FORM 2

THE PATENT ACT 1970

(39 OF 1970)

AND

The patent rules, 2003

COMPLETE SPECIFICATION

(See section 10: rule 13)

TITLE OF INVENTION

A SYSTEM FOR REHABILITATION THERAPY OF PATIENTS

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PREAMBLE TO THE DESCRIPTION

COMPLETE

Following specification particularly describes the invention and the manner in which it is to be performed.

DESCRIPTION

TECHNICAL FIELD OF INVENTION

The present invention is related to the field of computer science and engineering. More specifically, it relates to a system for rehabilitation therapy of patients.

BACKGROUND OF THE INVENTION

The background information herein below relates to the present disclosure but is not necessarily prior art.

Traditional physical therapy relies on repetitive exercises that often become monotonous, leading to poor patient engagement, while lacking real-time feedback and quantitative progress tracking, limiting personalization and effectiveness. Existing digital solutions require painful physical contact with devices, clinical supervision, and expensive specialized equipment, reducing accessibility for home-based therapy and limiting patient participation. Gaming-based rehabilitation enhances engagement but lacks customization for specific injuries, progressive difficulty adjustments, and precise movement tracking, essential for effective rehabilitation, while also missing adequate medical oversight.

Additional issues include limited personalization, poor patient compliance due to monotonous routines, and insufficient integration with healthcare providers for remote monitoring and feedback, with many systems lacking detailed real-time performance analytics for accurate progress tracking. Technological gaps persist as many solutions fail to leverage AI, machine learning, or augmented reality, which could improve feedback, monitor fine motor skills, and simulate real-life scenarios for rehabilitation. These shortcomings highlight the need for a more accessible, engaging, and personalized rehabilitation system that integrates modern technology for improved patient outcomes.

US20160129343A1 related to a kinetic rehabilitation system comprising: a kinetic sensor comprising a motion-sensing camera; and a computing device comprising a non-transient memory comprising a stored set of values of rehabilitative gestures each defined by a time series of spatial relations between a plurality of theo retical body joints, and wherein each time series comprises: initial spatial relations, mid-gesture spatial relations and final spatial relations, and a hardware processor configured to continuously receive a recorded time series of frames from said motion-sensing camera, wherein each frame comprises a three-dimensional position of each of a plurality of body joints of a patient, wherein said hardware processor is further configured to compare, in real time, at least a portion of the recorded time series of frames with the time series of spatial relations, to detect a rehabilitative gesture performed by the patient.

OBJECTIVE OF THE INVENTION

The primary objective of the present invention is to provide a system for rehabilitation therapy of patients.

Yet another objective of the invention is to transform repetitive rehabilitation exercises into interactive, enjoyable, and gamified challenges to maintain patient motivation throughout the recovery process.

Yet another objective of the invention is to provide precise measurement of movement accuracy to ensure that exercises are performed correctly, maximizing therapeutic benefits for the patient.

Yet another objective of the invention is to enable home-based rehabilitation, allowing patients to continue therapy without frequent hospital visits, making therapy more accessible, especially for patients in remote areas.

Yet another objective of the invention is to provide a more affordable and accessible alternative to traditional rehabilitation equipment, reducing the cost of therapy while maintaining its quality.

SUMMARY OF THE INVENTION

Accordingly the following invention provides a system for rehabilitation therapy of patients designed to enhance motor skill recovery through interactive and gamified therapy. It utilizes a motion-tracking sensor or camera to capture the user's hand gestures, which are analyzed by an AI-based processing unit to evaluate accuracy and provide real-time feedback. The system presents visual rehabilitation patterns that users replicate, progressively increasing the difficulty based on their performance.

Personalized therapy plans are generated according to the user's specific injury and progress, with dynamic levels and adaptive difficulty. The platform supports home-based use, offering accessibility and reducing the need for frequent clinic visits. A mobile app or web interface enables remote monitoring, allowing healthcare professionals to track progress and adjust therapy plans. TheraCanvas also features gamified elements to maintain patient engagement, making rehabilitation both effective and enjoyable. This system is particularly beneficial for hand injury recovery, motor skill improvement, and managing conditions like Parkinson's disease.

BRIEF DESCRIPTION OF DRAWING

Figure 1 of Sheet 1 illustrates the flowchart of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

As used in the description herein and throughout the claims that follow, the meaning of "a," "an," and "the" includes plural reference unless the context

clearly dictates otherwise. Also, as used in the description herein, the meaning of “in” includes “in” and “on” unless the context clearly dictates otherwise.

