Wire Less Wheel Chair Direction Control with Gesture Recognition (MEMS Accelerometer)

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Abstract: The main aim of this project is to control the wheel chair using MEMS. The MEMS will be fixed to the hand. Whenever the hand moves in a particular direction, the mechanical movement of the hand will be recognized by MEMS. MEMS converts this mechanical hand movement into equivalent electrical signals(X, Y, Z coordinates) and send it to the microcontroller. The communication between microcontroller and MEMS takes place based on i2c protocol. In this protocol microcontroller acts as a master and MEMS acts as a Slave. The master receives the signals from slave and based on them it controls the wheel chair. Wireless Wheel chair has two D.C gear motors. These motors move in 2D direction with the help of driver IC L293D according its input signals. This driver acts as H-bridge. This paper uses regulated 5V, 500mA power supply. 7805 three terminal voltage regulator is used for voltage regulation. Full wave bridge rectifier is used to rectify the ac output of secondary of 230/12V step down transformer.

Keywords: Micro-Electromechanical Systems (MEMS), Wheelchair, Hand Gesture Recognition.

I. INTRODUCTION

This paper proposes an integrated approach to real time detection, tracking and direction recognition of hands, which is intended to be used as a human-robot interaction interface for the intelligent wheelchair. This paper is to demonstrate that accelerometers can be used to effectively translate finger and hand gestures into computer interpreted signals. For gesture recognition the accelerometer data is calibrated and filtered. The accelerometers can measure the magnitude and direction of gravity in addition to movement induced acceleration. In order to calibrate the accelerometers, we rotate the device sensitive axis with respect to gravity and use the resultant signal as an absolute measurement. Integrating a single chip wireless solution with a MEMS accelerometer would yield an autonomous device small enough to apply to the fingernails, because of their small size and weight. Accelerometers are attached to the fingertips and back of the hand. Arrows on the hand show the location of accelerometers and their sensitive directions, that the sensitive direction of the accelerometer is in the plane of the hand. The gesture based wheelchair is suitable for the elderly and the physically challenged people who are unfortunate to have lost ability in their limbs due to paralysis or by birth or by old age. Elders find it tough to move inside the house for day to day activities without help or external aid. Our proposed system makes use of a wheelchair that can be used by elderly or physically challenged to move inside the home without difficulty and without external aid. The elders may also forget the way to the different rooms in house due to the increase in forgetfulness as they become older. The physically challenged, find difficult to move the wheel chair without help from others.

By making use of the system, the elderly and the physically challenged can go to different rooms in the house like kitchen, living room, dining room etc by just showing a gesture which is predefined to that particular room. It is also a virtue of the system that even the foot can be substituted in place of the hand for users who might find that more convenient. The aim of this project is to controlling a wheel chair and electrical devices by using MEMS Accelerometer Sensor (Micro Electro-Mechanical Systems) technology. MEMS Accelerometer Sensor is a Micro Electro Mechanical Sensor which is a highly sensitive sensor and capable of detecting the tilt. This sensor finds the tilt and makes use of the accelerometer to change the direction of the wheel chair depending on tilt. For example if the tilt is to the right side then the wheel chair moves in right direction or if the tilt is to the left side then the wheel chair moves in left direction. Wheel chair movement can be controlled in Forward, Reverse, and Left and Right direction along with obstacle detection using ultrasonic sensor. Automation is the most frequently spelled term in the field of electronics. The hunger for automation brought many revolutions in the existing technologies. One among the technologies, which had greater developments, is the MEMS Accelerometer Sensor.
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These had greater importance than any other technologies due its user-friendly nature as shown in Fig.1. MEMS ACCELEROMETER SENSOR based devices can be easily reachable to the common man due to its simpler operation.

**II. LITERATURE STUDY**

In today’s time, an estimated 1% of the world’s population needs a wheelchair. An increased percentage of elderly and disabled people who want to enhance their personal mobility, for them wheelchair is the best assistive device. A disabled or an invalid individual (usually the disability of the lower part of the body) can find it convenient to move around and maneuver using the help of a chair constructed on wheels which can either be pushed by another individual or propelled either by physical force or electronically. Such a chair is called as a Wheelchair. Traditional wheelchairs have some limitations in context to flexibility, bulkiness and limited functions [1]. Our approach allows the users to use human gestures of movement like hands and synchronize them with the movement of the wheelchair so that they can use it with comfort and ease on all kinds of terrains without the hurdle or cardiovascular problems or fatigue. Some existing wheelchairs are fitted with pc for the gesture recognition [2]. But making use of the pc along with the chair makes it bulkier and increases complexity. This complexity is reduced by making use of the mems accelerometer [3-4], the size of which is very compact and can be placed on the fingertip of the patients.

