Image and Gesture Based Single User Transportation System

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***Abstract*— The use of powered wheelchairs with high navigational intelligence is one of the great steps towards the integration of severely physically disabled people. Driving a wheelchair in domestic environments is a difficult task even for a normal person and becomes much more difficult for people with arms or hands impaired. This system uses the MEMS and RFID technologies to move the wheel chair without any assistance. The wheel chair uses MEMS sensors to identify the hand gestures made by the person sitting on it. The microcontroller now controls the movement of the chair by controlling the DC motors through PWM. The rear camera and display are provided for the patient to monitor the rear view of the wheel chair during the backward motion. RFID technology is used to identify the person who is sitting on the chair. Only the person wearing the RFID is authorized to control the chair.**

KEYWORDS: - ***MEMS, RFID, Microcontroller, DC Motors***

I. INTRODUCTION

Assistive technology for physically challenged personalities had wide scope in present research era. Micro Electro Mechanical systems are adopted as sensing devices. The sensors may be positioned to sense the head movement or to sense the gestures of the hand. This work considered the angle of tilt of the arm in order to determine the movement direction of the wheel chair. The span of the sensor output signal is 1.8 Volts to 3.6 Volts is normalized as an axis angle of '0' to '180' Degrees. X and Y axis is considered with reference to the Z-axis. Geared motor is specifically aligned for free movement of the wheel chair. This Robo Chair system is being developed to overcome the assistance problems, allowing the end-user to just perform safe movements and accomplish some daily life important tasks.

II. METHODOLOGY

The single user transportation system uses the MEMS technology and RFID technology.

A micro electromechanical system (MEMS) is the technology of very small devices it merges at the nano-scale into nano electromechanical systems (NEMS) and nanotechnology. MEMS are also referred to as micro machines (in Japan), or micro systems technology – MST (in Europe). MEMS are made up of components between 1 to 100 micrometres in size (i.e. 0.001 to 0.1 mm), and MEMS devices generally range in size from 20 micrometres (20 millionths of a metre) to a millimetre (i.e. 0.02 to 1.0 mm). They usually consist of a central unit that processes data (the microprocessor) and several components that interact with the surroundings such as microsensors.

Radio-frequency identification (RFID) is the wireless non-contact use of radio-frequency electromagnetic fields to transfer data, for the purposes of automatically identifying and tracking tags attached to objects. The tags contain electronically stored information. Some tags are powered by and read at short ranges (a few meters) via magnetic fields (electromagnetic induction), and then act as a passive transponder to emit microwaves or UHF radio waves (i.e., electromagnetic radiation at high frequencies). Others use a local power source such as a battery, and may operate at hundreds of meters. Unlike a bar code, the tag does not necessarily need to be within line of sight of the reader, and may be embedded in the tracked object.

RFID tags are used in many industries. An RFID tag attached to an automobile during production can be used to track its progress through the assembly line. Pharmaceuticals can be tracked through warehouses. Livestock and pets may have tags injected, allowing positive identification of the animal. On off-shore oil and gas platforms, RFID tags are worn by personnel as a safety measure, allowing them to be located 24 hours a day and to be quickly found in emergencies.

III. BLOCK DIAGRAM OF THE TRANSPORTAION SYSTEM

The Microcontroller starts the operation as the valid RFID card is flashed at the RFID reader. An accelerometer is attached to the patients hand and as per the gestures of the patients hand; the controller soft code receives the 3D- axis values and controls the motor to drive forward, backward, left, right or halt. The controller even monitors the Hall Effect current sensor values, once if the overload is detected on the motors, controller halts driving the motor. The rear camera and display are provided for the patient to monitor the rear view of the wheel chair during the backward motion. A power switch is also provided to switch of the entire system when the chair is not in use, in order to save the battery power.

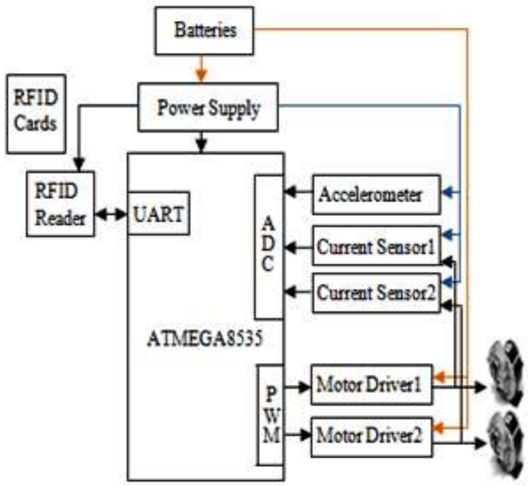

Fig 1. Block Diagram

IV. HARDWARE IMPLEMETATION

This section discusses the major hardware's used in the proposed system in brief.

A. RFID Reader and Cards

A radio frequency identification reader (RFID reader) EM-18 is a device used to gather information from an RFID tag, which is used to track individual objects/ detect the authorized person. Radio waves are used to transfer data from the tag to a reader.

