Hand Gesture Controlled Robot

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Abstract

The paper confers the structure, configuration, and function of the gesture-controlled robotic car. The Automated car robot can be operated by easy hand gestures, and an individual can handle the control of the robot vehicle without any hardships like pressing the buttons, joystick, or controllers, simply by wearing the gloves that possess a transmitter circuit that has an Arduino lilypad board, and an accelerometer with a 3-axis acceleration measurement apparatus with a +-3g capacity. The receiver circuit that has been set up on the robot car, is assembled with RF 433 transmitter module and two ICs an HT12D and L293DNE. Hereby the entire model contains two RF433 transmitters through which radio signals are transmitted between the receiver and transmitter circuits. The technique works by sensing the hand movement of the user through the sensor

Keywords: Gesture-controlled robot; Accelerometer; Arduino Lilypad.

1. Introduction

In the science sector, the presently growing technology is robotics. A robot can be described as an electromechanical machine that enacts tasks automatically either wired or wirelessly by having human supervision via remote control or with a machine language. Robotics is presently concentrated on formulating systems that provide modularity, flexibility, monotony, and defect tolerance. Robots can interact with the user with wireless communication technology. A breakthrough commemorated in wireless communications is the use of gestures in interaction. The gesture gadget and the robot are connected wirelessly via radio waves. In this Project, the gesture-controlled robot car is assembled using n Arduino Lily pad, a 3-axis accelerometer with an RF 433 transmitter module. The user must wear a gesture device with a sensor that records the motion of the hand in a particular orientation, causing the robot to move in the correct direction. The robot receives the data from the handheld motions through radio communication. There are separate transmission and reception parts for the entire prototype. This device produces an analogue result that is also acceleration-balanced. This accelerometer functions corresponding to hand movements and sends that data to a comparator (L293DNE). This data is disseminated to an encoder, which encodes it before RF transmission, On the other end, the data is obtained wirelessly via RF 433 transmitter. By guiding to the following circuit diagram, the components, and technique of the transmission and receiver circuit is examined and the working is illustrated completely.

2.Literature survey

Creation of an accelerometer-based hand gesture recognition sensor for controlling robot arms remotely. Utilising an accelerometer, this paper hand gesture sensor measures motion. An accelerometer, a sensor placed to the operator's hand, is used to record the operator's hand position when operating a gesture-controlled vehicle.[1]

Accelerometers are integrated into the gloves as sensors to translate changes in hand position into radio signals that the CPU can understand and use to carry out the commands.[2]

This procedure is built upon three steps. The first step is locating the hand region. The second step entails detecting the hand position, which includes locating the centroid and major axis. The transmitter then determines the hand position and transmits it to the robot car's receiving circuit.[3]

3. Block Diagram

Transmitter Circuit

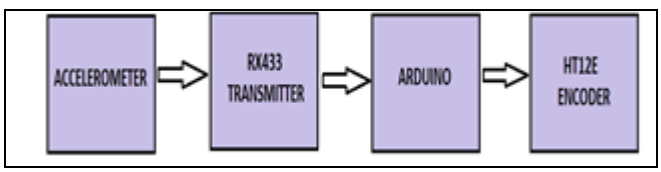

Figure 1: Transmitter Circuit

Receiver Circuit

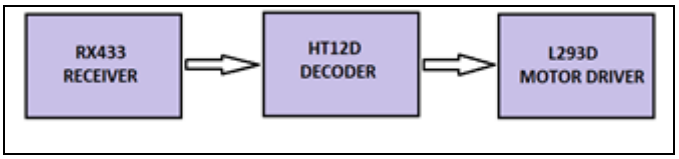

Figure 2: Receiver Circuit

4.Components Required

Accelerometer

An accelerometer is a tool used to measure a structure's vibration or acceleration of motion. An accelerometer's main mode of operation is the transformation of mechanical energy into electrical energy. This calculates voltage from acceleration and uses it to calculate vibration. meters per second square (m/s2) or G-forces (g) are used to measure it.

