

Real time Cloud Computing Based COVID-19 Health Monitoring System using IOT with integration of Machine Learning Approach to Create Safety Environment

P.Dileep,

Designation: Associate Professor,
Department of Computer Science and Engineering,
Malla Reddy College of Engineering and Technology, Kompally, Hyderabad,
Email Id :- p.dileep@mrcet.ac.in

Maanasa Thogaru,

Designation: Assistant Professor,
Department: Department of Computer Science and Engineering,
College Name: Vidya Jyoti Institute of Technology, Aziz Nagar, Hyderabad,
Email-id: maanasa.thogaru@gmail.com

Abstract

we propose a System that would enable everyone to have access to Personal Health Care Companion. Such that it helps individuals to perform health check at regular intervals and produce dynamic health reports on the health related problems that individuals may face. Health care field has a vast amount of data, for processing those data we have used some of the Machine Learning Algorithms and detected the presence of Disease. Sound health is necessary to do all our day to day works with the fullest hope. Nowadays all people are having more health- conscious than in the past years. Because of these reasons, there are different types of health check- ups, monitoring clinics are evolved, and they do a lot of monitoring processes like daily, monthly, and master check-ups. To provide multiple services, options, and facilities to their clients the technologies play a vital role in the current era.

. Our System is built to predict the presence of four major diseases such as Heart Disease and Chronic Kidney Disease using Sequential Neural Network Model, Diabetes using K-Nearest Neighbors Classification Model, and skin Cancer Detection using Convolution Neural Network Model. There are several IoT enabled sensors available to sense the patient complete details about a particular person's behavior, human anatomy, and physiology. This will lead the Big data. The Data gained over the sensors are uploaded to the internet, and connected to the cloud server. The affected person records could be saved in the web server and physicians can get right of entry to the data anywhere in the world. Any unexpected variation in the data of the patient who is using the health care system, in evitable the data of the patient will be uploaded to the concerned doctor with immediate notification. This type of health care system will be most useful in rural and remote areas. In this chapter, discuss the Machine learning techniques which are important to the build analysis models. Then how this model is integrated with IoT Technology and provides accurate data of individual person and also discusses the Cardio-vascular problems based on real-time input data.

KeyWords:IoT-Internet of Things ,Monitoring, Sensors ,Anatomy, Physiology, Cardiovascular Heart Disease , Chronic Kidney Disease Skin Cancer, , Diabetes, Neural Networks, Feature Extraction ,Image Processing,

1.Introduction

When people go for physical check-up, the doctor has not only considered the conventional based static and metabolic state measurements, but also consider current health condition of the person. This type of data provided by the IoT technology, are used for making decision about patient diseases. This type of technology used by the physician for diagnosis for a patient's diseases and early intervention of diseases, mainly used in improving the human life time [11]. This novel technology has an influence on healthcare industry and extremely reduction medical costs and increase the speed and accuracy of diagnoses. Based on up-to-date technological trends, one can voluntarily visualize repetitive physical investigation is preceded by a two-to three days of continuous biological one-to-one care using low-cost sensors [12]. Over this pause, the electronic sensors were used to record the vital symptoms of biological constraints and send the report to the doctor /patient and all the information's are stored in cloud server.

Due to the progress of advanced healthcare systems, Nowadays, a massive quantity of data is created by healthcare industries (i.e. like disease identification, patients present condition.,etc). These data are used for build predictive analysis model. Machine learning (ML) technique is used for analyzing data from various perceptions and constricting into valuable information. The most emerging application of ML is finding and forecast of diseases which was discussed in numerous research works. Hence, in this chapter, discuss a various machine learning algorithm, then how they are predictable for the heart disease. Remaining part of this chapter arrangement is explaining the health monitoring system integrated with IoT with various functional sensors and Arduino microcontrollers. In this new technology, sensor are used to Collect data from multiple place of body, analyze the data and afford two communication from patient to doctor anywhere in the world.

