Analysis and Prediction of Heart Disease

Submitted in Partial fulfillment of the requirements for the degree of **BACHELOR OF TECHNOLOGY** in Computer Science and Engineering

Six Month Industrial Training Report

Submitted by

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Acknowledgement

"The successful completion of any task would be incomplete without accomplishing the people who made it all possible and whose constant guidance and encouragement secured us the success."

The successful outcome of this assignment required lots of guidance and assistance from many people and we are extremely fortunate to have partially completed our project work. Whatever we have done is only due to such guidance and assistance and we should not forget to thank them. We respect and thank Mr. Prasenjit Jha at first place for giving me an opportunity to do this project and providing us support and guidance through which we could complete the major project in time. We are extremely grateful to them for providing such co-operation.

This major project also could not be completed without the help of our parents. We would also like to thank our friends for their most valuable effort to help us. Last but not the least; we would once again like to express our gratitude to our friends, teachers, our parents for their support and willingness to spend their important time with us.

We perceive as this opportunity as a big milestone in our career development. We will strive to use gained skills and knowledge in the best possible way, and we will continue to work on their improvements, in order to attain desired career objectives.

Harmandeep Kaur

Kajal Sodhi

Signature of the students

ABSTRACT

Heart disease is a term that assigns to a large number of medical conditions related to heart. These medical conditions describe the abnormal health conditions that directly influence the heart and all its parts. Heart disease is a major health problem in today's time. This project aims at analyzing the various data mining techniques introduced in recent years for heart disease prediction. The observations reveal that Neural networks with 15 attributes has outperformed over all other data mining techniques. Another conclusion from the analysis is that decision tree has also shown good accuracy with the help of genetic algorithm and feature subset selection.

The health care industries collect huge amounts of data that contain some hidden information, which is useful for making effective decisions. For providing appropriate results and making effective decisions on data, some advanced data mining techniques are used. In this study, a Heart Disease Prediction System (HDPS) is developed using Naives Bayes and Decision Tree algorithms for predicting the risk level of heart disease. The system uses 15 medical parameters such as age, sex, blood pressure, cholesterol, and obesity for prediction. The HDPS predicts the likelihood of patients getting heart disease. It enables significant knowledge. E.g. Relationships between medical factors related to heart disease and patterns, to be established. We have employed the multilayer perceptron neural network with backpropagation as the training algorithm. The obtained results have illustrated that the designed diagnostic system can effectively predict the risk level of heart diseases.

Chapter 1-Introduction to Project
Chapter 2-Project Idea & Related Studies
Chapter 3- Software Development Life Cycle (Related to Your Project Explain each and every phase independently)
Chapter 4 – Technology used
Chapter 5- System Requirements
Chapter 6- Screenshots
Chapter 7- Result and Discussion
Chapter 8- Conclusion and future scope
Chapter 9-References

INDEX

1. Introduction to Project

This major project evaluation was carried out in accordance with the IKGPTU guidelines. It is focused on all project activities starting from January 2020 until June 2020.

Now days, Heart disease is the most common disease. But, unfortunately the treatment of heart disease is somewhat costly that is not affordable by common man.
Heart disease is common among people who have the triggering factors such as unhealthy diet, obesity, smoking, cholesterol, high blood pressure, high blood glucose, lipids, physical inactivity, risky use of alcohol and hypertension. World Health Organization (WHO) stated that cardiovascular diseases are the primary cause of increasing global death. According to WHO, 17.7 million people around the world die due to cardiovascular diseases, which estimated 31% of all deaths worldwide as of 2015 report. More precisely, 7.4 million people around the world die due to coronary heart diseases and 6.7 million were due to stroke. Hence, we can reduce this problem in some amount just by predicting heart disease before it becomes dangerous using Analysis and Prediction of Heart Disease and Data mining. If we can find out heart disease problem in early stages then It becomes very helpful for treatment.Machine Learning and Data Mining techniques are used for the construction of Analysis and Prediction of Heart Disease . In healthcare biomedical field, there is large use of heath care data in the form of text, images, etc but, that data is hardly visited and is not mined. So, we can avoid this problem by introducing Analysis and Prediction of Heart Disease .This system will help us reduce the costs and to enhance the quality treatment of heart patients. This system can able to identify complex problems and can able to take intelligent medical decisions. The system can predict likelihood of patients of getting heart problems by their profiles such as blood pressure, age, sex, cholesterol and blood sugar. Also, the performance will be compared by calculation of confusion matrix. This can help to calculate accuracy, precision, and recall. The overall system provides high performance and better accuracy.

