A WIRELESS IOT SYSTEM FOR GAIT DETECTION IN STROKE PATIENT

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Abstract – Gait monitoring using IOT is an important medical diagnostic process for stroke patient. we will design and implement an IOT system with Wi-Fi communication model and smart phone to discreetly monitor insole pressure of the patient's motion. this system is helpful for fall detection, the best way to reduce number of falls and to predict and prevent them from happening in first place .in this system a Internet based body sensors are used which is a wireless portable network used for gait detection and prevention of fall in stroke patient.

For this study, a smart-phone built-in sensor a with a Wi-Fi communication module is used to discreetly monitor insole pressure and accelerations of the patient's motion. To the best of our knowledge, we are the first to use the gait spatiotemporal parameters implemented in smartphones to predict a cautious gait in a stroke patient. This system can warn the user about their abnormal gait and possibly save them from forthcoming injuries from fear of falling.

INTRODUCTION:-

IOT is for internet of things. It refers to ever growing network of physical object that feature an IP address for internet connectivity and communication that occurs between these objects and other internet enabled devices and systems.

IOT is a system of interrelated computing devices, mechanical and digital machines, objects that provided with unique identifiers and ability to transfer data over network without requiring human-to-human or human-to-computer interaction.

It is a modern wireless communication technology having its application areas in various diversified domain areas. The basic idea of this concept is the pervasive presence around us of a variety of things or objects – such as Radio-Frequency Identification (RFID) tags, sensors, actuators, mobile phones.

Injuries due to a heart attack are a major health problem all over the world. More than 85% of heart attack patients regain the capacity to walk but their gait differs from that of healthy subjects. In older adults, the fear of falling after a stroke, named ‘‘cautious gait’’ leads to a specific gait pattern with reduced stride length and gait velocity. This diagnosis will also help to predict and prevent users from an injury. Stroke is one of the leading

Causes of morbidity and mortality in adults, accounting for 17.3 million deaths per year. Strokes significantly contribute to reduced gait performance. The majority of stroke patients do not reach a walking level that enables them to perform all their daily activities

IOT has created an explosion of sensor data due to the increased number of devices with embedded sensors. the aim of this study is to determine if the gait of stroke patients changes significantly over successive gait trials using smart phones. Data from a pressure-sensor embedded shoe and smart phone sensor were used to validate the proposed approach and to identify fear of falling with cautious gaits.

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LITRATURE REVIEW:-

1) Daiwat A. Vyas, Dvijesh Bhatt, Dhaval Jha, Assistant Professor, Dept. of Computer Science and Engg. Nirma University, Ahmedabad, India [2] presented a IOT which is network of physical devices accessed through the internet. It is a embedded technology to interact with internal states or external environment, it is a wireless technology that has its application in various domains IOT focus on aspects such as global real time integration, mobility, distributed intelligence, continuous connectivity etc.

2) K. Snehasri, N V Raghava Swamy [3] presented a wireless system to analyse gait using pressure sensors along with the IoT system for the real time detection of abnormality in users' gait pattern. Quantitative analysis of gait is provided by a device in conditions outside of the motion lab. While this work is continuing to be developed, it shows great promise as a future contributor to clinical gait analysis. Also, we are planning to compare healthy and stroke patients' data where the pairs are closely comparable based on gender.

3) Mark Sullivan, Casey Knox, Juan Ding [4] presented a system for Gait analysis through the Internet of Things (IoT) is able to provide an overall assessment of daily living. They design a next generation sensor embedded

smart IOT shoe can detect abnormal walking patter by foot pressure variation. In this when voltage is small the small variation in voltage then there is large change in pressure it creates a problem for sensors.

4) Wenlong Zhang, Student Member, IEEE, Xiuming Zhu, et.al.[5] presented a network-based mobile gait rehabilitation system is proposed for improved mobility and tele-rehabilitation. A compact rotary elastic actuator (cRSEA) has been introduced as the rehabilitation device. A new wireless protocol called MB Star Plus has been proposed to achieve a high sampling rate and guarantee real-time communication. A modified linear quadratic Gaussian (LQG) controller has been combined with a disturbance observer (DOB) to deal with the packet loss in this system. System integration method has been introduced and experimental results have been shown to validate the performance of this system. The plan for future clinical testing has been developed.