2 Literature Survey :

Using Neural Networks they proposed a method for classifying skin lesions into their respective categories. This offers a way to rate complicated data with a high degree of precision. They categorized 463 images into their respective groups, with a high precision rate of 76.9% [1] They had done a lot of work in detection of Melanoma specifically. Moussaet is between different approaches. Al. detected Melanoma using its geometric features and used the k-Nearest Neighbors algorithm to distinguish it from benign lesions. The accuracy rate is 89 percent, the downside is that the dataset was small.[2]

This article gathered the Data Mining and heart disease Awareness number. Information on heart failure, symptoms of heart attack, and causes of heart disease is given.

Recent years, people have awareness in electronic sensors and devices which are commercially accessible for individual health care, capability, and movement. In addition to the part

of capability provided to by current IoT technology, there are many research applications considered in the clinical area. one of the emerging applications is continues health monitoring , recording and communicate the data who is in the remote place also.

For the estimation and treatment of chronic kidney disease they used these data mining classificatory. Rapid miner tool is used in this investigative work. Results obtained a Artificial Neural Network have accuracy of 72.73 percent. [7] In this paper, they had discussed about healthcare, 98% is achieved in the current status of patients healthcare

Sindu Divakaran et al.[6] the proposed diagnostic system which provides dynamic information of a patient report send to the medical professional who have the web enabled system. Priyanka Kakria et al. discuss the “Online telemedicine systems”, It is beneficial for the healthcare services and this system was based on advanced wireless and sensor technologies [7][13]. But this system generates alert messages to the doctor in the critical situations. The advantages of the system are two-way communication is possible between doctor and patient. But patient record data security is not maintained in this work. T. M. Cheng et al [8], in their

work, projected nonlinear controller of feed forward and feedback mechanisms. It was implemented in electronic controlled treadmill system and it was very useful for design of individuals the exercise materials. But dynamic model may be needed to describe at higher intensity exercises.

3 Existing healthcare monitoring system

Predictions of various diseases are done already. But they have failed to meet the accuracy level. And this occurs due to the choice of Machine Learning models. The Dataset used were also very limited. Even if the models were constructed, they were not available with user interface, and were not user friendly. A normal person felt difficulty in accessing it. Some of the existing system can show only the symptoms of diseases, they don't have the capability to analyze and generate reports regarding health issues in an individual. Only a limited number of health issues are taken into consideration, due to which proper awareness was not created among people.

Health related checkups are available but they are more expensive which makes the rural people less affordable. The electronic healthcare system needs a set of events consider to maintain the health monitoring system. Many sensors are required to provide real time data. so structural integrity valuations are need to integrated system. Yuehonget. Al [9] discuss the several survey in technologies specially medical environment. This is used to progress and support the present technologies of health care services. Among the various techniques IoT have played a vibrant role to communicate the available medical resources and provide smart health care services. They discuss the challenges of digital component and communication between the electronic device and human behavior. Liang et al. proposed problem of the sensor in a extensive sensor network and projected diagnostic and reconfiguration reasoning system [10][14] Methodology and data analysis

The novel healthcare monitoring system used to improve the traditional healthcare system in the patient information gathering which is from the digital sensor and IoT device. Machine Learning algorithm are used in this method to build analytic models. These analytic models are used in the

health monitoring system.

Based on the previous research work, three different ML algorithms were implemented on the Heart Disease related dataset. R programming tool is used to detect the probability of heart diseases analysis.

4 Proposed System Architecture

The block diagram of the proposed model is as exposed in Figure 1. It explains all the digital components like the Arduino microcontroller, which is used to relate to the internet of the system. Also explain the techniques and tools are used for developing the complete arrangement. To develop a prediction system, a software tool is used to train with real-time datasets and analysis with many machine learning algorithms. We have proposed a system that will integrate all these disease prediction. It has a single user interface, such that people who have the symptoms of any one of these diseases can easily access their Personal HealthCare Companion through internet and can get to know whether they have the disease or not through predictions. The high accuracy ML algorithm is selected, and implemented in the predictive system for detecting and disease like heart disease risk level. In the system, different digital components like various biomedical sensors, IoT device LCD, buzzer, etc. are connected.

