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Gesture Control Robot Using Accelerometer

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***Abstract:* - In this paper, we are introducing a robot with a gesture controlled 3-axis accelerometer (ADXL335) with an ATmega16 microcontroller. Gesture recognition is a topic which comes under the purview of the computer science, Electronics & Communication and language technologies field for the purpose of interpreting human gestures with the help of mathematical algorithms. The gestures can be interpreted from any kind of physical movement or condition, but usually arise from a person. Gesture recognition can be explained as a method by which a computer can understand the language of the human body, thereby creating a communication bridge between humans and machines than normal text based or a terminal user interfaces or even graphical user interfaces (GUIs) that still restrict most of the mouse and keyboard inputs.**

Keywords-Gesture;Accelerometer;Microcontroller;Wireless; GIU;

I. INTRODUCTION

A manual robot that controls uses gesture recognition to control the movement of the robot. Gesture recognition can be defined as the manner by which gestures acted by the user are detected and recognized by the receiver module. Gestures are just the significant movements of the body that are associated with the physical movements of the fingers, hands, face or any other part of the body. In this system, the movements of the human hands are perceived by the robot through an accelerometer. As a person moves the hand, the accelerometer also starts moving and perceives the parameters according to the position of the hand. Gestures captured by the accelerometer are sent to the comparator IC, which assigns the proper and different voltage levels according to the recorded movements. The information is then transmitted to the HT12E encoder to encode the data or serialize it, and then transmit it using the RF433 MHz transmitter. In the receiver section, the RF433 MHz receiver holds all the received parameters, and then the received data is decoded by the HT12D. According to the data received, we can control the robot using two DC motors in all four directions.

II. BLOCK DIAGRAM

A. Transmitter Module

Transmitter module consists of four components as shown in the figure. An Accelerometer is an electromechanical sensor

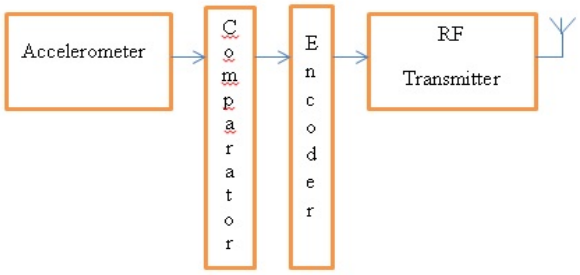

Fig.1. Block diagram of Transmitter Module

Which measures the dynamics (vibration and motion) or static (gravitational) acceleration force? It can perceive acceleration on one, two or three axes. In this system, we used the ADXL335, which is a 3-axis accelerometer. ADXl335 is a polysilicon surface microprocessor structure in which polysilicon springs suspends the structure over the surface of the plate. It also consists of a differential capacitor, which is used to measure the deviation in the structure. Any deviation in the design will unbalance the differential capacitor, leading to the output of the sensor, whose amplitude is directly proportional to the acceleration. The magnitude and direction of acceleration are measured using phase-sensitive demodulation.

The comparator is used to change the analog voltage to a digital voltage by comparing the analog voltage with the reference voltage and setting a specific high or low voltage. The radio frequency (RF) tx(transmitter) module operates at a frequency of 433 MHz and has a range of 100 m under standard conditions.

B. Receiver Module

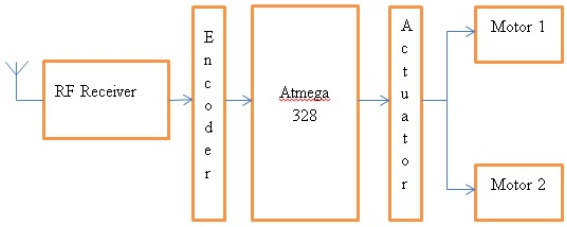

Fig. 2 Block diagram of Receiver Module

The radio frequency (RF) receiver module receives the data transmitted by the accelerometer and transmits them to the HT12D decoder. The HT12D decoder converts the received serial data into parallel data. It decodes the data only when there are no errors or inconsistent codes are found. Atmega 328 is a 28-pin high-performance Atmel 8-bit RISC microcontroller. It has 14 digital I / O pins, out of which six pins can be used as PWM outputs and six analog input contacts. It is an integrated circuit(IC) with a processor and the other support devices, such as the data memory, program memory and a serial communication interface, combined together.

III. System Implimentation

A. Methodology of hand motion Recognition

A manual accelerometer is a three-dimensional solid that can be rotated around three orthogonal axes. This rotation occurs as the X axis is called a step, and the next rotation axis Y is called roll, and the last rotation around the Z axis is called yaw. Any orientation can be achieved by drawing up these three spontaneous revolutions. In our work, all the planned manual movements for robot control are simple gestures, each of which contains only one of the three rotations of the element. Gestures consisting of more than one elementary rotation are too complex for such applications.

