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AUTOMATIC BELT CONTROLLED WHEEL CHAIR

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ABSTRACT

A Wheelchair is used for the mobilization of physically challenged people especially for those who are impaired with lower limbs and paralysed patients so on. In this work propose a wheelchair for the patients affected by DMD [Duchene muscular dystrophy] with automatic seat belt control, and adjustable handle. The automatic seat belt control unit works with the microcontroller ATMEGA 328, gyro sensor GY 521 and a motor. The sensor senses the altitude variation and sends the data to the controller, based on the variation level the controller drives the motor to fasten the seat belt. The controller is provided with a reset button to reset the height values of the chair which reduces the abnormal function of the controller. The limb raiser physically provides stimuli to the brain to recognize the presence of the certain organ which is paralysed. This works as a teaching unit for the brain about the immovable limb of the patient. The motors are operated by the 12 V battery sources which is rechargeable. The adjustable arm rest of the wheel chair enables the patient's guardian to seat the patient easily. These features are enrolled in a foldable wheelchair for easy transportation. This project also facilitates the joining of two wheelchairs. This aids the twin patients for the easy mobility.

Keywords: wheel chair, GYRO sensor, micro controller, servo motor.

INTRODUCTION

A large number of different types of wheelchair are available on the market, for the simple reason that chairs are required to fulfil a number of different functions. There are three different types of wheelchair: self-propelled, electric, and attendant-propelled. Any chair with large rear wheels is easier to push, especially up and down kerbs, than an 'attendant-propelled' chair with the small rear wheels. Therefore, users may buy, or be issued with, a standard 'self-propelled' chair solely to be pushed around by someone else. The lightest and most manoeuvrable wheelchairs on the market are the high performance chairs [2]. They have large rear wheels that can be positioned further forward than those on a standard wheelchair. As a result of this modification, weight is redistributed so that less effort is needed to propel or push this type of chair. The reduced weight is also an advantage and active user wheelchairs can be expensive. Some of the features are only available on active user chairs.

DUCHENNE MUSCULAR DYSTROPHY

DMD is a virulent and fatal muscle-wasting genetic disease. It is a genetic disorder transferred from mother to son via a compromised sex-linked X chromosome for the dystrophin gene [4]. Dystrophin is located chiefly in muscles and used for movement of skeletal, cardiac muscles and small amount of the protein is also present in nerve cells in the brain. Patients usually become wheelchair-bound by the age of twelve years and die of cardiorespiratory complications.

METHODOLOGY

The block diagram for the wheel chair with automatic belt control is shown in the Figure-1. The Gyro Sensor module used to Control the seat belt is shown in Figure-2. The sensor consists of 3 axes (x, y, z) with the digital output. In the sensor unit we can give both serial data and external data. This sensor consists of 16bit analog to digital conversion for each channel. The sensor also contains a 1024 byte FIFO buffer. The sensor values can be programmed to be placed in the FIFO buffer. And the buffer can be read by the Microcontroller. The microcontroller for the seat belt control is ATMEL 328. Gyro sensor consists of internal I2C bus the speed of the serial communication will be high and it has the internal regulator the supply to the sensor is about 3.3 volts to 5 volt.

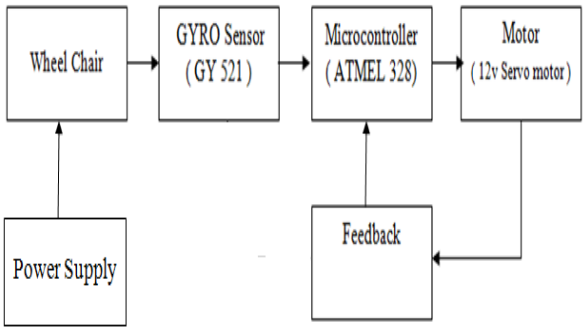
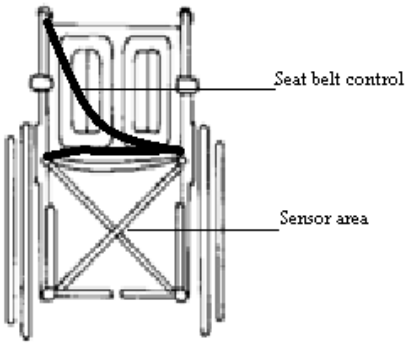


Figure-1. Block diagram for seat belt control.

