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Design Of Smart Therapy Device For Bone And Muscle Healing

Mr. M. Perarasi[a], S. Swethaa Priya[b], S. Shalini[c], D. Siva Sriya[d], P. BhanuShreeja[e]

[a,] assistant professor, [b,c,d,e,]Student)
Department of Electrical and Electronics Engineering RMK Engineering college, Chennai

Email:[a]mpi.eee@rmkec.ac.in, [b]swet17319.ee@rmkec.ac.in,
[c]shal17305.ee@rmkec.ac.in,[d]poth17222.ee@rmkec.ac.in ,[e] siva17309.ee@rmkec.ac.in

Abstract

Virtual physiotherapy delivers another way to obtain backing from a physiotherapist without the requirement for personal check-ups, by means of online program and exercises we can accomplish at our own place. In this project, an assistive system for paralysis, bone fractured patients and surgery undergone affected individuals; is proposed to train the muscles and retrieve the normal functioning of the lower limbs. The device is completely incorporated and there is no need for the extra settings other than charging the device. The patient can use their smart phone which is installed with our self-developed android application, to control the device by adapting their angles. Our device consists of dual modules; the former one is transmitter and later one is receiver, the transmitter has application which is used for controlling, given to the patient. This receiver module placed over the leg can be controlled using android application through Bluetooth connection. The module which receives the required information will be combined in end to end manner to gear motors that are related to the motor angle. In manual mode, the directions of motor rotation are regulated by the implementation of gear box with the help of the user commands which is given in the mobile phone. Further, this system has vibration motor at hardware side which will be accessed when the patient selects the massage mode in the android application at software side. The android application used in this project, is developed using Android studio..

Keywords:

1. Introduction

Disorders affecting musculoskeletal conditions or wounds in combination are one among the principal reasons for long-lasting incapacity throughout the world. The application of recovery which is assisted by robots in orthopedics was analyzed. In spite of its promising benefits, the application of robotic-supported rehabilitation of affected individuals with muscle related wounds and skeletal ailments have obtained less concentration. In our work, we specified the progress and assessment of a physiotherapy device which is assisted by robots as a novel approach of supported rehabilitation in orthopedics. Our work comprises of an improved end to end connection incorporated in a slower and steadier procedure which will enable the affected individuals to do lower-limb training procedure in order to support them throughout the therapeutically monitored procedure of the leg following wounds at the knees. The current approach characterizes a novel method to supported rehabilitation for potency and movement retrieval of leg actions. This system has four modes; paralysis mode, fracture mode, surgery mode and massage mode. We assessed the technique by the examination of the muscle movement of healthy patients, stating that the system can designate important working masses throughout characteristic physiotherapy treatment sketches. The proposed technique was possible for the analysis for consequently monitored tests. Lastly, an analytical form of the working grade in the

method of a narrow arrangement of movement study interpretations was employed in mission of hard coaching factors, as a mode of methodically personalizing the exercising at the time of treatment, for consequent analysis.

2.Objective

- Offering a smart and self-supporting therapy for paralyzed and bone fractured patients.
- Reducing the dependence on physiotherapist or others to improve one's physical health.
- To provide different modes of operation to be used according to the convenience of the patient.

3.Literature Survey

[1] G. D. Krischak, A. Krasteva, F. Schneider, D. Gulkin, F. Gebhard, and M. Kramer, "Physiotherapy after volar plating of wrist fractures is effective using a home exercise program"

Affected individuals with a distal radial fracture should need to stay quiet without carrying out any work for nearly several days to weeks for effective treatment. Actually, at the instant of enduring the wound, greater than fifty percent of the affected individuals are presently engaged.

[2] M. K. Dekkers and T. L. Nielsen, "Occupational performance, pain, and global quality of life in women with upper extremity fractures"

An analysis for assessing the correlation of suffering, functional activity, and life feature in ladies following arm fractures shows that fifty percent of the stated issues were related to efficiency, nearly 40% with self-care, and 10% with leisureliness.

[3] P. Harding, T. Rasekaba, L. Smirneos, and A. E. Holland, "Early mobilisation for elbow fractures in adults"

Deficiency of movement of the elbow may influence necessary self-sufficient operations in day to day life movements, comprises of self-care, movement, eating, or even walking with safety measures with support specifically for old age people.

