A Literature Review on Bone Fracture Detection System Using Android Application

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Abstract: A bone fracture is a medical condition in which there is a partial or complete break in the continuity of the bone. When outside forces such as direct blows or falls are applied to bone it has the potential to fail. Fractures occur when bone cannot withstand those outside forces. There are so many methods are used to detect bone fractures. This paper gives a survey on different bone fracture detection system. A review of the literature was conducted for finding the relevant publications on the viability, genuine and implementation and operation of bone fracture detection systems.

Keywords: Fracture, Bone, Diagnosis.

I. INTRODUCTION

Bone fracture is a medical condition where the continuity of the bone is broken. When outside forces such as direct blows or falls are applied to bone it has the potential to fail. Fractures occur when bone cannot withstand those outside forces. Fracture, break or crack all mean the same thing. One term does not imply a more or less severe injury. In more severe cases the bone may be broken into several pieces. A bone fracture may be the result of high force or minimal trauma injury as a result of certain medical conditions that weaken the bones, such as osteoporosis. Some fractures may lead to complications. That condition is known as compartment syndrome. A bone fracture can be diagnosed based on the history given and physical examination performed radiographic imaging often is performed to confirm the diagnosis. in situations where projection radio grapy alone insufficient, CT, MRI may be indicated. Doctors can usually recognize most fractures by examining the injury and taking X-rays. Sometimes an X-ray will not show a fracture; this is especially common with some wrist fractures, hip fractures (especially in older people), and stress fractures. In these situations, the doctor may perform other tests, such as MRI and CT scan, in some cases such as a possible wrist fracture with an initially normal- X-ray, Doctor may apply a splint to immobilize the area and order a second X-ray 10 to 14 days later when healing can make the fracture visible. Occasionally even after the fracture diagnosis has been made we may need other tests to determine whether other tissues around the bone have been damaged, in a bone fracture detection system using the android application a vibrating motor and an android application is used to detect the fracture. This method can be used for the initial diagnosis of fractures.

II. DISCUSSION

Bone fracture is a common problem in daily life, previous studies regarding fracture detection revealed that in past years vibrating devices such as tuning fork used to detection of fractures. CollierRJin 1987 used an accelerometer for detecting fracture of the human tibia. An accelerometer is an electromechanical device used to measure acceleration forces. Such forces may be static like the continuous force of gravity or is the case with many mobile devices, dynamic to sense movement or vibrations. Accelerometers are useful for sensing vibrations in systems or for orientation applications. So in Collier's experiment, he places the accelerometer at various positions on tibia, measurements had been done at 0-500Hz frequency range. From the experiment, he found that the fractures only transmitted low frequencies. And also he relates the tibia resonant frequency with the strength of the bone. For a fractured bone resonant frequency become low. Frequencies at which the response amplitude is a relative maximum are known as resonant frequencies of the system. Standard x-ray techniques are used to follow upon the healing process bone fractures. However, these methods allow indirect conclusions about the stability of the healing bone depending on the experience of the clinician, also by radiographic means delayed union or nonunion can only be diagnosed based on the absence of specific changes such as callus formation. Therefore the efforts have been made to develop alternative methods for monitoring the healing process. Fellinger M and Arch Orthop in 1994 experimented. The measuring principle of a noninvasive method I based on the evaluation of changes in mechanical vibration reactions. The measuring system is composed of two sound transducers, an amplifier module and an AD converter attached to a PC. The assessment of 150 healthy individuals, as well as an initial measuring series after treatment of tibial fractures with an external fixator system, revealed a highly significant difference between intact and fractured tibias thus computerized tonometry is capable supplying quantitatively recordable information about the stability of fractured bone at any time in the healing process. Furthermore, this noninvasive technique allows early diagnosis of disorders in the pair process by the absence of change I the parameter Finkenberg investigated a new means of diagnosing occult scaphoid fractures. Eighty-six patients underwent vibratory testing at presentation, while the clinical examination and standard four view x-ray examination finding were unknown to the persons who performed the vibratory testing on both the injured and uninjured wrists. Thirty-six patients had radiographically confirmed scaphoid fractures and after their vibratory tests were eliminated from the study. Fifty patients, 39 men, and 11 women were believed to have
scaphoid fractures based on history and clinical examination findings but were included in the occult scaphoid study group because standard four view x-ray films of the wrists did not reveal a scaphoid fracture. The distinction between the fracture and non-fracture patients was made with a limited two phase technetium bone scan and delayed X-ray examination. All patients with known scaphoid fractures (36) have positive findings in vibratory examination. Vibratory testing identified all six of the patients with occult scaphoid fractures (sensitivity 100%). Results of two examinations were false positive and none, where false negative (specifically 95%) one of the patients with false-positive results, had reflex sympathetic dystrophy. The vibratory testing of injured wrists is expensive, noninvasive and easy to perform, and it involves no ionizing radiation. Yrjama and Vanharanta evaluated 57 patients with low back pain immediately before the discography examination using an electrical tool that produced bony vibration to the lumbar spinal process. The vibrator was composed of a standard electric toothbrush shaft (Braun) with a blunt head instead of the brush. The lumbar spinal processes were compressed one by one for a few seconds with this vibrator. The patient’s pain provoked by vibration was compared with that from injections during discography.

