# ECG ARRHYTHMIA CLASSIFICATION

## using Convolution Neural Network

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# 1.INTRODUCTION

An arrhythmia is a problem with the rate or rhythm of the heartbeat. During an arrhythmia, the heart can beat too fast, too slowly, or with an irregular rhythm. Arrhythmia is caused by changes in heart tissue and activity or in the electrical signals that control your heartbeat. These changes can be caused by damage from disease, injury, or genetics. Often there are no symptoms, but some people feel an irregular heartbeat. You may feel faint or dizzy or have difficulty breathing. It can also occur suddenly as a result of exertion or stress, imbalances in the blood, medicines, or problems with electrical signals in the heart. Typically, an arrhythmia is set off by a trigger, and the irregular heartbeat can continue if there is a problem in the heart. Sometimes the cause of an arrhythmia is unknown .

The most common test used to diagnose an arrhythmia is an electrocardiogram (ECG). Your doctor will run other tests as needed. She or he may recommend medicines, placement of a device that can correct an irregular heartbeat, or surgery to repair nerves that are over stimulating the heart. If arrhythmia is left untreated, the heart may not be able to pump enough blood to the body. This can damage the heart, the brain, or other organs.

Common arrhythmia treatments include heart-healthy lifestyle changes, medicines, surgically implanted devices that control the heartbeat, and other procedures that treat abnormal electrical signals in the heart.

Electrocardiography is the process of producing an electrocardiogram (ECG). It is a graph of voltage versus time of the electrical activity of the heart using electrodes placed on the skin.

Some people may not experience active symptoms due to arrhythmia. However, treatment is still essential for preventing further complications, which may include stroke and heart failure.

Stroke: Atrial fibrillation means that the heart is not pumping effectively. This condition can cause blood to collect in pools and form clots. If a clot dislodges, it may travel to a brain artery, causing a potentially fatal blockage, or stroke. Stroke can cause brain damage and require emergency treatment.

Heart failure: Prolonged tachycardia or bradycardia can result in heart failure. When the heart is failing, it cannot pump enough blood to the body and its organs. Treatment can usually help improve this.

## 1.1 Overview

Nowadays heart disease is one of the serious diseases threatening human health, and a robust and efficient method is needed to achieve a real-time analysis and help doctors to diagnose. In this project, we propose an effective electrocardiogram (ECG) arrhythmia classification method using a deep two-dimensional convolutional neural network

(CNN), in which we classify ECG into 5 categories, one being normal and the other six being different types of arrhythmia. The overall goal of performing an ECG is to obtain information about the electrical function of the heart. Although convolutional neural networks (CNNs) can be used to classify electrocardiogram (ECG) beats in the diagnosis of cardiovascular disease, ECG signals are typically processed as one-dimensional signals while CNNs are better suited to multidimensional pattern or image recognition applications. In this study, the morphology and rhythm of heartbeats are fused into a two-dimensional information vector for subsequent processing by CNNs that include adaptive learning rate and biased dropout methods. The results demonstrate that the proposed CNN model is effective for detecting irregular heartbeats or arrhythmias via automatic feature extraction. When the proposed model was tested on the arrhythmia database, the model achieved higher performance than other state-of-the-art methods for five and eight heartbeat categories. In particular, the proposed system had better performance in terms of the sensitivity and positive predictive rate when compared to existing algorithms.

It is anticipated that the proposed method will be suitable for implementation on portable devices for the health monitoring of cardiovascular disease.

## 1.2 Purpose

1. Classification of electrocardiogram (ECG) signals plays an important role in clinical diagnosis of heart disease. Our Project proposes the design of an efficient system for classification of the fusion beat (F), normal beat (N), Premature Ventricular

Contractions(Q), supraventricular ectopic beat (S) and ventricular ectopic beat (V) using convolution Neural Networks.

2. Our aim from the project is to make use of keras to extract the libraries for machine learning .The aim of this research was to detect features for accurate images comparison.
3. Secondly, to learn how to hyper tune the different types of heart rhythm images to machine learning algorithm.
4. And in the end, we develop a model which can tell us type of ECG Arrhythmia . The objective is achieved through applying CNN

# 2. LITERATURE SURVEY

Several researchers has proposed and implemented classification of ECG arrhythmia using different approaches of image processing and machine learning.

- DANVILLE, Pa. – Geisinger researchers have found that artificial intelligence can examine electrocardiogram (ECG) test results to identify patients at risk of developing a potentially dangerous type of arrhythmia with an irregular heartbeat or of dying within a year. As a result, there classifier achieved 99.05% average accuracy with 97.85% average sensitivity.
- Jingshan Huang, Bin Yao, Wangpeng He proposed an ECG arrhythmia classification method based on deep learning techniques. In the procedure of the proposed method, the ECG signals in the time domain were transformed into

two-dimensional time-frequency ECG spectrograms by short-time Fourier transform. The resultant ECG spectrograms were used as input to the proposed method. The ECG arrhythmia was identified and classified using the CNN. The results show that the classification of ECG signals based on two-dimensional convolution neural network can reach an averaged accuracy of 99.00%.

- Xiaolong Zhai, Chung Tin proposed a CNN-based framework for heartbeat classification using dual-beat ECG coupling matrix. This 2-D encoded dual-beat coupling matrix of ECG is an effective representation of both heartbeat morphology and rhythm. They have also proposed an automatic selection procedure for picking the most useful training beats systematically to boost the classification performance. There proposed method was tested using the MIT-BIH arrhythmia database. They showed that our 2-D CNN-based classifier can offer 12.2% higher Sen and 11.9% higher Ppr respectively for S beat detection when compared with previous 1-D CNN based method . Furthermore, performance metrics for VEB detection are all well above 90%. These results support that there 2-D CNN framework could be a useful tool for automatic heartbeat classification without explicit ECG feature extraction.

In our project, we use deep learning techniques. Deep Learning is the process of analyzing data from different perspectives and extracting useful knowledge from it. It is the core of knowledge discovery process..

Different data learning techniques include

- Convolutional Neural Networks

- Recurrent Neural Networks (RNNs)
- Generative Adversarial Networks
- Self-Organizing Maps
- Boltzmann Machines
- Deep Reinforcement Learning
- Autoencoders.

Convolution neural network is the most applied deep learning technique, which detects predictions based on image classification and uses object detection code to predict image through video analysis. Identifying type of ECG Arrhythmia and identifying the object based on images are particularly well suited to deep learning techniques. In CNN, training set is used to build the model as the Imagedatagenerator class which can classify the data items into its images into appropriate classes. A test set is used to validate the model.

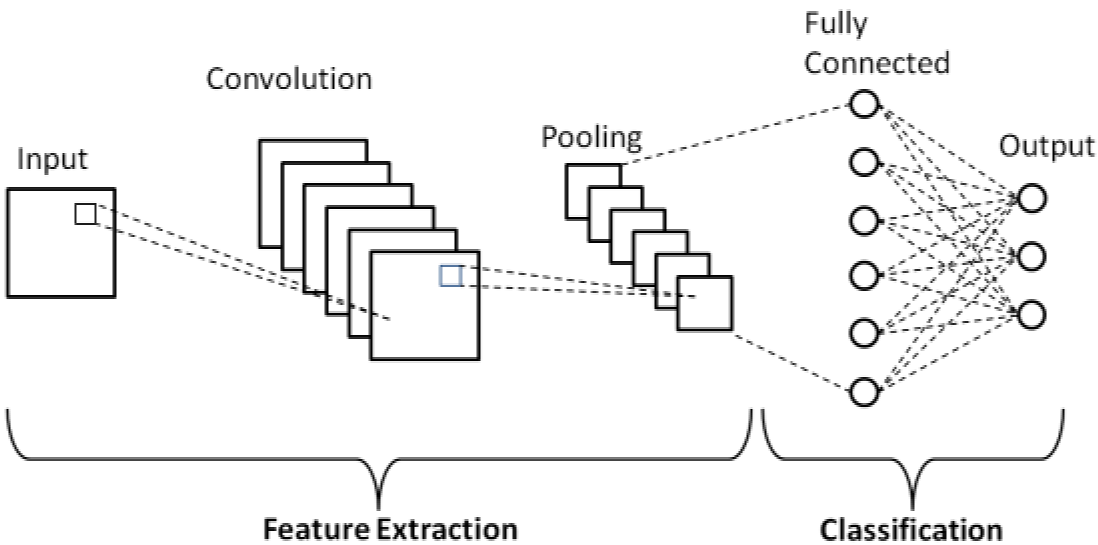
## 2.1 Existing Problem:

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. For example, prolonged premature ventricular contraction (PVCs) beats occasionally turn into a ventricular tachycardia (VT) or ventricular fibrillation (VF) beats which can immediately lead to heart failure. Thus, it is important to periodically monitor the heart rhythms to manage and prevent the CVDs. 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.

## 2.2 Proposed Solution:

### CNN Architecture

The proposed CNN architecture mainly consists of the following layers: two convolution layers which follow two max-pooling layers and one fully-connected layer with two softmax unit.the network begins with a convolution layer, in which the first convolution layer takes the image with input size of 50 × 50 pixels. The second convolution layer consists of 32 feature maps with the convolution kernel of 3 × 3. The kernel size for max pooling layers is 2 × 2 and the stride of 2 pixels, and the fully-connected layer generates an output of 1024 dimensions. These 10 outputs are then passed to another fully connected layer containing 2 softmax units, which represent the probability that the image is containing the regular heart rhythm or not. Note that each convolution layer in our CNN model is followed by a rectified linear unit (ReLU) layer to produce their outputs. After applying these architectures, some images detected with normal beats and some identified as Ventricular ectopic Beat, Supraventricular ectopic Beat, Fusion Beat, premature ventricular contractions. And also we have created an UI using the Flask for the ECG Arrhythmia Classification prediction,this UI will allow the users to predict the case status very easily and the User interface is user friendly not at least one complication in using the interface.

