HEART DISEASE CLASSIFICATION FROM ELECTROCARDIOGRAM

PROJECT REPORT

Submitted By

VINITHA AT (REG NO: MCT21MCA-2047)

to

APJ Abdul Kalam Technological University

In partial fulfilment of the requirements for the award of the Degree in

MASTER OF COMPUTER APPLICATIONS

DEPARTMENT OF COMPUTER APPLICATIONS

MOHANDAS COLLEGE OF ENGINEERING & TECHNOLOGY

Anad, Nedumangadu, Thiruvananthapuram

695541

2023

DEPARTMENT OF COMPUTER APPLICATIONS

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CERTIFICATE

This is to certify that the report entitled "**HEART DISEASE CLASSIFICATION FROM ELECTROCARDIOGRAM**" submitted by **VINITHA AT (Register No: MCT21MCA-2047)** to **APJ Abdul Kalam Technologies University** in partial fulfilment of the requirements for the award of the degree **MASTER OF COMPUTER APPLICATIONS** is a bonafide record of the project report carried out by her under my guidance and supervision. This report in any form not been submitted to any other University of Institute for any purpose.

Internal Supervisor **Project Coordinator**

Head of the department **External examiner**

DECLARATION

I undersigned hereby declare that the main project report for the "**HEART DISEASE CLASSIFICATION FROM ELECTROCARDIOGRAM"** submitted for partial fulfillment of the requirements for the award of the degree of Master of Computer Applications from APJ Abdul Kalam Technological University, Kerala, is a bonafide work done by me under the supervision of Prof. Dr. SAJITHA A V. This submission represents my ideas in my own words and where ideas or words of others have been included.I have adequately and accurately cited and referenced the original sources.

I also declare that I have adhered to academic honesty and integrity ethics and have not misrepresented or fabricated any data, idea, fact, or source in my submission. I understand that any violation of the above will be a cause for disciplinary action by the Institute and or the University and can also evoke penal action from the sources which have thus not been properly cited, or from whom proper permission has not been obtained. This report has not been previously formed as the basis for the award of any degree, diploma, or similar title of any other university.

Place: Trivandrum

Date :

Submitted by

Vinitha A T

ACKNOWLEDGEMENT

I am overwhelmed in all humbleness and gratefulness to acknowledge in depth all those who have helped me to put these ideas, well above the level of simplicity into something concrete. I would like to express my special thanks and gratitude to our principal **Dr. S. SHEELA** and our Director **Dr. ASHALATHA THAMPURAN** for providing all the necessary facilities.

I am greatly thankful to **Prof. SREEJA K,** (HOD, Department of Computer Applications) for her kind cooperation and guidance throughout the course of my project.

I am also thankful to my Guide Prof. **Dr. SAJITHA A V,** (Associate Professor, Department of Computer Applications) for her kind cooperation and guidance throughout the course of my project.

I would also like to acknowledge the contributions of my people from discord and other communities who have been a source of motivation and encouragement throughout this project.

Last but certainly not least, I would also like to thank all the staff of the Department of Computer Applications for their help and cooperation.

With gratitude

Vinitha AT

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ABSTRACT

Cardiac disease is the leading cause of death worldwide .Cardiovascular diseases can be prevented if an effective diagnostic is made at the initial stages. The ECG test is referred to as the diagnostic assistant tool for screening of cardiac disorder. The project purposes of a cardiac disorder detection system from ECG Images. The healthcare institutes used various ECG equipment that present results in non uniform formats of ECG images. The project proposes a generalized methodology to process all formats of ECG.There is no need to visit a doctor just to confirm the ecg report , following the initial findings, the patient may consult with a specialized doctor.Can be used in remote areas of the world where doctors are scarce and require long distance travel. Deep Neural Network architecture was used to detect cardiovascular disease detection.The project focused on detecting the four major cardiac abnormalities (i.e., myocardial infarction,abnormal heartbeat, previous history , and normal class).

1. INTRODUCTION

In the modern world, our body is affected with various types of diseases. Heart is one the most important organ of our body, many people around us die due to heart attacks. Clinical studies prove that most of the people diagnose heart disease only at the last stage. According to the World Health Organization, every year more than 12 million deaths are occurring worldwide due to the various types of heart diseases which is also known by the term cardiovascular disease. A risk of a heart attack or the possibility of the heart disease if identified early, can help the patients take precautions and take regulatory measures. Recently, the healthcare industry has been generating huge amounts of data about patients and their disease diagnosis reports are being especially taken for the prediction of heart attacks worldwide. When the data about heart disease is huge, the Deep learning techniques can be implemented for the analysis. The most common heart disease detection technique is based on electrocardiogram (ECG), angiography screening, and blood test. The ECG test is also referred to as the diagnostic assistant tool for screening heart diseases. ECG is a visual signal captured or measured by placing electrodes on the body's surface to detect voltage changes. ECG represents the possible cardiac abnormalities in their ST segments: normally, the rises in ST segments, changes in segments, or flipping of T waves, or new Q wave; these abnormal segments reflect cardiac disease symptoms.

1.1 ABOUT THE PROJECT

In this project, the main focus is to provide a novel automatic detection tool relatively similar and adaptable for cardiac hospitals by using a deep neural network (DNN). The DNN has been widely recognized as a reliable approach to directly detect the characteristics of features from medical images. DNN is best suited for medical images problem; that is the main reasons to used SSD MobileNet V2, a deep neural network-based architecture to detect the cardiac disorder on ECG images.

1.2 OBJECTIVE

The objective of this project is to implement Cardiac Disorder Classification by Electrocardiogram Sensing. It provides low cost, deep learning mechanism. It decrease the cases of misinterpretation of heart disease. It helps ordinary people to understand ECG images.

1.3 SCOPE

The scope of the project "Cardiac Disorder Classification by Electrocardiogram Sensing" involves developing a machine learning model that can accurately classify different types of cardiac disorders based on electrocardiogram (ECG) signals. The ECG signals will be collected from patients using ECG machines , and the data will be preprocessed to extract relevant features. The project will involve exploring different machine learning algorithms, such as deep learning and support vector machines (SVMs), to identify the most accurate and efficient method for classifying ECG signals. The model will be trained on a large dataset of ECG signals and validated using a separate testing dataset. The model will have practical applications in the medical field, where it can be used to diagnose and monitor cardiac disorders in patients.

1.4 EXISTING SYSTEM

The existing system for cardiac disorder classification using ECG sensing typically involves a manual interpretation of ECG signals by a trained healthcare professional. The ECG signal is collected using sensors and recorded on a paper or digital strip. The recorded signal is then analyzed visually by the healthcare professional to detect abnormalities or irregularities. The interpretation of ECG signals can be time-consuming and prone to errors, and it requires specialized training and expertise. Furthermore, the manual analysis of ECG signals can be subjective, as different healthcare professionals may interpret the same signal differently.To address these limitations, machine learning techniques have been developed to automatically classify ECG signals and detect abnormalities. These techniques can help to improve the accuracy and efficiency of cardiac disorder classification, and they have the potential to assist healthcare professionals in diagnosing and monitoring cardiac disorders. However, there are still limitations to the existing system of cardiac disorder classification using ECG sensing. For example, the accuracy of machine learning models can be affected by the quality of the ECG signal, and it may not be possible to detect all types of cardiac disorders using ECG signals alone. Additionally, the use of machine learning models in clinical settings requires careful validation and testing to ensure their safety and effectiveness.

A Review on Heart Disease Prediction using Machine Learning and Data Analytics Approach

Prediction of occurrences of heart diseases in medical field is significant work. Data analytics is useful for prediction from more information and it helps medical centre to predict of various disease. Huge

amount of patient related data is maintained on monthly basis. The stored data can be useful for source of predicting the occurrence of future disease. Some of the data mining and machine learning techniques are used to predict the heart disease, such as Artificial Neural Network (ANN), Decision tree, Fuzzy Logic, K-Nearest Neighbour(KNN), Na¨ıve Bayes and Support Vector Machine (SVM)

Heart Disease Prediction using Machine Learning

It is a system which predicts the heart disease based on the information or the symptoms entered into the system by the user and provides the accurate results based on that information. As an application of this system, hospitals can use this system for initial detection of heart disease of a patient.

1.4.1 DISADVANTAGES

1. Subjectivity of interpretation: The manual interpretation of ECG signals by healthcare professionals can be subjective, as different individuals may interpret the same signal differently. This can lead to inconsistencies in diagnosis and treatment.

2.. Time-consuming and labor-intensive: The manual analysis of ECG signals can be time-consuming and labor-intensive, particularly in busy clinical settings where healthcare professionals may have limited time and resources.

3. Limited access to specialized expertise: The interpretation of ECG signals requires specialized knowledge and expertise, which may not be available in all healthcare settings or regions. This can limit access to accurate and timely diagnosis and treatment for patients with cardiac disorders.

4. Lack of automation: The manual analysis of ECG signals does not lend itself to automation, which can limit the scalability and efficiency of cardiac disorder classification in large populations.

5. Dependence on quality of ECG signal: The accuracy of the existing system is highly dependent on the quality of the ECG signal collected. Factors such as poor electrode placement, movement artifact, or signal noise can affect the accuracy of the interpretation.

6. Inability to detect subtle abnormalities: The manual analysis of ECG signals may not be able to detect subtle abnormalities or variations in the signal, which can lead to missed diagnoses or delayed treatment.

7. Cost and infrastructure requirements: The existing system requires specialized equipment and infrastructure, such as ECG machines and trained healthcare professionals, which can be costly and may not be available in all healthcare settings.

8. Inefficient use of resources: The manual interpretation of ECG signals can result in inefficiencies in the use of healthcare resources, such as long wait times for patients and delayed diagnosis and treatment.

9 .Limited monitoring capabilities: The existing system may not be able to provide continuous monitoring of cardiac function, which can limit the ability to detect changes in cardiac function over time.

1.5 PROPOSED SYSTEM

The proposed system for cardiac disorder classification by electrocardiogram (ECG) sensing involves the development of a machine learning model that can automatically classify ECG signals and detect abnormalities with high accuracy and efficiency. The proposed system will use a dataset of ECG signals collected from patients using sensors, and the data will be preprocessed to extract relevant features. Machine learning algorithms such as deep learning will be explored to identify the most accurate and efficient method for classifying ECG signals. The proposed system will be trained on a large dataset of ECG signals and validated using a separate testing dataset. The performance of the machine learning model will be evaluated based on metrics such as accuracy, sensitivity, and specificity. The project proposes a generalized methodology to process all formats of ECG. Single Shoot Detection (SSD) MobileNet v2-based Deep Neural Network architecture was used to detect cardiovascular disease detection. The project focused on detecting the four major cardiac abnormalities (i.e., myocardial infarction, abnormal heartbeat, previous history of MI, and normal class).

