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## “Title of the Experiential Learning”

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Month, Year

# Certificate

This is to certify that the project titled **“AI and IoT based heart health screening system”** is a record of the bona fide work done by **Ayush and Sonam** (Reg No:209301457,209301273) submitted for the partial fulfilment of the requirements for the completion of the Experiential Learning (DA1001) course in the Department of \_\_CSE\_\_\_\_\_ of Manipal University Jaipur, during the academic session July-November 2021.

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# AI and IoT Based Heart Health Screening System(AIHHSS)

# Abstract

Cardiovascular diseases (CVDs) have now become the leading cause of mortality in India. These diseases contribute approximately 25% of the total mortality rate. Among all causes of heart diseases, ischemic heart disease and heart strokes are responsible for 80% of deaths. The death rate due to CVD is higher in India than the average death rate across the globe. We developed a framework in this exploration that can understand the principles of predicting the risk profile of patients with the clinical data parameters. The proposed model is constructed using machine learning techniques and IoT devices. Parameters such as temperature, heartbeat, pulse rate can be measured using IoT devices and prediction on this data is made by using machine learning algorithms. This system is low-cost solution for the people of remote areas. They can use it to find out whether they are suffering from a serious heart issue and cure it accordingly by contacting near hospitals. Results of the experiments also show that the proposed system is efficient and intelligent enough to provide health facilities.

# Introduction

# Health related issues are increasing day by day, among which heart diseases is top listed. Heart diseases are more prevalent in men than in women. According to statistics from WHO, it has been estimated that 24% of deaths due to non-communicable diseases in India are caused by heart ailments. One-third of all global deaths are due to heart diseases. Around 17 million people die due to cardiovascular disease (CVD) every year worldwide, and the disease is highly prevalent in Asia. Age, sex, smoking, family history, cholesterol, poor diet, high blood pressure, obesity, physical inactivity, and alcohol intake are considered to be risk factors for heart disease, and hereditary risk factors such as high blood pressure and diabetes also lead to heart disease. Some risk factors are controllable. Apart from the above factors, lifestyle habits such as eating habits, physical inactivity, and obesity are also considered to be major risk factors. There are different types of heart diseases such as coronary heart disease, angina pectoris, congestive heart failure, cardiomyopathy, congenital heart disease, arrhythmias, and myocarditis. It is difficult to manually determine the odds of getting heart disease based on risk factors. Monitoring heart health by wireless technology is a modern concept. Wearable sensors and portable remote health system are efficient in monitoring health parameters. However, machine learning techniques are useful to predict the output from existing data. Hence, this project applies machine learning technique for predicting heart disease risk and determining the values of parameters using IoT devices.

# Literature review

An extensive analysis of existing literature in the field of disease diagnosis and visualization by using machine learning techniques gave insights about technological solutions. Various teams of researchers worked in the field of heart disease diagnosis using IoT and machine learning.

Kanchan Katake et. al [1] proposed a real time diagnostic system for remotely located heart prone patients to measure heart rate, blood pressure, and body temperature using biomedical sensors. They used the publicly available dataset at the UCI Machine Learning Repository and real time data collected via ECG sensor, temperature sensor, Pulse rate sensor etc. This system can simultaneously monitor multiple parameters onto a single chip integrated with wearable devices were.  This data is sent to Arduino and a cloud server. The Recurrent Neural Networks (RNN) based model was used to determine the local and temporal dependencies among data attributes and to accommodate variable sequence lengths. It can receive the values of parameters in a sequence as inputs and can produce corresponding sequences of values as outputs. The authors claimed that their system achieved the highest accuracy of 92%. Thus, their approach is useful to analyse the data and to make predictions from the data. Also, it can send alerts to the patient in the form of SMS, Email etc. as soon as the value(s) of parameter (s) exceeds the present threshold.

Chao Li along with Xiangpei Hu et. Al[2] proposed a health monitoring system for the data acquisition and transmission. The system continuously monitors the physical parameters viz.blood pressure, ECG, SpO2, heart rate, pulse rate, blood fat, blood glucose and environmental indicators viz. Room temperature, humidity etc. Further, it provides four modes for data transmission. Its first mode facilitates the real-time transmission of data, second mode supports the periodic transmission, third mode allows the event triggered transmission and the fourth mode transmits the data only on the demand of patients. However, the system is efficient in real-time data collection and transmission, but it does not provide any mechanism for the data interpretation and decision making.

Priyanka Kakria et. al [3] proposed a real-time diagnostic system that can remotely monitor heart disease prone patients. The system makes use of wearable sensors to collect the values of heart rate, blood pressure, and body temperature. Now, it employs the Fuzzy logic algorithms to interpret the data and diagnose the diseases such as bradycardia, tachycardia, hypertension, hypotension, fever, and hypothermia. Further, it provides an interface to patients via an android handheld device and a web portal. The system also sends the alert when the values of parameters exceed the pre-set threshold. But, the system is prone to generate false alarms due to the battery issues of sensors and smartphones. Also, the poor signal strength can lead to delay in alert generation and transmission.

