Wagon - The Smart Wheelchair

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Abstract : A survey reveals that there are around 21 million people suffering from some or the other kind of disability in India alone, out of which 27.9% are physically disabled. A wheelchair plays a crucial role in the life of a physically disabled individual. There are a lot of such disabled people who can not use traditional wheelchairs as they may have restricted limb movements. An alternative to the above problem is proposed. This project "Wagon - The smart wheelchair" comprises a wheelchair that works on hand gestures, voice command inputs, app inputs(Keypad), and head movements input for successful locomotion of the differently-abled persons. This project incorporates an additional SoS feature in the application for emergency situations. In this work, an attempt is made to make the lives of the differently-abled people simpler, i.e., self-reliant, which will thereby reinstate their confidence and happiness

IndexTerms - physically disabled, smart wheelchair, voice command control, head movement control, hand gesture control, app control, SoS .

I. INTRODUCTION

Locomotion is one of the basic needs of humans which is lacking in people having limited abilities of movement thereby rendering them to use a wheelchair for moving from one place to another.

The physically challenged people, who use conventional wheelchairs usually require assistance to navigate the chair. To address these issues an automated wheelchair system is designed and developed which can be used by the elderly and the physically challenged people in an user friendly manner. The overall framework of the project is to restore autonomy to severely disabled people for independent navigation using the wheelchair.

The wheelchair is fitted with a combination of control circuitries and sensors such as accelerometer and flex sensor. . By tilting the head fitted with an accelerometer sensor, the wheelchair can be moved in different directions. For voice recognition an Android app is developed to receive voice command, which is installed in an Android phone paired to the wheelchair, through bluetooth connection, which also displays a touch panel so that the user can move in any direction of his/her choice using touch. AT-mega328p microcontroller is used to check the signal associated with command and compare with the stored commands, if both matches it performs operations namely left,right,forward,backward and stop. Similarly, the wheelchair can be controlled using Hand gestures with the help of a flex sensor interfaced to Raspberry Pi. So in this way, the wheelchair system is taken to a new level by the usage of automation.

II. LITERATURE SURVEY

A Hand Gesture System of Control for an Intelligent Wheelchair

The authors in [1] discuss here that due to some unforeseen circumstances the motor capacity of an individual may be affected, and it becomes necessary to use devices like wheelchairs to assist movement for patients with motors disabilities in the lower limbs. A few individuals who can not operate the wheelchair with their arms due to a lack of force or psychomotor disabilities in the upper limbs, require the powered wheelchairs, usually manipulated with joysticks; however the authors find that the joystick control is even not practical and frequently it must be handled with the mouth. The presenters of this paper have come up with partial results in the development of a wheelchair controlled by such an interface, where the commands are given in the form of hand gesture instructions. The developments are presented by realizing the control software using a Webcam and some distances and presence sensors which are under the control of a PIC microcontroller that sets up the communication with a program developed in Labview.

B Dynamic Finger Movement and Voice Commands based Smart Wheelchair

Many disabled patients can operate joystick-controlled electric wheelchairs however there are numerous individuals who don't have the prestidigitation required to work a joystick. Additionally, a significant number of them face trouble to avoid impediments. The point of this paper [2] is to carry out a multi-control framework to control the development of the wheelchair by coordinating finger development global positioning framework, a little vocabulary speaker subordinate based word acknowledgment framework and a gathering of observing sensors to keep away from obstructions. Additionally, a joystick control framework is likewise carried out to work with the patients that can utilize the joystick. The subject is cultivated by utilizing a miniature regulator with advanced sign processor for confined word acknowledgment and sets of sensors. The outcomes are likewise given toward the end of the paper

C MEMS based gesture recognition

Gesture recognition has been widely explored and has generally been refined by strategies dependent on PC vision. In this paper the authors [3] present a hand signal acknowledgment framework which is of general utilize and can be utilized for various applications. The framework depends on a MEMS accelerometer and it can perceive a few motions which have been recently recorded into a suitable vocabulary..

D Accelerometer and voice controlled wheel chair

Wheelchairs are the technique for restoring every day schedule in the lives of severely disabled people. A uservoice recognition feature and ultrasonic sensor systems have been interfaced in this wheelchair [4]. And the authors here provide for a customized smart wheelchair which can be driven using voice commands and with the provision of avoiding obstacles by using ultrasonic sensors .

The wheelchair has moreover been made to work on improvement of accelerometer which will be of a great help for the individuals whose upper and/or lower limbs are disabled. Accelerometer can be attached to any body part of a physically-

disabled or crippled individual, which he can without a doubt move, like head, hand, etc. Furthermore, the creators have integrated the wheelchair with a joystick for crippled persons who can easily move their hand.

