

# PROJECT REPORT

Date	
Team ID	PNT2022TMID50013
Project Name	Classification of Arrhythmia byUsing Deep Learning with 2 -D ECG Spectral Image Representation

## 1. INTRODUCTION

### Project Overview

According to the World Health Organization (WHO), cardiovascular diseases (CVDs) are the number one cause of death today. Over 17.7 million people died from CVDs in the year 2017 all over the world which is about 31% of all deaths, and over 75% of these deaths occur in low and middle-income countries. Arrhythmia is a representative type of CVD that refers to any irregular change from the normal heart rhythms. There are several types of arrhythmia including atrial fibrillation, premature contraction, ventricular fibrillation, and tachycardia. Although a single arrhythmia heartbeat may not have a serious impact on life, continuous arrhythmia beats can result in fatal circumstances. In this project, we build an effective electrocardiogram (ECG) arrhythmia classification method using a convolutional neural network (CNN), in which we classify ECG into seven categories, one being normal and the other six being different types of arrhythmia using deep two-dimensional CNN with grayscale ECG images. We are creating a web application where the user selects the image which is to be classified. The image is fed into the model that is trained and the cited class will be displayed on the webpage.

### Purpose

- The main purpose of this application is to make people aware of their general health.
- Know fundamental concepts and techniques of the Artificial Neural Network and Convolution Neural Networks
- Gain a broad understanding of image data.
- Work with Sequential type of modeling
- Work with Keras capabilities
- Work with image processing techniques
- know how to build a web application using the Flask framework.



## 2. LITERATURE SURVEY

### Existing problem

- <https://apps.apple.com/us/app/ecg/id1459546745>

### References

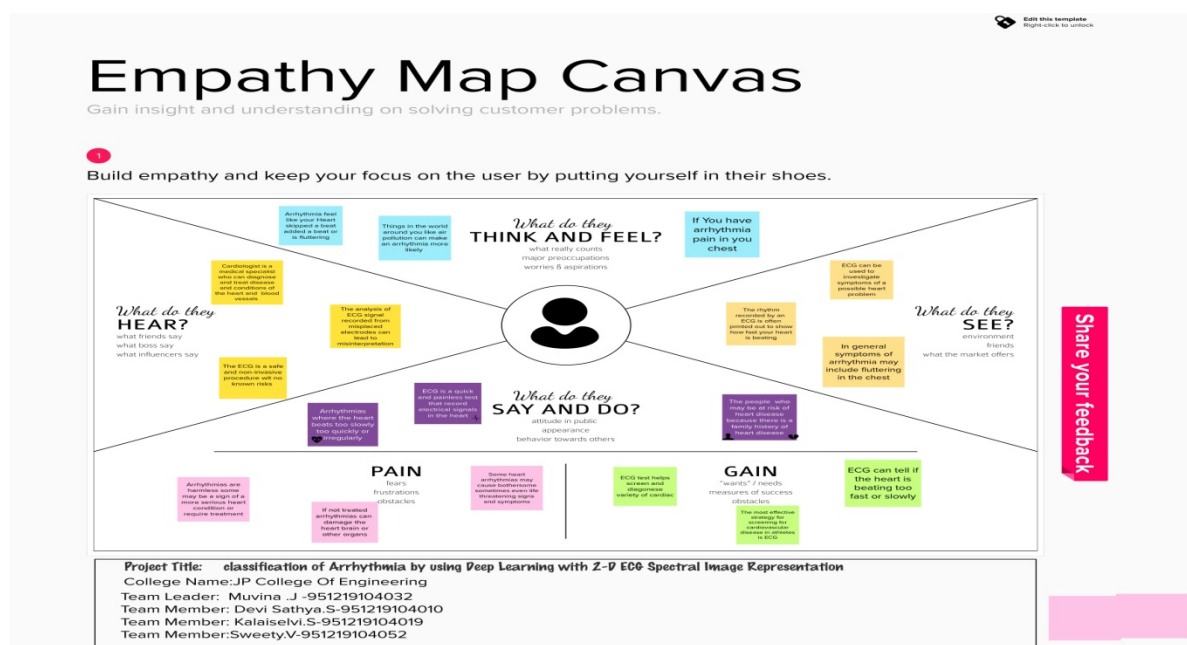
- [https://www.researchgate.net/publication/341623436\\_Classification\\_of\\_Arrhythmia\\_by\\_Using\\_Deep\\_Learning\\_with\\_2-D\\_ECG\\_Spectral\\_Image\\_Representation](https://www.researchgate.net/publication/341623436_Classification_of_Arrhythmia_by_Using_Deep_Learning_with_2-D_ECG_Spectral_Image_Representation)

### Problem Statement Definition

- According to the World Health Organization (WHO), cardiovascular diseases (CVDs) are the number one cause of death today.
- The annual number of deaths from CVD in India is projected to rise from 2.26 million (1990) to 4.77 million (2020).
- Arrhythmia is a representative type of CVD that refers to any irregular change from the normal heart rhythms.

