VISVESVARAYA TECHNOLOGICAL UNIVERSITY

Jnanasangama, Macche, Santibastwada Road
Belagavi-590018, Karnataka

A
Project work Phase-1 Report
on

HeartSage: An Advanced ML Predictive Analytics System for Cardiovascular Health

Submitted in partial fulfillment of the requirement for the degree of
Bachelor of Engineering
in
Electronics & Communications Engineering - ECE
by

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Under the guidance of
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DAYANANDA SAGAR COLLEGE OF ENGINEERING
Department of Electronics &Communication Engineering
(An Autonomous College affiliated to VTU Belgaum, accredited by NBA & NAAC, Ranked by NIRF)
Shavige Malleshwara Hills, Kumaraswamy Layout,
Bengaluru-560078, Karnataka, India

2023-24

Project work Phase-1(19EC7ICPR1) Declaration

Certified that the project work entitled, "……..

……..…….." is a bonafide work that is carried out by ourselves in partial fulfillment for the award of degree of Bachelor of Engineering in Electronics & Communication Engg. of the Visvesvaraya Technological University, Belagavi, Karnataka during the academic year 2023-24.

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Place : Bengaluru -78

Project guide

_____ _____

Signature **HOD**,**ECE**

Dr. Suma M R

ABSTRACT

Public healthcare has been paid increasing attention given the exponential growth human population and medical expenses. It is well known that an effective health monitoring system can detect abnormalities of health conditions in time and make diagnoses according to the gleaned data. As a vital approach to diagnosing heart diseases, ECG monitoring is widely studied and applied.

In this project, we propose a new method for ECG monitoring based on Internet-of-Things (IoT) techniques. ECG data are gathered using a wearable monitoring node and are transmitted directly to the IoT cloud using Wi-Fi. Both the HTTP and MQTT protocols are employed in the IoT cloud in order to provide visual and timely ECG data to users. Nearly all smart terminals with a web browser can acquire ECG data conveniently, which has greatly alleviated the cross-platform issue.

The key components of this Project includes a ESP32 Module, a cloud platform (e.g., AWS, Azure, Google Cloud) for data storage, analysis, and deployment of the machine learning model. Implement an alerting system that can notify users and healthcare professionals when the model predicts a high risk of cardiovascular disease

.

To ensure robustness and accuracy, the system needs to deploy the machine learning model on the cloud platform so that it can make real-time predictions based on incoming data.Regularly update and improve the model as more data becomes available and research advances in cardiovascular disease prediction and Collecting the feedback from users to improve the user interface and enhance the system's usability.

Once Experiments are carried out on healthy volunteers in order to verify the reliability of the entire system. Experimental results reveal that the proposed system is reliable in collecting and displaying real-time ECG data, which can aid in the primary diagnosis of certain heart diseases.

The making of such system involves expertise in IoT, machine learning, data engineering, and cloud computing. Additionally, it's crucial to collaborate with healthcare professionals to ensure the model's accuracy and its compliance with medical standards. Data privacy and security should be a top priority throughout the development and deployment process. Creating a methodology for an IoT cloud-based cardiovascular disease predictor using machine learning involves a structured approach that encompasses various phases, tasks, and considerations.

CONTENTS

1. Introduction

Heart diseases are becoming a big issue for the last few decades and many people die because of certain health problems. Therefore, heart disease cannot be taken lightly. A cloud-based mobile ECG monitoring service was demonstrated. These can detect ECG signals using a sensor and communicate them to a screen using wireless transmission systems like Bluetooth, Low - power wireless, and Wi-Fi. An ECG monitoring device that can be worn on the body and delivers data directly to the IoT cloud through Wi-Fi without the use of a mobile terminal is available. This system still has flaws, such as the requirement for a good internet connection so that doctors may access it at any time. presented a system that can send messages to users and doctors if a deformity is discovered following an ECG analysis.

a. *Data Collection Network*
b. *Data Storage and Display*
c. *Cloud Server*
d. *Graphical User Interface (GUI)*

As a result, a new era of smart, proactive healthcare would emerge, especially given the significant obstacle of limited medical resources. By 2020, the Internet of Things (IoT) will have grown to the point where it will be possible to converse with about a billion connected gadgets over the internet.

1.1 Problem Statement:

- Cardiovascular diseases, including heart disease and stroke, have reached epidemic proportions, becoming the leading cause of death worldwide.
- Advance self-diagnosis capabilities for individuals concerned about their cardiovascular health.
- The early detection not only reduce the cost but also improves the quality of life.

