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Voice & Accelerometer Controlled Wheel Chair

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ABSTRACT
IOT based wheel chair is an android application attached wheel chair, to help the handicapped people. It contains a control unit (CU) that control the wheel chair to work according to the control, provided by the android device and the sensor attached to the device. The modules are embedded device and android application. The handicapped user who uses the device, wheel chair, should be added to the system by a caretaker so that the location uploaded by the user can be easily identified by the caretaker. The android device continuously upload the location in real-time to an online service which will be easy for real-time tracking. The device can be worked from the voice produced from the android device with the help of Google speech engine. The accelerometer connected to the device can also be used to control the wheel chair. The movement of the powered wheelchair depends on the motor control and drive system which consists of microcontroller, motor driving and solar panel attached on top of the roof. Once the voice recognition system recognizes the voice commands in comparison to the stored memory, the respective coded digital signals would be sent to the microcontroller which power the wheelchair. A roof will be built on top of the wheelchair so that it act as a shelter to whoever is using it. On top of the wheelchair, a solar panel will be used to make use of solar energy which assists in the movement of the wheelchair, thereby reducing the extra costs incurred which makes our project distinct from the existing systems.
***Keywords* :-** Accelerometer control, IOT, Speech Recognition

I. INTRODUCTION

Smart wheelchairs are designed to provide assistance to users in different ways. Its purpose is to reduce or eliminate the user's full responsibility on moving the wheelchair. One drawback of the Smart wheelchairs is the higher price of them comparing with the manual or the simple electrical powered wheelchairs. Manual or electrical wheelchairs are satisfying for most of the low and medium level disability case where patients can use the wheelchair independently. However, in severe cases, it is difficult or impossible to use wheelchairs independently. In such cases wheelchair users often lack independent mobility and rely on somebody else to handle the wheelchair.

A dependent user recognition voice system and ultrasonic sensor systems has been integrated in this wheelchair. In this way we have obtained an automatic wheelchair which can be driven using voice commands. The Wheel chair has also been developed to work on movement of accelerometer which will help the person whose limbs are not working. Accelerometer can be attached to any part of body of physically disabled person which he can easily move like head, hand etc. Electronic system configuration, a sensor system, a mechanical model, voice recognition control, and accelerometer control are considered.

Here, Accelerometer and Voice controlled wheel chair we intend to find a cost effective design to build a wheel chair for disabled people, who would find hard to use their energy in moving the wheelchair for their displacement. In this project we are going to make a wheel chair which can be controlled automatically as well as manually. He/ she just need to move his/her hand into the direction it wants to move by using accelerometer.

The proposed Speech Recognition Based Wheelchair Operation allows physically disabled person to control the wheelchair easily without the need to use hands. The movement of the powered wheelchair depends on the motor control and drive system which consists of microcontroller and motor driving. Once the voice recognition system recognizes the voice commands in comparison to the stored memory, the respective coded digital signals would be sent to the microcontroller which then controls the wheelchair accordingly. A person develops self-capability thereby improving his/her life and also motivates others to be independent. We utilize the acceleration data to recognize the hand gestures and then transfer the gesture information which indicates certain motion commands into the wheelchair's smooth motions. It's a try to realize the natural interaction for the older and handicapped with the wheelchair through the hand gestures. Our design shows that the motion and voice controlled wheelchair can guide the paraplegic. We have provided a design that is efficient in helping the quadriplegic and paraplegic people without putting their strengths and efforts to pull the wheelchair, by commanding it on their voice.

II. LITERATURE SURVEY

The existing system is the one which has a rolling switch and works accordingly with that. There is no unit for location sharing and voice based working .The navigation information

is not informed to the user.

Existing systems are :

The NavChair is a human-machine system in which the machine must share control with the user. VFH obstacle avoidance modifies the user's input command to achieve safe travel. This approach allows the user effective control while overriding unsafe maneuvers. Two types of problems were encountered in the application of the VFH method to a power wheelchair system. First, the power base is significantly different than typical mobile robots. In addition, the geometry and kinematics of the wheelchair are significantly more complicated than those of most mobile robots. The second type of difficulty is related to the application of obstacle avoidance to a human-machine system.

