Hardware Implementation Based On Head Movement Using Accelerometer Sensor

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Abstract: The challenging problem faced by the paralyzed people is their independent mobility. They need an external help to perform their daily activities. The main objective of this project is to rehabilitate the disabled people who cannot perform their voluntary movement. The hardware implementation of the wheelchair will be a mobility aid for the patients who are extremely suffering from the quadriplegia. The wheelchair will work based on the head movement of the user. The recognized gestures are used to generate motion control commands to the controller so that it can control the motion of the wheelchair according to the users intention. Head movement is one of the natural gestures which can be easily tracked. The head movement is the gesture which can be performed by the quadriplegic patients whose body parts below the neck is paralysed. So the head movement is possible for the patients. The wheelchair includes the accelerometer sensor which detects the movement of head and the controller will process the signal and will transmit to the wheelchair for its navigation. This is will offer a small relief to the patients who are tolerating from this condition. The wheelchair is implemented in a cost effective way which reduces the complexity in the design. It is intended to be used as a human-friendly interface for elderly and disabled people to operate wheelchair using their head gestures rather than their hands. This autonomous navigation ensures safety, flexibility, mobility, obstacle avoidance and an intelligent interface for the users.

Keywords: Accelerometer, Gestures, Head movement, Navigation, Quadriplegia.

1. Introduction

Rehabilitation Engineering is the application of engineering principles and technology in the field to uplift the people with disabilities. Quadriplegics are persons who are not able to use any of the extremities. The reasons for such decreased motion possibilities can be due to stroke, arthritis, high blood pressure, degenerative diseases of bones and joints and cases of paralysis and birth defects and the quadriplegia appears as a consequence of accidents or age. the robotic wheelchair supports two ways of controlling. The first way is through the usual joystick or keypad control. The second way is through the movements of head. Head movements control is particularly useful for severely-handicapped people who have spinal cord injury or quadriplegia which cannot use their hands to control the wheelchair. This will be an effective method to eradicate the social problems faced by the physiologically challenged persons. This is directly interfering with the social relevance of the society. The mobility aid which will help to an extend for the challenged people for their locomotion. Usually these peoples are bedridden and difficult for their movements from their bed. It is very difficult to make them move from one place to another. The main reason behind the implementation of this project is to give a helping hand for the sufferers of the challenged people. They have no way to get rid of from the bed due to their lack of movements. Degeneration of nerve cells and muscle fibers can lead to the challenges. To defeat the challenges is the
main objective of this project. By designing the wheelchair for the challenged people can reduce the sufferings of the patients to an extent. Powered wheelchairs play a vital role in bringing independence to the severely mobility–impaired and allow people to get on with their activities of daily living. Many people who suffer from mobility–impairments rely on powered wheelchairs to get out and about. However, a substantial number of users find it difficult to operate their chairs effectively; this can be due to a variety of physical, perceptive or cognitive impairments. It needs for the development of smart wheelchairs that would empower people with mobility impairments to get on safely with their activities of daily living. The disabled people can direct the wheelchair to the designation without any difficulty.

2. System Details

2.1 Existing System

The existing system is the wheelchair which is using the head movement based wheelchair. The existing uses different techniques which includes the face recognition algorithm which is used to find out the face and from that and detect the position of head and motion of the head is detected and the wheelchair is navigated. The existing system includes more complex algorithms for detecting the head movements and the rate of complexity and the computational time is required.

2.2 Proposed System

The proposed system uses the accelerometer to find out the movement of the head is detected. The proposed system implements a wireless wheelchair which includes only hardware and lacks the software part. The software part will increases the cost implementation. The main objective of this project is to design a wheelchair for the quadriplegics patients in a cost effective manner. The implementation is done with more accuracy and cost effective way. The wireless hardware implementation is controlled by the controller and the signals will be transmitted to motor which gives the result as the movement of wheelchair in the respective direction.

The project implements the wheelchair that will move according to the head movements of the user. The wheelchair will take the direction of the user according to their head movements. The accelerometer that will be connected and the data signals will be collected from accelerometer. The data will be processed with the help of a processor and the digital signals will give commands to the wheelchair. By receiving the signals from the processor the wheelchair will give the assigned movements according to the head movements given by the user. The head movements of the user will be according to the right, left, forward and reverse direction, and accordingly the wheelchair is programmed so that when the head movement is performed then the wheelchair will move in the right direction. Respectively for each head movements the wheelchair performs the movement accordingly.

