Embedded Monitoring Based Rehabilitation System System

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Abstract— Physiotherapy is required for individuals suffering from the orthopedic intervention. In this paper the main target goes to make restoration of patient's practical capability by doing exercises. By using the System that mentioning in the paper presents, for the patients to do their physiotherapy exercises within the home itself. In this paper, we are presenting a straightforward to use and cost effective system for the physically disabled persons. This equipment can be used for finding the range of the movement of the muscle of the patient.

Keywords— AT mega 16 microcontroller, feedback training system, range of motion, strain gauge, and theraband tube.

I. INTRODUCTION

Stroke or accident connected injuries can be executed by home-based rehabilitation technique. This may be done at rehabilitation centre. Monitoring incessantly the physical activity is an important area in rehabilitation [1]. The results that are obtained by using this monitoring are wont to verify the effectiveness and progress of a rehabilitation program [2]. The injured patients need appropriate rehabilitative and multi-disciplinary assessed treatments after they were fired from the hospital [3]. Physiotherapy is the main rehabilitative technique for these movement disorders. Movement disorders occur due to injury or muscle replaced etc. After removing plaster of paris, two to a few weeks later people needs exercise to become normal. For performing exercises the patient has to come back to the hospital whenever the patient wants to do exercise. If the patient's home are far-off from the hospital is not easy to return back and do exercise in the hospital. The aim of the paper is to assist the patient to do exercise painlessly and harmonic in every-day situations. By using this system the expert teaches exercises to the patient in the hospital. The therapist controls the rehabilitation process and then gives additional advice to the patient if the patient needs. The accuracy of exercise influences the healing process of the patient. This paper aimed to develop, low-cost and mobile training system that makes home training and gives guidance and control to the patient.

The cost effective coaching system needs

    1) Low value training apparatus and
    2) Control aspects.

This equipment can be used for finding the motion range of the patient which is obtained by comparing the patient's motion range with normal person's .The normal person's motion range is in recorded form. For performing exercises theraband tube is required. This data transmits to the AT mega 16 microcontroller and so transmitted wirelessly through the ZigBee module. The data is received by another At mega 16 microcontroller and it can be seen by LCD.

II. THE SUMMARY OF THE SYSTEM

The system is used for physically disabled persons for recovering from the physical disability. Correct exercise doing makes the healing faster.

A. Methods

1) Conception:

The introduced system for home rehabilitation ought to alter the patient to perform his rehabilitation exercises on his own responsibility however controlled exercises at the home. The exercises are performed together with the patient. The patient's movements are supervised by the therapist and that is recorded with the feedback training system to serve as reference.

Each exercise incorporates a reference movement that is chosen from the recorded training. These are stored together with the training plan within the feedback training system. In the feedback training system at home is attached to the private PC and presents information concerning the exercise. The visual information is displayed on the computer monitor to help the patient to indicate variances in his movements and serving him to correct them. The information keep or transmitted to the therapist for later review.

2) Feedback Training System:

The system is based on the resistive elements like gymnastic bands or tubes. For analysing therapy exercise, the movement path, speed and amplitude of the extremities should be assessed. The moved extremities lengthen the resistive element. The force within the element is proportional to the amplitude and range of motion.

3) Resistive Elements:

The mechanical characteristics of resistive elements are similar to that of rubber. The stress-strain curve is used to define the relation between force and elongation.

4) Force Sensor:

The force sensors here is two strain gauges .These two strain gauges are placed on the metallic element. When force applies the resistance of the strain gauges varies. Then the changes in the resistance obtained, by voltage variation in output.

