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Hand gesture Controlled Robotic Vehicle

Mebandonbok Wanninag, Dhiru Pfuzhe, Saurav zaman
B.Tech/Department of ECE Assam down town University, Guwahati, India
B.Tech/Department of ECE Assam down town University, Guwahati, India
Assistant Professor Department of Electronics and Communication Engineering,Assam Downtown University, Guwahati, India

Abstract: *In the modern technological age human-machine interaction is widespread and new technology being invented and improved on a regular basis that rapidly aid in human thriving, survival and health. This paper is our little contribution towards helping humanity progress in the modern era. This paper deals with design, construction and implementation of an accelerometer based hand gesture controlled robot controlled wirelessly using a small 3axis accelerometer. We have controlled the movement of robot with normal hand gesture. The project is divided into two main parts the transmitter section and the receiver section. The transmitter transmits the appropriate signal which will be received by the receiver. Accelerometer is connected to Arduino board, which is programmed to take analog readings from accelerometer and transmit them with the help of RF transmitter to the receiving unit. The programming is done in Arduino board with the help of the software Arduino IDE*

Keywords—*adxl335, 433 MHz RF module, L298N, arduino uno R3*

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I. Introduction

Robots serves great purpose in human lives whether directly or indirectly and we are always dependent on them on a daily basis and without them life would become more tedious and difficult as it would slow as down as a species and we would be busy most of the time. But robots have done many works for us in the food manufacturing, clothes manufacturing and machine manufacturing etc which saves us a huge quantity of time and now more than ever we have too much free time which needs to utilize for the progress and development of human species. Our aim in this project is to offer our small contribution towards the building of this project for the purpose of being able to help people in the not so distant future.

In this project the robotic vehicle is controlled by the gestures of our hand and depending on the orientation and angle of our hands we can programme which orientation and angle should be corresponding to which direction we desire. The sensing of the hand movements can be sensed by accelerometer which is the adxl335. As the person moves their hand, the accelerometer also moves accordingly sensor displaces and this sensor senses the parameter according to the position of hand. In this system, the hand gesture is measured and captured by the adxl335 and is processed by microcontroller software and the parameters are sent to microcontroller, It is further transmitted (transmitter section) by RF433 MHZ transmitter. In the receiver section, the RF 433 MHZ receiver holds down the received parameters and process with microcontroller and gives those parameters to the robotic vehicle so that it act accordingly to the gesture. Hence we can achieve long distance transmission without the use of wires which is a remarkable accomplishment.

II. Related work

Balaji Sivakumar, Pravin kumar, Bhuvaneswari Balachande [1],Design of Hand Gesture Controlled Robot using Arduino Lilypad. In this paper the signal transmission through radio frequency has better capacity in comparison with Infrared and the utilization of RF allows the transmission of the signal through longer separations and furthermore signal can travel even in the presence of obstruction between the transmitter and the receiver. The working of the transmitter and the benefit and the efficiency is 433 MHz and Radio transmitter recipient through the receiving antenna. The information being transmitted through the radio wire and the receiver accepts the information and changes over to unique type of sign and move to engine driver and engine driver works the engine according to the client hand movement.

Arkaprabha Lodh, Debopama Ghosh , Debosama Ghosh [2] Accelerometer and Arduino Based Gesture Controlled Robocar. In this paper, an automated robotic vehicle has been developed which works corresponding to the different hand gestures of the user. The robot moves wirelessly according to palm or hand gesture. The RF module is used which works on the frequency of 433 MHz which has a range of 50-80 meters. It further stated that the upgradation of this robotic vehicle can be made possible to detect life signs of human being or pets

trapped in rubble due to earthquake and landslide by implementing appropriate sensors accordingly. Furthermore it can be upgraded to detect explosives as a bomb detecting robot as it has robotic mechanical arms that can lift the explosives and GPS can be added to the robot to track its location

Viren Sugandh [3] HAND BASED GESTURE CONTROLLED ROBOT. This paper stated that the robotic vehicle uses image processing to detect the hand gesture of the user and act on that information to move the robot. . The webcam sent individual frames and the gesture recognition algorithm was processed on them and instruction based on certain gestures of hand was performed, since the main application was to control the robot equipped with sensors, the instruction set was limited. In this paper the instructions were sent from the laptop to the robot through WiFi using WiFi module. The images were processed and then the corresponding instructions were sent as a file through HTTP port 80 to ESP8266 Wi-Fi microchip. The Wi-Fi microchip and the Arduino were connected through FTDI programmer. The baud rate of Arduino was set at 9600.The sensors were added to demonstrate the application of gesture controlled robot in places where smoke has been generated thus it will be able to indicate the level of poisonous gas present as well as the temperature of the surroundings. Arduino IDE was used to program Arduino to control the movement of the motors and take the readings from the sensors. The CO gas sensor was MQ-7, it was calibrated and the readings were were verified with known values of CO levels. GSM module was to send message in case the reading was higher than the normal limit.