## 3. IDEATION & PROPOSED SOLUTION

### Empathy Map Canvas



# Ideation & Brainstorming

## Brainstorm & idea prioritization

Use this template in your next brainstorming sessions so your team can unleash their imagination and start shaping concepts even if you're not sitting in the same room.

- 1. Welcome to canvas
- 2. Share to collaborate
- 3. 24 people recommended

### Before you collaborate

A checklist of preparation given along with this session. Here's what you need to do to get going.

- 1. Get going
- 2. Get to go
- 3. Get to go

### Define your problem statement

What problem are you trying to solve? Frame your problem as a how might we statement. This will be the focus of your ideation.

**PROBLEMS**

- How to help the customer
- How to help the customer
- How to help the customer

**Key idea of brainstorming**

- Brainstorming with ideas
- Brainstorming with ideas
- Brainstorming with ideas

### Brainstorm

Write down any ideas that come to mind that address your problem statement.

### Group ideas

Take turns sharing your ideas with the group and/or related notes as you go. In the last 10 minutes, give each other a thumbs up for ideas. It's okay to be a bit of a cheerleader. Give each other a thumbs up for ideas.

### Prioritize

Your team should all sit on the same page about which important moving forward. Place your ideas on this grid to determine which ideas are important and which are feasible.

### After you collaborate

You can export the final as an image or pdf to share with members of your company who might find it helpful.

- Quick will-ers
- Share to go
- Share to go
- Share to go

# Proposed Solution

## Project Design Phase-I

### Proposed Solution Template

Date	24 September 2022
Team ID	PNT2022TMID50013
Project Name	Project – Classification Of Arrhythmia By Using Deep Learning With 2-D ECG Spectral Image Representation
Maximum Marks	2 Marks

#### Proposed Solution Template:

Project team shall fill the following information in proposed solution template.

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	Medicines are used to control abnormal heart rhythms . Ablation procedure can cure some types of arrhythmia completely. Eat Healthy Food. Excersie Regularly.
2.	Idea / Solution description	Vitamin C. Arrhythmia and other heart conditions associated oxident strees and Immplamation
3.	Novelty / Uniqueness	Users can Identify the Type of Arrhythmia
4.	Social Impact / Customer Satisfaction	Avoid smoking, Maintain a regular healthy wait, keep blood pressure and cholestreol level under control
5.	Business Model (Revenue Model)	We can provide the application in a subscription based.
6.	Scalability of the Solution	Identify the type of heart disease. An ECG is used to how the Heart is functioning. It can give about importance of heart attack and Irregular beat.



