ACCELEROMETER BASED HEAD GESTURE CONTROLLED WHEELCHAIR FOR ASSISTANTSHIP OF PHYSICALLY DISABLED PEOPLE

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ABSTRACT

This paper describes a system of an assistantship for physically disabled people to overcome the problem of mobility via head gestures. A sensor such as an accelerometer is used for the detection of the head gesture. And with the help of the detected gesture, physically disabled person will be able to control the wheelchair in a particular direction. The system consists of two main circuits, one at the transmitting end and the other at the receiving end. The transmitting circuit consists of an Accelerometer interfaced with the Atmega Microcontroller. And this transmitting circuit is integrated into a hat. A hat is easy to carry and use, so we have selected Hat for integrating transmitter circuit. So, the physically disabled person has to wear the hat on his head to make the gesture.

Keywords: Accelerometer, Gesture, Head, Micro Electromechanical System(MEMS), Wheelchair**.**

1. INTRODUCTION

In the modernized age, the automaton is becoming controlled in a variety of ways. Assessing it through gesture is a part of it, and in the event, the wearable tech is integrated, then it becomes much brighter, efficient and straightforward to use. The purpose of the work is to offer simple to use medical aid for people who are physically disabled, using a gesture-controlled medical aid system. Even though the range of this job is not confined to just medical discipline, it may be utilized in the military area and significant industry. As mentioned earlier, any artificial medical aid ought to be simple to use, and if it is connected with the individual, i.e. when a patient should take it to acquire the support, it needs to be simple to carry. Our job fulfills the grade [1].

Formerly several functions [2-4] are reported on a motorized wheelchair with gesture management. The heretofore proposed systems utilize heavy and bulky transmitter components, which is not in any way easy to transport, so makes it tough to use. In our work, we've utilized Atmega 328P. E-textile becomes comfortable with Atmega 328P. Therefore, it becomes appropriate for wearable technology, which consequently makes the entire transmitter part quite lightweight. Everyone can sew the microcontroller into a sheet of fabric and use it to produce the gesture. Altogether it makes the transmitter area simple to carry, simple to use, thinner and thinner compared to the systems formerly suggested [5].

The quantity of individuals, who should maneuver around with the assistance of an artificial means, because of an accident or illness, is always increasing. It signifies of the locomotion needs to be sophisticated & cost-effectively operate to be able to boost their wellbeing and strengthen their integration in their functioning world [6].

2. LITERATURE REVIEW

A variety of approaches have been suggested for enabling disabled persons, such as a person with quadriplegia to control a motorized wheelchair. There are stated methodologies in recent instances that demand different gestures such as touchscreen & voice controlled, hand gesture, and EEG established program.

A. Touchscreen and Voice Controlled System

This work relates to a wheelchair for the physically disabled people. It has a MEMS motion detector along with voice recognition kit. An individual determined voice recognition system have incorporated into the wheelchair. This way they had got a wheelchair which can be pushed using both voice and motion commands [7].

B. Hand Gesture System

This paper involves the data coming from the accelerometer to comprehend the movement of hand gestures and transfer the gesture data which suggests the specific motion commands to the smooth movement of the wheelchair. It is a trial strategy to see the live interaction for the disabled and older using the wheelchair throughout the hand gestures [8].

C. EEG System

This system suggests two control modes: Utilization of this gyroscope Emotive EPOC headset to detect head moves. Emotive EPOC headset is a system that steps EEG activity from 14 saline electrodes. These electrodes are organized based on the 10/20 system, and their places are FC6, F4, F8, FC5, T7, P7, AF3, F7, F3, O1, O2, P8, T8, and AF4 [9].

3. BLOCK DIAGRAM OF OVERALL WORK

The general working principle of this work is introduced with the next block diagram in Fig 1. The comprehensive work has mainly two components one transmitter segment and another receiver segment.

In the transmitter section, an accelerometer is interfaced to the Atmega328P. As stated by the gestures input the output changes. Those values are then encoded with encoder and transmitted via the RF transmission module attached to it.

The recipient section is included of the RF receiver module, motor driver, decoder and motors. The obtained values are subsequently decoded with the decoder in the receiver end. In accordance with this, the motion of wheels is controlled via the motor driver IC that's attached with the DC motors.