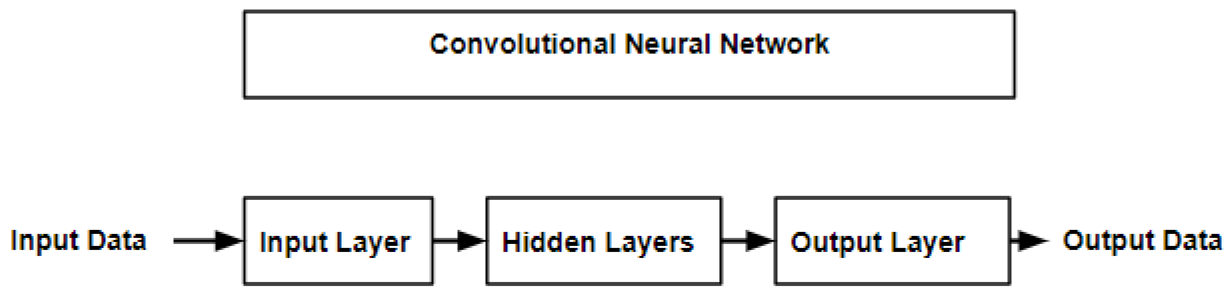


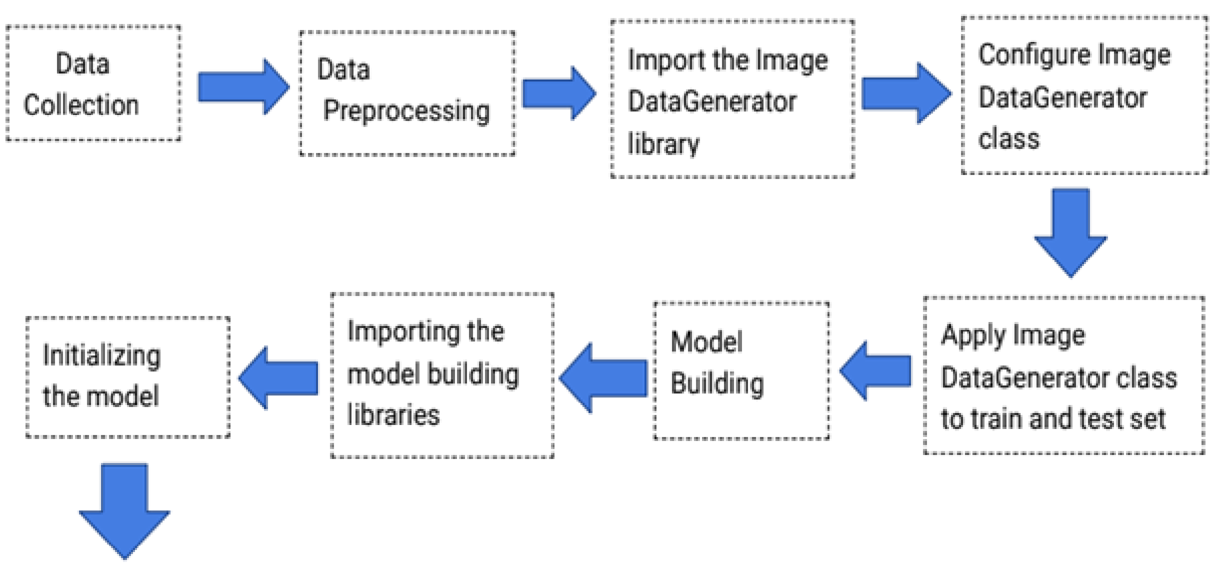

## 3. THEORITICAL ANALYSIS

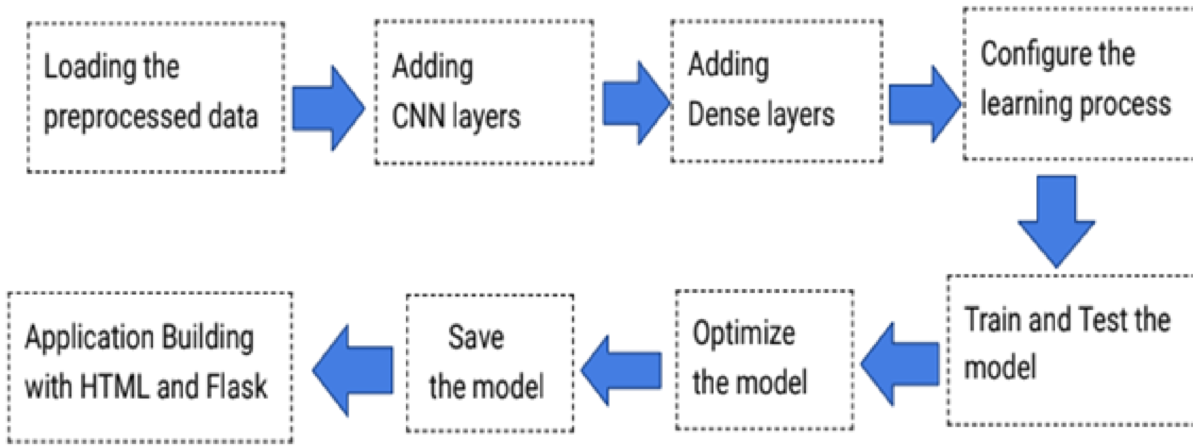
Recently, image processing techniques are widely used in several medical areas for image improvement in earlier detection and treatment stages, where the time factor is very important to discover the abnormality issues in target images, especially in various risk factors for an enlarged heart such as high blood pressure or symptoms of heart disease, such as chest pain, shortness of breath, an irregular heartbeat or heavy heartbeats. Image quality and accuracy is the core factors of this research, image quality assessment as well as improvement are depending on the enhancement stage where low pre-processing techniques are used . The proposed technique is efficient for segmentation principles to be a region of interest foundation for feature extraction obtaining.

In recent years, advanced analysis of medical imaging using radiomics, machine, and deep-learning, including convolutional neural networks (CNNs), has been explored. These approaches offer great promise for future applications for both diagnostic and predictive purposes. CNNs are nonexplicitly programmed algorithms that identify relevant features on the images that allow them to classify an input object. They have been applied in various tasks such as detection, segmentation , and diagnosis

