DUAL ANGLE COMPARISON FOR WHEEL CHAIR VEHICLE USING FUZZY LOGIC

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Abstract - In this paper an auto calibrated head orientation controller for wheelchairs and rehabilitation robotics application is proposed. The system use two Orientation Detection (OD) units, each unit includes three MEMS sensors: accelerometer, gyroscope and magnetometer which are combined together. The first OD Unit reads the wheelchair orientation, which is used as a reference orientation to calibrate the system performance, when the system is faced non-straight road. The reference orientation is used to cancel the changes in orientation in case of non-straight roads and also to compensate the speed in case of ascent or descent a ramp. The second OD unit is fixed on the user's head and is used to control the speed and direction of the system. The head orientation is measured using Euler angles (Roll, Pitch and Yaw).The system movement and speed control depend on the position of the user's head related to X, Y and Z axis. The system uses powerful AVR Atmega 328-PU microcontroller to perform the control of the intelligent application.

Key Words: Orientation Detection (OD), MEMS sensor, AVR Atmega 328-PU microcontroller

1. INTRODUCTION

The tilting of the head around X and Y axis is considered to a wheelchair movement in the left and right, forward, backward direction. The movement of the head around Z axis are not used by the controller in order to give the chance of moving his head all-around without affecting the control of the system. The system has the capability to regulate the speed depending on the slope of the road. Euler angles (Pitch, roll and Yaw) are used by the system to detect the head orientation. Accelerometer, gyroscope and magnetometer are the three Euler angles picked by the three MEMS sensors. The 3 sensors are combined along to create a high correct orientation sensor. The system uses 2 orientation sensors. The primary is mounted within the chair chassis to be used as a reference orientation provider. The second is mounted within the user's head to notice the pinnacle movement and provides the orientation information to the microcontroller. Compared to previous work, the conferred work is performed by using two management algorithms. Thus, the machine graduated orientation formula prevents wrong management commands to the system just in case of fixing the position of the user's head in outdoor non-straight roads. It's the pliability to perform the pinnacle movement management once the system is employed in out of doors environments with nonstraight roads. The brink management angle is changeable with the road slope. The tilting of the head around X and Y axis is considered to a wheelchair movement in the left and right, forward, backward direction. The movement of the head around Z axis are not used by the controller in order to give the chance of moving his head all-around without affecting the control of the system. The system has the capability to regulate the speed depending on the slope of the road. Euler angles (Pitch, roll and Yaw) are used by the system to detect the head orientation. Accelerometer, gyroscope and magnetometer are the three Euler angles picked by the three MEMS sensors. The 3 sensors are combined along to create a high correct orientation sensor. The system uses 2 orientation sensors. The primary is mounted within the chair chassis to be used as a reference orientation provider. The second is mounted within the user's head to notice the pinnacle movement and provides the orientation information to the microcontroller. Compared to previous work, the conferred work is performed of uses 2 management algorithms. Thus, the machine graduated orientation formula prevents wrong management commands to the system just in case of fixing the position of the user's head in out of doors non-straight roads. It's the pliability to perform the pinnacle movement management once the system is employed in out of doors environments with non-straight roads. The brink management angle is changeable with the road slope.

2. LITERATURE REVIEW

The existing present systems include hand gesture based, Joystick control, accelerometer and voice controlled systems etc. In system based on hand gesture, hand gesture information commands is required to move the wheel chair [1]. The voice controlled and accelerometer system are required to use voice identification kit and MEMS (MicroElectro-Mechanical Systems) motion sensor to create movement in the wheel chair and voice control is an important way to control the wheelchair which is done by using the Voice Recognition (VR) technology. The work of the VR technology to convert the sound wave to an electrical signal [8]. Otherwise, the head movement can also be used as a control for the wheelchair using different processes. Ultrasound and Infrared sensors were used to detect the head movement and used as controller. Other researchers used cameras to detect the head gesture as a wheelchair controller [10]. Wheel chair Automation can also be controlled via Joystick/Head-Joystick supported by Smart

Driving Assistance [2].This paper propose to control the movement of wheel chair by integrating finger movement tracking system which also includes small speaker depends on word recognition system and ultrasonic sensor for obstacle detection [3].This paper reviews smart wheel chair using android based messenger system. In this paper wheel chair is automated by android messenger application which also includes Bluetooth module and proximity sensor for controlling directions [4]. In this paper wheel chair automation is implemented using Iris Movement [7]. This paper propose an automated wheel chair which is controlled by head gesture using an accelerometer device (ADXL535) based transmitter to control the navigation of wheel chair [10]. With the help of bio signals, like EOG (Electroocculogram), and ECG (Electromyogram) can be used as a controller for a wheelchair or robotics application [5][6].

3. PROPOSED MODEL

The system's core functioning is based on use of mems sensor for the determination of different slope and that information is used up to manage the torque of the motors in use as per requirements. As far as the working of movement in all four direction is concerned using mems sensor 1 fixed in the head, it's already been discussed in Fig: 1 and Fig: 3 Overall, the system uses two orientation sensors.

