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FINAL YEAR PROJECT REPORT

**PROGRAM NAME:
DIPLOMA IN MEDICAL ELECTRONIC ENGINEERING**

**COURSE CODE:
DEE 40082 (PROJECT 1 &2)**

**PROJECT TITLE:
IoT BASED MUSCLE FINGERS THERAPY TOOL FOR
STROKE PATIENT**

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ABSTRACT

Fingers play an important role in human activity in daily life. Stroke patients having difficulty to perform hand tasking because of severe muscle injuries. Stroke patients needs to undergo rehabilitation device is needed to perform therapy fingers exercise. Muscle fingers therapy tool has been developed for self-evaluation of hand fingers as well as to improve the strength of fingers movement. It comprises an array or electrode sensors coupled with a glove, microcontroller and android phone for exercise evaluation. The data interface has been designed for displaying the strength of hand therapy exercise and future reference by the physician.

CHAPTER 1

1.1 INTRODUCTION

Many people lose the use of their arm and hand after a stroke. Many also experience spasticity, uncontrollable muscle tightness, and stiffness, which make movement difficult. According to Stroke Connect, experts estimate that 20-50% of stroke survivors have some spasticity. Paralysis or weakness on one side of the body happens to about 80% of people. This usually happens on the opposite side of the body from where the stroke occurred in the brain. In rehab, you'll work with a health care team to regain use of your arm. The present research deals with hand paralysis. Whatever its cause, paralysis is a significant health problem. Strokes are an increasing problem, affecting all ages, genders, and ethnicities. A lack of resources in providing and monitoring physiotherapy limits the efficacy of conventional rehabilitation techniques. Stroke rehabilitation begins once your condition has stabilized -- as soon as 24 to 48 hours after your stroke. Early, individualized therapy helps improve your chance of recovery. While some stroke survivors recover fully, others will always have some disability.

1.2 PROBLEM STATEMENT

Nowadays stroke is the leading cause of disability and brings difficulty to the one who suffered of it. Traumatic injury as well as conditions like muscular dystrophy or arthritis or regional pain syndrome, also add on as the chief causes of a patient's disability and functional dependence. Shortcomings in motor control and coordination synergy patterns, in spasticity and in pain are some of the most recurrent symptoms of these conditions. Rehabilitation is very much necessary to take care of flexor tendon injuries or to evade scarring and adhesion following surgery. Rehabilitation is performed manually by physiotherapists. High personnel costs and lack of motivation of patients to perform exercises at home is present problem. Some devices help the physiotherapists by applying a uninterrupted passive motion to the patient's hand. After hand operations it is necessary to perform rehabilitation to recover previous dexterity. Sensing gloves could be a prospective tool for increasing the effectiveness and dependability of performing a rehabilitation task. A review of the most related hand rehabilitation systems that have contributed by representing a blend of technological advances along with clinical outcomes is presented.

Currently there is a wide variety of research groups that are developing robotic devices that can help in hand rehabilitation. Studies indicate that stroke patients who have robotic assistance when performing intense repetitive movements can attribute this to significant improvement in hand motor functions. The main challenge associated with developing a hand rehabilitation device is that traditional robotic devices use actuators that are less compliant than the joints themselves.

1.3 OBJECTIVE

- a) To help paralysis or stroke patients to improve their muscles fingers by using rubber ball with hand gloves.
- b) To acknowledge the doctors of the patient's fingers hand status or level in graphical views on smartphone.

1.4 SCOPE OF PROJECT

- a) Paralysis or stroke patient who encounter of muscles problem

1.5 IMPORTANT OF RESEARCH

- a) To help the patients to have a fast recovery process.
- b) Give the doctors, medical officer and nurse a good reading of nerve and muscle movement to be record.

CHAPTER 2

LITERATURE REVIEW

What is Physiotherapy treatment?

Physical therapy exercise are based on a detailed understanding of how the body works, posture, balance and movement, knowledge of disease, injury and the healing process. Physiotherapy, physical therapy is health care profession that aims to develop throughout life.