The final deliverable of the proposed system will be a working machine learning model that can classify ECG signals into different types of cardiac disorders, such as myocardial infarction, previous history of myocardial infarction, abnormal heartbeat and normal class .The model will have practical applications in the medical field, where it can be used to diagnose and monitor cardiac disorders in patients..Overall, the proposed system has the potential to improve the accuracy, efficiency, and scalability of cardiac disorder classification using ECG sensing, and to provide more timely and accurate diagnosis and treatment for patients with cardiac disorders.

1.5.1 ADVANTAGES

- There is no need to visit a doctor just to confirm the ecg report.
- Without any delay, the results are instant.
- Following the initial findings, the patient may consult with a specialized doctor.
- Can be used in remote areas of the world where doctors are scarce and require long distance travel.
- The machine learning algorithms used in the proposed system have the potential to improve the accuracy of cardiac disorder classification by automatically detecting abnormalities in ECG signals that may be missed by manual analysis.
- The system has the potential to increase the efficiency of cardiac disorder classification by automating the analysis process, reducing the time and expertise required for manual analysis.
- The proposed system can be easily scaled to analyze large datasets of ECG signals, making it potentially useful for population-level studies and screening programs.
- The proposed system may have implications for remote monitoring of patients with cardiac disorders, allowing for more frequent and accurate monitoring of cardiac function outside of traditional healthcare settings.
- The proposed system can be designed to be accessible and cost-effective, potentially increasing access to accurate and timely diagnosis and treatment for patients with cardiac disorders in resource-limited settings.

2. METHODOLOGY

2.1 AGILE METHODOLOGY

For my final year academic project, I implemented Agile methodology to manage the development of a cardiac abnormality detection tool. Agile methodology is a project management framework that emphasizes flexibility, collaboration, and continuous improvement. This report describes the process of implementing Agile in my project and discuss the benefits, challenges, and lessons learned. Agile methodology is a project management approach that focuses on delivering value to the customer through flexible, iterative development. Unlike traditional project management approaches, which rely on detailed planning and fixed requirements, Agile is designed to be adaptable to changing circumstances and customer feedback. Agile teams work in short cyclescalled sprints, with each sprint delivering a working increment of the project.

2.2 ROLES

For my final year academic project on Decentralized Exchange, I decided to implement Agile methodology to ensure that I could work efficiently and effectively. Since I was working alone, I adapted the roles of the team members to fit my needs.

Head of Department, Prof Sreeja K, acted as my designated Scrum master, helped to facilitate meetings and ensure that I followed the Scrum framework.

Prof. Dr. Sajitha A V, served as my product owner, providing guidance on the project goals and priorities.

2.3 PRODUCT BACKLOG

ID	As a..	I want to be able to…	So that…	Priority	Remarks
1	Developer	Create a user interface	User can interact with the platform	High	
2	Developer	Pre process the ECG image	This helps to remove the noise in the image	High	
3	Developer	Identify and select appropriate features from ECG	Necessary features can be extracted	High	
4	Developer	Develop algorithms to detect abnormalities	Can predict cardiac abnormalities.	High	
5	Developer	Detects abnormalities like heart attack, previous history of heart attack, abnormal heart beat and normal	can view those abnormalities	High	
6	user	access the platform	Can identify their abnormalities	High	
7	user	Input the ECG image	can view those abnormalities	High	
8	user	View four major cardiac abnormalities	Can identify the condition of heart	High	

2.4 SPRINT BACKLOG

Sl No	Tasks	Start Date	End Date	Status
1	Data collection	09/02/2023	15/02/2023	Completed
2	Data preprocessing	20/02/2023	25/02/2023	Completed
3	Feature extraction	27/02/2023	02/03/2023	Completed
4	Model building and training	05/03/2023	15/03/2023	Completed
5	deployment	20/02/2023	30/03/2023	Completed
6	Interface designing	1/04/2023	10/04/2023	Completed
7	documentation	15/04/2023	23/04/2023	Completed

2.5 FEASIBILITY STUDY

A feasibility study is a test of system proposal according at its workability, impact on the organization, ability to meet user needs and effective use of resources. The objective of feasibility study is not to solve the problem, but so acquire a sense of its scope During the study, the problem definition is crystallized and aspects of the problem to he included in the system are determined, consequently costs and benefits are estimated with greater detail at this stage.

Feasibility Analysis involves eight steps Form a project team and appoint a project leader, Prepare a system flow chart, Enumerate potential candidate systems, Describe and identify characteristics of candidate systems

Here are some factors that could be considered in the feasibility study:

1. Technical feasibility: The technical feasibility of the project would involve assessing whether the proposed system can be developed using existing technology and resources, and whether it can meet the technical requirements of accuracy, efficiency, and scalability. This could involve evaluating the performance of different machine learning algorithms and ECG sensors, and conducting a proof-of-concept study to validate the system's accuracy and efficiency.

2. Economic feasibility: The economic feasibility of the project would involve assessing the costs and benefits of developing and implementing the proposed system. This could involve evaluating the cost of hardware and software development, data collection and analysis, training and support, and ongoing maintenance and updates. The potential benefits could include improved patient outcomes, reduced healthcare costs, and increased revenue from the sale of the system.

3. Legal feasibility: The legal feasibility of the project would involve assessing whether the proposed system complies with relevant laws and regulations related to patient privacy, data protection, and medical device certification. This could involve consulting with legal experts and regulatory bodies to ensure that the system meets all necessary requirements.

4. Operational feasibility: The operational feasibility of the project would involve assessing whether the proposed system can be effectively integrated into existing healthcare workflows and systems. This could involve conducting a needs analysis to understand the requirements of healthcare professionals and patients, and designing the system to meet these needs.

5. Scheduling feasibility: The scheduling feasibility of the project would involve assessing whether the proposed system can be developed and implemented within a reasonable timeframe. This could involve conducting a project timeline analysis to identify potential bottlenecks and risks, and developing a realistic project plan that takes into account all necessary tasks and dependencies.

2.5.1 TECHNICAL FEASIBILITY

The technical feasibility of the project Cardiac Disorder Classification by Electrocardiogram Sensing refers to the ability of the proposed system to be developed and implemented using existing technology and resources, and to meet the technical requirements of accuracy, efficiency, and scalability. Here are some factors that could be considered in the technical feasibility analysis. The proposed system would require the availability of advanced machine learning algorithms, ECG, and other hardware and software components that are capable of accurately detecting and analyzing ECG signals. The technical feasibility analysis would need to evaluate whether the necessary technology is readily available and accessible, and whether it can be integrated into the proposed system. The system would need to collect and process large amounts of ECG data from a variety of sources, such as hospitals, clinics, and wearable devices. The technical feasibility analysis would need to evaluate whether the data can be collected and processed efficiently and accurately, and whether the system can handle large volumes of data.

The proposed system would rely on machine learning algorithms to analyze the ECG data and classify cardiac disorders. The technical feasibility analysis would need to evaluate the performance of different machine learning algorithms and identify the most suitable algorithms for the proposed system .It need to be accurate and reliable in classifying cardiac disorders based on ECG signals. The technical feasibility analysis would need to evaluate the system's performance in terms of accuracy, sensitivity, specificity, and reliability, and identify any potential sources of error or bias.It must need to be scalable to handle large datasets of ECG signals and to support a growing number of users. The technical feasibility analysis would need to evaluate the system's scalability and identify any potential bottlenecks or limitations.The proposed system would need to be seamlessly integrated into existing healthcare workflows and systems, such as electronic health records (EHRs) and clinical decision support systems. The technical feasibility analysis would need to evaluate the system's compatibility with existing systems and identify any necessary modifications or integrations.

2.5.2 ECONOMIC FEASIBILITY

Economic feasibility refers to the ability of the proposed system to generate a positive return on investment and to be financially sustainable over the long term. Here are some factors that could be considered in the economic feasibility analysis. The development costs of the proposed system would include the costs of hardware and software components, salaries of developers and engineers, and other related expenses. The economic feasibility

analysis would need to evaluate whether the development costs are within the budget and whether the return on investment is sufficient to cover the costs. The operating costs of the proposed system would include the costs of maintaining and upgrading hardware and software components, salaries of staff, and other related expenses. The economic feasibility analysis would need to evaluate whether the operating costs are sustainable over the long term and whether the revenue generated by the system is sufficient to cover the costs.The revenue streams of the proposed system would include fees charged for sales of hardware and software components, and other related sources of income. The economic feasibility analysis would need to evaluate whether the revenue streams are sufficient to generate a positive return on investment and whether they are sustainable over the long term.The market demand for the proposed system would depend on factors such as the prevalence of cardiac disorders, the availability of competing products and services, and the willingness of healthcare providers and patients to adopt the system. The economic feasibility analysis would need to evaluate the market demand for the proposed system and identify any potential barriers to adoption.

2.5.3 LEGAL FEASIBILITY

It is the ability of the proposed system to comply with all applicable laws and regulations. Here are some legal considerations that could be relevant to the project:

Data privacy and security: The proposed system would likely involve the collection, storage, and transmission of sensitive patient data, which could be subject to various data privacy and security regulations. The system would need to implement appropriate measures to protect patient data and ensure compliance with all applicable regulations.

Liability issues: The proposed system could potentially be used to diagnose and treat cardiac disorders, which could raise liability issues if the system fails to accurately diagnose a disorder or if a treatment based on the system's diagnosis causes harm to a patient. The system would need to include appropriate disclaimers and warnings, and healthcare providers using the system would need to obtain appropriate informed consent from patients.

Intellectual property: The proposed system could potentially involve the use of patented technology, such as algorithms or software components, which could raise intellectual property issues. The system would need to ensure that all necessary licenses or permissions are obtained to use such technology, and any patents or other intellectual property developed by the system would need to be properly protected.

2.5.4 OPERATIONAL FEASIBILITY

It is the ability of the proposed system to be successfully implemented and integrated into the existing healthcare infrastructure. Here are some factors that could be considered in the operational feasibility analysis:

User acceptance: The proposed system would need to be accepted by healthcare providers and patients, who would be the primary users of the system. The operational feasibility analysis would need to evaluate whether the system meets the needs and preferences of these users and whether they are willing and able to use the system effectively.

