IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

STROKE PREDICTOR SYSTEM USING IOT

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ABSTRACT

In this modern era, we have seen increased number of heart diseases and increased risk of heart attacks. Heart attacks pose a serious health risk and can be life-threatening. They occur when a blockage in the coronary arteries disrupts blood flow to the heart, which can cause permanent damage. Hence it is very much imperative to detect the Heart Attack on time and provide necessary lifesaving medical care to the patients. In our proposed project, the system provides sensors that allow detecting heart rate of a person using heartbeat sensing even if the person is at a remote place (i.e. home, office, travel etc.). The sensors are then interfaced to a microcontroller that allows checking heart rate readings and transmitting them over internet. The user is enabled to set the various levels i.e. HIGH, LOW levels of heart beat limit. Once these limits are setup / configured, the system starts monitoring and as soon as patient heart beat goes above a certain limit (i.e. crossing the Thresholds), the system sends an alert to the controller which then transmits this over the internet and alerts the doctors as well as concerned users. Also the system alerts for lower heartbeat rates. Whenever the user logs on for monitoring, the system also displays the live heart rate of the patient. Thus, concerned stake holders can monitor heart rates and receive alerts of heart attack to the patient immediately from anywhere and the person's life can be saved on time.

Keywords: Heartbeat, Heart rate, Internet of Things, Sensors, Microcontroller.

1. INTRODUCTION

The heart is one of the most important organs in the human body. It acts as a pump for circulating oxygen and blood throughout the body, thus keeping the functionality of the body intact. A heartbeat can be defined as a two-part pumping action of the heart which occurs for almost a second. It is produced due to the contraction of the heart. When blood collects in upper chambers, the SA(SinoAtrial) node sends out an electrical signal which in turn causes the atria to contract. This contraction then pushes the blood throughtricuspid and the mitral valves; this phase of the pumping system is called diastole. The next phase begins when the ventricles are completely filled with blood. The electrical signals generating from SA node reach the ventricle and cause them to contract. This phase of the pumping system is called systole. The tricuspid and mitral valves are closed tightly to prevent the backflow of blood; the pulmonary and aortic valves are opened. Once the blood moves from the pulmonary artery and aorta the ventricles relax and the pulmonary and aortic valves close. Tricuspid and mitral valves open because of the lower pressure from the ventricles leading to the start of another cycle. In today's scenario, health problems related to heart are very common. Heart diseases are one of the most important causes of death among men and women; it claims approximately 1 million deaths every year. Heart rate is a critical parameter in the functioning of the heart. Therefore, heart rate monitoring is crucial in the study of heart performance and thereby maintaining heart health. This paper proposes a heart rate monitoring and abnormality detection system using IoT. Nowadays treatment of most of the heart-related diseases requires continuous as well as long term monitoring. IoT is very useful in this aspect as it replaces the conventional monitoring systems with a more efficient scheme, by providing critical information regarding the condition of the patient accessible by the doctor in any remote place, at any time through the internet. In addition, the nurses or the duty doctor available at the hospital can monitor the heart rate of the patient in the serial monitor through the real-time monitoring system. Also, a warning system is incorporated in which if the patient's heartbeat goes below or exceeds a particular value the doctor receives an alert message through a mobile application. GPS technology is used in the software system for monitoring the live location of the device. The prototype can also store the data of the heartbeat as well as other details of the patient and this can be used by the doctor to analyze the heart condition of the patient and for other future purposes. Early recognition of the disease is very vital in preventing more complications in the future. The suggested prototype consists of both hardware and software components. The hardware consists of NodeMCU, pulse sensor, and LCD display. The software consists of two IoT platform, Adafruit (along with GPS Technology), and blynk along with a mobile application. The system is based on a portable heart rate monitoring system designed in a cost-efficient manner. The prototype is also easy to use and access the data. And also can be used by people of different age groups. The real-time data can be viewed as well as stored for future studies with respect to the heart condition of the patient. A system based on the ECG sensor and pulse sensor is adapted to design a wrist band for early detection of a heart attack and availing medical facilities as soon as possible [1]. The proposed layout consists of a smart wrist band using IoT technology where the device communication is made possible by using a Bluetooth device. The prototype is based on Lilypad Arduino and Android application, additionally, the panic button is provided as part of an alert system in case of heart attack detection. Moreover, a mobile application called ECG analytics is used for the analysis of the data collected from the sensor [2]. Real-time monitoring of the heartbeat is made possible through the Thing Speak platform.