5) Feedback:

The computer is employed to show the visual feedback. By seeing through the computer the patient will analyze the exercise he's doing. The performed exercises information may be recorded and can be sending to the therapist offline.
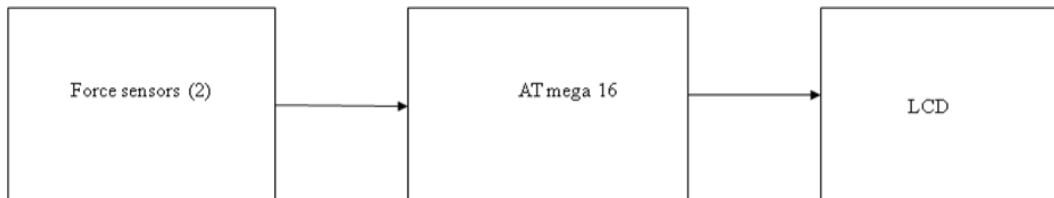

Fig 1: Overview of the system

The data from the force sensors by using the low pass filter. These are amplified by electronic equipment circuit and sent to the AT mega 16. The AD7796 is used for sensing the inputs of the two strain gauges. The chip itself has instrumentation electronic equipment of gain of 128 and temperature sensing element for monitoring temperature. Exercises are done by the patient using the theraband tube in which the sensing element is attached to the metal element. One gauge is placed where maximum bending of the metal happens. The other gauge is placed where minimum bending of the metal happens. The strain gauge will find the strain corresponding to that of the bending. These data is transmitted to AT mega 16 is used. Through LCD the data can be viewed.

III.MATERIALS

A. *AT mega 16*

The AVR is the one amongst the first microcontroller families to use on-chip non-volatile for program storage, as opposed to one-time programmable EEPROM, ROM, or EPROM used by the other microcontrollers at the time. AT mega 16 has advanced RISC architecture. In AT mega 16 has 8-channel, and 10-bit ADC.

Fig 2: AT mega 16

B. *Strain gauge*

A typical strain gauge arranges a thin long conductive strip in an exceedingly zigzag pattern of parallel lines. Strain gauges measure only deformations that are local and can be manufactured sufficiently little to permit "finite element" like analysis of the stresses to which the specimen is subject.

The gauge factor GF is defined as:

$$GF = (\Delta R / RG) / \varepsilon$$

Where ΔR is the change in resistance caused by strain, RG is the resistance of the distorted gauge, and ε is strain.
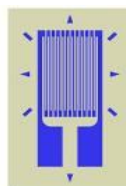

Fig 3: Strain Gauge (Foil Type)

C. *ZigBee*

ZigBee has applications that require an extended battery life and its data rate is low, and net security is also low. ZigBee has a rate is about 250 Kbit/s, and so it's suited to periodic or intermittent data or a single signal transmission from input device. This technology outlined by the ZigBee specification is intended to be easier and less expensive than Bluetooth.

Fig 4: ZigBee (Xbee)

IV. RESULT
TABLE I
The voltage consistent with the bending of the strain gauge.

Vin(mv)	R1	R2	R3	Vout(mv)	Rg
5000	357	357	357	8	355.29
5000	357	357	357	7.8	355.33
5000	357	357	357	8.3	355.22
5000	357	357	357	7	355.50
5000	357	357	357	9.2	355.03
5000	357	357	357	6.9	355.52
5000	357	357	357	7.4	355.42
5000	357	357	357	8.1	355.27
5000	357	357	357	6.7	355.57

A. *Strain gauge characteristics*

In this experiment, by using a multi-meter simply verified the voltage changes of the strain gauge. The more strain gauge is bent, the more voltage will be shown in the multi-meter.

B. *Experimental setup*

The experimental setup uses theratube for doing exercise. In which U shaped aluminium material is placed in hook. Within the aluminium material two strain gauges are placed. One in the place where maximum bending of the gauge occurs and other is placed on the minimum bending happens. The strain gauge output is in terms of milli voltage. So AD7796 chip is using for the amplifier circuit. The strain gauges are connected to AD7796 IC. One end of the theratube is fixed on the foot and other end is movable using hand and the movable end is used as handle. While doing the exercise the voltage varies corresponding to the movement. By seeing the variation in the voltage the healing can be detected. The output is displayed in the 16*2 LCD.

Fig 5: Experimental Setup

V. CONCLUSION AND FUTURE SCOPE

The force sensing element setup is implemented for comparing the range of motion of physically disabled persons therewith of the traditional person information. The comparisons are useful to trace the rehabilitation of the patient.

ACKNOWLEDGMENT

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