DEVELOPMENT OF IOT BASED ANKLE EXOSKELETON FOR ANKLE REHABILITATION THERAPY MONITORING

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Electrical Engineering Technology (Industrial Automation And Robotics) with Honours.

by

PREMANATH S/O KAVUTHAMAN

B071710160

950317-14-5371

FACULTY OF ELECTRICAL AND ELECTRONIC ENGINEERING TECHNOLOGY

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.....

PREMANATH S/O KAVUTHAMAN

Alamat Tetap:

PPR SRI PANTAI

JALAN LEMBAH PANTAI

59200 KUALA LUMPUR

Tarikh: 15 / 01/ 2021

Disahkan oleh penyelia:

.....

TS MOHD RAZALI BIN MOHAMAD SAPIEE

Cop Rasmi Penyelia

TS. MOHD RAZALI BIN MOHAMAD SAPIEE
Pensyarah
Jabatan Teknologi Kejuruteraan Elektrik
Fakulti Teknologi Kejuruteraan Elektrik Dan Elektronik
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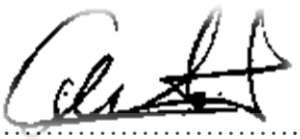
I hereby, declared this report entitled DEVELOPMENT OF IOT BASED ANKLE EXOSKELETON FOR ANKLE REHABILITATION THERAPY MONITORING is the results of my own research except as cited in references.

Signature: 

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Date: 15 / 01/ 2021

APPROVAL

This report is submitted to the Faculty of Electrical and Electronic Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of Mechanical Engineering Technology (Industrial Automation and Robotics) with Honours. The member of the supervisory is as follow:

Signature : .....

Supervisor : TS MOHD RAZALI BIN MOHAMAD SAPIEE

ABSTRAK

‘Development of IoT Based Ankle Exoskeleton for Ankle Rehabilitation Therapy Monitoring’ terutamanya direka dalam teknologi kemajuan pintar untuk memudahkan dan membantu memantau status pemulihan buku lali pesakit. Ciptaan ini terutamanya untuk tujuan rawatan doktor ortopedik dalam bidang hospital. Ia juga boleh digunakan oleh klinik swasta yang menyediakan rawatan ortopedik. Microcontroller NodeMCU digunakan dalam projek ini untuk mengawal dan memantau penggunaan projek. NodeMCU adalah teras utama projek ini, dalam menyambung semua input dan peranti output. Server ThingSpeak dan Blynk aplikasi yang dicipta melalui pelayan web dan telefon pintar untuk memantau status pemulihan buku lali dalam graf masa nyata. NodeMCU mentafsir data sensor dan memaparkan graf nyata dalam aplikasi ThingSpeak dan Blynk. Projek ini boleh mendedahkan graf masa nyata dalam masa 15 saat. Development of IoT Based Ankle Exoskeleton for Ankle Rehabilitation Therapy Monitoring untuk pemantauan terapi pemulihan buku lali sedang dijalankan memantau data dari sensor gyroscope dan aktiviti pendedahan melalui ThinkSpeak. Sehubungan dengan kemelut pandemik Covid-19 projek ini membantu pesakit dan doktor untuk menjalankan rawatan mereka tanpa sebarang sekatan.

ABSTRACT

The ‘Development of IoT Based Ankle Exoskeleton for Ankle Rehabilitation Therapy Monitoring’ is mainly designed a smart advance technology to ease and helps to monitor the ankle recovery status of a patient. This invention is mainly for treatment purpose of orthopedic doctors in hospital fields. It also can use by private clinics who provides orthopedic treatment. Microcontroller NodeMCU used in this project for control and monitor the usage of project. NodeMCU is the main brain of the project it will interface between all the input and output devices. The cloud server ThingSpeak and Blynk application created via the web server and smartphone to monitor the ankle recovery status in real time graph. The NodeMCU interpret the sensor data and display the real time graph in ThingSpeak and Blynk application. This project can expose the real time graph in 15 seconds. Development of IoT based ankle exoskeleton for ankle rehabilitation therapy monitoring is undertakes monitoring the data from gyroscope sensor and exposure activities through ThinkSpeak. Due to Covid-19 pandemic this project helps the patient and doctors to carry out their treatments without any restriction.

DEDICATION

I would like to acknowledge my sincere dedication, honours and gratitude to my supervisor, Mr Ts Mohd Razali Bin Mohamad Sapiee whom had guided me throughout my studies and during this Bachelor Degree Project 1 progress. I would like to thank my parents, friends and lecturer whom had helped and supported me. I would like also to thank all my friends who always been with me throughout this challenging semester and help me during this pandemic Covid-19. I hope all of their supports and encourage will help me to make this project successful.

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Praise to God the most Gracious, the most Merciful. There is no power no strength save in God, the Highest, the Greatest.

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PCA	Principal Component Analysis
LED	Light Emitting Diode
USB	Universal Serial Bus
MHz	Megahertz
MCU	Microcontroller Unit
PIC	Programmable Integrated Circuit
IOT	Internet of Things
EWS	Effective Workspace
TWS	Theoretical Workspace

CHAPTER 1

INTRODUCTION

1.1 Overview

The whole chapter will offer a brief clarification of the project undertaken In addition, this chapter also presented the user with some significant information, including such project background, problem statement, goals, and work scope plus document structure.