System performance: The proposed system would need to be able to accurately diagnose cardiac disorders based on electrocardiogram sensing. The operational feasibility analysis would need to evaluate whether the system meets the necessary performance standards, such as accuracy and speed, and whether it can be reliably and consistently implemented in different healthcare settings.

Training and support: The proposed system would require training and support for healthcare providers and other users. The operational feasibility analysis would need to evaluate whether sufficient training and support resources are available and whether they can be effectively deployed to ensure the successful implementation of the system.

Integration with existing systems: The proposed system would need to be integrated with existing healthcare systems and workflows to ensure efficient and effective use. The operational feasibility analysis would need to evaluate whether the system can be seamlessly integrated with existing systems and workflows, or whether significant changes or modifications would be required.

Cost-effectiveness: The proposed system would need to be cost-effective in terms of both development and operating costs. The operational feasibility analysis would need to evaluate whether the benefits of the system, such as improved diagnostic accuracy and patient outcomes, outweigh the costs of development and operation, and whether the system can be implemented in a financially sustainable manner.

2.5.5 SCHEDULING FEASIBILITY

This refers to the ability of the project to be completed within the proposed schedule. Here are some factors that could be considered in the scheduling feasibility analysis:

Project scope: The scheduling feasibility analysis would need to evaluate the scope of the project, including the number of features and functionalities to be developed, the complexity of the algorithms and models to be used, and the level of testing and validation required. The more extensive the project scope, the longer the project is likely to take.

Resource availability: The scheduling feasibility analysis would need to evaluate the availability of the necessary resources, including personnel, equipment, and funding. The project would need to be staffed with the appropriate personnel with the necessary technical expertise and experience, and adequate equipment and funding would need to be available to support the project.

Project dependencies: The scheduling feasibility analysis would need to evaluate any dependencies between the project and other related projects or initiatives.Delays or changes to these dependencies could impact the project schedule.

Development methodology: The scheduling feasibility analysis would need to evaluate the development methodology to be used, such as agile or waterfall. Different development methodologies have different timelines, and the selected methodology should be appropriate for the project's scope and resources.

Testing and validation: The scheduling feasibility analysis would need to evaluate the time required for testing and validation of the proposed system. Testing and validation are critical components of the project, and adequate time should be allocated to ensure that the system meets the necessary performance and quality standards.

3. SYSTEM REQUIREMENTS

3.1 HARDWARE REQUIREMENTS

CPU : Intel i5 3rd Generation/AMD Ryzen 3 or above

RAM : 4GB, 8GB(for best performance)

GPU : Intel HD 4000/Nvidia GT 710/AMD HD 3450 or above

Disk Space : At least 5 GB

Key board : PC/AT enhanced type

Mouse : HP wired standard mouse

3.2 SOFTWARE REQUIREMENTS

Front end : HTML, CSS

Backend : python

Framework : Django

Language : python

Operating system : Windows 8-11

3.3 HTML

HTML stands for Hypertext Markup Language. It is a markup language used for creating web pages and applications for the internet. HTML allows developers to structure content and create a hierarchy of information on a web page using a series of tags and attributes.HTML documents consist of a series of elements, such as headings, paragraphs, images, links, and forms, which are defined using HTML tags. These tags are enclosed in angle brackets < >, with the name of the tag indicating the type of element and its function on the page. HTML is often used in conjunction with other technologies such as CSS (Cascading Style Sheets) and JavaScript to

create visually appealing and interactive web pages. The latest version of HTML is HTML5, which includes new features such as video and audio playback, semantic tags for more structured content, and improved support for mobile devices.

3.4 CSS

CSS stands for Cascading Style Sheets. It is a style sheet language used to describe the visual appearance and formatting of HTML and XML documents, including web pages.CSS allows developers to separate the presentation of a web page from its content, making it easier to maintain and update the design of a website. CSS accomplishes this by defining rules that determine how different elements of a web page should be styled and displayed.

CSS works by targeting specific HTML elements using selectors, and then defining various properties such as color, font, size, layout, and positioning, among others. The style rules can be applied to individual elements, groups of elements, or even the entire document.

3.5 Python

Python is a high-level, interpreted and dynamically typed programming language created by Guido Van Rossum. Python are multi paradigm ie ,it supports both object oriented and procedural programming. It is one of the fastest growing language in terms of no. of developers who are using it and in terms of no. of libraries they have. Python is a general purpose programming language because it can be applied in so many fields such as machine learning, GUI, software development, web development etc. And it is the easiest language available in the market.

Installation -

Navigate to https://www.python.org/downloads/ in the web browser. You can see all the versions available here. The latest version available here is python3.10. For the implementation of the project we need python 3.6 version. So select it, Then follow the normal installation steps in Windows after downloading it. To verify the installation just go to windows and search for python. You can see python setup and python IDLE there.

3.5.1 Python libraries

Python library is a reusable chunk of code that you may want to include in your programs/ projects. Compared to languages like C++ or C, Python libraries do not pertain to any specific context in Python. Here, a 'library'

loosely describes a collection of core modules. Essentially, then, a library is a collection of modules. A package is a library that can be installed using a package manager like ruby gems or npm.

3.5.1.1 Python Standard Library

The Python Standard Library is a collection of exact syntax, token, and semantics of Python. It comes bundled with core Python distribution. We mentioned this when we began with an introduction. It is written in C, and handles functionality like I/O and other core modules. All this functionality together makes Python the language it is. More than 200 core modules sit at the heart of the standard library. This library ships with Python. But in addition to this library,you can also access a growing collection of several thousand components from the python pckage index.

3.6 Visual Studio Code

Visual Studio Code is a source-code editor that can be used with a variety of programming languages, including Java, JavaScript, Go, Node.js, Python and C++. It is based on the Electron frame- work, which is used to develop Node.js Web applications that run on the Blink layout engine. Visual Studio Code employs the same editor component (code named ”Monaco”) used in Azure DevOps (for- merely called Visual Studio Online and Visual Studio Team Services). Instead of a project system, it allows users to open one or more directories, which can 36 then be saved in work spaces for future reuse. This allows it to operate as a language Diagnostic code editor for any language. It supports a number of programming languages and a set of features that differs per language. Unwanted files and folders can be excluded from the project tree via the settings. Many Visual Studio Code features are not exposed through menus or the user interface but can be accessed via the command palette. It can be extended via extensions, available through a central repository. This includes additions to the editor and language support. A notable feature is the ability to create extensions that add support for new languages, themes, and debuggers, perform static code analysis, and add code linters using the Language Server Protocol. Installation VS Code releases a new version each month with new features and important bug fixes. Most platforms support auto updating and you will be prompted to install the new release when it becomes available. You can also manually check for updates by running Help ¿ Check for Updates on Linux and Windows or running Code ¿ Check for Updates on macOS.

3.7 Django

Django is a free and open source web application framework written in Python. A framework is nothing more than a collection of modules that make development easier. They are grouped together, and allow you to create applications or websites from an existing source, instead of from scratch. This is how websites - even simple ones designed by a single person - can still include advanced functionality like authentication support, management and admin panels, contact forms, comment boxes, file upload support, and more. In other words, if you were creating a website from scratch you would need to develop these components yourself. By using a framework instead, these components are already built, you just need to configure them properly to match your site.The official project site describes Django as ”a high-level Python Web framework that encourages rapid development and clean, pragmatic design. Built by experienced developers, it takes care of much of the hassle of Web development, so you can focus on writing your app without needing to reinvent the wheel. It’s free and open source.” Django offers a big collection of modules which you can use in your own projects. Primarily, frameworks exist to save 38 developers a lot of wasted time and headaches and Django is no different. You might also be interested in learning that Django was created with front-end developers in mind. ”Django’s template language is designed to feel comfortable and easy-to-learn to those used to working with HTML, like designers and frontend developers. But it is also flexible and highly extensible, allowing developers to augment the template language as needed.”

4. ALGORITHM

Our proposed system could be divided into five main steps

- Preprocessing
- Feature Extraction
- Training
- Testing and Detection

ALGORITHM

• Read the ECG image dataset.

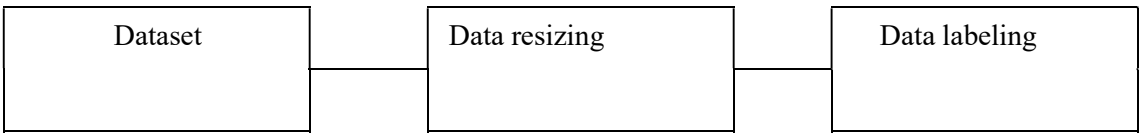
• Convert the RGB image to binary grayscaled image and crop the image according to the size.

• we use the pre-trained MobilenetV2 model and extract the unique characteristics and features from the ECG images.

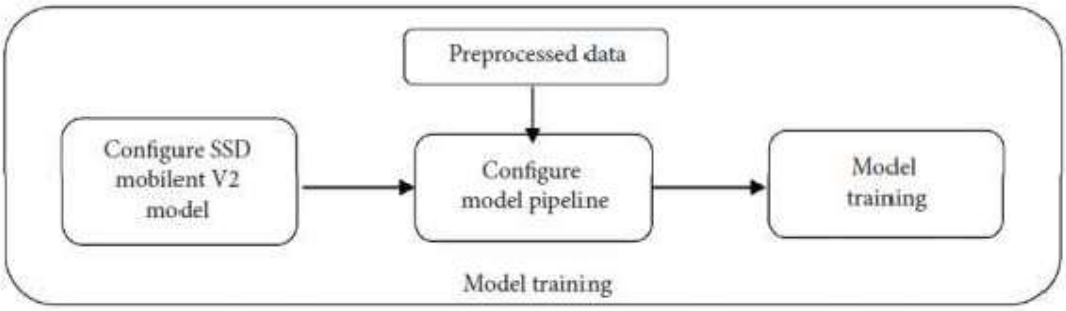
• Pass the features to the Deep neural network and fit the data

4.1 PREPROCESSING

Preprocessing is required to clean image data for model input. Adjusting existing training data to generalize to other situations allows the model to learn from a wider array of situations.



