

CLASSIFICATION OF ARRHYTHMIA BY USING DEEP WITH 2D ECG SPECTRAL IMAGE REPRESENTATION

Team ID:PNT2022TMID16980

1. INTRODUCTION

1.1 Project Overview

The electrocardiogram (ECG) is one of the most extensively employed signals used in the diagnosis and prediction of cardiovascular diseases (CVDs). The ECG signals can capture the heart's rhythmic irregularities, commonly known as arrhythmias. A careful study of ECG signals is crucial for precise diagnoses of patients' acute and chronic heart conditions. In this study, we propose a two-dimensional (2-D) convolutional neural network (CNN) model for the classification of ECG signals into eight classes; namely, normal beat, premature ventricular contraction beat, paced beat, right bundle branch block beat, left bundle branch block beat, atrial premature contraction beat, ventricular flutter wave beat, and ventricular escape beat. The one-dimensional ECG time series signals are transformed into 2-D spectrograms through short-time Fourier transform. The 2-D CNN model consisting of four convolutional layers and four pooling layers is designed for extracting robust features from the input spectrograms. Our proposed methodology is evaluated on a publicly available MIT-BIH arrhythmia dataset. We achieved a state-of-the-art average classification accuracy of 99.11%, which is better than those of recently reported results in classifying similar types of arrhythmias. The performance is significant in other indices as well, including sensitivity and specificity, which indicates the success of the proposed method.

1.2 Purpose

The electrocardiogram (ECG) recordings are widely used for diagnosing and predicting cardiac arrhythmia for diagnosing heart diseases. Towards this end, clinical experts might need to look at ECG recordings over a longer period of time for detecting cardiac arrhythmia. The ECG is a one-

dimensional (1-D) signal representing a time series, which can be analyzed using machine learning techniques for automated detection of certain abnormalities. Recently, deep learning techniques have been developed, which provide significant performance in radiological image analysis [4,5]. Convolutional neural networks (CNNs) have recently been shown to work for multi-dimensional (1-D, 2-D, and in certain cases, 3-D) inputs but were initially developed for problems dealing with images represented as two-dimensional inputs [6]. For time series data, 1-D CNNs are proposed but

are less versatile when compared to 2-D CNNs. Hence, representing the time series data in a 2-D format could benefit certain machine learning tasks [7,8]. Hence, for ECG signals, a 2-D transformation has to be applied to make the time series suitable for deep learning methods that require 2-D images as input.

2. LITERATURE SURVEY

2.1 Existing problem

The ECG records the electrical signals of the human heart and is mostly used for clinical diagnosis of cardiac arrhythmias. More than 300 million ECGs are obtained worldwide

every year. The huge diagnostic workload leads to inefficiency and misdiagnosis of cardiac arrhythmias based on ECG. So the combination of extensive digitization of ECG data and automatic classification algorithms has attracted more and more attention. In the early research on the automatic classification of cardiac arrhythmia, most algorithms based on machine learning are usually divided into two parts: feature engineering and classification. Specifically, researchers first manually extracted a large number of ECG features with medical meaning, such as wavelet features, composite features, heart rate variability statistical feature, related statistical features, higher order statistical features and morphological features. Meanwhile, the principal component analysis and independent component analysis use mathematical methods to extract ECG features from high-dimensional space to low-dimensional space. After feature engineering, support vector machine, self-organizing map, clustering and other machine learning algorithms are used to analyze artificial features and give the prediction result. Although machine learning has broad research applications in the classification of cardiac arrhythmia, there are still some problems that need to be solved. For example, feature

engineering based on subjective factors leads to the elimination of some potentially important features, which may affect the final classification performance.

2.2 References

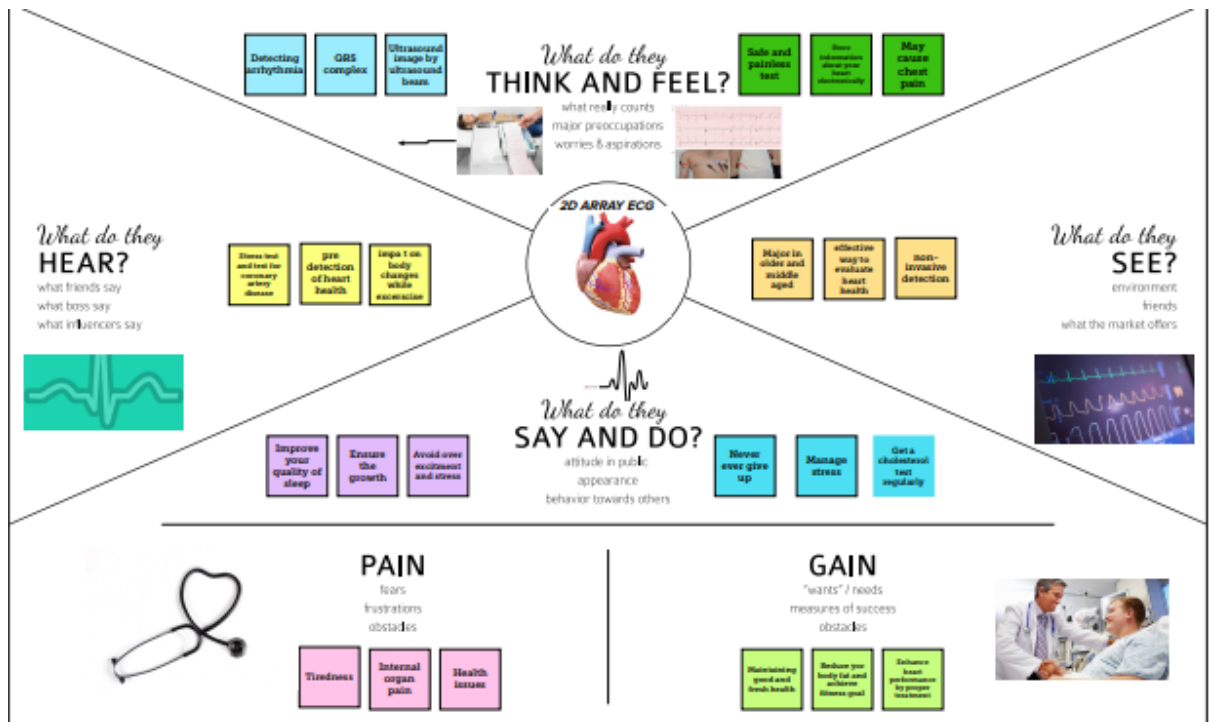
1. Mc Namara, K.; Alzubaidi, H.; Jackson, J.K. Cardiovascular disease as a leading cause of death: How are pharmacists getting involved? *Integr. Pharm. Res. Pract.* 2019, 8, 1. [CrossRef] [PubMed]
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3. Mustaqeem, A.; Anwar, S.M.; Majid, M. A modular cluster based collaborative recommender system for cardiac patients. *Artif. Intell. Med.* 2020, 102, 101761. [CrossRef] [PubMed]
4. Irmakci, I.; Anwar, S.M.; Torigian, D.A.; Bagci, U. Deep Learning for Musculoskeletal Image Analysis. *arXiv* 2020, arXiv:2003.00541.
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6. Gu, J.; Wang, Z.; Kuen, J.; Ma, L.; Shahroudy, A.; Shuai, B.; Liu, T.; Wang, X.; Wang, G.; Cai, J.; et al. Recent advances in convolutional neural networks. *Pattern Recognit.* 2018, 77, 354–377. [CrossRef]
7. Wu, Y.; Yang, F.; Liu, Y.; Zha, X.; Yuan, S. A comparison of 1-D and 2-D deep convolutional neural networks in ECG classification. *arXiv* 2018, arXiv:1810.07088.
8. Zhao, J.; Mao, X.; Chen, L. Speech emotion recognition using deep 1D & 2-D CNN LSTM networks. *Biomed. Signal Process. Control* 2019, 47, 312–323.
9. Ortega, S.; Fabelo, H.; Iakovidis, D.K.; Koulaouzidis, A.; Callico, G.M. Use of hyperspectral/multispectral imaging in gastroenterology. Shedding some–different–light into the dark. *J. Clin. Med.* 2019, 8, 36. [CrossRef]
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2.3 Problem Statement Definition