E A Novel Multipurpose Smart Wheelchair

In this paper [5] that we referred to, an intelligent wheelchair which can provide assistance to physically handicapped, visually impaired as well as old and weaker people, was proposed by the authors. Elderly and physically impaired individuals usually find themselves unable to do their day-to-day tasks without external assistance. In the present fast-paced world it is really difficult for the elderly and differently-abled individuals to be dependent on others. This project was developed with the objective to provide independence to such people in need. The project is an integration of a navigation system which uses an accelerometer and a magnetometer, the system comprises a navigation pad which can be held in hand or tied to the head for controlling the movement of the wheelchair. It also has provision for obstacle avoidance consisting of four ultrasonic sensors, real time location tracking system which uses RFID for tracking the wheelchair in any building and a voice control system to assist the visually impaired.

III. METHODS

This section deals with the block diagram and its description. The block diagram of Wagon - The smart wheelchair is shown in Fig.1.The core of this project is Raspberry-pi , supported by Arduino UNO. The wheelchair has a total of five motions, namely forward, reverse, left, right and stop.

Initially, the user will get an option to select the mode of operation. The system consists of an Accelerometer for detecting head movement of the patient and flex sensor to read the hand gestures and control the wheelchair accordingly. A java based android application is developed, which is enabled with a touch-panel having buttons to control the wheelchair, and also a voice feature to control the motion, through single word voice commands. The app also has an SoS feature to help the patient in case of emergency. This feature is GPS enabled and successfully sends the user location to his caretaker. This feature is also enabled to make and manage calls to emergency helplines when needed. This app is built on Android Studio.All the four control mechanisms are capable of controlling the wheelchair motion in above stated directions.

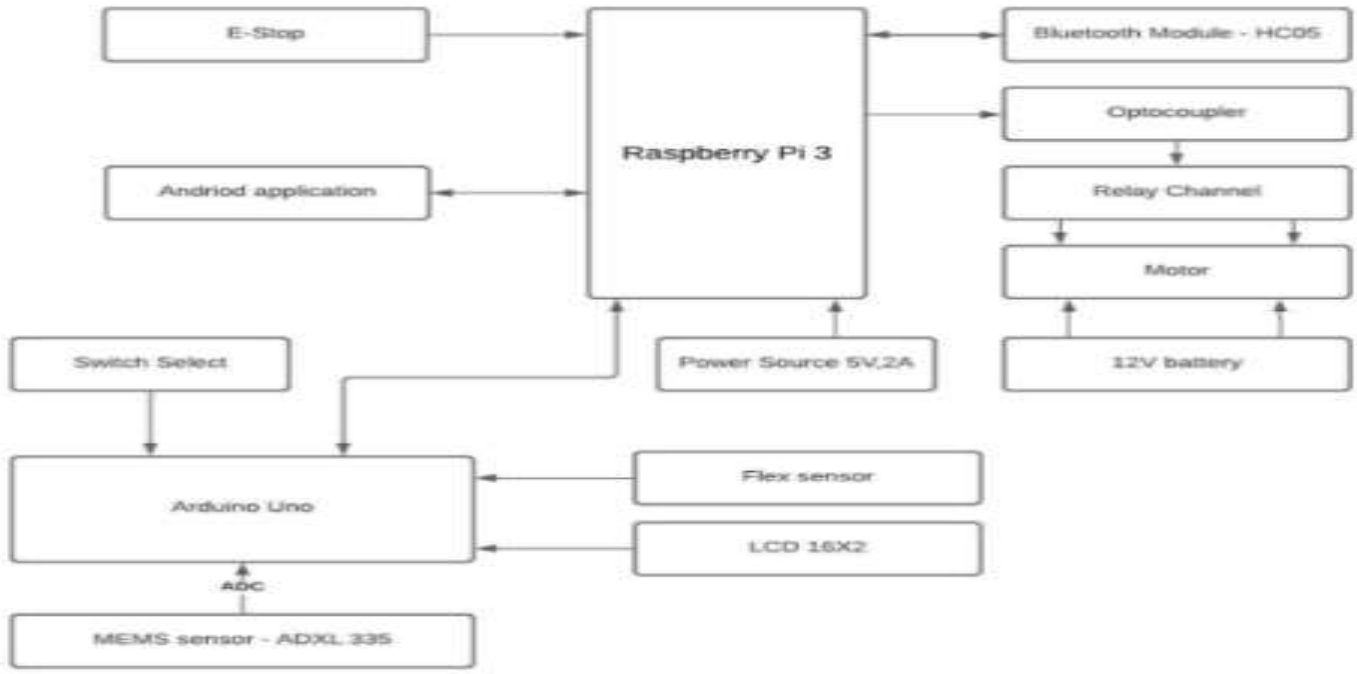


Fig. 1 Block Diagram

Workflow of the project

The workflow of our project is depicted in the flowchart in figure 2. This flowchart graphically shows the working algorithm of the project along with its four major control features, their selection decisions and execution, systematically.