The SPAM is a motorized wheelchair with sensors that detect obstacles and software that modifies the path of the wheelchair to avoid obstacles. Unfortunately, the SPAM still does not offer the same maneuverability as manual wheelchairs. It is also not as light as manual wheelchairs and thus is more difficult to transport in a car. In addition, if multiple obstacles are detected at once, the SPAM sometimes will not move in any direction.

III. METHODOLOGY

The Wheelchair operates with hand movement, taking action as an input signal for the movement of wheelchair in a particular direction. An Accelerometer (Motion Sensor) is used to track these movements. This sensor is tied as a band to hand/head. The wheelchair also operates based on voice input given by the user. The voice recognition kit is used to recognize voice uttered by the user. The variations of the sensor are trapped and those signals are fed as inputs to the signal conditioning circuit . Now based on these variations the micro-controller is programmed to take decisions which in turn control the movement of wheelchair.

When the user is sitting on the wheelchair with his hand in straight position, the stop condition is being met and wheelchair shows no response. Now if the user want to move in forward direction he has to tilt the hand downward. As long as the users hand orientation remains unchanged, the wheelchair will continue to move forward unless user moves the hand where stop condition sets true. Similarly is the case for left and right conditions. The micro-controller, Arduino Mega 2560, receives new values from the accelerometer after every 100ms.

Arduino is also powered by the 24 V batteries source. The mechanical part of the wheelchair is done first by attaching a motor at the back of the wheelchair connected to a battery which will be charged using solar panels attached on top of the wheelchair. An accelerometer will be attached to monitor the movements of the chair. By detecting the hand movements using accelerometer, the directions will be sensed. Voice can also be used as input to move the wheelchair using predefined commands. A location tracking app is included to track the motion of the wheelchair, thereby preventing unauthorized access, thus ensuring security. Seats are made adjustable to enhance the comfort of the user. The IMU sensor attached on the headset gives the movement commands by detecting the orientation of the head.

Following are the commanding options available for patient:

- Forward command
  By tilting his hand in forward direction at a certain angle.
- Backward Command
  By tilting his hand in backward direction at a certain angle.
- Stop Command
  By keeping the hand in straight position.
- Right Command
  By tilting his hand towards right at a certain angle
- Left Command
  By tilting his hand towards left at a certain angle.

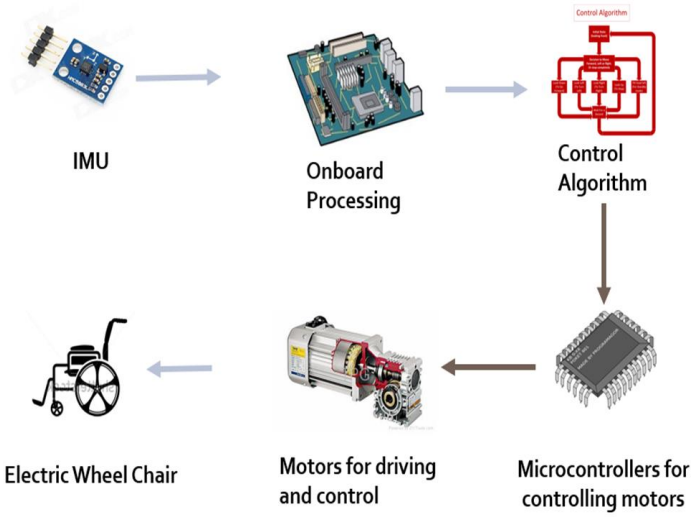

Figure 1- Block Diagram Of The Proposed System

The quality of our project design is that any standard wheelchair available in the market can be converted into an electronic wheelchair. In our project we purchased a standard light weight wheelchair from the market. We welded a steel plate at the back of the wheelchair so that motors can be attached on this steel plate. Also a steel plate in the front bottom is welded to place the electronic components and batteries. After welding these plates the folding features of the wheelchair has been eliminated. After this welding process, the frame of the wheelchair became misaligned and it required enough time and effort to realign the frame and maintain the stability. We repainted the wheelchair to cover the welded parts and steel plates.