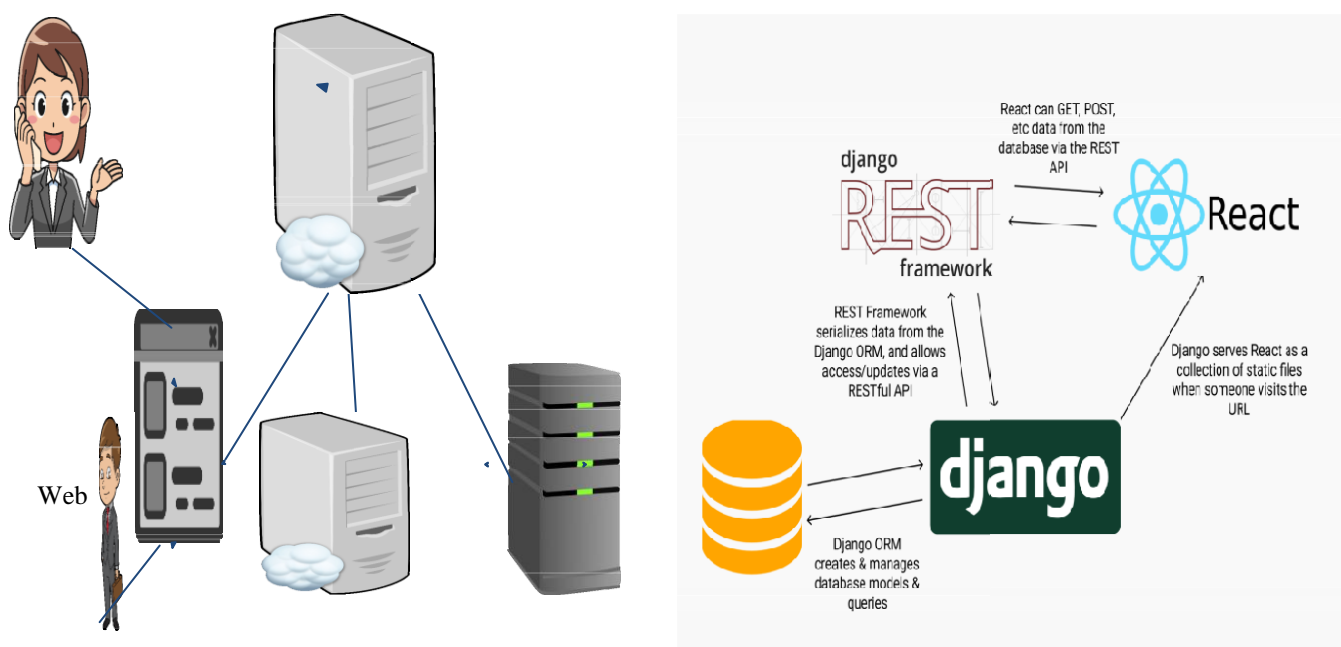


Figure 1. Block diagram of the proposed model

5.1 TECHNOLOGY USED

In our proposed work, web service REST API using Django

5.1.2 Django Rest framework

Django Rest framework is powerful and flexible toolkit for building Web APIs. Main advantages are Simplicity, Flexibility, quality, and test coverage of source code. Powerful serialization engine compatible with ORM and non-ORM data sources. Pluggable and easy to customize emitters, parsers, validates and authenticators.

