Hybrid Wheelchair Controller for Handicapped and Quadriplegic Patients

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Theses

1. The huge increase of elderly in the society, increasing of the accident, wars and paralyzed persons makes the main reason to develop new control methods for wheelchairs and rehabilitation robots.

2. Quadriplegia and paralyzed patients can be the primary targets of this work to help them in using an electric wheelchair in their daily activities.

3. The comfort, simplicity, and safe use, of the control solution, can directly affect their social efficiency and quality of life.

4. Limited effective and useful control signal from quadriplegia patient can be used.

5. User's voice can be used as one of the effective solutions for quadriplegic patients to control a wheelchair or rehabilitation applications.

6. Embedded voice recognition modules with a microcontroller can be covered the required number of voice commands need to be used for wheelchair control purpose and also they can provide a low-cost and a small size solution.

7. Speaker dependent mode of voice recognition can be the best choice for controlling wheelchair and rehabilitation application to let the system responds only to the wheelchair user commands.

8. Speaker independent mode can be used for general purpose control application such as lab automation based on the application requirements.
9. Using two or more voice recognition modules can improve the voice controller performance and help the system to detect the false positive errors in the recognition process. The test of this implementation with 1260 voice samples in two different noise environments shows that it improves the voice recognition accuracy ≈ 5% in 42 dB noise test environment and ≈ 3% in 72 dB noise test environment.

10. False positive cancellation function can be used to reduce the false positive errors. The practical tests show successful performance with ≈ 0 false positive errors for the tested samples.

11. Head tilts can be used as a control solution for quadriplegic patients to control the wheelchairs using head orientation.

12. Measuring the head orientation and wheelchair reference orientation can add an important feature to the head tilts controller to avoid the change in the control commands thresholds in the case of ascending and descending ramps. Auto-calibrating algorithm has been implemented and tested successfully to avoid these drawbacks.

13. A command confirmation function can be used in the head tilts controller to avoid the system response for involuntary head motion. The function implemented and tested successfully.

14. Orientation sensor error handling function can be used to inform the user if any of the orientation modules stop updating orientation data due to any reason.

15. A wrong head orientation handling function can be used to stop the system and protect the user if the head orientation goes out of the programmed ranges of the control commands tilts angles.

16. The Integration of voice and head tilts controller in one hybrid controller produces a simple, fixable and comfortable controller that allows quadriplegics and disabled users to select and change the voice and head tilts controller easily.

17. The head tilts controller has shorter reaction time than a voice controller and it can be used as the main controller. The practical tests revealed that the users of the head tilts controller with previous training have a better performance in indoor as well as outdoor tests.