**3.1 Block Diagram:**.





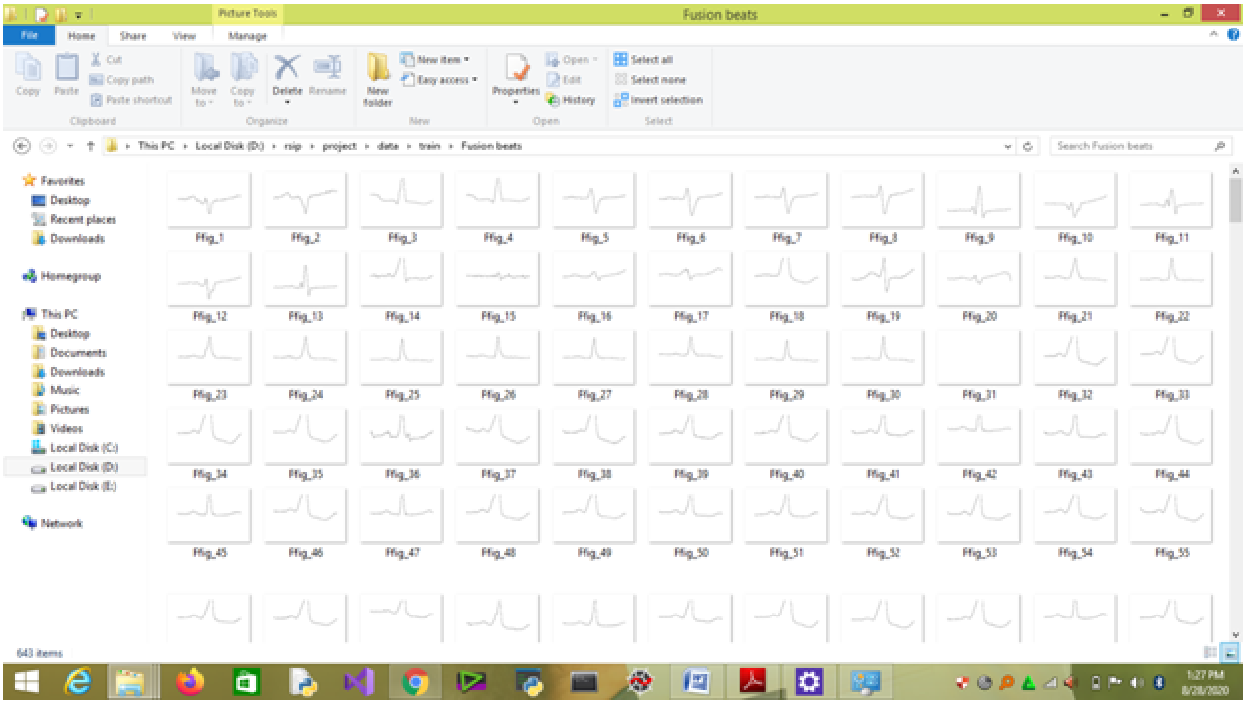

## 3.2 Software Designing

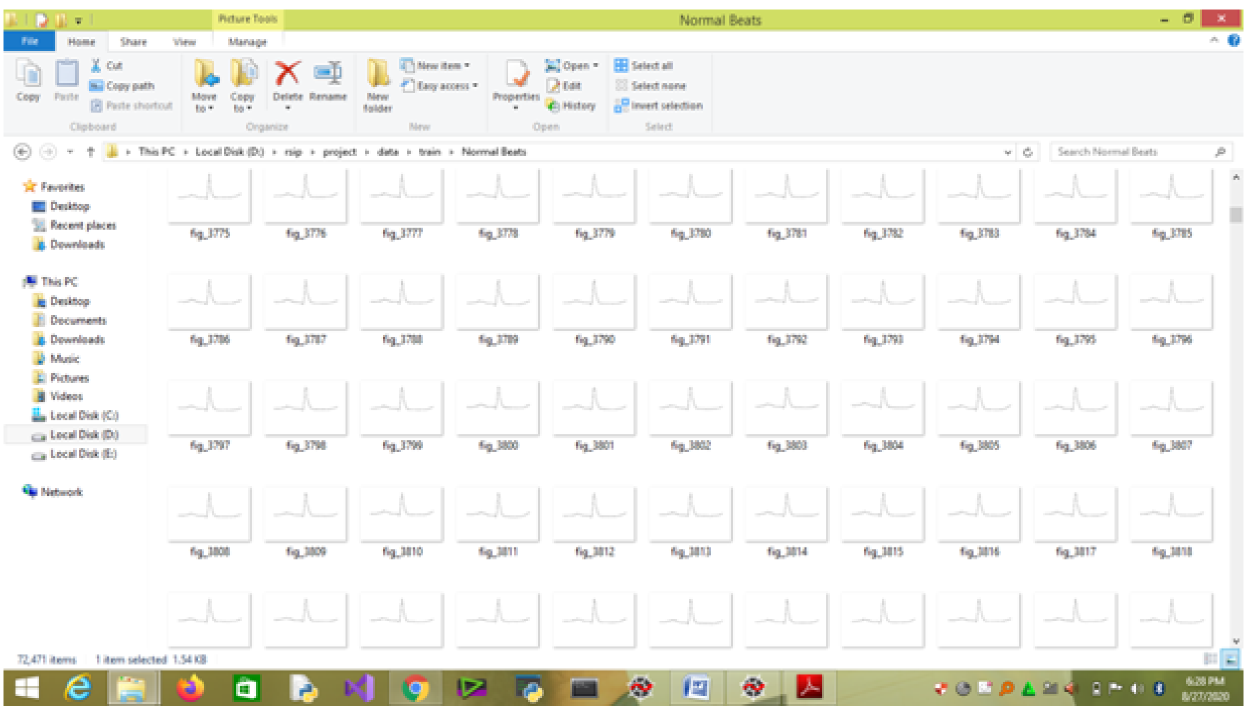
- ➤ Jupyter notebook Environment
- ➤ Spyder IDE
- ➤ Deep Learning Algorithm(CNN)
- ➤ HTML
- ➤ Flask App

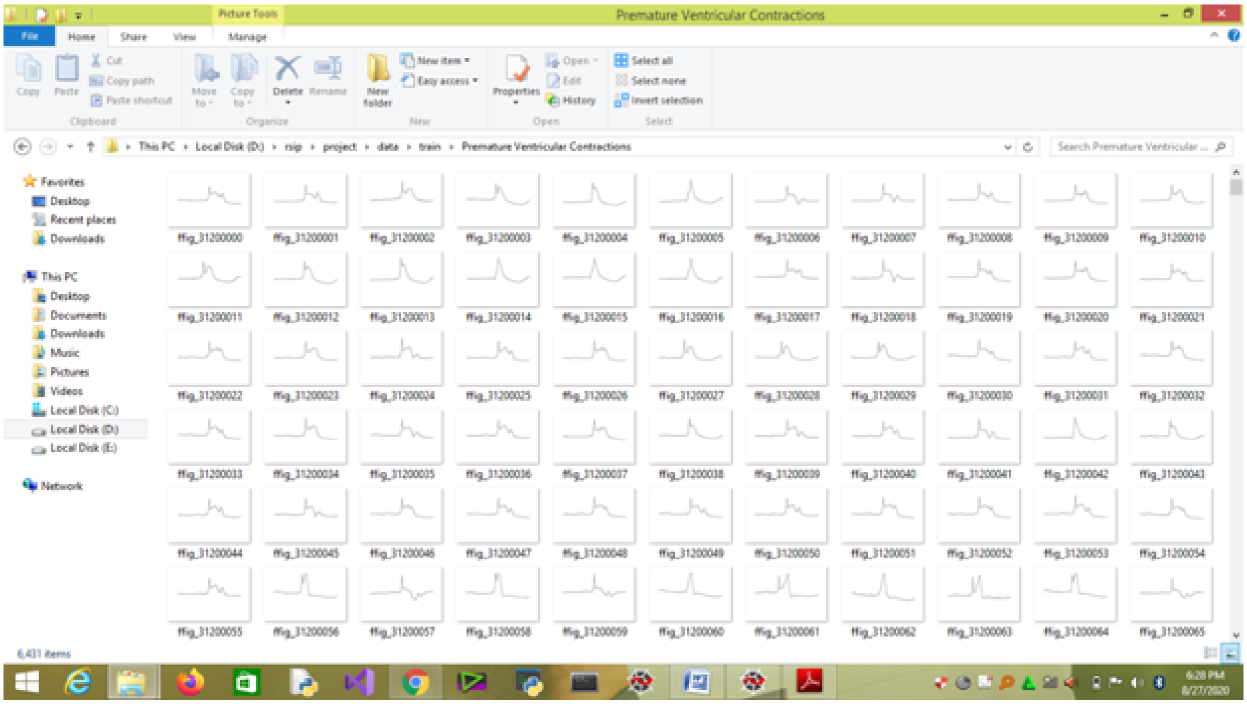
We developed this ECG Arrhythmia Classification by using the Python language which is a interpreted and high level programming language and using the Deep Learning algorithms. For coding we used the Jupyter Notebook environment of the Anaconda distributions and the Spyder, it is an integrated scientific programming in the python language. For creating an user interface for the prediction we used the Flask. It is a micro web framework written in Python. It is classified as a micro framework because it does not require particular tools or libraries. It has no database abstraction layer, form validation, or any other components where pre-existing third-party libraries provide common functions, and a scripting language to create a webpage is HTML by creating the templates to use in the functions of the Flask and HTML.

