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VIBROARTHOGRAPHY SIGNAL ANALYSIS FOR BONE DISORDER USING LOROWAN

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Abstract: Bone disorder is a common abnormality in most of the human kind. This emerges with mild stiffness and later ends up with joint immobility. X-rays are the most commonly used means of visualizing the joint, but at times ultrasound and MRI are also used. The methods can be classified into invasive methods and noninvasive methods. Invasive methods are generally done through image studies which do not furnish information regarding the early disorders in bone joints and on the other hand study procedures are painful to the subjects. This work deals with a non- invasive method of early diagnosis of bone disorders. The VAG signals acquired on the surface of the suspicious bone joint are analyzed using Node MCU which yields information regarding the bone disorders. The study can be extended for early diagnosis of bone disorders.

INTRODUCTION

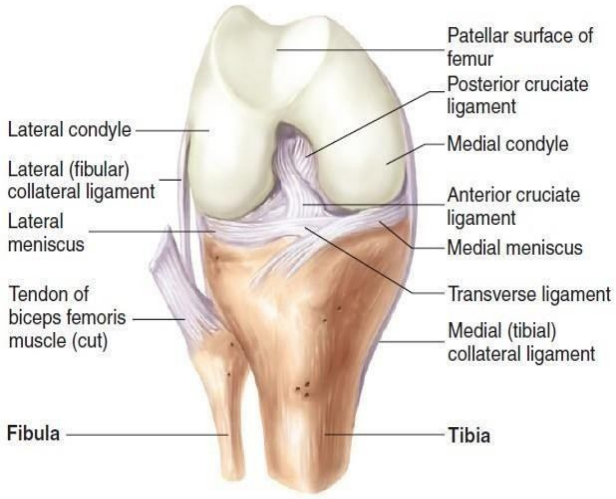
The most frequent injured spot in the human being is knee because without its well- functioning human motion could not be compromised along with the capability to perform simple daily tasks. Osteoarthritis (OA) is the most common joint disease and one of the most common diseases diagnosed in clinical practice resulting from the progressive degeneration of joint constituents including articular cartilage and sub-chondral bone. OA causes inflammation, swelling, pain and subsequently reduced motion in joints. As a progressive disease, it gradually worsens with time being highly prevalent among obese and elderly people substantially decreasing their quality of life.

Human Joints:

Human joints are when the ends of two bones come together. The joints hold them together and allow for the movement of your skeleton. Most of our joints are synovial joints and contain synovial fluid as lubrication. Muscles and ligaments provide movement and stability. All of the bones, except the hyoid bone in the neck, form a joint.

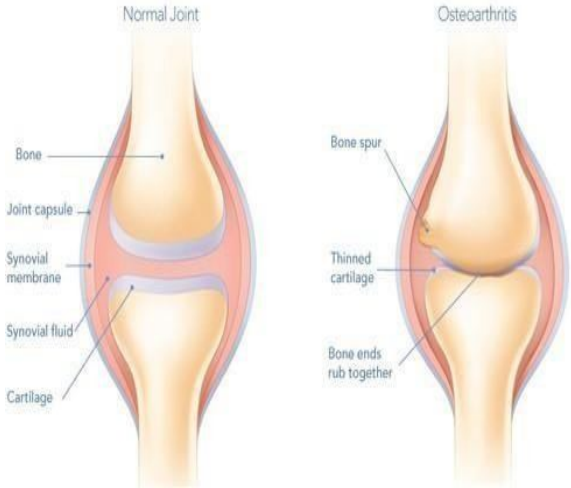
Types of Arthritis:

There are two main types of arthritis, degenerative arthritis (e.g., osteoarthritis) and inflammatory arthritis (e.g., rheumatoid arthritis**).**



Knee Joint Osteoarthritis:

