International Journal of Scientific Research in Computer Science, Engineering and Information Technology
ISSN : 2456-3307 (www.ijsrcseit.com)
doi : https://doi.org/10.32628/IJSRCSEIT

Orthopedic Rehablitation Health Monitoring at Home

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Article Info
Volume 6, Issue 5
Page Number: 20-28
Publication Issue :
September-October-2020

Article History
Accepted : 01 Sep 2020
Published : 09 Sep 2020

ABSTRACT

The monitoring system has been developed for serious cases of orthopedic injury and for the health of older people's lifestyles. It is designed for testing and discussion purposes, and the functionality was the most significant as opposed to the form factor. While significant, other aspects, such as defense, maintenance and economies of scale, were beyond our reach. This is important if the device continues to be used but is not enough for our testing. Orthopedic rehabilitation health monitoring at Home is Interconnecting devices and facilities that reduce human interference in order to live a healthier life. Acceleration readings are given in this project by using accelerometers for various axes x,y,z. The signals obtained by measuring adjustments in the movement of the two accelerometers mounted one on above knee and other on below the knee,either sides to knee joint of the person. Any movements in the joints will change in the accelerometers are mounted which makes the accelerometers to generate the output voltage with respect to the variation in gravity. In addition, along with heartbeat, temperature, alcohol concentration sensor output is generated voltage is fed as inputs to the microcontroller. Further the microcontroller will process this information to delivers output that is transmitted via Bluetooth on a mobile Android based device. The android app transforms incoming messages to report in detail information and alert to physician and caretaker.

Keywords: Audiono UNO, IoT and Sensors.

I. INTRODUCTION

The human body is a mechanical system which is well created. The human body 's skeleton consists of 206 divergently shaped bones, which act as the body's foundation, and the joints are the places where bones meet. Joints keep the bones together, which provide support which mobility for the skeleton. Joints tend to deteriorate as we get older due to wear and tear, as well as disease states. The human body comprises three types of joints: fibrous (immovable), cartilaginous (semi-movable), and synovial (free-movable) joints. Synovial joints Figure 4.1(a) are our body's main joints, as they provide mobility through load bearing, low-friction, wear-resistant smooth movement between articulating

bone surfaces. We have into our body six classes of synovial joints. These are classified by the opposing bone surface at the joints and the types of movement that they allow: pivot, hinge, saddle, plane, condyloid and ball and socket joints, as shown in below Figure.