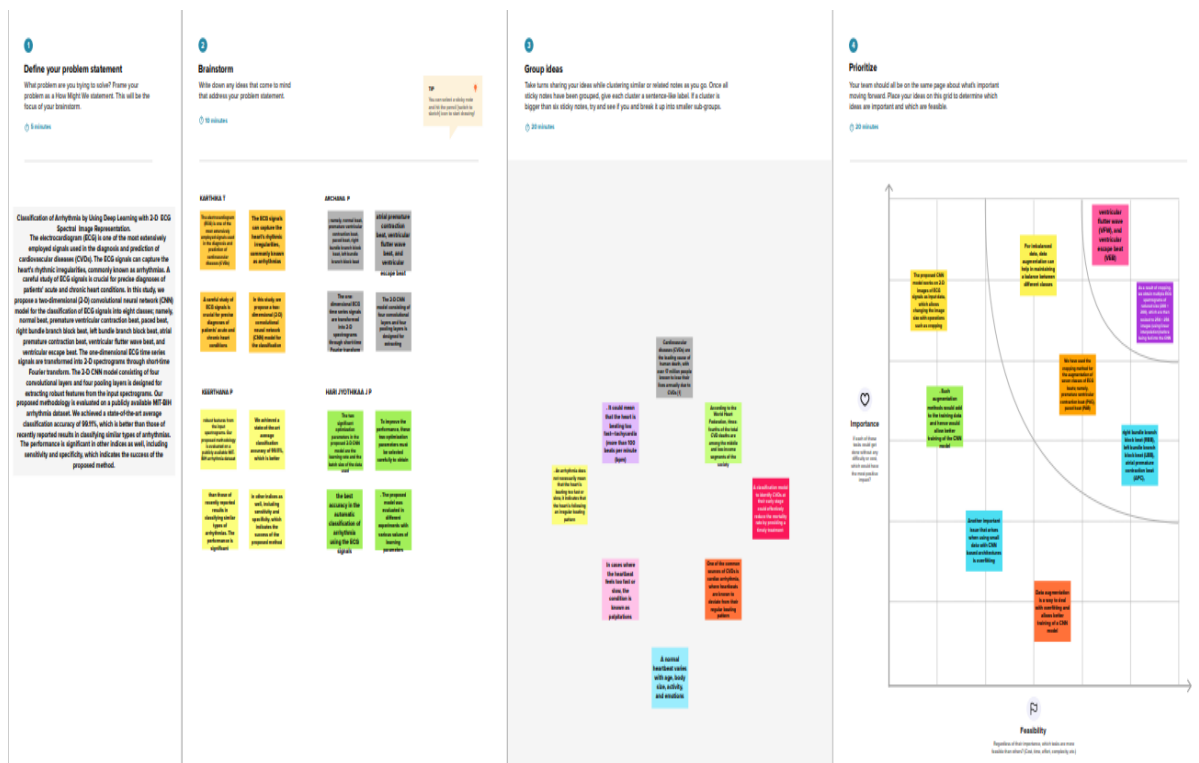
Define CS, fit into CL	1. CUSTOMER SEGMENT(S) CS Cardiovascular disease patients and Doctors.	6. CUSTOMER LIMITATIONS CL <small>EG. BUDGET, DEVICES</small> <ul style="list-style-type: none"> Lack of awareness Not having knowledge about this 	5. AVAILABLE SOLUTIONS AS <small>PLUSES & MINUSES</small> We have 24/7 collaboration with the hospitals and diagnosis center.	Explore AS, differentiate
	2. PROBLEMS / PAINS + ITS FREQUENCY PR The agenda of this proposed system is to detect Cardiovascular diseases using the 2-D ECG Spectral image	9. PROBLEM ROOT / CAUSE RC <ul style="list-style-type: none"> It is because of lack of healthy diet and not working of properly. If there is any problem occurs it will notify the hospitals. 	7. BEHAVIOR + ITS INTENSITY BE Having a proper awareness about the health, following a healthy diet, going for a regular check-ups.	
Identify strong TR & EM	3. TRIGGERS TO ACT TR Not keeping a track on individuals health, not having a proper diet.	10. YOUR SOLUTION SL <ul style="list-style-type: none"> Classification of Arrhythmia by using deep learning with 2-D ECG Spectral Image Representation It helps patients to get to the hospital on time before any major problem occurs. 	8. CHANNELS of BEHAVIOR CH ONLINE: It will directly connect with hospitals even when the patients is not near the doctor just by monitoring the heartbeat.	Extract online & offline CH of BE
	4. EMOTIONS EM <small>BEFORE / AFTER</small> BEFORE: Patients are not aware of their health condition. AFTER: Keeping a track on individuals health for all 24 hours.		OFFLINE: The patient must have be under the observation under the doctor.	

3. IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas



3.2 Ideation & Brainstorming

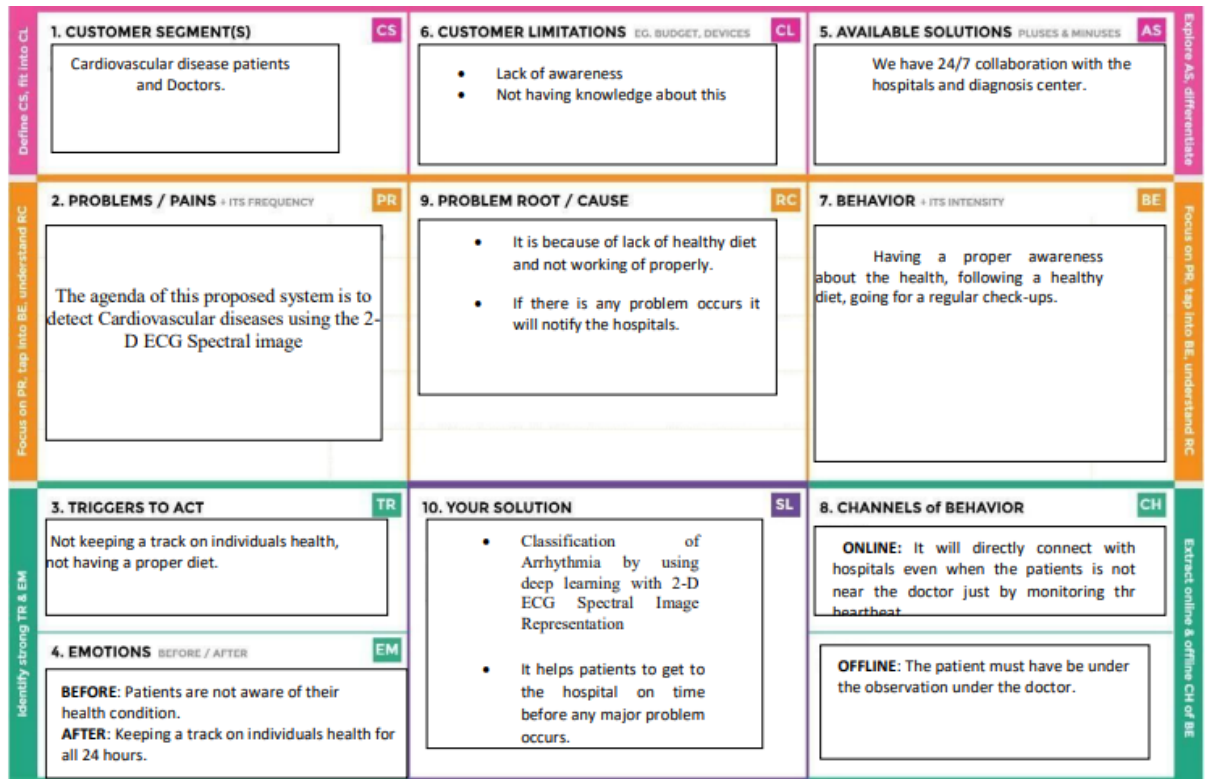


3.3 Proposed Solution

S.NO	PARAMETER	DESCRIPTION
1	Problem Statement	<ol style="list-style-type: none">1. The developing application must be very efficient and useful for the user friendly.2. The agenda of this proposed system is to detect Cardiovascular diseases using the 2-D ECG Spectral image.
2	Idea/solution description	<ol style="list-style-type: none">1. This will caution them about the irregular pattern of their heartbeat(Arrhythmia).2. We are proposing that the automated detection of such pattern to clinical consultation.
3	Novelty/uniqueness	<ol style="list-style-type: none">1. Spectrograms(2-D images) are employed which are generated by the 1-D ECG signal using STFT. In addition, data augmentation was used for the 2-D image representation of ECG signals.2. The method consists of five steps signal processing, generation of spectrograms, augmentation of data, extraction features from the data(using CNN model), classification based on features.
4	Social Impact/Customer Satisfaction	<ol style="list-style-type: none">1. The main purpose of this application is to make people awareness on their general health.2. Can collaborate with doctors and hospitals.
5	Business model	<ol style="list-style-type: none">1. By approaching the government to organize awareness camps.2. By collaborating with diagnosing centers.

6	Scalability of the solution	<ol style="list-style-type: none">1. It is very essential for everyone to keep a track on individuals health.2. It helps in monitoring one's health.
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3.4 Problem Solution Fit



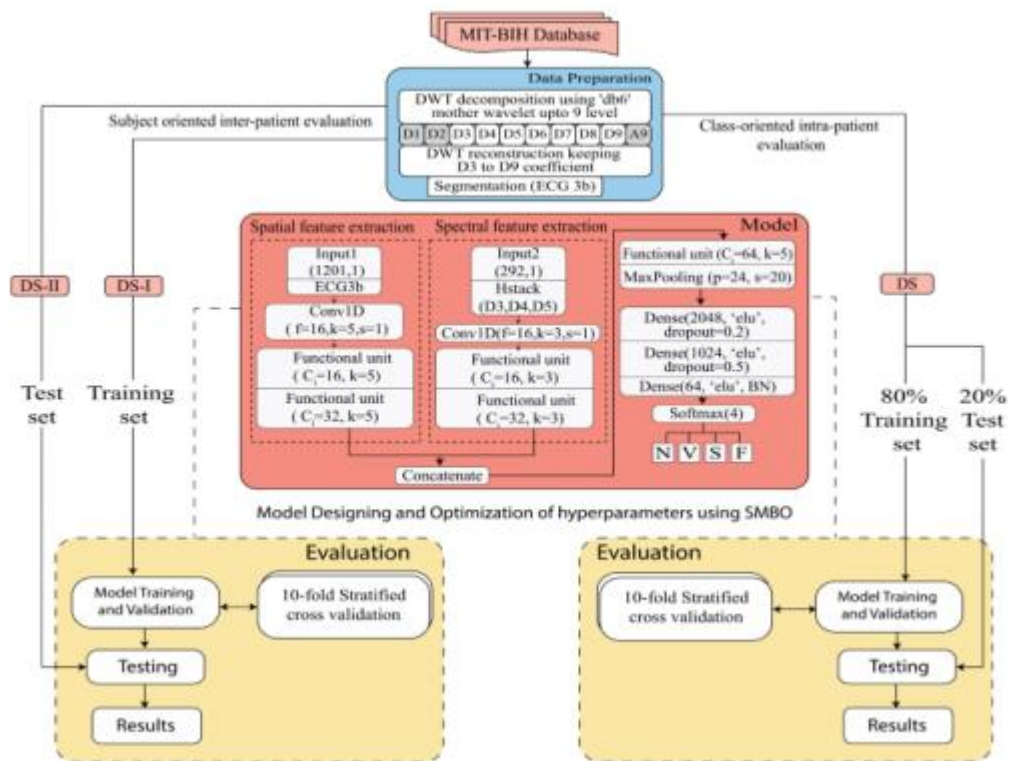
4. REQUIREMENT ANALYSIS

4.1 Functional Requirement

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Download the app Registration through Gmail Create an account Follow the instructions Connect the app to the hospital
FR-2	User Confirmation	Confirmation through Email Monitoring starts after confirmation
FR-3	Interface	Good interface for the user to operate
FR-4	Accessing datasets	Health history of the patient is noted Personal details about the patient is recorded Information about the hospital is registered
FR-5	Mobile application	AI, Heart beat sensor and Blood pressure sensor can be accessed by the hospital through this mobile Application.