A solar panel will be attached on top of the roof of the wheelchair so that it uses solar energy to charge the wheelchair. The existing system of automatic wheelchair is costly and normal people cannot afford to use such expensive

wheelchairs. It was due to that reason that we came up with the idea of implementing an automatic wheelchair that makes use of solar energy from the sun and use it to charge the wheelchair.

The system comprises of two main parts: Transmitter and Receiver. The main block is the wheelchair management unit. Control block is heart of this system though which controlling and monitoring of system is carried out. It includes an emergency button and uses an accelerometer to ensure the smooth functioning. The transmitter part has the provision for speech recognition.

The android app consists of user and caretaker interface. The registration is done by logging in. The features provided are Google speech, accelerometer movement, emergency switch, location share. After the use, the user can logout. The caretaker needs to login to view the user and track the location. The caretaker can add a new user. It's the caretaker who receives message from the user including location. There are use case diagrams that shows the user's interaction with the system.

1. Transmitter

In transmitter part we use two hand gesture is recognized by the sensor, digital output is transmitted to the controller and then transmitted to receiver side by the transmitter. DC Motors which are interfaced to the controller by the motor driver controls the direction of the wheelchair. Security is ensured by sending SMS to their relatives at the time of emergency to help the person when the IR signals can travel between transmitter & receiver.

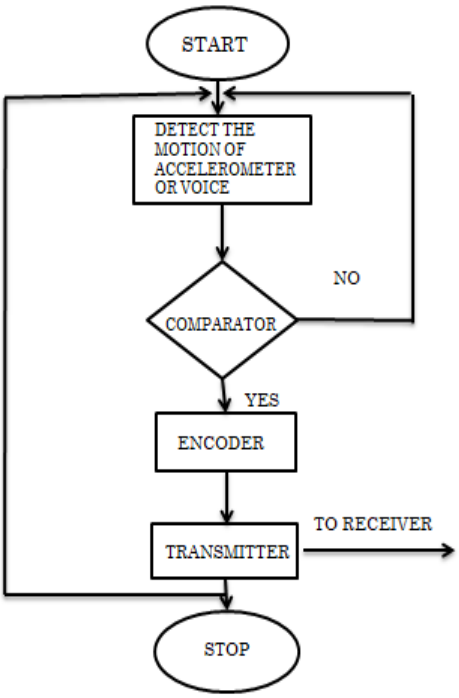

Figure 2 – Use Case Diagram of Transmitter

2. Receiver

The same data is received at receiver side by the receiver. The data obtained from the accelerometer for the various orientations of the hands gave us the readings to decide the direction of movement. The values obtained from the accelerometer are analog values which should be further converted into digital values so they can be used by the controller. The accelerometer sensor senses the accelerating force and thus gives a particular voltage which helps in sensing the direction of movement of the wheelchair.

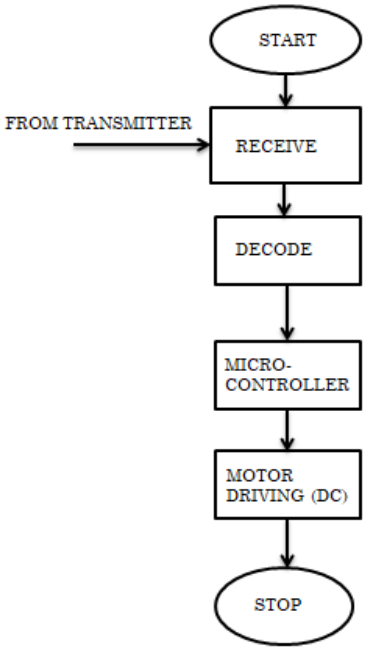

Figure 3 – Use Case Diagram of Receiver

3. User

The Android app that is used in tracking the location of the user consists of two parts. One is for the user and the other for the caretaker.