Research has shown that the most effective types of physiotherapy are exercises and practising specific tasks that you aren't able to do well. So if you are having difficulty keeping your balance when standing, you need to practise standing up a lot; if you have difficulty lifting your arm, you need to practise doing activities which make you lift your arm, and if you are having difficulty walking you need lots of walking practice.

The glove design proposed in this paper, follows an open palm configuration to ensure quick, easy and safe fitting to the human hand. The main material used to manufacture the glove, an elastic fabric (neoprene) allows maximum conformability with fingers at all bending angles of the joints.

What is the definition of stroke in medical?

Stroke is the sudden death of brain cells which due to the lack of oxygen delivered to the brain and can lead to the brain injury, serious disability or death. It is caused by the blockage of blood flow or rupture of an artery to the brain. The person can be diagnose to have a stroke by looking at the symptoms of stroke which could be like :-

- Loss of speech,
- Weakness, paralysis or difficulty with muscle strength and numbness on one side of the body
- Facial dropping
- Severe headache
- Vision changes

But of course having those symptoms only can not clarify you as stroke patient. The suspected patient must go under several test such as CAT scan. The patient also can test or check this symptom if they feel they having stroke symptom by using FAST method that are recommended by National Stroke Association to help them identify the warning signs of a stroke.

- **Face:** When you smile, does one side of your face droop?
- **Arms:** When you raise both arms, does one arm drift down?
- **Speech:** Is your speech slurred? Are you having trouble talking?
- **Time:** If you experience any of these symptoms, call the ambulance or seek for help immediately.

There are also many additional symptoms for stroke that don not fit in the FAST description method such as sudden confusion, difficulty seeing in one or both eyes, severe headache and etc.

Stroke diseases can occur complication to its host but the complication may be vary according to the type of stroke. Examples of complication include the behavior changes to the person that having a stroke which contribute to depression, anxiety and can be more impulsive or more withdrawn from socializing with others. Not only that, stroke also can impact the areas of your brain that are involves speech which will give

you difficulty to reading, writing, or understanding other people who are speaking with you. You also might be lost your motor function or swallowing abilities. A stroke also can cause numbness and decreased sensation in parts of your body and it can be worst until half side of your body are experience paralysis.