5.1.3 React JS

React JS is an open source JavaScript library, which is used primarily for single- applications to create user User Rest API (Web service). interfaces. It's used for web and mobile devices screen layer handling. React also lets us create reusable UI components React lets developers build massive web applications that can alter data without reloading the page

5.1.4 Python Library

Keras is a Python-written Neural Network Library that is high in design-making it incredibly easy and intuitive to use. It works as a wrapper to low-level libraries like tensor flow written in python.

Scikit learning is potentially the most powerful machine learning library in Python. This collection contains many effective machine learning and statistical modeling resources including classification, regression, clustering, and reduction in dimensionality

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5.1.5 Heart disease

This dataset includes a variety of variables, along with a target condition of having heart disease or not. There are 13 features are available in this dataset We will try to use this data to create a Sequential Neural Network model which tries predict if a patient has this disease or not. The "goal" field refers to the patient's existence of heart

5 Machine Learning Approach

Machine learning leads to intelligent approaches used to improve performance of the system using example data or previous experience(s) through learning. More exactly, ML algorithms developed models of behaviours using mathematical techniques on huge data sets. **There are many** tools publicly available to implement machine learning algorithms. Some recent open source tools are WEKA tool for data mining applications, MATLAB for mathematical applications and R programming for data science application used. Based on the previous researchwork, the following machine learning algorithms, Multiple Linear Regression Algorithm, Random Forest, Support Vector Machine are considered in this chapter.

Multiple Linear Regression Algorithm

This Algorithm is used to find the association between the variables and also find the predict the future. Predict the value of one dependent and predicted variable on the basis of other independent variables. The equation that denotes linear relationship between two variables a and b are:

$$b = \beta_0 + \beta_1 a$$

When $a=0$, then the value of intercept is the value of b . When $\beta_0=0$, then the b is directly proportional to a . When $\beta_1=0$: then Y is a constant, there is no relationship between b and a . Consider two or more quantitative and qualitative variable ($a_1, a_2, a_3 \dots a_n$) to predict a quantitative but dependent variable b . The output is the function model to predict the dependent variable with a new set of independent variables. A straight line is drawn, fitted to the data. Find the relationship between the two or more quantitative and qualitative variable ($a_1, a_2, a_3 \dots X_n$) and the dependent variable b to generate a regression model for predict the future values of b .

Random Forest Algorithm:

This is the one of the most powerful and well-known learning algorithm in ML. This algorithm is also called Bagging or Bootstrap Aggregation algorithm. In order to valuation the sample data such as mean, the bootstrap is a very powerful statistical method. Using training data, frequent models are measured and for every data sample the models are created. For the prediction model, each prediction model is averaged and get an improved the output value.

Support Vector Machine:

SVM is a supervised learning algorithm, used to perform classification and regression analysis model. They analyses the large amount of data and perform classification by making parallel lines between data. [16,17] It splits the single line to generate flat and linear partitions also called hyper plane. These hyper planes have the prime margin in a high-dimensional space to isolated given data into various classes. The margin between the two classes denotes the distance among the adjoining data points of the classes. So hyper-plane is used to create the classification of various the data points. Figure 2. Shows the sample Classification can be made by the hyper-plane among the two classes. Select the hyper-plane which is used to isolates the two classes. [18] In the figure 2. Shows the various available hyper- planes A, B and C and these are used to classify the data points into various modules.

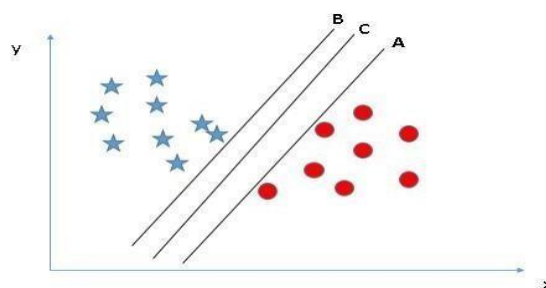


Figure 2. Classification using hyperplane

Data Source Module

In this work two data sets heart disease data bases and C level and Heart Disease dataset[2] are used in this work because, they have same type of features. These datasets are combined to create new larger dataset.[19,20]After the preprocessing implementation, 566 instances are used in this work for model validation. In this work, machine learning algorithm Multiple Linear Regression Algorithm, Random forest Algorithm and SVM Algorithms are used for classification of data and predictive model are created for the effective identification of Heart related diseases and the performance of algorithms were evaluated in terms of accuracy.