4.2 TRAINING AND TESTING



SSD Algorithm

The SSD (Single Shot MultiBox Detector) algorithm is a popular object detection algorithm used in computer vision applications. It was first introduced in a research paper in 2016 by Wei Liu et al. at ECCV. The SSD algorithm is a deep learning-based approach that combines two key components: a feature extractor network and a set of default boxes. The feature extractor network is typically a pre-trained convolutional neural network (CNN) such as VGG, ResNet or MobileNet, that is used to extract features from an input image. The default boxes are pre-defined bounding boxes that are placed at different positions and scales cross the image. During training, the SSD algorithm learns to predict the presence and location of objects in an image by making predictions for each default box. The algorithm generates a set of class probabilities and offsets for each default box, which are used to refine the location and size of the predicted object bounding boxes. One of the advantages of the SSD algorithm is that it can perform object detection in real-time, making it suitable for applications where speed is critical. It is widely used in a range of applications, including autonomous driving, robotics, and surveillance.

Mobilenet v2

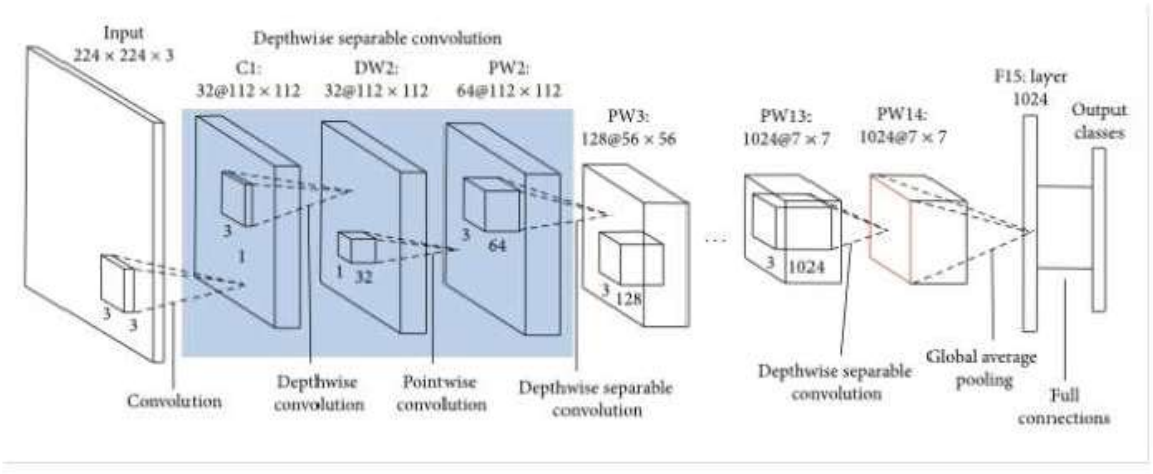
MobileNetV2 is a convolutional neural network architecture that seeks to perform well on mobile devices. It is based on an inverted residual structure where the residual connections are between the bottleneck layers. The intermediate expansion layer uses lightweight depthwise convolutions to filter features as a source of non-linearity. As a whole, the architecture of MobileNetV2 contains the initial fully convolution layer with 32 filters, followed by 19 residual bottleneck layers.

CNN (Convolutional Neural Network)

It is a type of deep learning neural network commonly used in computer vision tasks such as image classification, object detection, and image segmentation. It was first introduced by Yann LeCun et al. in 1998. The architecture of a CNN consists of multiple layers, including convolutional layers, pooling layers, and fully connected layers. In a convolutional layer, a set of filters is applied to an input image to extract relevant features. The pooling layer is used to downsample the feature maps generated by the convolutional layer, reducing the dimensionality of the input. The fully connected layer is used to classify the input based on the extracted features. One of the advantages of CNNs is that they can automatically learn features from the input data, without the need for manual feature extraction. This makes CNNs well-suited for tasks where the input data has a high degree of variability, such as image recognition.

Convolution Layer

The Kernel In the fig 2 demonstration, the green section resembles our input image. The element involved in carrying out the convolution operation in the first part of a Convolutional Layer is called the Kernel/Filter, K, represented in the color yellow. We have selected K as a 3x3x1 matrix. The objective ofthe Convolution Operation is to extract the high-level features such as edges, from the input image. ConvNets need not be limited to only one Convolutional Layer.Conventionally



A simple structure of MobilenetV2

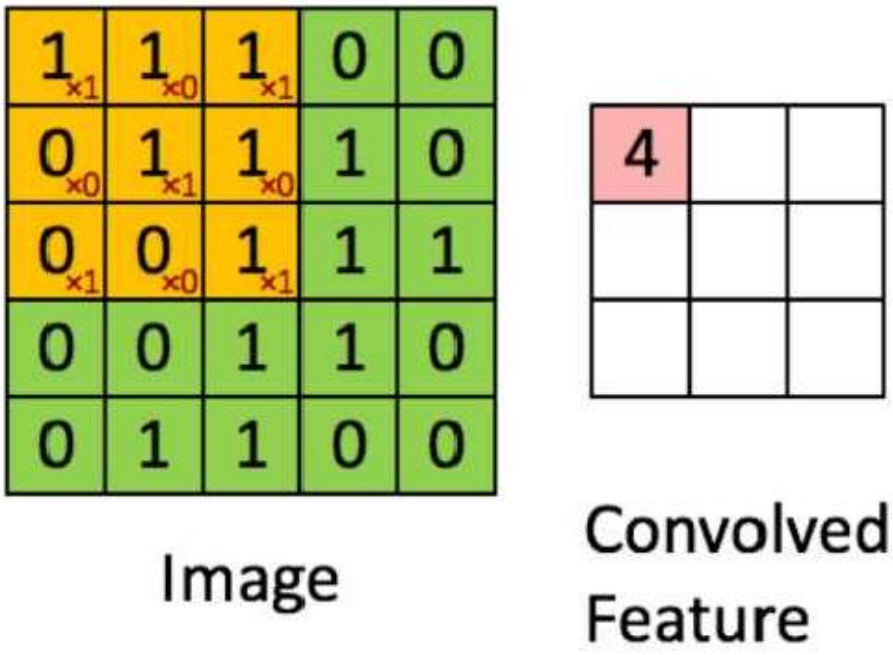


Fig 2 Convolved layer-The Kernel

the first ConvLayer is responsible for capturing the Low-Level features such as edges, color,gradient orientation, etc. With added layers, the architecture adapts to the High-Level featu es as well, giving us a network which has the wholesome understanding of images in the dataset, similar to how we would.

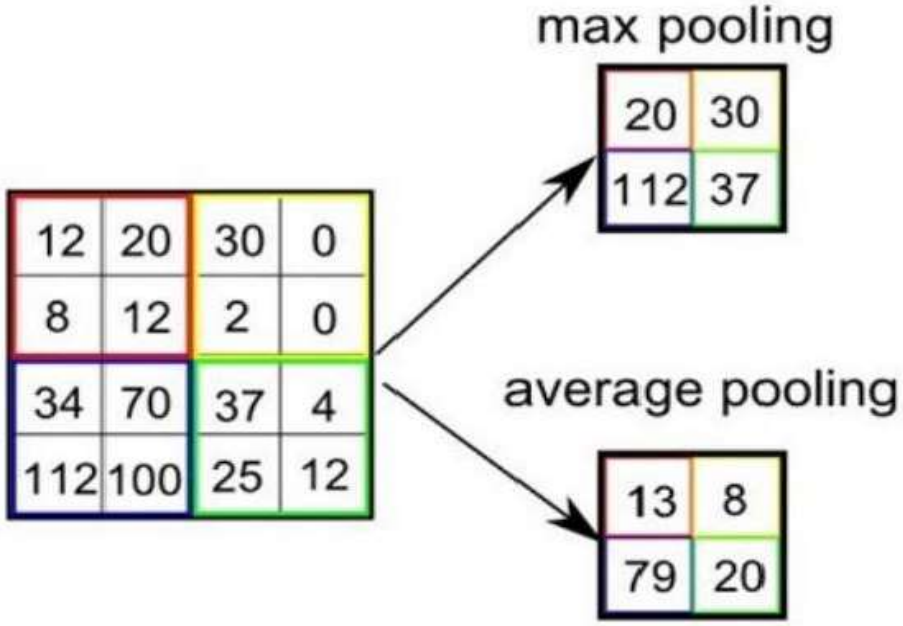
Pooling

Similar to the Convolutional Layer, the Pooling layer is responsible for reducing the spatial size of the Convolved Feature. This is to decrease the computational power required to process the 13 data through dimensionality reduction. Furthermore, it is useful for extracting dominant features which are rotational and positional invariant, thus maintaining the process of effectively training of the model. There are two types of Pooling: Max Pooling and Average Pooling. Max Pooling returns the maximum value from the portion of the image covered by the Kernel. On the other hand, Average Pooling returns the average of all the values from the portion of the image covered by the Kernel. Max Pooling also performs as a Noise Suppressant. It discards the noisy activations altogether and also performs de-noising along with dimensionality reduction. On the other hand, Average Pooling simply performs dimensionality reduction as a noise suppressing mechanism. Hence, we

can say that Max Pooling performs a lot better than Average Pooling. The Convolutional Layer and the Pooling Layer, together form the i-th layer of a Convolutional Neural Network. Depending on the complexities in the images, the number of such layers may be increased for capturing low-levels details even further, but at the cost of more computational power. After going through the above process, we have successfully enabled the model to understand the features. Moving on, we are going to flatten the final output and feed it to a regular Neural Network for classification purposes.