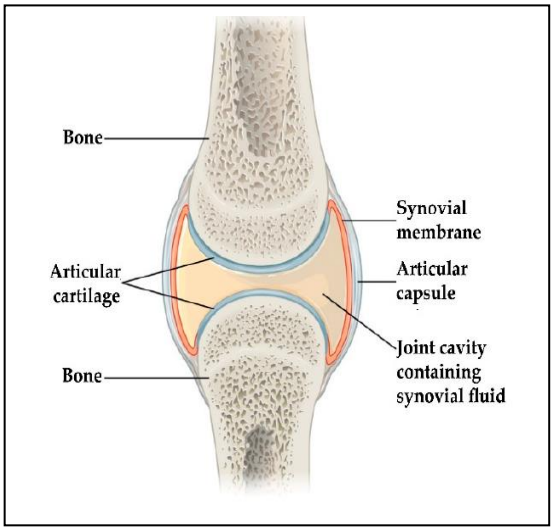


Figure: Synovial joint

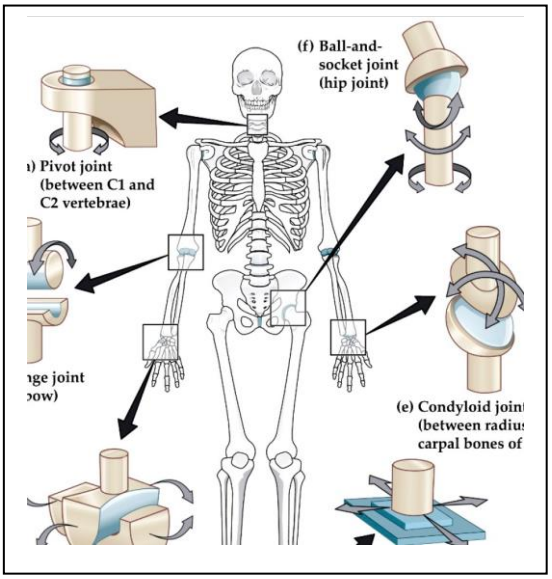


Figure: Types of synovial joints

All the human body's synovial joints are connected by a complex system of ligaments, muscles, tendons, and cartilage. Protective membranes and synovial fluid are available that lubricate those joints to allow smooth movement and load bearing. Throughout our lives and for any physical operation, these joints are vital and multiple bear our weight and are essential to our movements. With aging, the development of synovial fluid is decreased, cartilage sheds and the articulating bones come into direct contact, causing irregular articular surface and bone density loss that are usually considered musculoskeletal harm. The symptoms of this musculoskeletal damage are discomfort, deformation, inflammation and swelling in joints. Musculoskeletal disorders have been a major challenge to healthy ageing worldwide. The second most common cause of the condition is this disease. According to the 2010 Global Burden of Disease Report (GBD 2010), the effect of musculoskeletal disorders on the global disability burden is significant, and it is the top-ranking common cause of disability among older adults. In both developed and developing countries, the proportion of years living with disability (YLD) due to musculoskeletal disorders is substantially higher when considering older age groups (50 years and older) and expected a drastic rise in the coming decade. And movement is important for a broad range of activities related to mobility, such as rehabilitation, sports medicine, human activity Evaluation and interactive led instruction. A full collection of data relating to mobility and musculoskeletal health status is required to conduct such an examination. The medical experts can then interpret mobility-related parameters from the processed data to provide solutions.

Muscular Skeletal Disorders

Arthritis is one of the most common among muscular skeletal conditions and is a significant contributor to the burden of worldwide disability. It increased by 75 per cent across the population of the world from 1990 to 2020. Arthritis has more than 100 different types. It can affect virtually any joint, and arthritis-related problems can occur in people of all ages, genders and races. This eventually led to physical impairment and loss of mobility, making it very difficult for the affected joints to function. According to the Arthritis Foundation, about 54.4 million adults in the U.S. (22.7% of all adults) had been formally diagnosed

with arthritis, and 23.7 million (43.5% of those with arthritis) had arthritis-attributable activity limitations such as inability to do daily activities. Losing mobility of this kind has severe physical, mental, and social consequences for older adults. Poor mobility gradually leads to a lack of independence, depression, reduced productivity, weakened ability to handle daily activities and a deterioration in the quality of life associated with health. Direct treatment and healthcare costs constitute a major social and financial burden on society and caregivers. In addition, costs due to loss of productivity (indirect economic loss to society) including primary prevention, early detection and effective intervention for people at risk with common musculoskeletal health problems. Ageing, poor or infrequent physical activity and/or poor diet leading to obesity and several chronic illnesses are common factors that result in loss of mobility.

JOINT MOVEMENT ALGORITHMS AND TECHNIQUES

Various types of joint surveillance devices based on various sensing techniques and algorithms

Are recommended in literature. The main focus of many researchers is to make the system with wireless communications simple, easy-to-use, cost-effective, non-invasive, unobtrusive and wearable. Such features, the system can be used to monitor and analyze the continuously collected data in real time based on the person being monitored 's detailed input, requirements and specifications. In this paper we present a detailed survey of joint monitoring technologies and methods proposed and developed by deferent.

Inertial Measurement Unit (IMU)

IMUs are the most effective and lightweight instruments for both clinical testing and scientific trials to build a wearable measurement method for human joint motion due to their small size and ability to calculate joint movement with precision and accuracy. Three-dimensional angular velocity and linear acceleration are measured using IMU sensors to detect position and orientation.