2. OBJECTIVE

The system should compute and display capacity and performance measures to evaluate stroke patients during daily-life activities (for example: grasping an object) in a home setting. The INTERACTION system should be divided into several modules: upper extremity (shirt), watch, gloves and shoes. This will allow clinicians to assign different modules to different patients according to the clinician's specific interests. Analysis of the sensor data will not be done in real time. The system should be able to store the computed data such that it can be accessed by a clinician when needed.

3. PROBLEM STATEMENT

Data Storage Management is required more Space. Less Data Secure. Data Loss are occurring while the device is in moving Stage Data Loss are occurring while the Network Switching Condition (NSC). The cost effective of LoRa technology is little more.

4. LITERATURE SURVEY

JAEHAK YU; SEJIN PARK- IEEE ACCESS (VOLUME: 10) ENTITLED AS **"AI-BASED STROKE DISEASE PREDICTION SYSTEM USING ECG AND PPG BIO-SIGNALS"**.

Since stroke disease often causes death or serious disability, active primary prevention and early detection of prognostic symptoms are very important. Stroke diseases can be divided into ischemic stroke and hemorrhagic stroke, and they should be minimized by emergency treatment such as thrombolytic or coagulant administration by type. First, it is essential to detect in real time the precursor symptoms of stroke, which occur differently for each individual, and to provide professional treatment by a medical institution within the proper treatment window. However, prior studies have focused on developing acute treatment or clinical treatment guidelines after the onset of stroke rather than detecting the prognostic symptoms of stroke. In particular, in recent studies, image analysis such as magnetic resonance imaging (MRI) or computed tomography (CT) has mostly been used to detect and predict prognostic symptoms in stroke patients. Not only are these methodologies difficult to diagnose early in real-time, but they also have limitations in terms of a long test time and a high cost of testing. In this paper, we propose a system that can predict and semantically interpret stroke prognostic symptoms based on machine learning using the multi-modal bio-signals of electrocardiogram (ECG) and photo plethysmography (PPG) measured in real-time for the elderly. To predict stroke disease in real-time while walking, we designed and implemented a stroke disease prediction system with an ensemble structure that combines CNN and LSTM. The proposed system considers the convenience of wearing the bio-signal sensors for the elderly, and the bio-signals were collected at a sampling rate of 1,000Hz per second from the three electrodes of the ECG and the index finger for PPG while walking. According to the experimental results, C4.5 decision tree showed a prediction accuracy of 91.56% while Random Forest showed a prediction accuracy of 97.51% during walking by the elderly.

MENG WANG; XINGHUA YAO; YIXIANG CHEN - JOURNAL OF ENGINEERING AND TECHNOLOGY (FUOYEJET), VOL. 5, ISSUE 2 ENTITLED AS "AN IMBALANCED-DATA PROCESSING ALGORITHM FOR THE PREDICTION OF HEART ATTACK IN STROKE PATIENTS"

Early predicting heart attack out of stroke patients in a view of data analysis is an approach to reduce a high mortality rate. Stroke-patient data in Intensive Care Unit are imbalanced due to that stroke patients with heart attack are in the minority of stroke patients. How to predict heart attack in the stroke-patient data becomes a challenge. For processing the imbalanced data, this paper designs an algorithm by leveraging random under sampling, clustering and oversampling techniques, which is called under sampling-clustering-oversampling algorithm (shortly, UCO algorithm). The UCO algorithm generates nearly balanced data which are utilized to train machine-learning models for predicting heart attack. Over the database of Medical Information Mart for Intensive Care III, extensive experiments are conducted to evaluate the UCO algorithm. A setting of under sampling number of 120 in the algorithm UCO, denoted UCO (120), shows good performance in helping machine-learning classifiers extract features. Five classifiers are separately deployed to predict heart attack based on outputs of the UCO (120). Our results show that random forest classifier achieves the best predicting performance with an accuracy of 70.29%, and precision of 70.05%. It could be well-predicted using UCO (120) and random forest that whether a stroke patient will have heart attack or not.