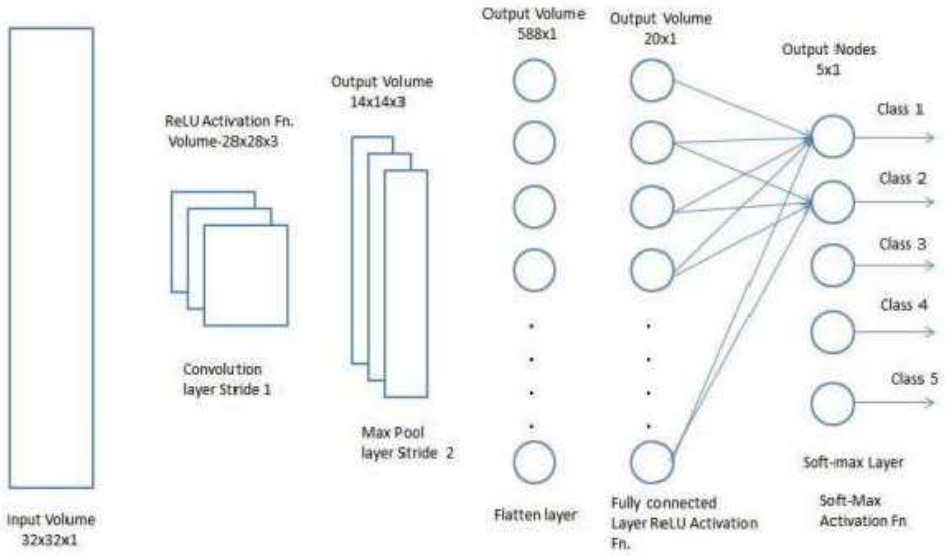
Classification Fully Connected Layer (FC Layer)

Fully Connected Layer (FC Layer) Adding a Fully-Connected layer is a (usually) cheap way of learning non-linear combinations of the high-level features as represented by the output of the convolutional layer. The Fully-Connected layer is learning a possibly non-linear function in that space. Now that we have converted our input image into a suitable form for our Multi-Level Perceptron, we shall flatten the image into a column vector. The flattened output is fed to a feed-forward neural network and back propagation applied to every iteration of training. Over a series of epochs, the model is able to distinguish between dominating and certain low-level features in images and classify them using the Softmax Classification technique. The first layer is the input layer; the size of the input image is 28 × 28. The second layer is the convolution layer C2, it can obtain four different feature maps by convolution with the input image. The third layer is the pooling layer P3. It computes the local average or maximum of the input feature maps . The next convolution layer and pooling layer operate in the same way, except the number and size of convolution kernels. The output layer is full connection; the maximum value of output neurons is the result of the classifier in end.



Types of pooling

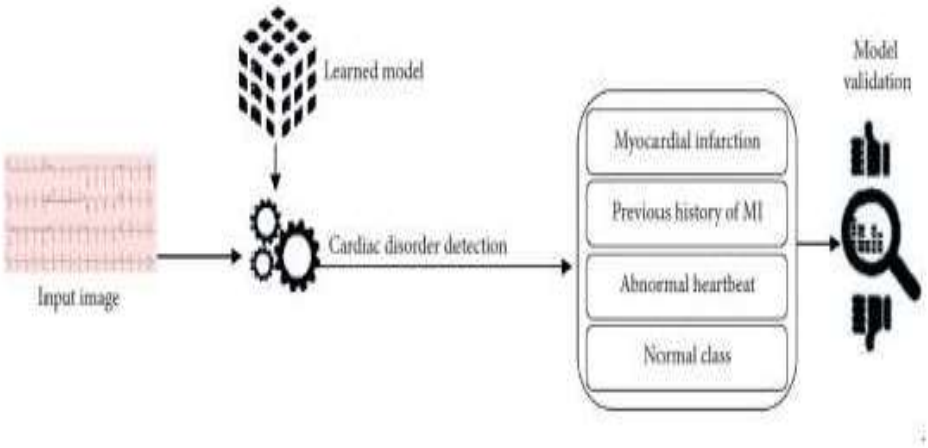
Classification of fully connected layer



5. SYSTEM DESIGN

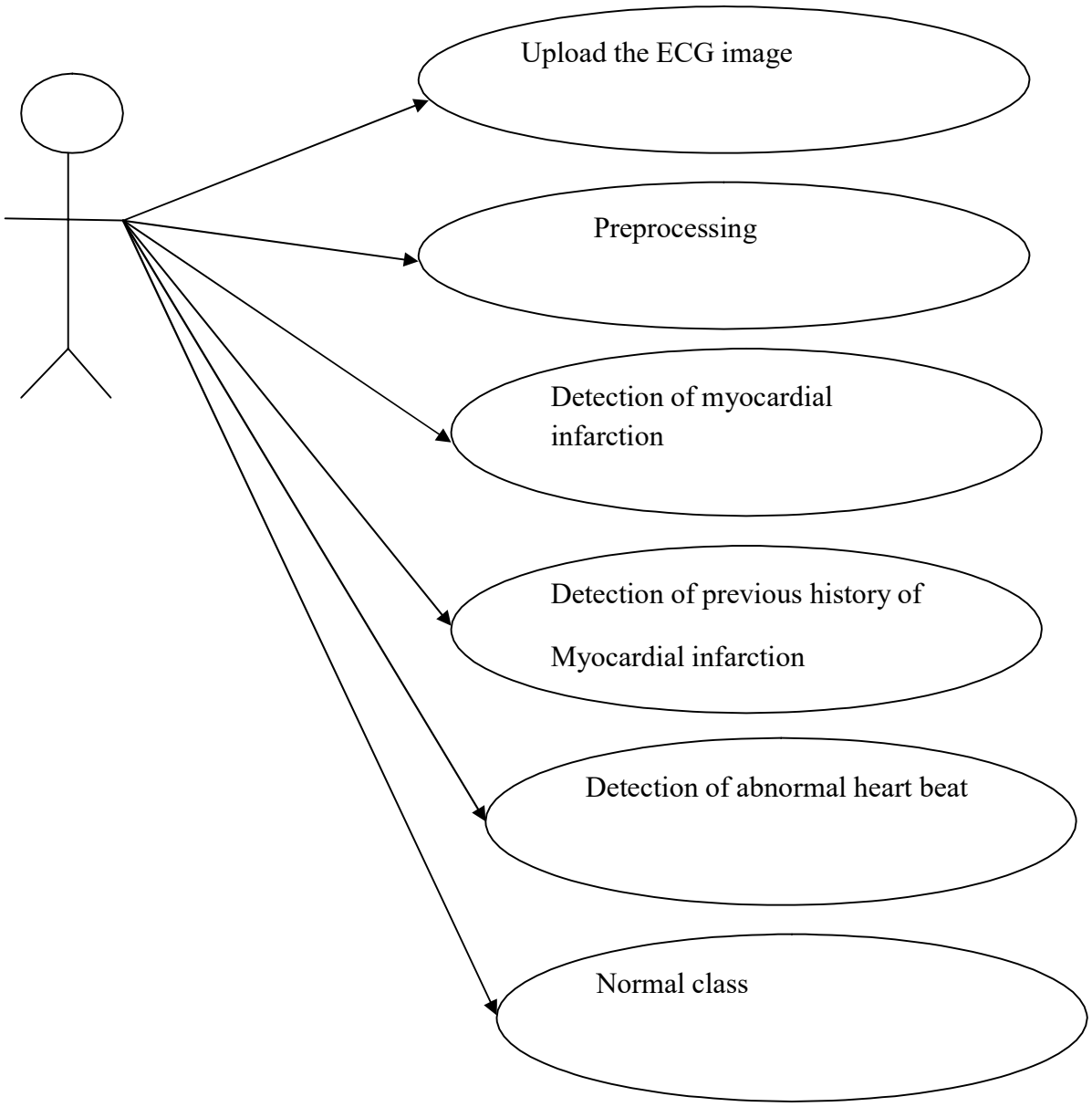
5.1 SYSTEM ARCHITECTURE

An architectural diagram is a diagram of a system that is used to abstract the overall outline of the software system and the relationships, constraints, and boundaries between components. It is an important tool as it provides an overall view of the physical deployment of the software system and its evolution road map.

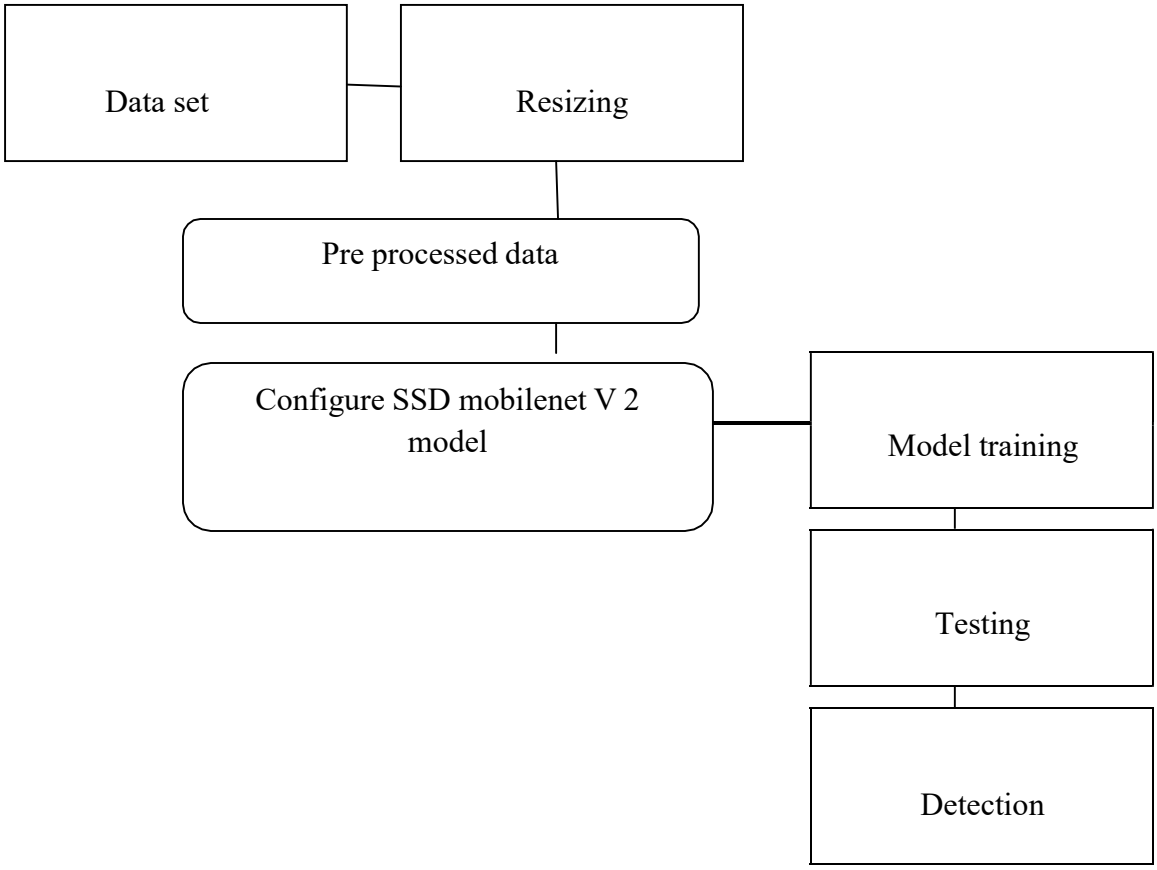


Model architecture

5.2 USE CASE DIAGRAM



5.3 WORK FLOW DIAGRAM



5.4. DATASET

Data set of total 4260 images of five different abnormalities collected from resources ”https://data.mendeley.com/datasets/gwbz3fsgp8/2”.We have Myocardial infarction(1200), Abnormal heartbeat(900), Previous history of MI(1010), Normal(1150) number of images.