The present invention is related to a system for rehabilitation therapy of patients designed to enhance motor skill recovery through interactive and gamified therapy. TheraCanvas provides an engaging, gamified approach using air gesture recognition for interaction, ensuring precise movement accuracy measurement and progress tracking to enable tailored therapy plans with progressive difficulty levels.

The system facilitates remote monitoring by healthcare professionals, reducing dependency on constant therapist presence while enhancing accessibility and convenience. By transforming repetitive rehabilitation exercises into interactive challenges, it improves patient engagement, maintains motivation, and provides real-time feedback, boosting commitment to therapy. Precise movement tracking and pattern matching ensure correct exercise execution, maximizing therapeutic benefits, while adaptive difficulty levels and customizable exercise patterns cater to various injury types for a personalized rehabilitation approach.

Designed for home-based use, it reduces the need for frequent hospital visits, lowering costs and making therapy accessible to remote patients while offering a cost-effective alternative to traditional rehabilitation equipment. Additionally, TheraCanvas benefits Parkinson’s disease patients by providing a touch-free platform for motor therapy, interaction, and tremor tracking. Parkinson’s symptoms, including tremors, stiffness, and slowness of movement, make daily tasks challenging, but

TheraCanvas enables hand gesture-based interaction for drawing, writing, or digital device control, offering a safe and engaging way to manage movement disorders. Real-time tremor tracking provides valuable data for healthcare providers to monitor disease progression and personalize therapy. Gesture-based controls improve accessibility to smart devices, reducing reliance on touchscreens or physical buttons. By integrating virtual exercises and games, the system enhances physical capabilities and cognitive engagement, making therapy more effective. TheraCanvas

delivers an innovative, non-invasive solution that combines therapy, monitoring, and accessibility to improve the quality of life for Parkinson's patients.

Unlike traditional systems, it supports home-based use with customizable therapy plans, diverse input devices. Its flexible processing options and mobile app interface ensure accessibility, cost-effectiveness, and adaptability, addressing gaps in existing rehabilitation solutions.

A smart exercise game designed for individuals recovering from hand injuries or motor skill challenges integrates gesture-based interaction and gamified rehabilitation to facilitate recovery through structured and engaging exercises. The system features an AI-driven gesture recognition model that evaluates patient movements against displayed patterns, ensuring accurate assessment and adaptive progression. The process begins with a visual pattern displayed on a screen, which the patient mimics using hand gestures.

A motion-tracking sensor or camera captures the gesture, and the AI model processes it to determine accuracy. Based on the results, the patient either advances to the next pattern or repeats the current one, systematically improving motor skills through an interactive recovery process. Key functions include recognizing hand gestures through a camera or sensor, processing gestures and matching them to predefined patterns, calculating accuracy, providing immediate feedback, and managing progression through levels based on performance thresholds.

A system for rehabilitation therapy of patients comprises a gesture recognition unit with at least one depth sensor, infrared camera, or motion-tracking sensor to capture hand movements in real-time using computer vision and sensor fusion techniques to enhance movement accuracy detection. The processing unit, implemented with an AI-driven machine learning model, processes captured hand gestures, compares them with predefined exercise patterns, evaluates accuracy, and provides real-time feedback, employing convolutional or recurrent neural networks to analyze movement patterns and detect inconsistencies. The user interface module,

including a display screen or smart device interface, presents interactive exercises, gamified therapy tasks, visual cues, real-time feedback, and progression levels, offering customizable therapy exercises for patients with Parkinson's disease, post-surgical recovery, or general motor skill improvement.

A communication module establishes connectivity with a cloud-based or local server for remote patient monitoring, secure storage of therapy data, and accessibility by healthcare professionals for therapy adjustments, supporting wireless connectivity via Wi-Fi, Bluetooth, or LoRa for real-time synchronization with cloud databases. A mobile application allows users to access rehabilitation progress, enables therapists to modify therapy plans, and provides alerts and reminders for scheduled exercises, incorporating secured authentication and data encryption to protect patient health records.

The adaptive difficulty adjustment module, integrated with the processing unit, modifies exercise complexity based on patient performance, offering personalized therapy sessions tailored to individual recovery needs, using AI-based learning models to dynamically adjust therapy sessions. The feedback module includes audio, visual, and haptic feedback mechanisms to guide patients during exercise execution, improving engagement and adherence to rehabilitation therapy while providing AI-generated insights and recommendations based on historical data and real-time performance tracking.

The technology utilizes computer vision module and motion-tracking sensors for gesture recognition, a machine learning-based AI model for accuracy evaluation and feedback, and Python for system logic and gesture processing. Each user is assigned a unique personal ID, with all medical reports, including hand-related injury details and progress data, securely stored and dynamically analyzed. Based on these reports and injury specifics, the system generates personalized rehabilitation levels designed to address individual conditions and promote gradual recovery. A camera captures hand movements, which are then evaluated using advanced AI models trained for gesture recognition and analysis. An interactive exercise interface displays

patterns corresponding to rehabilitation exercises, requiring users to replicate them through hand gestures.