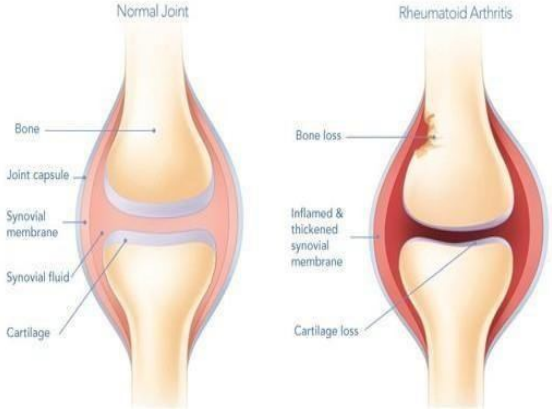
When you have osteoarthritis, the most common form of arthritis, the protective cartilage that covers the ends of the bones in a joint wears down over a period of years. Although osteoarthritis can affect any joint, it is most common in the knees, hips, hands, and spine.



Schematic comparison between a healthy and a OA knee joint

Inflammatory:

Rheumatoid arthritis, by contrast, is an autoimmune disease and an inflammatory type of arthritis. The immune system goes awry and attacks the body's own tissues. It can develop at any age. Rheumatoid arthritis can also affect any joint in your body but typically involves your wrists, knuckles, and the middle joints of your fingers. Gout is another example of inflammatory arthritis.



Schematic comparison between a healthy and a RA and OA knee joint

Existing System:

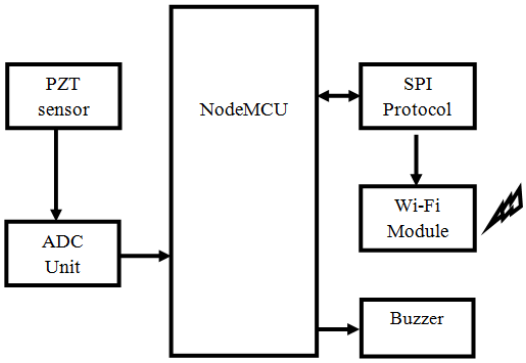
There are several diagnostic tools available to assess knee joint condition. Image-based techniques such as X-rays, Computerized tomography (CT) and magnetic resonance imaging (MRI) are the most currently used non- invasive techniques while arthroscopy is used as semi- invasive. Arthroscopy is considered to be the gold standard diagnostic tool for the evaluation of cartilage condition. However such technique is not suitable for all patients due to its invasive nature, required anesthesia and surgery related risks. However such technique is not suitable for all patients due to its invasive nature, required anesthesia and surgery related risks. Moreover, it is not appropriate for long term or periodic follow-up evaluations of cartilage status. Despite the availability of such techniques, small and progressive changes at cartilage level remains undetected until they are noticeable, either anatomically or symptomatically. Therefore a novel diagnostic method is indeed needed to fully characterize functional integrity of cartilage over time and to assess knee joint status prematurely.

Proposed System:

The development of a vibrational-based classification system for knee joint assessment was successfully obtained during the course of this preliminary study recurring only to the use of a miniature piezoelectric sensor during a knee extension/flexion test. This innovative system showed that it may provide the differentiation between a healthy and pathological knee with relatively good accuracy, as reported in several other studies. This system could be used as a reliable, accurate, cheap and non-invasive screening diagnostic tool in the clinical practice or even at home for preliminary screening. Additionally, it would provide detailed insight, at cartilage level, about the knee joint status and affected structures that may not be detected with other current diagnostic tool (only gross and symptomatic changes are detected with the current image-based techniques), possibly enabling the early detection of knee joint disorders.

COMPONENTS USED:

Node MCU: Node MCU is a low-cost open source IoT platform. It initially included firmware which runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which was based on the ESP-12 module. Later, support for the ESP32 32-bit MCU was added. The name "Node MCU" combines "node" and "MCU" (micro-controller unit). The term "Node MCU" strictly speaking refers to the firmware rather than the associated development kits.



Acoustic Emission Sensor:

Acoustic emission sensor is a device that transforms a local dynamic material displacement produced by a stress wave to an electrical signal. AE sensors are typically piezoelectric sensors with elements maid of special ceramic elements like lead zirconate titanate (PZT).