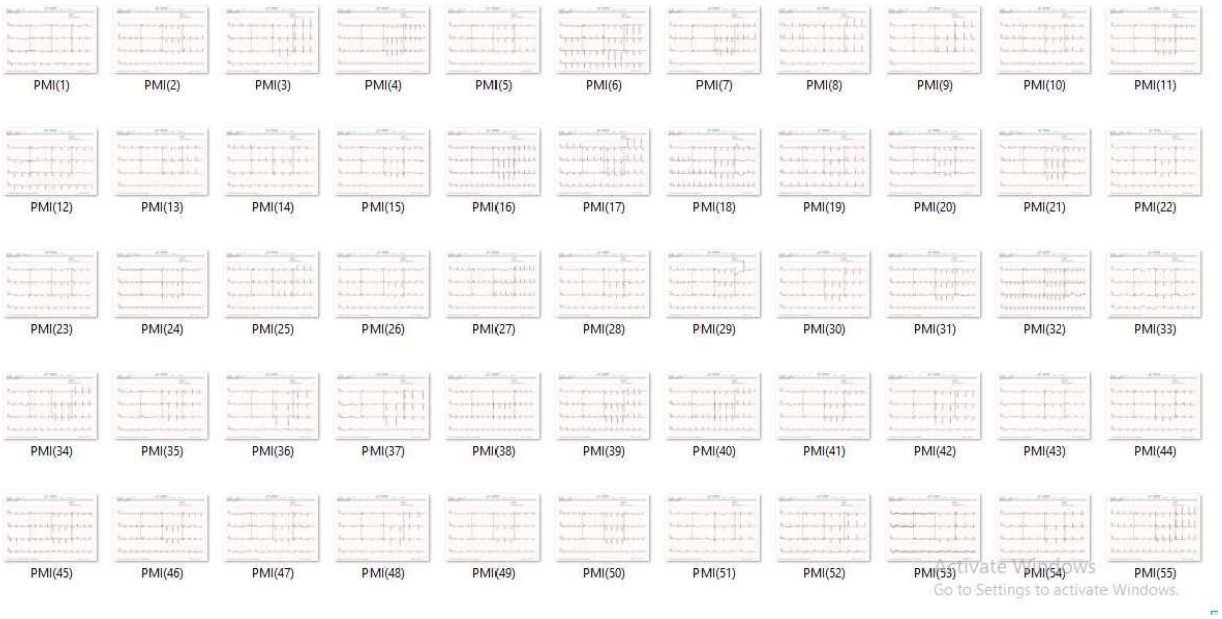


Figure 3. Abnormal Heartbeat

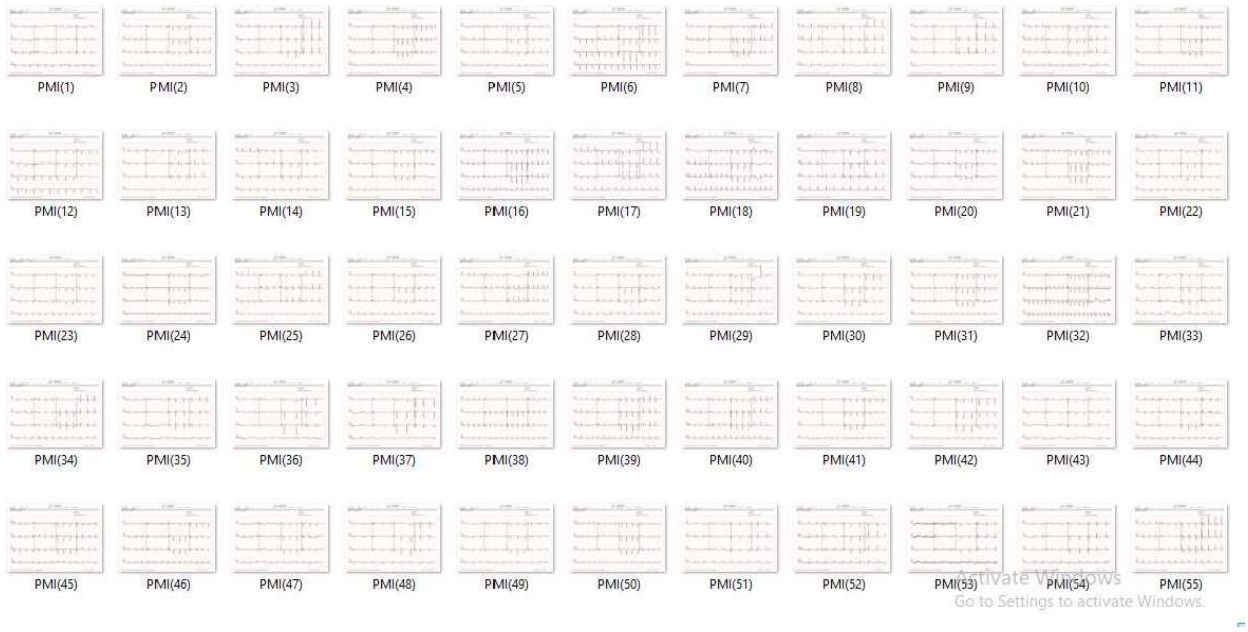


Figure 4.Myocardial infarction

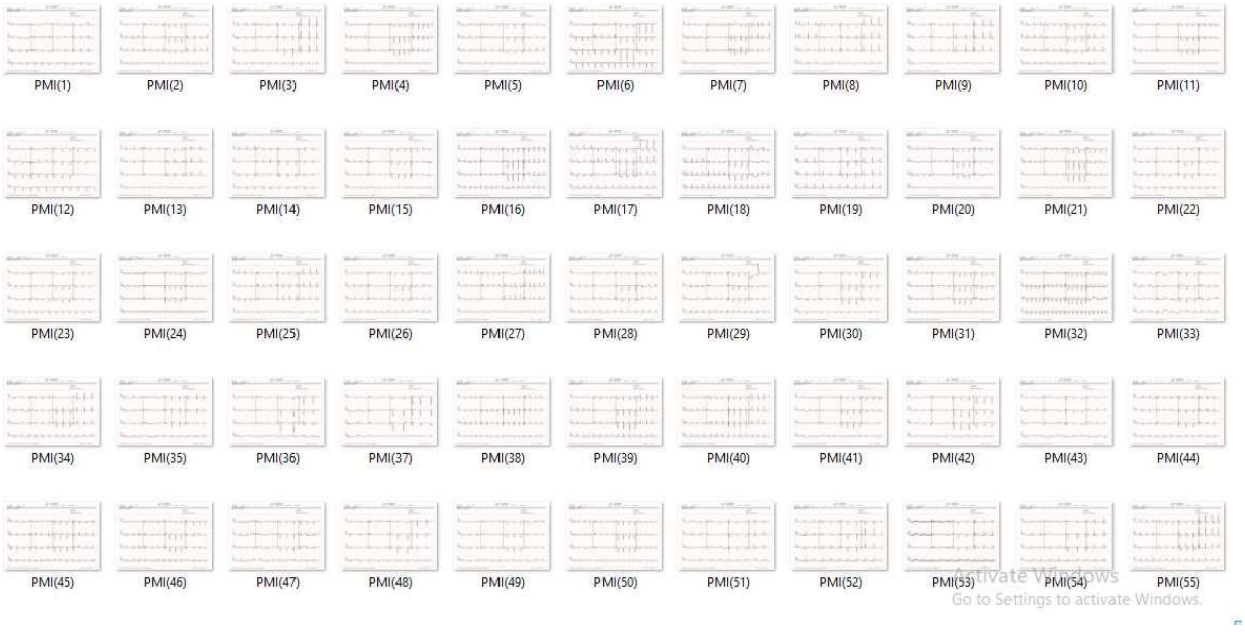


Figure 5.previous history of myocardial infarction

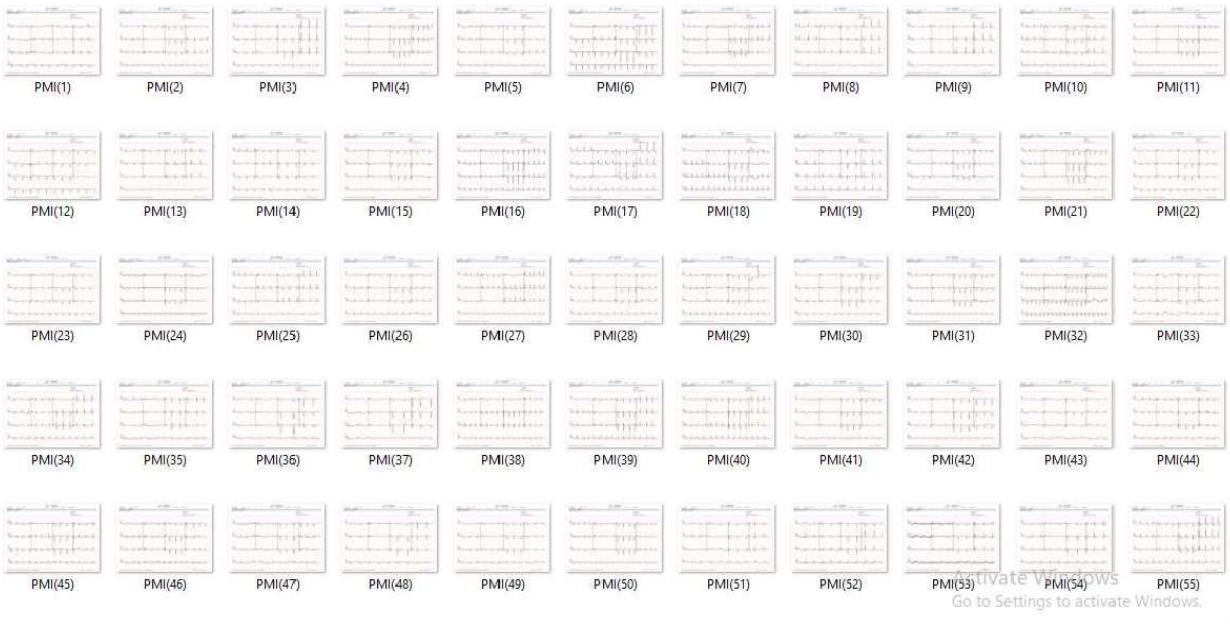


Figure 6. Normal class

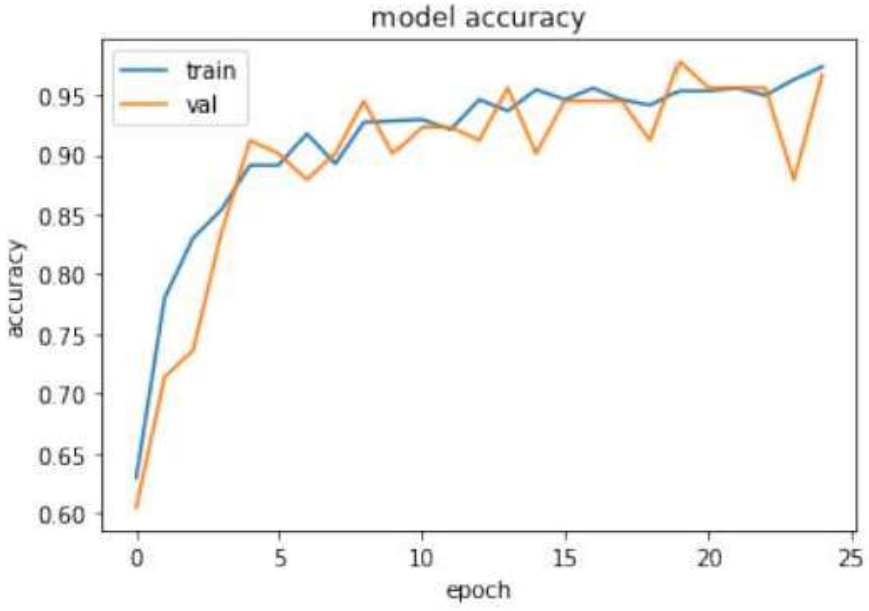


Figure 7.Accuracy

6 .SYSTEM TESTING

Software testing can be stated as the process of verifying and validating whether a software or application is bug-free ,meets the technical requirements as guided by its design and development ,and meets the user requirements effectively and efficient by handling all the exceptional and boundary cases.

6.1 Unit Testing

Unit testing is a software testing technique where individual units or components of a software application are tested in isolation to ensure that they function as expected. The goal of unit testing is to identify and fix defects in individual units of code before they are integrated into the larger system. Unit tests are typically written by developers and are automated, which means that they can be run quickly and easily as part of the software development process. Unit tests are designed to test the functionality of individual methods or functions and are typically small and focused on a single piece of code. In unit testing, the inputs to a method or function are carefully chosen to ensure that all possible scenarios are tested, including edge cases and boundary conditions. The output of the method or function is then compared to the expected output to ensure that the code is working correctly. Unit testing is an important part of the software development process because it helps to catch bugs early in the development cycle, which can save time and money by reducing the cost of fixing defects later on. Unit tests also make it easier to refactor code because developers can be confident that changes they make to the code will not introduce new defect

6.2 INTEGRATION TESTING

Integration testing is a software testing technique that involves testing how different components of a software system work together to ensure that they function as expected. The purpose of integration testing is to detect and diagnose any defects that may arise from the integration of these components. In integration testing, multiple modules or subsystems are tested together to ensure that they work correctly as a group. This type of testing is usually performed after unit testing and before system testing. Integration testing can be performed in a variety of ways, such as top-down, bottom-up, or a combination of both.

In top-down integration testing, the higher-level modules are tested first, followed by the lower-level modules. This approach is useful when the higher-level modules are more critical to the system's functionality than the lower-level modules.

In bottom-up integration testing, the lower-level modules are tested first, followed by the higher-level modules. This approach is useful when the lower-level modules are more critical to the system's functionality than the higher-level modules.

6.3 ACCEPTANCE TESTING