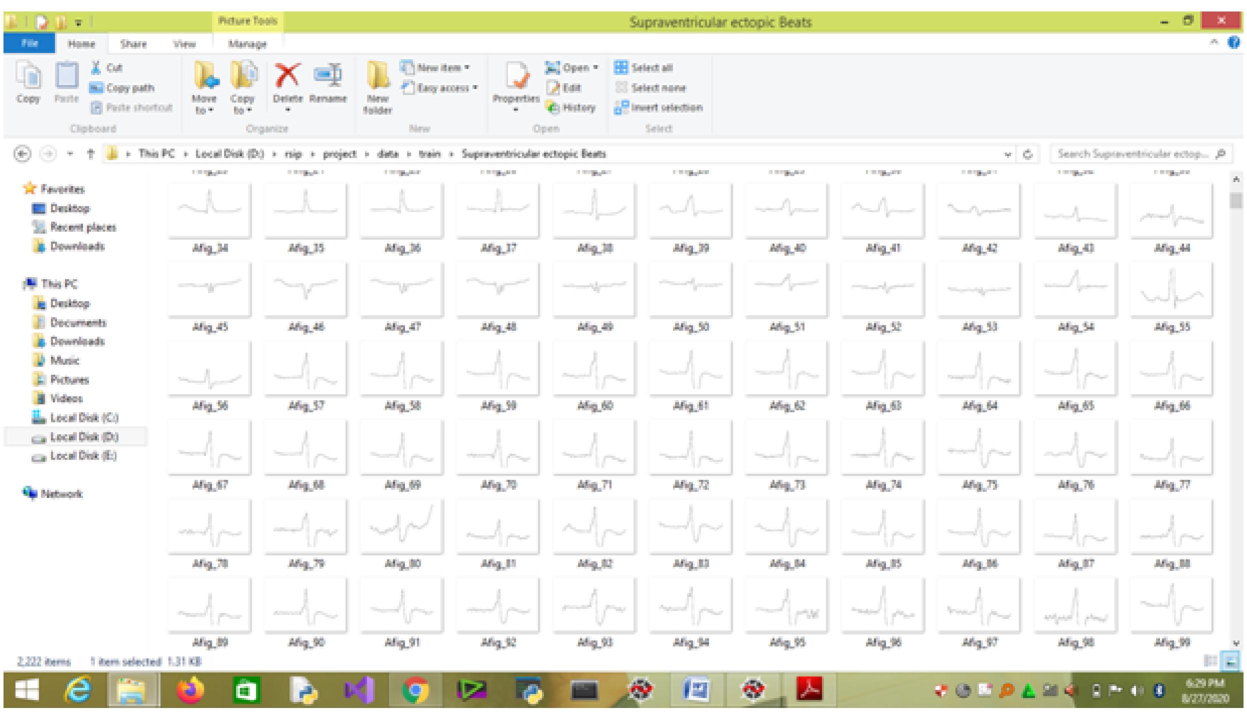
## 4. EXPERIMENTAL INVESTIGATION

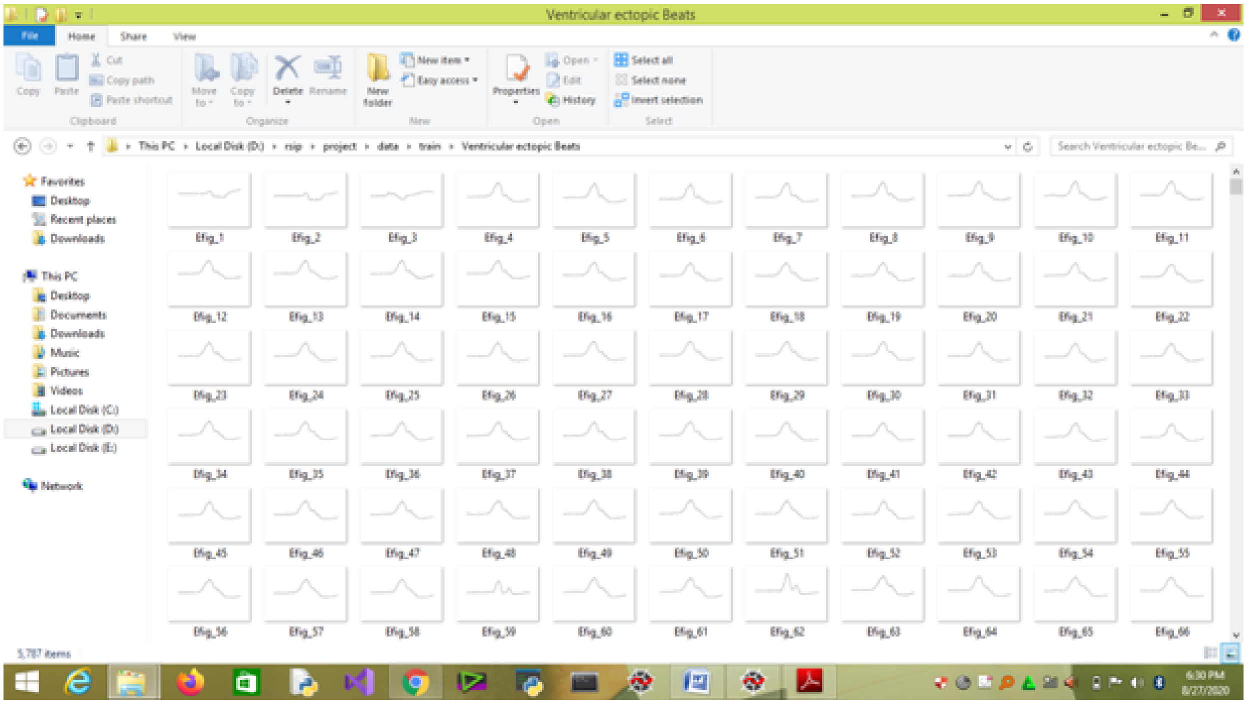
Our dataset consists of two sets of folders they are train set and test set. In train set we have five classes named as Fusion Beat,Normal Beat, premature ventricular contractions,Supraventricular ectopic Beat , Ventricular ectopic Beat with total 89555 images in train set where Fusion Beat images are 643,Normal Beat images are 72,471, premature ventricular contraction images are 6,431, Supraventricular ectopic Beat images are 2,222and Ventricular ectopic Beat images are 5,788.In test set we have five classes named as Fusion Beat,Normal Beat,premature ventricular contractions,Supraventricular ectopic Beat,Ventricular ectopic Beat with total 21,890 images in test set where Fusion Beat images are 160,Normal Beat images are 18,118, premature ventricular contraction images are 1,607, Supraventricular ectopic Beat images are 557 and Ventricular ectopic Beat images are 1,448 .CNN is a machine-learning technique based on an artificial neural network with deep architecture relying on convolution operations (the linear application of a filter or kernel to local neighbourhoods of pixel/voxels in an input image) and downsampling or pooling operations (grouping of feature map signals into a lower-resolution featuremap). The final classification or regression task relies on higher-level features representative of a large receptive field that is flattened into a single vector. The development of an algorithm entails selection of the hyper parameters, training and validation, and testing. The hyper parameters include the network topology, the number of filters per layer, and the optimisation parameters. During the training process, the dataset of input images (divided into training and validation sets) is repeatedly submitted to the network to capture the structure of the images that is salient for the task. Initially, the weights for each artificial neuron are randomly chosen. Then, they are adjusted at each iteration, targeting minimisation of the loss function, which quantifies how close the prediction is to the target class. The performance of the trained model is then evaluated using an independent test dataset. This is also aimed at assessing whether an “overfitting” has occurred. The overfitting problem can arise in the case of limited datasets with too many parameters compared with the dataset size, in which case a model “memorises” the training data rather than generalising from them .



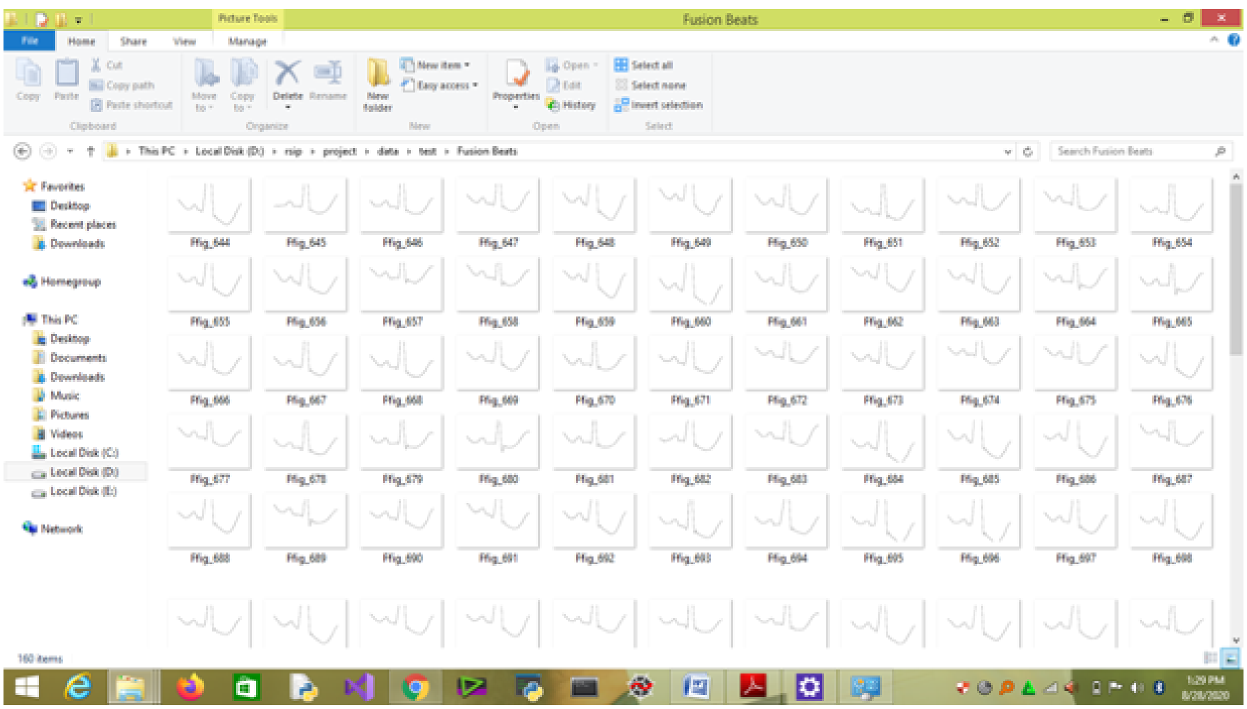


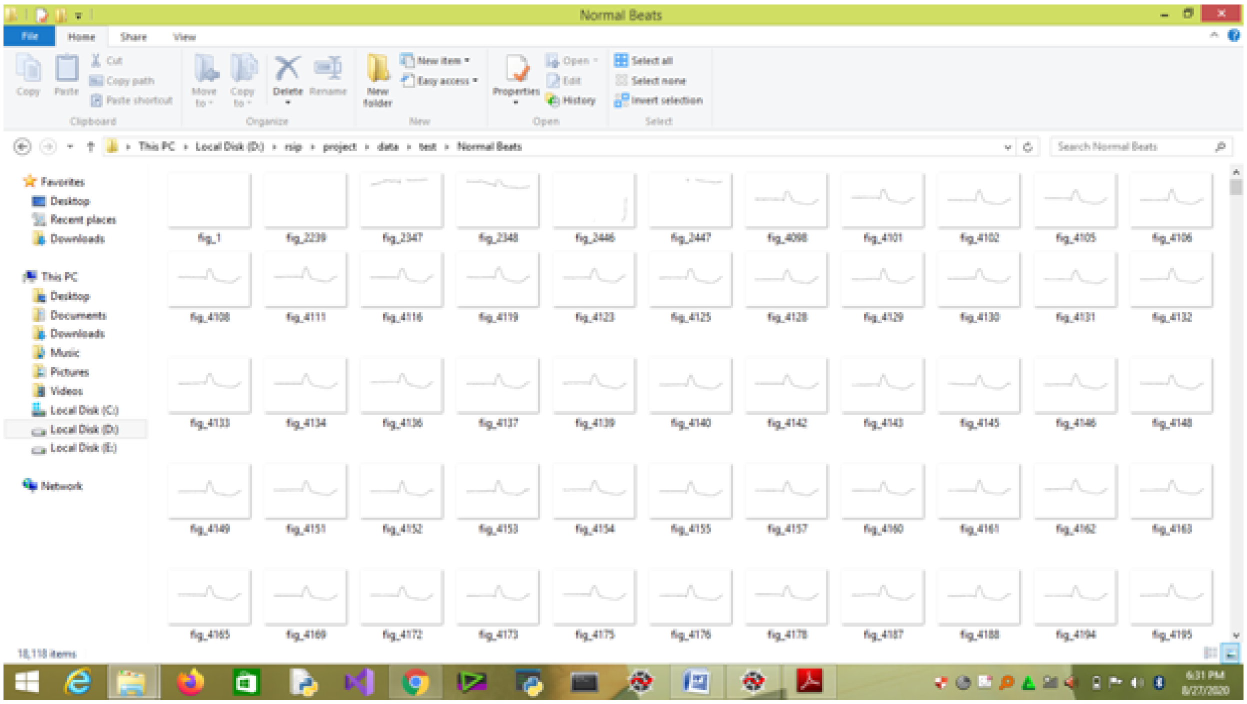

Premature Ventricular Contractions
This PC › Local Disk (D:) › rsip › project › data › train › Premature Ventricular Contractions
6,431 items

