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Diagnosis of Scoliosis in Juvenile Patients

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***Abstract:** In this paper, a wearable device used to monitor the posture variations. This device is useful in early detection and monitoring of patient having spine related disease such as scoliosis, kyphosis. Scoliosis is a 3-dimensional deformation of spine. The most common characteristics are bending of backbone in coronal plane and rotation of vertebrae, which results in various deformations of human postures. It mostly occurs in juvenile stage (3-10 years). The existing system consists of wearable sensor network for posture data acquisition, wireless data transmission and conventional smartphone for data processing. The biofeedback device helps to improve the self-awareness in natural environment, but it is not suitable in case of severe deformity. The flex sensor used because of its High level of reliability, consistency, repeatability and harsh temperature resistance.*
***Keywords:** scoliosis, microcontroller, flex sensor*

I. INTRODUCTION

Posture monitoring has beneficial effect on the spine related disorders such as scoliosis. Scoliosis is a common medical condition in which a person's spinal axis has a three dimensional deviation. It is basically classified as either congenital or idiopathic. Congenital and idiopathic scoliosis occurs in children under the age of 10 is referred to as Early Onset Scoliosis (EOS). Scoliosis that develops at the age 10 or above is referred to as Adolescent Idiopathic Scoliosis. It occurs seven times more frequently in females than in male. Many screening programs are conducted for the early detection of disease and the patient is referred to a specialist for treatment.



Fig 1.1 scoliotic curve

The most general method to treat scoliosis is the use of hard material brace which forces the patient mechanically to hold in corrective posture to prevent further deformations. But it is a challenging task to hold that bracing over a long period of time. Hence, for a detailed information of human posture a 3D inclination measurement accelerometers are used as it is small and a low power sensor where it can be integrated in garments almost invisibly. This system consists of body mounted sensor network and portable data processing with alarm system.The sensor is a wireless network of wearable computing devices. They may be embedded inside the body, implants or may be surface mounted on the body or may be accompanied devices where humans can carry in different positions, in clothes, pockets, by hand or in various bags. Here, the flex sensors are used to collect angle deviation of the back bone. Thus, this paper is about the diagnosis of spinal curvature i.e. scoliosis to monitor the inclination of spine of juvenile to provide early corrective measures.

II. EXISTING METHOD

The existing method consists of two parts. One is wearable sensor system that is used for data acquisition and transfer of patient's data. It includes body mounted sensor network (BSN) using various tri-axial accelerometer network, microcontroller and Bluetooth (BTM-112) that uses Serial Port Profile(SPP) to provide wireless data transfer. The Bluetooth BTM-112 can support maximum baud rate up to 921.6 kbps. The second part is the conventional smartphone for sensor data processing. In the wearable sensor system part, a sensor network is attached to human spine that is eventually spread around the back surface providing detailed information about posture deformities. The tri-axial accelerometers contain the readings of acceleration due to gravity and using this reading, it is possible to obtain inclination angle of each sensor. A series of microcontroller such as MSP430 is used to sample data from sensors and send them to Bluetooth module for wireless data transmission.

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Sensor data processing is implemented in smartphone application to provide system portability, reduce complexity and cost. This receives the data from sensor network through Bluetooth. The obtained data is processed to reconstruct geometric model of posture where, the decision of whether to generate a feedback is done by comparing the previously stored reference data to the acquired data. The feedback is provided using vibrating alerts.

III. PROPOSED METHOD:

In proposed model, the Flex sensor patented technology is based on resistive carbon elements. As a variable printed resistor, the Flex Sensor achieves great form-factor on a thin flexible substrate. When the substrate is bent, the sensor produces a resistance output correlated to the bend radius—the smaller the radius, the higher the resistance value. This flex sensor offers the variable resistance readings. The resistance value of the sensor is dependent on the bending angle with respect to the spine. As the bending angle increases, the resistance value increases accordingly, and shows nominal resistance value at rest. Then, the signals (resistance value, bend radius, Cobb angle, etc.) are acquired from flex sensors and sent to microcontroller for further programming and conditioning. Finally, the resultant output from microcontroller is display in LCD screen with an alert in the form of alarm. The alarm alert is given in the form of sound (audio), that occurs when the deflection of spine occurs, which indicates the presence of scoliosis for juvenile patients.