Depending on user input, the control will switch as follows:

- Finger Gesture control
- Head Movement Control
- Voice Control through App
- Touch Panel Control through App
- SoS for Emergency

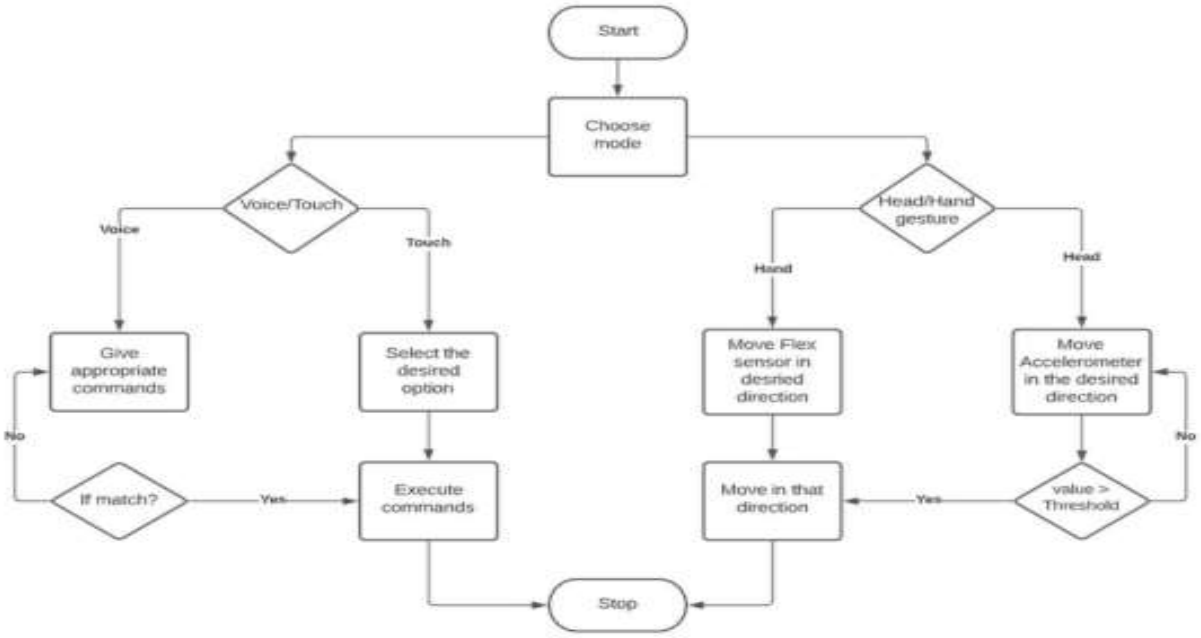


Fig. 2 Flow Chart

A. *Finger Gesture Control*

Flex Sensors fitted in a glove can be used to control the movement of our wheelchair in any four directions. The sensor is useful in calculating bent , flex,or the change in angle of the instrument or thing its fixed upon. The change in resistance with the bend in sensor is approximately linear in manner. Thus by connecting sensor to the device, we can have the bend angle in form of resistance which is an electrical parameter.This flex sensor is interfaced with Arduino UNO microcontroller through its digital pins , and it is programmed to read finger movements in forward, reverse,left and right directions to sync the movement of the wheelchair accordingly. Low signals indicating no movement, cause the wheelchair to halt at a position.

B. *Head Movement Control*

One of the four control mechanisms of Wagon - The Smart Wheelchair is the head movement control. Implemented through an Accelerometer Sensor, ADXL335, using Raspberry pi 3 and Arduino UNO microcontroller. An accelerometer sensor is used to measure proper acceleration on which it is used upon. Proper acceleration is basically acceleration of a body in its own instantaneous rest, differing from coordinate acceleration.This MEMS sensor is interfaced with Arduino UNO microcontroller, and it is programmed to read head movements in forward, reverse,left and right directions to sync the movement of the wheelchair accordingly. Low signals indicating no movement, cause the wheelchair to halt at a position.