SANGHYUN BAEK; JIYONG JANG; SUNG-HWAN CHO - 2020 42ND ANNUAL INTERNATIONAL CONFERENCE OF THE IEEE ENGINEERING IN MEDICINE & BIOLOGY SOCIETY (EMBC) ENTITLED AS **"BLOOD PRESSURE PREDICTION BY A SMARTPHONE SENSOR USING FULLY CONVOLUTIONAL NETWORKS"**

Heart disease and stroke are the leading causes of death worldwide. High blood pressure greatly increases the risk of heart disease and stroke. Therefore, it is important to control blood pressure (BP) through regular BP monitoring; as such, it is necessary to develop a method to accurately and conveniently predict BP in a variety of settings. In this paper, we propose a method for predicting BP without feature extraction using fully convolutional neural networks (CNNs). We measured single multi-wave photo plethysmography (PPG) signals using a smartphone. To find an effective wavelength of PPG signals for the generation of accurate BP measurements, we investigated the BP prediction performance by changing the combinations of the input PPG signals. Our CNN-based BP predictor yielded the best performance metrics when a green PPG time signal was used in combination with an instantaneous frequency signal. This combination had an overall mean absolute error (MAE) of 5.28 and 4.92 mmHg for systolic and diastolic BP, respectively. Thus, our CNN-based approach achieved comparable results to other approaches that use a single PPG signal.

GIHUN JOO; YEONGJIN SONG; HYEONSEUNG IM- IEEE ACCESS (VOLUME: 8) ENTITLED AS **"CLINICAL IMPLICATION OF MACHINE LEARNING IN PREDICTING THE OCCURRENCE OF CARDIOVASCULAR DISEASE USING BIG DATA"**

Machine learning (ML) and large-scale big data are key factors in developing an accurate prediction model for cardiovascular disease (CVD). Although the CVD risk often depends on the race and ethnicity, most previous studies considered only US or European populations for the CVD risk prediction. In this work, to complement previous researches, we analyzed the Korean National Health Insurance Service-National Health Sample Cohort (KNHSC) data and studied the characteristics of ML and big data for predicting the CVD risk. More specifically, we assessed the effectiveness of various ML methods in predicting the 2-year and 10-year risk of CVD such as atrial fibrillation, coronary artery disease, heart failure, and strokes. To develop prediction models, we considered the usual medical examination data, questionnaire survey results, comorbidities, and past medication information available in the KNHSC data. We developed various ML-based prediction models using logistic regression, deep neural networks, random forests, and LightGBM, and validated them using various metrics such as receiver operating characteristic curves, precision-recall curves, sensitivity, specificity, and F1 score. Experimental results showed that all ML models outperformed the baseline method derived from the ACC/AHA guidelines for estimating the 10-year CVD risk, demonstrating the usefulness of ML methods. In addition, in our analysis, whether we included the past medication information as a feature or not, the prediction accuracy of all ML models was comparable to each other.

Since the use of medications by the physicians provided important information on the occurrence of diseases, when we included it as a feature, all prediction models achieved a slightly higher prediction accuracy.