Dushyant Singh, Riturvanjali Singh, Neelam Sharma, Sagar Shrivastav , and Ashutosh Mittal [4] Hand Gesture Based Wireless Controlled Robot. In this paper a robotic vehicle is controlled using a accelerometer in the four directions left, right, forward and backward.this project include wireless camera (night vision) which is use to send audio video signal up to 30 meter, and human motion sensor working on the principle of infrared it detect 790 nanometer wavelength from human body. This paper describes non specific person gesture recognition System by using MEMS accelerometers. The recognition system consists of sensor data collection, segmentation and recognition. The acceleration data is received from the sensing device, where an algorithm is applied to determine the starting and end points of every input gesture automatically

A MEMS Based Single Arm Robotic System [5] B. Suresh Ram , Chitti Babu. In this paper the Robot works according to a person's hand movements and also does certain pick and place task. A Robotic ARM with Jaws is used for the pick and place purpose. This Pick and place robot is designed for this purpose. Radio Frequency technology is a communication process which ranges from 30Hz to 300Ghz. RF Transmitter and RF Receiver operates at a frequency of 434 MHz. MEMS Accelerometer Sensor and RF Transmitter are interfaced to AT89S52. DC motors are used to picking and placing objects. RF Receiver and DC motors are interfaced to LPC2148. The wireless data transmission from Transmitter Block to Receiver Block is done using RF Transmitter 434 MHz and RF Receiver 434 MHz.

Rasveen, Mayank Sautiyal, Priyanka Gusain [6] Wireless Hand Glove Mouse. In this paper it describes about a device that serves as a wireless mouse through various simple hand gestures such as left click, right click, and drag operation rotation operation and pointing operation. The output can be observed on the screen monitor. This makes the proposed device user friendly and enhances the user interaction with computer. This devices uses accelerometer to sense the hand gestures with the help of ATMEGA 16 microcontroller. The accelerometer is mounted on a wearable hand glove. This device uses RF modules at both user side and computer side and provides wireless communication.

J. Davis, M. Shah [7] "Visual Gesture Recognition". This paper describes the method in which various hand gestures sequences are captured by developing a computer vision method all within a gloved environment. A specialised Finite state machine (FSM) was constructed as an alternative to image sequence warping. The FSM is used to model four qualitatively distinct phases of a generic gesture. The fingertips movement are tracked in multiple frames to compute motion trajectories where it is used to find the start and stop position of the gesture. 7 Different gestures are pre recorded and upon the user new gesture command the input is matched with the pre recorded or pre-programmed gestures model. Results are presented showing recognition of even gestures using images sampled at 4 Hz on a SPARC-1 without any special hardware. The seven gestures are representatives for actions of left, right, up, down, grab rotate and stop.

Tinku Acharya, Sushmita Mitra, [8] Gesture Recognition: A Survey. This paper describes the survey on the recognition of various gestures with specific emphasis on the hand gestures and also the various facial expressions. The different applications include in this are hidden Markov models, particle filtering and condensation, finite-state machines, optical flow, skin colour, and connectionist models. The major tools surveyed for this purpose includes Hidden Markov Models (HMMs), particle filtering and condensation algorithm, Finite state machines (FSMs), and Artificial Neural Network (ANNs). In this paper a vast quantity of research has been undertaken on sign language recognition, mainly using the hands and lips. Facial expression modelling involves the use of Eigen faces, FACS, contour models, wavelets, optical flow, skin colour modelling, as well as a generic, unified feature-extraction-based approach.

Stefan Waldherr, Roseli Romero Sebastian Thrun [9] A Gesture Based Interface for HumanRobot Interaction. In this paper it describes a human-robot interaction using a vision-based gesture interfaced. An adaptive colour-filter and two alternative methods for recognizing human arm gestures: pose template matcher

and neural-network based method is used for this approached. To recognised variable-length motion gestures from streams of feature the Viterbi algorithm was used. The interface has been integrated into a mobile robot navigation architecture, where it was evaluated in the context of a mobile manipulation task cooperatively carried out with a human instructor.