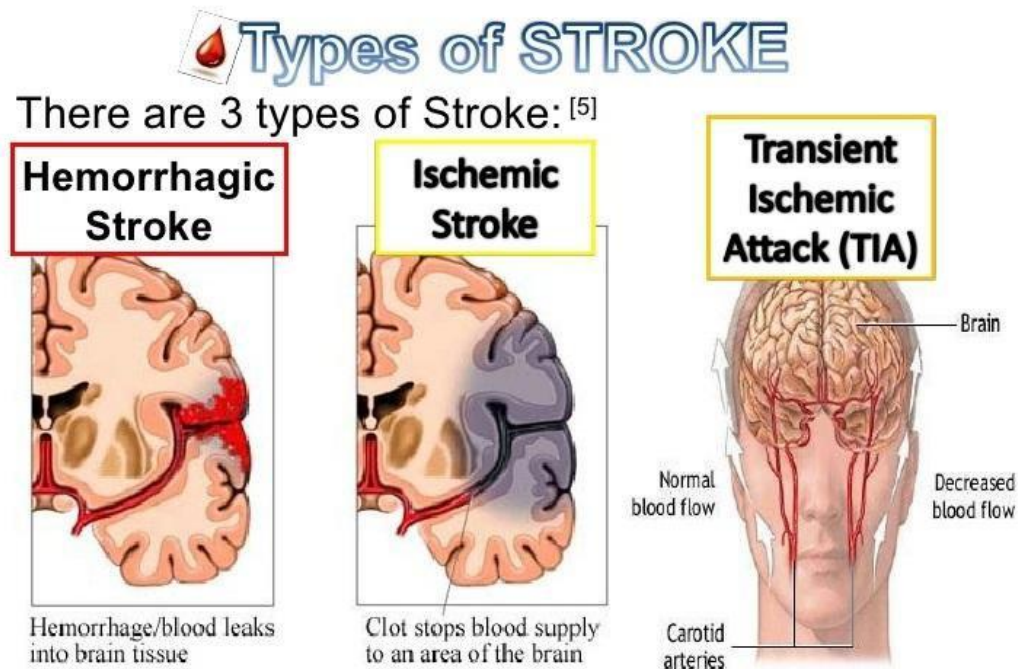


Figure 2.1. shows the diagram type of stroke

There are 3 main types of stroke which is Transient Ischemic Attack(TIA), Ischemic stroke and Hemorrhagic stroke. Transient Ischemic Attack (TIA) also known as mini stroke in medical field. This mini stroke (TIA) are temporary blockages of the blood vessels in the brain. The blood clot and TIA symptoms last for a short period of time. TIA can produce mild stroke symptoms that resolve. TIAs often occur before a stroke happens, therefore they served as a warning signs to the person that may need the preventive therapy of stroke.

An ischemic stroke occurs when a blood clot keeps blood from flowing to your brain. The blood clot is often due to atherosclerosis, which is a buildup of fatty deposits on the inner lining of a blood vessel. A portion of these fatty deposits can break off and block blood flow in your brain. Fatty deposits can cause two types of obstruction which is cerebral thrombosis that is a thrombus (blood clot) that develops at the fatty plaque within the blood vessel. Cerebral embolism is a blood clot that forms at

another location in the circulatory system. The blood clot forms in an artery outside the brain. Often these blood clots start in the heart and travel until they become lodged in an artery of the brain. The physical and neurological damage embolic strokes cause is nearly immediate. These two are the main subtypes of ischemic stroke.

The other type of stroke is Hemorrhagic stroke. Hemorrhagic strokes make up about 13 percent of stroke cases. It is caused by a weakened vessel that ruptures or breaks, spilling blood into the surrounding tissues. The blood accumulates and compresses the surrounding brain tissue. The two types of hemorrhagic strokes are intracerebral (within the brain) hemorrhage or subarachnoid hemorrhage. Intracerebral means “within the brain,” and it refers to a stroke caused by a diseased blood vessel bursting within the brain. Intracerebral strokes are usually caused by high blood pressure. Meanwhile subarachnoid hemorrhage refers to bleeding immediately surrounding the brain in the area of the head called the subarachnoid space. The main symptom of a subarachnoid stroke is a sudden, severe headache, possibly following a popping or snapping feeling. Many factors can cause a subarachnoid stroke, including head injury, blood thinners, bleeding disorders and bleeding from a tangle of blood vessels known as an arteriovenous malformation.

Therefore, exercise therapy is a key element of stroke rehabilitation. But exercises performed after stroke may differ with regards to their objectives (goal-directed, task-oriented, repetitive task training) or their technical characteristics (duration, training load, and type of feedback). The decisional tree is based on the stage of stroke, the presence of hand movement and the presence of spasticity. According to the stage of stroke, some rehabilitation concepts may be more appropriate than others. In acute stroke patients, the following rehabilitation approaches have been studied and are recommended: muscle strengthening exercises, constraint-induced movement therapy with a lower dosage regimen and many more.

Rehabilitation exercises tracking is important because exercises tracking data provide practitioners with a sense of direction, help them adjust their exercise routine and enhance their motivation and willingness to recover. With the recent development of wearable computing and sensor technology we propose an IoT Based Muscle Fingers Therapy Tool For Stroke Patient that can track rehab exercise whenever there is direct

interaction between the user's hand and the force sensor. The force sensor,FSR are used to detect physical pressure, squeezing, and weight. They are easy to use and low-cost. In general, FlexiForce and Interlink are the two common type of FSR sensor that are available, cheap and easily found in the market. The data sampling and communication unit read the data from the force sensors and sends the data to the computing and visualization unit. For now we are just using only one hand of the glove.