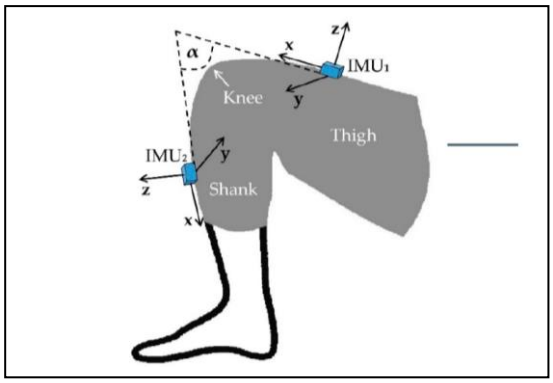


Figure: Inertial measurement unit (IMU) sensors' orientation and position for knee angle measurement

system having an average deviation range of 0.08 to 3.06 from each other. Figure 4.2 illustrates two IMU sensors-based configuration for measuring the knee angle α.

Sitting or Standing Finding Method

Static incidents have been categorized by standing or sitting. The decision stages are depending on inclination of the system. This method has been using in widely available systems emulated by Godfrey and al Site Stand Transformations are now counted as changes in pose.

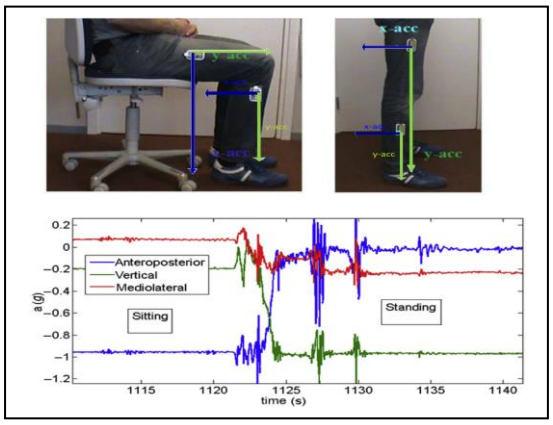
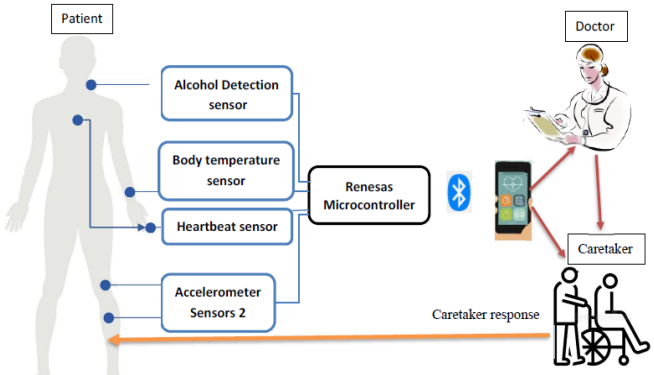


Figure: sitting or standing static event output

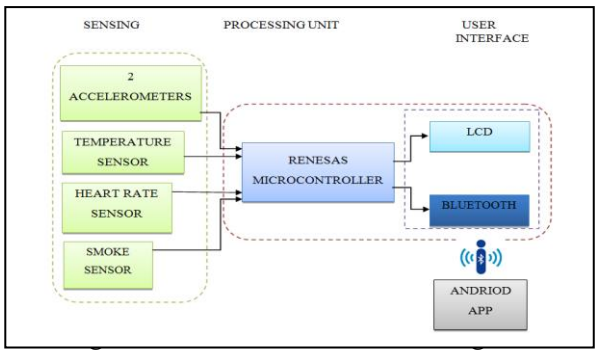
The future pattern in public health services is projected to be shorter hospital stays and improved community care. In objective to determine efficacy to the remote therapy program, physio- therapists should assess the characteristics of motion while standing up, sitting and lie down/sleep and so on. In view of this context, we have built a framework for tracking human activity using an accelerometer and tracking of patients' heartbeat, temperature and smoke. We evaluated human position sensing technology to monitor human movement, compared various technologies, discussed research problems, and the current and future applications of human activity data. General Architecture & the comprehensive design of the proposed framework for Orthopedic Rehabilitation Health monitoring at Home system has been discussed.

II. SYSTEM DESIGN

In this chapter, we are introducing service-oriented architecture System Design Shows the overall components of our proposed device architecture Orthopaedic rehabilitation health monitoring at Home healthcare system for patient with orthopaedic disorders, athlete patient or old age people. Which has main components are patient , general architecture design of sensor and module, and the Physician, caretaker to analyze or guide the patient for earliest recovery and provide him quality care by remotely.