In 1995 Bates B compare the Weber test and Rinne test. A Rinne test evaluates hearing loss by comparing air conduction to bone conduction. Air conduction hearing occurs through the air near the ear, and it involves the ear canal and eardrum. Bone conduction hearing occurs through vibrations picked up by the ear’s specialized nervous system. A Weber test is another way to evaluate conductive and sensorineural hearing losses. Conductive hearing loss occurs when sound waves are unable to pass through the middle ear to the inner ear. Bates conducts the Rinne and Webber test by using a tuning fork. Tests are based on the transmission of the vibration. Rinne and Weber tests both use 512-Hz tuning forks to test how we respond to sounds and vibrations near our ears. Rinne and Weber test are noninvasive and cause no pain, and there are no risks associated with them. The information they provide determines the type of hearing loss we may have, especially when the results of both tests are used together. In 1984 Bache JB conducted a Barford test to detect fracture at the femoral neck that tests combined tuning fork and auscultation. In 1987 Misurya RK studied the use of tuning fork in diagnostic auscultation of fractures. This study was conducted on 50 patients in the central institute of orthopedics, Safdarjung Hospital, New Delhi, from June to October 1985. with the help of a child’s stethoscope and a tuning fork of 128-Hz, the sound conducted by an injured limb was compared with that by the uninjured limb. The presence of fracture reduced or abolished the conduction of sound by a bone. This method allows a quick examination without causing any pain, which is an advantage in an uncooperative patient. it is also reliable in the unconscious. The test is so simple that paramedical staff can use it. The results were correct in 94 percent of patients and were confirmed by radiological examination whereas clinical diagnosis was correct it only 88 percent of cases. Two peer-reviewed scientific studies have been conducted on the efficiency of the tuning fork test for diagnosing a stress fracture. The first was published in 1997 by Emil Patrick Lesho, a military doctor stationed at Fort Richardson in Arkansas. His study is to compare the performance of the tuning fork test (TFT) with nuclear scintigraphy for the identification of tibial stress fractures. Fifty-two patients with a history and physical examination suggestive of tibial stress fracture underwent a TFT followed by a bone scan. The TFT was performed by applying a 128-Hz tuning fork to the anterior surface of the bared tibia. If the patient reported a marked exacerbation or reproduction of shin pain in a localized area of the tibia, the TFT was considered positive. All patients also underwent a bilateral lower-extremity bone scan. The sensitivity and specificity of the tuning fork test were 75 and 67%, respectively. The positive and negative predictive values were 77 and 63%, respectively. The positive and negative likelihood ratios with 95% confidence intervals were 2.33 (1.17-4.60) and 0.34 (0.16-0.71), respectively. The tuning fork test is not sensitive enough to rule out a stress fracture based on a negative test. However, in a setting in which there is a moderate to high pretest likelihood of stress fractures, such as military installations with new basic training recruits, it may be reasonable to avoid the cost and delays associated with nuclear imaging by instituting treatment for tibial stress fractures without obtaining a bone scan when the TFT is positive. But he suggested that a positive tuning fork test might be enough to justify treating a patient for a stress fracture immediately instead of waiting for advanced imaging results. Another study published in 2009 looked at the tuning fork test as well, but this time, in distance runners specifically Robert Wilder and colleagues at the University of Virginia studied forty-five distance runners with a suspected stress fracture. Wilder experimented similar to Lesho’s but tested 256 Hz and 512 Hz tuning forks in addition to the 128Hz fork used by Lesho. The 256 Hz tuning fork performed best, with a sensitivity of about 90%, but unfortunately, the test had very poor specificity only around 20%. This means that many people without stress fracture will nevertheless have pain during a tuning fork test, making it difficult to use it as a diagnostic aid. A review study published in 2012 examined Lesho and Wilder's results, recommending that clinicians hold off on relying on tuning fork test until there’s more research validating it. The review study criticized the methodology of Wilder and noted that testing procedures were not standardized either study, so the results can’t be pooled for