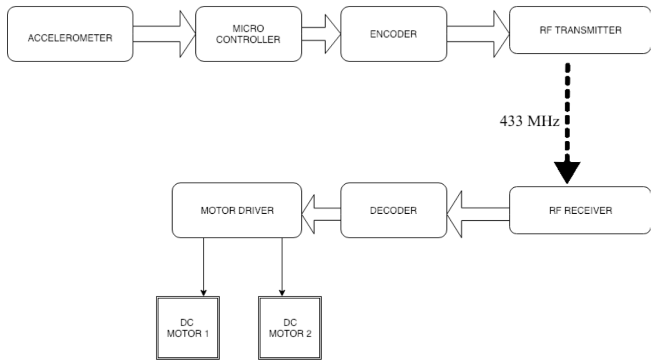

Fig 1 Block diagram of the complete work

4. TRANSMITTER SEGMENT

The transmitting segment consists of four components such as Accelerometer, Microcontroller, Encoder, and Transmitter RF Module.

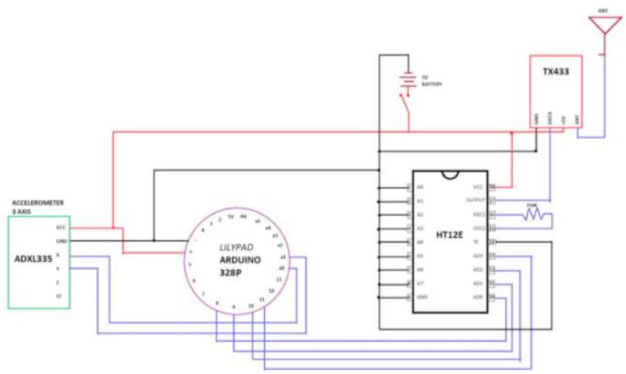

Fig 2 (a) Transmitter segment circuit diagram

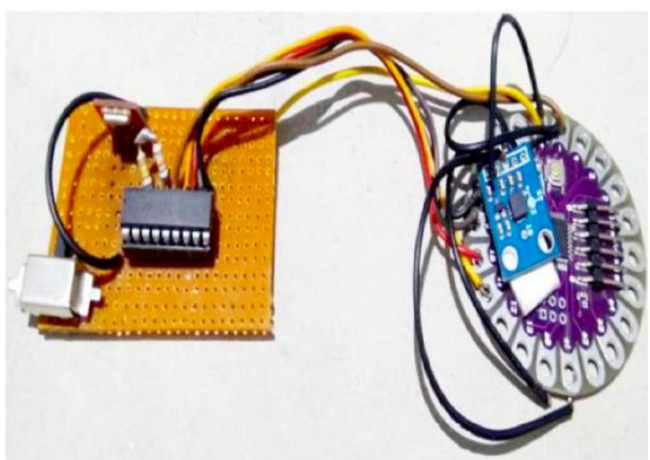

Fig 2 (b)Transmitter segment implementation

The Accelerometer is an electromechanical tool that estimates the speed of an item across the 3-axis or several axes. It finds position, velocity, vibration, and orientation of an element. Here we've utilized ADXL335, which offers X, Y, and Z coordinate of the related object. The Y and X coordinate has been utilized in this task to discover the gesture that's fed into the microcontroller. We've employed Atmega 328P microcontroller [10]. The commanding gesture algorithm was written on Arduino IDE. Afterward, it's been uploaded into the microcontroller. After obtaining X and Y coordinate in the accelerometer, the microcontroller sends the choice in electronic format into the encoder. The encoder HT12E is utilized in this work. We have utilized a 433 MHz transmitter-receiver module to produce the data transmission procedure wirelessly. The circuit of the transmitter section is displayed in Fig 2 (b).

5. RECEIVER SEGMENT

The receiving segment consists of 5 components such as Receiver RF Module, Motor Driver IC, Decoder, Voltage Regulator, and DC Motors, displayed in Fig 3 (a).