5. PROJECT DESIGN

5.1 Data Flow Diagrams



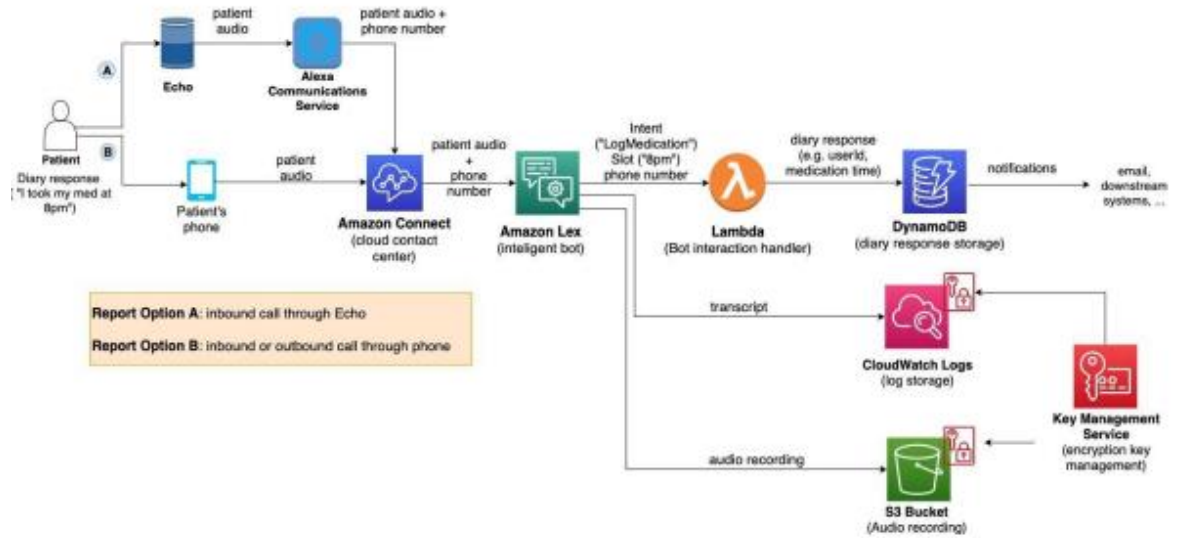
5.2 Solution and technical architecture

Solution Architecture

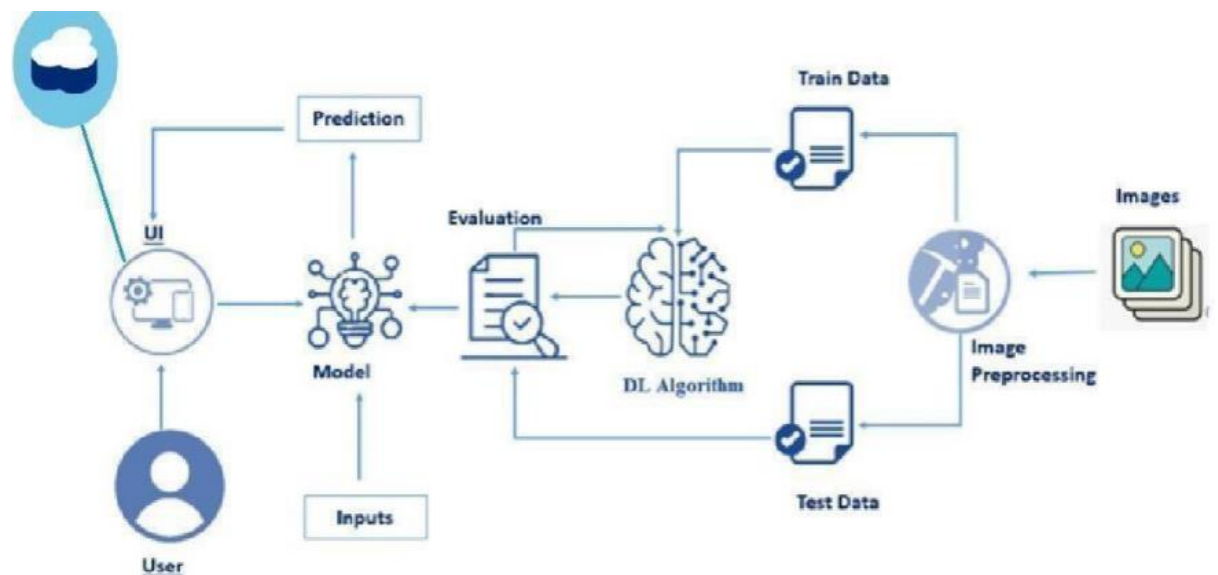
Solution Architecture: Solution architecture is a complex process – with many sub-processes – that bridges the gap between business problems and technology solutions. Its goals are to:

- Having a proper awareness about the health, following a healthy diet, going for a regular check-ups
- It is because of lack of healthy diet and not working of properly.
- If there is any problem occurs it will notify the hospitals.
- Not keeping a track on individuals health, not having a proper diet.
- It will directly connect with hospitals even when the patients is not near the doctor just by monitoring the health.

Solution Architecture Diagram



Technical Architecture

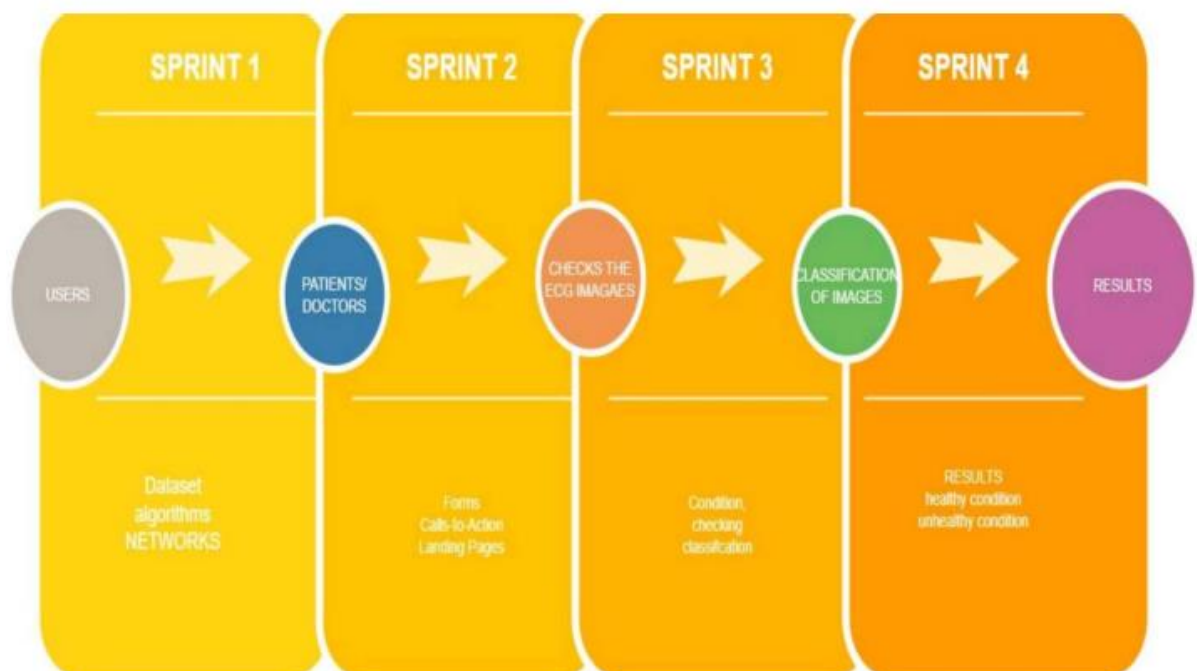


5.3 User stories

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Mobile user)	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	I can access my account /dashboard	High	
	Login	USN-2	As a user, I can log into the application by entering email & password	I can access the application	High	
	Dashboard	USN-3	As a user I can enter my income and expenditure details.	I can view my daily expenses	High	
Customer Care Executive		USN-4	As a customer care executive, I can solve the log in issues and other issues of the application.	I can provide support or solution at any time 24*7	Medium	
Administrator	Application	USN-5	As an administrator I can upgrade or update the application.	I can fix the bug which arises for the customers and users of the application	Medium	

6. PROJECT PLANNING AND SCHEDULING

6.1 Sprint Delivery Schedule



7. CODING AND SOLUTIONING:

7.1 Feature 1

The system will be able to predict the gesture such as which alphabet or number the person is trying to say. Various techniques like preprocessing, feature extraction are applied. CNN was used for classification. The web application is been developed using PHP and bootstrap for the Frontend and Python for Backend. The user captured image is passed and captured images features are extracted. Extracted features will be matched with the training model, depending on nearby match the predicted output is obtained.

7.2 Feature 2

CNN's are used for image classification and recognition because of their high accuracy. The CNN follows a hierarchical model which works on building a network, like a funnel, and finally gives out a fully-connected layer where all the neurons are connected and the output is processed. Hence we are using a Convolutional Neural Network as a important feature.

