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Automatic Gait /Posture Detection System

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ABSTRACT: An attempt is made to design and fabricate the Automatic Gait Detector belt which helps to detect bad posture of the patient / user with gait abnormalities. This belt will facilitate doctors to treat a person with gait abnormalities. Gait analysis deals with the study of walking pattern, to understand the gait abnormalities. To treat these gait abnormalities, its necessary to analyze gait parameters such as foot angle, stride distance, step distance, step count, cadence, speed, progression line etc. This project presents a belt to measure these parameters with the help of flex sensor. The flex sensor is fixed inside the belt with vibrator motor. Four flex sensors and four motors are placed inside the belt at front, back, left and right side of belt. The digital output of these sensors is monitored through a ARDINO UNO controller and the result i.e. deviation from the expected position of the patient detected by the controller and feedback is given to the patient through vibrations of the motor. The system will vibrate to notify the user that they are slouching. The vibrations give alarm patient to retain in normal position.This data may alsosend to the doctors phone through wireless communication. Hence, this wireless belt helps to overcome the disadvantages of the existing system which is practiced in gait motion analysis laboratory. Results of belt can be compared with the gait of a normal person to differentiate and study the abnormal and normal gait of a person. The development of belt is mainly concerned with features like low cost, portable, ease of use and accurate measurements waist angle. When the user needs to adjust their posture, they will feel a vibration from the wearable system. This Posture Sensor is an effective way to record instances of bad posture in both short-term and long-term methods. This device is use in patient suffering from Scoliosis, Kyphosis, after limb prosthesis.

KEYWORDS: Arduino,Flex Sensor,Bluetooth,

I. INTRODUCTION

The technological aspects of design and developing healthcare systems to cope with the increase of global widespread of chronic neurological disorders related to human locomotion. Locomotion involves standing, walking, jogging, running, etc. The systematic study of locomotion is called Gait Analysis.In simple terms Gait can be defined as manner or style of walking and its analysis is the combination of kinematics and kinetics data. A gait abnormality is a deviation from normal walking. Cerebral vascular disease is the main cause of gait disability; it may result in long-term disability and handicap. The quality of life depends on the mobility of a person hence the walking recovery becomes main aim of a gait Analyst, which determine the status, activities of patients.Recently Quantitative Gait analysis has become a tool through which doctors can measure gait parameters and treat the persons with walk- ing disabilities. The proposed system is different from observational gait analysis in terms of tool usage and result generation. The obser- vational analysis is just watching a walking of individual and analyzing it which can be quick but not accurate. Quantitative analysis can be time-consuming and costlier than observational due to the involvement of instruments to exactly measure gait parameters but there are exact results which help a doctor to treat gait abnormality person. The pro- posed work is to overcome all the above traditional methods and give a new dimension to the analysis of gait disability by digitalizing the output.

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II. REQUIRED COMPONENT

1. Arduino Nano

The Arduino Nano is a small, complete, and breadboard-friendly board based on the ATmega328P released in 2008. It offers the same connectivity and specs of the Arduino Uno board in a smaller form factor.

The Arduino Nano is equipped with 30 male I/O headers, in a DIP-30-like configuration, which can be programmed using the Arduino Software integrated development environment (IDE), which is common to all Arduino boards and running both online and offline. The board can be powered through a type-B mini-USB cable or from a 9 V battery.

In 2019, Arduino released the Arduino Nano Every, a pin-equivalent evolution of the Nano. It features a more powerful ATmega4809 processor and twice the RAM.