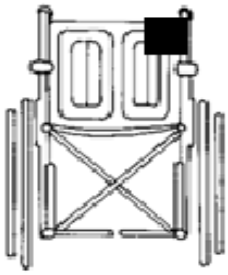
Figure-2. Gyro sensor (GY 521).

The signal from the sensor is given to the microcontroller unit. The high-performance Atmel 8-bit AVR RISC-based microcontroller combines 32KB ISP flash memory with read-while-write capabilities, 1024B EEPROM, 2KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, a 6-channel 10-bit A/D converter, programmable watchdog timer with internal oscillator, and five software selectable power saving modes. The device operates between 1.8-5.5 volts. Output signal is given to the motor unit to control the belt with the help of a feedback from the motor.

MECHANICAL MODEL OF A WHEEL CHAIR



a) Front view



b) Back view

Figure-3. Model of a wheel chair with belt control unit.

The mechanical model of a seat belt control has been shown in Figure-3. Mechanical model of a seat belt has been designed by using the AUTOCAD software. The designing of a wheelchair is done by considering seat size, shape and angle. A seat belt, also known as a safety belt, it is a safety device designed to secure the patient in a vehicle against harmful movement or sudden stop. [11].

Three point seat belt

A 3-point belt is a Y-shaped arrangement, similar to the separate lap and sash belts. 3-point belt spreads out the energy of the moving body over the chest, pelvis, and shoulders. In a typical seatbelt system, the belt webbing is connected to a retractor mechanism. The central element in the retractor is a spool, which is attached to one end of the webbing. Inside the retractor, a spring applies a rotation force, or torque, to the spool. The retractor has a locking mechanism that stops the spool from rotating when the car is involved in a collision. The Hardware module for this proposed work is shown in Figure-4.

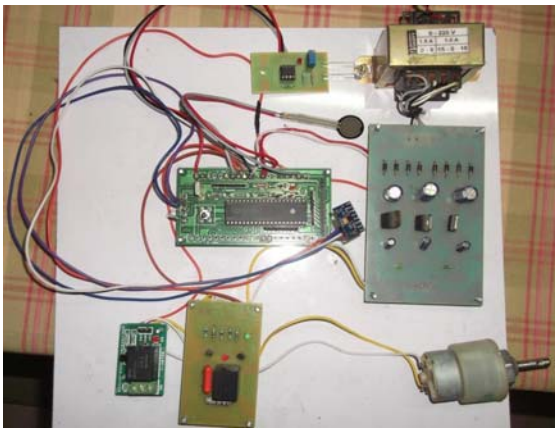


Figure-4. Hardware module.

RESULTS AND DISCUSSIONS

The outcome of the project is tightening of the belt my controlling the motor. This action faces various constrains as over tightening will provide discomfort to the patient and causes pain as well as it may cause threats to patient life as the belt runs over the neck. To avoid these kinds of constrains the pressure sensor and the proximity sensor are used [6].

When the wheelchair is pushed over a sloppy surface the gyro sensor senses the slanting level of the chair. This output is fed to the controller is shown in Figure-5.

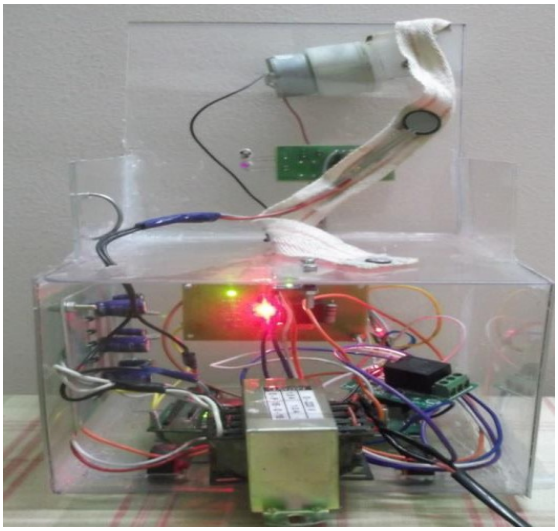


Figure-5. Wheelchair module of the proposed work.

As a result of slope variation the controller processes the output and enables the motor to tight the belt. One end of the belt is attached to the side of the chair and the other end is fixed to the motor shaft directly (it doesn't require any gear reduction system as the DC geared motor is high torque motor and its speed is around 30 rpm) shown in Figure-6.