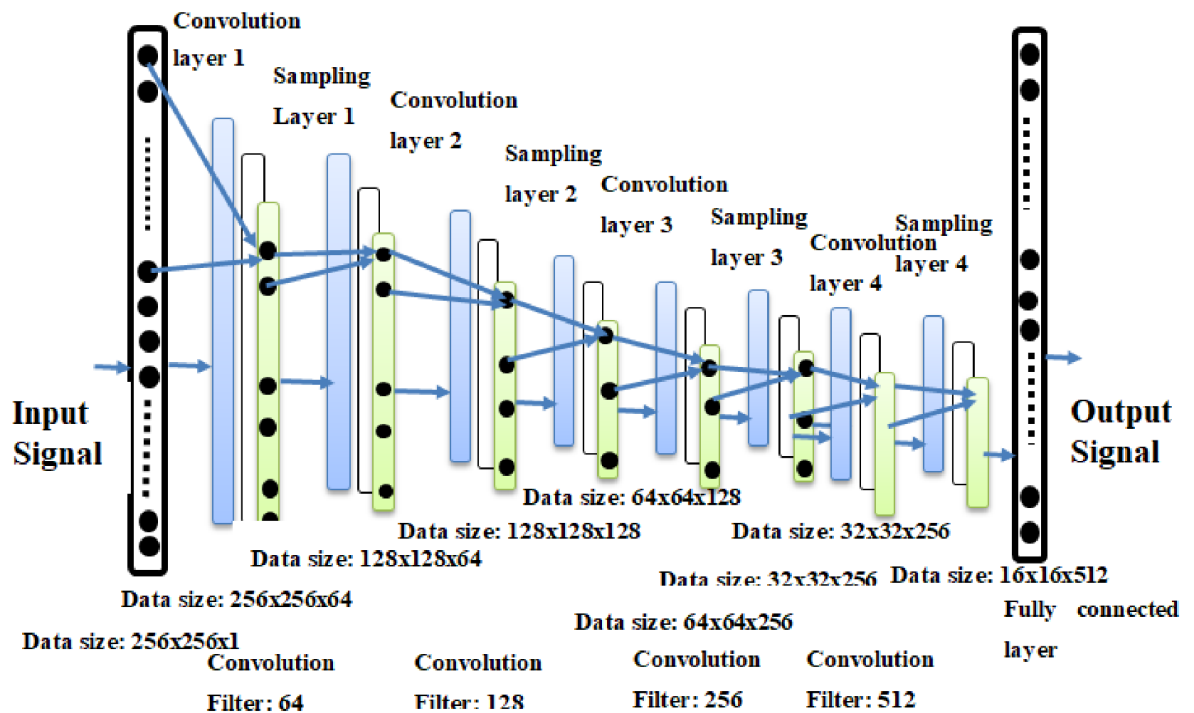
8. TESTING

8.1 Test cases

A test plan documents strategy that will be used to verify and ensure that a product or a system meets its design specification and other requirements. A test plan is usually prepared or by with significant input from the engineer. This document describes the plans for testing the architectural prototype of system. In my project the system has to be tested to get the desired output. I use different speed for testing the system.

8.2 User Acceptance Testing

User interface design(UI) or user interface engineering is the design of user interfaces for machines and software, such as computer, home appliances, mobile devices and other electronic devices, with the focus on maximizing usability and the user experience. The goal for user interface design is to make the user's interaction as simple and efficient as possible, in terms of accomplishing user goals(user centered design).



9. RESULTS

The two significant optimization parameters in the proposed 2-D CNN model are the learning rate and the batch size of the data used. To improve the performance, these two optimization parameters must be selected carefully to obtain the best accuracy in the automatic classification of arrhythmia using the ECG signals. The proposed model was evaluated in different experiments with various values of learning parameters. For a smaller value of the learning rate (i.e., less than 0.0005), the speed of the convergence was very slow. However, when the value of the learning rate was large (i.e., greater than 0.001), the speed of convergence improved. At the same time, asymmetrical changes were observed in the accuracy rate. Henceforth, we selected an optimum value of 0.001 for the learning rate, as this value can attain better accuracy for the proposed model (i.e., optimum value).

10. ADVANTAGES AND DISADVANTAGES

Advantages

Your healthcare provider will be able to explain your results to you such as,

- [Heart arrhythmias](#), such as [premature ventricular complexes](#) or [atrial fibrillation](#)
- Whether you have conduction abnormalities, which result from issues regarding how the electrical impulse spreads across the heart (such as with a [bundle branch block](#))
- Signs of an ongoing or a prior [myocardial infarction](#) (heart attack)
- Whether you have signs of severe [coronary artery disease \(CAD\)](#), such as stable angina or unstable angina
- If your heart muscle has become abnormally thickened, as in [hypertrophic cardiomyopathy](#)
- Signs of congenital electrical abnormalities, such as [Brugada syndrome](#)
- Electrolyte imbalances, particularly elevated or decreased levels of potassium, calcium, or magnesium
- Congenital (from birth) heart defects
- Infections involving the heart, such as pericarditis, which is an infection of the protective tissue surrounding the heart

Disadvantages

- The ECG reveals the heart rate and rhythm only during the few seconds it takes to record the tracing.
- If an arrhythmia (heart rhythm irregularity) occurs only intermittently, an ECG might not pick it up, and [ambulatory monitoring](#) may be required.
- The ECG is often normal or nearly normal with many types of heart disease, such as [coronary artery disease](#).
- Sometimes, abnormalities that appear on the ECG turn out to have no medical significance after a thorough evaluation is done.

11. CONCLUSION

The study presented results of a review on different methods for classifying arrhythmia on ECG signals. The objective of the review method was to investigate the most powerful Deep Learning methods detecting various types of arrhythmia. Technical details of the common methods were discussed. The GRU/LSTM, CNN, and LSTM, showed outstanding results for correct classification of Atrial Fibrillation, Supraventricular Ectopic Beats, and Ventricular Ectopic Beats, respectively. It is also concluded that the use of a proper type of Deep Learning method can considerably improve the classification performance for the corresponding application.

12. FUTURE SCOPE

According to the best classification methods represented, CNN-based have proven to be effective for arrhythmia classification. Recent trend of research in this scope shows that dynamic classification methods that are capable to learn both short and long term contents of the signal in an efficient way, would be employed for such applications. CNN has shown excellent performance in classifying different types of arrhythmia. This powerful method would be one of the most efficient learning tool for this application.

13. APPENDIX

Deep Learning Method	Computational Complexity
MLP	medium-complexity
CNN	high-complexity
DBN	low-complexity
RNN	medium-complexity
LSTM	medium-complexity
GRU	low-complexity

SOURCE CODE

```
import
numpy as
np
import
pandas
as pd
from
pathlib
import
Path
import
os.path

import tensorflow as tf

dir = Path('../input/ecg-image-
data/ECG_Image_data/train')  filepaths =
list(dir.glob(r'**/*.png'))
labels = list(map(lambda x:
os.path.split(os.path.split(x)[0])[1], filepaths))

filepaths = pd.Series(filepaths,
name='Filepath').astype(str)  labels =
pd.Series(labels, name='Label')

dataframe = pd.concat([filepaths ,
labels] , axis=1)dataframe

dataframe['Label
'].value_counts(
)
dataframe['Label
'].unique()
```



```

samples = []

for category in ['N', 'M', 'Q', 'S', 'V']:
    category_slice = dataframe.query("Label == @category")
    samples.append(category_slice.sample(2223, random_state=1))

dataframe_train = pd.concat(samples, axis=0).sample(frac=1.0,
random_state=1).reset_index(drop=True)

dataframe_train['Label'].value_counts()

dir = Path('../input/ecg-image-data/ECG_Image_data/train')

filepaths = list(dir.glob(r'F/*.png'))

labels = list(map(lambda x: os.path.split(os.path.split(x)[0])[1],
filepaths))

filepaths = pd.Series(filepaths,
name='Filepath').astype(str) labels = pd.Series(labels,
name='Label')

F = pd.concat([filepaths , labels] ,
axis=1)F

%%time

dir = Path('../input/ecg-image-data/ECG_Image_data/test')

filepaths = list(dir.glob(r'**/*.png'))

labels = list(map(lambda x: os.path.split(os.path.split(x)[0])[1],
filepaths))

filepaths = pd.Series(filepaths,
name='Filepath').astype(str) labels = pd.Series(labels,
name='Label')

dataframe_test = pd.concat([filepaths , labels] ,
axis=1)dataframe_test