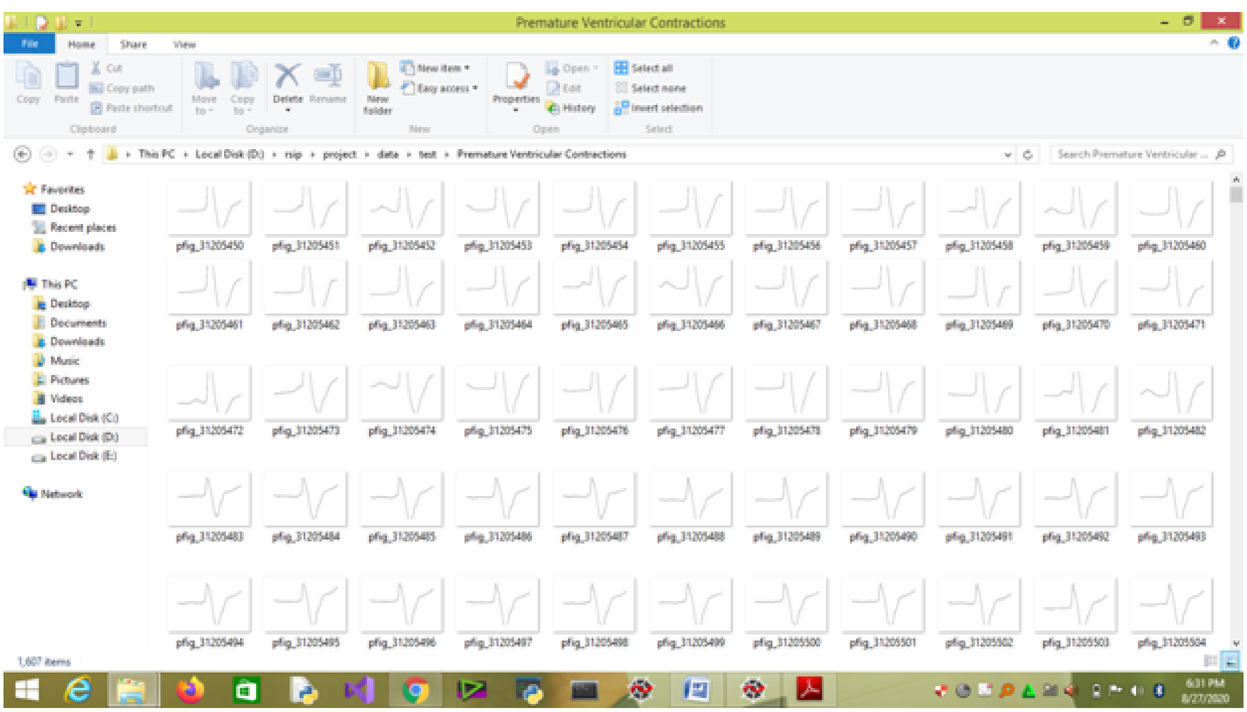

Supraventricular ectopic Beats
This PC › Local Disk (D:) › rsip › project › data › train › Supraventricular ectopic Beats
2,222 items

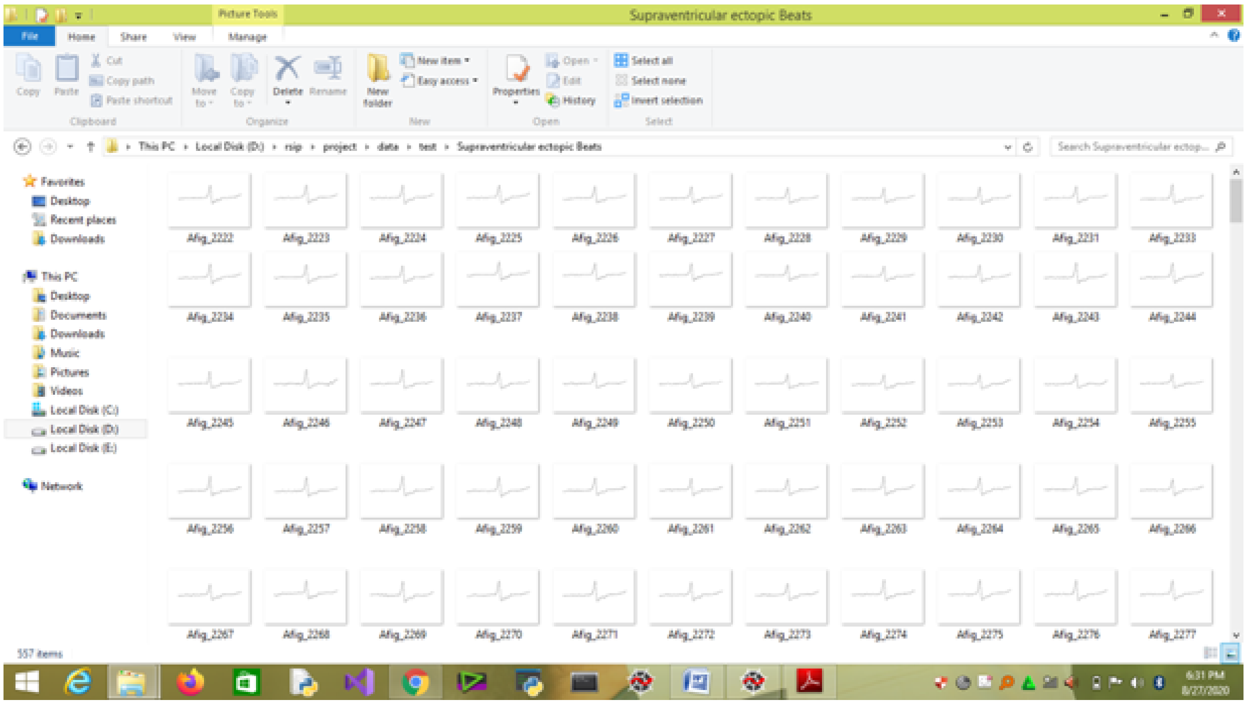


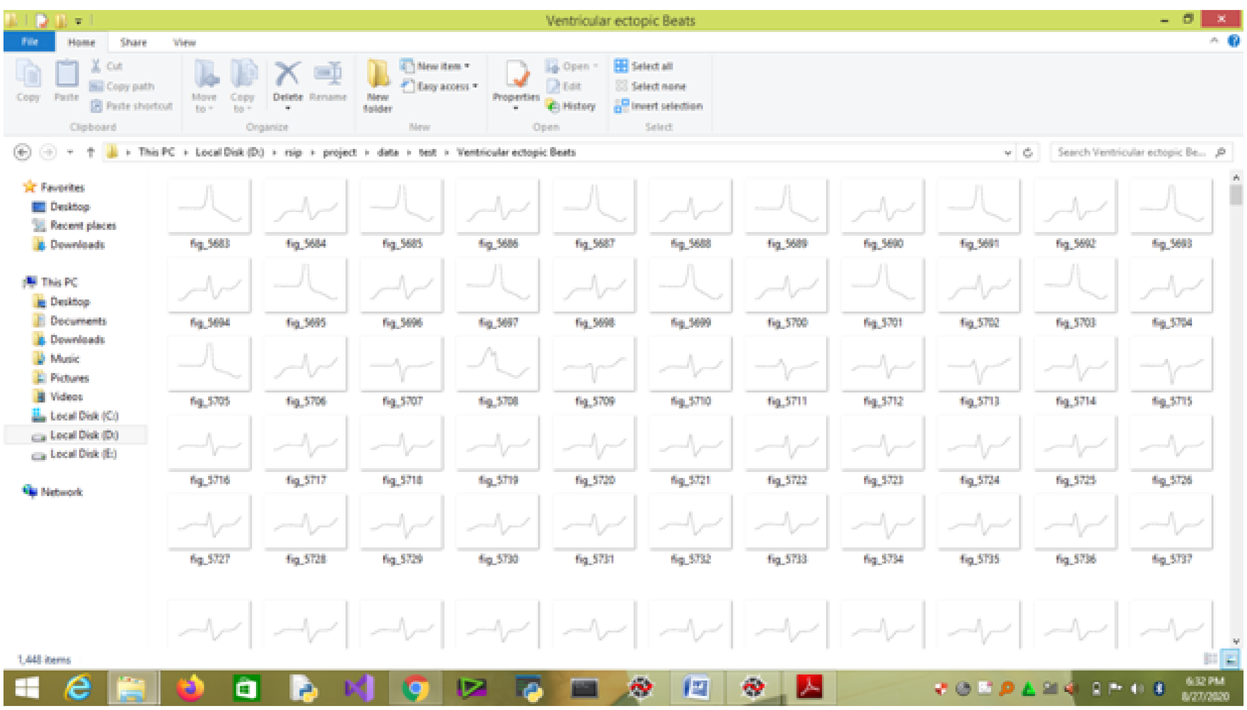

The Above Figures are of Train set




Normal Beats
This PC › Local Disk (D:) › rsip › project › data › test › Normal Beats

