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Rehabilitation Exercise Monitoring System

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Abstract— **Personalized therapy is needed for the people suffering from the orthopedic intervention. Rehabilitation makes regaining of patient's functional capability. By using the system that mentioning in the paper describes for the patient to do their physiotherapy exercises in the home itself. The existing devices are very complex and the patient has to come to the hospital and has to do exercises in the hospital. If the patient's home are far away it is not easy to come to the hospital and to do the exercises. In this paper, we are presenting an easy to use and cost effective system for the physically disabled persons those have injured or muscle displaced. This equipment can be used for finding the range of the movement of the muscle of the patient.**

Index Terms— **AT mega 16 microcontroller, feedback training system, range of motion, strain gauge.**

I. INTRODUCTION

Stroke or accident related injuries can be executed by home-based and rehabilitation method can be done at rehabilitation centre. Monitoring continuously the physical activity is an important area in rehabilitation [1]. The results obtained using these monitoring can be used to verify the effectiveness and progress of a rehabilitation program [2]. The injured patients needed appropriate rehabilitative and multi-disciplinary assessments treatments after they were dismissed from the hospital [3]. Physiotherapy is the main rehabilitation technique for these movement disorders. Movement disorders occur due to injury or muscle replacement etc. After removing plaster of paris two to three weeks later people needs continuous exercise to become normal one. For performing exercises the patient needs to come to the hospital whenever the patient wants to do exercise. For the patient's those home are far-off from the hospital isn't simple to come back and do exercise. 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 if the patient needs it. The accuracy of exercise influences the healing process of the patient. . **This paper aimed to develop straightforward to use, low-cost and mobile training system that makes home training and gives guidance and control to the patient.**

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The cost effective value 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 persons range .The normal persons motion range is in recorded form. For doing the exercises theraband tube is needed. This data transmits to the AT mega 16 microcontroller and then transmitted wirelessly through ZigBee. The data is received by another AT mega 16 microcontroller and Scan be seen by PC.

II. RELATED WORK

Fereshteh Ghasemi et al [2] present a unique multilateral telerehabilitation system for Patient has diminished hand function that desires minimum interaction between patient and expert. The configuration consists of the central intelligent system (CIS) including multi-function modules in a homepage for patient and in physical therapy workplace, and a hand rehabilitation system together with a mechanism, motion analysis module as body network in patient's home.

M. S. Ahmad et al [3] present continuous observance of physical activity that is important subject in rehabilitation. The results getting from the observations are accustomed verify and can be used for determining the progress and effectiveness of the rehabilitation program. The main goal is to effectively motivate patients to do the physical activity daily.

H. Zhou et al [4] discuss a new human motion system that uses two wearable inertial sensors that are placed very close to the gliding joint and elbow joints of the higher limb. Each inertial sensor has accelerometer, tri-axial magnetometer.

Stéphane Choquette et al [5] discuss the primary objective of this study to check time and motion measures while real life physical therapy that estimates the active time (i.e. The time in which a patient is active physically) is obtained with a wireless body area network (WBAN) of 3D accelerometer modules positioned at the hip, ankle and wrist. The next objective was to assess the differences that estimates the active time by using a single accelerometer module positioned at the hip. WBAN estimates the active time that compares favorably with results from observation-based time and motion measures.

Shumei Zhang et al [6] introduces an interactive telecommunication system which supports audio or video signal acquisition, transmission, data processing and 3D animation for the post stroke rehabilitation. That is designed

for the patients suffering stroke, for using in their homes. This records motion of the exercise, and transfers this data to hospitals through internet. The real-time videoconferencing interface is adopted for patients to observe therapy instructions from therapists.

HuiyuZhou et al [7] introduces a real-time human arm motion detector which has been developed for aiding the home-based rehabilitation to the stroke patients. The two tri-axial sensors are adopted for measuring the arm orientation. Kinematics models allow for recovering the coordinates of the elbow and wrist joints, given the still joint in the shoulder. One of the main contributions of the paper is the use of a total variation based optimization in smoothing the measurements due to the rapid or unstable movements.

Maja J. Matari´c et al [8] describes an autonomous assistive mobile robot that aids stroke patient rehabilitation. The robot navigates continuously and monitors the patient's arm position, and allows the patient remember to follow a rehabilitation process. The paper is aimed to develop an autonomous assistive mobile robot that aid persons post-stroke with arm disabilities during their rehabilitation.

III. 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 should enable the patient to perform his rehabilitation exercises on his own responsibility but 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 has a reference movement that is chosen from the recorded training. These are stored together with the training plan in the feedback training system. In the feedback training system at home is attached to the private PC and presents information about the exercise. The visual data is displayed on the computer screen to help the patient to show variances in his movements and helping him to correct them. The data stored 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 analyzing physiotherapeutic exercise, the movement path, speed and amplitude of the extremities must 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 PC is used to display the visual feedback. By seeing through the PC the patient can analyze the exercise he is doing. The performed exercises data can be recorded and can be sending to the therapist offline.

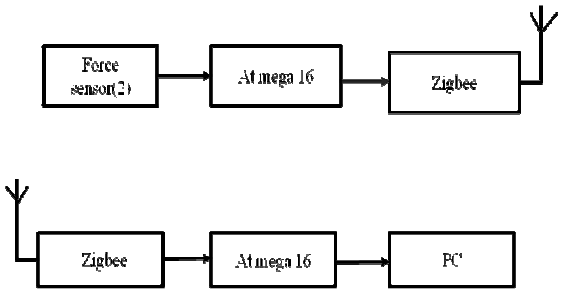

Fig1: Overview of the system

IV. Materials

A. AT mega 16

The AVR is the one of the first microcontroller families to use on-chip nonvolatile 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.

B. Strain gauge

A typical strain gauge arranges a thin long conductive strip in a zigzag pattern of parallel lines. Strain gauges measure only deformations that are local and can be manufactured small enough to allow a "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 deformed gauge, and ε is strain.

C. ZigBee

ZigBee has applications that require a long battery life and low data rate, and networking security. ZigBee has a rate nearly 250 Kbit/s, and it is suited for periodic or intermittent data or a single signal transmission from input device. This technology defined by the ZigBee specification is intended to be simpler and less expensive than Bluetooth.

V. RESULT

Table 1: The voltage variation according to 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

VI. CONCLUSION

The force sensor setup is implemented for comparing the range of motion of physically disabled persons with that of the conventional person data. The comparison will be helpful to trace the rehabilitation of the patient.

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