5) Parameters Felix Kluge, Heiko Gaßner, Julius Hannink, et.al. Presented a system for the sensor-based system [6] presented in this has great potential for the assessment of spatiotemporal gait parameters of healthy subjects and mildly affected gait of patients with PD. The possibility to quickly analyse a large number of steps that contribute to clinical decision making or treatment evaluation is an advantage compared to traditional motion capture laboratories. 6) Ruth E. Taylor-Piliae, M. Jane Mohler1, Bijan Najafi, Bruce M. Coull [7] presented a system in this Falls and fall risk are major concerns for stroke survivors. Since the majority of fall-related events occur at home or in community settings, the use of wearable mobile technology in stroke survivors may be useful to monitor fall risk and gait in these settings, which could further enhance recovery and/or prevent injuries. We have demonstrated the utility of the PAM Sys system for incorporation into cross-sectional monitoring of fall risk and gait assessment, with the potential for rehabilitation outcome assessment. As sensor algorithms become increasingly more predictive with less obtrusive applications, the potential for continuous monitoring of those at high risk for falling will develop into practical solutions for home and community settings.

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monitoring of those at high risk for falling will develop into practical solutions for home and community settings.

Objectives :-

1. To study the different techniques for GAIT monitoring.
2.To implement subject specific IOT system for gait assistant.
3.To simulate the model for monitor a stroke patients status in real time.
4.To verify the operation by process of GAIT monitoring for stroke prevention.
5.To analyse the spatiotemporal parameters and kinematic motion of gaits.

SYSTEM ARCHITECTURE AND PROPOSED WORK :-

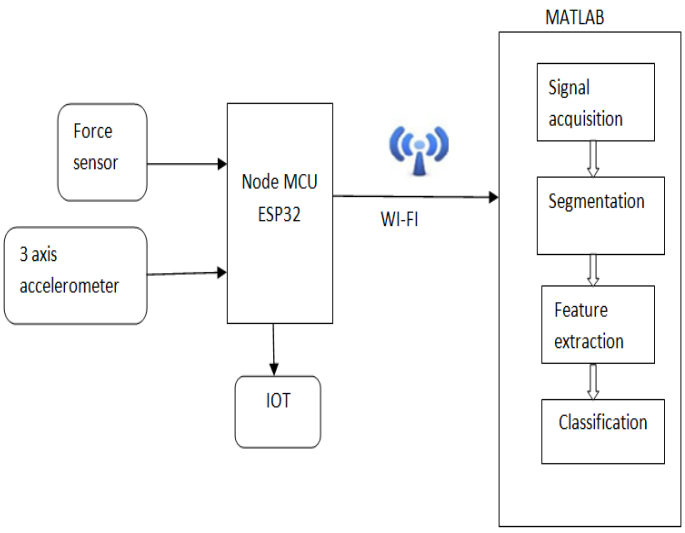
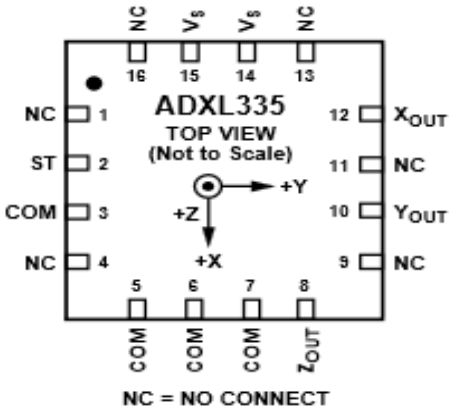


Fig : Block Diagram

SYSTEM/BLOCK DESCRIPTION:-

1) Accelerometer ADXL 335:-

ADXL335 is accelerometer sensor which deals with rule of piezoelectric effect. Whenever we will tilt the sensor the ball should move towards that path because of Gravitational force. The walls are comprised of piezoelectric elements. In this way , every time ball is contacting the wall an electric current will be created which will be translated in the form of values in any 3D space. ADXl335 is a three axis accelerometer i.e. it gives 3 values in output. It is a gadget which is utilized for detecting the adjustment in the increasing accelerations.