# Problem Solution fit

## Problem-Solution fit canvas 2.0

Purpose / Vision

Define CS, fit into CC	<p><b>1. CUSTOMER SEGMENT(S)</b> <span>CS</span></p> <p>Who is your customer?</p> <p><b>people who are aged 60 years and older. It's in part due to wear and tear of an older heart. Other health or heart problems may also play a role. People who are older are more likely to have many health problems.</b></p>	<p><b>6. CUSTOMER</b> <span>CC</span></p> <p>What constraints prevent your customers from taking action or limit their choices of solutions? i.e. spending power, budget, no cash, network connection, available devices.</p> <p><b>New technology, Current supply, Customer Safety, Network connection, Belief</b></p>	<p><b>5. AVAILABLE SOLUTIONS</b> <span>AS</span></p> <p>Which solutions are available to the customers when they face the problem or need to get the job done? What have they tried in the past? What pros &amp; cons do these solutions have? i.e. pen and paper is an alternative to digital notetaking</p> <p><b>Medications,therapies, Loss excess weight, Avoid tobacco smoke</b></p>	Explore AS, differentiate
	Focus on J&P, tap into BE, understand RC	<p><b>2. JOBS-TO-BE-DONE / PROBLEMS</b> <span>J&amp;P</span></p> <p>Which jobs-to-be-done (or problems) do you address for your customers? There could be more than one; explore different sides.</p> <p><b>1. Keep blood pressure and cholesterol levels under control.</b> <b>2. Maintain follow-up care.</b></p>	<p><b>9. PROBLEM ROOT CAUSE</b> <span>RC</span></p> <p>What is the real reason that this problem exists? What is the back story behind the need to do this job? i.e. customers have to do it because of the change in regulations.</p> <p><b>1. people's hearts rhythm may affect by most common type such as a heart attack, smoking, congenital heart defects, and stress.</b> <b>2. Some substances or medicines may also cause arrhythmias.</b></p>	
Identify strong TR & EM		<p><b>3. TRIGGERS</b> <span>TR</span></p> <p>What triggers customers to act? i.e. seeing their neighbour installing solar panels, reading about a more efficient solution in the news.</p> <p><b>Stress can contribute to heart rhythm disorders (arrhythmias) such as atrial fibrillation.</b></p> <p><b>4. EMOTIONS: BEFORE / AFTER</b> <span>EM</span></p> <p>How do customers feel when they face a problem or a job and afterwards? i.e. lost, insecure &gt; confident, in control - use it in your communication strategy &amp; design.</p> <p><b>They feel palpitations, feeling dizzy, fainting and being short of breath.</b></p>	<p><b>10. YOUR SOLUTION</b> <span>SL</span></p> <p>If you are working on an existing business, write down your current solution first, fill in the canvas, and check how much it fits reality. If you are working on a new business proposition, then keep it blank until you fill in the canvas and come up with a solution that fits within customer limitations, solves a problem and matches customer behaviour.</p> <p><b>Cardioversion is a medical procedure that uses quick, low-energy shocks to restore a regular heart rhythm.</b></p>	<p><b>8. CHANNELS of BEHAVIOUR</b> <span>CH</span></p> <p><b>ONLINE</b></p> <p>What kind of actions do customers take online? Extract online channels from #7</p> <p><b>An online consultations enables you to contact a GP or other health professional over the internet.</b></p> <p><b>OFFLINE</b></p> <p>What kind of actions do customers take offline? Extract offline channels from #7 and use them for customer development.</p> <p><b>An customers take arrhythmia treatment offline consuming time.</b></p>



Problem-Solution fit canvas is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 license Created by Daria Neprikachina / Amaltama.com



Edit with WPS Office



## 4. REQUIREMENT ANALYSIS

### Functional requirement

FR No.	Functional Requirement(Epic)	Sub Requirement (Story / Sub-Task)
FR 1	User Registration	Registration through Form Registration through Gmail Registration through LinkedIn
FR 2	User Confirmation	Confirmation via Email Confirmation via OTP
FR 3	User interface	Check your profile Choose your file Sign Out your account and change your password.
FR 4	Data processing	Evaluating the model using test data Training DL algorithm for a accuracy result Trained CNN model using Tensorflow,Kearas.
FR 5	Predict ECG image	User ECG images in our web application Collection of datasets Database read ECG images.