1.2 Objective:

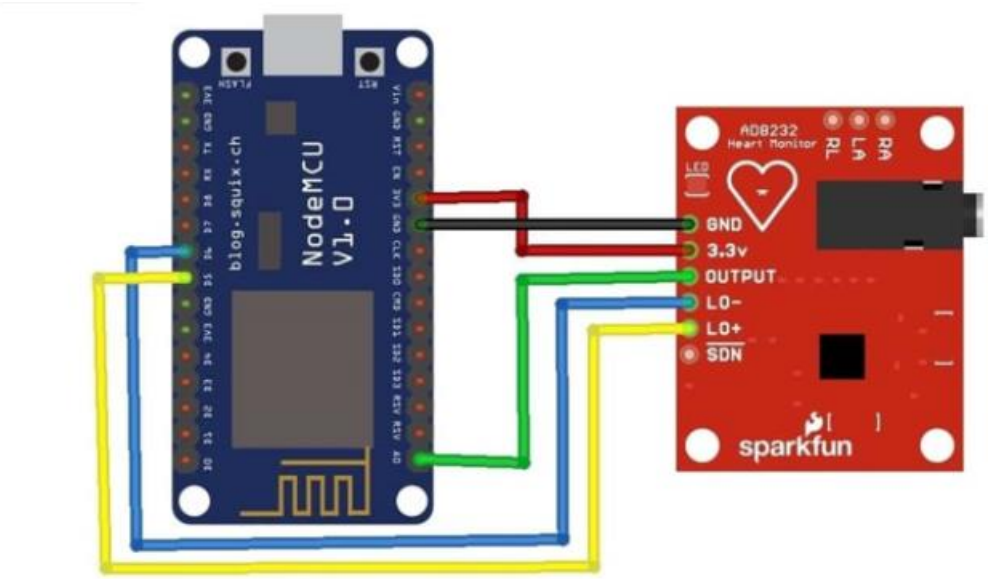
- The primary objective of a cardiovascular health management system is to predict the likelihood or risk of an individual experiencing cardiovascular health issues based on various parameters, data, and risk factors.

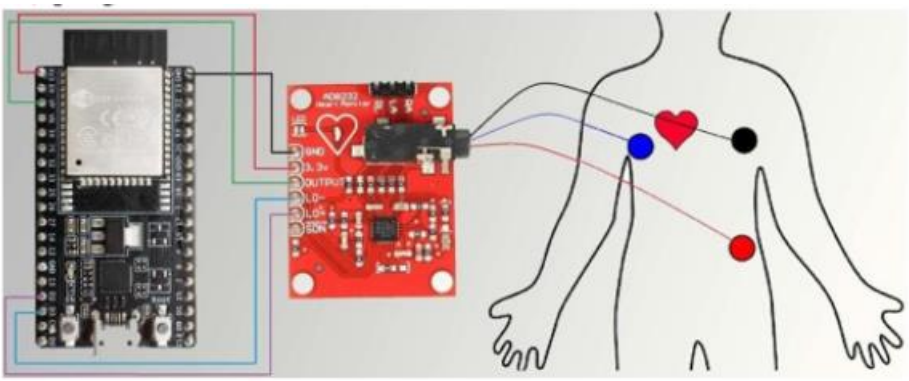
- Provide tailored recommendations and guidance to individuals to make lifestyle modifications that can reduce their risk of a heart attack, such as dietary changes, exercise routines, stress management, and smoking cessation.
- Optimize healthcare resource allocation and efficiency by focusing resources on high-risk individuals, leading to better management and outcomes in cardiovascular care.
- Evolve the prediction system continuously by incorporating the latest medical knowledge, technological advancements, and data analytics techniques to enhance predictive accuracy and relevance.