The above system consists of a structural design of the project which has patient connected wearable four parameter detection sensor along with system of microcontroller which are briefly explained under the general architectural and which consists of several hardware components along with the wireless configuration of the Bluetooth technology by which the data acquired from the patient is transmitted to the mobile phone android app which is installed on the patient caretaker or healthcare advisor , or user itself so this data is examined and guided by the healthcare advice provider to the patient for rehabilitate him using technology without accessing him to the hospital through continuous monitoring of the diseased health and simultaneously to improve health condition of the patient in home by providing him remotely healthcare.



It consists mainly of three simple modules.

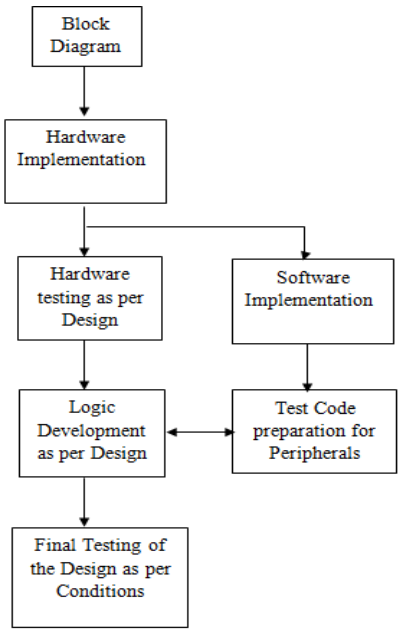
- Power Supply unit
- Sensing unit
- Processing and user interface Unit

Power Supply unit which gives DC Supply source powered by AC supply 220V and has battery powered as additional along with SMPS adaptor and this section has regulator IC which gives different DC powers 12V,5V, DC Respectively according to requirement of project. Accelerometers (2) Sensors, Heartbeat Sensor, Temperature Sensor arrange sensing unit of the system, smoke sensor is employed to detect alcohol the required data of the patient in the form of analog output which is later characterized and converted in digital form to reads by the processing unit. Processing and user interface

unit consists of Renesas microcontroller which processed the data as per the programmed and compile the instruction set to reached values of data and provide the digital output through the user interface unit that is Bluetooth system for transmit the data to the user wireless through Mobile app and to alert he care taker/Doctor to rehabilitate the patient.

III. METHODOLOGY

Implementation of system methodology is a executing process of the design includes the several level of stages in which initially the system cleared theoretical observations of the sensors and their response towards the human body and extreme angular calculations for knee joint movements and synchronizing with the accelerometers sensors , then the as per the block diagram system architecture is drafted and hardware implementation and software implementation then configuration of the sensors to the system, then comes commissioning a hardware to interconnect with sensors then software is debugged into the hardware then system evaluation is done for the model testing.



Android application development for health

An app is a common slang word for a software application or software program that can be run on a mobile device. to accomplish a task easier and more efficiently than we could do it ourselves as mere mortals.in this project we design the application user friendly GUI-Graphical User interface with basic home screen which has logo of health @ Home on top left of screen and Firstly need privacy credentials to login.

The Android software development process is the application process for devices running the Android operating system. Written using Java, C++, an Android software development kit (SDK) language with minimal API support. Some programming languages and tools make Android support for cross-platform apps. Third-party software, application environments, the detailed information of every particular process of developing application are the login, synchronizing the JavaScript with the present Bluetooth connectivity is explained in the below further along with flowcharts , dataflow diagrams and sequences of the system to develop a robust app which could assists the user by its easy user interface.

