DESIGN OF A LIGHTWEIGHT COMPLIANT FOR STROKE PATIENTS

Mrs.G.Valarmathi[1], Haripriya.M[2], Indurupa.S[3], Keerthana.S.[4]

[1,2,3,4]*Sri Sai Ram Institute of Technology, Chennai.(India)*

ABSTRACT

Ankle Foot Orthosis (AFO) are externally applied devices that control the foot and ankle joint complex. The goal of this project is to create a smart device and sensor based control, communicator and mechanical performance analyzer for a prototype AFO, which is powered by artificial pneumatic muscles to aid walking in patients with ankle and foot injuries. The preliminary proof of concept study of the system to improve comfort and offer settings control will be presented. It can potentially provide a higher computing and analyzing power in the design of medical devices by the combination of smart SENSOR device technology with microcontrollers and GSM Technology. Depending on sensor values, the device provides appropriate force to the person in the extremities like hand and leg where the normal functioning is lagging. By consistent wearing of this device, faster recovery will be observed. It also prevents foot drop and foot collapses in the patients.

Keyword: foot orthosis ,sensor.

I.INTRODUCTION

A stroke is the result of blood flow obstruction within the brain that can permanently damage the affected area. One of the many ill effects that impact stroke victims is the loss of mobility. It has been observed that the majority of victims with impacted muscle control lose sensation in their extremities, like hands and feet. Those who lose muscle control of their feet or ankle typically struggle to create the necessary force for both dorsiflexion and plantar flexion. However, with the help of custom made orthoses, many victims can recover mobility but tend to remain dependent on the device. Therefore, AFO's are an important part of the medical treatment for patients with foot and lower extremity pathology

There are many options when selecting an orthosis dependent on the patient's preference and budget. Most of these options can be categorized as either passive or active orthoses. Passive orthoses do not contain powered mechanisms. Instead, they strive to provide a better walking ability by using different materials and manufacturing techniques [1]. Passive orthoses are merely for support and limit natural motion. On the other hand, active orthoses have portable or tethered source of power to actually assist the patient in creating the necessary force for a more natural and normal gait cycle. Most of the active orthoses function under the same principles as springs, adding enough force to return the users foot to its neutral position to assist drop foot [2]. To actively control our prototype orthosis, we will be utilizing pneumatic artificial muscles, which consist of a hollow elastomer cylinder embedded with aramid fibers. Pneumatic artificial muscles are natural impedances with true mechanical compliance. Forces are controlled by manipulating the pressure in the membrane, and compliance is provided by the compressibility of air and the membrane. The natural compliance can be controlled to offer a pneumatic artificial muscle the ability to mimic the biological muscle-tendon architecture of a human ankle joint complex.

II.EXISTING SYSTEM

In existing system the use of foot and ankle orthoses to cure related injuries has been limited because these devices are not tailored specifically to the intended patient. Kao and Ferris indicated that subjects had different adaption responses of the two tibialis anterior EMG bursts during dorsiflexion-assisted walking using a powered AFO. To assist individuals with dorsiflexor weakness, each device should be individually configured to accommodate different human response to the device. Yakimovich et al examined the engineering designs of various stance-control knee-ankle-foot orthoses. An important functional limitation of these devices is dependence on specific joint angles for control mode switch. Nolan et al evaluated a dynamic AFO in hemiplegic gait and found out that the dynamic AFO had a positive effect. However, further research is necessary to generalize the the use of foot and ankle orthoses to cure related injuries has been limited because these devices are not tailored specifically to the intended patient. Kao and Ferris indicated that subjects had different adaption responses of the two tibialis anterior EMG bursts during dorsiflexion-assisted walking using a powered AFO.

III.DISADVANTAGES

- Need specific devices for specific patients
- Complexity in design

IV.PROPOSED SYSTEM

In an attempt to create a sturdy but light and comfortable ankle foot orthosis powered by a pneumatic artificial muscle. The two major components attached to the calf and the shoe are The device shown above is designed to be worn around the patients shoe and strapped to the shoe and calf via two or three Velcro bands. Using a pneumatic muscle, this AFO is able to create forces necessary for both dorsiflexion and plantar flexion control while allowing for a more fluid motion and flexibility of the ankle joint. AFO control interface, which is a microcontroller circuit that can effectively communicate with the Sensors and gsm . In our project we are using MEMS sensor for measuring the movement of ankle foot direction and pressure sensor for leg stress level. Depends upon the movement of leg direction in MEMS the motor will show the direction to us. Also if any abnormal condition in pressure sensor , controller will enable the GSM and message alert to emergency contacts.

