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Intelligent Flexible Locomotor for Physically Challenged People

Sethupathy P, Arun Balaji T, Rohith M, Sheyam Joshua R

Department of Mechatronics Engineering

SNS College of Technology, Coimbatore-641035, India

ABSTRACT: The paper proposes the intelligent semi-automated locomoting vehicle rooted by gesture control technology. Aiming smooth locomotion and caring unit for physically challenged persons who find it arduous to move from a place to another and changing posture of body for their regular routines. As various limb movements are prohibited various posture like wheelchair position, stretcher, standing posture are made possible with flexible construction of locomotor assisted by linear actuators. The locomotor is plotted as transmitter unit which senses the gesture recognition of respectable acknowledged part of the body, produces output signal for receiver unit using accelerometer and RF modules. Where the receiver unit receives input RF signals and processes with microcontroller to actuate the vehicle. Intelligent services like heartbeat monitoring system, obstacle detection, GPS tracking module assist the locomotor with self-monitoring the health of the user.

KEYWORDS: Semi-automated vehicle, linear actuators, gesture control, self-monitoring unit.

I.INTRODUCTION

All the living organisms exhibit a special characteristic feature of moving the whole or a part of the body from one place to another called locomotion. Particularly we humans locomote to have food, reach our shelter, work, excrete etc., unanimously we locomote to achieve our daily basic routines at least. Just thinking of in perspective of physically challenged people who find it arduous to locomote and hardships in achieving their daily duties, if modern day technologies could contribute in their life enhancement it will be the best prospect of science. [1] The wheelchair is one of the most commonly used assistive devices for enhancing the personal mobility of people with disabilities. An estimated 1% of the world's population, or just over 65 million people, need a wheelchair. A stretcher is an apparatus used for moving patients who require medical care or emergency bed for a patient who cannot withstand any more sitting or standing posture or may be even for the purpose of rest. [2] The global stretcher market is expected to reach an estimated $2 billion by 2023 and is forecast to grow at a CAGR of 5.9% from 2018 to 2023.So especially for the people who find hardships in all three major postures of sitting, standing, sleeping postures including Locomotion; Intelligent Flexible Locomotor (IFL) could be a combined one fine solution. As the locomotor is designed in such flexible model to achieve various postures in one unit which is semi automated with help of linear actuators. People with serious disability problems like Parkinson's disease who tend to have less voluntary movable parts in their body could be assisted by gesture technology for their locomotion. Intelligent services like obstacle avoidance, GPS tracking, self-monitoring health unit etc., will amplify the systems capability to assist the user in more efficient way.

II.MULTI-POSTURE DESIGN

Usual wheelchairs are equipped unanimously with sitting posture design, rarely equipped with standing or\and lying posture flexibility. Though the developed wheel chair has those all-flexible features they lack control systems mostly functioning on manual switching method. [3] In addition, if patients want to get on to the bed from the wheelchair, or do some rehabilitation exercises, they need help from others. It is not only a waste of human resource but it also brings mental pressure to patients. They will gradually

loose confidence. Therefore, it will be necessary to develop a versatile wheelchair with good performance and which will be easy to use.

IFL opens the gateway for all the three important postures,

I) Sitting posture,

II) Standing posture,

III) Lying posture - under one roof of design which is controlled by gesture or user's choice of semi-automation technology.

II.A MULTI POSTURE GESTURE CONTROL SYSYTEM

When multiple posture mechanically flexible model is achieved, the controlling mechanism of various posture switching is to be decided. In this case, usage of gesture technology could play a crucial role. Linear actuators are acting as drivers of individual holding unit in locomotor. A linear actuator is an actuator that creates motion in a straight line, in contrast to the circular motion of a conventional electric motor. Those linear actuators upward and downward movement is controlled on the basis of user's wish as gesture input. Gesture control system is divided as two unit as transmitter and receiver unit.

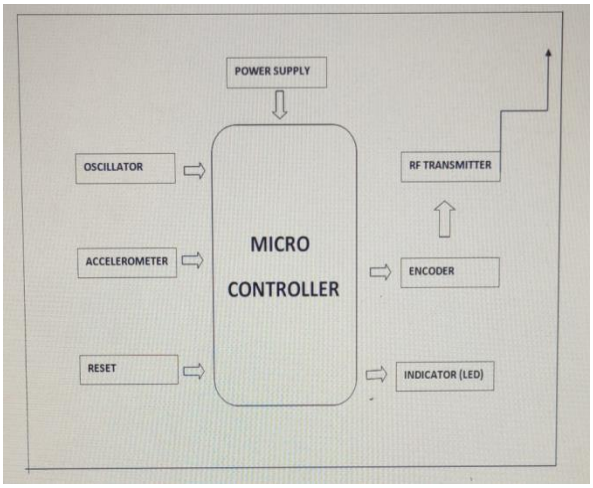

Fig.1 Block diagram of Transmitter Unit

The transmitter unit sense the user's gesture signal with the help of accelerometer, which is an input fed into microcontroller, then encoded message is transmitted to mitter.