2. Literature Review

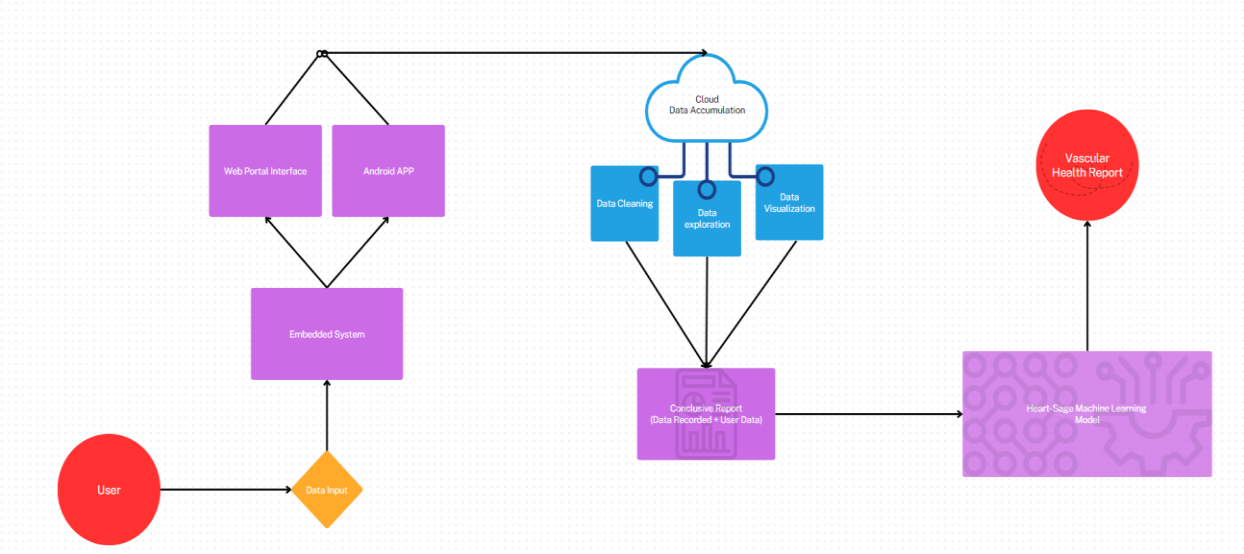
Title	Authors	Focused on	Disadvantage
Using PSO algorithm for producing best rules in diagnosis of heart disease. [2017]	H. Alkeshuosh, M. Z. Moghadam	PSO used in this model is a less complex algorithm	Slow convergence in the refined search stage.
Backpropagation neural network for prediction of heart disease. [2013]	J. Theor	The paper uses a publicly available dataset.	The model is based on a single dataset.
Heart diseases prediction with data mining and neural network techniques. [2018]	B. S. S. Rathnayakc and G. U. Ganegoda	This paper compares the accuracy and error rate.	The paper only presents a survey of different data mining and neural network techniques
Identification of significant features and data mining techniques in predicting heart disease. [2019]	M. S. Amin, Y. K. Chiam, K. D. Varathan	The paper uses a dataset of 13 medical attributes and evaluates the performance of seven data mining methods	The paper does not compare its results with other existing studies on heart disease prediction.
Heart Attack Probability Analysis Using Machine Learning. [2021]	A. A. Shanbhag, C. Shetty, A. Ananth, A. S. Shetty, K. Kavanashree Nayak and B. R. Rakshitha	Accuracy of prediction with highest value of accuracy as 85.7% for SVM model.	Only single SVM algorithm used in the model.