CHAPTER 3 METHODOLOGY

We here propose a physiotherapy hand tools in paralysis that can allows patients to do their exercise using advanced technology.

a. GLOVES



Figure 3.1

The glove fully encloses the soft actuators, which reduces the chances of damage, and reduces distraction to the patient. We designed the glove to fit an average adult's hand and we used a modified sports glove to provide both comfort and the durability to have components mounted on to it.

b. FORCE SENSING RESISTOR ELECTRODE

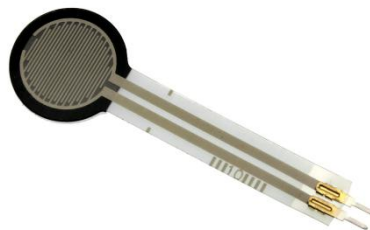


Figure 3.2

To measure muscle response or electrical activity in response to a nerve simulation of the muscle. The test is used to help detect neuromuscular abnormalities. During the test, one or more small needles (also called electrodes) are put on top of the skin to detect the nerve muscles.

c. LCD DISPLAY

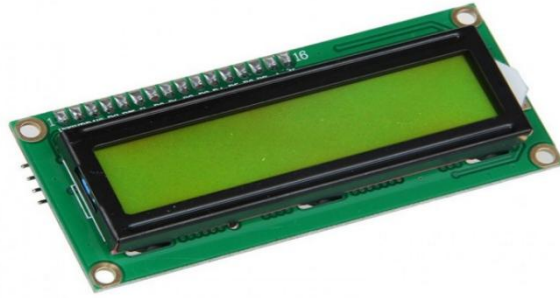
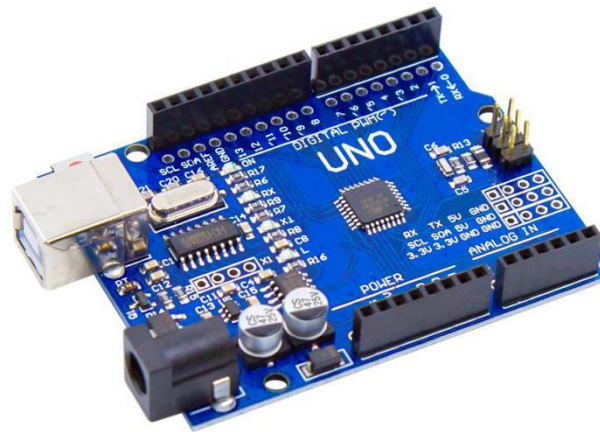


Figure 3.3

A liquid-crystal display is a flat panel display or other electronically modulated optical device that use the light modulating properties of liquid crystals. Liquid crystals do not emit light directly, instead using a backlight or reflector to produce image in colour or monochrome.

d. ARDUINO UNO R329+*



c

Figure 3.4

Open source electronic photocopying platform enabling users to create interactive electronic object. We found that it is more easier to use Arduino Uno R3 microcontroller, therefore we are using these type of microcontroller. The Arduino can control the environment by receiving input signals (Digital/Analog) and can effects its surroundings by controlling lights, relays and other devices. The microcontroller on the board is programmed using Arduino Software.

e. RUBBER BALL



Figure 3.5

A rubber ball designed for physical training, warm-up exercise, and physiotherapy.

f. RECHARGEABLE LITHIUM ION BATTERY



Figure 3.6

A battery is a device consisting of one or more electrochemical cells with external connections for powering electrical devices. When a battery is supplying electric power, its positive terminal is the cathode and its negative terminal is the anode. A **lithium-ion battery** or **Li-ion battery** (abbreviated as **LIB**) is a type of rechargeable battery. Lithium-ion batteries are commonly used for portable electronics and electric vehicles and are growing in popularity for military and aerospace applications.