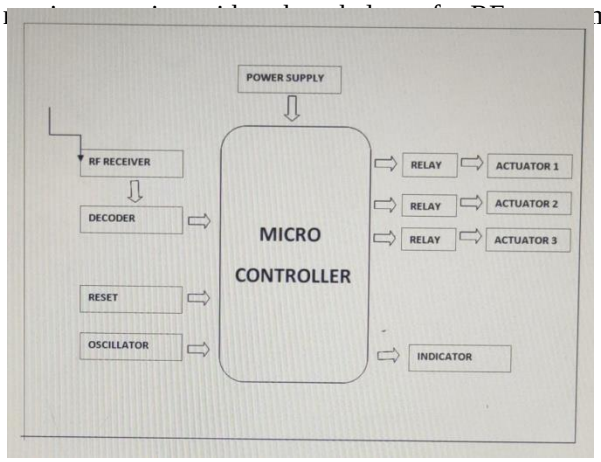

Fig.2 Block diagram of Receiver Unit

The RF receiver receives the encoded message then decoded signals are fed into microcontroller in which linear actuators are interfaced by relays.

II.B WORKING MECHANISM

For the various gesture movements of user respective postures are achieved by designing the controller program of actuators in a planned manner. For example to achieve the standing posture after the input from user, the receiver controller should actuate the actuator 1 to downward movement, actuator 2 & 3 to upward movement respectively. Movements of the actuators are restricted to certain length from initial position depending upon the height of the user.

S.NO	POSTURE	ACTUATOR 1	ACTUATOR 2	ACTUATOR 3
1	SITTING	DOWN	DOWN	UP
2	LYING	UP	DOWN	DOWN
3	STANDING	DOWN	UP	UP

Fig.3 Movement of actuators for various postures

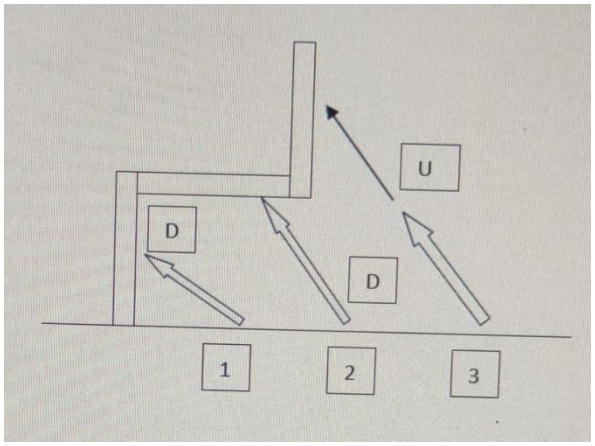

Fig.4 Working mechanism of Sitting Posture

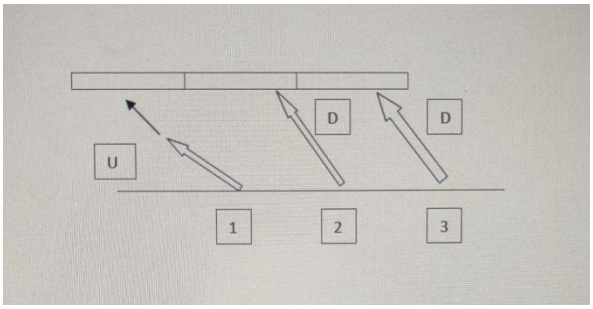

Fig.5 Working mechanism of Lying Posture

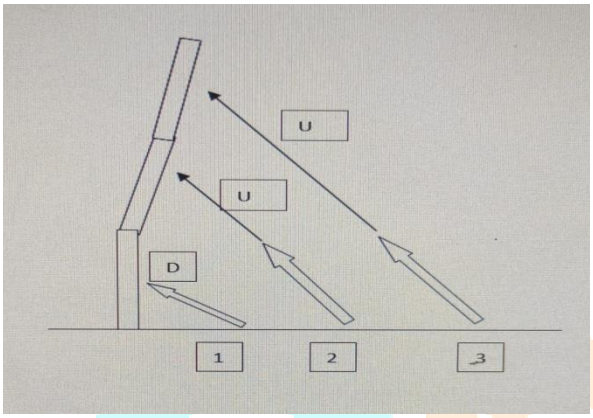

Fig.6 Working mechanism of Standing Posture

III) LOCOMOTOR DESIGN

Intelligent Flexible Locomotor (IFL) is designed in manner to achieve locomotion in all postures especially while sitting and standing postures. This plays a major role in covering up the disability of immobile patients. Likewise in posture managing system here to locomotion from one place to another is gesture controlled. Same two units namely transmitter and receiver unit will master the gesture control.