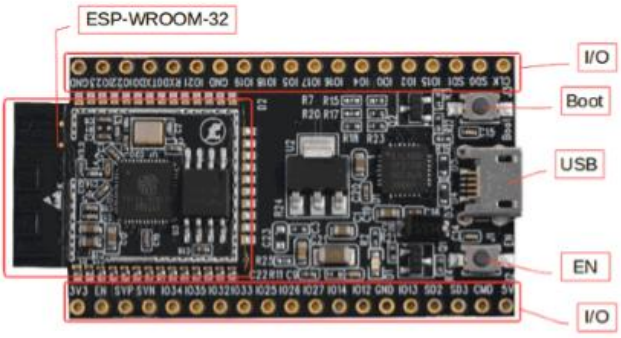


2) Pressure sensor:-

It is a gadget for measure the pressure typically of gases or fluids . Pressure is an outflow of power to stop gas or fluid. To examine the spatiotemporal parameters and kinematic movement of the gait, four piezo-resistive pressure sensors were set at the base of the shoe to evaluate the pressure distribution. It is seen that more than 70% body pressure is estimated from the front foot and back foot districts while walking.

3) Node MCU ESP32**:-**

ESP32 is a series of minimal cost, low power framework on a chip microcontrollers with incorporated wi-fi and double mode Bluetooth .the ESP32 arrangement utilizes Tensilica Xtensa LX6 microchip in both double core and single core variations and incorporate into constructed radio wire switches, RF balun, power enhancer , filters and power management modules. ESP32 is made and created by espressif frameworks. It is single 2.4 G HZ WI-FI and blue-tooth chip planned with low power 40nm innovation .It is programmed using Aurdino software.



4) IOT:-

The Internet of things (IOT) is the inter-networking of physical devices , vehicles (also referred to as "connected devices" and "smart devices") buildings and other items embedded with electronics ,software ,sensors ,actuators and network connectivity which enable this objects to collect and exchange data .

IOT is expected to offer advanced connectivity of devices , systems and services that goes beyond machine-to-machine (M2M) communication and covers a variety of protocols , domains and applications. The interconnection of this embedded devices (including smart objects), is expected to used in automation in nearly all fields, while also enabling advanced applications like smart grid , and expanding to areas such as smart cities .

5) Signal Analysis:-

a] Segmentation:-

The data taken through the WI-FI is get separated i.e. the unwanted data is removed and expected data is taken.

b] spatiotemporal parameters:-

The parameters measured from the insole pressure variation from an IOT-shoe and from the accelerometer of the smartphone was calculated to investigate common information between the parameters. Parameters with a higher coefficient were interpreted as being significant contributors to normal or abnormal walking detection. We investigated the relative error of spatiotemporal gait parameters of free gait with respect to parameters from the simulated motion gait. We observed that cadence and stride time for motion gait is higher than free gait for each trial.

C] Signal Classification:-

signal classification is to build a predictive model of signal trajectory densities in an RPS and differentiate between signals First, we applied our technique to the two data sets generated from free gait and simulated cautious gait events. It was observed that the pressure variation with one or two sensors during cautious

gait was much higher than free gait with respect to subject's gender age, height and weight. We can also see the variations of different walking patterns for different subject. Random forest technique is used for the classification of data. Two types of data i.e. motion gait and free gait is provided and check according to input data and gives the output data. For that There are 5 person, from each person we took 5 samples from it. 3 persons has free gait and 2 person's has cautious gait means fear of falling motion. So in data base we take 5 samples from each person, first 15 will be free gait and remaining 10 will be cautious gaits. In classification there are two methods training and testing.

1) Training:-

In training firstly the signal is given to signal acquisition where it converts the signal in digital form and then the signal is get segmented and from that we get the required data then it can be stored in feature database and then the classifier get trained and then it is given to validation block where signal is checked and gives the accurate data and then it goes to the trained classifier and we get the required signal and then it can be tested.

2) Testing :-

In testing the signal again converted into digital form and then it can be segmented and we get the required data and then the classifier is get loaded and it gives the classified result and then we get the output signal which is required.

