**Title:** Using 3D sensing and projecting technology to improve the mobility of Parkinson's disease patients

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**Abstract:** Parkinson's is a neurological condition in which parts of the brain responsible for movements becomes incapacitated over time due to the abnormal dopamine equilibrium. Freezing of Gait (FOG) is one of the main Parkinson's Disease (PD) symptoms that affects patients not only physically but also psychologically as it prevents them from fulfilling simple tasks such as standing up or walking. Different auditory and visual cues have been proven to be very effective in improving the mobility of People with Parkinson's (PwP). Nonetheless, many of the available methods require user intervention or devices to be worn, charged, etc. to activate the cues. This research suggests a system that can provide an unobtrusive facility to detect FOG and falling in PwP as well as monitoring and improving their mobility using laser-based visual cues casted by an automated laser system. It proposes a new indoor method for casting a set of two parallel laser lines as a dynamic visual cue in front of a subject's feet based on the subject's head direction and 3D location in a room. The proposed system controls the movement of a set of pan/tilt servo motors and laser pointers using a microcontroller based on the real-time skeletal information acquired from a Kinect v2 sensor. A Graphical User Interface (GUI) is created that enables users to control and adjust the settings based on the user preferences. The system was tested and trained by 12 healthy participants and reviewed by 15 PwP who suffer from frequent FOG episodes. The results showed the possibility of employing the system as an indoor and on-demand visual cue system for PwP that does not rely on the subject's input or introduce any additional complexities to operate. Despite limitations regarding its outdoor use, feedback was very positive in terms of domestic usability and convenience, where 12/15 PwP showed interest in installing and using the system at their homes.

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This research group has led the PERFORM project (A soPhisticatEd multi-paRametric system FOR the continuous effective assessment and Monitoring of motor status in Parkinson's disease and other neurodegenerative diseases), an European research project partially funded by the European Commission through the Seventh Framework Programme whose consortium includes universities, hospitals, SMEs and big companies from Spain, Italy, United kingdom, Poland, Cyprus and Greece. These researchers not only have worked on the design of the sensors and the algorithms used to monitor patients but also have studied how to improve the user experience for these kinds of systems even among people that are unfamiliar with new technologies. Many Parkinson's patients eventually lose 80 percent or more of their dopamine-producing cells. While the neurons' underlying cause of death remains uncertain, researchers have identified several cellular characteristics that are common in this disease and which appear to play a role in the neuronal degeneration. Another commonly used scale is the Unified Parkinson's Disease Rating Scale (UPDRS). This much more complicated scale has multiple ratings that measure mental functioning, behavior, and mood; activities of daily living; and motor function. They also are working to improve the technology available for DBS. Parkinson’s Disease: Challenges, Progress, and Promise 9.