Successful replication above a predefined performance threshold prompts the display of a new pattern. Each level consists of multiple patterns that increase in complexity, with detailed performance analysis provided upon completion, including scores, areas of improvement, and problem resolution insights. Real-time feedback on accuracy and efficiency, along with gamified features like performance percentages and achievements, keeps users motivated and engaged.

Advanced monitoring generates detailed progress reports after each level, outlining improvements and remaining challenges, which can be accessed by users and shared with therapists for further guidance. If inaccuracies in gesture replication are detected, corrective feedback is provided to help users perform exercises correctly.

Post-surgery rehabilitation requires carefully structured programs to help patients regain functionality, especially in cases of tendon repair, joint replacement, or reconstructive surgery where precise movement control is essential. The system also supports general motor skill improvement, benefiting elderly individuals maintaining hand dexterity, professionals requiring fine motor control, and those looking to enhance hand-eye coordination.

Additionally, it serves as a therapeutic tool for managing stress and anxiety. The technology incorporates smartphone-based motion tracking for basic versions, machine learning for pattern recognition, various input devices such as depth sensors and infrared cameras, and both cloud-based and local processing options.

While various embodiments of the present disclosure have been illustrated and described herein, it will be clear that the disclosure is not limited to these embodiments only. Numerous modifications, changes, variations, substitutions, and

equivalents will be apparent to those skilled in the art, without departing from the spirit and scope of the disclosure, as described in the claims.

I/We Claim:

1. A system for rehabilitation therapy of patients, comprising of;

a gesture recognition unit comprising at least one depth sensor, infrared camera, or motion-tracking sensor, configured to capture a patient's hand movements in real-time using computer vision module and sensor fusion techniques to enhance movement accuracy detection;

a processing unit implemented using an AI-driven machine learning model, configured to process captured hand gestures, compare them with predefined exercise patterns, evaluate accuracy, and provide real-time feedback, employing a convolutional neural network (CNN) or recurrent neural network (RNN) to analyze movement patterns and detect inconsistencies in gesture execution;

a user interface module, including a display screen or smart device interface, configured to present interactive exercises or gamified therapy tasks, display visual cues, real-time feedback, and progression levels, and provide customizable therapy exercises tailored to the rehabilitation needs of patients with Parkinson’s disease, post-surgical recovery, or general motor skill improvement;

a communication module configured to establish connectivity with a cloud-based or local server for remote patient monitoring, secure storage of therapy data including injury history and progress analysis, and accessibility by healthcare professionals for therapy adjustments, supporting wireless connectivity via Wi-Fi, Bluetooth, or LoRa to enable real-time synchronization with cloud databases and healthcare professionals;

a mobile application configured to allow users to access their rehabilitation progress, enable therapists to modify therapy plans, and provide

alerts and reminders for scheduled exercises, incorporating a secured authentication system and data encryption techniques to protect patient health records and therapy progress;

an adaptive difficulty adjustment module integrated with the processing unit, configured to modify exercise complexity based on patient performance and offer personalized therapy sessions tailored to individual recovery needs, utilizing artificial intelligence-based learning models to dynamically adjust therapy sessions in response to a patient's recovery rate;

a feedback module including audio, visual, and haptic feedback mechanisms, configured to guide patients during exercise execution and improve engagement and adherence to rehabilitation therapy, providing AI-generated insights and recommendations for optimizing therapy progress based on historical data and real-time performance tracking.

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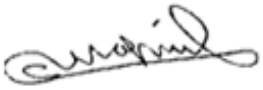

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ABSTRACT

A SYSTEM FOR REHABILITATION THERAPY OF PATIENTS

The present invention relates to a system for rehabilitation therapy of patients. The system integrates depth sensors, infrared cameras, and motion-tracking sensors to capture patient movements, which are processed using machine learning models for accuracy evaluation and real-time feedback. A mobile application facilitates remote monitoring by healthcare professionals, enabling personalized therapy plans with adaptive difficulty levels. The system provides visual, audio, and haptic feedback, improving patient engagement and adherence to therapy. Connectivity is established via Wi-Fi, Bluetooth, or LoRa, allowing secure cloud-based data storage and synchronization. Designed for home-based use, TheraCanvas benefits Parkinson's disease patients, post-surgery rehabilitation, and general motor skill improvement. The system supports wearable integrations and ensures low-latency real-time gesture recognition, making it a cost-effective, non-invasive alternative to traditional rehabilitation methods.