1.2 Background

Ankle injuries are often considered as simple as trying to walk on an irregular terrain can cause a serious, painful muscle strain. There are three sorts of lower leg wounds which are injuries, strains and cracks ankle wounds are characterized mostly by muscles form which can affect the spot, such as the bone, ligament or tendon. A lower leg is where your foot bone meets three bones the tibias and fibula of your lower leg. Tendons hold these bones together at the lower leg joint which are solid versatile groups of connective tissues which keep the bones set up while permitting typical lower leg development. Ligaments attach tendons to the issues that remains to be worked out the lower leg and foot move and help fortify joints.

A cracks of one or more of the bones defines a crack. A sprain, the term used to describe ligament injury when it is extended beyond its normal radius of motiona

ligament sprain can domain from multiple microscopic tears in the fibres make up the ligament to a complete tear or break.

The strains of the muscles and tendons are more common in the legs and lower back there is two tendons in the ankle which are sometimes strained. these are the peroneal tendons, and the ankle is stabilised and secured. They can become inflamed by overuse or traumas Acute tendon tear are the product of a sudden pain or force. At tendon swelling is called tendinitis. Microscopic tendon tears that occur actively due to excessive stretching, and do not heal properly, result in a condition called tendinosis.

The ankle joints which is also identified as the talo-crural joint is a synovial joint which connects the leg bones, the fibula and tibia, to the foot talus. It is a complex hinge joint composed of two joints. The ankle joint's main function is to allow the foot to dorsiflexion and plantarflexion. His ankle joint being a pivot joint, permits just plantar (flexion) and dorsiflexion (expansion) which event on the transverse (average sidelong) hub of the sagittal plane through the bone. The ankle joint being a hinge joint, allows only plantar flexion (flexion) and dorsiflexion (extension) which occurrence on the transverse (medial-lateral) axis of the sagittal plane via the talus. The degree of motion in the ankle joint is about 30 to 50 degree of plantar flexion and about 20 degree of dorsiflexion. At an ankle joint, plantar flexion and dorsiflexion are barely do alone, but rather in tandem with the subtalar and mid-tarsal joints. This meaning that plantarflexion is most usually accompanied by adduction and inversion allowing the foot to supine, whereas dorsiflexion is accompanied by abduction and eversion Enabling the foot to pronate.

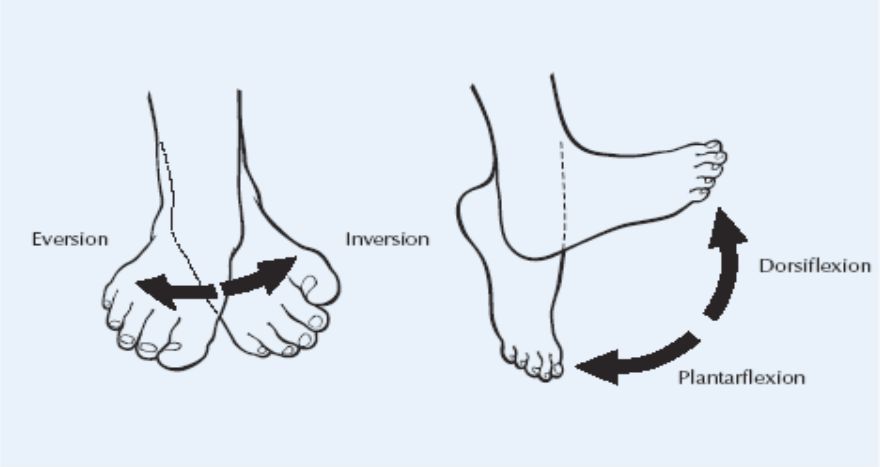

Figure 1.1: Movements of an Ankle

In the concept of this monitoring system of rehabilitation on an ankle using IoT can monitor the patient's ankle recovery in real time by the doctor from anywhere. Internet of Things (IoT) makes all objects become interconnected and smart, which has been recognized because the next industrial revolution. As its typical case, smart rehabilitation systems based on IoT are becoming a better way of mitigating problems associated with aging populations and lack of health professionals. The system use sensors such as gyroscope sensor and Wi-Fi module as its main function to collecting the data from patients, angular degree of ankle movement and transfer the data to doctors through their mobile and laptop with the help of web server. In this system, the obtaining data from the sensors will be transfer via database where the doctors can access and monitor the patients' conditions through Think Speak Internet of Things application. The angular movement of an ankle in degree will be kept recorded and send to Think Speak Internet of Things application. Think Speak Internet of Things application whereas produce a system to read the stored data using smartphone or web server.

1.3 Problem Statement

In current situation the entire world were facing a new pandemic called Coivd-19 and still counting the death of people in every country in tremendously especially in United States of America (USA). Moreover, for first time in world history the entire world were in lockdown in order to stop the contagion Covid-19 from spreading.

During this lockdown period the people cannot come out from their places where they are. However, this pandemic did had changed the routine of people that used to do daily. On the other, aged in between from 15 till 24 years old have high rate on ankle sprain compare to girls that are aged below 30 years old who have higher rate than men. Quarter the ankle sprains occur during physical activity when the people trying to doing such as jogging, running etc. Based on a statistic analyses data every day at the United State around 25,000 people sprain their ankle and quite one million people step in emergency rooms annually due to ankle injuries.

Due to abundance of patient with complex health problem there were shortage of doctors to treat these patient especially for the ankle injuries. This project proposed to be solve this problem where the doctors can monitor their patients from their own respective places as well as this project comes with the idea of IoT where doctors can access from home to monitor their patients.