Result and Disscussion :-

6.1) Flow Chart :-

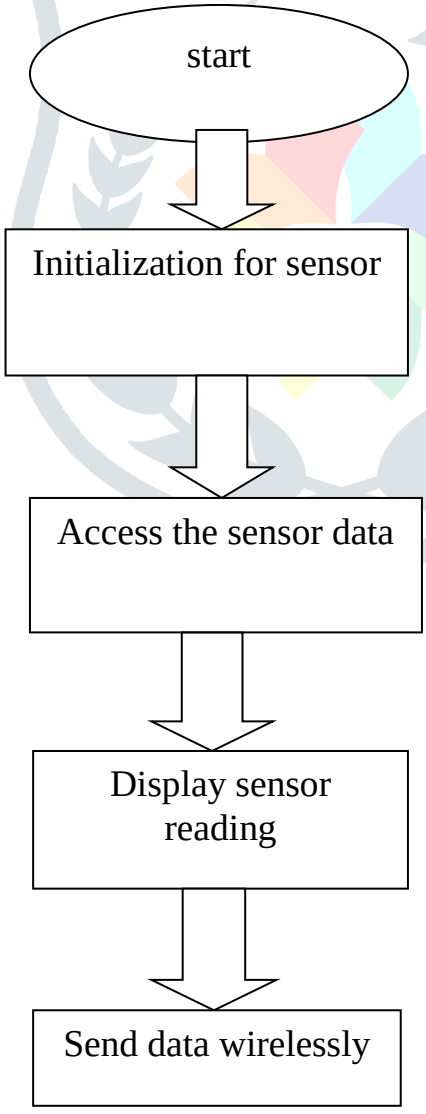


Fig :- flow chart for transmitt

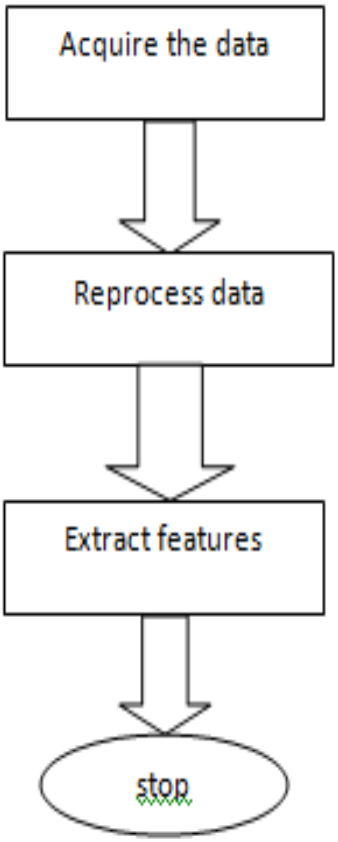


Fig :- flow chart for receiver

6.2) Results:-

In this project , the acceleration sensor and pressure sensor are the input data and then with help of MCU the output data is taken on IOT with help of "BLYNK" app and also analyze the data on MATLAB and that here we use the random forest technique for classifier . In that the 5 persons are considered, from each person we took 5 samples from it. 3 persons has free gait and 2 person's has cautious gait means fear of falling motion. So in data base we take 5 samples from each person, first 15 will be free gait and remaining 10 will be cautious gaits.

6.2.1) hardware of project:-

Fig :- hardware for gait detection

In this hardware ,we can take two sensors accelerometer and pressure sensor it senses the i/p signals and then that signals are given to MCU then MCU provides the data to mobile through IOT and also provide the data to MATLAB for analysis of that data in this hardware we provide the lithium battery of 5v for i/p voltage and make it portable device.