C. *Voice Control*

Speech-to-text Intent is used in the android application to assist movement of the wheelchair based on the user's voice instructions.Speech to text means that anything that the user says is converted into text. This feature has come out to be a very common and useful feature for the users. onClickListener is added with the mic icon so when the user clicks on the icon(image) of mic it is invoked.

RecognizerIntent.ACTION_RECOGNIZE_SPEECH is used in the listener that starts an activity that prompts the user for speech and sends it through a speech recognizer. The results will be returned via activity results in the onActivityResult() method, when the main intent is to start using the startActivityForResult(). In the onActivityResult() method a list of strings is returned and the text is replaced with it in the textview. The commands are prompted to the wheelchair through the bluetooth module, which in turn is interfaced to the raspberry pi, and prompts the wheelchair to move in the directed direction accordingly.

D. Touch Control via App

OnClickListener events enable the user to control the movement of the wheelchair through the touch panel GUI on our mobile application. These events recorded on screen, trigger the click events, which in turn prompts the bluetooth module HC05 to send the signal to raspberry pi microcontroller and that in turn moves the wheelchair in the desired direction.

E. SoS

This feature of our project is app-exclusive. It empowers the user to feel safe and can come in-handy during emergency situations. By clicking on the SoS button present on the main screen of the app, the user calls the police or fire station.or their caretaker and family members on one click.

This feature can make and manage phone calls to the registered numbers, and it immediately sends the GPS location of the user to their caretaker, through the mobile GPS tracker. A buzzer also gets activated on pressing the SoS button,to alert the people nearby.

IV. RESULTS AND DISCUSSIONS

The proposed project was successfully implemented. The results are shown below:

1. *Hardware Integration:*

All the different hardware components, like raspberry pi,Arduino UNO, sensors, motors, drivers, bluetooth module and the LCD, were integrated into the wheelchair chassis. Resulting images are as shown below:

Fig.3 Side View of Wagon

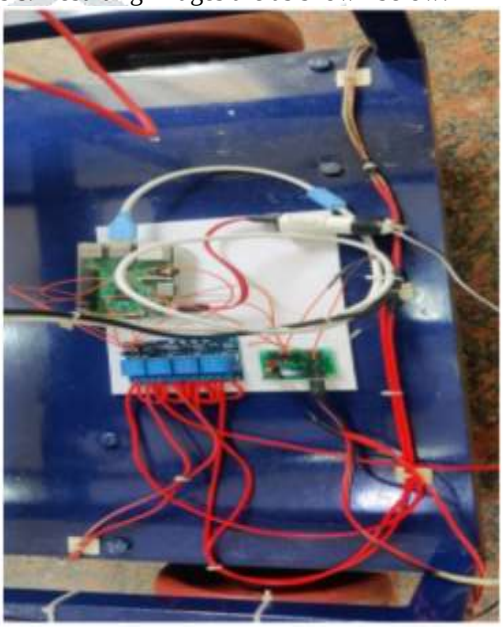
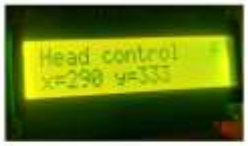


Fig.4 Top View of Wagon

2. *Head Movement Control:*

The result for Head Movement control in forward, backward, left and right movement control and stop position are shown below:



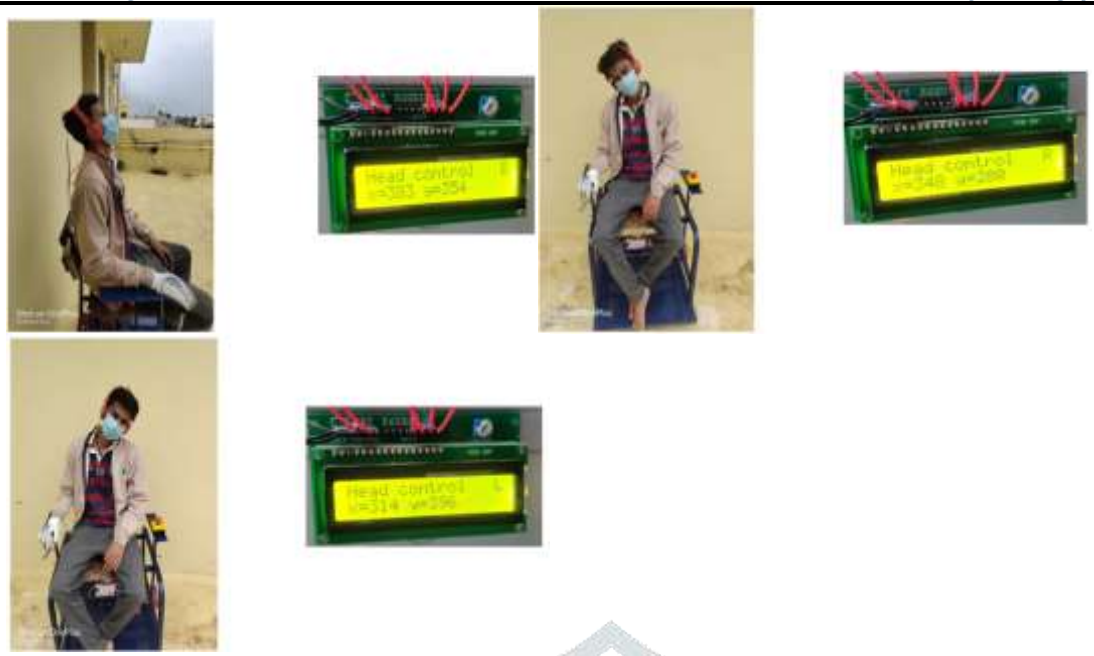


Fig 5 Head Movement Control in Forward, Backward, Left, Right Directions

3. *Hand Gesture Control:*

The result for Hand Gesture control in forward, backward, left and right movement control and stop position are shown below:

Fig 6 Hand Gesture Control in Forward, Reverse, Left and Right Directions

4. *Voice Control through App:*

The application results are shown below for control of the wheelchair through voice commands in forward, backward, left and right motion :

Fig 7 Voice Control through Mobile Application

5. *Touch Panel Control through App:*

The application results are shown below for control of the wheelchair through the touch panel in forward, backward, left and right motion :

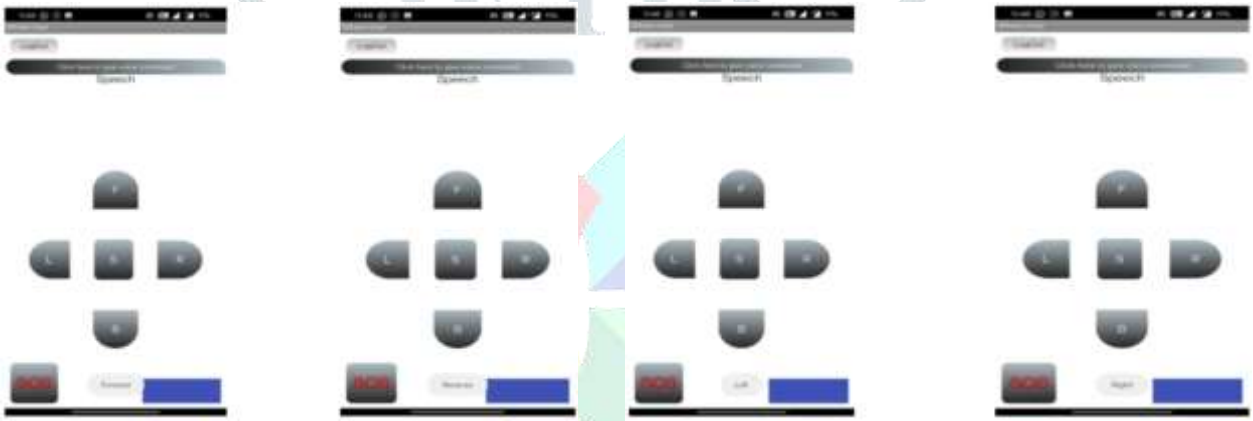


Fig 8 Touch Panel Control through Mobile Application

A. CONCLUSION

By utilizing this framework physically crippled individuals find a simple approach to move independently inside the house without any assistance. This gives simplicity of operation.Also since the framework utilizes Smartphone, the precision is expanded. Less lag is experienced in case of phone control features, touch and voice. The SoS feature and location sharing proves to be a boon for disabled patients in case of any emergency situation. The head movement and hand gesture control provide assistance in case of severe disabilities of the patients.Thus, here we successfully provide an integrated solution for all kinds of physical disabilities.

B. FUTURE SCOPE

The potential future scope of this project are :

- The project can be upgraded in terms of speed and the lag can be overcome by improving the technologies used and/or replacing them with more advanced tools and sensors.
- Wagon can also be converted into an IoT project by interfacing it along with a wifi module and thus making the wheelchair more technically advanced to control through a phone and the SoS and location sharing feature more convenient and user friendly.

V. ACKNOWLWDGEMENT

We express our sincere thanks to our institution Siddaganga Institute of Technology, Tumkur, the Departments of Computer Science and Engineering and Electronics and Communication Engineering for encouraging us to take up this project and guiding us throughout the development process.

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