more statistical power. In 2013 Chandrasekaran published an article regarding the use of smartphones for diagnosing blood pressure. Smartphones today have become increasingly popular with the general public for their diverse functionalities such as navigation, social networking, and multimedia facilities. These phones are equipped with high-end processors, high-resolution cameras, and built-in sensors such as accelerometer, orientation sensor, and light sensor. According to the Comscore survey, 26.2% of US adults use smartphones in their daily lives. Motivated by this statistic and the diverse capability of smartphones, we focus on utilizing them for biomedical applications. We present a new application of the smartphone with its built-in camera and microphone replacing the traditional stethoscope and cuff-based measurement technique, to quantify vital signs such as heart rate and blood pressure. We propose two differential blood pressure estimating techniques using the heartbeat and pulse data. The first method uses two smartphones whereas the second method replaces one of the phones with a customized external microphone. We estimate the systolic and diastolic pressure in the two techniques by computing the pulse pressure and the stroke volume from the data recorded. By comparing the estimated blood pressure values with those measured using a commercial blood pressure meter, we obtained encouraging results of 95-100% accuracy. In 2018 Zakria Qadir published a conference paper Design and development of a low-cost device for bone fracture using FFT technique on MATLAB. In this A bone fracture technique was designed using FFT and the results are analyzed on MATLAB software. The output waveforms clearly illustrate the variation in amplitude response and SD, between healthy and cracked
bones. It is observed that healthy bones are showing greater amplitude (mV) and less distortion than unhealthy bones. Therefore, it instantiates that when sound waves pass through the cracked surfaces its amplitude is reduced and SD is increased due to refraction and distortion. The designed portable device can detect cracks or fracture in bones that will be helpful for doctors and people to examine themselves. It will also be helpful for veterinary doctors to examine animals and can also be useful for horse trainers to detect bone fracture quickly hence saving time, health and cost. Vimal Samsingh Ramalingam in 2019 experiments fracture diagnosis of the human tibia by using a microwave device. In this, a portable system for noninvasive detection of fractures in human bones is presented. A planar microwave ring resonator is used as the sensor. The proposed planar microwave sensor is designed using the finite integration based CST Microwave Studio and tested on a human bone covered by porcine tissues. Fracture induced in the bone was detected by monitoring the transmission characteristics of the sensor as it scans the affected region. The resonant frequency of the ring resonator has been observed at every scan point, and the values are plotted using iterative curvature-based interpolation, improved new edge directed interpolation, and Lanczos imaging technique. The extent of fracture is then derived from the image. The average accuracy of the detected fracture for the Lanczos method of resampling was 98.86%. The specific absorption rate was below the minimum level of 1.6 W/Kg at every point of scanning. Portable noninvasive monitoring of fractures in the Tibial bone will help in immobilizing the affected part at an earlier stage, thereby reducing the recovery time for patients. In recent times, the use of flexible sensors has gained tremendous importance for its portable nature and its ability to sense in textured and curved surfaces. The literature also points to the ability of the flexible sensors to have a larger sensing area contact compared to rigid sensors when deployed on curved surfaces. Since body regions are mostly curved surfaces like the limbs, the sensing accuracy could be improved and the probability of missed detections could be avoided through flexible sensors. Hence, future work could be extended to the development of microwave sensors on flexible substrates for more efficient detection.

III. CONCLUSION

A fracture is when the continuity of a bone is broken. It can range from a thin crack to a complete break. Most fractures happen when a bone is impacted by more force or pressure than it can support. In early days vibratory devices like tuning forks are used for the detection of fractures. This paper gives a survey on the different bone fracture detection system

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IV. REFERENCES


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