P. Ravi Teja B. Tech Student B. Tech Student A.V. Mythra Varun Vivekananda Reddi [10] Biomimetic Robotic Arm with Gesture Control Interface. In this paper the replication of the movements made through the gestures of the human arm by the robotic arm is achieved. This was achieved through the seamless connectivity between the transmitter and the receiver section. The project had been fulfilled with an interface being created that can be used, according to the program being run in the microcontroller, to either replicate the movements of the human arm.The robot arm is operated accordingly by servo motors. The wireless signal transmission is executed through the use of Zigbee transmitters working at a frequency of 2.4GHz. All of the computing is performed on the P89V51RD2 microcontroller.

Benjula Anbu Malar M B, Praveen R, Kavi Priya K P [11] Hand Gesture Control Robot. In this paper it describes the design of a basic robotic chassis which can be controlled through the help of accelerometer instead button control. The accelerometer is the 3 axis estimation gadget with +-3g range.. The outcome of the accelerometer is analog in nature and corresponding to the acceleration. This gadget measures the static acceleration of gravity when it is tilt and gives an outcome in type of movement or vibration. The hand position is sensed and the coordinates generated is considered as the parameter and if neccessary conditions are met, the statement prescribed in the arduino code is executed and the direction of the robot chassis is changed accordingly So that it can perform the task such as forward moving, backward moving, turning left, turning right and stop.

III. Block Diagram

The project can be divided into two parts with each part performing different functions. The following is a block diagram of the transmitter part and the receiver part.

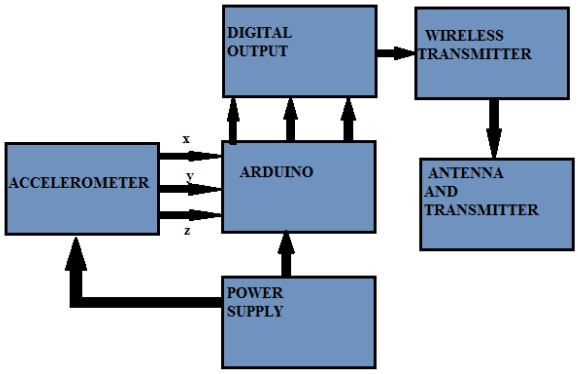

Fig: 1. Block diagram of transmitter module

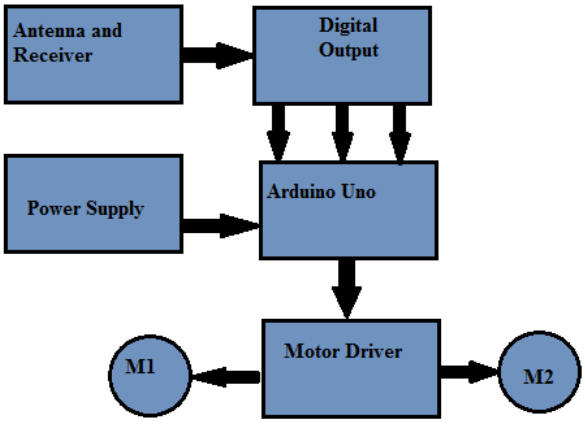

Fig: 2- Block diagram of receiver module

IV. Circuit Diagram

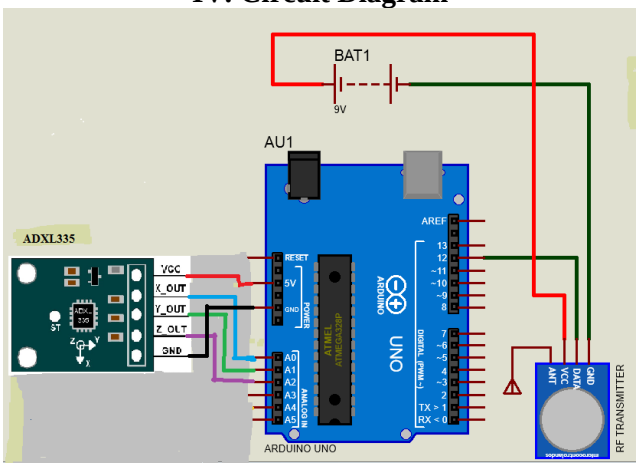

Fig: 3: Circuit diagram of the transmitter section.