[4] P. Maciejasz, J. Eschweiler, K. Gerlach-Hahn, A. Jansen-Troy, and S. Leonhardt, "A survey on robotic devices for upper limb rehabilitation"

Inappropriately, in spite of the probable advantages, the elevated occurrence of muscle related issues and skeletal wounds, and the recent requirement for quicker and improved physical treatments, the application of robot-assisted systems for orthopedic recovery endures nearly revealed, and the study in this domain is relatively rare, in association with neuro-recovery systems.

[5] C. Nerz, L. Schwickert, C. Becker, S. Studier-Fischer, J. A. Müßig, and P. Augat, "Effectiveness of robot-assisted training added to conventional rehabilitation in patients with humeral fracture early after surgical treatment: protocol of a randomized, controlled, multicentre trial"

On contrast, if few recovery robots stated for neuro-recovery could have the promising application in orthopedic recovery, the approved human-robot interface structures and supported physiotherapy techniques of these systems cannot be exactly used for the requirements of orthopedic patients.

4.Existing And Proposed System

4.1.Existing System

In this existing method, the patient is trained with the exercises with the presence of physiotherapist. The device is pre-installed with certain type of exercises at initial stages and it will perform the same sort of exercises whenever the patient wears it. The controlling of the device and the rotating feature of the system is performed by the use of actuators.

4.2.Disadvantages:

•It has no implementation to detect the condition of the muscles in patient's leg.

•It cannot enable the patient to have the control over exercises i.e., customized exercise performance is not present in this system.

•Physiotherapist has to visit in person to monitor the performance of the patient using this device since there is no updating of data wirelessly.

5.Proposed System

This system uses the AVR microcontroller as a processor which performs the required actions to be done to complete the task assigned to the system. The user's mobile phone will be paired with the system using Bluetooth communication. The user can control the system by sending commands from mobile to the system. The self-developed android application in the user's mobile phone will have four options to enable the four respective modes of the system; paralysis mode, fracture mode, surgery mode, and massage mode. In paralysis mode, the pre-defined angle calibration will be done for the purpose of performing exercises. In fracture and surgery mode, the user can set the angle at which the system has to move accordingly in order to perform treatment procedure or exercise for bone-fractured patients and patients who undergone surgeries that can affect muscle stiffness to a great extent. In massage mode, the user can activate the vibration motor which will provide comfort to the patient by performing massage at the affected areas of the patient's leg. The system has electromechanical relay to activate the vibration motor and driver board to drive the gear motors which performs the required movement of leg.

5.1.Advantages

- This system will enable the user to control the device at distance.
- The user can also enable the massage mode to give soothing effect to the patient using vibration motor.

6.Architecture Design

The system has two sections; Hardware section and software section which are represented as follows,