Attribute Documentation

In this work, attributes like age, sex, chest pain type etc. are consider for the implementation of prediction system of heart diseases. patient's mobile number is used as a key attribute (*i.e.* unique identifier). Attributes are play the important role to analysis the diseases.[21]

Performance Analysis of Machine Learning Algorithms module

Machine learning algorithm which mentioned above are implemented in the R programming Environment on new renewed dataset. Using 10-fold cross validation method, the performance of all the algorithm are analyzed. [22,23] The best five experimental results have been displayed in the figure.3, figure.4,figure.5 and figure 6. From the experimental, it has been observed that the SVM provides better results on the renewed dataset.

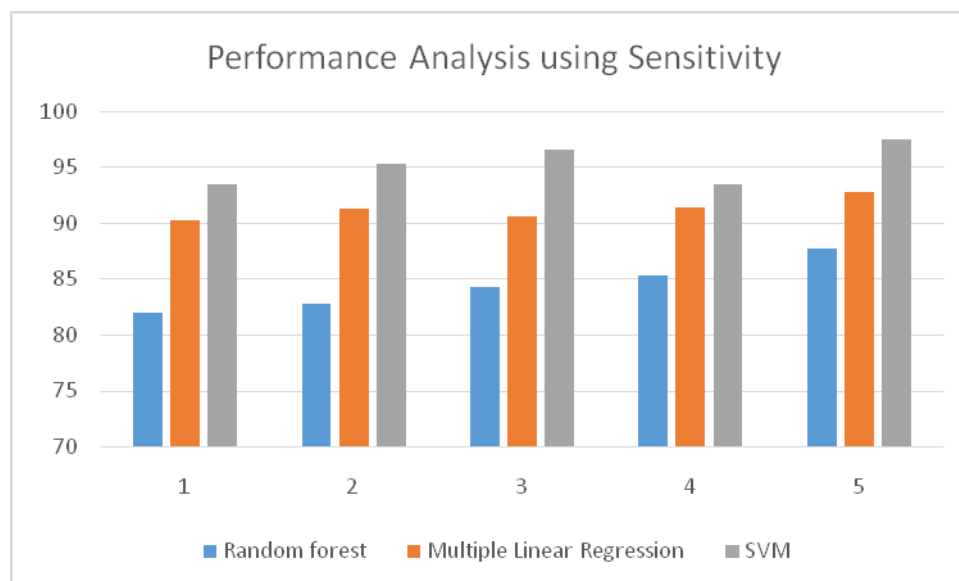


Figure 3. Performance Analysis using Sensitivity

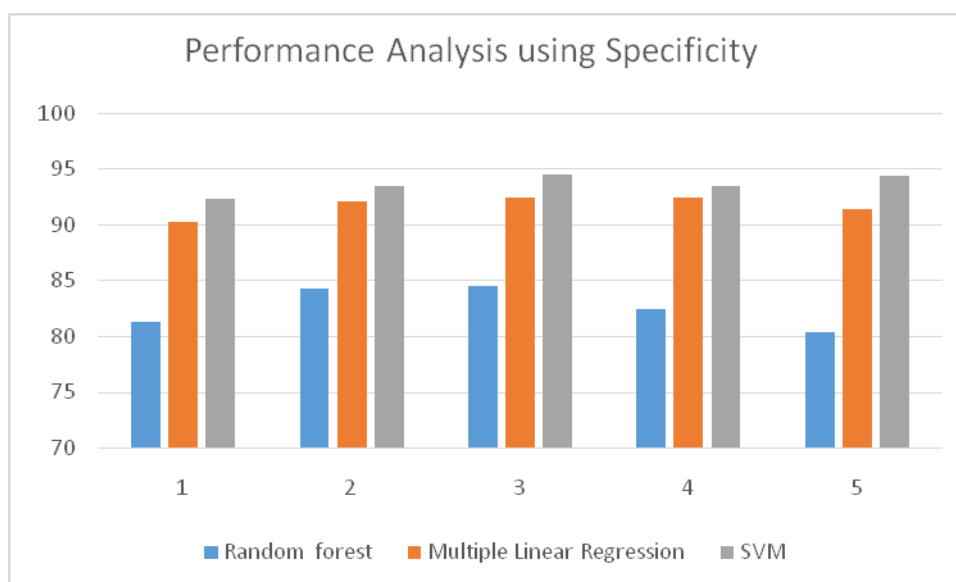


Figure 4. Performance Analysis using Specificity

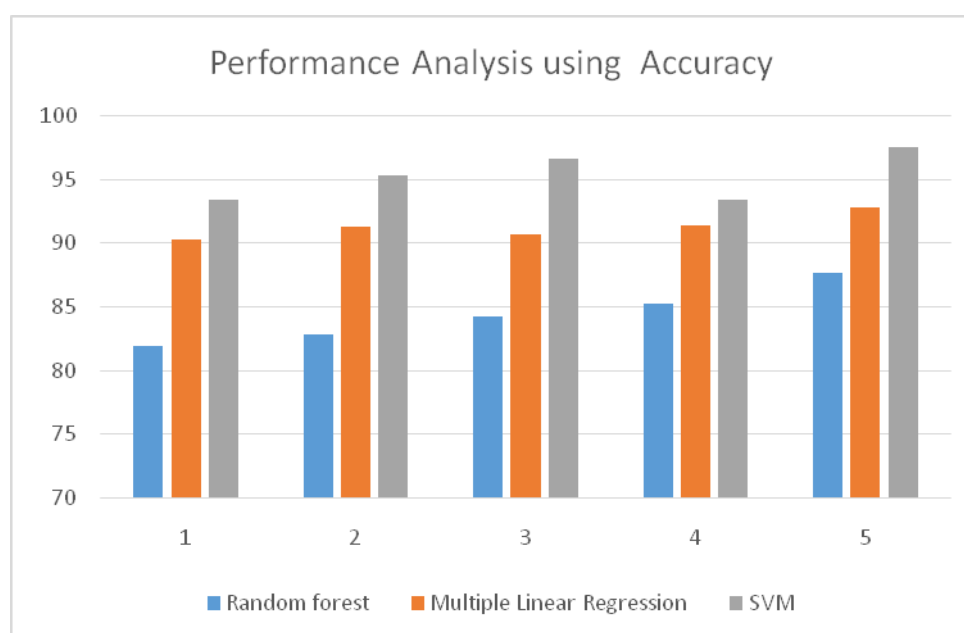


Figure 5. Performance Analysis based on Accuracy (%)

6 System Design of Health MonitoringSystem

Systems design is explaining the overview of proposed architecture and interfaces of the application and UML (Unified Modelling Language) is used to model system designs.