```

Preprocessing of code

Model summary

Html coding

<!DOCTYPE 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>Aroma Shop - Home</title>
  <link rel="icon" href="static/img/Favicon.png" type="image/png">
  <link rel="stylesheet" href="static/vendors/bootstrap/bootstrap.min.css">
  <link rel="stylesheet" href="static/vendors/fontawesome/css/all.min.css">
  <link rel="stylesheet" href="static/vendors/themify-icons/themify-icons.css">
  <link rel="stylesheet" href="static/vendors/nice-select/nice-select.css">
  <link rel="stylesheet" href="static/vendors/owl-carousel/owl.theme.default.min.css">
  <link rel="stylesheet" href="static/vendors/owl-carousel/owl.carousel.min.css">

  <link rel="stylesheet" href="static/css/style.css">
</head>
<body>
  <!--===== Start Header Menu Area =====-->
  <header class="header_area">
    <div class="main_menu">
      <nav class="navbar navbar-expand-lg navbar-light">
        <div class="container">
          <a class="navbar-brand logo_h" href="index.html"></a>
          <button class="navbar-toggler" type="button" data-toggle="collapse" data-
target="#navbarSupportedContent"
          aria-controls="navbarSupportedContent" aria-expanded="false" aria-label="Toggle
navigation">
            <span class="icon-bar"></span>
            <span class="icon-bar"></span>
            <span class="icon-bar"></span>
          </button>
          <div class="collapse navbar-collapse offset" id="navbarSupportedContent">
            <ul class="nav navbar-nav menu_nav ml-auto mr-auto">
              <li class="nav-item active"><a class="nav-link" href="index.html">Home</a></li>
              <li class="nav-item submenu dropdown">
                <a href="#" class="nav-link dropdown-toggle" data-toggle="dropdown"
role="button" aria-haspopup="true"
                aria-expanded="false">Shop</a>
                <ul class="dropdown-menu">
                  <li class="nav-item"><a class="nav-link" href="category.html">Shop
Category</a></li>
                  <li class="nav-item"><a class="nav-link" href="single-product.html">Product
Details</a></li>
                  <li class="nav-item"><a class="nav-link" href="checkout.html">Product
Checkout</a></li>
                  <li class="nav-item"><a class="nav-link"
href="confirmation.html">Confirmation</a></li>
                  <li class="nav-item"><a class="nav-link" href="cart.html">Shopping
Cart</a></li>

```

```

        </ul>

        </li>
        <li class="nav-item submenu dropdown">
            <a href="#" class="nav-link dropdown-toggle" data-toggle="dropdown"
            role="button" aria-haspopup="true"
            aria-expanded="false">Blog</a>
            <ul class="dropdown-menu">
                <li class="nav-item"><a class="nav-link" href="blog.html">Blog</a></li>
                <li class="nav-item"><a class="nav-link" href="single-blog.html">Blog
                Details</a></li>
            </ul>
        </li>
        <li class="nav-item submenu
        dropdown">
            <a href="#" class="nav-link dropdown-toggle" data-toggle="dropdown"
            role="button" aria-haspopup="true"
            aria-expanded="false">Pages</a>
            <ul class="dropdown-menu">
                <li class="nav-item"><a class="nav-link" href="sign.html">Login</a></li>
                <li class="nav-item"><a class="nav-link" href="/register">Register</a></li>
                <li class="nav-item"><a class="nav-link" href="tracking-
                order.html">Tracking</a></li>
            </ul>
        </li>
        <li class="nav-item"><a class="nav-link" href="contact.html">Contact</a></li>
    </ul>

    <ul class="nav-shop">
        <li class="nav-item"><button><i class="ti-search"></i></button></li>
        <li class="nav-item"><button><i class="ti-shopping-cart"></i><span class="nav-
        shop_circle">3</span></button> </li>
        <li class="nav-item"><a class="button button-header" href="#">Buy Now</a></li>
    </ul>
</div>
</nav>
</div>
</header>
<!--===== End Header Menu Area =====>

<main class="site-main">

<!--===== Hero banner start =====>
<section class="hero-banner">
    <div class="container">
        <div class="row no-gutters align-items-center pt-60px">
            <div class="col-5 d-none d-sm-block">
                <div class="hero-banner_img">
                    
                </div>
            </div>
        </div>
    </div>
</section>

```

```

</div>
<div class="col-sm-7 col-lg-6 offset-lg-1 pl-4 pl-md-5 pl-lg-0">
  <div class="hero-banner_content">
    <h4>Shop is fun</h4>
    <h1>Browse Our Premium Product</h1>
    <p>Us which over of signs divide dominion deep fill bring they're meat beho upon
own earth without morning over third. Their male dry. They are great appear whose land fly
grass.</p>
    <a class="button button-hero" href="#">Browse Now</a>
  </div>
</div>
</div>
</div>
</div>
</section>
<!--===== Hero banner start =====-->

<!--===== Hero Carousel start =====-->
<section class="section-margin mt-0">
  <div class="owl-carousel owl-theme hero-carousel">
    <div class="hero-carousel_slide">
      
      <a href="#" class="hero-carousel_slideOverlay">
        <h3>Wireless Headphone</h3>
        <p>Accessories Item</p>
      </a>
    </div>
    <div class="hero-carousel_slide">
      
      <a href="#" class="hero-carousel_slideOverlay">
        <h3>Wireless Headphone</h3>
        <p>Accessories Item</p>
      </a>
    </div>
    <div class="hero-carousel_slide">
      
      <a href="#" class="hero-carousel_slideOverlay">
        <h3>Wireless Headphone</h3>
        <p>Accessories Item</p>
      </a>
    </div>
  </div>
</section>
<!--===== Hero Carousel end =====-->

<!-- ===== trending product section start ===== -->
<section class="section-margin calc-60px">
  <div class="container">
    <div class="section-intro pb-60px">
      <p>Popular Item in the market</p>
      <h2>Trending <span class="section-intro style">Product</span></h2>
    </div>
  </div>
</section>

```

```

</div>
<div class="row">
  <div class="col-md-6 col-lg-4 col-xl-3">
    <div class="card text-center card-product">
      <div class="card-product_img">
        
        <ul class="card-product_imgOverlay">
          <li><button><i class="ti-search"></i></button></li>
          <li><button><i class="ti-shopping-cart"></i></button></li>
          <li><button><i class="ti-heart"></i></button></li>
        </ul>
      </div>
      <div class="card-body">
        <p>Accessories</p>
        <h4 class="card-product_title"><a href="single-product.html">Quartz Belt
Watch</a></h4>
        <p class="card-product_price">$150.00</p>
      </div>
    </div>
  </div>
  <div class="col-md-6 col-lg-4 col-xl-3">
    <div class="card text-center card-product">
      <div class="card-product_img">
        
        <ul class="card-product_imgOverlay">
          <li><button><i class="ti-search"></i></button></li>
          <li><button><i class="ti-shopping-cart"></i></button></li>
          <li><button><i class="ti-heart"></i></button></li>
        </ul>
      </div>
      <div class="card-body">
        <p>Beauty</p>
        <h4 class="card-product_title"><a href="single-product.html">Women
Freshwash</a></h4>
        <p class="card-product_price">$150.00</p>
      </div>
    </div>
  </div>
  <div class="col-md-6 col-lg-4 col-xl-3">
    <div class="card text-center card-product">
      <div class="card-product_img">
        