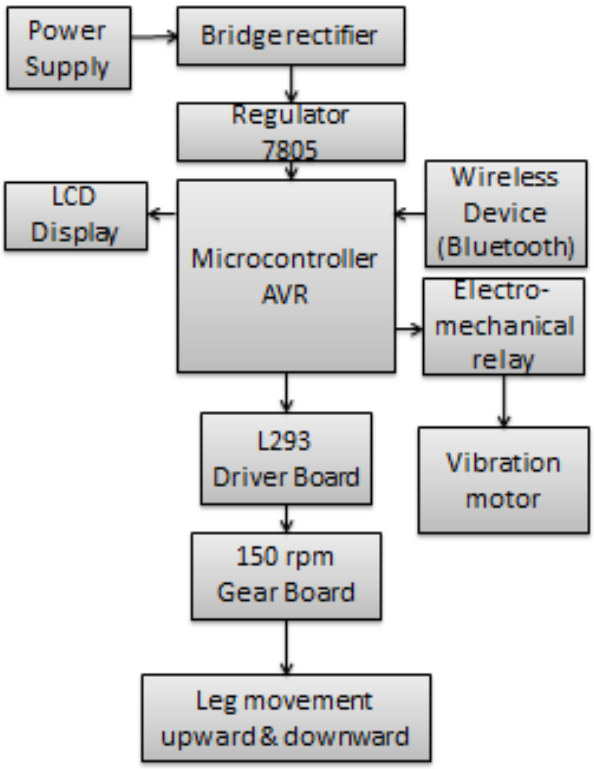

Fig.no: 1: Hardware side

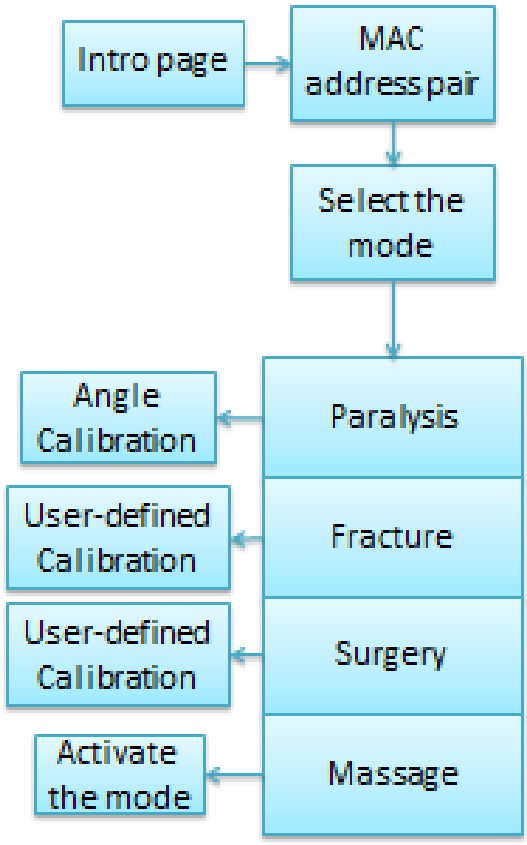

Fig.no: 2: Software side

7.Description

In this system, the software will have a self-developed android application which is installed in the user's mobile phone. Through the application, the patient can control the device using the command options in the screen. It has four modes; paralysis mode, fracture mode, surgery mode, massage mode. In which the patient can define their own customized angle for the upward and downward movement. Further the vibration motor in the device will provide massage support to the patient by giving soothing effect. The vibration motor will be started by activating the relay. The Device and the application in the smart phone will be connected for the purpose of effective communication enhancement through the use of Bluetooth communication. The LCD display will state the condition of the process frequently. The pairing of device will be done by pairing the MAC address which will ensure the security of the data transmission.

8.Circuit Design

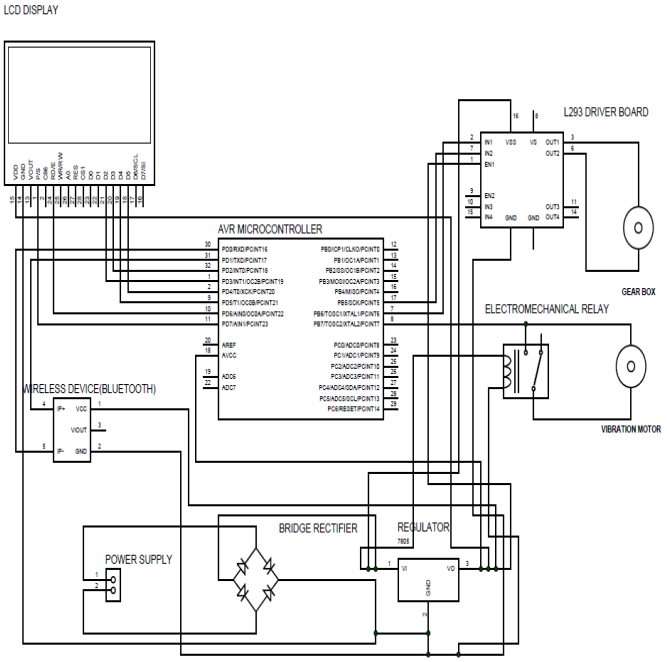

Fig.no:3: Circuit Diagram

9.System Specifications

9.1.Hardware Components

- AVR Microcontroller
- Electromechanical relay
- Vibration motor
- L293 driver board
- Gear motor
- Bluetooth device
- LCD Display
- Power supply

