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UPES to enhance mobility for elderly with hand gesture device-based wheelchair

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Students from School of Advanced Engineering at UPES have developed a wheelchair that is aimed at enhancing mobility for the elderly and individuals with lower limb disabilities. The modular design of the wheelchair incorporates several essential features such as hand-gesture recognition using inertial measurement units, and a dual motor control system resembling four-wheeler steering, fall detection amongst others. During an interaction with BioSpectrum, Dr Piyush Kuchhal, Professor, School of Advanced Engineering, UPES shares more details about this innovation.



Tell us about the genesis of this idea and what made you work on developing the wheelchair?

The genesis of this idea came into being as we aimed to implement our previously system based on the principles of a previously developed home automation system. We recognised the increasing popularity of Inertial Measurement Units (IMUs) due to their exceptional capability to accurately detect orientation and motion and how they could be implemented in a wide range of application with proper degree of calibration. Not only this a huge driving factor of our project remains to be the social impact that this device can have on people with mobility impairments, congenital mobility issues and accident victims. This device provides a new prospect to the traditional manual as well as joystick wheelchairs as it not only provides more independence to the user but also comes in a much more feasible range. For patients with high limbic mobility issues, this wheelchair can be highly assistive as it can be controlled using the palm and finger movements of the hand alone. Moreover, the implementation of a differential axle to a wheelchair to distribute power efficiently, incorporated with a hand gesture device is not yet available in documentation and therefore adds rarity and significance to our endeavour.

What's the technology behind developing this product and how exactly does the product solve mobility problem for the elderly people efficiently?

Our project introduces a cost-effective solution for enhancing electronic wheelchairs with improved Human-Machine Interaction (HMI). We utilise an open-differential axle and a rack and pinion mechanism to enable directional movement, powered by servo DC motors. Hand gestures replace traditional joystick controls, enhancing user independence. An embedded IMU sensor on a glove detects real-time gestures, wirelessly transmitting commands to the wheelchair's motors via Bluetooth modules. Safety features include an emergency SOS system triggered by a flex sensor and touch sensor, ensuring user security in case of emergencies. This comprehensive system prioritises user comfort, safety, and autonomy.

Are you looking to apply for a patent or is already applied?

Yes, the team has recently applied for a patent.

Tell us about the team and students behind this project. How much time did it take to develop the product?

Our team consists of two final year students from electronics and communication engineering namely, Kriti Chauhan and Anubhav Tyagi. They have been highly motivated individuals eager to acquire practical knowledge and expertise in the design and development of embedded systems, encompassing sensor calibration, microcontroller programming, and assistive automation applications. The entire project was finalised in eight months from ideation to final testing and implementation.

What are your future plans for this innovation? Do you plan to upgrade this in other stages?

It is possible to upgrade this project in various ways in accordance with industry standards, compactness and further optimisation like implementing advanced power monitoring to optimise usage and extend battery life, ensuring reliability, creating sophisticated battery management systems to improve performance. Further, optimised current consumption by assessing and adjusting current draw for various loads to enhance energy efficiency and minimise consumption.

How do you plan to commercialise this product?

After much refinement and upgradations in terms of long-term use and industry standards, this project can be commercialised for mobility assistance. As of now, it is a lab prototype.

Are you looking for industry partners?

No

How much was invested in the R&D? Any grants that were used?

About Rs 60,000 were invested in the development of this project, of which 48% was funded by the university as part of a departmental project (Electrical Cluster), while the rest was invested by the students.

How is the technology unique from what is already available in the market?

Our technology revolutionises conventional mechanical wheelchairs by seamlessly transitioning them into electronic counterparts capable of responding to electronic sensory inputs. Unlike existing market offerings, our system incorporates an open differential and rack and pinion mechanism, enabling efficient execution of electronic commands. Through the integration of motors with these mechanisms, we empower users with a more versatile and responsive mobility solution. What sets us apart is our intuitive control system, allowing users to effortlessly navigate using simple hand gestures.

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