Analysis and Prediction of Heart Disease consists of training dataset and user input as the test dataset. Weka data mining tool with api is used to implement the Analysis and Prediction of Heart Disease. The source code of Weka is in java. The system is designed with java swing and use Weka api to call the different methods of Weka. The components used are instances, different classifiers and methods for evaluation. Supervised learning method is used here. A supervised learning algorithm analyses the training data and deduces a function from the labeled training set. It can be used for mapping new examples. The training data obtained from Cleveland heart disease database is the training example.

This training data consist of the class label and its corresponding value. Naive Bayesian, J48 and Random Forest classifiers are supervised learning algorithms. They learn from the provided training examples.

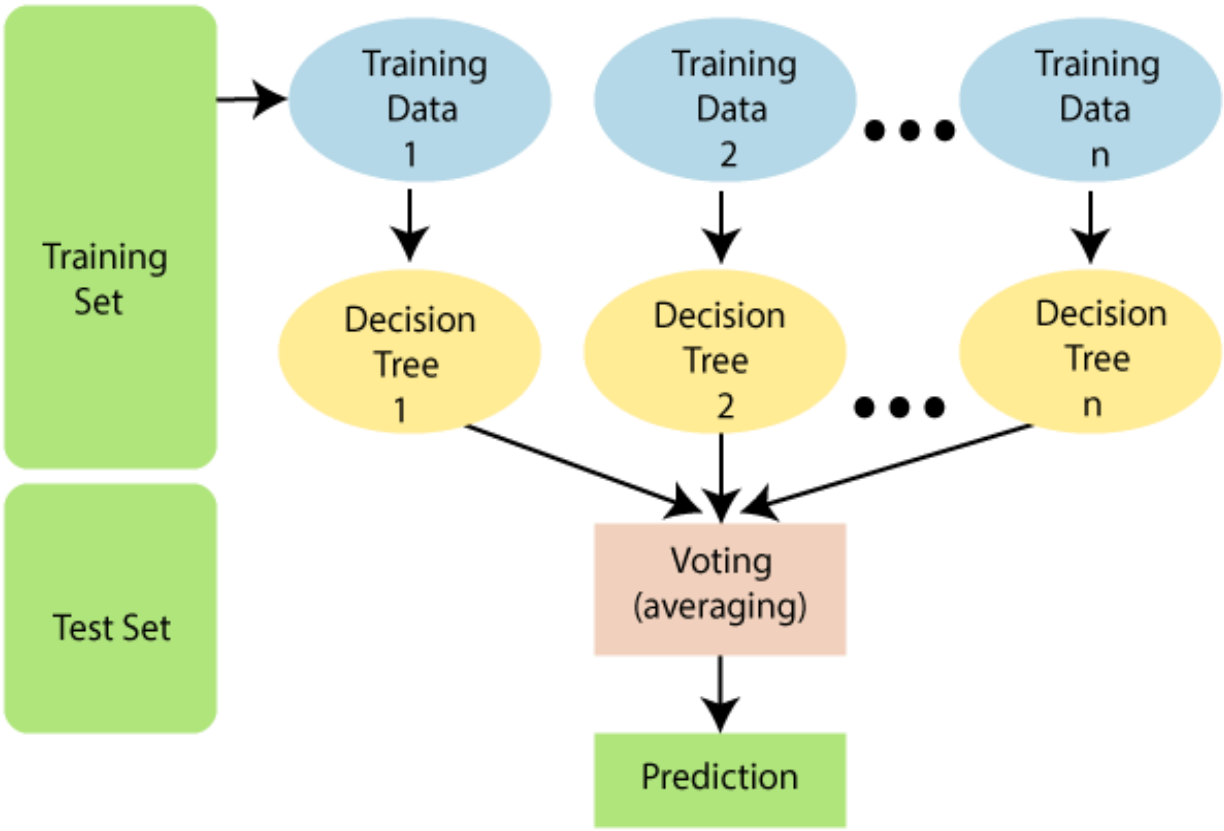


Fig 1.1 Working of the Random Forest algorithm

When a new instance with same attributes as in training data with different values other than those in the training example comes, these algorithms correctly classify the new instance based on the generalization created from the training set. Naive Bayesian, J48 and Random Forest classifiers are classify the new observation into two categories on the basis of training dataset. The training dataset is in the ARFF format. The training set consists of 14 attributes including the class attribute.