9.2.Avr Microcontroller

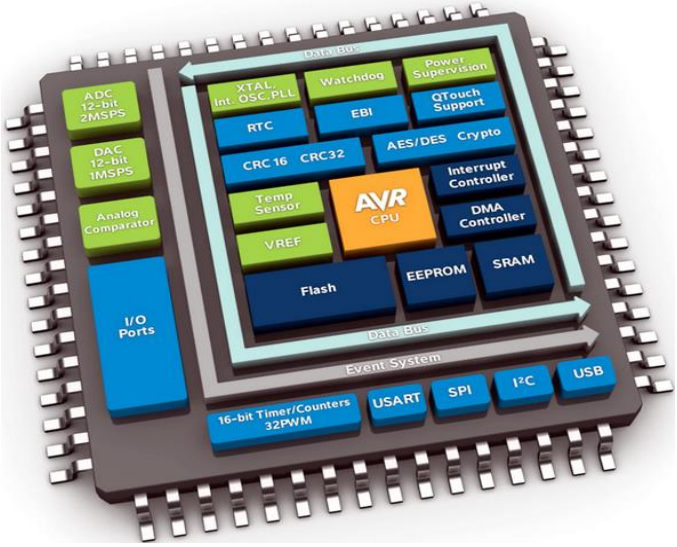

Fig.no:4: Architecture of AVR controller

It consists of whole or many of the characteristics embedded in to one chip, thus it doesn't require a motherboard and more components, LEDs for example, could be joined straightly to the controller. These microcontrollers available in various bundles, a few created for surface mount and a few through-hole mounting. These microcontrollers come with 8-pins to 100-pins, even though whatever 64-pin or over are surface mount only. Mostly, the beginners prefer a 28-pin chip like ATmega328 or the 40-pin ATmega16 or ATmega32.

9.3.Relay

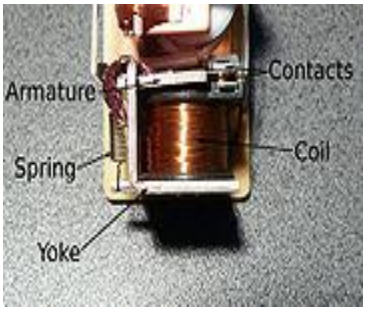

Fig no: 5: Simple electromechanical relay

The Electromechanical Relay is a type of relay exists in solid form and offers 3 main operations inside one mechanism:

- timer operations
- relay operations
- protective operations

The several timer operations could be designated inside extensive restrictions and the protecting operation could be regulated more elastically to the use.

It comes in a 4-pin or 7-pin Mini self-propelled typical relay attached with rankings from 1 A to 30 A. It is applicable for automobiles with 12 V DC or 24 V DC voltages of electrical systems.

Major operations and high current safety measures, if needed switching thresholds or time windows of the relay could be convention configured with our fabricator. So, we get a mechanism which is correctly custom-made to the needs of our use.

9.4.Vibration motor

Vibration motor is of 2 fundamental kinds. A unconventional revolving load, a kind of motor that generates vibrations (ERM) employs a little unstable weight on a motor which operates on DC current while it spins it generates a drive which converts into ambiences. A narrow echoing motor consists of little interior weight combined with a spiral mechanism that generates a drive while it is driven.

Fig no: 6: Vibration motor

L293 driver board

Fig no: 7: l293 driver board

It is created to operate along with a type of IC, which is termed as L293D. This IC is a familiar IC to drive motor, that is created to give dual directional force currents of range till 600-mA at voltages ranges from 4.5 V to 36 V, along with end Units for combining actuators & source of power and for the purpose of commanding, Berg Sticks are used and regulating indications from the controller. It could regulate two DC Motors, direction of those motors by applying regulating lines and also rate of those motors by applying Pulse Width Modulation.

Gear motor

Fig no: 8: gear motor

Gear motors will be described as an enlargement of DC motor that previously contained its Intuition particulars elucidated as follows. A gear motor contains a gear arrangement combined to the actuator. The rate of actuator is estimated in relation to spins of the shaft for a minute and is called as RPM .The gear arrangement aids in raising the torque and decreasing the rate. Applying the exact connection of gears in a gear motor, its rate could be decreased to any required design. This idea where gears decrease the rate of the automobile but raise its torque is termed as gear decrement. This intuition will discover all the less important and more important particulars, which make the gear head and thus the operation of gear motor.

Bluetooth device

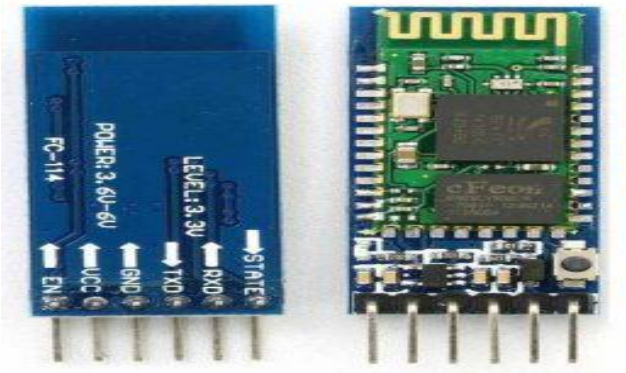

Fig.no: 9: Bluetooth device

HC-05 module Information

- This module consists of LED (red) that represents status of connection, whether the Bluetooth is connected or not. Before the connection to this module the LED blows as a blink uninterruptedly in a frequent way. Whenever the module combined to another wireless device, its blowing as blink reduces the rate to 2 sec.
- It operates on 3.3 V. It is possible to supply 5V and then it consists of an integrated 5 to 3.3 V regulators.
- Since this type of wireless device consists of 3.3 V point for receiver/transmitter and controller could spot 3.3 V point, thereby, it is not required to change transfer point of this device. Yet we have to modify the modified voltage point from controller to Receiver of Bluetooth device.