IV. ADVANTAGES

A. Custom designed to match customer specifications, Variety of flexible or stationary surfaces for mounting.
B. High level of reliability, consistency, repeatability, harsh temperature resistance.
C. Infinite number of resistance possibilities and bend ratios, it is portable and easy to handle.
D. X-ray can be avoided for diagnosis of scoliosis for juvenile patients.

V. BLOCK DIAGRAM

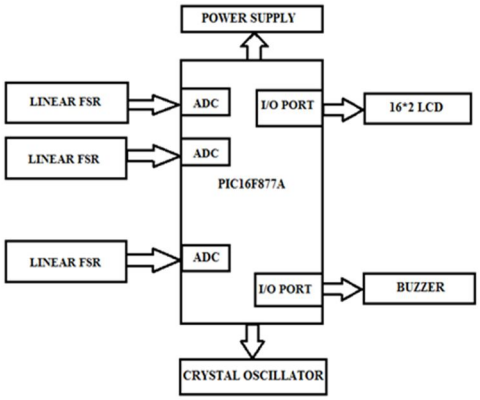


Fig 4.1 Block diagram

VI. MATERIAL AND METHODOLOGY

Microcontroller is used to sample data from sensors. The microcontroller used here is PIC16F877A. All PIC16F87XA devices have a host of features intended to maximize system reliability, minimize cost through elimination of external components, provide power saving operating modes and offer code protection.

Brace is a medical device used to restrict or assist body movement. It may stop the progression of spinal curvature in a growing child/ adolescent. In some cases, the back brace may also help decrease the amount of curvature in the spine. An alarm system is a basic operator system for managing abnormal situation and it has following two functions. The primary function of the alarm system is to warn the operator about a situation that is not normal. The secondary function of the alarm system is to serve as an alarm and an event log. A liquid-crystal display (LCD) is a flat-panel display or other electronic visual display that uses the light-modulating properties of liquid crystals. Liquid crystals do not emit light directly. LCDs are available to display arbitrary images or fixed images with low information content, which can be displayed or hidden, such as preset words, digits, and 7-segment displays, as in a digital clock.

LCD screens are available in a wider range of screen sizes than CRT and plasma displays, with LCD screens available in sizes ranging from tiny digital watches to huge, big-screen television set. Before an electric field is applied, the orientation of the liquid-crystal molecules is determined by the alignment at the surfaces of electrodes.

A flex sensor or bend sensor or force sensitive resistance is a sensor that measures the amount of deflection or bending. The flex sensor used is of length 4.5 inches is used, which is stuck to the surface, and resistance of sensor element is varied by bending the surface. Since the resistance is directly proportional to amount of bend it is used as goniometer, and often called flexible potentiometer. As the bending angle increases, the resistance value increases accordingly, and shows nominal resistance value at rest.

A. Force Sensitive Resistance

FSRs are sensors that allow you to detect physical pressure, squeezing and weight. They are simple to use and low cost. The 1/2" diameter round part is the sensitive bit.

The FSR is made of 2 layers separated by a spacer. The more one presses, the more of those Active Element dots touch the semiconductor and that makes the resistance go down.

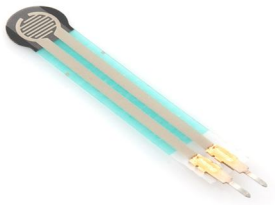


Fig 6.2 Picture of flex sensor

B. Microcontroller

Peripheral Interface Controller (PIC16F877A) contains FLASH memory technology so that program can be written or erase many times. It consists of 40 pins and requires 5v DC power supply. Crystal oscillator used to keep on track of time and to provide a stable clock signal. It operates at the frequency of 16 MHz.