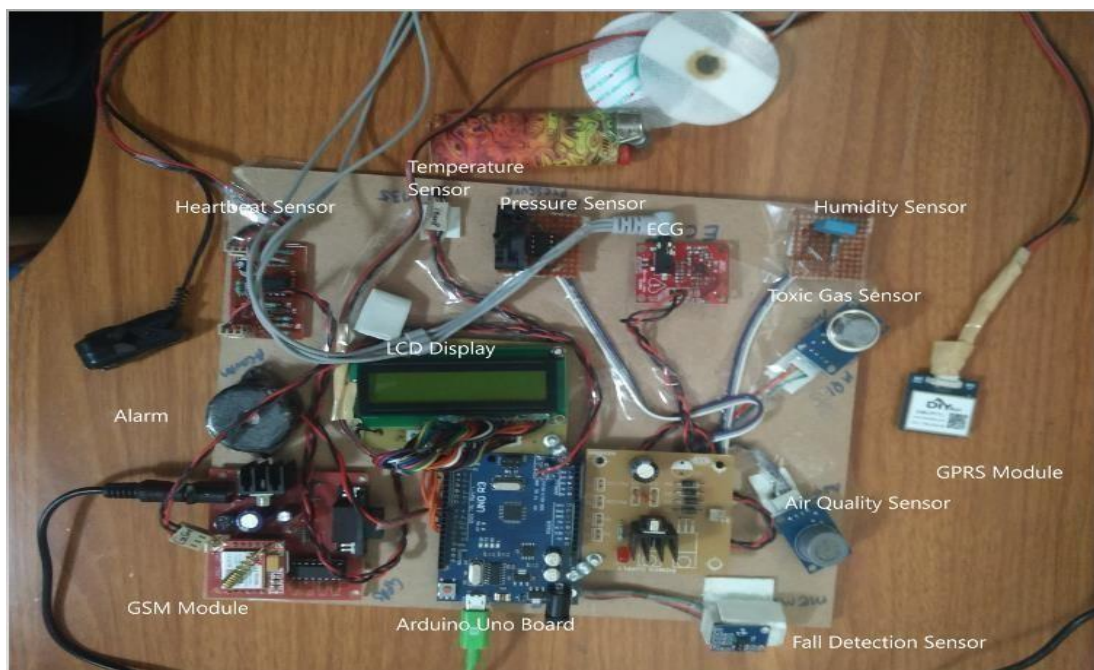


Figure 6. Overview of architecture and interfaces of a system

Figure.8 shows the complete hardware setup includes sensors like Heartbeat sensor etc. The microcontroller board Arduino/resberry pi and GPRS modules are used to communicate with cloud server. For information sharing between patient and doctors, electronic device like mobile, LCD display are used. Any abnormal value found in the data immediate notification communicate to the doctor and patient via communication media. Table 1 shows the some of the example of about the condition of patient which is used to make the decision about the heat diseases.

Table.1 Patient's condition for decision making

| Temperature | Humidity | Human awareness | Pulse rate | Action taken | Risk Level |
|-------------|------------|-----------------------------------|--------------------|----------------------|------------|
| <37°C | 41%-46% | Normal | 60-100 | Not Need | Normal |
| >38°C | 41% - 46% | Abnormal for above age persons 50 | 40-60 or 100-120 | Notify caretakers to | Medium |
| >38°C | 46% - >52% | Abnormal body condition | 40- 60 or 100- 120 | Inform to doctor | High |
| >38°C | 46% - >52% | Abnormal body condition | 40- 60 or 100- 120 | Need Emergence care | Emergency |

Sequence Diagrams are also called interaction diagrams,[24] it will give the detailed operations of the application. In the diagram vertical axis of represent time of messages are sent to the other objects. Figure 7 illustrate the sequence diagram of system design