B. Methodology of communication signal

The RF transmitter (tx) module is a compact printed circuit board (PCB) that can transmit and modulate the wave radio waves efficiently for the data transmission. The module used for transmitting the radio waves is implemented together with a microcontroller that will provide data to the module. Radio frequency transmitters are usually subjected to the regulatory requirement that dictates the maximum permissible transmitter output power, the harmonics and the band edge requirement. The RF433-RX radio frequency receiver module is a 433 MHz radio frequency receiver, receives a modulated radio signal, and then demodulates it. The super regenerative modules are usually having small cost and power, and use a series of amplifiers to extract modulated data from a carrier wave. Modules with super regeneration, as a rule, are inaccurate, since their operating frequency varies in significant volumes at the supply voltage and temperature. The super heterodyne receiver has an advantage over super-regenerative, provide more accuracy and higher stability over a wide range of voltages and temperatures. This stability comes from the fixed design of the crystal, which finally leads to a relatively more costly product. A radio receiver that receives the transmitted encoded data from a remote location digitizes the code and transfers it to the pin number 2 of microcontroller as an output. It's a pin of the built-in microcontroller's art. Based on the codes given as input, master microcontroller give the command to the slave microcontroller, and the robot could move forward and backward. It could turn left or right while moving in forward or reverse direction. And in case of bump, it will move backward and wait for the next instruction.

C. Methodology of identifying Obstacles

Ultrasonic measurement module HC-SR04 is used to detect obstacles and determine the range of obstacles from the robot. The ultrasonic sensor consists of two parts: one is a transducer creating an ultrasonic sound wave with a frequency of 40 kHz, and the other is for listening to an echo. This robot has 3 mutually perpendicular ultrasonic sensors covering three directions. HC-SR04 has four contacts - ground, Vcc, trigger and echo. The ground pins and Vcc sensors are connected to ground and 5 V contacts on the Ardiuno board respectively, while the trigger and echoes are connected to any digital I/O terminal on the Ardiuno board.

To create an ultrasound, one needs to set Trig to high state for 10 µs. This will send the Eight-stroke sound pulse that will move with the sound of the speed, and thus it will be received in the echo buffer.

IV. Components Testing

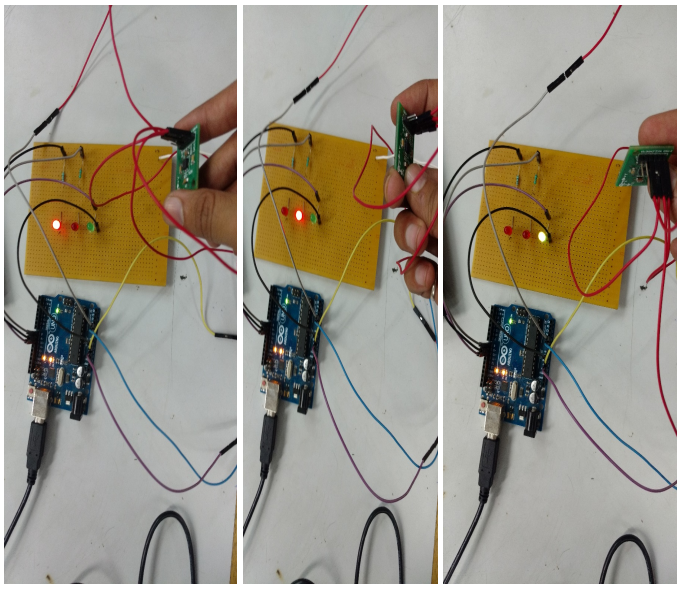

Fig. 3 Testing of Accelerometer

The Accelerometer ADXL335 was tested using an Ardiuno microcontoller and three LEDs. As shown in Fig. 3, the LED lights up according to the movement of accelerometer and ensuring proper working of ADXL335 module.