Other existing systems, which make use of the similar kind of sensors are wired, which again increases the complexity of the system. They also limit the long range communication. This complexity is removed by using the RF transmission. Signals through RF travel larger distances. Irrespective of line of sight communication, signals through RF travel even when there is obstruction between the transmitter and receiver. The processing speed of this system is made faster by making use of I2C protocol as shown in Fig.2. When an unfortunate event affects the motor capacity of a person, it is necessary to use devices like wheelchairs that offer a means of displacement for patients with motors problems of the lower limbs. Tremendous leaps have been made in the field of wheelchair technology. However, even these significant advances haven’t been able to help quadriplegics navigate wheelchair unassisted.

**Fig.1. Arduino Uno.**

Arduino is a open source electronics prototyping platform based on flexible, easy-to-use hardware and software. It’s intended for artists, designers, hobbyists, and anyone interested in creating interactive objects or environments. It’s an open-source physical computing platform based on a microcontroller board, and a development environment for writing software for the board.

**Fig.2. Receiver Block Diagram.**

Some patients that cannot manipulate the wheelchair with their arms due to a lack of force or psychomotor problems in the superior members, request electric wheelchairs, frequently manipulated with joysticks; however the joystick manipulation is even not practical and frequently it must be handle with the mouth. The present article presents the partial results in the development of a wheelchair controlled by an intuitive interface, where the instructions are given by hand gesture instructions. The advances are presented in the realization of the control software using a Webcam and some distances and presence sensors controlled by a PIC microcontroller that establishes the communication with a program developed in Lab view. This paper is inspired from an IEEE Research Paper Titled „A Wearable Head- Mounted Sensor-Based Apparatus for Eye Tracking Applications” that was presented in the IEEE International Conference on Virtual Environments, Human-Computer Interfaces, and Measurement Systems Istanbul, Turkey, dated 14-16 July 2008. The above paper approach was dealing with wheelchair control using eye ball movement with slight modification to it. Our paper deals with the control of wheelchair motion by hand gesture.

**III. ACCELEROMETER**

An accelerometer is a device that measures the proper acceleration of the device. This is not necessarily the same as the coordinate acceleration (change of velocity of the device in space), but is rather the type of acceleration associated with the phenomenon of weight experienced by a test mass that resides in the frame of reference of the accelerometer.
device. For an example of where these types of acceleration differ, an accelerometer will measure a value when sitting on the ground, because masses there have weights, even though they do not change velocity. However, an accelerometer in gravitational free fall toward the centre of the Earth will measure a value of zero because, even though its speed is increasing, it is in an inertial frame of reference, in which it is weightless. By measuring the amount of static acceleration due to gravity, you can find out the angle the device is tilted at with respect to the earth. By sensing the amount of dynamic acceleration, you can analyse the way the device is moving (S. Tameemsultana, 2011). With the help of the accelerometer, as shown in Fig.3, we can control the movement of any robotic arm or movement or control of any electrical appliances. If we install our accelerometer to our hand, then it is possible to control anything with the help of our hand. With the help of four different motions we control the direction of chair for forward, reverse left and right. An accelerometer thus measures weight per unit of (test) mass, a quantity also known as specific force, or g-force (Khairul anuar abd Wahid, 2008).

**Fig.3. Power supply block diagram.**

### IV. APPLICATIONS

This automated wheelchair is valuable research for the people who could not move independently. Some of example of different categories of physically challenged people is listed below:

- **Amputees** - Missing Legs and/or Arms but with active upper bodies.
- **People with Weak or Poorly Controlled Upper Bodies** using standard joystick.
- **People with Little or No Upper Body Movement**, using special quad controls.
- **Paralyzed Small People** - Children and "very small" Adults ...in special seats.
- **Paraplegics** - Healthy, Fit & Active are typically the safest users of manual, power-assisted, and fully powered wheelchairs.

### V. CONCLUSION

In the race of man v/c machine, hand gesture controlled s/m comes as an e.g. of companionship of man and machine. Taking the technology to the next level from speech recognitions and wired connections is the technology of wireless hand gesture controlled s/m. Using a simple I2C chip we can connect up to 128 chairs using a single remote. The applications of the same can be plenty. This s/m gives the user independence and a psychological advantage of being independent. To avoid physical hardship to the user come the accelerometer to the rescue as with the slight twist of the finger the user gets the ability and freedom to turn the wheelchair into the desired direction. Of course some training is essential to use the acc as its quite sensitive but in the end there could not be a better use of technology for an individual who is deprived of the same physical strength. In future several wheelchairs (up to 128) can be operated using a single remote with accelerometer and PIC as master and various wheelchairs developed using microcontrollers as slave. This system can be extended by including GSM which sends an SMS during emergency by assigning particular gesture command. By including GPS, position of the wheelchair can also be known. Wheel chair can be fitted with direct mind reader. For example, if a person is paralyzed and cannot move his body parts, in that case it can be used.

### VI. REFERENCES