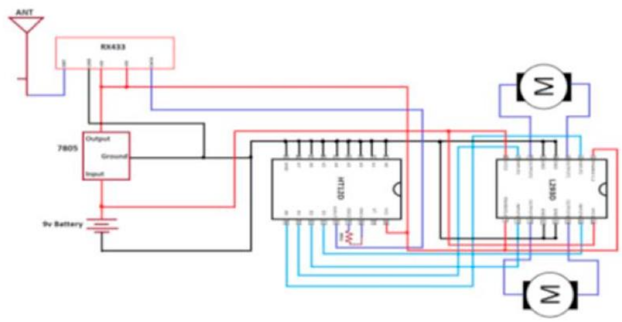

Fig 3 (a) Receiver section circuit diagram

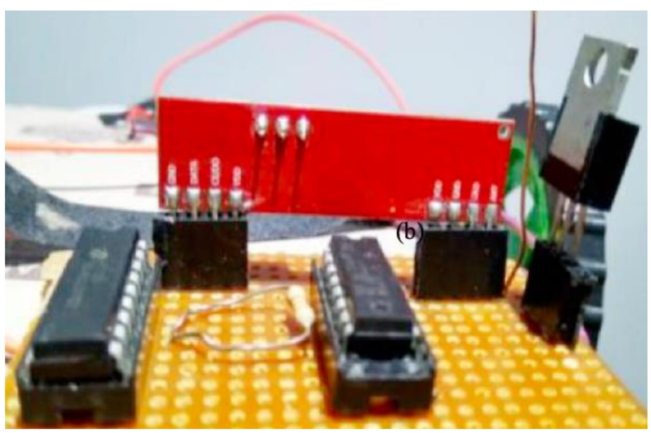

Fig 3(b) Receiver segment implementation

The receiver module gets the analog signal in the transmitter and sends it to the decoder via 'DATA' pin. We have utilized HT12D decoder. The serial data obtained from the receiver module is compared with the address bits, and if it gets matched, the collected information gets decoded. It transforms the analog signal to digital signal and sends it to the motor driver IC. Pin VT generates a high signal on legitimate data transmission. The motor driver IC L293D includes two H-bridge driver circuit inside that helps to push two motors in two directions, i.e. clockwise and anti-clockwise simultaneously.

a. Interfacing of Motor Driver with Microcontroller

Movement of the engine based on the log inputs is displayed in table 1. Here complete four DC motors were utilized and also for driving the motors, a motor driver IC L293D was used [11].

Table-1: Movement of Motor according to input logic

Input Logic	Movement
00	STOP
01	Move Clockwise
10	Move Anti- Clockwise
11	STOP

As stated, motor driver L293D has used for driving the motors. L293D is a 16PIN IC in which two DC motors have connected to PIN 3, 6, 11, 14. And L293D motor driver is connected to Atmega 328P microcontroller.

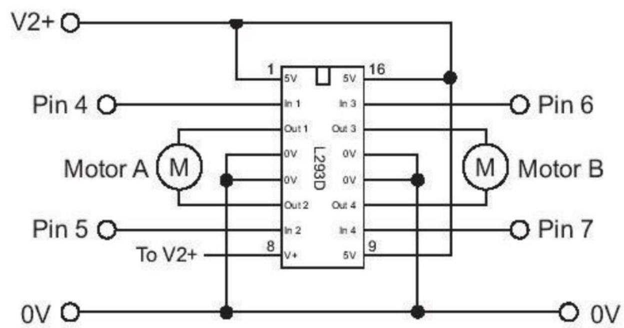

Fig 4. Schematic diagram of motor driver circuit

6. SOFTWARE IMPLEMENTATION

The software part is carried out in Arduino IDE. The flow graph of the comprehensive software implementation is provided in Fig 5. After all of the initializations, accelerometer transmits the coordinate values in line with the gestures. A gesture algorithm [12] is subsequently implemented at which the specific values of x and y coordinates are assessed, and accordingly, the choice is made, whether the medical aid system ought to be moved forward, backward, right, left or ceased [13].