g. ESP8266

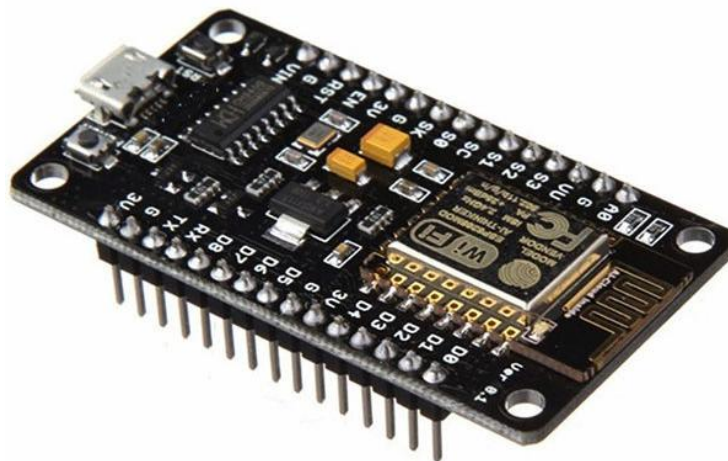


Figure 3.7

The ESP8266 WiFi Module is a self contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your WiFi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor.

SOFTWARE

Arduino Software



Figure 3.8

We here propose a physiotherapy hand tools in paralysis that can allows patients to do their exercise using advanced technology. Since we are using Arduino Uno R3 microcontroller, therefore we need the use the Arduino Software. The Arduino microcontroller is an easy to use yet powerful single board computer that has gained considerable traction in the hobby and professional market. The Arduino is open source, which means hardware is reasonably priced and development software is free.

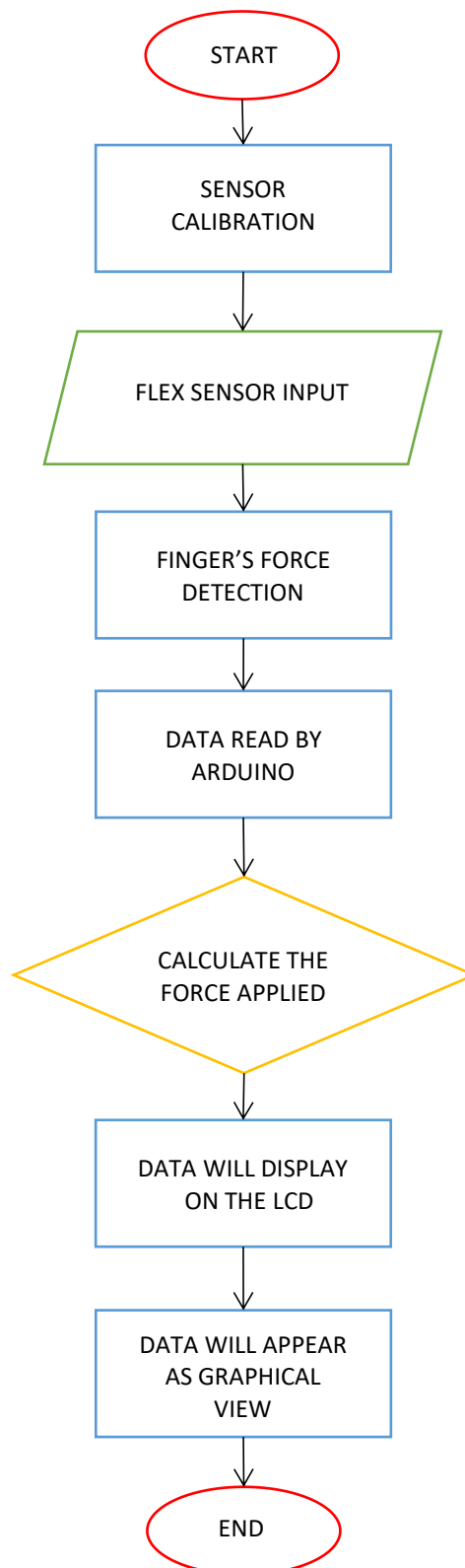
ThingSpeak



Figure 3.9

To digitized signal from microcontroller is sent to laptop through internet to make the system more easier. The application software is designed using Laboratory Virtual Instrument Engineering Workbench, is a programming environment in which you create programs using a graphical notation (connecting functional nodes via wires through which data flows); in this regard, it differs from traditional programming languages like C, C++, or Java, in which you program with text. ThingSpeak is an IoT analytics platform service that allows you to aggregate, visualize, and analyze live data streams in the cloud. You can send data to ThingSpeak™ from your devices, create instant visualizations of live data, and send alerts using web services like Twitter® and Twilio®. With MATLAB® analytics inside ThingSpeak, you can write and execute MATLAB code to perform preprocessing, visualizations, and analyses. ThingSpeak enables engineers and scientists to prototype and build IoT systems without setting up servers or developing web software.