Process follows

- Privacy Credential login screen.
- Main Screen with options of Bluetooth connectivity, Received Data Packet, Active Status
- The next screen is fetched information or Data, which consists of full detail report of patient

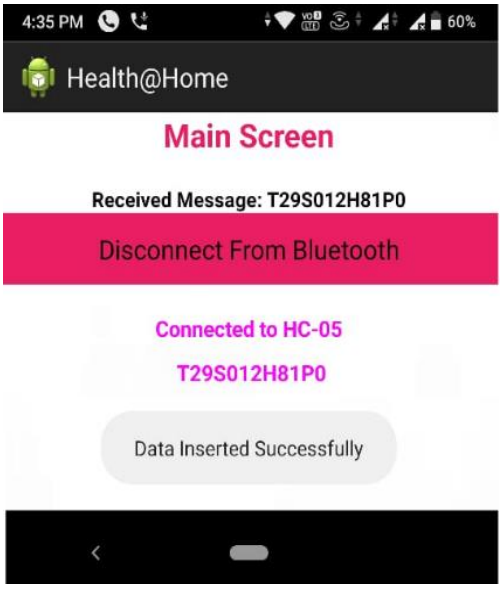
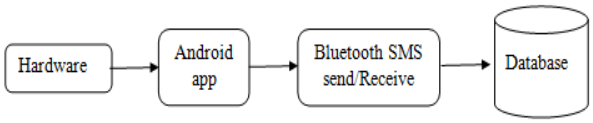


Figure: Android app Main screen

Dataflow of system architecture

The Data flow of the android Bluetooth data sending is the android access points which allows hardware to interact with android app by allowing access through Bluetooth technology.



IV. SYSTEM EVALUATION AND EXPERIMENTAL RESULTS

The arrangement of sensors while a person is sitting, standing or asleep. If the sensor is physically placed on the thigh of Patient, each position is sustained for around 10-20 seconds. On during this time, 100 samples were obtained. By taking multiple samples of a single Postion, we determined the means of all samples and after finally evaluated the performance of the proposed orthopedic rehablitation health monitoring system. This is shown in Table 7.1. The device evaluation shall be the correctness of each state for the samples collected. Table 7.1 reflects the percentage of times that a specific condition is correctly remembered.

Figure: Patient wearing a sensor

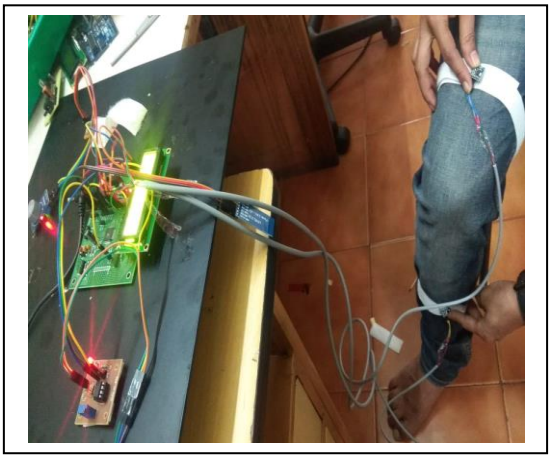


Figure: Patient Data Recording

ACTUAL /DETECTED	SIT	STAND	LIE / SLEEP	WALK	TRANSITION
SIT	98 %	-	-	-	2%
STAND	-	97%	-	-	3%
LIE/SLEEP	-	-	92%	-	8%
WALK	-	11%	-	80 %	9%

The validation protocols for healthy individuals took an average of 30 minutes per person. During this time, the participants sat, stood, rested, walked, ascended and descended along with body temperature, heart rate, smoke / alcohol concentration detection, the key concept of the proposed method is to provide safer and more effective healthcare facilities to the patients at home by Continued data transfer through mobile devices so that specialists and physicians can make use of this data to provide a quick and reliable orthopedic rehabilitation solution. The final model will be well equipped with features that allow the doctor to test his patient from anywhere and at any time. through "orthopedic rehabilitation Health monitoring at Home" mobile application. The emergency for sending an emergency warning to a doctor with current patient status and full medical history may also be operated on.