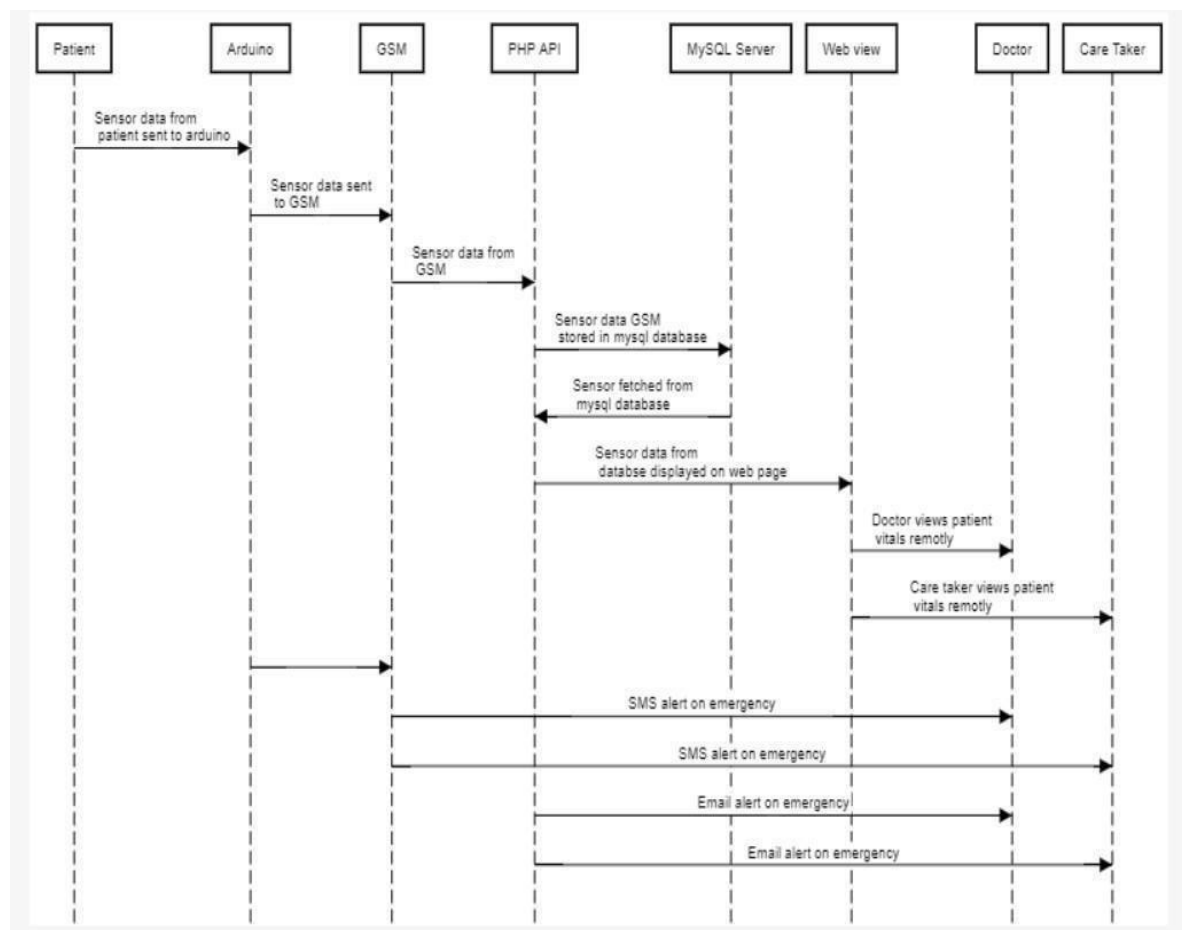


Figure 7 .Sequence diagram of system design

7 Conclusion

As technology keeps improving, our improving as well. Standards keep Predictions would be of great help when it comes to the health of a person. Since we have a combination of prediction algorithms all in a capsule, the benefit is that we get is massive. Machine Learning will be a part of every individual's life in future. This would be a better way to keep track of your health. In the current pandemic COVID-19, effective and dynamic healthcare data analysis and decision is needed on patients 'health record. ML Techniques are used to develop the analytic models and these models are integrated to IoT based health monitoring system to improve the performance of the health care system. From the above analysis SV M algorithm, exposed better accuracy rates of more than 90 percent, this algorithm may be considered for medical applications to disease detection and prediction purpose. But

Compare to the previous research work, even though the number of features is reduced, the SVM algorithm performance was good with renewed dataset. Therefore, it is significant that SVM is the most effective ML algorithm to be implemented on medical application system.

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