MUHAMMAD SALMAN PATHAN; ZHANG JIANBIAO; DEEPU JOHN - IEEE ACCESS (VOLUME: 8) ENTITLED AS "IDENTIFYING STROKE INDICATORS USING ROUGH SETS"

Stroke is widely considered as the second most common cause of mortality. The adverse consequences of stroke have led to global interest and work for improving the management and diagnosis of stroke. Various techniques for data mining have been used globally for accurate prediction of occurrence of stroke based on the risk factors that are associated with the electronic health care records (EHRs) of the patients. In particular, EHRs routinely contain several thousands of features and most of them are redundant and irrelevant that need to be discarded to enhance the prediction accuracy. The choice of feature-selection methods can help in improving the prediction accuracy of the model and efficient data management of the archived input features. In this paper, we systematically analyze the various features in EHR records for the detection of stroke. We propose a novel rough-set based technique for ranking the importance of the various EHR records in detecting stroke. Unlike the conventional rough-set techniques, our proposed technique can be applied on any dataset that comprises binary feature sets. stroke. We evaluated our proposed method in a publicly available dataset of EHR, and concluded that age, average glucose level, heart disease, and hypertension were the most essential attributes for detecting stroke in patients. Furthermore, we benchmarked the proposed technique with other popular feature-selection techniques. We obtained the best performance in ranking the importance of individual features in detecting stroke.

5. EXISTING SYSTEM

Stroke diseases can be divided into ischemic stroke and hemorrhagic stroke, and they should be minimized by emergency treatment such as thrombolytic or coagulant administration by type. First, it is essential to detect in real time the precursor symptoms of stroke, which occur differently for each individual, and to provide professional treatment by a medical institution within the proper treatment window. However, prior studies have focused on developing acute treatment or clinical treatment guidelines after the onset of stroke rather than detecting the prognostic symptoms of stroke. In particular, in recent studies, image analysis such as magnetic resonance imaging (MRI) or computed tomography (CT) has mostly been used to detect and predict prognostic symptoms in stroke patients. Not only are these methodologies difficult to diagnose early in real-time, but they also have limitations in terms of a long test time and a high cost of testing.

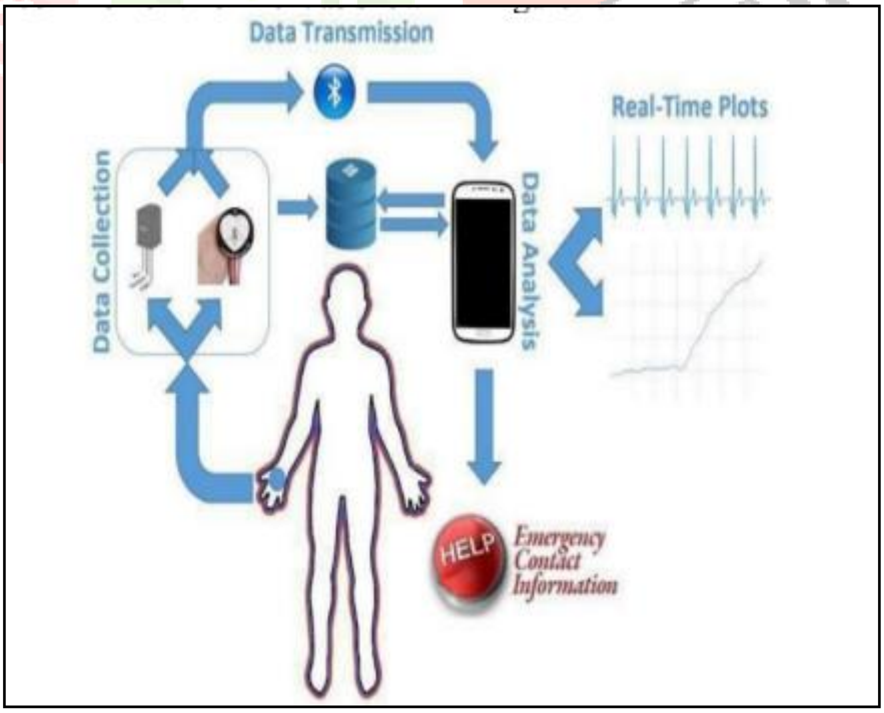


FIGURE 1: EXISTING MODEL DIAGRAM

6. PROPOSED SYSTEM

Stroke represents a global concern that currently affects a significant part of the world's population. Physical rehabilitation plays a fundamental role for stroke patients to recover mobility and improve quality of life. This process is costly, considering that patients must attend face-to-face rehabilitation sessions in hospitals or rehabilitation centers. Plus, there is a lack of specialized medical staff, who are usually insufficient to properly address the growing number of stroke patients that need physical rehabilitation. This situation has been exacerbated by the COVID-19 pandemic, as some of the human resources have been devoted to fight against the pandemic, and the physical presence of rehabilitation patients in hospitals has been severely limited.