10.Software Components

While Android Studio is installed and operating, we'll need to begin and start our first work. We could perform it by beginning this software and next choosing our work, or else we select File > New > New Project at some instance within the IDE as sufficient requirement.

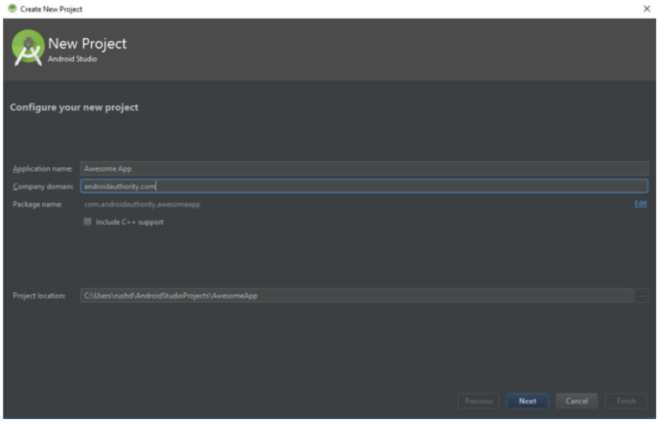

Fig no: 10: android studio create new project.

10.1.More types of files

It is small for 'resources' and which comprises of 'images we will place in our application and also 'layout' where our XML files will be saved. The Whole thing in the res folder requires being no-upper case, and that's why underscore is applied in various places to segregate names of files into titles that can be easily read even with the non-presence of certain case.

'Values' is another beneficial file to search everywhere. It consists of many XML files which can hold the variable values such as names of application and values of color.

11.Embedded C Program

It is an arrangement of machine language enlargements for the languages that is used for coding language like C by the committee of C Benchmarks to focus unity problems which occur among C enlargements for various devices. Factually, this type of C coding requires unusual enlargements to the C code for the purpose of supporting exotic characteristics like standard-point arithmetic, numerous dissimilar memory reservoirs, and simple Input/output functions.

It employs many of the syntax and semantics of standard C, e.g., arrays and strings, variable definition, structures, data type declaration, union, conditional statements (if, switch. case), main () function, loops (while, for), functions, and bit op.

11.1.Java Programming

Java has powerful features. The following are some of them:-

- Code can be reused
- Given importance for data than for procedure
- Data can be hidden and couldn't gain access to external operations

- By using operations, tools could send and receive data with each other
- Addition of new functions and data could be done easily
- Sophisticated
- Platform Independent (Portable)

12.Results

Our system is successfully implemented to serve the purpose of the system in an effective manner. The Android Application and the prototype model are represented as follows,