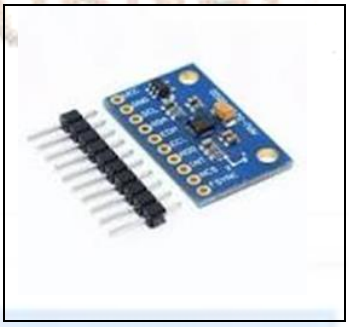

Figure 3: Accelerometer

HT12E

The 2^12 series of encoders' HT12E encoder integrated circuit. It includes an internal oscillator that just needs a modest external resistor to function and can run in a wide voltage range of 2.4V to 12V. The selected pair of encoders and decoders must share the same data format and number of addresses. It is mostly utilised for RF and infrared circuit interface.

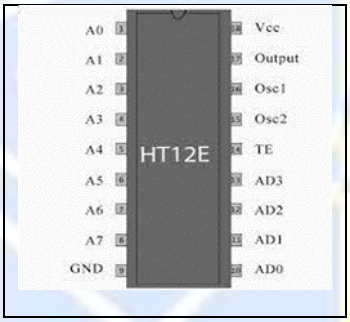

Figure 4: HT12E

HT12D

The decoder integrated circuit HT12D belongs to the 212 series of decoders. It is a CMOS LSI IC with a wide operating range of 2.4 to 12 volts. The principal applications for this line of decoders include remote control systems for security systems, vehicle door openers, and burglar alarms. Low power consumption and strong noise immunity characterise it.

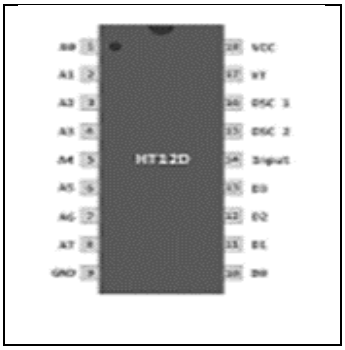

Figure 5: HT12D

Arduino Lilypad

A microcontroller board called the Lilypad Arduino USB is based on the ATmega32u4. It features nine digital input/output pins, four of which are PWM outputs and four of which are analogue inputs. It is intended for wearable projects and e-textiles. Using the Arduino Software-IDE, it is programmed.

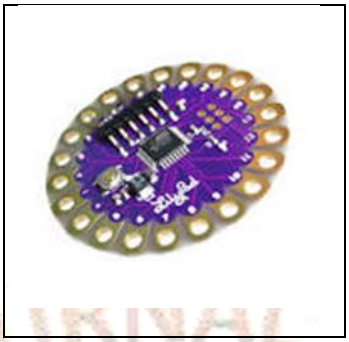

Figure 6: Arduino Lilypad

SPECIFICATIONS	RANGE
Microcontroller	ATmega168 or ATmega328V
Operating Voltage	2.7-5.5 V
Input Voltage	2.7-5.5 V
Digital I/O Pins	14
PWM Channels	6
Analog Input Channels	6
DC Current per I/O Pin	40mA
Flash Memory	16KB
SRAM	1KB
EEPROM	512 bytes
Clock Speed	8MHz

Table 1

RF Module

The term "RF" refers to the use of electromagnetic radiation for information transfer between two circuits that do not directly have an electrical connection. RF TX-RF Modules -433MHZ is the name of a pair of receiver-transmitter modules that are useful for short distances(5-6meters) wireless data transmission/ reception and control

Specification RF 433MHz Receiver:

- 433.92 MHz frequency range;
- 5 volts input

Specifications RF 433MHz Transmitter:

- Input Voltage: 3-12V;
- Frequency Range: 433.92MHz

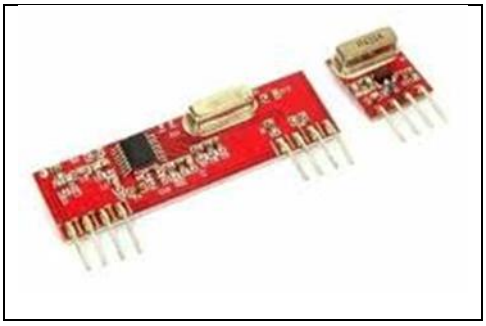

Figure 7: RF Module

Voltage Regulator

The output voltage is kept constant using a regulator integrated circuit (IC). A common integrated circuit (IC) used to maintain these fluctuations is the 7805 voltage regulator, which is a part of the 78xx series of fixed linear voltage regulators. The 7805 IC offers a regulated +5 volt power supply with space for a heat sink.

Specifications of the 7805 Voltage Regulator IC

The minimum input voltage is 7V, the maximum is 35V, the current rating is 1A, the maximum output voltage is 5.2V, and the minimum output voltage is 4.8V.

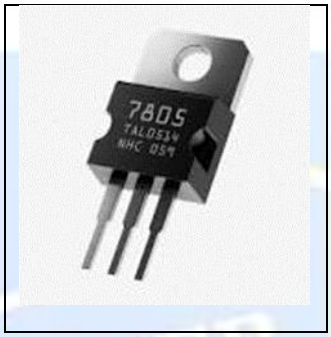

Figure 8: Voltage Regulator

L293D

A 16-pin motor driver IC called an L293D is capable of simultaneously controlling two DC motors in any direction. At voltages ranging from 4.5V to 36V, it is intended to give bidirectional drive currents of up to 600mA. It serves as an interface between Arduino and the motors and has two H-bridges.

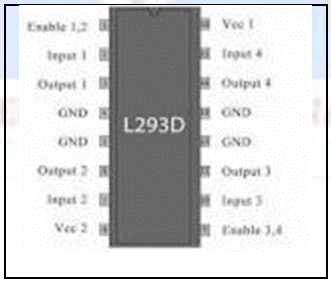

Figure 9: L293D

BO Motor

An electric motor that runs on a rechargeable battery is called a BO motor. It is ideal for creating small and medium robots since it operates between 3 and 12 volts and draws 0.01 amps at no load and 0.07 amps at maximum efficacy. Both 60 and 150 RPMs are offered.

Figure 10: BO Motor

5.Software Required

Arduino IDE

The open-source Arduino IDE is a programming environment for writing, compiling, and uploading code to Arduino microcontroller devices. It has features including syntax highlighting, a serial monitor, and a library manager and offers an intuitive user interface for programming and debugging. The IDE employs a condensed version of C++ and is based on the Processing programming language. It is frequently used to build a range of electronic projects by professionals, students, and amateurs**.**