1. Project Idea and Related Studies

1.1 Existing System

- Clinical decisions are often made based on doctor's intuition and experience rather than on the knowledge rich data hidden in the database.
- This practice leads to unwanted biases, errors and excessive medical costs which affects the quality of service provided to patients.
- There are many ways that a medical misdiagnosis can present itself. Whether a doctor is at fault, or hospital staff, a misdiagnosis of a serious illness can have very extreme and harmful effects.
- The National Patient Safety Foundation cities that 42% of medical patients feel they have had experienced a medical error or missed diagnosis. Patient safety is sometimes negligently given the back seat for other concerns, such as the cost of medical tests, drugs, and operations.
- Medical Misdiagnoses are a serious risk to our healthcare proffesion. If they continue, then people will fear going to the hospital for treatment. We can put an end to medical misdiagnosis by informing the public and filling claims and suits against the medical practitioners at fault.

1.2 Proposed System

- This practice leads to unwanted biases, errors and excessive medical costs which affects the quality of service provided to the patients.
- Thus, we propose that integration of clinical decision support with computer based patients records could reduce medical errors, ehance paitent safety, decrease un wanted practice variation, and improve patient outcome.
- This suggestion is promising as data modeling and analysis tools, e.g., data mining, have the potential to generate a knowledge-rich environment which can help to significanty improve the quality of clinical decisions.
- The main objective of this project is to develop a system based on Analysis and Prediction of Heart Disease using data mining modeling technique.
- So its providing effective treatments, it also helps to reduce treatment cost. To enhance visualization and ease of interpretation.
- The Heart Disease Prediction application is an end user support.
- Here, we propose a web application that allows users to get instant guidance on their heart disease through an intelligent system online.

- The application is fed with various details and the heart disease associated with those details.
- The application allows user to check their heart related issues.
- Here we use some intelligent data mining techniques to guess the illness that could be associated with patient's details.
- Based on result, system automatically shows whether the patient is suffering from any kind of heart disease or not.
- The system can be use in case of emergency.

The system comprises of single module as follows:

- **Admin/User Module**

1. Upload Files
2. View Files Report
3. View User Details
4. Update User Details
5. View Training Data
6. Delete Training Data
7. Prediction of Dataset

2. Software Development Life Cycle (Iterative Model)

The iterative model is a particular implementation of a software development life cycle (SDLC) that focuses on an initial, simplified implementation, which then progressively gains more complexity and a border feature set until the final system is complete. When discussing the iterative method, the concept of incremental development will also often be used liberally and interchangeably, which describes the incremental alterations made during the design and implementation of each new iteration.

The iterative model is best thought of as a cyclical process. After an initial planning phase, a small handful of stages are repeated over and over, with each completion of the cycle incrementally improving and iterating on the software. Enhancements can quickly be recognized and implemented throughout each iteration, allowing the next iteration to be at last marginally better than the last.