### Non-Functional requirements



## Non-Functional requirements

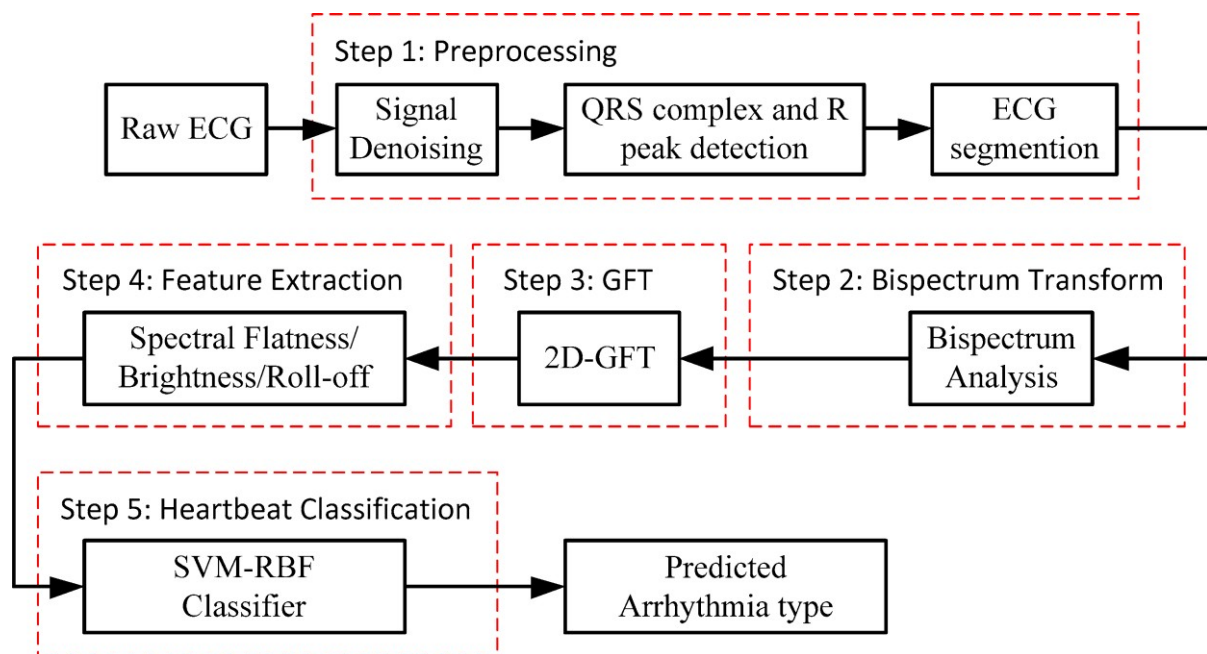
FR NO.	Non Functional Requirement	Description
NFR-1	Usability	Wireless ECG body sensor Savvy is a feasible solution for reliable and accurate long-term heart rhythm monitoring. However, there were no studies dealing with usability of the sensor.
NFR-2	Security	The work presented in this paper is applicable for encrypting and decrypting personalized Electrocardiograph ECG signals for secure transmission.
NFR-3	Reliability	The extent to which the system consistently performs the specified functions without failure.
NFR-4	Performance	It essentially specifies how the system should behave and that it constrains the ECG wavelength of accurate disease information gathering.
NFR-5	Availability	Availability describes how likely the system is accessible to a user at a given point on time and the periodicity for a solution.
NFR-6	Scalability	The ability of the user problem (ion arrhythmia disease) to handle an increase in workload without performance degradation or its ability to quickly enlarge.





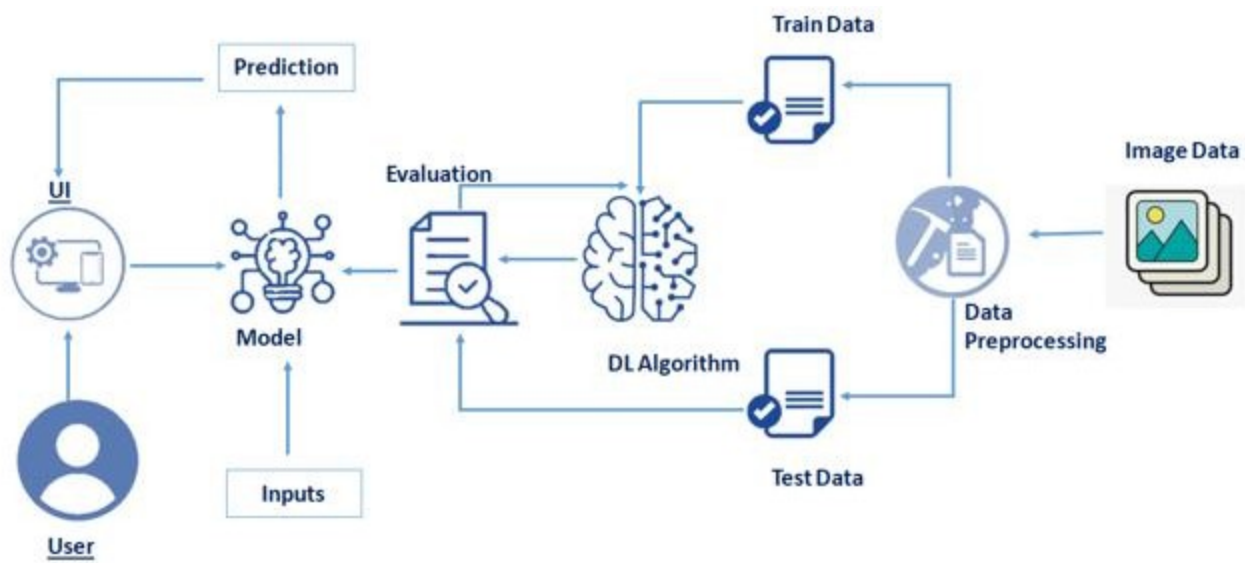
# PROJECT DESIGN

## Data Flow Diagrams



- A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system.
- A neat and clear DFD can depict the right amount of the system requirement graphically.
- It shows how data enters and leaves the system, what changes the information, and where data is stored