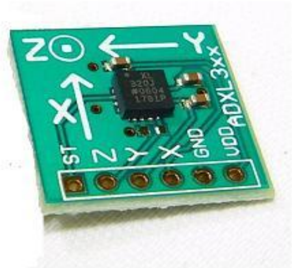
International Journal of Advance Research in Science and Engineering
Volume No.07, Special Issue No.(02), March 2018
www.ijarse.com
IJARSE
ISSN: 2319-8354

ADVANTAGES

- Not necessary to depend upon the specific foot steps
- Simple design

V.COMPONENTS USED

MEMS ACCELEROMETER



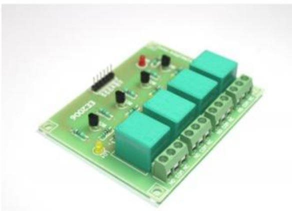
An **accelerometer** is a device that measures proper acceleration. An accelerometer measures proper acceleration, which is the acceleration it experiences relative to freefall and is the acceleration felt by people and objects.

MEMS (Micro Electro-Mechanical Systems) Technology:

In early MEMS systems a multi-chip approach with the sensing element (MEMS structure) on one chip, and the signal conditioning electronics on another chip was used. The latest generation ADXL2O2E is the result of almost a decades worth of experience building integrated MEMS accelerometers.

MEMS and Nanotechnology blurs the distinction between complex mechanical systems and integrated circuit electronics.Here in this project it also performs the same function , it is used to move the robotic hand in the direction reverse to the direction of MEMS.

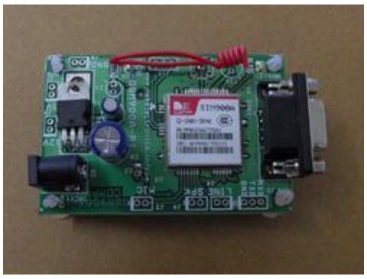
RELAY:



A **relay** is an electrically operated switch. . Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts.

In this project it is used to make the motor move and activate the different motors at different positions of the hand.

GSM MODEM :



GSM (**Global System for Mobile communications**: originally from ***Group Special Mobile***) is the most popular standard for mobile phones in the world. GSM differs from its predecessors in that both signaling and speech channels are digital, and thus is considered a *second generation* (2G) mobile phone system

In this project it is used to send the sms to the people monitoring the patients in case of any emergency.

LCD :

- **Pin-1 Vss- Ground**
- **Pin-2 VDD- Power 5V**
- **Pin-3 VEE- LCD Contrast Adjustment**

In this project it is used to display the values of the pressure. Once it exceeds the threshold value it shows 'S' symbol implying message is being passed.

PIC16F877 MICROCONTROLLER:

PIC 16F877 is one of the most advanced microcontroller and a family of Harvard architecture microcontrollers from Microchip. This controller is widely used for experimental and modern applications because of its low price, wide range of applications, high quality, and ease of availability.

In this project we are using it to collect data from the 2 sensors(pressure and MEMS) and it provides data to the relay and gsm.

VI.ROBOTIC MODEL

GENERAL DESCRIPTION

A 3 axis robotic arm contains five DC gear motors. The machine consists of minimum mechanical tools resulting in a high quality robot. These motors are directly controlled by two modes. Pulses from micro controller and it can be controlled by means of relay switch. It can be moved in multi directions to pick or place the object. Arms can be programmed to execute different types of motion profiles using any of the 3 servo channels simultaneously. The arm is built with as many unmodified components as possible. In addition to reducing the amount of time necessary for fabrication, this facilitates the final design being easily reproduced.

PRODUCT DESCRIPTION

The Robotic arm is made up of high grade machined / injection moulded Aluminium alloy. The arm uses 4 x NRS-995 17Kg/cm dual bearing, metal gear servo motors and light weight 2 x micro servo motors. The ability of the arm to move an object is primarily symbolic. We have multiple available radio and controller options. With radios we offer analog, digital, and COFDM. For the controller housings we offer rugged aluminum and pelican style enclosures. Fixed front and back cameras can be added to the robot too.

POWER SUPPLY:

Power supply is a reference to a source of electrical power. A device or system that supplies electrical or other types of energy to an output load or group of loads is called a power supply unit or PSU.

PRESSURE SENSOR:

The pressure sensor is used to monitor the pressure of the hand and provide data to the pic microcontroller.