3. Block Diagram/Schematic





4. Methodology

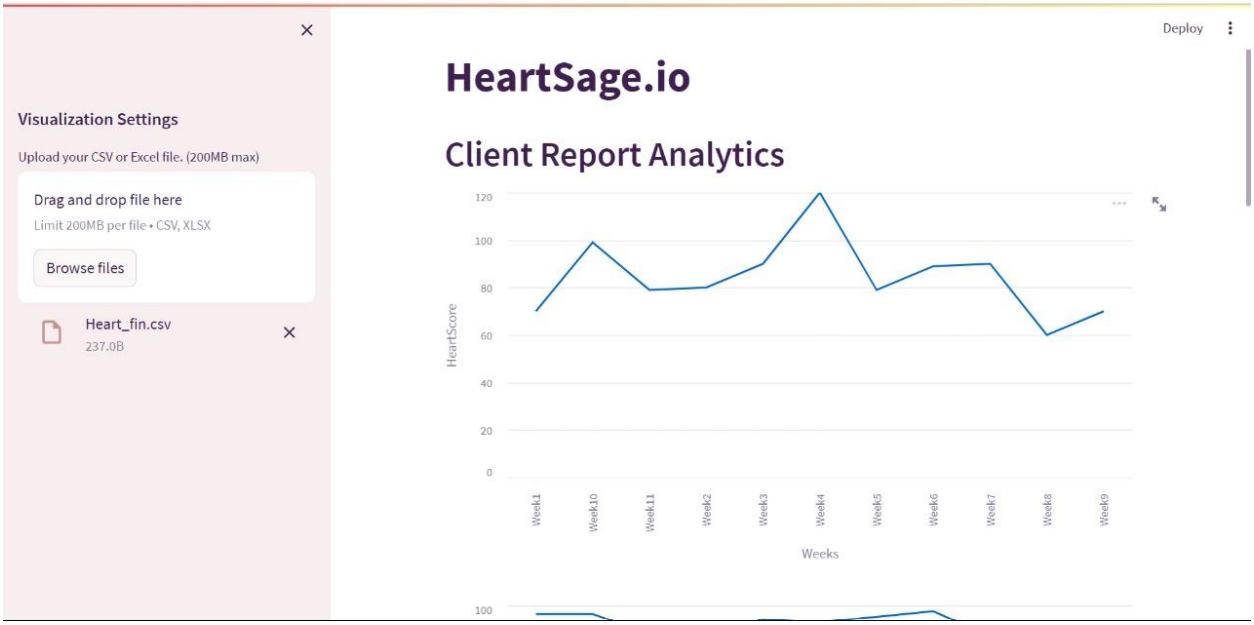


5. Tools

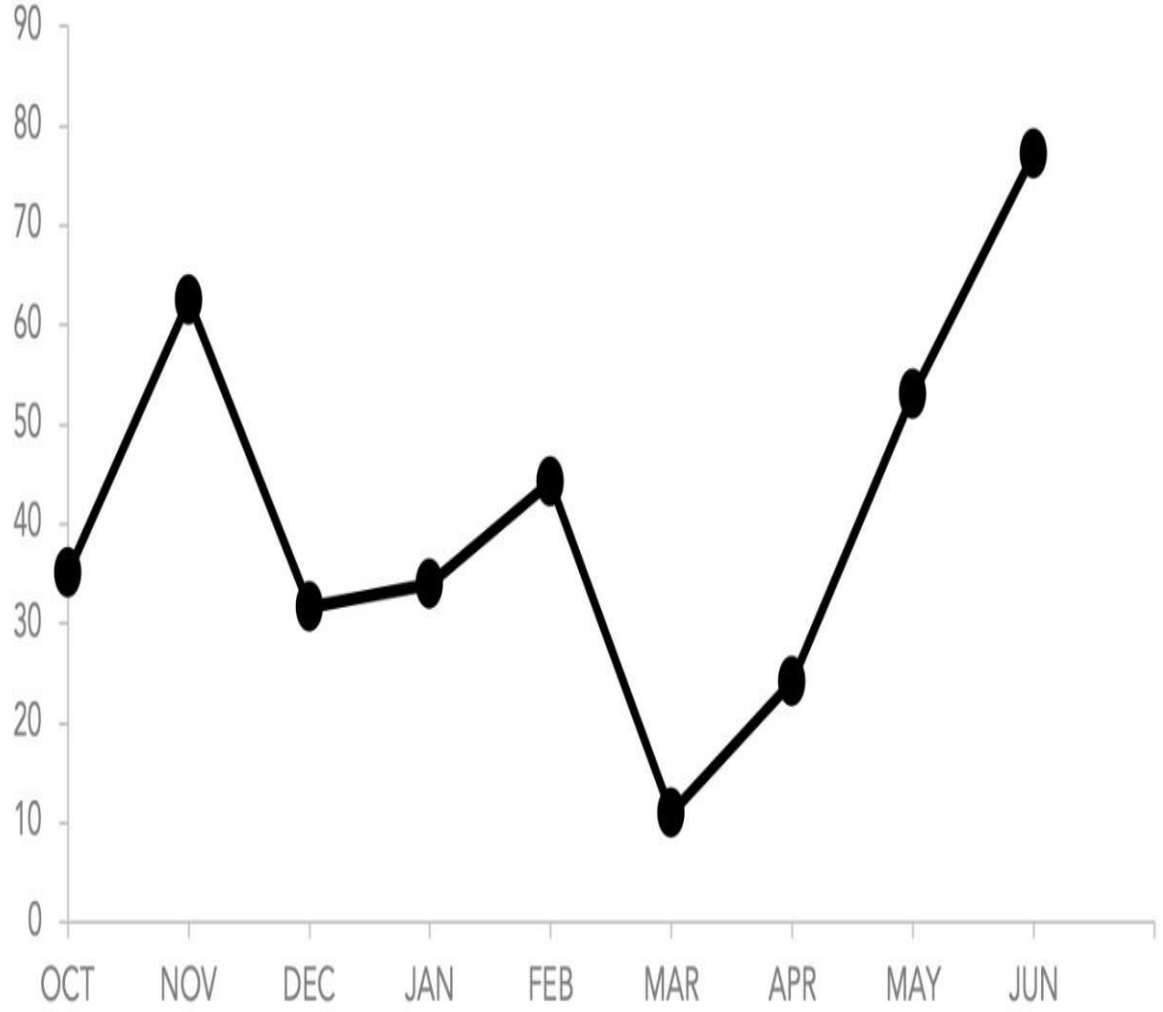
- Technology –
  - Ubidots
  - Arduino IDE
  - Streamlit
  - Pandas
  - Visual Studio
- Hardware –
  - Arduino UNO
  - ESP32 devkit
  - OLED display
  - MAX 30100
  - ECG sensor

6. Results

Current results Phase-1



7. Expected Results:



The above graph shows the past health score records of the person.