FLOWCHART



BLOCK DIAGRAM

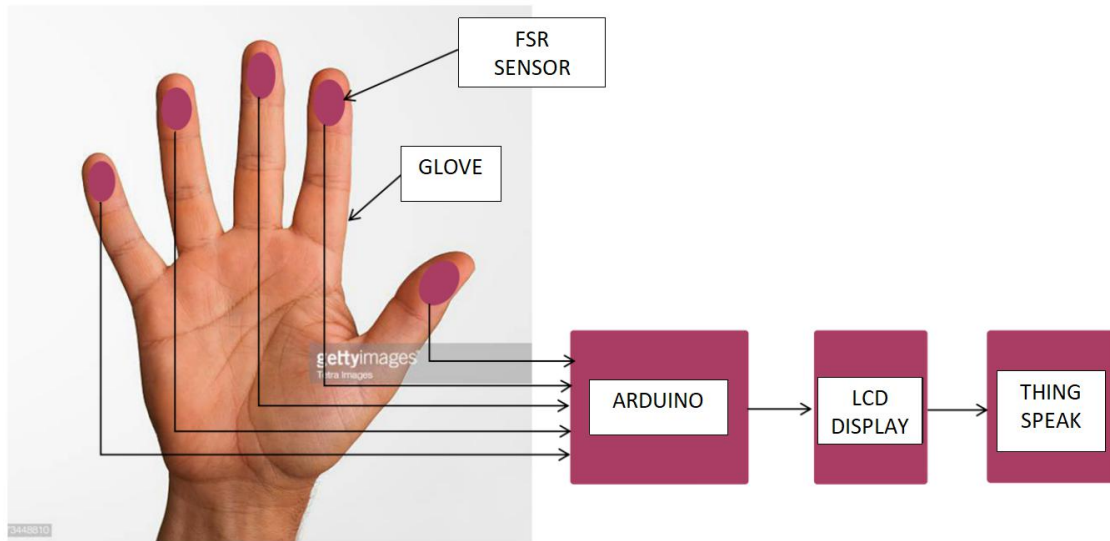


Figure 3.10

- Switch on the hotspots and connect the sensor to the phone.
- If it is not connected, it would not be able sent the data to Thingspeak.
- If it is success, open Thingspeak website and login into Thingspeak account
- Put on the glove that have been attached with the sensor
- Grasp the ball and wait for a few seconds
- The force of the muscle strength will be calculated
- The result will be appear in the graphical view on the Thingspeak and the result also will be display on the LCD in percentage value.
- The data will be automatically save in the Thingspeak account