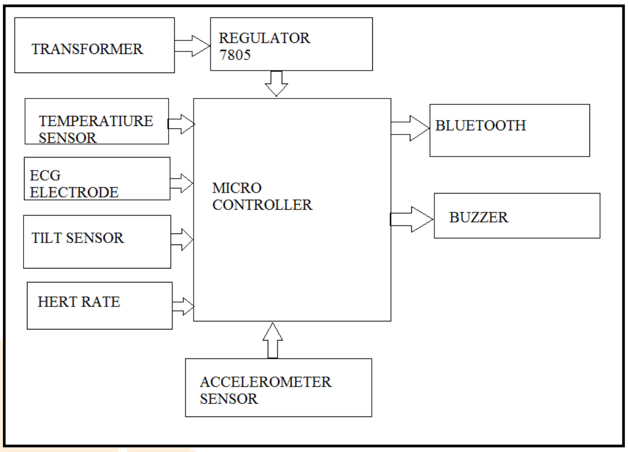


FIGURE 2: PROPOSED MODEL DIAGRAM

Heart rate sensor, temperature sensor, ecg sensor and tilt sensors are attached wearable band and output of the sensors are connected to the microcontroller. By using the IoT technology, the output of the sensor data is saved in the cloud. This received data are compared with the existing data set using un supervised machine learning algorithm. This algorithm has estimated the possibility of heart stroke Two acceleration sensors are connected in the wearable band to detect the falling down of the patient and immediate message send to caregivers through IoT technology. After analyzing the heart stroke prediction parameters through machine learning algorithm, the risk data set send to the cloud and mobile app maintained by the hospital for immediate treatment.

7. SYSTEM REQUIREMENTS

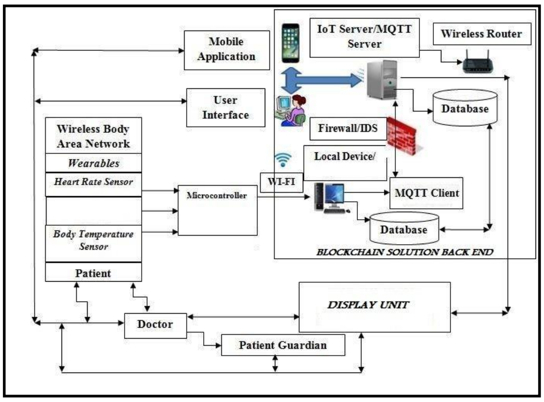
Operating system	:	Windows 7/10.
Coding Language	:	Embedded 'C' Language
Software Platform	:	Arduino, Sketchware

8. HARDWARE REQUIREMENTS

Power Supply
Microcontroller
ECG Electrodes
Temperature Sensor
Humidity
Heart Rate
Accelerometer

9. SYSTEM DESIGN

9.1 SYSTEM ARCHITECTURE



The architectural framework describes the entire process of the implemented system. The application framework was broadly divided into three:

User Framework
Synchronization Framework
Medical Diagnostic Framework.