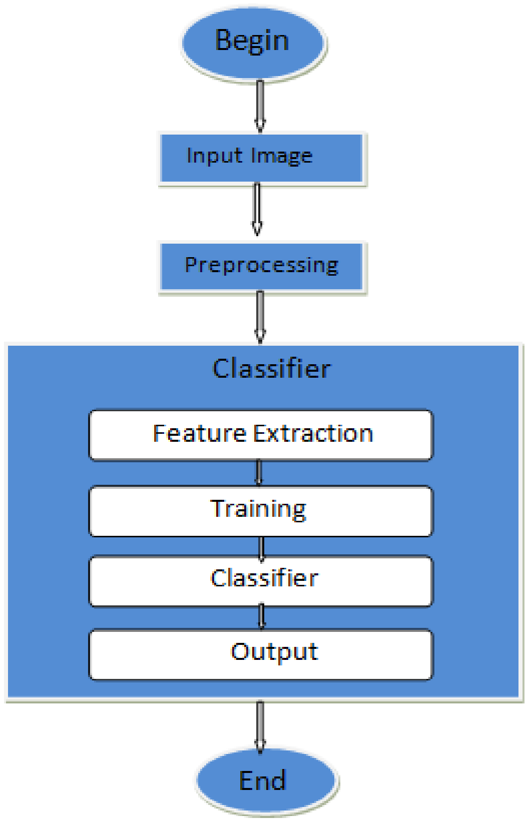

Premature Ventricular Contractions
This PC › Local Disk (D:) › rsip › project › data › test › Premature Ventricular Contractions

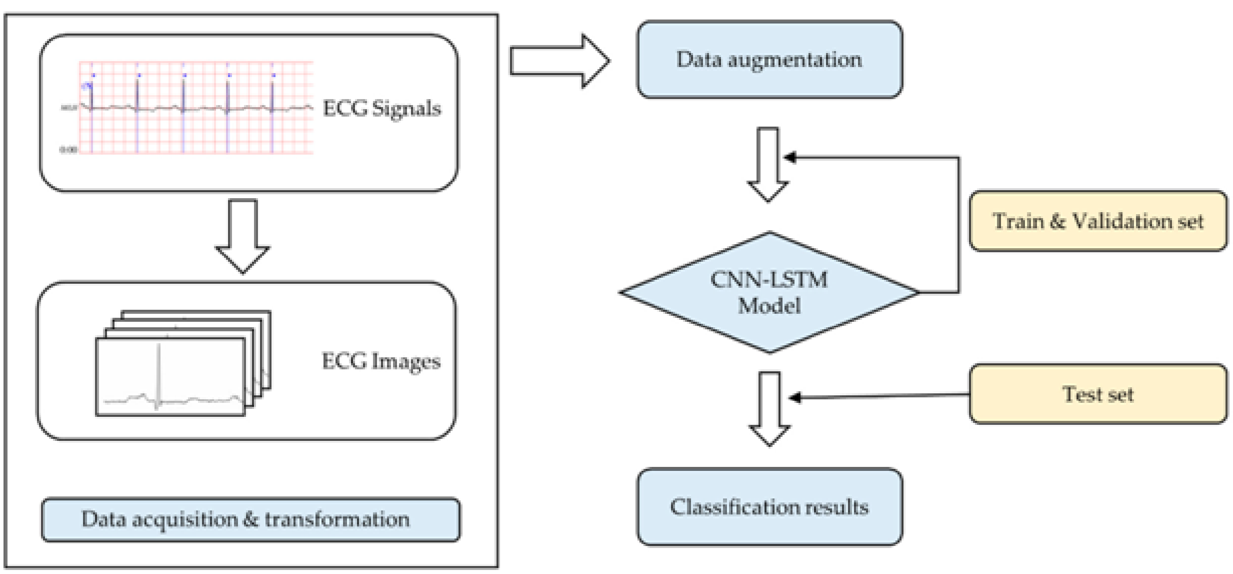



The Above Figures are of Test set

# 5. Flowchart

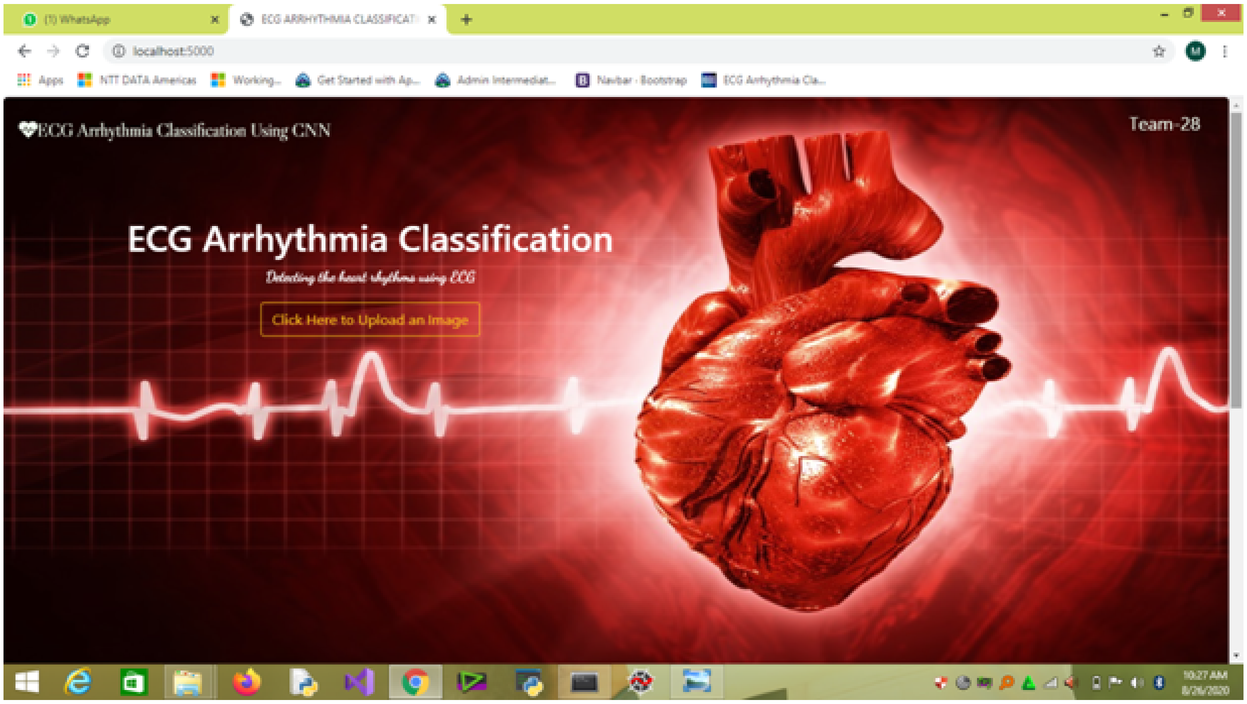

Begin
Input Image
Preprocessing
Classifier
Feature Extraction
Training
Classifier
Output
End

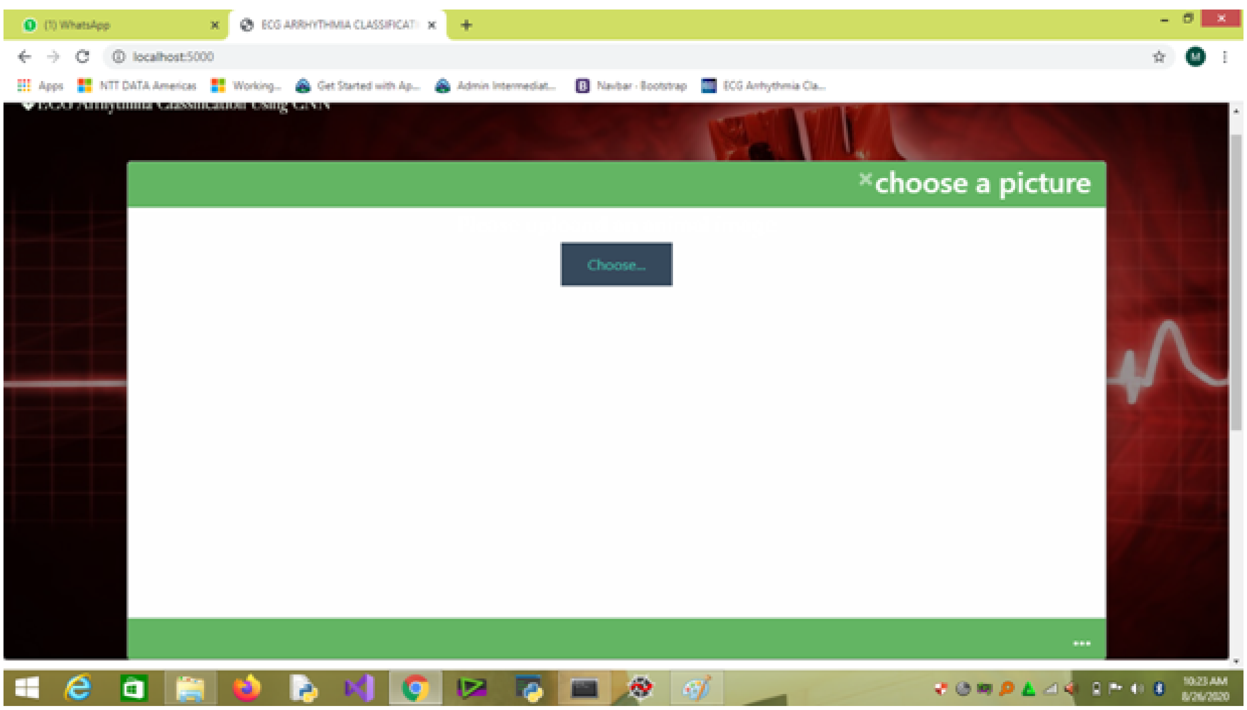

ECG Signals
ECG Images
Data acquisition & transformation
Data augmentation
Train & Validation set
CNN-LSTM Model
Test set
Classification results

