Economic Voice and Gesture Navigated Wheelchair

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Abstract

The wheelchair navigation system has been intensively studied in all across the globe, because of the higher demands in biomedical instruments for handicapped people. The project implements wheelchair navigation system which implements a wheelchair which can be navigated via speech and gesture. Along with mundane navigation system such as joystick, wheelchair can be operated by speech, touch-screen as well as gesture. Different modules of voice, gesture and touch screen are connected to centre platform and motors which will navigate the wheelchair. In earlier inventions, joystick and voice module has been implemented, but gesture control acts as innovative approach for wheelchair navigation and helps handicapped people. Apart from navigation, wheelchair also has apt acknowledgment of obstacles and it will avoid collision providing more safety to user.

1. Introduction

For people with some kind of locomotion disability, some tasks and situations of everyday life can have physical constrains sometimes impossible to overcome for them. In this case manual or powered wheelchairs are devices that help them to increase their locomotion ability and quality of life. But it is very difficult for a wheelchair user to make a plan to move in a place never visited before.

Help from care givers and/or care-giving devices are indispensable to the daily lives of aged or handicapped people. However, help from care givers imposes large physical and time loads on the care givers and also imposes a mental burden on those who receive help, such as a feeling of constraint in the care giver's presence. To reduce such loads, it is necessary to introduce an autonomous care-giving device that does not require the help of a care giver.

In this project, we implement the electric wheelchair from among other care giving devices. Therefore, we planned to develop an automated travel system for electric wheelchairs. In this project, we develop a system that travels by establishing the route autonomously for those who have the greatest handicaps.

The current project is a multi-controlled powered wheelchair supplementary which allows physically disabled person to maneuver the wheelchair easily without the need to use hands. Wheelchair navigation System(WNS) is comprises: a wheelchair, control modules and navigation module. It can be used by an elderly or physically challenged person to move without any difficulty, at home, hospitals or other places.

By making use of WNS, elderly and the physically challenged can go to different rooms in the house like kitchen, living room, dining room etc by just speaking out direction of the particular place. In case if person is not able to utter direction, he/she can navigate just by moving his hand or head, and the wheelchair will go in the direction of the gesture of person.

If the physically handicapped person is dumb then there will be provision for touch screen navigation, joystick navigation. In this, person will make use of his hands and can navigate around in the home.

Wheelchair will also have the sensors by which it will detect an obstacle which comes under it way. If obstacle in found, wheelchair will stop its motion thus avoiding collision and giving user safety.

2. Limitations of Available Products

Currently available automated wheelchairs have joystick as basic input. Main problem with joystick control is that it is not suitable for physically disabled person who cannot control their movements especially the hands. Voice controlled wheelchairs are also available in market but they are not cost-effective as compared to the current project. Apart from cost-effectiveness, if the physically challenged person is unable to speak words in appropriate way then he/she may not be able to use the wheelchair at all.

3. Working of Voice Control

Voice and Gesture control are the primary and important features of the project.

The voice of the person is detected by voice capture module which will be compared by voice recognition module with predefined voices loaded in to the system.

According to the received voice, the direction is decided (Left, Right, Forward etc) and the wheelchair moves according to the route which is predefined. It is also equipped with obstacle avoidance technique, where the person may not be able to provide proper voices at the right time. By this avoidance technique, chair itself will keep safe distance from obstacle.

The above Flow Chart is of voice recognition module. It has two modes, as follows:

1) Training Mode

Before using the voice module person must train the device with his/her voice. Person will have to select training mode from screen and then to the appropriate icons, he/she should provide voice. That voice will be stored in memory.

2) Recognition Mode

In this mode, speech recognition IC is ready to accept the voice input to be recognized. When the voice input is detected, it will be compared with all the voice inputs which are stored in memory. If person says 'Forward', then it will search for similar voice pattern in its memory. If detected, it will then flow according to the instructions provided. In idea case, if person has stored 'Forward' word for forward movement of wheelchair, as soon as person will say 'Forward' then wheelchair will move in forward direction.

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4. Gesture Control

In gesture mode, the accelerometer is fixed on the headphone or kept on hand of disabled person. Firstly we have to synchronize the accelerometer module parallel to the ground. When we turn the head/hand then there is change in the axis. As per the change of axis, wheelchair will start moving in the directions given. If person bends his hand of left side then wheelchair will move in the left direction.

5. Joystick and Touch Screen Mode

5.1. Touch Screen

Touch-screen acts as the basic component of the wheelchair navigation system. As soon as wheelchair is starts, touch-screen module will start. User will have to select which input method to choose. He/she will have to click appropriate icon on the screen which will then give control to that module. If person selects joystick then control will go to the joystick. Apart from acting as primary selection method, screen also acts as display. It will show the current status of the wheelchair. It will also have 'Exit' button in case if person wishes to change the input module.

5.2 Joystick

Joystick is simplest way to operate the wheelchair. Two axis resistive joystick can be used for simple navigation.

6. Diagram and Working

The overall diagram of image can be showed as follows. Person will have jostick in his/her right hand and touch-screen near left hand. If person wishes to use joystick as input, he/she will have to move joystick in appropriate direction. If person wishes to use touch-screen control then he/she will have to access touch-screen and navigate via touch -screen by using keys on screen. And if person wishes to use voice or gesture control, he/she will have to click on touch-screen and select appropriate option of control on screen which is pre-defined. Once person selects the option, control will be gone to the selected module as long as person does not select 'Exit' option from touch screen.

If person select Voice control he/she will have to speak the direction or the destination of pre-defined path. If person speaks direcions such as Left-Right, Forward-Backward, then wheelchair will follow in that direction as long as person does not speak the word 'Stop' or does not come to nearby obstacle.

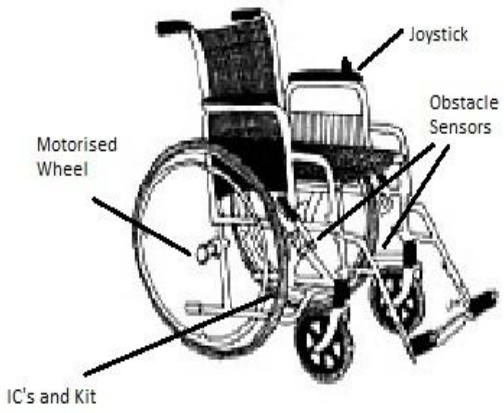

Fig1: Prototype of WNS

For the gesture control, a accelerometer device will be placed on handicapped person's hand/head. If person selects Gesture control, then he/she will have to move his hand/head where the device is kept. If it is on his head and he bends his head downwards, then it will be considered as 'Forward' direction and wheelchair will start moving in forward direction as long as person

does not moves his head in other direction. If person moves his head in right or left direction then the wheelchair will move to the selected direction.

7. Mechanical Components

The basic mechanical component used in Wheelchair navigation system is brushless DC motor. Pair of two motors is attached to the wheels and is operated via brushless motor driver.

8. Results

The result of the project is successful working of the cost-effective wheelchair navigation system. Working includes the movement of wheelchair via various inputs such as joystick, touch-screen, voice and gesture control. Result also includes obstacle detection: if obstacle comes under 30 cms from wheelchair, wheelchair will stop.

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