This is a cumulative heart score that is calculated by considering several parameters.

8. Applications:

- **Personalized Healthcare Plans:**
  Heart attack prediction systems can aid in creating personalized healthcare plans for individuals based on their risk levels.
- **Preventive Health Screenings:**
  Health institutions can use these systems to identify high-risk groups within the population for targeted preventive health screenings.
- **Health Insurance Assessment:**
  Health insurance companies can utilize these systems to assess the risk of potential policyholders, leading to more accurate risk assessment and appropriate premium adjustments.

9. Conclusions

HEARTSAGE: AN ADVANCED ML PREDICTIVE ANALYTICS SYSTEM FOR CARDIOVASCULAR HEALTH**:**

Integration of healthcare with IoT has opened up a vast arena of development. It will not only facilitate healthcare but will also find out new measures to prevent diseases by processing data and by analyzing global trends. Moreover, a vast future lies entirely in the automation of hospitals and treatment mechanisms that can help doctors understand diseases through artificial intelligence and IoT. However, we should take a step at a time and not rush in into this field, since it deals with human health and safety and security needs to be the top agenda. On a large scale, this can also lead to cheaper treatments and cheaper nursing costs for patients. If technology and health go hand in hand, we can reach the goal of cheap, safe, and efficient disease prevention and treatment.

References

- V. Sharma, S. Yadav and M. Gupta, "Heart Disease Prediction using Machine Learning Techniques," 2020 2nd International Conference on Advances in Computing, Communication Control and Networking (ICACCCN).
- J. S. Rose, P. Malin Bruntha, S. Selvadass, R. M. V, B. C. Mary M and M. J. D, "Heart Attack Prediction using Machine Learning Techniques," 2023 9th International Conference on Advanced Computing and Communication Systems (ICACCS).
- M. Neyja, S. Mumtaz, K. M. S. Huq, S. A. Busari, J. Rodriguez and Z. Zhou, "An IoT-Based E-Health Monitoring System Using ECG Signal," GLOBECOM 2017 - 2017 IEEE Global Communications Conference.
- O. Y. Tham, M. A. Markom, A. H. A. Bakar, E. S. M. M. Tan and A. M. Markom, "IoT Health Monitoring Device of Oxygen Saturation (SpO2) and Heart Rate Level," 2020 1st International Conference on Information Technology, Advanced Mechanical and Electrical Engineering (ICITAMEE).

PO and PSO Mapping for Project - 2023-24

Batch Number:

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1DS20EC116	Neeraj Jain
1DS20EC197	Smarak Mishra
1DS20EC214	Suryansh Devasthali
1DS20EC215	Suryansh Saha

Guide Name:

Justification for PO & PSO mapping for Project

Project Title		
PO▼	**Levels 3/2/1**	**Justification**
PO1	3	Engineering knowledge is applied through various electronic circuits and application of algorithms.
PO2	1	Problem analysis is justified accordingly.
PO3	2	An accessible solution is designed in accordance to certain algorithms.
PO4	1	Investigation of complex problems is done and result is to find out an accessible solution.
PO5	3	Modern tools are used such as sensors, python libraries, Arduino etc.
PO6	3	This solution improves the society by developing a solution to maintain day to day health.
PO7	1	Environment and sustainability is justified.
PO8	1	Ethics is justified by developing a solution in accordance to professional ethics and responsibilities.
PO9	2	Full team has dedicated their resources to develop a solution.
PO10	3	Necessary communication was done by conducting team meetings to discuss solutions.
PO11	2	Project management and finance was justified by principles.
PO12	2	Life long learning is achieved by future working this solution.
PSO1	3	Electronic circuits and systems are designed using current practices and standards.
PSO2	3	Hardware and software knowledge is applied.

Signature of Guide

Budget Estimation

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Guide Name:

Sl. No.	Particulars	Estimated Cost in Rs.
1	Max 30100 Pulse Sensor	150
2	ESP32D PCB Module	340
3	OLED 1.3”-White	350
4	Arduino UNO R3-Compatible Clone	500
5	HC05 6pin Bluetooth Module	225
6	ECG Sensor Module AD8232	450
7	Breadboard 800 Points GL-12	120
8	Data Transfer USB Cables	250
9	Data Transfer Printer Cables	200
10		
11		
12		
	Total	3200

Signature of Guide