we discussed the accomplishment and objectives of gesture controlled robot Robots are used in various fields, including automobile field, but not used effectively and securely.

Table 2: Result

AXES	ANALOG VALUES	DIRECTIONS
+X	>1.25V	FORWARD
-X	<1.25V	BACKWARD
+Y	<1.25V	RIGHT
-Y	<1.25V	LEFT

Though it reduces manual work, still to avoid some malfunctions and heavy loss, controlling these robots by the user will be a better job. So this paper will pave the ways for implementing robots in agricultural field to reduce the manpower utilization in the same way by controlling the in human hands. Since the control is in our hand many malfunctions can be prevented. The following table examines [2] (K. Ashokkumar et al.) the resulting work. In this paper, the design and implementation of Gesture Controlled Robot is presented and developed using ARDUINO microcontroller and Android Smartphone. An algorithm has been provided and its working is detailed thoroughly. Since the updating possibilities are endless, updating the system has been kept as a future scope. The built device is cheap, and is easy to carry from one place to another. The addition of the some additional sensors or camera will make it more productive. The limitation of the hardware being associated with a system has been reduced to a great extent. As an end thought, the system will allow the user to control it in a way that reduces the gap between the physical world and the digital world with an output more intuitive.

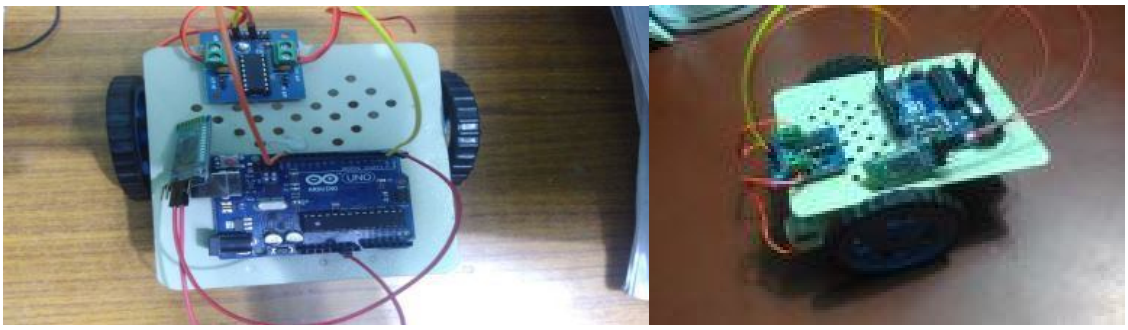

Figure 2: Experimental Setup

The Figure 2 shows the resultant assemble of experiment .Various experiments have been conducted to determine the best fitting correlation value for this project on gesture controlled bot. 2 axes of the accelerometer is used for the project i.e. X and Y. The analog values obtained from the accelerometer were from the range 0-5 volts which were mapped to 10 output channels which were ranging from 0-1023 using analog Read() function. For forward and backward motion, Y axis values are found to be constant. Similarly for left and right motion X axis values were found to be constant.

5.1 ADVANTAGES

- Replacement of man power by using the digital control.
- Components and experimental setup takes much less amount when compared to others.
- The handling and operation of process is very easy and accurate.
- It doesn't need a skilled person to operate the control.
- Manual steering difficulties will be avoided.
- Efficiency is high both steering and controlling.

6. CONCLUSION

It's always a challenge for engineers to make the things simpler and cheaper the way they were before. Also our main target was to make it less expensive so we were more conscious about choosing the components. Although we tried to make less expensive but we did not compromise on the quality. We tried to make it more reliable and simple. The biggest advantage of our project is that it's very easy to control. The Gesture controlled robot designed in this work has many future scopes. In this paper, the design and implementation of Gesture Controlled Robot is presented and developed using ARDUINO microcontroller and Android Smartphone. An algorithm has been provided and its working is detailed thoroughly. Since the updating possibilities are endless, updating the system has been kept as a future scope. The built device is cheap, and is easy to carry from one place to another. The addition of the some additional sensors or camera will make it more productive.

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