IOT Based Human Orthospinal Roundback Curvature-Kyphosis Disease Recovery-Monitoring Technique Using Flex-Jacket

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Abstract: ORC-Kyphosis is an excessive outward spinal curve in the upper back which can result hunch back, poor posture, upper back pain, spine stiffness, tight hamstrings, muscle fatigue and it can occur mainly in adolescence. Normally in the thoracic spine, kyphotic angle is ranging between 20 to 45 degrees. But when the curvature is greater than threshold range i.e. more than 45-50 degree then it’s called Kyphosis. To overcome this problem doctors usually prescribe PCPRB(Posture-Correction-Pain-Relieving-Brace). But a kyphosis patient can’t know how much bend of the thoracic spine is recovered and how long he/she have to wear this belt. So we introduce a IOT based mobile controlled KRMOS (Kyphosis-Recovery-Measurement-Outercover-Strip) through which a patient can get the analytical and graphical report of the recovery from our proposed KRMA(Kyphosis-Recovery-Monitoring-Analyzer) android application. KRMOS should be attached perpendicularly along the thoracic spine on the doctor’s prescribed PCPRB. KRMOS is incorporated into two sections. In the first section we can use two flex sensors in the outer-cover strip. First flex sensor is used for measuring the bend of the upper thoracic spine and second is for lower thoracic spine. Both of them are used to measure kyphotic angle. In the second section after wearing the belt the patient should manually turn on the MCDTB (Mobile-Controlled-Data-Transferring-Box) which includes IoT devices. Now the patient will turn on the hotspot of the smart-phone and then open the KRMA. The data of the natural kyphotic angle and the curvature of the thoracic spine is already predefined in our application. So after wearing the belt when patient first turn on the MCDTB then flex sensors will measure pathological curving of the upper & lower thoracic spine and transfer the data to KRMA and it will calculate the kyphotic angle of the thoracic spine. Then the patient will get the damage report of his/her kyphosis and curvature of thoracic spine from the KRMA in graphical and analytical form. After wearing the belt several weeks the curvature will decrease and patient can monitor the recovery of kyphotic angle in a graphical form.

Keyterms: ORC (Orthospinal-roundback-Curvature), PCPRB(Posture-Correction-Pain-Relieving-Brace), KRMA (Kyphosis-Recovery-Monitoring-Analyzer), MCDTB(Mobile-Controlled-Data-Transferring-Box)

I. INTRODUCTION

The objective of this paper is related to a very unique and advanced method for improving the utilization of PCPRB (Posture Correction Pain-Relieving Brace). The PCPRB is a medically prescribed belt that is given to the patients suffering with Kyphosis. Kyphosis is a spinal disorder in which an excessive outward curve of the spine results in an abnormal rounding of the upper back. This disease primarily affects the thoracic spine and results in a bend of it which changes the posture of a person. This is usually caused due to poor posture, developmental issues, older age and abnormal vertebrae. As Kyphosis angle exceeds 45°, the physical performance of a person decreases which causes muscle fatigue and back pain. So, PCPRB has a steel plate in it which is placed perpendicularly to the thoracic spine of the patient and pushes the spine inward and the shoulders outward in order to straighten the posture of the patient. The general issue of PCPRB is that it doesn’t notify the patients about their recovery and thus, the patients are ill-informed. So, the purpose of this paper is to modify the belt by introducing an IOT based mobile operated KRMOS (Kyphosis-Recovery-Measurement-Outer-Cover-Strip) which would help the patient to track the recovery through our proposed android application, KRMA (Kyphosis-Recovery-Monitoring-Analyzer). The strip is connected to an MCDTB (Mobile-Controlled-Data-Transferring-Box) and after wearing the brace when patient turn on the MCDTB then flex sensors will measure the kyphotic angle of the thoracic spine and send the data to the Arduino. Arduino forwards the data to the web server using a Node MCU esp8266. Then the information is fetched by our proposed algorithm that we have written and configured in the KRMA application. The natural kyphotic angle and the information about the curvature of upper and lower thoracic spine is already predefined in our application. After that the fetched information is compared with the pre-defined data of the application. Through this process, the damage report is collected and shown to the patient in graphical and analytical form which would help the patient to track the recovery after several weeks of usage of the belt. This updated version of the belt would enhance the medical treatment of kyphotic patients and would give a relief to the patients more earlier than it does now. In today’s world of technical advancement, our project would stand-out in its technology that would be economical and helpful for the benefit of the user.