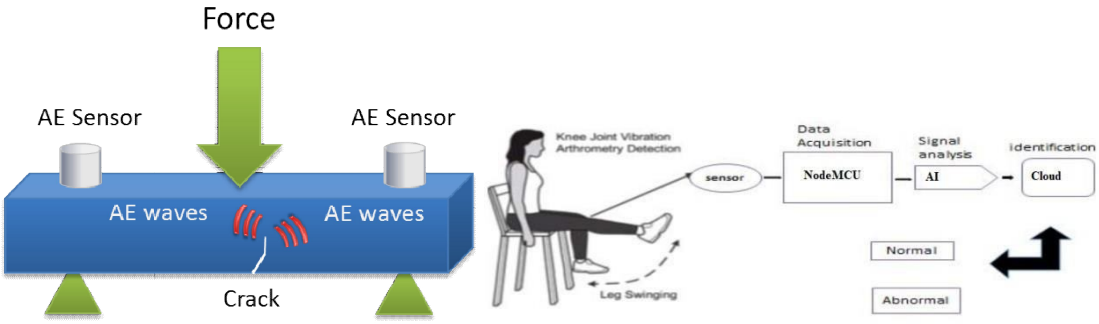
LORAWAN:

The LoRaWAN specification is a Low Power, Wide Area (LPWA) networking protocol designed to wirelessly connect battery operated 'things' to the internet in regional, national or global networks, and targets key Internet of Things (IoT) requirements such as bi-directional communication, end-to-end security, mobility and localization services.

OPERATION:

Degenerated joint produces a complex set of sounds known ascrepitus.Crepitus or crepitation is defined as the crackling or grinding sound emitted during passive or active range of motion of the joint resulting from cartilage friction. The regenerated sounds are non-stationary involving multiple components and are thought to be related with actual condition of the joint. Moreover, it is believed that crepitus it's related to different pathologies affecting distinct structures within the joint. Mechanical vibratory signals arising from the defected joint were recorded using Acoustic Emission Sensor.

VAG signal is the acoustic and vibrational signal generated during a leg active flexion and extension caused by the vibration of articular surfaces of the defected joint. Vibrations generated by the friction of deteriorated articular surfaces are different in terms of frequency and amplitude compared to healthy ones, originating distinct VAG signals. Using nodeMCU and signal analysis using AI. NodeMCU is an open source firmware and development kit. It gives integrated support for WiFi network.



COMPONENTS USED PNEUMATIC CYLINDERS:

Pneumatic equipment can be split up into two basic categories of cylinders and valves. Cylinders are the 'muscles' of pneumatic systems as they are used to move, hold and lift objects. They can even be used to operate other pneumatic components. Cylinders are operated by compressed air and they covert the stored energy in the compressed air into linear motion. Linear motion is motion in a straight line: an apple falling from a tree or a sliding door closing is an example of linear motion. We can represent linear motion by arrows like the ones below.

Fig.1.1

There are two types of cylinder that we will be using:

- Single-Acting Cylinders
- Double-Acting Cylinders

COMPRESSOR

Compression ratio is expressed by the discharge pressure measured in the generally accepted unit of bars. Compressors should be installed in a separate room. Special care is required to ensure that the compressors will be able to take in air that is preferably cool but above all dry and substantially dust-free. At locations where clean suction air is not available, the installation of a separate intake filter can answer this requirement. Piping leading from the filter to the compressor intake should be amply dimensioned. In this way it is also possible for clean suction air to be supplied to a multiple number of compressors via a common intake duct.