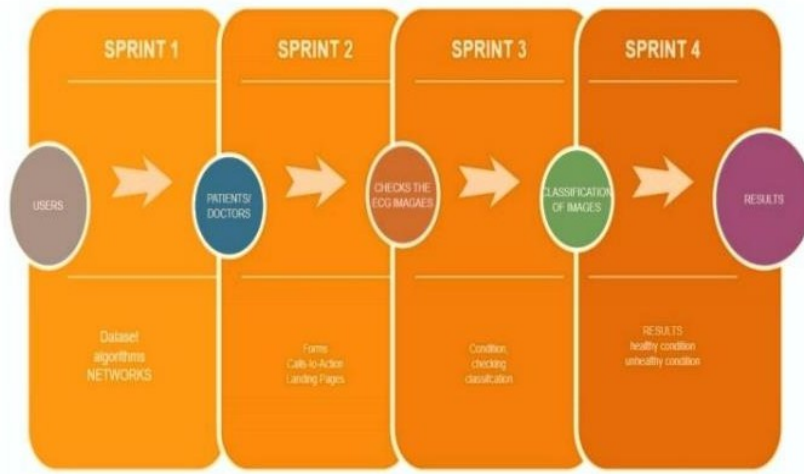
## Solution & Technical Architecture



## User Stories

## 5.PROJECT PLANNING & SCHEDULING

### Sprint Planning & Estimation



### Sprint Delivery Schedule

#### SPRINT 1:

- The team should conduct a survey of the project developed.
- The team should have a proof of the results been executed.
- The team should start by completing the

#### milestones.SPRINT 2:

- The team should monitor the efficiency of the process.
- The team should show a demo to the team mentors.
- The team should analyse the project

#### specifications.SPRINT 3:

- The team-mates should always work in coordination.
- The team-mates should understand the project work flow and structure.
- The team-mates should have a complete knowledge of the

#### project.SPRINT 4:

- The team should always be updating the project as per the recent trends and requirements.
- The team should finally deploy and train the project.



- The team should always have a check on the result of the projects.

## Reports from JIRA

### 5. CODING AND SOLUTIONING

#### Feature 1

```
import os

import numpy as np #used for numerical analysis

from flask import Flask,request,render_template

# Flask-It is our framework which we are going to use to run/serve our application.

#request-for accessing file which was uploaded by the user on our application.

#render_template- used for rendering the html pages  from tensorflow.keras.models import
load_model#to load our trained model  from tensorflow.keras

.preprocessing import image  app=Flask(__name__)#our flask app

model=load_model('ECG.h5')#loading the model  @app.route

("/") #default route  def about():    return render_template("home.html")

#rendering html page  @app.route("/home")

#default route  def home():    return render_template("home.html")#rendering html page

@ app.route("/info")

#default route  def information():    return render_template("info.html")

#rendering html page  @app.route("/upload") #default route  def test():    return
render_template("predict.html")

#rendering html page  @app.route("/predict",methods=["POST","GET"])

#route for our prediction  def upload():

if request.method=='POST':

f=request.files['file'] #requesting the file  filepath=os.path.dirname('__file__')

#storing the file directory  filepath=os.path.join(basepath,"uploads",f.filename)
```



```

#storing the file in uploads folder f.save(filepath)

#saving the file  print("file save") img=image.load_img(filepath,target_size=(64,64))

#load and reshaping the image x=image.img_to_array(img)

#converting image to array x=np.expand_dims(x,axis=0)                                #changing the
dimensions of the image

## pred=model.predict(x)                                                            #predicting
classes

## y_pred = np.argmax(pred)
##print("prediction",y_pred)#printing the prediction

preds=model.predict(x)#predicting classes

pred=np.argmax(preds,axis=1)#predicting classes

print("prediction",pred)#printing the prediction

index=['Left Bundle Branch Block','Normal','Premature Atrial Contraction','Premature Ventricular
Contractions', 'Right Bundle Branch Block','Ventricular Fibrillation']

## result=str(index[y_pred])result=str(index[pred[0]])return result
#resturing the result  return None  #port = int(os.getenv("PORT")) if __name__=="__main__":
app.run(debug=False)#running our app  #app.run(host='0.0.0.0', port=8000)