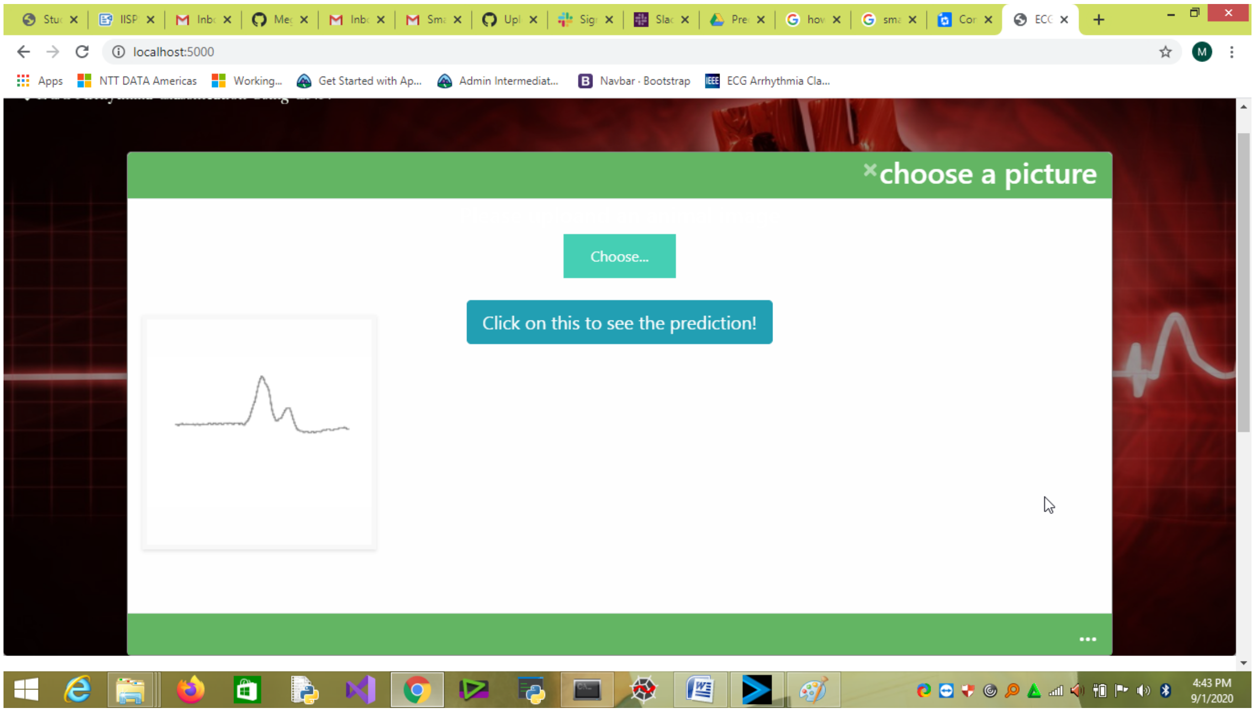
# 6.RESULT

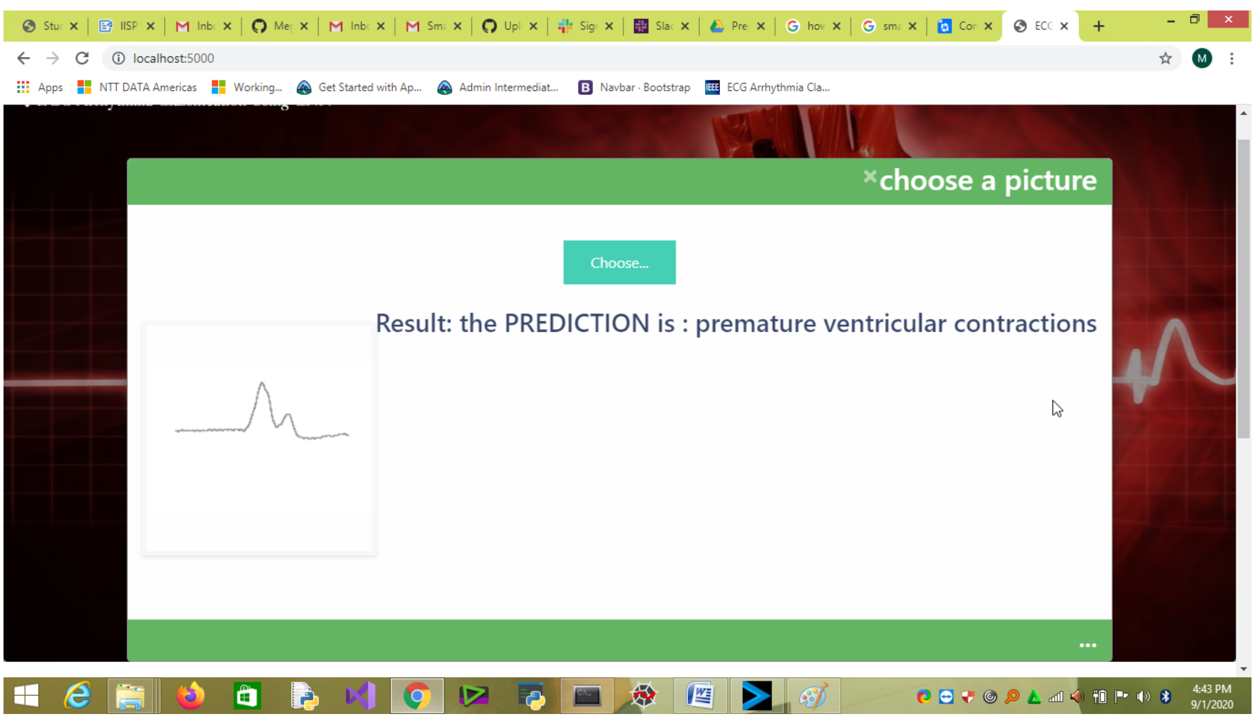
In this methodology, we can recognize and classify the ECG Arrhythmia and analyze the condition of a person.

In this, the convolution neural networks is used to predict the outcome based on image analysis by giving an object detection code. There are many algorithms in machine learning techniques which are used to classify the ECG arrhythmia, but the technique I have used in this project is deep learning technique. The neural networks using ImageDataGenerator class and feature detectors it predicts an image whether the ECG beat is normal or other category. By having good amount of training images for training and testing images for testing my model has predicted good accuracy with 96% and validation accuracy as 65%.Firstly I have saved my model and checked the predictions whether it is giving correct predictions or not. Secondly after getting correct predictions I have built an web application using flask and html. The screenshots below shows the application building in the UI.


ECG Arrhythmia Classification Using CNN
Team-28
ECG Arrhythmia Classification
Detecting the heart rhythms using ECG
Click Here to Upload an Image


choose a picture
Choose...


localhost:5000
Apps
NTT DATA Americas
Working...
Get Started with Ap...
Admin Intermediat...
Navbar · Bootstrap
ECG Arrhythmia Cla...
choose a picture
Choose...
Click on this to see the prediction!
4:43 PM
9/1/2020


localhost:5000
Apps
NTT DATA Americas
Working...
Get Started with Ap...
Admin Intermediat...
Navbar · Bootstrap
ECG Arrhythmia Cla...
choose a picture
Choose...
Result: the PREDICTION is : premature ventricular contractions
4:43 PM
9/1/2020

# 7. ADVANTAGES AND DISADVANTAGES

## Advantages:

**1.** This work provides a simple method for interpreting ECG related condition for the clinician and helps medical practitioners to make diagnostic decisions.

2. Easily prediction can be done which results in faster treatment for the patient.

3.Once trained, the predictions are pretty fast

## Disadvantages:

1.Needs a clear image for prediction
2.Not robust to unclear images it may predict but it may be not robust in predicting.
3.But in order to predict perfectly the Classification of Images should be done with different Positions

# 8. APPLICATIONS

● Can also be used for different diseases to predict the disease in a short time.
● Not only in predicting the disease but also to predict anything via images this can be used.
● Used to analyze visual imagery.

● Decoding facial recognition.

## 9. CONCLUSION:

Our work mainly focused in the advancement of predictive image analysis and video analysis to achieve good accuracy in predicting valid disease outcomes using Deep learning methods. The analysis of the results signify that the integration of data augmentation images along with different ,feature detectors and Imagedatagenerator class to transform the original data into new data using random translations. Further research in this field should be carried out for the better performance of the classification techniques so that it can predict on more images.

A decision support system for classification ECG Arrhythmia helps and assist physician in making optimum, accurate and timely decision, and reduce the overall cost of treatment. The proposed system greatly reduces the cost of treatment and improves the quality of life by predicting classification of ecg arrhythmia at early stage of development.

## 10. FUTURE SCOPE:

The future work will focus on exploring more of the dataset values and yielding more interesting outcomes. This study can help in making more effective and reliable disease prediction and diagnostic system which will contribute towards developing better healthcare system by reducing overall cost, time and mortality rate. In further study, we will try to conduct experiments on larger data sets or try to tune the model so as to achieve the state -of-art performance of the model and a great UI support system making it complete web application model.