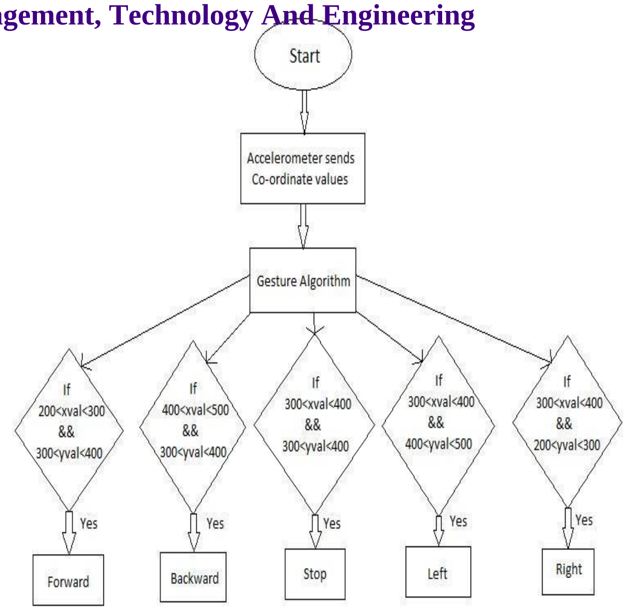

Fig 5. Flowchart of processing of signals

1. *Forward Motion*

On leaning the accelerometer, when it creates X coordinate values between 200 to 300 and Y value between 300 to 400, it sends 'HIGH' into AD0 and AD2 and sends 'LOW' into AD1 and AD3 of encoder HT12E, which moves the vehicle in a forward direction. The gesture and corresponding values of X and Y coordinate in a serial monitor of ARDUINO IDE are exhibited in Fig 6 respectively.

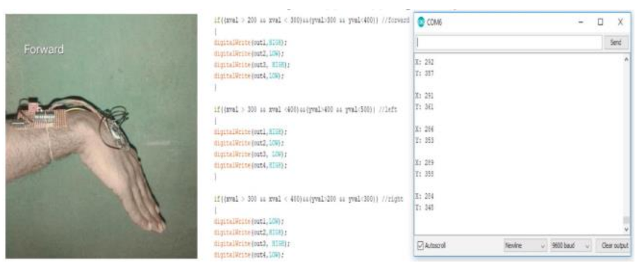

Fig 6. Gesture and co-ordinate value of the forward motion

2. *Backward Motion*

On leaning the accelerometer in the opposite direction, when it creates X coordinate values between 400 to 500 and Y value between 300 to 400, it sends 'LOW' into AD0 and AD2 and sends 'HIGH' into AD1 and AD3 of encoder HT12E, which moves the vehicle in a backward direction. The gesture and corresponding values of X and Y coordinate in a serial monitor of ARDUINO IDE are exhibited in Fig 7 respectively.

Fig 7. Gesture and co-ordinate value for backward motion

3. Stop

If the accelerometer is placed in parallel to the floor, both Y and X coordinate value ranges from 300 to 400, and it sends 'HIGH' to each of the data pins of encoder HT12E which then stops the vehicle. The gesture and corresponding values of X and Y coordinate in a serial monitor of ARDUINO IDE are exhibited in Fig 8 respectively.

Fig8. Gesture and co-ordinate value for stop

4. Left Motion

On leaning the accelerometer perpendicular to the floor, when it creates X coordinate values between 300 to 400 and Y value between 400 to 500, it sends 'HIGH' into AD0 and AD3 and sends 'LOW' into AD1 and AD2 of encoder HT12E, which moves the vehicle in a left direction. The gesture and corresponding values of X and Y coordinate in a serial monitor of ARDUINO IDE are exhibited in Fig 9 respectively.

Fig 9. Gesture and co-ordinate value for left motion

5. Right Motion

On leaning the accelerometer perpendicular to the floor in opposite direction, when it creates X coordinate values between 300 to 400 and Y value between 200 to 300 it sends 'HIGH' into AD1 and AD2 and sends 'LOW' into AD0 and AD3 of encoder HT12E, which moves the vehicle in a right direction. The gesture and corresponding X and Y coordinate value in a serial monitor of ARDUINO IDE are exhibited in Fig 10 respectively.

Fig 10. Gesture and co-ordinate value for right motion

CONCLUSION

This work professes a head gesture established wireless medical aid system for physically disabled people, with Atmega 328P. Atmega microcontroller is mainly created for e-textile function, which decreases the dimensions and weight of the easily wearable transmitter component. Outcomes of this system design are also discussed in details. As stated by the head gesture, the motors of the medical aid system could be controlled in various directions.

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