CIRCUIT

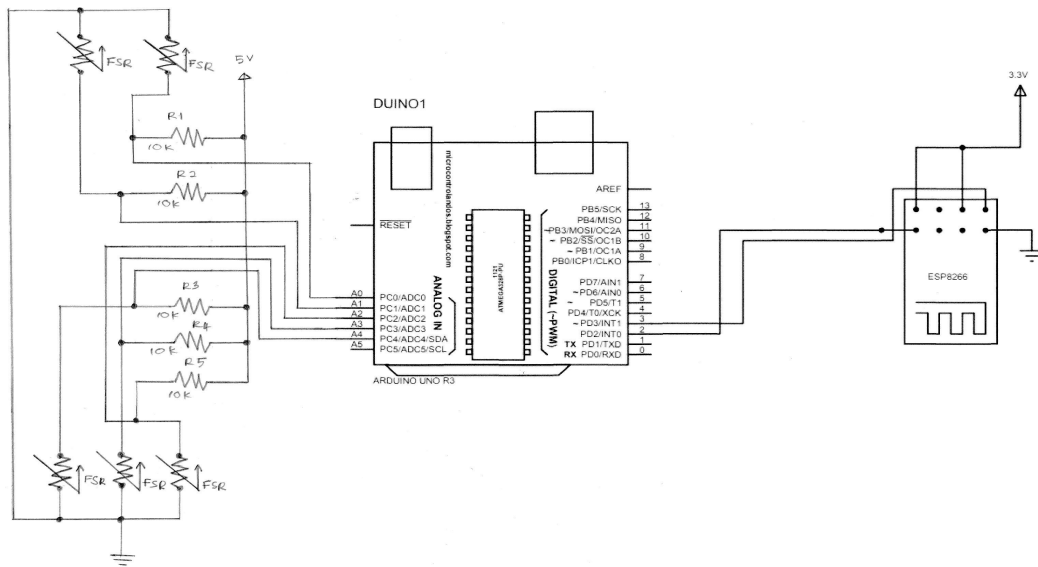


Figure 3.11

This is the schematic circuit of the prototype.

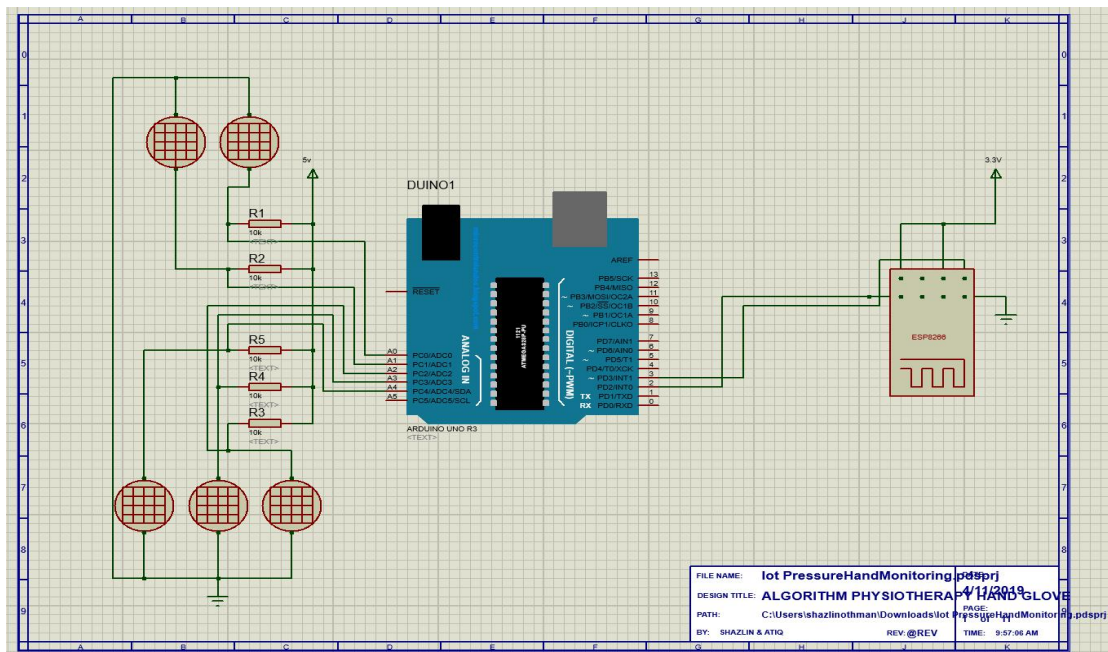


Figure 3.12

Figure 3.12 shows that the simulation circuit using Proteus.

CHAPTER 4

DATA ANALYSIS AND RESULTS

This is the results that we will be obtained from the force sensitive resistor and the data that have been processed into graphical method.