Output Images:

Figure: LED Indication of All ouput parameter

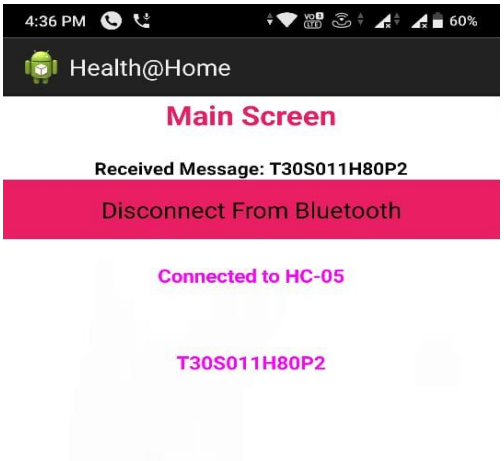


Figure: Received output message on Mobile app

This Record in Mobile Application is brief information of Patient medical parameters that is temperature, heart rate, smoke/Alcohol concentration in body and Position of a patient. Which will vary from time to time and will be recorded that could be monitored by caretaker and used by the Doctor to rehabilitate the patient, according to his recovery condition monitoring eventually, and may prescribe or train him to possible recovery through without reaching to hospital that may reduce efforts and cost of patient.

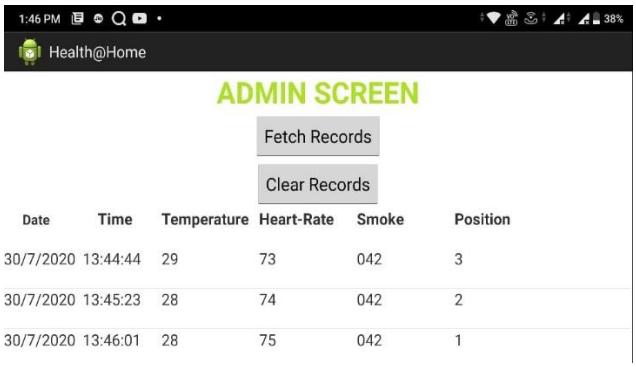


Figure: Detail Patient data Record Mobile App

Above Fetch Record has simple user friendly screen on Health at home app which is built for Orthopedic rehablitation Health monitoring at home , this design has basic window screen of the Andriod app which consists of four paramters mainly Body temperature, Heart rate, smoke/alcohol concentration, and along with key parameter of posture monitoring. this data

is secured by user in app for privacy reason ,so after enter the correct username and password access will be provided and can add the caretaker, doctor to whom user want to send the information about his vital recovery parameters.

V. CONCLUSION

The project is designed using systematic modeling and can produce the desired results. It will be effectively implemented as a Real Time framework with some modifications. Acceleration readings are given in this project by using accelerometers for various axes x,y,z. The signals obtained by measuring adjustments in the movement of the two accelerometers mounted one on above knee and other on below the knee,either sides to knee joint of the person. Any movements in the joints will change in the accelerometers are mounted which makes the accelerometers to generate the output voltage with respect to the variation in gravity. And along with heartbeat, temperature ,alcohol concentration sensor output is generated voltage is fed as inputs to the microcontroller. further the microcontroller will process this information to delivers output that is transmitted via Bluetooth on a mobile Android based device. The android app transforms incoming messages to report in detail information and alert to physician, caretaker. The last model will be very much outfitted with the highlights where specialist can look at his patient from anywhere and whenever. to send emergency message to the specialist with patient's present status and full restorative data can likewise be dealt with.

VI.FUTURE SCOPE

We are currently successful in data acquisition from the patient and sending that data to the mobile app on various parameters including main monitoring data of Patient Posture Detection, along with the heart rate, temperature, alcohol level detection.

- Improving the accuracy of automatically collected exercise information.
- Get input from actual users. The device is being developed and tested in a smart home facility. We 're hoping to have a few users with orthopaedic health issues and old age people Using the framework and include the family members of the consumers and health providers.
- integrating with motion sensors to study the behavioural changes and record the of patient to provide them quality care at home during the injury or wellness time. In order to encourage any correction in movements associated with any individual joints requiring correction in their body movements.

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Cite this article as :

Mohammed Moulana Ali, Dr. Ravi Shankar, Praveen K, Dr. Ibrahim Patel, "Orthopedic Rehablitation Health Monitoring at Home", International Journal of Scientific Research in Computer Science, Engineering and Information Technology (IJSRCSEIT), ISSN : 2456-3307, Volume 6 Issue 5, pp. 20-28, September-October 2020.
Journal URL : http://ijsrcseit.com/CSEIT20656