9.2 USER FRAMEWORK COMPRISES:

Wearable Sensor (Fit bit): This was used to measure the heart beat rate, sleeping rate and steps or distance covered. Mobile Phone: This was the device used in this research to house the lightweight database management system used (SQLite). This database was built to store the readings of the basic vital signs considered in this work directly from the wearable sensor. The mobile application that interprets the readings from the sensor was also installed on the mobile phone. SQLite Database: SQLite is a software library that implements a self-contained, zero-configuration, transactional SQL database engine. This was installed with the mobile app built for user framework. Mobile Communication Signal

9.3 SYNCHRONIZATION FRAMEWORK

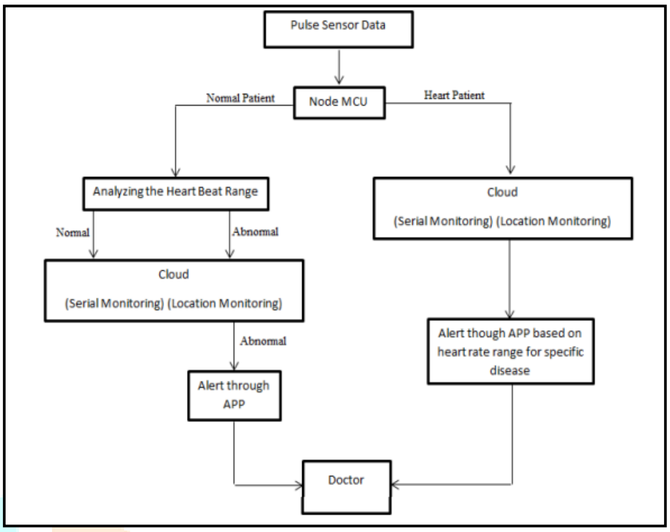
Sync Framework is a comprehensive synchronization platform that enables collaboration and offline access for applications, services, and devices. This framework consists of intermediate resources to transfer data to and from the remote patient to the medical experts. The components in this model are: Database Server: This server was used to store all the remote patients' record, while the SQLite stored only the pieces of information of a specific user, the database server stored all the records of the entire patients. The database management system used in this research was Microsoft SQL Server 2012. The medical diagnostic framework used the data stored here to make clinical decisions. Web Server: The user framework and medical diagnostic framework cannot communicate to the database directly for security purpose and Separation of Concern in software engineering, therefore a web service was developed to administer interoperability, because the mobile framework was built with proprietary Java programming language and the medical diagnostic framework was built using C#. The web service was stored on the web server (Internet Information Service) in order to be accessible via hypertext transfer protocol which interprets the Simple Object Access Protocol message to any of the application.

9.4 MEDICAL DIAGNOSTIC FRAMEWORK

This framework is composed of the team of medical expert purposely charged for this responsibility; they made use of laptops, iPhones and tablets to access information from the synchronization framework. Shift management was also considered for the design in this framework. The components of the framework are: Wearable Sensor: This component represents the Wristband Sensor for taking readings. Bluetooth: This represents the Bluetooth component embedded inside the phone for communicating with the sensor. SQLite: This is a lightweight database used to store the readings from the sensor; this was installed on the phone to manage records read from the device via the Bluetooth. Mobile phone: This component has both the Bluetooth and the SQLite database. It is also programmed to synchronize with the synchronization framework. Medical Diagnostic Platform: This component was used to manage the Medical Diagnostic

Framework. Synchronization: The component has the capability to process data transfer from the User and the Medical Diagnostic Platform. Web Server: The web server of choice was the Internet Information Service (IIS) server

9.5 FLOW CHART



The proposed prototype is a device that can be attached to the wrist of the patient. The pulse data from the patient's wrist is collected by the pulse sensor. The process of working is given in the flowchart The data is transferred to the microcontroller, nodeMCU coded with different algorithms for heart patients and normal people. From the nodeMCU, the data is sent to the cloud, Adafruit. Adafruit, an IoT platform is used for serial monitoring as well as location monitoring using GPS technology as shown in Fig. 6. A local server is used to provide security, privacy, and low latency.

10. CONCLUSION

In this system a real time heart rate monitoring and heart attack detection system is realised by using IoT. The proposed design is advantageous to patients of different age groups by providing real time heart health monotoring. It also provides security and privacy to the datas of the patient. The proposed design is implemented as the real time monitoring system which helps in providing immediate health care facilities to the patient by using MQTT protocol and IFTTT protocol, alert system and location monitoring are other features of the design. In addition to this a local server is used to provide security, privacy and low latency.

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