II. OUR PROPOSED WORK

II.A. Hardware Components required

(a) Microcontroller Board (ATMega328P- Arduino UNO-R3): Arduino is an open-source hardware and software company. The Arduino Uno is a microcontroller board which is based on the ATMega328. It has 20 digital input/output pins of which 6 can be used as PWM outputs and 6 can be used as analog inputs, a 16 MHz resonator, a power jack, a USB connection, an in-circuit system programming (ICSP) header, and a reset button. It contains everything which is needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.
Fig-1: Microcontroller: Arduino UNO(R3)

(b) WiFi-Module (Node MCU): The NodeMCU is an open-source firmware and development kit which is based on an ESP8266-12. It contributes in creating a prototype or build IOT products. It consists a firmware which runs on the ESP8266 Wi-Fi SoC (System on Chip) from Express if systems and hardware which is based on ESP-12 module. The firmware uses the Lua scripting language. It features a built-in serial over USB interface and other amenities like 2 buttons and 2 LEDs. It’s advantage is that it is compact and fits on a breadboard. It can also be programmed using the wiring/Arduino framework as any other ESP8266 boards.

Fig-2: WiFi-Module: ESP8266 NodeMCU

(c) Bread Board:
A breadboard is a construction base for prototyping or building of electronics. A breadboard is used to commonly build and test circuits quickly before finalizing any circuit design. The breadboard has many holes into which circuit components like ICs and resistors can be inserted.

Fig-3: Bread Board

(d) Flex Sensor:-
A flex sensor (commonly known as bend sensors too) is used to measure the amount of deflection or bending. One phase of the sensor is printed with a polymer ink that has conductive particles embedded on it which enable resistance on it. When the sensor is straight, the particles give the ink a resistance of about 30k ohms, whereas the resistance increases to about 50k to 70k ohms when the sensor is bent at 900. Usually the sensor is stuck to the surface and it’s resistance varies with the bend of the surface. This direct proportional relation between resistance and the amount of bend enables it to be used as a goniometer and it is also often named as flexible potentiometer.

Fig-4: Flex Sensor

(e) Jumper Wires: Jumper wire is a thin and simple wire which has a connecting pin at both the ends. It establishes connection between two components without any soldering. This is used to resolve the problem of lose connection. Also, it is mostly used in breadboards and other prototyping tools to simplify the connection and to change it as needed.

Fig-5: Jumper Wire
II.B BLOCK DIAGRAM

Fig-6: Block Diagram of Proposed work

II.C CIRCUIT DIAGRAM

Fig-7: Circuit Diagram of Proposed work

II.D PROPOSED EXPLANATION:

**Step1:** In our proposed work at first Node MCU receives the Mobile App Data from the web server.

**Step2:** Then Mobile App data is transferred from Node MCU to Arduino.

**Step3:** After that Arduino will check data from the flex sensors is received or not. If data is already received then go to Step 4 otherwise go to Step 5.

**Step4:** Then the data is forwarded from Arduino to Node MCU then go to 6.

**Step5:** Next Arduino will send a positive signal to the flex sensors for measuring the pathological curving of the patient’s upper thoracic spine and lower thoracic spine and analog data is transferred to the Arduino and then go to step 4.

**Step6:** After that Node MCU sends the data to the web server.

**Step7:** Then the data is fetched in our proposed KRMA application and it will calculate the kyphotic angle of the thoracic spine and measure the damage level.

**Step8:** Then the patient will get the diagnostic report of his/her kyphosis and curvature of thoracic spine from the KRMA in graphical and analytical form. After wearing the belt several weeks the curvature of the thoracic spine will decrease and bend of the flex sensors would also decrease and the patient can monitor the recovery report of his/her kyphosis.
III. Experiment and Result

In our project we are going to create such Kyphosis-Recovery-Measurement-Outercover-Strip which can able to measure the kyphotic angle of the upper and lower thoracic spine and it can be easily attached perpendicularly along the thoracic spine on the doctor's prescribed PCPRB. Another feature of our project is Kyphosis-Recovery-Monitoring-Analyzer android application from which a patient can easily monitor the curvature of the thoracic spine and get recovery and diagnostic report in graphical and analytical form. Therefore it is more reliable and accurate.

IV. CONCLUSION

The significance of technological advancement is at peak in today’s modern world and we have tried to make a crude effort at contributing to it by modifying the PCPRB. Our project aims at simplifying the process of understanding the medical recovery of a patient. The KRMA is not only helpful for a patient to track the recovery of kyphosis but also helpful to understand how long they have to continue their diagnosis using the belt. The results shown in the application are graphical and analytical which would make it easier for a patient to understand. The proposed modification of the belt would make the Kyphotic diagnosis more effective, economical, advanced and time-saving.
REFERENCES