3. Result and Discussion

The wheelchair implementation using the head movement consists of hardware and software part. The software part consists of the simulation of the hardware implementation. The hardware output will be simulated using the software. The software used here is the ISIS proteus which helps in simulation of the hardware part.
The rotation of the motor which help in the wheelchair movement is simulated. The microcontroller is the main controller which will control the movement of the motor. The controller will control the motor rotation in the respective direction such as left, right, forward and reverse direction. The controller will give commands to the motor and the motor will rotate which gives the movement of the wheelchair.

The wheelchair can be navigated by using the motor rotation which helps by the ISIS Proetus software which helps in the simulation of the system components. The system components will be arranged and connected using the software. The output can be obtained as the rotation of the motor in the right direction when the potentiometer value given corresponding to it. Otherwise it will rotate in the left direction. Also there will be forward and reverse direction using the next motor. The potentiometer is set in such a way that the motor will be rotating in the forward direction or else if the value is changed and it will be rotating in the reverse direction. Hence the motor will be rotating in 4 different directions according to the value given. This movement which corresponds to the navigation of the wheelchair according to the head movement of the user.

4. Conclusion

The main objective in carrying out this project was to provide the quadriplegic patient, who cannot use his arms, with means of control over his direct environment. Residual head motion was considered to be adequate, first, to control an electric wheelchair. The wheelchair based on head movement is used for the quadriplegics people who are unable to move their hind limbs and fore limbs. The people who can move their head portions but cannot able to move their limbs can make benefit of this wheelchair. This will aim to help people who are suffering from mobility impairments (and often compound disabilities) achieve a level of independence, so that they can get on with their activities of daily living. According to the head movement wheelchair will get oriented and take movements. This will be mobility aid for the patients who are bedridden and cannot move without the help of bystanders. By connecting the accelerometer to the head of the patients and the signal processing system will be collecting and recording the signals. The processed signal will be given to the microcontroller and it gives various commands and accordingly the motor connected to the wheelchair rotates. It will take the direction according to the commands given by the

Figure 1: Block diagram of the proposed system
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Microcontroller. The wheelchair will turn its direction according to the commands given by the controller. The controller will make the decisions from the head movements given by the users. It is fully a user controlled mobility aid for the quadriplegic people to handle the wheel chair using their head movement.

4.1 Future Scopes

The future scopes of the project are based on the head movements controlled wheelchair. The accuracy will be more if the motor specification is used in upgraded manner. To turn the wheelchair according to the head movement direction it should use the motor with high specifications. There will be no obstacle identification in this project. But as a future work, the wheelchair should detect the obstacles and will change its navigation path according to that. The automatic detection of the obstacle already exists and it will navigate by avoiding the obstacles. It will help the user to navigate the wheelchair by automatic detection of the obstacles in the pathway. It need not require user control and it will be automatically change its navigation path while detecting the obstacle. By combining the eye tracking and head movement gestures it will become more effective than individual gestures. The eye tracking have its own demerits and head movement have its own limitations. The combination of those two gestures will reduce the limitation of both and will work efficiently. The accuracy of the eye tracking system will have accuracy which will depend upon the eye movement. The accuracy can be upgraded by the combination of vision based and head movement gestures.

5.3 Application

The main application of hardware implementation of the wheel chair is for the people who are affected by paralysis and stroke. It is very difficult to move for them without the help of others. They face barriers at their each turn and they need some helpers in their daily works. The assistive device acts as a boon for them. The most widespread assistive device is the wheelchair. Hence, there is a need to develop a platform for those people who are physically challengeable. The application of this hardware implementation is mainly aiming the rehabilitation of the physically challenged people.[9] This wheelchair will be mobility device for the patients who are confined to the bed who cannot move without the help of others. This can be a helping aid for the elderly people and the people who are suffering from quadriplegia and paralysis can effectively use this wheel chair for their navigation.

6. References


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