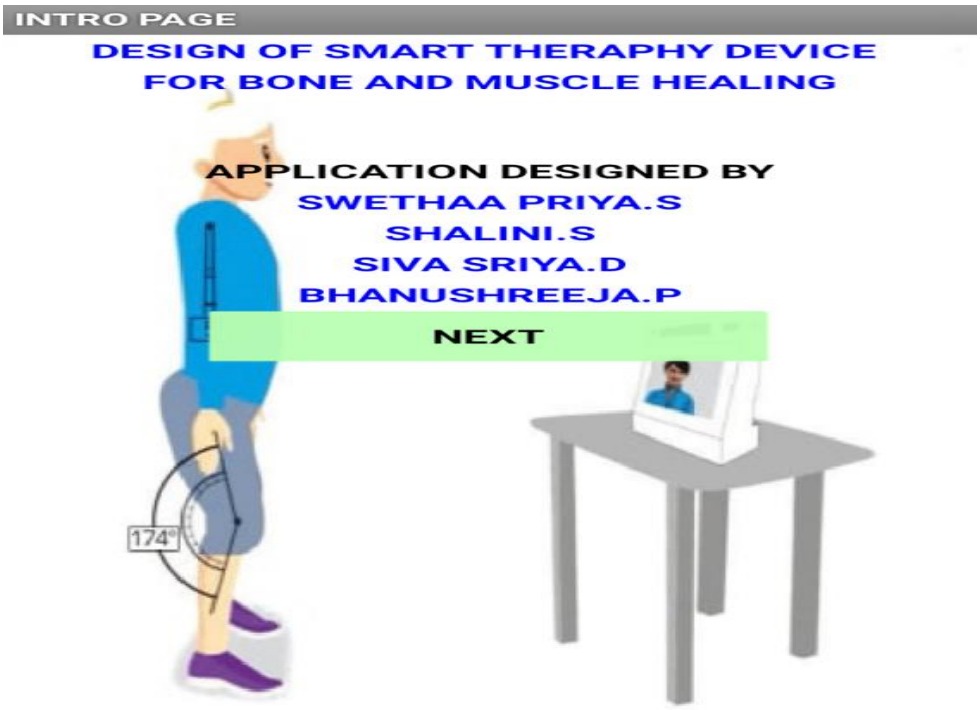

Fig.no: 11: Intro page

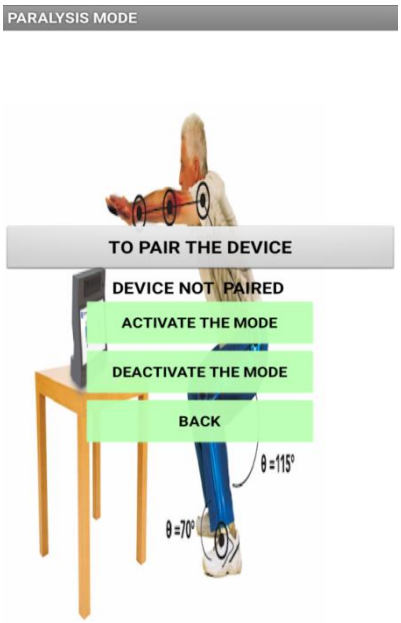

Fig.no: 12: Paralysis mode

Fig.no: 13: Fracture mode

Fig.no: 14: Massage mode

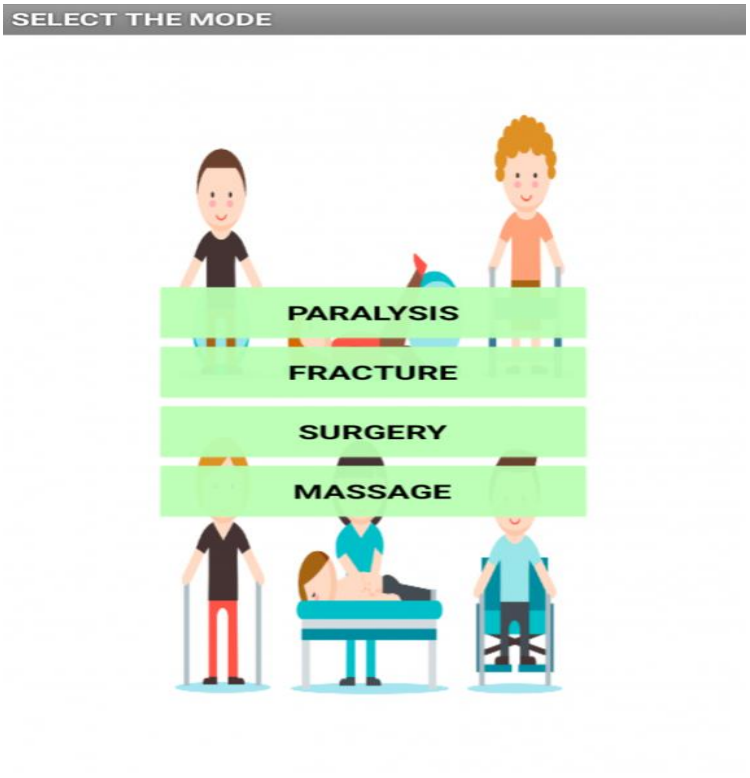

Fig.no: 15: Mode selection Page

Fig.no: 16: Prototype model

12.Conclusion

Finally, our work has implemented the improvement of a novel rehabilitation mechanism termed as intelligent treatment device for bone and muscle healing. It was considered with characteristics which could be capable of speed up the procedure of treatment and rise the efficiency by means of exercise and massage. The mobile application based on wireless device (Bluetooth) is implemented for the person to instruct the device. Various kinds of treatment feature generated a novel revolution by this self-controlled device. Besides, the intended mechanism is reliable, cost-effective. Due to its upgraded whole proposal, the system mitigates

restrictions offered by the occurring mechanisms. The mechanism proposes a innovative result to the advancement of the present rehabilitation procedure.

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