Acceptance testing is a software testing technique that focuses on determining whether a software system meets the requirements and specifications set forth by the client or end user. The goal of acceptance testing is to ensure that the software system is ready to be released to the end user and is functioning as expected. Acceptance testing can be performed in several ways, such as manual testing, automated testing, or a combination of both. Typically, acceptance testing is conducted after system testing and before the software is released to the end user.

6.4 TEST CASES

Here the entire software system is tested. The reference document for this process is the requirements document, and the goal is to see if software meets its requirements. Here the entire software has been tested against requirements of project and it is checked whether all requirements of project have been satisfied or not.

Here is the testing process:

1. Set up interface : create an interface with 2 button .One is for uploading image and another is for predict the result. Tested whether its worked properly .

2. Gather test images :Gather all the images for testing and preprocess the image .

3. Run the test images through the detection system: Can upload the image and preview of the image is shown in the interface.

4. Validation of the result: Cross checked the result with actual result.

7. CONCLUSION

Cardiac disorder detection plays a significant role in medical and health science. The project focuses on processing the ECG images to detect cardiac abnormalities. The deep neural network has proven its capabilities in various applications of image processing and computer vision. The project proposes a generalized methodology to process all formats of ECG. SINGLE SHOOT DETECTOR (SSD) MobileNet v2 based Deep Neural Network architecture was used to detect

Cardiovascular disease detection. The project presented high accuracy results in differentiating and detecting four major cardiac abnormalities and showed remarkable results. In this proposed system we provide a smart way to recognize heart disease using deep machine learning.This application will help for those people who suffer from cardiac disorders. I believe that this project can make an impact in the current medical field. There can be problems like internet availability, reach to common people and others but within a span of time this product can make the changes it's expected to make.

8. FUTURE ENHANCEMENT

The proposed system of Cardiac Disorder Classification by Electrocardiogram Sensing can be further developed into an android application. The data in this system is small, in the future ,aim to validate our results by using big data set and we can use another algorithm and compare the results and to predict more accurate results. This work can be extended by training a larger dataset, particularly on more cardiac abnormalities, validating the recognition ratio using DNNs. The extraction of advanced features on ECG images with image acquisition, adaptive image enhancement, and various boundary detection algorithms on various cardiac-related issues can be detected with medical experts' help with new developing tools.