User is the one who uses the wheel chair. It has an android app. When logged in, it uploads the location to the server that helps the caretaker to track the user. It includes an emergency button and uses accelerometer to ensure the smooth functioning. It has the provision for speech recognition. . The one who uses the wheel chair is the user and has an android app. When logged in, it uploads the location to the server that helps the caretaker to track the user.

The list of users will be made visible to the caretaker. In case of any kind of emergency situation, the user is able to inform the caretaker by sending an alert message. The

caretaker can not only track the location but also he/she is able to know the information regarding the surrounding areas.

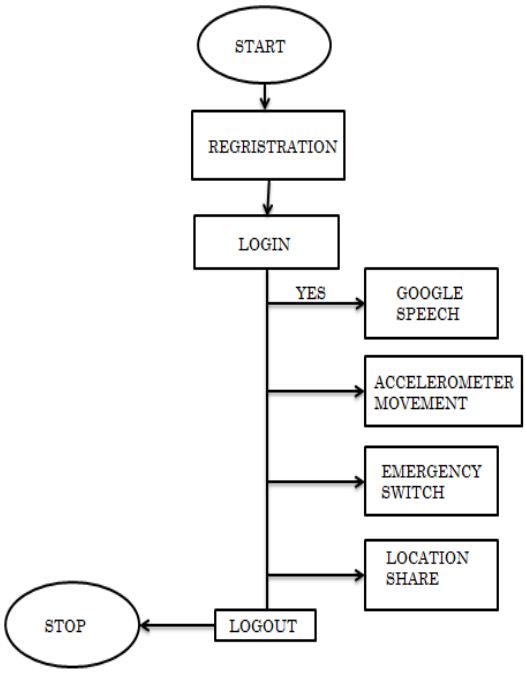

Figure 4 – User Part Of Android App

4. Caretaker

The caretaker, when logged in, can track the current location of the user. It receives any kind of notification from the user.

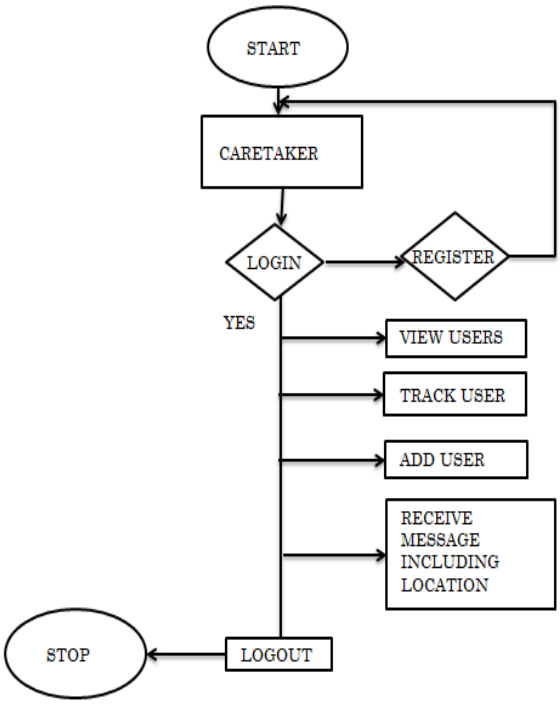

Figure 5 – Caretaker Part Of Android App

IV. IMPLEMENTATION

System Requirements :
Software Requirements :

- Windows 7 or above
- Android studio 3.0.1 or above
- Arduino platform (Latest Version)
- Dream Weaver cc

Hardware Requirements :

- Wheel chair – Carrying capacity upto 145 kg
- Node MCU
- I3 processor or higher
- 120GB to 1TB HDD
- 4GB RAM or above

Based on the system, we now propose a detailed block level design.

Block Level Design :

1. Accelerometer unit - This unit is the sensing unit. Here based on the direction in which the motion sensor is moved there will be change in output voltage. This output voltage is given to signal conditioning circuit.

2.Voice Recognition - The voice recognition kit REF stores the voice command in memory and is done using speech recognition. Then analog voice signals are converted into digital signals using ADC. This digital input now should have the voice commands in binary form which is given as an input to the micro-controller.