The EM-18 RFID Reader module operating at 125 kHz is an inexpensive solution for your RFID based application. The Reader module comes with an on-chip antenna and can be powered up with a 5V power supply. Power-up the module and connect the transmit pin of the module to receive pin of your microcontroller. Show your card within the reading distance and the card number is thrown at the output

Fig 4.1 EM-18 RFID Reader and Passive Card

B. MEMS Sensor

ADXL335 is used as a 3-Axis accelerometer MEMS sensor. The output signal of this sensor is drawn between 1.8 V to 3.6 V for X and Y axis. Static acceleration gravity is measured by tilting the MEMS Sensor. The change of output voltage is depending on the change in the supply voltage. The tilt position of the sensor caused to produce the output signal in order to determine the motion of the wheel chair. This signal is processed by the microcontroller to enable the motion of the wheel chair.

Fig 4.2 ADXL335 Accelerometer

C. Driver Unit

The analog output of the MEMS Sensor is given as an input signal to the microcontroller (ATMEGA 8535) for further processing. The processed output signal of the microcontroller causes to drive the motor through IBT-2 motor driver.

This driver uses two high current half bridge Infineon BTS 7960 chip for motor drive applications. Interfacing to a microcontroller is made easy using this driver which features current sensing, slew rate adjustment and protection against over-temperature, overvoltage, under-voltage, Over-current and short circuit. This small size driver provides a cost optimized solution for protected high current PWM motor drives.

Fig 4.3 IBT-2 Drivers

D. Hall Effect Current Sensor

The Allegro ACS712 provides economical and precise solutions for AC or DC current sensing in industrial, commercial, and communications systems. This sensor is used for the heavy load detection.

Fig 4.4 ACS712 Current Sensors

E. Display and camera

The rear camera and display are provided for the patient to monitor the rear view of the wheel chair during the backward motion.

Fig 4.5 Rear View Camera and Display

F. Motors

MY1016Z2 PMDC geared motor is 24 volt, 250 watt output bike motor. Comes with 9 Tooth only fits 410 bicycle chains

Note: This electric motor is capable of rotation in either the clockwise or counter clockwise direction by reversing the motor's power wires (reversing the polarity to the motor).

Power output - 250 W / 24 V
RPM - 300 (after gearbox reduction)
Full load current - 13.4 A
No-load current - 2.2 A
Torque Stall - 240 kgcm
Constant torque - 80 kgcm

Fig 4.6 MY1016Z2 Motor

V. SOFTWARE IMPLEMENTATION

Algorithm is developed to move the wheel chair forward, backward, left and right directions.

A. Algorithm

Step1: Initialize UART
Step2: Initialize PWM0
Initialize PWM2
Initialize PWM1A
Initialize PWM1B

Step3: enable the forward and reverse enable pins of the drivers
Step4: wait for receiving the unique RFID card number
Step5: check if the RFID card number is valid, if valid move to step6 and if invalid move to step4
Step6: read the data from ADC channels
(MEMS sensor and current sensor values)
Step7: x= x-axis of MEMS sensor
y= y-axis of MEMS sensor
c1=current sensor of left motor
c2=current sensor of right motor
Step8: if x is greater than 87 then
PWM1 is high
PWM2 is zero
PWM1A is high
PWM1B is zero
Else if x is less than 83 then
PWM1 is zero
PWM2 is high
PWM1A is zero
PWM1B is high
Else if y is less than 83 then
PWM1 is zero
PWM2 is zero
PWM1A is high
PWM1B is zero

Else if y is greater than 87 then
PWM1 is high
PWM2 is zero
PWM1A is zero
PWM1B is zero
Else if x is between 83 and 87 and y is between 83 and 87
PWM1 is zero
PWM2 is zero
PWM1A is zero
PWM1B is zero
If c1 and c2 are above max-value then
PWM1 is zero
PWM2 is zero
PWM1A is zero
PWM1B is zero
Step9: go to step7

VI. RESULTS

The wheel chair is tested with variable load conditions. The transportation delay is influenced on the developed model due to mechanical rigidness of the motor assembly and frictional forces. This delay is influenced with increasing the load.

Table 6.1 Delay Influence with Respect to Different Loads

Direction	No load	50kgs	80kgs
	Time (secs)	Time (secs)	Time (secs)
Forward	4.5	5.05	5.6
Backward	4.5	6.5	8.5
Left	5.3	6.95	8.6
Right	5.3	6.95	8.6

The movement of the hand is sensed by the MEMS accelerometer sensor and the corresponding signal based on the angle of elevation is sent to the micro controller. The signal is processed in the micro controller and corresponding directions are given to the motors. The developed model had been tested with an increasing load from 50 Kg to 80 Kg.

Fig 6.1 Wheel chair Motors Alignment

Fig 6.2 Completely Assembled Wheel Chair

VII. CONCLUSION

This model is useful to all the disabled people, who are unable to move and unable to drive normal wheel chair by their own. With their hand movements they can move wheel chair right, left, front, and back directions with 3-axis accelerometer (MEMS SENSOR) which is a highly sensitive sensor and capable of detecting the tilt. The results are tested with various loads. The model produced favorable results to move in all directions with maximum load. The motor load driving capacity is to be reconsidered in future scope of the research work. Improvements can be made by using various body gestures such as eye gaze, or head movement accordingly

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