VII.RESULTS AND DISCUSSIONS

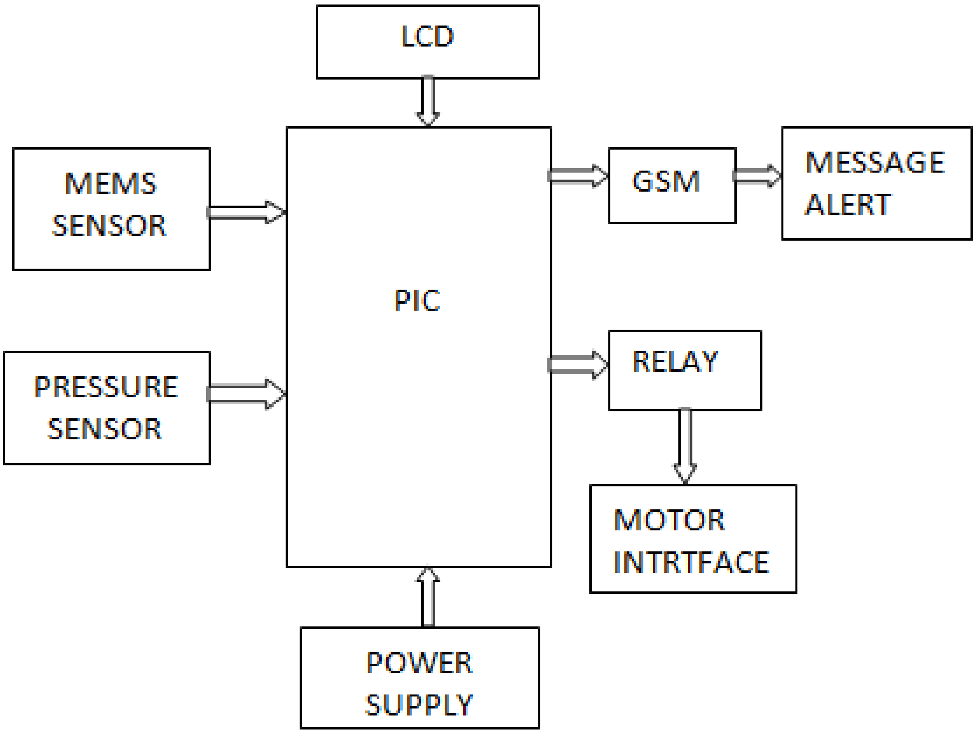
OBSERVATION-1:

The robotic hand is moved in the opposite direction with respect to the MEMS. This shows that the direction can be changed in the x- and y- direction and the hand is moved in the opposite direction. There are totally 3 directions in which the hand can be moved up-bottom, left-right, rotational.

OBSERVATION-2:

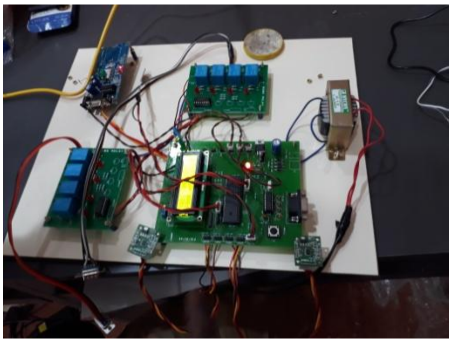
The pressure sensor held by the patient has a threshold value of 100 and above it a sms alert will be sent to the patient. Hence any emergency can be handled carefully.

VIII.BLOCK DIAGRAM



IX.BLOCK WORKING

Initially the MEMS sensor identifies the foot direction of the person and sends the appropriate details to the PIC microcontroller. The microcontroller after comparing it with the precoded database and finally chooses the proper values of the signal to be applied in order to compensate it.such values are given to the relay board. The relay gets on and passes the signal to the robot,which in turn moves according to those commands received. This will leads to an appropriate change in the previous position of the foot. Simultaneously the pressure sensor monitors the pressure values of the leg,whenever it exceeds the threshold value,the foot drop or foot collapse in the persons will be detected and an alert signal will be send to the care taker numbers previously given.



REFERENCES

[1.] Lidar-based Gait Analysis and Activity Recognition in a 4D Surveillance System

[2.] BY Csaba Benedek, Bence Galai, Bal´ azs Nagy and Zsolt Jank´ o´

[3.] Joint inertial sensor orientation drift reduction for highly dynamic movements

[4.] BY Benedikt Fasel, Jörg Spörri, Julien Chardonnens, Josef Kröll, Erich Müller, and Kamiar Aminian, Senior Member

[5.] A Closed-Loop Brain–Computer Interface Triggering an Active Ankle–Foot Orthosis for Inducing Cortical Neural Plasticity

[6.] BY Ren Xu, Student Member, IEEE, Ning Jiang, Member, IEEE, Natalie Mrachacz Kersting, Chuang Lin, Guillermo As´ın Prieto, Juan C. Moreno, Member, IEEE, Jose L. Pons, Senior Member, IEEE,Kim Dremstrup, Member, IEEE, and Dario Farina*, Senior Member, IEEE.

[7.] Cyberphysical System With Virtual Reality for Intelligent Motion Recognition and Training

[8.] BY Fei Hu, Qi Hao, Qingquan Sun, Xiaojun Cao, Rui Ma, Ting Zhang, Yogendra Patil, and Jiang Lu, Member, IEEE

[9.] Adaptive Control of a Variable-Impedance

[10.] Ankle-Foot Orthosis to Assist Drop-Foot Gait

[11.] By Joaquin A. Blaya and Hugh Herr

[12.] Angular-Velocity Control Approach for Stance-Control Orthoses Edward D. Lemaire, Louis Goudreau, Terris Yakimovich ,Member, IEEE, and Jonathan Kofman, Member, IEEE

[13.] Design and Functional Evaluation of a Quasi-Passive Compliant Stance Control Knee–Ankle–Foot Orthosis Kamran Shamaei , Student Member, IEEE, Paul C. Napolitano, and Aaron M. Dollar, Senior Member, IEEE

[14.] Design and Evaluation of an Orthotic Knee Extension Assist

[15.] By Alexander N. Spring , Member, IEEE , Jonathan Kofman , Member, IEEE ,and Edwar d D. Lemaire , Member, IEEE