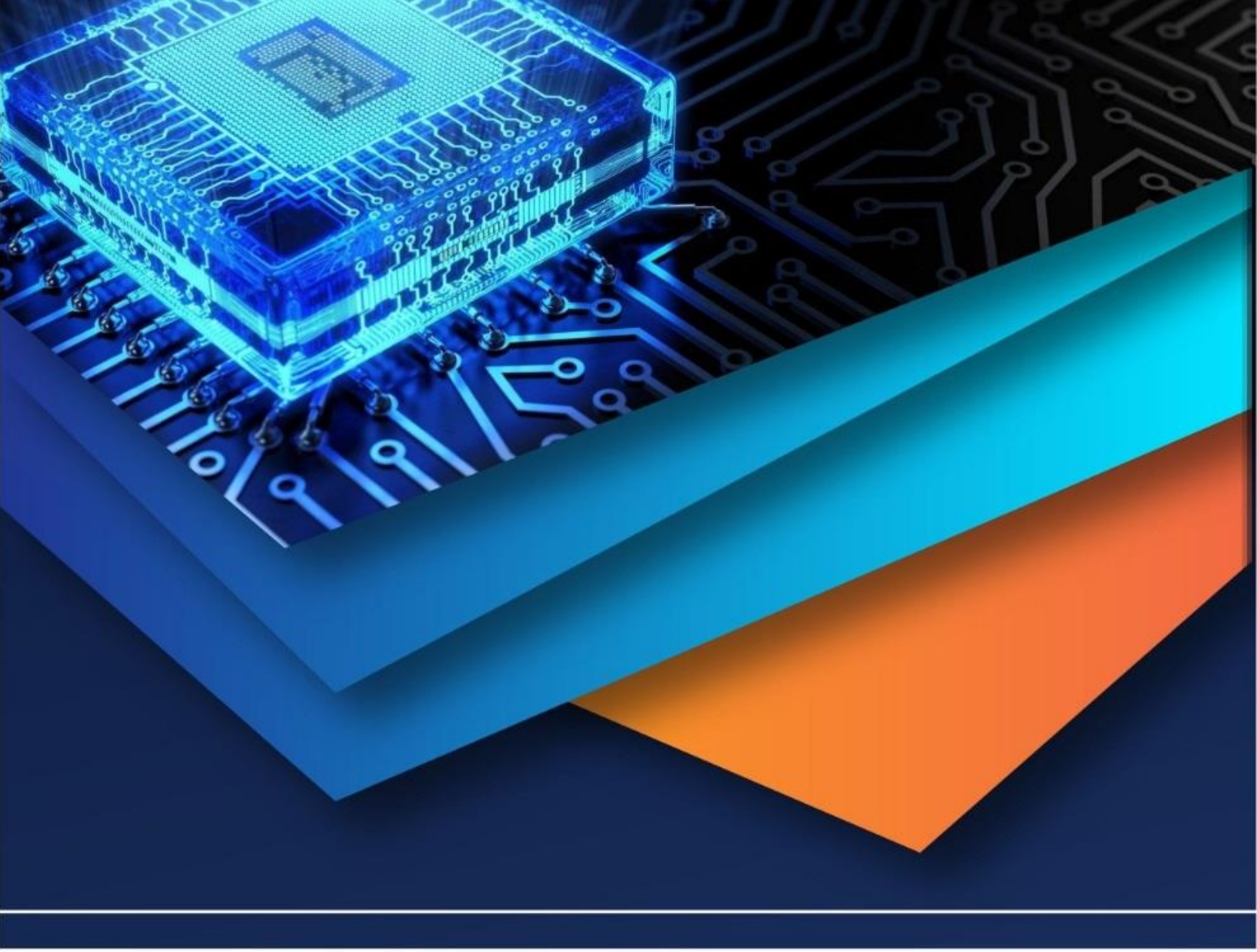
MPLAB X IDE is software that is used to develop application for embedded system designed by microchip microcontroller.

VII. CONCLUSION

This is to conclude that, the diagnostic device in the form of brace helps in early detection of scoliosis for juvenile patients. This early detection helps the patients to refer specialists for treatment by posture variation corrective measures. The inclination angle of spine is determined by flex sensor where the pressure created during motion plays a vital role.

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