```

## Feature 2

```

<!DOCTYPE html>

<html>                                                                    <head>
<meta charset="UTF-8">
<meta http-equiv="X-UA-Compatible" content="IE=edge">
<meta name="viewport" content="width=device-width, initial-scale=1.0">
<title>Home</title>
<style>

body {                            margin: 0px;                padding: 0px;                font-family: sans-serif;                }                /*
.pd {

padding-bottom: 100%;                } */

.navbar {                padding: 20px 0px 40px;                ;

background-color: #222;

font-size: 25px;

text-align: center;                }                .

navbar a {                color: #eee;                float: right;

```



```

text-decoration: none;
font-style: normal;
font-family: sans-serif;
padding-right:
10px;    }
a:hover {
color: rgb(0, 0, 0);
rgb(17, 194, 238);
radius: 5px;
5px;    }    .content{    background-image: url("https://thumbs.gfycat.com/ChiefHeftyBasil-
small.gif");

background-size: cover;
background-repeat: no-repeat;
height: 87vh;    margin-top: -21px;    }    .dic p {    color: white;    text-align: center;
font-family: sans-serif;    font-size: 30px;    }

```

```

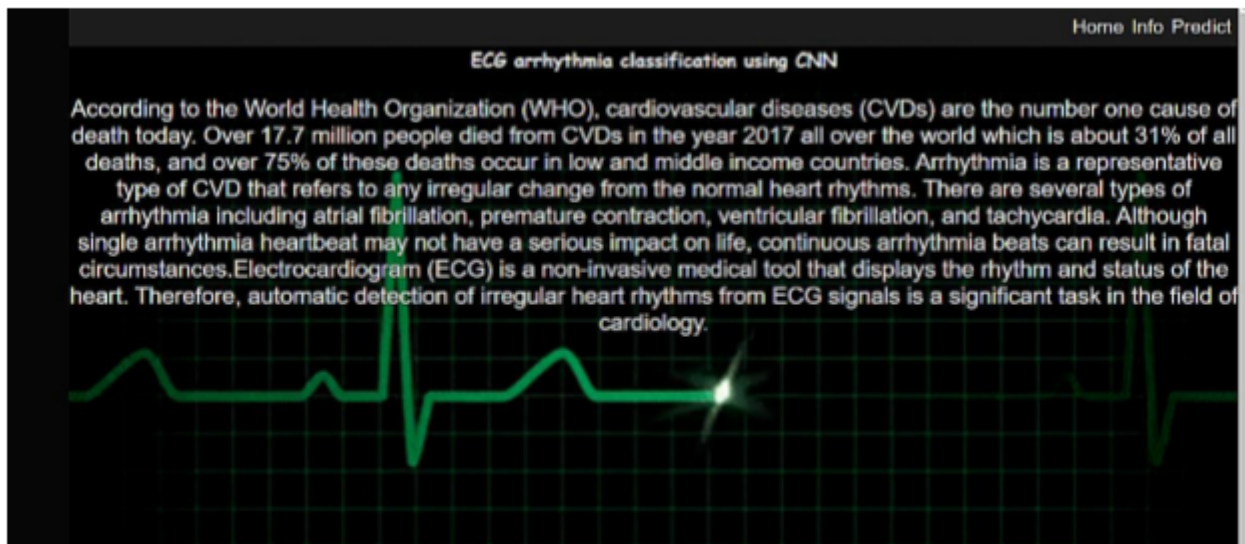
    footer{
flex;
background-color: #222;
margin-top: -10px;
color: white;    }
</head>
<body>
<div class="navbar">
<a href="/upload">Predict</a>
<a href="/info">Info</a>
<a href="/home">Home</a>
</div>
<div class="content">
<h2 style="display: flex;justify-content: center;
color:white;size:15;font-family:comic Sans MS">
ECG arrhythmia classification using CNN
</h2>
<div class="dic">
<p>According to the World Health Organization (WHO), cardiovascular diseases (CVDs) are the
number one cause of death today. Over 17.7 million people died from CVDs in the year 2017    all
over the world which is about 31% of all deaths, and over 75% of these deaths occur in low and middle
income countries. Arrhythmia is a representative type of CVD that refers to any irregular change from the
normal heart rhythms. There are several types of arrhythmia including atrial fibrillation, premature
contraction, ventricular fibrillation, and tachycardia. Although single arrhythmia heartbeat may not have a
serious impact on life, continuous arrhythmia beats can result in fatal circumstances.Electrocardiogram
(ECG) is a non-invasive medical tool that displays the rhythm and status of the heart. Therefore,
automatic detection of irregular heart rhythms from ECG signals is a    significant task in the field
of cardiology.
</p>
</div>