        <ul class="card-product_imgOverlay">
          <li><button><i class="ti-search"></i></button></li>
          <li><button><i class="ti-shopping-cart"></i></button></li>
          <li><button><i class="ti-heart"></i></button></li>
        </ul>
      </div>
      <div class="card-body">
        <p>Decor</p>

```

```

        <h4 class="card-product title"><a href="single-product.html">Room Flash
Light</a></h4>
        <p class="card-product_price">$150.00</p>
    </div>
</div>
</div>
<div class="col-md-6 col-lg-4 col-xl-3">
    <div class="card text-center card-product">
        <div class="card-product_img">
            
            <ul class="card-product_imgOverlay">
                <li><button><i class="ti-search"></i></button></li>
                <li><button><i class="ti-shopping-cart"></i></button></li>
                <li><button><i class="ti-heart"></i></button></li>
            </ul>
        </div>
        <div class="card-body">
            <p>Decor</p>
            <h4 class="card-product_title"><a href="single-product.html">Room Flash
Light</a></h4>
            <p class="card-product_price">$150.00</p>
        </div>
    </div>
</div>
<div class="col-md-6 col-lg-4 col-xl-3">
    <div class="card text-center card-product">
        <div class="card-product_img">
            
            <ul class="card-product_imgOverlay">
                <li><button><i class="ti-search"></i></button></li>
                <li><button><i class="ti-shopping-cart"></i></button></li>
                <li><button><i class="ti-heart"></i></button></li>
            </ul>
        </div>
        <div class="card-body">
            <p>Accessories</p>
            <h4 class="card-product_title"><a href="single-product.html">Man Office
Bag</a></h4>
            <p class="card-product_price">$150.00</p>
        </div>
    </div>
</div>
<div class="col-md-6 col-lg-4 col-xl-3">
    <div class="card text-center card-product">
        <div class="card-product_img">
            
            <ul class="card-product_imgOverlay">
                <li><button><i class="ti-search"></i></button></li>
                <li><button><i class="ti-shopping-cart"></i></button></li>
                <li><button><i class="ti-heart"></i></button></li>
            </ul>
        </div>

```

```

<!-- ===== offer section start ===== -->
<section class="offer" id="parallax-1" data-anchor-target="#parallax-1" data-300-
top="background-position: 20px 30px" data-top-bottom="background-position: 0 20px">
  <div class="container">
    <div class="row">
      <div class="col-xl-5">
        <div class="offer_content text-center">
          <h3>Up To 50% Off</h3>
          <h4>Winter Sale</h4>
          <p>Him she'd let them sixth saw light</p>
          <a class="button button--active mt-3 mt-xl-4" href="#">Shop Now</a>
        </div>
      </div>
    </div>
  </div>
</section>
<!-- ===== offer section end ===== -->

```

```

<!-- ===== Best Selling item carousel ===== -->
<section class="section-margin calc-60px">
  <div class="container">
    <div class="section-intro pb-60px">
      <p>Popular Item in the market</p>
      <h2>Best <span class="section-intro_style">Sellers</span></h2>
    </div>
    <div class="owl-carousel owl-theme" id="bestSellerCarousel">
      <div class="card text-center card-product">
        <div class="card-product_img">
          
          <ul class="card-product_imgOverlay">
            <li><button><i class="ti-search"></i></button></li>
            <li><button><i class="ti-shopping-cart"></i></button></li>
            <li><button><i class="ti-heart"></i></button></li>
          </ul>
        </div>
        <div class="card-body">
          <p>Accessories</p>
          <h4 class="card-product_title"><a href="single-product.html">Quartz Belt
Watch</a></h4>
          <p class="card-product_price">$150.00</p>
        </div>
      </div>

      <div class="card text-center card-product">
        <div class="card-product_img">
          
          <ul class="card-product_imgOverlay">
            <li><button><i class="ti-search"></i></button></li>
            <li><button><i class="ti-shopping-cart"></i></button></li>

```

```

            <li><button><i class="ti-heart"></i></button></li>

```



```

        </ul>
    </div>
    <div class="card-body">
        <p>Beauty</p>
        <h4 class="card-product_title"><a href="single-product.html">Women
Freshwash</a></h4>
        <p class="card-product_price">$150.00</p>
    </div>
</div>

<div class="card text-center card-product">
    <div class="card-product_img">
        
        <ul class="card-product_imgOverlay">
            <li><button><i class="ti-search"></i></button></li>
            <li><button><i class="ti-shopping-cart"></i></button></li>
            <li><button><i class="ti-heart"></i></button></li>
        </ul>
    </div>
    <div class="card-body">
        <p>Decor</p>
        <h4 class="card-product_title"><a href="single-product.html">Room Flash
Light</a></h4>
        <p class="card-product_price">$150.00</p>
    </div>
</div>

<div class="card text-center card-product">
    <div class="card-product_img">
        
        <ul class="card-product_imgOverlay">
            <li><button><i class="ti-search"></i></button></li>
            <li><button><i class="ti-shopping-cart"></i></button></li>
            <li><button><i class="ti-heart"></i></button></li>
        </ul>
    </div>
    <div class="card-body">
        <p>Decor</p>
        <h4 class="card-product_title"><a href="single-product.html">Room Flash
Light</a></h4>
        <p class="card-product_price">$150.00</p>
    </div>
</div>

<div class="card text-center card-product">
    <div class="card-product_img">
        
        <ul class="card-product_imgOverlay">
            <li><button><i class="ti-search"></i></button></li>

```

```

        <li><button><i class="ti-shopping-cart"></i></button></li>
    </li><button><i class="ti-heart"></i></button></li>
</ul>
</div>
<div class="card-body">
    <p>Accessories</p>
    <h4 class="card-product_title"><a href="single-product.html">Quartz Belt
Watch</a></h4>
    <p class="card-product_price">$150.00</p>
</div>
</div>

<div class="card text-center card-product">
    <div class="card-product_img">
        
        <ul class="card-product_imgOverlay">
            <li><button><i class="ti-search"></i></button></li>
            <li><button><i class="ti-shopping-cart"></i></button></li>
            <li><button><i class="ti-heart"></i></button></li>
        </ul>
    </div>
    <div class="card-body">
        <p>Beauty</p>
        <h4 class="card-product_title"><a href="single-product.html">Women
Freshwash</a></h4>
        <p class="card-product_price">$150.00</p>
    </div>
</div>

<div class="card text-center card-product">
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        <ul class="card-product_imgOverlay">
            <li><button><i class="ti-search"></i></button></li>
            <li><button><i class="ti-shopping-cart"></i></button></li>
            <li><button><i class="ti-heart"></i></button></li>
        </ul>
    </div>
    <div class="card-body">
        <p>Decor</p>
        <h4 class="card-product_title"><a href="single-product.html">Room Flash
Light</a></h4>
        <p class="card-product_price">$150.00</p>
    </div>
</div>

<div class="card text-center card-product">
    <div class="card-product_img">
        
        <ul class="card-product_imgOverlay">

```

```

        <li><button><i class="ti-search"></i></button></li>
        <li><button><i class="ti-shopping-cart"></i></button></li>
        <li><button><i class="ti-heart"></i></button></li>
    </ul>
</div>
<div class="card-body">
    <p>Decor</p>
    <h4 class="card-product_title"><a href="single-product.html">Room Flash
Light</a></h4>
    <p class="card-product_price">$150.00</p>
</div>
</div>
</div>
</div>
</section>
<!-- ===== Best Selling item carousel end ===== -->