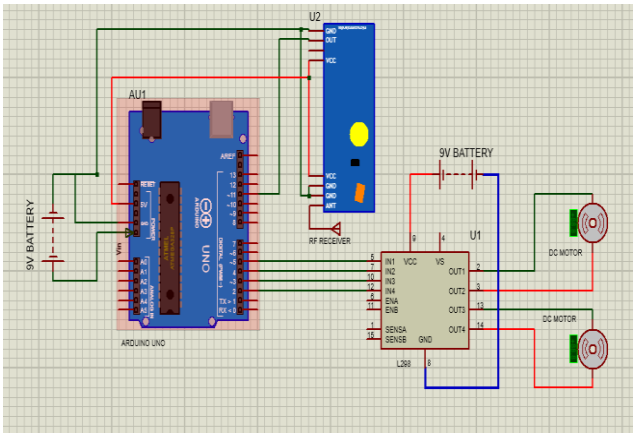

Fig: 4: Circuit diagram of the receiver section

V. Working Principle

The accelerometer is tilted in various directions and inclinations and on reading the inclinations the robotic vehicle moves in the required direction with respect to the accelerometer inclination. When the accelerometer is tilted in the forward direction (Fig:4) the robotic vehicle moves forward and on tilting the accelerometer at angle parallel to the ground it the vehicle will stop (Fig 5). On tilting in the backward direction (Fig 6) the vehicle will move in the backward direction. When we tilt in the left (Fig 7) or right (Fig 8) the robotic vehicle will move towards the left or right respectively.

The various inclinations in the accelerometer is programme into the arduino and upon performing the various gestures or inclinations the arduino will transmitted this information via the 433 RF transmitter to the 433 RF receiver where the information is processed in the other arduino to performed the required movement operation.

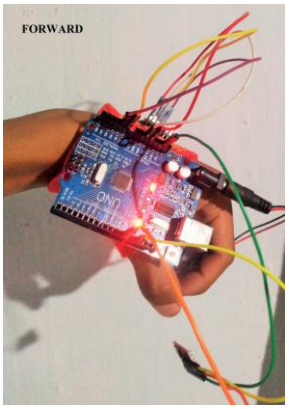

Fig: 4. Forward gesture orientation

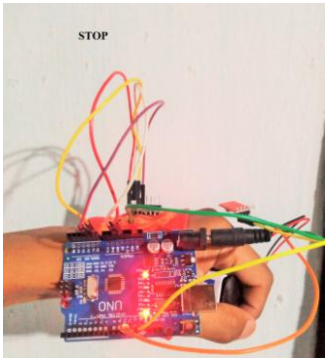

Fig: 5. Stop gesture orientation

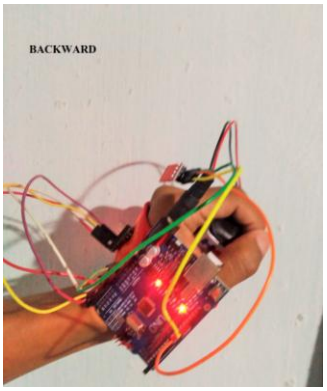

Fig: 6. backward gesture orientation

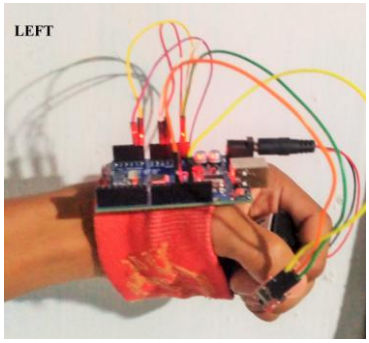

Fig: 7. Left gesture orientation

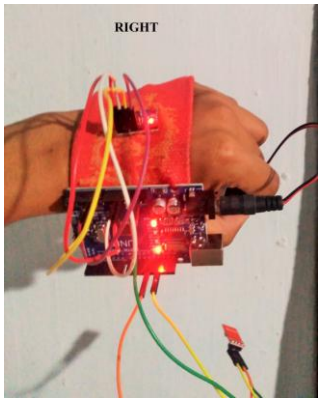

Fig: 8. Right gesture orientation

L298N	Left motor forward	Righ tmotor baclward	Left motor backward	Right motor forward
Forward movement	1	0	0	1
Backward movement	0	1	1	1
Left turn	0	0	0	1
Right turn	1	0	0	0
stop	0	0	0	0

VI. Implementation Of Hand Gesture Controlled Robotic Vehicle

A. Software implementation

The program is written in Arduino Integrated Development Environment (IDE). The version used for this project is 1.8.9. It connects to the Arduino hardware to upload programs with the help of a cable. We should note that before uploading the program algorithm there is a need to select appropriate Microcontroller to, "Arduino Uno" from the Tool menu. And for proper serial communication with computer and Arduino Uno boards there is a need to select appropriate COM port from the Tool menu.