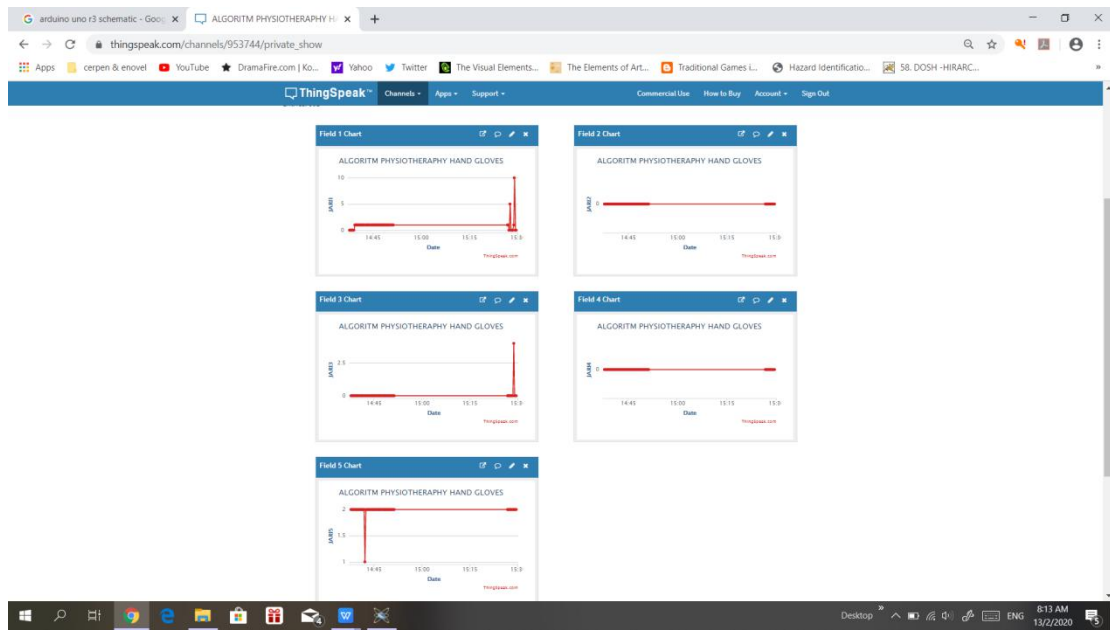


Figure 4.1. results that are generated by ThingSpeak



Figure 4.2

Figure 4.2 show the result of the thumb.



Figure 4.3

Figure 4.3 show the result for the index finger.



Figure 4.4

Figure 4.4 how the result for the middle finger.



Figure 4.5

Figure 4.5 show the result for the ring finger.



Figure 4.6

Figure 4.6 show the reading of the baby finger.

From the results that we were obtained, we can observed that every each of the fingers have a different type of reading according to their finger force. This is because not all the fingers have the same value of strength and force that can be applied when the person grab and squeezs the ball. Muscle weakness has been considered as a common dysfunction after stroke. Conceivable reasons for this weakness incorporate diminished number of motor units, disturbed recruitment order of motor units, diminished firing rate of motor units and muscle atrophy after disuse The resistivity values of the FSR sensor mainly depends on the person's strength, the curved shape

of the hand palm, and the sensor's position therefore calibration is needed everytime before use the glove in order to get the best results. In stroke, motor learning does not refer to the acquisition of new skills, but to the re-learning process of a previously acquired movement pattern. Stroke patients might have lost their significant portion of the brain tissue that supporting the neural associated with the execution or learning of movements. Therefore the results that we obtain from the exercise may be vary for each attempt and interventions aiming to improve muscle strength post stroke are considered crucial part in stroke rehabilitation

CHAPTER 5

CONCLUSION

There are three major conclusions can be drawn from this project. Firstly, the developed device exhibits a full working system. The system which operates on oscillometric principle is suitable to be located at any medical institutions such as private clinics, government hospital and even can be employed at home. It is also suggested that by using this instrument, people may save their time to travel, and get their blood pressure being check regularly. Indirectly, this shows the benefit of proposed system to meet the demand of health. Secondly, the developed device adapted the wireless technology and using smart phone which enable the user to view the previous results of blood pressure at any time on the smart phone. This makes the results more valuable for future reference. Thirdly, it can be seen that the machine proposed new prototype for medical instrument which can be used as a medium for Telemedicine application. Furthermore, this instrument has a potential to be improved in the future.

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SUPERVISOR

This report has been reviewed and validated as it fulfills the requirements of the final project design as set forth.

Disclaimed by

Signature :

Signature's name :

Date :