Figure 11: Arduino IDE

6.Circuit Diagram

Transmitter Circuit

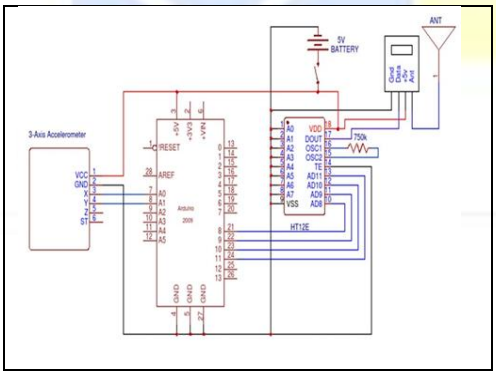

Figure 12: Transmitter circuit

Receiver Circuit

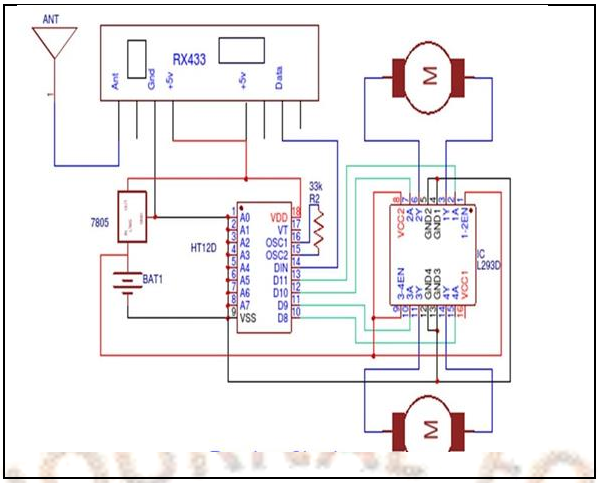

Figure 13: Receiver Circuit

7.Working

The working principle of a hand gesture control robot using Arduino Lilypad, accelerometer, RF module 433, encoder, and decoder can be explained as follows:

- The accelerometer is a device that measures acceleration forces in three axes - X, Y, and Z. The accelerometer is connected to the Arduino LilyPad.
- A microcontroller board called the LilyPad is based on the ATmega328P. The accelerometer measurements are read by the software, which then processes them to identify hand gestures.
- The RF module 433 is used for wireless communication between the LilyPad and the robot. The encoder is connected to the LilyPad and encodes the data to be transmitted wirelessly, while the decoder is connected to the robot and decodes the received data.
- The robot is equipped with motors that are controlled by the decoder based on the received data from the RF module 433.
- To control the robot using hand gestures, the LilyPad reads the values from the accelerometer and recognizes the hand gestures based on the patterns of the acceleration forces. The LilyPad then encodes the recognized gesture and transmits it wirelessly using the RF module 433.
- The decoder on the robot receives the encoded gesture and decodes it to determine the corresponding action to be taken. The decoder then sends the control signals to the motors to move the robot in the desired direction.
- Program is uploaded in the Arduino Lilypad using Arduino IDE software to perform the transmission operation via accelerometer.

In summary, the hand gesture control robot using Arduino Lilypad, accelerometer, RF module 433, encoder, and decoder works by recognizing hand gestures through the accelerometer, encoding and transmitting the gesture wirelessly using the RF module 433, decoding the received data on the robot, and controlling the motors based on the decoded gesture to move the robot in the desired direction.

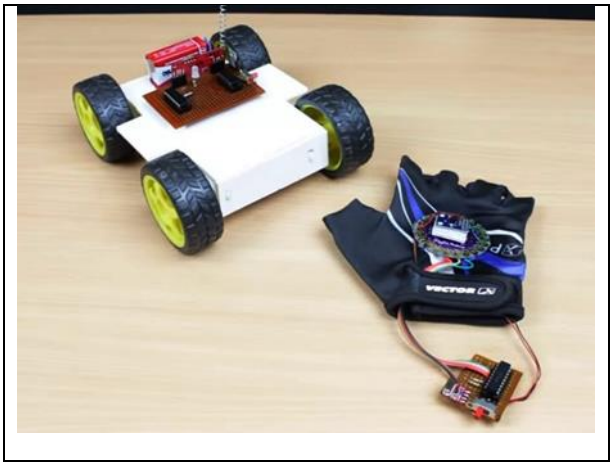

Figure 14: Gesture controlled robot

8.Future Scope

The robot is devised to have tremendous scopes in the future. The robot can be turned to for surveillance intentions and is particularly beneficial for a disabled individual, as that person can handle the control of the robot vehicle without any hardships in a wheelchair where the wheelchair can be navigated by the actions of the rider's hand. There are limitless possibilities so the technique has a lot of hereafter abilities The device which has been constructed is on the cheaper flank and is manageable to carry from one spot to another.

9.Conclusion

The system's goal is to utilize an Arduino Lilypad and the specified components for the building of the gesture-controlled car. Simple hand actions can be used to make the robot move in any path. We have worked to take this system to the level that its response to the hand motion is well stabilized. Gesticulation control is a more genuine way of operating machines making the control of robots additionally efficient and uncomplicated.

References

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