The Fig.1 shows the transmitter unit which commands the movement of vehicle. When certain posture is fixed then by switching locomoting mode, accelerometer senses the gesture signs of user in certain axis and fed into controller. Then processed encoded message is fed into RF transmitter to transmit it to receiver unit.

[4] Transmission through RF is better than IR (infrared) because of many reasons. Firstly, signals through RF can travel through larger distances making it suitable for long range applications. Also, while IR mostly operates in line-of-sight mode, RF signals can travel even when there is an obstruction between transmitter & receiver. Next, RF transmission is more strong and reliable than IR transmission.

RF communication uses a specific frequency unlike IR signals which are affected by other IR emitting sources. This RF module comprises of an RF Transmitter and an RF Receiver. The transmission occurs at the rate of 1Kbps - 10Kbps.The transmitted data is received by an RF receiver operating at the same frequency as that of the transmitter.

The receiver unit receives the encoded message and after decoding it will send the data to microcontroller. Then after processing, controller commands the motor driver to actuate the DC motors in particular direction of certain velocity of locomotion. Velocity is based on the angle of input gesture movement.

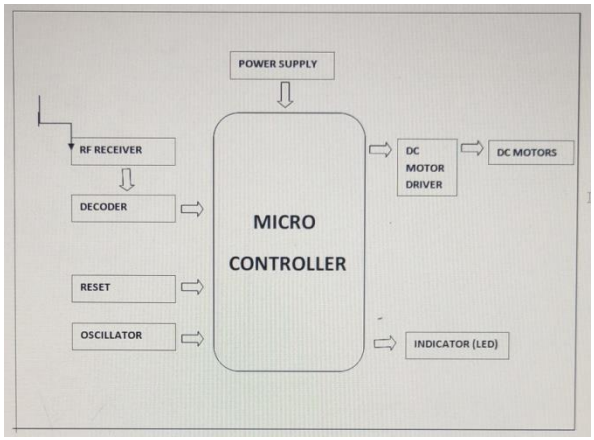

Fig.7 Block diagram of Receiver Unit

IV) PROTOTYPE OF LOCOMOTOR

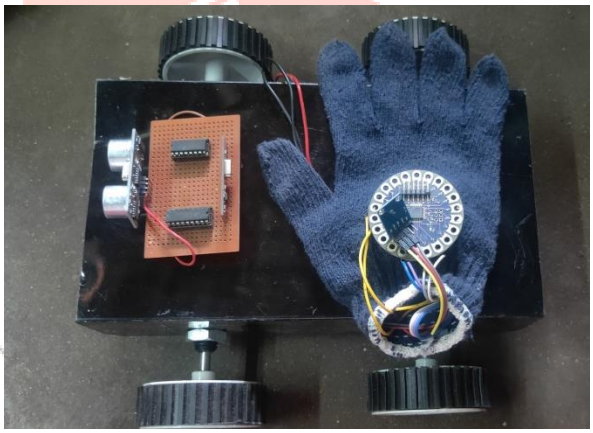

Fig.8 Gesture Base of Locomotor Design

We designed base model of locomotor to test the gesture control in moving a vehicle from one place to another. Where transmitter unit is integrated with glove to sense gesture signals where receiver unit is

integrated with vehicle module. To avoid obstacles ultrasonic sensor module has been used.

V) OVERALL CONTROL

Intelligent Flexible Locomotor control basically constitutes two modes of operation, namely

I)Gesture control of posture mode, II) Gesture control of locomotor mode.

So to fix the posture of vehicle initially posture mode should be activated followed by locomotor mode. Other intelligent services are accessed by Graphic User Interface (GUI) on monitor or by manual switches.

VI) INTELLIGENT SERVICES

Physically disabled people require continuous monitoring unit on their health and to intimate others on emergency situation. To monitor their heart beat rate, sensors will be interfaced which intimates on unusual data. To require emergency help from others or to share their location details, GPS tracking module will be installed. To avoid obstacles which are beyond their sight ultrasonic technology will assist the vehicle. Intimating the user's scheduled duty like in taking medicine, routine checkups etc., are done by notifying them on correct time. Making sure the seat belts and other locks are properly interlocked respectively to verify the stability and safety of the user.

VII) CONCLUSION

Various postures design gives Flexibility to user for attaining required postures. Gesture control modes in posture attaining and locomotion make the movements easier for them. Other services like GPS, obstacle avoider, self monitoring, and alarming unit make the unit further Intelligent. Thus Intelligent Flexible Locomotor (IFL) makes the life of physically challenged people more enhanced and comfortable.

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