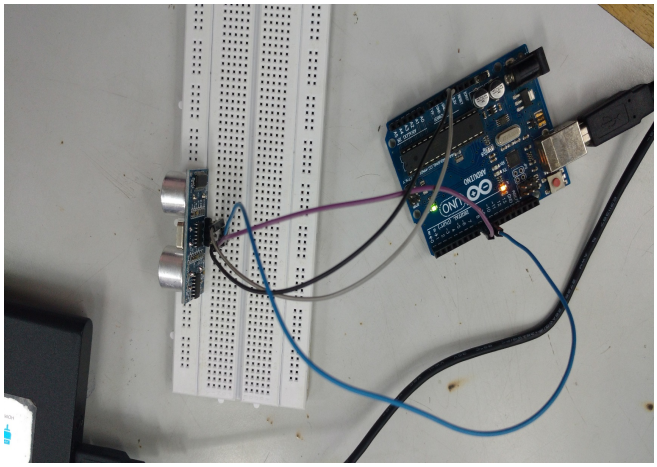

Fig. 4 Testing of Ultrasonic Sensor

V. Results

In the paper, a hand-gesture controlled interface for navigating a car robot is introduced. A user can be able control the car robot with the gesture of his or her hand. The output of the three coordinate axis i.e. x, y and z is displayed on the screen when simulated on simulation software. When the accelerometer was tilted towards the x-axis, the value of x-coordinate changed, similarly when the hand was tilted towards y and z-axis, the values of both the axis was also changed. The change in the values of the coordinates of the x-axis, y-axis and z-axis made the robot turn in desired directions. The path between the hand module and robot module was made by a transceiver circuit.

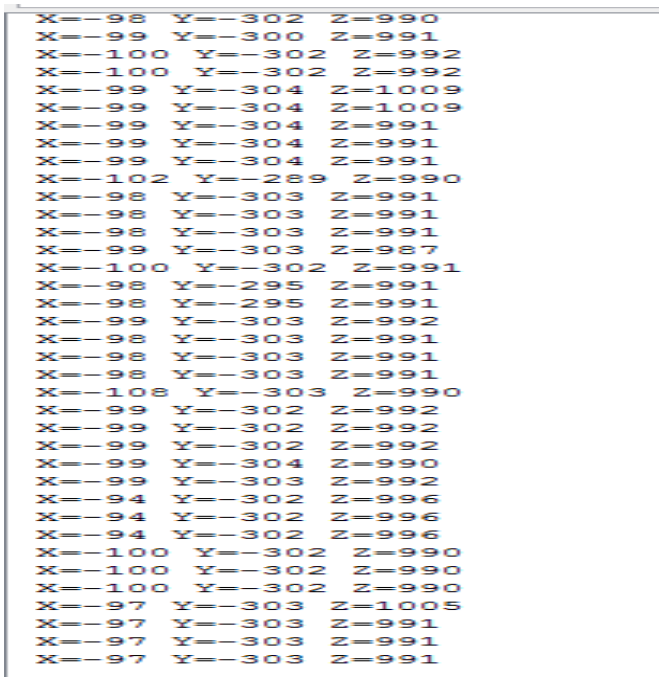

Fig. 5 Output of Accelerometer

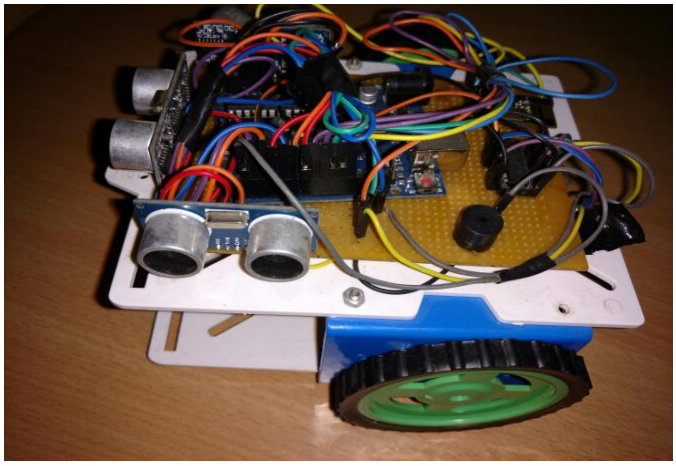

Fig. 6 Side view of Robot

VI. Conclusion

In the paper, we have suggested a prototype of a robot based on “Human Gesture Recognition”, i.e. to control of a robot using gestures, without any complication. The robot moves in accordance with 3-axis accelerometer, which is the input device of the system and captures the human hand gesture. The ADXL335 accelerometer is a robust and easy to use input device. It reduces the physical hardship of user and provide user with an ability and freedom to maneuver the robot in desired direction. Along with successfully using accelerometer in the robot, we have also employed ultrasonic sensors which would help a user to detect any obstacle in his/her way and also provide the distance of obstacle from the robot. In this age of technology where humans and machines are working together to take technology to the next level, such type of prototype could play a vital role in various fields and pave the way for future generation.

VII. Future Scope

The future of gesture controlled technology is very promising. The gesture controlled robots can be used in various applications such as by surgeons in medical surgery. One of the biggest challenges world is facing today is proving a better world to handicapped people. This technology is expected to make their life easier. The gesture controlled robot module can be used in wheel chairs of physically challenged people, promising a better life to physically disabled .It also has Entertainment applications. Video gaming will become more interesting and creative with the help of hand gesture control technology. Gesture controlled robots has a potential in growing market all around the world.

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