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SMART WALKERS: ROBOTIC HUMAN WALKING ASSISTANCE DEVICE

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***Abstract*— This paper presents a unique control system that is used in rehabilitation of walking impaired persons. The system can function in both wireless and manual modes. It improves the walking ability of people and provides assistance for elderly and disabled people. The system can detect obstacles, maintain body balance, provides physiotherapy, control speed of the system and it can be used by visually impaired persons.**

***Index Terms*— control system, therapeutic device, user intention-based control system, walking assist control, walking rehabilitation.**

I. INTRODUCTION

This device can be used for rehabilitation of walking after injuries and can provide walking assistance for elderly people. The system can maintain balance, detect obstacles and is capable of doing exercise. Rehabilitation of walking is a multi-step process that is aimed to return the freedom of motion to the patient [6]. Instead of the traditional forearm and underarm crutches for young adults with temporary leg injuries, this system provides a walking assistance which can be controlled by the person.

Walking disability problems increases with age. Assistive devices increases patient's base support, improve balance, and mobility. Patients with assistive devices can travel anywhere according to their wish. Selection of a device depends on the patient's strength, balance, cognitive function, and environmental demands. Canes can help people with vision impairments and weak body and it can aid balance and is used as a means of physical support.

Crutches are useful for patients that transfer weight from the legs to the upper body. It is often used for people who cannot walk without the help of others. Walkers improve stability for people with poor balance and provide improved mobility by increasing the patient's base of support and supporting the patient's weight. Smart walkers assist the people with disability and also provide physiotherapy. The system contains four wheels and assists the people to different places. To aid the elderly and the disabled to allow them living independently and supported in their private homes, a home assistant robot is developed for intelligent walking support and manipulation tasks such as fetching and carrying tasks [2].The device in this article provides walking assistance and physiotherapy.

The paper is structured as follows: The control system implemented is described in section II detailing the accelerometer, ultrasound sensor, conveyor system and microcontroller in separate sub-sections. The hardware description is given in section III.The conclusions drawn are presented in section IV.

II. CONTROL SYSTEM

The device is built with four wheels that enable the system to move. It consists of a conveyor system and a stand to hold the hands. The system contains 6 motors and 3 motor drivers. Each motor driver controls 2 motors. Four of them are for the movement of the system. One motor is for the conveyor system and one is used to maintain body balance. The system has two mode of operation: one is for manual control and other is for wireless control. An ultrasound sensor is used to detect the obstacles. When the system detects any obstacle, the buzzer beeps a sound and the speed of the system decreases. An LCD is used to display the data. An accelerometer sensor is used to maintain body balance.

A. Accelerometer

One of the common inertial sensors is the accelerometer, which is capable of vast range of sensing. In this system, an accelerometer is used to detect body balance. The accelerometer used is ADXL335, which reads off the X, Y and Z acceleration. But here the system uses only Y-axis.

B. Ultrasound Sensor

Ultrasound transducers convert ultrasound waves to electrical signals or vice versa. The HC-SR04 ultrasound transducer used in this paper contains a transmitter, receiver, and a control unit. The ultrasound sensor is used to detect obstacles. When any obstacle is less than or equal to 30cm from the system, the buzzer gives a beep and the speed of the system decreases.

C. Conveyor System

A conveyor system is used to provide treadmill like action. One DC motor is required to run the conveyor system. This system provides physiotherapy to disabled people.

III. HARDWARE DESCRIPTION

Smart walkers provide walking assistance to elderly and disabled people in which they can control the system by themselves or the system can be controlled by

another person through Bluetooth. Here block diagram for two modes of control section is given.

A. Manual Mode

The system can be controlled by manually using switches. One switch is used for changing the mode selection. ARM 7 microcontroller is used for this project. It is a 32-bit microprocessor, which offers high performance and very low power consumption.

Six 12V 100rpm DC motors are used that are driven through the motor driver, L293D. There are 4 switches, in which one is to control mode selection. The others are to control the movement of the system. The system uses a 12MHZ crystal oscillator is used. The fig. 1 shows the block diagram of manual mode section. In order to display the current status of the system, an LCD display is used. Universal Synchronous/Asynchronous Receiver/Transmitter (USART) is used to communicate the microcontroller with other devices.

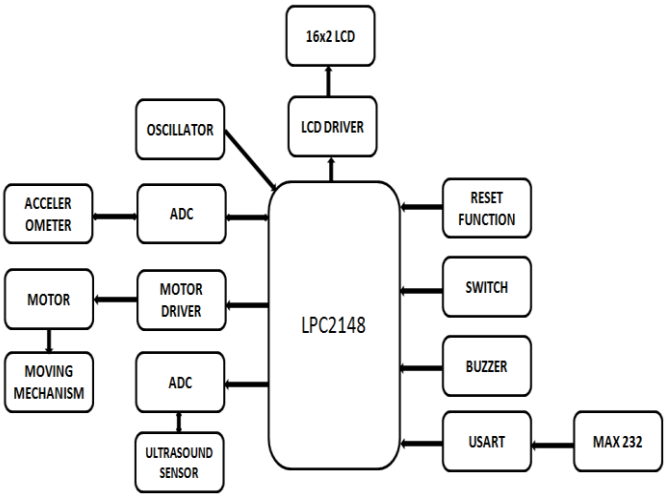

Fig. 1 Manual mode section

B. Wireless Mode

The system can be controlled by another person using a mobile phone through Bluetooth so that the system can be used by visually impaired persons. The block diagram for wireless mode section is shown in fig. 2.

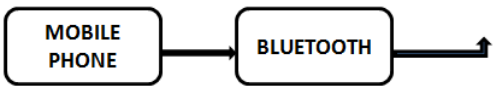

Fig. 2 Wireless mode section

Using a mobile phone through UART communication, the signals are transmitted and received. The data received from the mobile phone is transmitted to the microcontroller and microcontroller send signals to the input pins of the motor driver. Thus the system can move towards forward, backward, left, right and also can stop the motor.

IV. RESULT AND DISCUSSION

The proposed system has been experimentally demonstrated in both manual and wireless modes. The user can move the system in any direction. They can also control the speed of the system.

Fig. 3 Smart Walker - Hardware

The system provides complete safety to the user. It can maintain the body balance of the user. Also, the system detects obstacles and avoids danger. Fig. 3 shows the hardware setup of the system.

V. CONCLUSION

Smart walkers are very useful for disabled, elderly and visually impaired people. The system contains many features such as obstacle detection, maintaining body balance, speed control, physiotherapy and control by mobile phone. The system improves the mobility of people. The focus was on providing assistance for walking with complete safety to the users.

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