```



<footer>  
<h4>@All Rights Reserved</h4>  
</footer> </body> </html>

#### OUTPUT:



## 6. TESTING

### Test Cases



This report shows the number of test cases that have passed, failed, and untested

Section	Total Cases	Not Tested	Fail	Passes
Home page	3	0	3	3
Information page	6	1	1	5

Predict page	2	0	0	2
Final Report Output	4	0	0	4
Version Control	2	0	0	2

## User Acceptance Testing

				UAT ID	UAT ID				
				Team ID	PNT202TMD19938				
				Project Name	Classification of Arrhythmia by Using Deep Learning				
				Maximum Marks	4 marks				
Test case ID	Feature Type	Component	Test Scenario	Pre-Requirement	Steps To Execute	Test Data	Expected Result	Actual Result	Status
Navigation	Functional	Home Page	Validate all the tabs in the navigator		1. Enter URL and click go		All the three tabs should be visible	Working as	pass
Home	Functional	Home page	Verify the visibility of the video		1. Enter URL and click go		User should able to view the video	Working as	Pass
Home pageTC_002	Functional	Home Page	Validate the description of the image		1. Enter URL and click go		Description should be visible on	Working as	Pass
Home pageTC_003	Functional	Home Page	Verify the user is able to navigate to		1. Enter the URL and click go		It should redirect the user to the	Working as	pass
Information page_T	Functional	Introduction	Verify the user is in the introduction		1. Enter the URL and click go		User should be in the introduction	Working as	pass
Information	Functional	Introduction	Verify the page title and information		1. Enter the URL and click go		User should able to view the	Working as	pass
Predict page	Functional	predict	Verify the working of predict page		1. Enter the URL and click go		User should be able to visit the	Working as	pass
Predict page	Functional	predict	Verify the upload image option		1. Enter the URL and click go		Make sure the option works	Working as	Pass
Predict	Functional	predict	Verify the choose button is enabled		1. Enter the URL and click go		The choose button option should	Working as	Pass
Predict	Functional	predict	Verify the user is able to access		1. Enter the URL and click go		Image should be uploaded	Working as	pass
Predict	Functional	predict	Verify the selected image is same		1. Enter the URL and click go		Selected image should be an ECG 2D	Working as	pass
Predict	Functional	predict	Verify the working condition of the		1. Enter the URL and click go		The type of arrhythmia should be	Working as	pass

## 7. ADVANTAGES & DISADVANTAGES

### ADVANTAGES

- The proposed model predicts Arrhythmia in images with a high accuracy rate of nearly 96%
- The early detection of Arrhythmia gives better understanding of disease causes, initiates therapeutic interventions and enables developing appropriate treatments.

### DISADVANTAGES

- Not useful for identifying the different stages of Arrhythmia disease.





➤ Not useful in monitoring motor symptoms.

## 8. CONCLUSION

- In this project, we proposed a 2-D ECG-based classification model for automatic classification of cardiac arrhythmias using ECG signals.
- An accurate taxonomy of ECG signals is extremely helpful in the prevention and diagnosis of CVDs.



These results indicate that the prediction and classification of arrhythmia with 2-D ECG representation spectrograms and the CNN model is a reliable operative technique in the diagnosis of CVDs.

- It is endowed with an ability to effectively process the non-filtered dataset with its potential anti-noise features. Besides that, ten-fold cross-validation is implemented in this work to further demonstrate the robustness of the network.

## 9. FUTURE SCOPE

- ✓ For future work, it would be interesting to explore the use of optimization techniques to find a feasible design and solution.
- ✓ The limitation of our study is that we have yet to apply any optimization techniques to optimize the model parameters and we believe that with the implementation of the optimization, it will be able to further elevate the performance of the proposed solution to the next level.

## 10. APPENDIX

Demo Link: [IBM-Project-41147-1660639817/Demo video.mp4](#)