B. Hardware implementation

This paper consists of the following hardware components.

1. **Arduino uno**- It is a microcontroller board based on ATmega328 which has 14 digital I/O and 6 analog pins. It is a revolutionary device that offers flexibility of use for the hardware and software. Arduino can receive input from a variety of sensors that is connected to it and can perform operations through other output device.
2. **Accelerometer**- The ADXL335 is a small, thin, low power, complete 3-axis accelerometer with signal conditioned voltage outputs. It has 6 pins. 3 pins are for X, Y, Z axis. First pin for power supply (VCC), second pin for ground (GND) and the last one for self-test (ST). It operates on 3.3V from the Arduino Uno board. It can measure the static acceleration of gravity from tilt sensing applications as well as dynamic acceleration resulting from motion, shock or vibration and gives corresponding analog values through X,Y,Z axis pins
3. **433 RF Transmitter and Receiver Module**-RF module is available in different operating frequencies and with different operating range. We have used 433 MHz RF Tx/Rx module.. It can transmit the signal up to 500 ft of range at rate of 1 Kbps to 10 Kbps.
4. **L298N**- It is an integrated monolithic circuit in a 15- lead Multiwatt and PowerSO20 packages. It is a high voltage, high current dual full-bridge driver designed to accept standard TTL logic level sand drive inductive loads such as relays, solenoids, DC and stepping motors. Two enable inputs are provided to enable or disable the device independently of the in-put signals .The emitters of the lower transistors of each bridge are connected together rand the corresponding external terminal can be used for the connection of an external sensing resistor. An additional Supply input is provided so that the logic works at a lower voltage
5. **Battery Operated (BO) Motor**- DC motor (BO) Battery Operation. Dc motor converts electrical energy into mechanical energy. Why DC gear motor used in robot Motor control circuit. DC Motor concept is where gears reduce the speed of the vehicle but increase its torque is known as gear reduction. In DC motor is assembled with multiple gear setup. Speed of motor is counted in terms of rotations of the soft per minute is called RPM. RPM means Revolution Per Minute.In any DC motor, RPM and Torque is inversely proportional. In all DC gear motor PWM Pulse Width modulation circuit is used

VII. Results

A gradual bit by bit approach is adhered to in designing the arduino based system for the hand gesture controlled robotic vehicle. The finished product is shown in the figure 9 and 10.

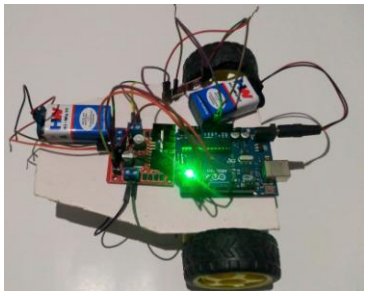

Fig: 9. Receiver section

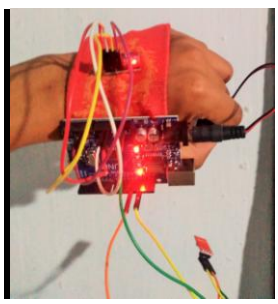

Fig:10. Transmitter section

VIII. Conclusion

After working on this system we can conclude that when user moves his hand in Left, Right, Down, Up then accelerometer detect variations and send particular signal to the Arduino board and that signal sent to the receiver part of the system then based on transmitted signal robot moves in the direction desire. In this paper, a programmed component has been built up that works in accordance with our hand signal. The RF module is operating on the frequency of 433 megahertz and can operate within a circumference of 20-40m approximately and with the increase of distance from the receiver module the transmitter module consumes much energy from the 9v battery. Like any other project difficulties are always there and overcoming them has been difficult for some and easy for others and experiencing them has made me respect the works other people have undergone towards more complex projects. This project offers great potential for future upgradation and development to more complex robotics vehicles potentially bomb disposal robot, robotic vehicle with arm for picking and placing and many other endeavors.

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