6.2.2) outputs of data analysis in MATLAB:-

a) Training :-

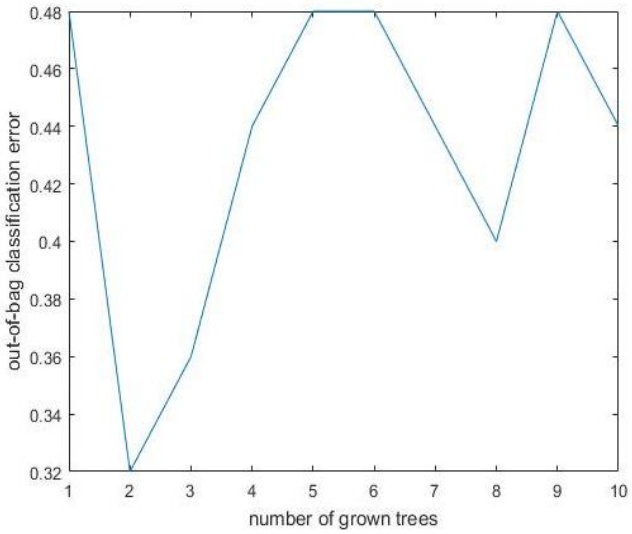


Fig :- out of bag error

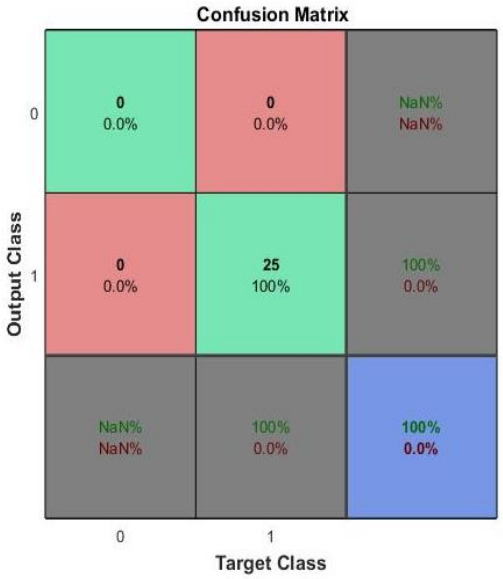


Fig :- confusion matrix

b) Testing:-

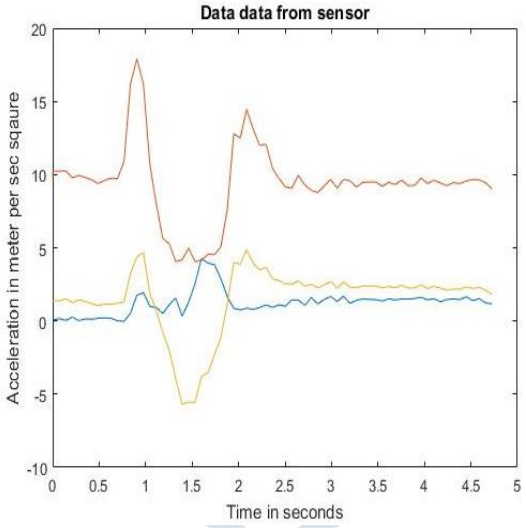


fig :- tested data of aacelerometer

Fig :- test the gait

In MATLAB, first the data is trained by using random forest technique and then the data is get then then it can be tested and depending on that it gives the result for accelerometer and pressure sensor .

6.2.3) BLYNK Results:-

Fig:- result through IOT in Mobile

In this BLYNK app , we get the output data by connecting that MCU with the mobile with help of SSID and Pass-ward . And also get the different values of accelerations and pressure and also observe the graph of accelerations on it and depending on that it predict that the gait is free or cautious.

ADVANTAGES AND APPLICATION:-

Advantages:-

a) The percentage of fall due to caution gait is reduced.

b) It also reduce the rate of morbidity and mortality in adults.

c) It identifies the problem within patient and protect them from injuries.

d) It helps in assessing, planning and treating an individual with condition affecting his or her ability to walk.

Applications:-

a) Medical diagnostics :

Pathological get may reflect compensation for underlying pathologies or be responsible for causation of symptoms in itself. The study of gait allows diagnoses and intervention strategies to not made as well as permitting future development in rehabilitation engineering .

b) Chiropractic and osteopathic utilization :

Observation of gait is beneficial for diagnoses in Chiropractic and osteopathic professions as hindrances in gait may be indicative of misaligned pelvis or sacrum. Chiropractic adjustment of pelvis has shown a trend in helping restore gait patterns as has osteopathic manipulative therapy

c) Comparative biomechanics:

By studying the gait of non human animals, more insight can be gained about mechanics of locomotion, which has diverse implications for understanding the biology of species in question as well as locomotion more broadly.

d) Gait as biometrics:

Gait has been established as biometrics to recognize people by the way they walk. This advance in gait recognition has therefore led to development f techniques for forensics use since each person can have a gait defined by unique measurements such as location of ankle, knee, and hip.

CONCLUSION AND FUTURE SCOPE

CONCLUSION:-

Gait monitoring using IOT is an important medical diagnostic process for stroke patient. We will design and implement an IOT system with Wi-Fi communication model and smart phone to discreetly monitor insole pressure of the patient's motion. in this system a Internet based body sensors are used which is a wireless portable network used for gait detection and prevention of fall in stroke patient and this is most helpful as number of falls mostly in older people is increased due to the abnormality in gait of stroke patient.

In this paper, we presented a wireless system to analyze gait using sensors through a real-time detection of abnormality in users gait patterns. The proposed Iota system can detect and predict cautious gait that can lead to a fall. Here presented preliminary results from a patient using the embedded IoT system and showed that the data can be used to analyze the cautious gait**.** The system may also find multiple applications in gait behavior detection for people with various disabilities who are at a high risk of falls related injuries with location information.

FUTURE Scope:-

It was built on a single embedded platform which is smart watch and also connected to mobile through IOT and we get the required data on a single platform and also able to connect more amount of sensors on this embedded platform and get more results.

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