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Scholar

# APPENDIX

## HTML:

```
<html lang="en">
<head>
<meta charset="UTF-8">
<meta name="viewport" content="width=device-width, initial-scale=1.0">
<meta http-equiv="X-UA-Compatible" content="ie=edge">
<title>ECG ARRHYTHMIA CLASSIFICATION</title>
<script src="https://kit.fontawesome.com/c98fe7b6bb.js" crossorigin="anonymous"></script>
<link href="https://fonts.googleapis.com/css2?family=Dancing+Script:wght@700&display=swap" rel="stylesheet">
<link href="https://fonts.googleapis.com/css2?family=Niconne&display=swap" rel="stylesheet">
<link href="https://fonts.googleapis.com/css2?family=Libre+Caslon+Display&display=swap" rel="stylesheet">
<link rel="stylesheet" href="https://cdnjs.cloudflare.com/ajax/libs/font-awesome/4.7.0/css/font-awesome.min.css">
<link href="https://cdn.bootcss.com/bootstrap/4.0.0/css/bootstrap.min.css" rel="stylesheet">
```

```
<script
src="https://cdn.bootcss.com/popper.js/1.12.9/umd/popper.min.js"></script>
    <script src="https://cdn.bootcss.com/jquery/3.3.1/jquery.min.js"></script>
<script
src="https://cdn.bootcss.com/bootstrap/4.0.0/js/bootstrap.min.js"></script>
    <link href="{{ url_for('static', filename='css/main.css') }}" rel="stylesheet">
        <style>

        .bg-primary {
                background-color:#3498DB;
        }
        #result {
                color: #0a1c4ed1;
        }
        .jumbotron {
background-image:
url("https://heartrhythmcentral.com/wp-content/uploads/2018/01/ECG-abstract-
backgrounds-with-human-3D-rendered-heart.jpg ");
      height: 650px;
      background-size: 100% 100%;
      filter: grayscale(10%);
      color: #ffffff;
      padding: 100px 50px;
```

```
        border:100px 50px;
        margin:0px 0px;
   }
  .text {
  text-align: center;
  position: absolute;
  top: 20%;
  left: 10%;
  }
  .navbar-brand{
  color: #F0FFF0      ;
  }

.img-preview {
    width: 256px;
    height: 256px;
    position: absolute;
    border: 5px solid #F8F8F8;
    box-shadow: 0px 2px 4px 0px rgba(0, 0, 0, 0.1);
    margin-top: 1em;
    margin-bottom: 1em;
```

```
}
.img-preview>div {
   width: 100%;
   height: 100%;
   background-size: contain;
   background-repeat: no-repeat;
   background-position: center;
}
.modal {
  display: none;
  position: fixed;
  z-index: 1;
  padding-top: 100px;
  left: 0;
  top: 0;
  width: 100%;
  height: 100%;
  overflow: auto;
  background-color: rgb(0,0,0);
  background-color: rgba(0,0,0,0.4);
}
.modal-content {
```

```
  position: relative;
  background-color: #fefefe;
  margin: auto;
  padding: 0;
  border: 1px solid #888;
  width: 80%;
   height: 100%;
  box-shadow: 0 4px 8px 0 rgba(0,0,0,0.2),0 6px 20px 0 rgba(0,0,0,0.19);
  -webkit-animation-name: animatetop;
  -webkit-animation-duration: 0.4s;
  animation-name: animatetop;
  animation-duration: 0.4s
}
/* Add Animation */
@-webkit-keyframes animatetop {
  from {top:-300px; opacity:0}
  to {top:0; opacity:1}
}
@keyframes animatetop {
  from {top:-300px; opacity:0}
  to {top:0; opacity:1}
}
```

```
/* The Close Button */
.close {
  color: white;
  float: right;
  font-size: 28px;
  font-weight: bold;
}
.close:hover,
.close:focus {
  color: #000;
  text-decoration: none;
  cursor: pointer;
}
.modal-header {
  padding: 2px 16px;
  background-color: #5cb85c;
  color: white;
}
.modal-body {padding: 2px 16px;}
.modal-footer {
  padding: 2px 16px;
  background-color: #5cb85c;
```

```
  color: white;
}
/* Add Animation */
@-webkit-keyframes slideIn {
  from {bottom: -300px; opacity: 0}
  to {bottom: 0; opacity: 1}
}
@keyframes slideIn {
  from {bottom: -300px; opacity: 0}
  to {bottom: 0; opacity: 1}
}
@-webkit-keyframes fadeIn {
  from {opacity: 0}
  to {opacity: 1}
}
@keyframes fadeIn {
  from {opacity: 0}
  to {opacity: 1}
}
        </style>
        </head>
<body>
```

```
<div class="jumbotron text-center">
<nav class="navbar fixed-top navbar">
<a class="navbar-brand" href="#" style="font-family: 'Libre Caslon Display', serif;"><i class="fas fa-heartbeat"></i>ECG Arrhythmia Classification Using CNN</a>
<form class="form-inline">
<a class="navbar-brand" href="#">Team-28</a>
</form>
</nav>
<div class="text">
<h1>ECG Arrhythmia Classification</h1>
<p style="font-family: 'Dancing Script', cursive;">Detecting the heart rhythms using ECG</p>
<button type="button" class="btn btn-outline-warning"  id="myBtn">Click Here to Upload an Image</button>
<div id="myModal" class="modal">
<div class="modal-content">
<div class="modal-header">
<span class="close">&times;</span>
<h2>choose a picture</h2>
</div>
<div class="modal-body">
<div>
```

```
<h4>Please uploand an animal image</h4>

<form action = "http://localhost:5000/predict" id="upload-file" method="post" enctype="multipart/form-data">

<label for="imageUpload" class="upload-label"> Choose..</label>

<input type="file" name="image" id="imageUpload" accept=".png, .jpg, .jpeg" width="304" height="228">

</form>

<div class="image-section" style="display:none;">

<div class="img-preview">

<div id="imagePreview">

</div>

</div>

<div>

<button type="button" class="btn btn-info btn-lg " id="btn-predict">Click on this to see the prediction!</button>

</div>

</div>

<div class="loader" style="display:none;"></div>

<h3>

<span id="result" style="float:right"> </span>

</h3>

</div>

</div>
```

```html
    <div class="modal-footer">
     <h3>...</h3>
   </div>
  </div>
</div>
</div>
  </div>
      <div class="container">
      <div id="content" style="margin-top:2em">
                  <div class="row">
                        <div class="col-sm-6 bd" >
                         <h3>DETECTING THE HEART RHYTHM USING ECG </h3>
                         <br>
  <p style="font-family: 'Niconne', cursive;">Electrocardiogram (ECG) signal which is the recording of the cardiac electrical activity provides the important information about heart's condition. Detection of ECG arrhythmias is necessary for the treatment of patients for diagnosing the heart disease at the early stage. It is very difficult for doctors to analyze long ECG records in the short period of time and also human eye is poorly suited to detect the morphological variation of ECG signal, hence imposing the need for an effective computer aided diagnostic (CAD) system. The automatic ECG signal analysis faces a difficult problem due to large variation in morphological and temporal characteristics of ECG waveforms of different patients as well as the same patients [1]. The ECG waveforms may differ for the same patient at different time and may be similar for different patients having different types of beats. </p></div>
<div class="col-sm-6">
```

```
                                                                                <img
src="https://www.carolinaheartandleg.com/wp-content/uploads/2018/04/ARRHY
TMIA-2.jpg" style="width:800px" class="img-thumbnail" alt="">

                    </div>

               </div>

              </div>

  </div>

  <script>
// Get the modal
var modal = document.getElementById("myModal");
// Get the button that opens the modal
var btn = document.getElementById("myBtn");
// Get the <span> element that closes the modal
var span = document.getElementsByClassName("close")[0];
// When the user clicks the button, open the modal
btn.onclick = function() {
  modal.style.display = "block";
}
 // When the user clicks on <span> (x), close the modal
span.onclick = function() {
  modal.style.display = "none";
}
```

```
// When the user clicks anywhere outside of the modal, close it
window.onclick = function(event) {
  if (event.target == modal) {
    modal.style.display = "none";
  }
}
</script>
<footer>
    <script src="{{ url_for('static', filename='js/main.js') }}" type="text/javascript"></script>
</footer>
</body>
</html>
```

## APP.PY:

```
import numpy as np
import os
from keras.models import load_model
from keras.preprocessing import image
import tensorflow as tf
global graph
graph = tf.get_default_graph()
```

```
from flask import Flask , request, render_template
from werkzeug.utils  import secure_filename
from gevent.pywsgi  import WSGIServer
 app = Flask(__name__)
model = load_model("ECG.h5")
 @app.route('/')
def index():
    return render_template('base.html')
 @app.route('/predict',methods = ['GET','POST'])
def upload():
    if request.method == 'POST':
        f = request.files['image']
        print("current path")
        basepath = os.path.dirname(__file__)
        print("current path", basepath)
        filepath = os.path.join(basepath,'uploads',f.filename)
        print("upload folder is ", filepath)
        f.save(filepath)
          img = image.load_img(filepath,target_size = (64,64))
        x = image.img_to_array(img)
        x = np.expand_dims(x,axis =0)
         with graph.as_default():
```

```
            preds = model.predict_classes(x)
           print("prediction",preds)
        index = ['Fusion Beat','Normal Beat','premature ventricular
contractions','Supraventricular ectopic Beat','Ventricular ectopic Beat']
       text = "the PREDICTION is : " + str(index[preds[0]])
       return text
if __name__ == '__main__':
    app.run(debug = True, threaded = False)
```