<!-- ===== Blog section start ===== -->
<section class="blog">
    <div class="container">
        <div class="section-intro pb-60px">
            <p>Popular Item in the market</p>
            <h2>Latest <span class="section-intro_style">News</span></h2>
        </div>

        <div class="row">
            <div class="col-md-6 col-lg-4 mb-4 mb-lg-0">
                <div class="card card-blog">
                    <div class="card-blog_img">
                        
                    </div>
                    <div class="card-body">
                        <ul class="card-blog_info">
                            <li><a href="#">By Admin</a></li>
                            <li><a href="#"><i class="ti-comments-smiley"></i> 2 Comments</a></li>
                        </ul>
                        <h4 class="card-blog_title"><a href="single-blog.html">The Richland Center
Shooping News and weekly shooper</a></h4>
                        <p>Let one fifth i bring fly to divided face for bearing divide unto seed. Winged
divided light Forth.</p>
                        <a class="card-blog_link" href="#">Read More <i class="ti-arrow-
right"></i></a>
                    </div>
                </div>
            </div>
            <div class="col-md-6 col-lg-4 mb-4 mb-lg-0">
                <div class="card card-blog">
                    <div class="card-blog_img">
                        
                    </div>
                </div>
            </div>
        </div>
    </div>

```

```

        </div>
    <div class="card-body">
        <ul class="card-blog_info">
            <li><a href="#">By Admin</a></li>
            <li><a href="#"><i class="ti-comments-smiley"></i> 2 Comments</a></li>
        </ul>
        <h4 class="card-blog_title"><a href="single-blog.html">The Shopping News also
offers top-quality printing services</a></h4>
        <p>Let one fifth i bring fly to divided face for bearing divide unto seed. Winged
divided light Forth.</p>
        <a class="card-blog_link" href="#">Read More <i class="ti-arrow-
right"></i></a>
    </div>
</div>
</div>

```

```

<div class="col-md-6 col-lg-4 mb-4 mb-lg-0">
    <div class="card card-blog">
        <div class="card-blog_img">
            
        </div>
        <div class="card-body">
            <ul class="card-blog_info">
                <li><a href="#">By Admin</a></li>
                <li><a href="#"><i class="ti-comments-smiley"></i> 2 Comments</a></li>
            </ul>
            <h4 class="card-blog_title"><a href="single-blog.html">Professional design staff
and efficient equipment you'll find we offer</a></h4>
            <p>Let one fifth i bring fly to divided face for bearing divide unto seed. Winged
divided light Forth.</p>
            <a class="card-blog_link" href="#">Read More <i class="ti-arrow-
right"></i></a>
        </div>
    </div>
</div>
</div>
</div>
</div>
</section>
<!-- ===== Blog section end ===== -->

```

```

<!-- ===== Subscribe section start ===== -->
<section class="subscribe-position">
    <div class="container">
        <div class="subscribe text-center">
            <h3 class="subscribe_title">Get Update From Anywhere</h3>
            <p>Bearing Void gathering light light his eavening unto dont afraid</p>
            <div id="mc_embed_signup">
                <form target="_blank" action="https://spondonit.us12.list-
manage.com/subscribe/post?u=1462626880ade1ac87bd9c93a&amp;id=92a4423d01"
method="get" class="subscribe-form form-inline mt-5 pt-1">

```

```

        <div class="form-group ml-sm-auto">
            <input class="form-control mb-1" type="email" name="EMAIL"
placeholder="Enter your email" onfocus="this.placeholder = ''" onblur="this.placeholder =
'Your Email Address ' " >
            <div class="info"></div>
        </div>
        <button class="button button-subscribe mr-auto mb-1" type="submit">Subscribe
Now</button>
        <div style="position: absolute; left: -5000px;">
            <input name="b_36c4fd991d266f23781ded980_aefe40901a" tabindex="-1"
value="" type="text">
        </div>

    </form>
</div>

```

```

    </div>
</div>
</section>
<!-- ===== Subscribe section end ===== -->

```

```
</main>

```

```

<!--===== Start footer Area =====-->
    <footer class="footer">
        <div class="footer-area">
            <div class="container">
                <div class="row section_gap">
                    <div class="col-lg-3 col-md-6 col-sm-6">
                        <div class="single-footer-widget tp_widgets">
                            <h4 class="footer_title large_title">Our
Mission</h4>
                            <p>
                                So seed seed green that winged
                                cattle in. Gathering thing made fly you're no
                                divided deep moved us lan
                                Gathering thing us land years living.
                            </p>
                            <p>
                                So seed seed green that winged
                                cattle in. Gathering thing made fly you're no divided deep moved
                            </p>
                        </div>
                    </div>
                    <div class="offset-lg-1 col-lg-2 col-md-6 col-sm-6">
                        <div class="single-footer-widget tp_widgets">

```

```

<h4
class="footer_title">Quick

<ul class="list">
  <li><a

href="#">Home</a></li>
  <li><a href="#">Shop</a></li>
  <li><a href="#">Blog</a></li>
  <li><a

  <li><a href="#">Brand</a></li>
  <li><a

    </ul>
  </div>
</div>

<div class="col-lg-2 col-md-6 col-sm-6">
  <div class="single-footer-widget instafeed">
    <h4 class="footer_title">Gallery</h4>
    <ul class="list instafeed d-flex flex-

wrap">
      <li></li>
      <li></li>
      <li></li>
      <li></li>
      <li></li>
      <li></li>
    </ul>
  </div>
</div>

<div class="offset-lg-1 col-lg-3 col-md-6 col-sm-6">
  <div class="single-footer-widget tp_widgets">
    <h4 class="footer_title">Contact

    <div class="ml-40">
      <p class="sm-head">
        <span class="fa fa-

location-arrow"></span>

        Head Office
      </p>
      <p>123, Main Street, Your

      City</p>

      <p class="sm-head">
        <span class="fa fa-

phone"></span>

```

Phone Number

+123 456 7890

+123 456 7890

envelope">

<p class="sm-head">
<span class="fa fa-

Email

</p>
<p>
free@infoexample.com

www.infoexample.com

</p>

</div>

</div>

</div>

</div>

</div>

</div>


```
<div class="footer-bottom">
  <div class="container">
    <div class="row d-flex">
      <p class="col-lg-12 footer-text text-center">
        <!-- Link back to Colorlib can't be removed.
```

Template is licensed under CC BY 3.0. -->

Copyright ©<script>document.write(new Date().getFullYear());</script> All rights reserved | This template is made with <i class="fa fa-heart" aria-hidden="true"></i> by Colorlib

<!-- Link back to Colorlib can't be removed. Template is licensed under CC BY 3.0. --></p>

```
</div>
```

```
</div>
```

```
</div>
```

```
</footer>
```

```
<!--===== End footer Area =====-->
```

```
<script src="static/vendors/jquery/jquery-3.2.1.min.js"></script>
```

```
<script src="static/vendors/bootstrap/bootstrap.bundle.min.js"></script>
```

```
<script src="static/vendors/skrollr.min.js"></script>
```

```
<script src="static/vendors/owl-carousel/owl.carousel.min.js"></script>
```

```
<script src="static/vendors/nice-select/jquery.nice-select.min.js"></script>
```

```
<script src="static/vendors/jquery.ajaxchimp.min.js"></script>
```

```
<script src="static/vendors/mail-script.js"></script>
```

```
<script src="static/js/main.js"></script>
```

```
</body>
```

```
</html>
```