BLOCK DIAGRAM

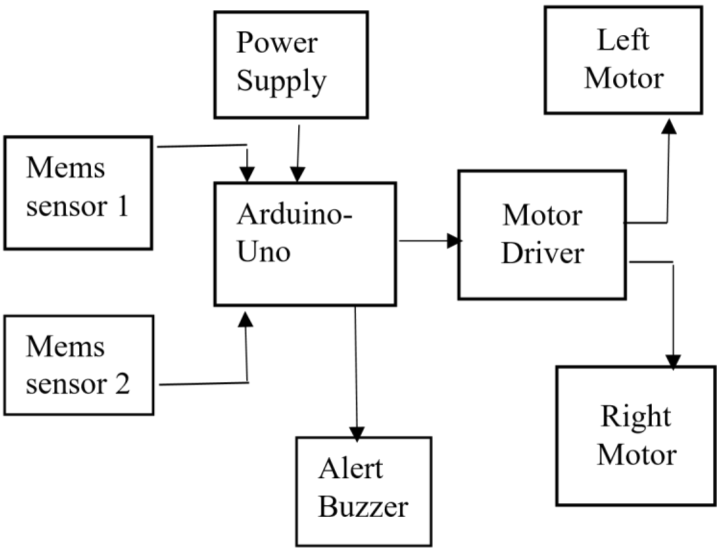

Fig 1: Block Diagram

Figure 4 mems sensor used in the Fig: 2 wheelchair chassis determines whether the slope now faced by the chair is easy to overcome or not. Based on that judgment, the system will provide necessary torque to the motors as per the requirements. The sensor 2 mounted on the chassis after reaching a certain threshold voltage (either negative or positive) will command the motors through Arduino to adjust the torque accordingly by giving different PWM values. The threshold control angle is changeable with the road slope. In the code part, standard ADC values are used to set threshold conditions. There is a specific ADC value associated with each voltage value in the mems sensor used. Since we are using Arduino, the voltage range is 0V5V and ADC value ranges from 0-1023. These two are related by the formula –

$$\frac{\text{Resolution of ADC}}{\text{System Voltage}} = \frac{\text{ADC Reading}}{\text{Analog Voltage Measured}} = \frac{1023}{5}$$

The table given below shows the different motions of the wheelchair and the ADC value of Arduino, Voltage generated by mems sensor which we can calculate by the formula and the angle of mems sensor in each case:-

Direction	Axis	ADC value	Voltage	Angle (appx)
Forward	X	< 260	1.27	deg
Backward	X	>420	2.05	deg
Left	Y	<260	1.27	deg
Right	Y	>420	2.05	deg

Fig 2: Wheelchair chasis

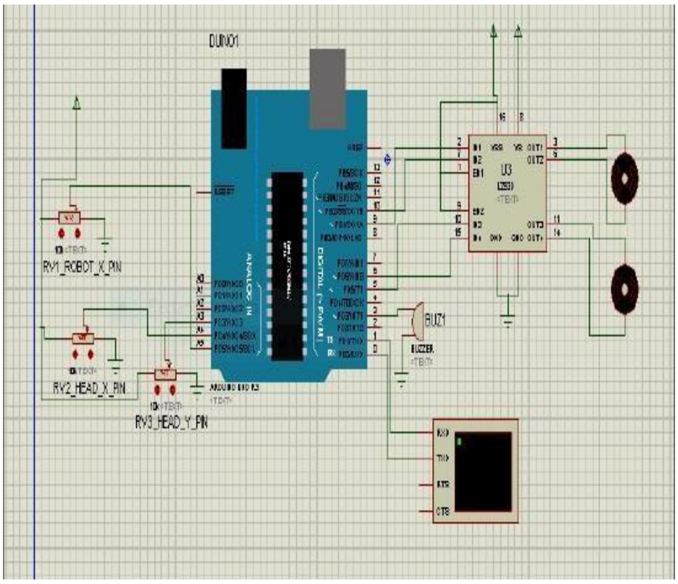

Fig 3: Circuit Diagram

Fig 4:MEMS Sensor

4. RESULTS AND DISCUSSION

When the head orients in x and y axis , the system give response quickly with minimal delay so that the wheel chair move in forward, backward, left and right Directions. System recognizes only standard gestures so as to get desired results. Any other nonstandard gestures are treated as an error sending back the calibration mode. The speed change across any kind of slope is not impulsive as the system has the ability to adjust the speed depending on the road slope.

5. CONCLUSION

The table given below shows the different motions of the wheelchair and the motor functioning in each case:-

Direction	Left Motor	Right Motor
Forward	Forward	Forward
Backward	Backward	Backward
Left	Forward	Backward
Right	Backward	Forward

For slope up and slope down condition if direction is forward then both motor will move in forward direction and if the direction is backward then both motor will move in backward direction but torque varies according to the table given below:-

Direction	Slope Up	Slope Down
Forward	High Torque	Low Torque
Backward	Low Torque	High Torque

6. FUTURE SCOPE

Furthermore instead of using wires the system can be made wireless. Health monitoring system can also be added in this system. We can add GPS module in it. The proposed model is a two wheel drive system, but it can be made into a four wheel drive system for better movement experience. The same concept can be used not only for wheelchairs, but for other vehicles as well. And if put together with wireless technology, there is a good scope to design unmanned vehicles controlled by mems sensors wirelessly.

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