3.Interfacing circuit - The interfacing circuit consists of a differential amplifier. The output voltage of accelerometer is given as input to non inverting terminal of differential amplifier. The differential amplifier compares the input voltage with reference voltage and gives the output. This output voltage is given to micro-controller.

4.Micro-controller - The output of interfacing circuit is given to micro-controller. The micro-controller gives the output signal to motor driving circuit based on fixed program stored in ROM.

5.Motor - The output of relay driving circuit is given to BLDC motor external controller for low voltage interfacing. Based on the signal given by relay driving circuit the controller

switches the motor accordingly. The ultrasonic sensor senses obstacle and sends a signal to micro-controller to stop the chair.

6.Accelerometer - After completion of our design, first the wheel chair was tested by using MEMS motion sensor. Here based on the gesture of the hand the wheel chair moved in front, left, right and backward direction . Here in this mode the wheel chair worked properly without any problems.

In our proposed system, Accelerometer and Voice controlled wheel chair we intend to find a cost effective design to build a wheel chair for paraplegic and quadriplegic people, who would find hard to use their energy in moving the wheelchair for their displacement.

For handicapped people, it have been found a wheel chair which can be moved by using hands for those who don't have legs. But in the case of people who don't have legs as well as hands cannot move the wheel chair by themselves. They need some other person to move their wheel chair. But sometimes such person faces so many problems if they don't get any person to move their wheel chair. This proposed system of Auto Wheel Chair aims to resolve the above mentioned issue.

In this project we have made a wheel chair which can be controlled automatically as well as manually. This wheel chair controlled manually through hand gestures of the person sitting on it. He/ she just need to move his/her hand into the direction it wants to move by using accelerometer. In automatic control user just need to press keys for saved destination.

V. FUTURE WORK

The wheelchair is fully capable of carrying the load up to 110Kg, and moving in accordance to the gesture given by the person who is using the wheel chair. Certain improvisation and improvement can be done to make the wheelchair more reachable to those whose whole body is paralyzed. Certain eyes gesture or brain signals reader can be imparted on the wheelchair system so as to make it better. The hand gesture wheelchair has the ability to bridge the gap between man and machine. Further this hand gesture can be changed to brain signal detection using EMG (Electromyography). EMG signals have to be analysed and translated into multi-directional control commands that can also be used to control the speed of the wheelchair.

Further safety features can be added into the wheelchair like implementation of ultrasonic sensor for the object detection. A solar panel can be added on top of the wheelchair as a shelter and energy conservation. A fingerprint security system can be implemented to prevent unauthorised access.Currently there is no mechanism for obstacle detection, however a system can be introduced in such a way that if some obstacle is detected the wheelchair should stop to avoid any collision or incident. Presently our wheelchair is moving with a constant speed. The speed cannot be varied by users or patients desire. So two types of modifications can be done i.e. either by PWM pins in the Arduino code or by providing variable voltage to the motors of the wheelchair. A health monitoring system should be introduced in the wheelchair such that it can measure basic information about health, such as temperature, blood pressure and pulse etc. Upper and lower ranges should be defined and immediate emergency indication should be provided to the care taker on crossing these ranges.

VI. CONCLUSION

By using the proposed system of Voice & Accelerometer Controlled Wheel Chair, physically challenged people finds easy way to navigate within the home using wheelchair without any external aid. This provides ease of operation as the system is user friendly and size is small. Voice commands will be received through microphone and for gesture recognition small IC will be placed at finger tips. By utilizing the acceleration data to recognize the hand gestures and then transfer the gesture information which indicates certain motion commands into the wheelchair's smooth motions. It's a try to realize the natural interaction for the older and handicapped with the wheelchair through the hand gestures. The proposed system utilize the acceleration data to recognize the hand gestures and then transfer the gesture information (motion commands) into wheelchair's smooth motions. This automated wheelchair has a voice recognition device, microcontroller, accelerometer and an android app for location tracking which are easier to interface with each other and their use is not very difficult. We believe that people who are socially isolated due to their physical disability will have the opportunity to move freely without any assistance by using voice commands and hand movements. In the future work, we will focus on these problems and do more experiments to improve and verify the method in real environment further.

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