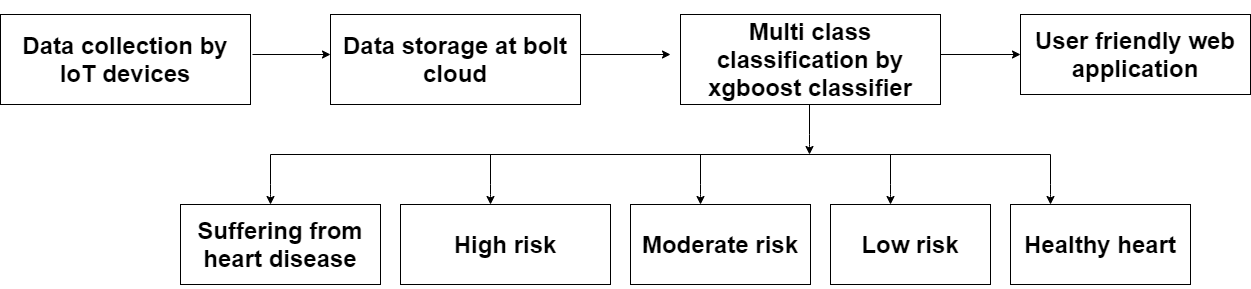
Md.Milon Islam et. al  [4] proposed a system for continuous monitoring of patients and her or his room conditions. It comprises a sensor module, data processing module and web user interface. The sensor module comprises a heart beat sensor to measure change in blood volume, ‘LM35’ sensor for monitoring the body temperature, ‘DHT11’ for sensing the room temperature and humidity level, ‘MQ-9’ sensor for detection of gases viz. Liquified Petroleum Gas(LPG), Carbon Mono-Oxide (CO), and methane (CH4), and ‘MQ-135’ sensor for testing the air quality. The sensor module collects the data and transfers it to the data processing module comprising ESP32 with an inbuilt Wi-Fi module. The ESP32 module processes the data and sends it to the gateway server. The third module of the system involves the web user interface. It uses ThingSpeak for the graphical interpretation, display of results, and process of transactions. The authors claimed that their system reported the highest error rate of 4.28%, 0.81%, and 3.07% in monitoring of heart rate, body temperature and room humidity respectively. Although the system is easy to use for a medical staff, it does not provide the option for tele-consultation. Also, the bulkiness of the system works as a hindrance in its use for real-time monitoring. Further, the password protected access of data does not ensure the security of the data collected at the server.

# Methodology

This project focuses on designing and developing an AI and IoT based Health Screening System (HHSS). The system will monitor the body parameters such as blood pressure, blood glucose level, temperature and heart rate using IoT sensors and send the collected data to the cloud. Machine learning algorithms make predictions of heart health. Algorithm used in our proposed system is Convolutional Neural Network [CNN]. These algorithms perform automatic pre-processing, feature extraction, multi class classification and evaluation. Thus, minimizes human intervention. It will notify the person in case of deviation from the standard values of body parameters. The degree of emergency will be decided by setting a threshold for different body parameters on consulting the specialist doctors for respective diseases.

The sensor module comprises a heartbeat sensor to measure change in blood volume, ‘LN35’ sensor for monitoring the body temperature sensor to evaluate cardiac rate and rhythm. The sensor module collects the real time data and transfers data to the bolt cloud server. Different machine learning models are trained on this data and the one with highest accuracy is used. Authenticated dataset from Kaggle was used for training models. We trained multiple regression models and acquired the highest accuracy of the CNN supervised classifier for making the ranking based predictions. It reported approximately 97% accuracy. We are working on further improving its accuracy. Flask was used to connect it with a user-friendly web application. Users have the option to enter their health parameters if they have reports from the laboratory or it can be checked by your hardware. The person can log in our web app and can enter the details. Machine learning model analyses this data and makes the predictions into five classes viz. low risk, moderate risk, high risk, healthy or diseased heart.

In this report, we proposed the system for diagnosis of heart health. The working of the proposed system is demonstrated in figure.

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# Results and Discussions

System enables to collect real time data using IoT devices.

CNN multi class classification model predicts the risk of heart disease with the accuracy of about 97%.

System can be accessed even at remote locations.

It is a low cost and eco-friendly solution for heart patients.

It can act as an intelligent assistant to doctors.

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# Probability of heart disease based on gender.

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**Data visualization of heart disease patients in dataset.**

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# Conclusions and Future Work

Heart disease is one of the corners for society. In this project we developed a self-operating diagnosis model for heart disease detection using IoT and machine learning. It is efficient in collecting real time data of patients. This work will be useful for identifying the patients who suffers from heart disease. This data can be visualized and help in increasing the accuracy of model. Family history of heart disease is also a reason for developing heart disease, hence this information of the patient can also be included in the dataset which improves the accuracy of the model.

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