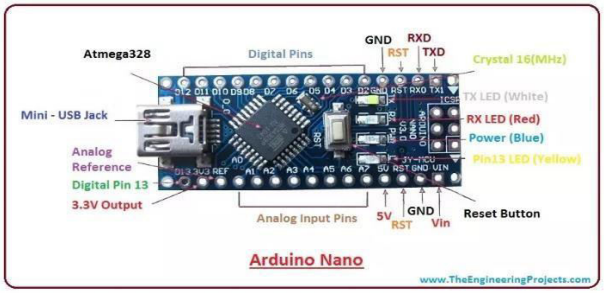

Fig 1. Arduino Nano

2.Flex Sensor

Flex sensor is a type of transducer which provides variation in resistance as we change the angle of a flex sensor. Hence, it consists of carbon resistive elements in the thin flexible strip. As the angle changes, there will be a change in carbon concentration. Bend in flex sensor is directly proportional to change in resistance. It is used in gait analysis to provide a variation of resistance between 22K ohm to 40K ohm when it bends up to 0-30.Smaller the bend value, higher is the resistance, this change in re- sistance further connected to voltage divider circuit where we get a change in voltage. Then this change in voltage is connected to one of the Arduinos analog input.Flex sensor are normally attached to the belt they require 5V input and output between 0 and 5V.the resistivity varying with the sensors degree of the bent and the voltage output change accordingly the sensor is connected to the device via 3 pin connectors.

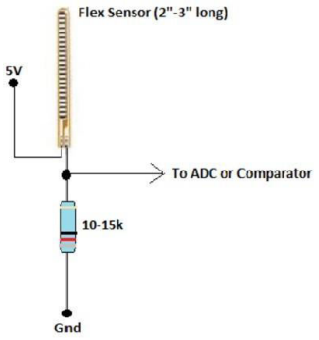

Fig 2. Flex Sensor

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3.HC-05 Bluetooth Module

HC05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. The HC-05 Bluetooth Module can be used in a Master or Slave configu- ration, making it a great solution for wireless communication. This serial port bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz ra- dio transceiver and baseband. It uses CSR Bluecore 04External single chip bluetooth system with CMOS technology and with AFH (Adaptive Frequency Hopping Feature).

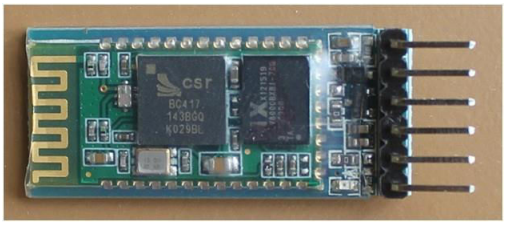

Fig 3. Bluetooth Device

4.Power Supply

This series of fixed voltage integrated circuit voltage regulator is designed for a wide range of applications.Thhese applications include on card regulations for elimination of noise and distribution problems associated with single point regulation.Each of these regulators can deliver upto 1.5A of output current. The internal current-limiting and thermal-shutdown features of these regulators essentially make them immune to overload. In addition to use as fixed-voltage regulators, these devices can be used with external components to obtain adjustable out- put voltages and currents, and can be used as the power-pass element in precision regulators.

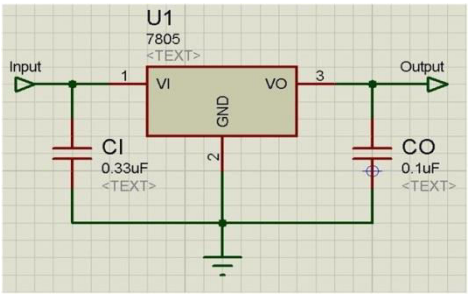

Fig 4. Power Supply

5.LCD Display

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits.In our circuit, it is used to display the all four-parameter front, back, left and right, this parameter is shown in degree.