OPERATION

There are many valve design variations. Ordinary valves can have many ports and fluid paths. A 2- way valve, for example, has 2 ports; if the valve is open, then the two ports are connected and fluid may flow between the ports; if the valve is closed, then ports are isolated. If the valve is open when the solenoid is not energized, then the valve is termed normally open (N.O.). Similarly, if the valve is closed when the solenoid is not energized, then the valve is termed normally closed. There are also 3-way and more complicated designs. A 3- way valve has 3 ports; it connects one port to either of the two other ports (typically a supply port and an exhaust port). Solenoid valves are also characterized by how they operate. A small solenoid can generate a limited force. If that force is sufficient to open and close the valve, then a direct acting solenoid valve is possible. An approximate relationship between the required solenoid force *Fs*, the fluid pressure *P*, and the orifice area *A*

WORKING PROCESS

The working process of the robotic arm is very simple. All kinematic motion is control by pneumatic cylinder with the help of the compressor in effective manner. It was particularly design for hospital patent. So that each parts or components are made up of light weight material so that patent can able to use in friendly manner. It was similar to the real hand principal so that it will perfectly suitable for the every person. Whole system completely work depend upon the pneumatic cylinder, performance of these robotic is completely depends upon the compressed air supply to into the pneumatic cylinder. Skeleton of the robotic arm an able to perform all kind of operations similar to the real hand. It was completely control by the pneumatic cylinder. With the help of the air pressure which supply form the compressor. It was perfectly design for the patent comfortless. So that it was very user friendly to the patent. The model image of the project was given in above block diagram. Inlet and outlet of the pneumatic cylinder was control by the solenoid valve in effective manner with the support of the electric power supply.

CONCLUSION

An articulated robot arm was developed using pneumatic linear actuators to carry out material handling tasks for industries where the usage of electric components can be hazardous. The design of the arm employed crank mechanism in which linear displacement from actuation was converted to angular displacement of the joint effectively. A 5/3-way proportional control valve proved to be very effective in controlling the highly nonlinear arm compared to normal 5/3- way directional control valve. It was also found that the force changes with the position of the articulated arm dynamically

REFERENCE

1. "Robot Arm and Computer Vision". Retrieved 29 July 2016.
2. "MeArm Open Source Robot Arm (source files)". Retrieved 21 June 2016.
3. Staff (Sandia National Labs) (August 16, 2012), "Life-like, cost-effective robotic hand can disable IEDs", R&D Magazine, rdmag.com, retrieved September 13, 2012
4. IEEE Xplore: The Canadarm grasps this boom and can position it in the necessary positions to permit a complete inspection "Curiosity Rover - Arm and Hand". JPL. NASA. Retrieved 2012-08-21.
5. Jandura, Louise. "Mars Science Laboratory Sample Acquisition, Sample Processing and Handling: Subsystem Design and Test Challenges" (PDF). JPL.NASA. Retrieved 2012-08-21.
6. Dr.R.Satish kumar, Dr.M.Y.Sanavullah Theoretical and experimental study of cooking regions for shell eggs in a domestic Microwave oven VL- 4 DO- 10.1109/ICECTECH.2011.5941909 JO - ICECT 2011 - 2011 3rd International Conference on Electronics Computer Technology
7. Dr.R.Satish Kumar and Dr.K.Umadevi " A Novel peak torque Excitation Technique for Torque Improvement in Exterior Rotor Permanent Magnet Brushless DC Motor", International journal of Innovative research in Advanced Engineering, Vol. 1, 2014, pp. 227-236 (Impact factor 1.311).
8. Dr.R.Satish Kumar and Dr.K.Umadevi " Torque Improvement for an Exterior Rotor Permanent Magnet Brushless DC Motor", International journal of Innovative research in Advanced Engineering, Vol. 1, 2014, pp. 1-5 (Impact factor 1.311).
9. Dr.R.Satish Kumar and Dr.K.Umadevi " Novel Technique for Measurements of Dielectric Properties and Microwave Heating of In-Shell Eggs without Explosions in Microwave Oven for Pasteurization", International journal of Innovative research in Advanced Engineering, Vol. 2, , 2015, pp. 69-77 (Impact factor 1.311).
10. Dr.R.Satish Kumar and Dr.M. Y. Sanavullah" Theoretical and experimental study of cooking regions for shell eggs in a domestic Microwave oven", International Conference on Electronics Computer Technology, 2011, https://doi:10.1109/ICECTECH.2011.5941909