9. RESULT

9.1 SCREENSHOTS

Figure 9 .Home page

Figure 10 .select the ECG image

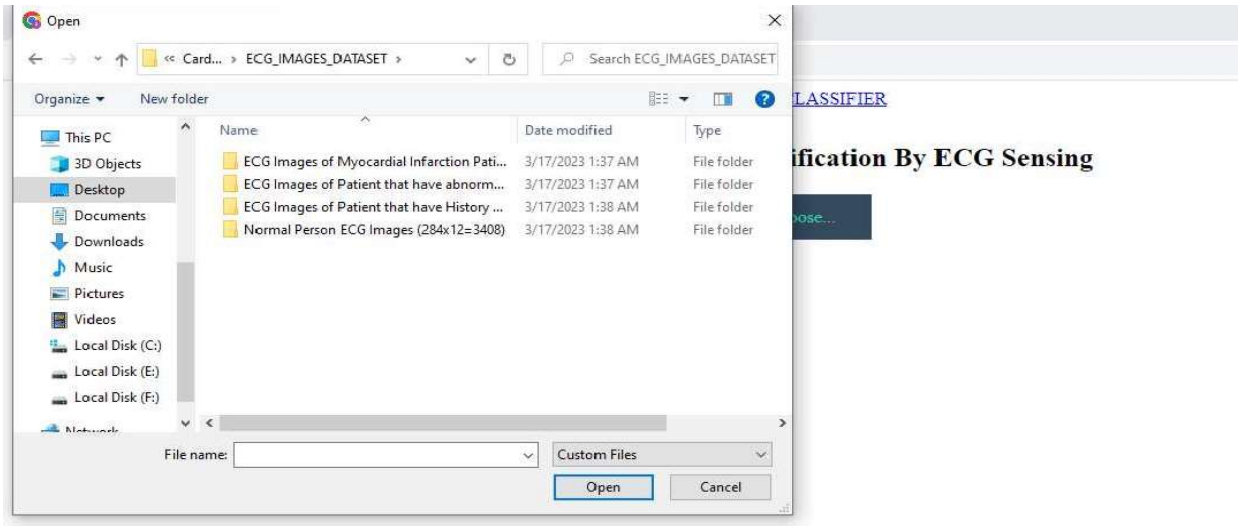


Figure 11 .choose an image

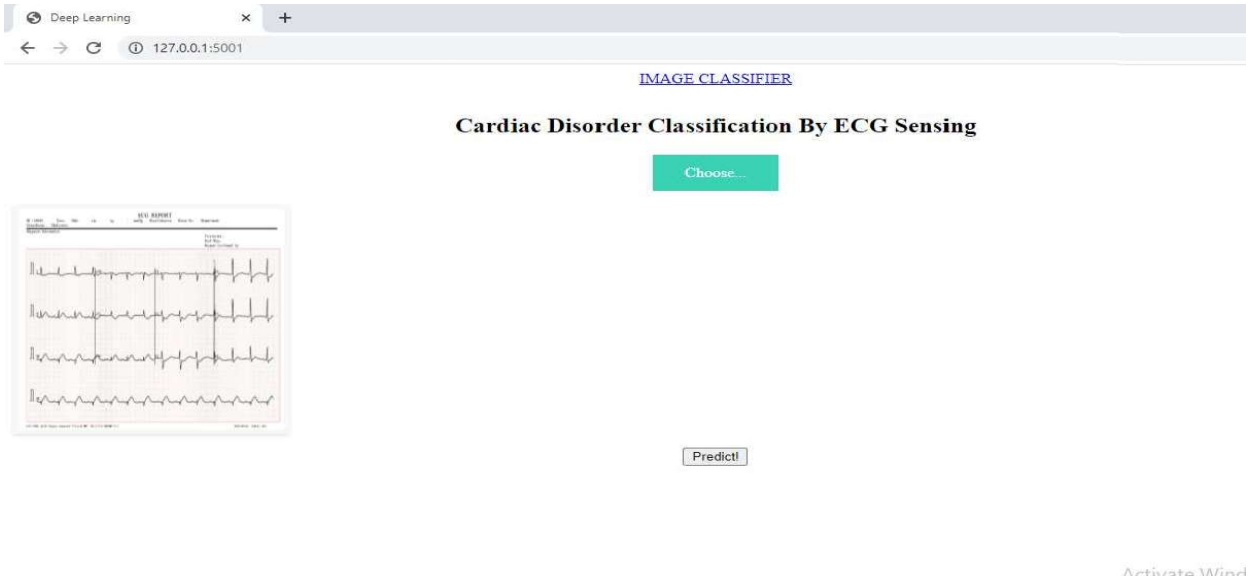


Figure 12 .Myocardial infraction

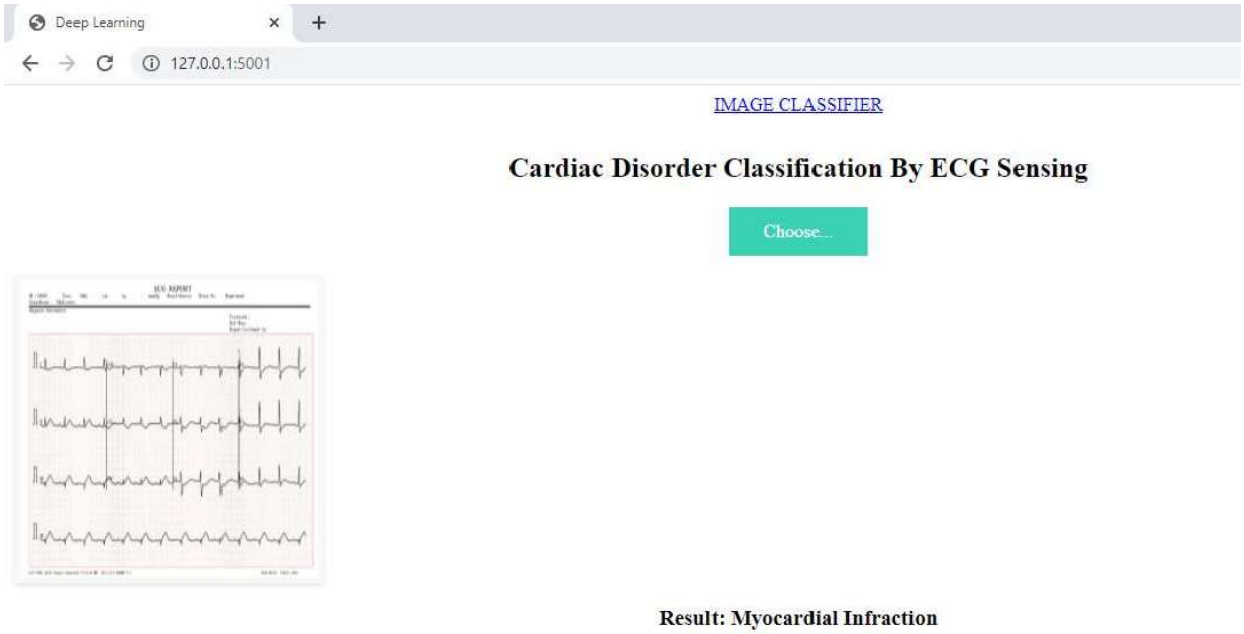


Figure 13 .abnormal heartbeat

Figure 14 .History of myocardial infraction

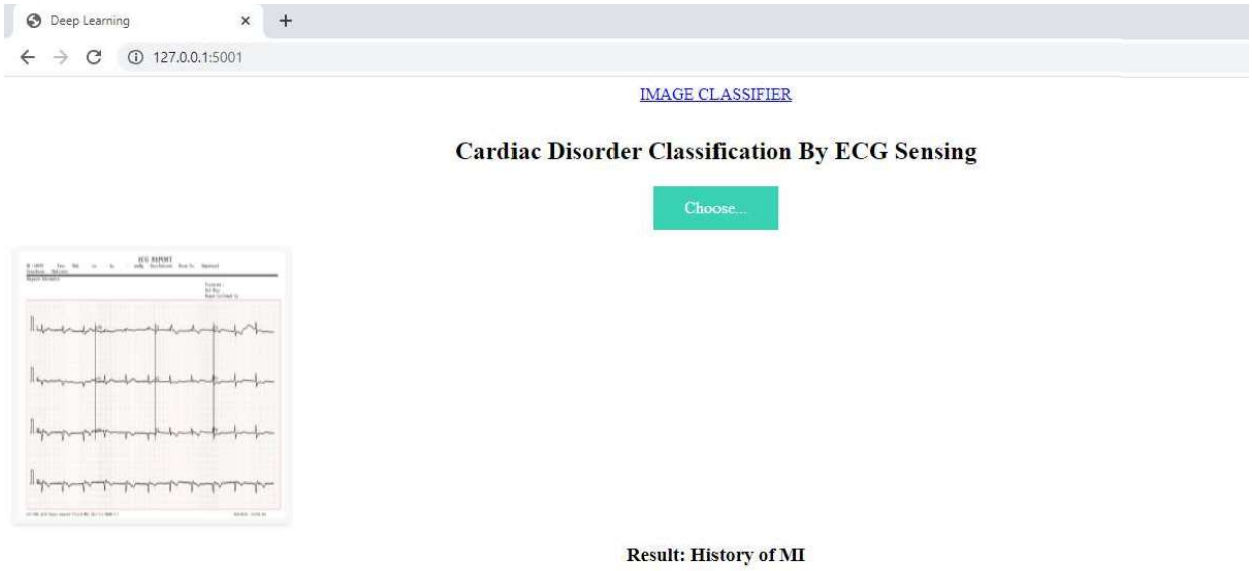
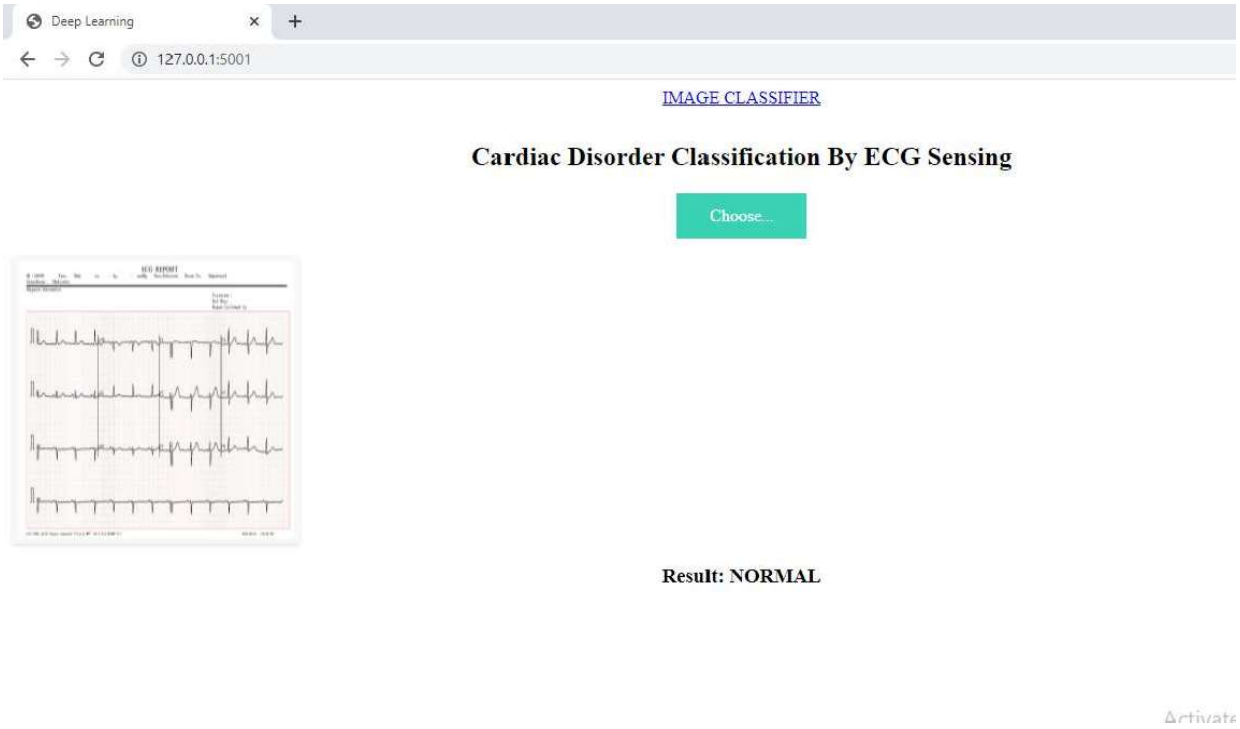


Figure 15 .Normal



10. BIBILOGRAPHY

1. Acharya, U. R., Oh, S. L., Hagiwara, Y., Tan, J. H., Adam, M., & Gertych, A. (2017). A deep learning approach to on-demand classification of a single heartbeat for diagnosis of cardiac arrhythmias. IEEE Journal of Biomedical and Health Informatics, 22(3), 828-835.

2. Hannun, A. Y., Rajpurkar, P., Haghpanahi, M., Tison, G. H., Bourn, C., Turakhia, M. P., & Ng, A. Y. (2019). Cardiologist-level arrhythmia detection and classification in ambulatory electrocardiograms using a deep neural network. Nature medicine, 25(1), 65-69.

3. Liu, M., & Zhang, J. (2021). Heartbeat classification using deep learning for heart disease diagnosis. Biomedical Signal Processing and Control, 65, 102370.

4. Zhang, Y., Yang, L., Chen, C., & Fan, Y. (2021). ECG classification based on residual neural network and active learning. Journal of medical systems, 45(5), 49.

5. Zhou, Y., Zhang, L., Hu, Y., & Cheng, J. (2019). Heartbeat classification using 1-D convolutional neural network. Biomedical Signal Processing and Control, 47, 312-317.

11. REFERENCES

1. Silipo, R., & Marchesi, C. "Artificial neural networks for automatic ECG analysis." IEEE Transactions on Signal Processing, vol. 46, 1998, pp. 1417-1425.

2. Kiranyaz, S., Ince, T., & Gabbouj, M. "Real-Time Patient-Specific ECG Classification by 1-D Convolutional Neural Networks." IEEE Transactions on Biomedical Engineering, vol. 63, no. 3, 2016, pp. 664-675.

3. World Health Organization. Cardiovascular Diseases. WHO, Geneva, Switzerland, 2020, http://www.who.int/mediacentre/factsheets/fs317/en/.

4. Khan, A. H., & Hussain, M. "ECG images dataset of cardiac and COVID-19 patients." Mendeley Data, vol. 1, 2020.