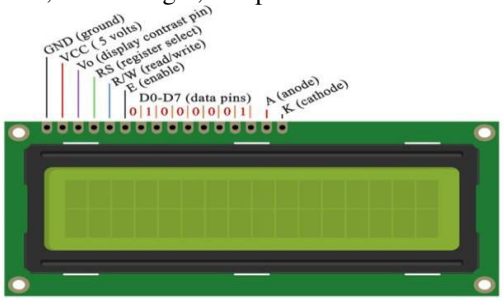

Fig 4. LCD Display

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III. WORKING PRINCIPLE

We placed four flex sensors on each side of the patient i.e. right, left, forward, backward. Along with flex sensor, vibrator motor is also placed in a belt that is wrapped around the patient to give the alarm signal. We connected output of flex sensor to Arduino UNO via analog pin. The Arduino UNO converts that analog signal to digital form. We scaled this analog output of flex sensor to degree form. For scaling we used mapping function. For example, if analog 500 at 0 degree and analog value 800 at 90 degree then we mapped 0=500 and 90=800 so that if analog value lies between this range, then it will automatic convert that analog value into degree. We gave two threshold value at 15 degree and 30 degree. We can change this value. If any flex sensor bends within this threshold range then vibrator motor gives alarm to the patient on that flex sensor side i.e. right, left, forward or backward. It means if patient bends in between 0 degree to 15 degree then it is normal bending. So, we do not give alarm to the patient. If patient bend above 15 degree then it is abnormal bending. So, it is necessary to give alarm to the patient. If patient bend above 15 degree, vibrator motor starts vibrating. But if patient wants to bend intentionally, then we should not give alarm to patient. So, we set second threshold value i.e. 30 degree. So, if patient bend above 30-degree vibrator motor stops vibrating. The current required for the motor to work is high. So, we give separate supply to whole motor circuit driver for proper working of motor. We used transistor as a switch to drive a motor. If patient bending is in between set threshold values then high supply is given at the base of the transistor. So, the motor starts vibrating. We placed four flex sensors on each side of the patient i.e. right, left, forward, backward. Along with flex sensor, vibrator motor is also placed in a belt that is wrapped around the patient to give the alarm signal. We connected output of flex sensor to Arduino UNO via analog pin. The Arduino UNO converts that analog signal to digital form. We scaled this analog output of flex sensor to degree form. For scaling we used mapping function.

IV. BLOCK DIAGRAM

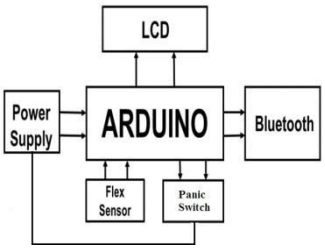

Fig 4. Block Diagram

V.CIRCUIT DIAGRAM

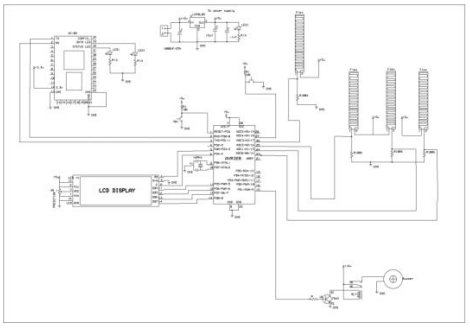

Fig 5. Circuit Diagram

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VI. RESULT

The project is successfully completed as presently the .belt is being used by many needy patients is the .center. The digital output from all the four flex sensors at four different positions is acquired by the Ardino UNO and after analyzing the data / detecting errors by com- paring with normal persons gait, controlling of vibration motors is carried out successfully. The bending values of four positions in degrees are also displayed on the LCD. The results are analyzed by a doctor for improvement or treatment in gait disability.The final output of the project is as shown as in Fig.7. The sys- tem gives a continuous reading as the patient completes walking. This reading can be given to any android mobile phone that is connected to Bluetooth module. The patient can monitor his statistically significant changes in the phase of walking. Gait belt device is used by patient after knee surgery Functional strength and movement analysis can be precisely done.

VII. CONCLUSION

This project is successfully implemented for the Gait analysis helps in detecting the defects which are difficult to spot from a physical test or by observation. Automatic Gait Detector Belt helps in spotting these defects exactly by quantifying it using the techniques of instrumentation and study of sensors. Different results were obtained from several patients wearing a belt. The doctor observed the results through the Bluetooth to treat the patients accordingly. This device helps in accurate analysis and the results will be obtained immediately which helps in improving the quality life for patients. It is portable when compared to the present-day equipment available. The cost is low and is affordable by all classes of society. This project can be treated as a great help to patients having gait abnormalities and hence can be successfully deployed in rehabilitation centers.

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