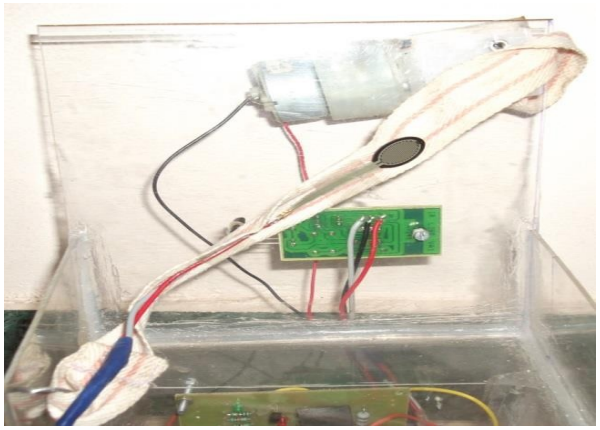


Figure-6. Seat belt assembly in the proposed work.

The proximity sensor and force sensor act as a feedback system for the project. The proximity sensor is a basic IR sensor which senses the distance or nearness of an object irrespective of the type (either living system or not). The force sensor is used to sense the pressure of the belt over the patient. Its output is volt, analogue type and varies with the pressure exerted on the sensing area. The pressure sensor is attached along the belt and it is placed over the chest of the patient. The active mode of the gyro sensor module is shown in Figure-7. The appearance of the wheelchair with subject is shown in Figure-8.

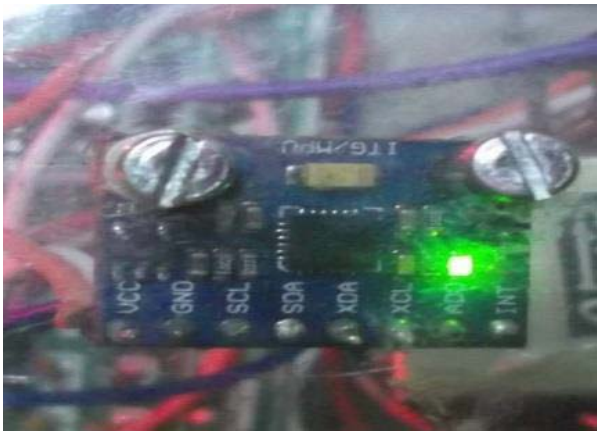


Figure-7. Active Gyro sensor module.

Figure-8. Wheelchair with subject.

When the chair leans forward in the slope the controller triggers the motor to tight the belt based on the gyrosensor output which is shown in Figure-9. This tightening occurs till the motor is switched off. This is done with the help of the output of the proximity sensor and the force sensor. When the belt is get tightened the patient moves towards the backrest, where the proximity sensor is fixed. The IR sensor senses the patient approach and switches the force sensor. The force sensor senses the pressure exerted on the patient and if the threshold value is approached the motor is stopped.

The motor used for tightening is a DC geared motor which does not require a braking system to hold on its position if the power supply is turned off. The motor rotates only when the supply is given.

Wheel chair ramp

Maximum recommended slope of ramps is 1:20. Assistance is required when greater than 1:10.

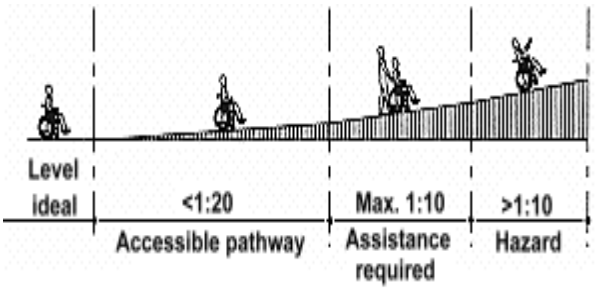


Figure-9. Wheel chair ramp-Upwards.

Mostly climbing upward stairs with wheel chair may not require assistance with seat belt because the patient assisted by helper and climbing downward stairs with wheel chair requires assistance [9, 10] as shown in Figure-10.

Figure-10. Wheel chair ramp-Downwards.

Table-1. Performance of the wheel chair ramp.

Slope of ramp (ratio)	**Condition**
1:20	Patient belt is loosened.
1:10	Patient belt is tightened when the slope of ramps is 1:10 or greater.

CONCLUSION AND FUTURE SCOPE

Thus the wheelchairs using automatic belt control need appropriate methodologies to map the position and control of the seat belt in the wheel chair. This paper described the design and the implementation of wheel chair with automatic seat belt control for the DMD patients.

a) By selecting the appropriate material for the seating arrangement we can avoid back pain.
b) Limb raiser which helps the partially paralyzed patient to regain the original functions to certain extends.

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