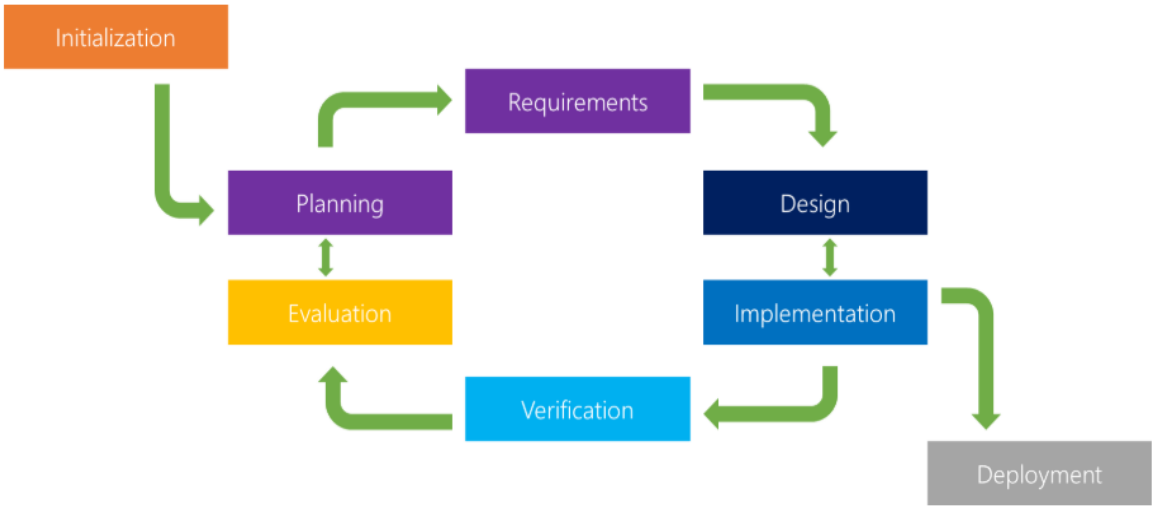


Fig 2.1 Software Development Life Cycle

2.1 Phases used in project:

The entire SDLC process divided into the following stages:

- Phase 1: Requirement collection and analysis
- Phase 2: Feasibility study:
- Phase 3: Design:
- Phase 4: Coding:
- Phase 5: Testing:
- Phase 6: Installation/Deployment:
- Phase 7: Maintenance

Phase 1: Requirement collection and analysis:

The requirement is the first stage in the SDLC process. It is conducted by the senior team members with inputs from all the stakeholders and domain experts in the industry. Planning for the quality assurance requirements and recognization of the risks involved is also done at this stage.

This stage gives a clearer picture of the scope of the entire project and the anticipated issues, opportunities, and directives which triggered the project.Requirements Gathering stage need teams to get detailed and precise requirements. This helps companies to finalize the necessary timeline to finish the work of that system.

Phase 2: Feasibility study:

Once the requirement analysis phase is completed the next step is to define and document software needs. This process conducted with the help of 'Software Requirement Specification' document also known as 'SRS' document. It includes everything which should be designed and developed during the project life cycle.

Phase 3: Design:

In this third phase, the system and software design documents are prepared as per the requirement specification document. This helps define overall system architecture.This design phase serves as input for the next phase of the model.

There are two kinds of design documents developed in this phase:

1. High-Level Design (HLD)

- Brief description and name of each module
- An outline about the functionality of every module
- Database tables identified along with their key elements
- Complete architecture diagrams along with technology details

2. Low-Level Design(LLD)

- Functional logic of the modules
- Database tables, which include type and size

- Listing of error messages
- Complete input and outputs for every module

Phase 4: Coding:

Once the system design phase is over, the next phase is coding. In this phase, developers start build the entire system by writing code using the chosen programming language. In the coding phase, tasks are divided into units or modules and assigned to the various developers. It is the longest phase of the Software Development Life Cycle process.

Phase 5: Testing:

Once the software is complete, and it is deployed in the testing environment. The testing team starts testing the functionality of the entire system. This is done to verify that the entire application works according to the customer requirement.

During this phase, QA and testing team may find some bugs/defects which they communicate to developers. The development team fixes the bug and send back to QA for a re-test. This process continues until the software is bug-free, stable, and working according to the business needs of that system.

Phase 6: Installation/Deployment:

Once the software testing phase is over and no bugs or errors left in the system then the final deployment process starts. Based on the feedback given by the project manager, the final software is released and checked for deployment issues if any.

Phase 7: Maintenance:

Once the system is deployed, and customers start using the developed system, following 3 activities occur

- Bug fixing - bugs are reported because of some scenarios which are not tested at all
- Upgrade - Upgrading the application to the newer versions of the Software
- Enhancement - Adding some new features into the existing software

3. Technology Used

3.1 Front End

3.1.1 Introduction to HTML

A template is a file that we can re-use to present different information in a consistent format – for example, you could use a template to help you write a letter because although each letter might contain a different message and be addressed to a different person, they will share the same format. A Django template's format is described in a language called HTML.HTML is a code that is interpreted by your web browser – such as Chrome, Firefox or Safari – to display a web page for the user.

HTML stands for "HyperText Markup Language". HyperText means it's a type of text that supports hyperlinks between pages. Markup means we have taken a document and marked it up with code to tell something (in this case, a browser) how to interpret the page. HTML code is built with tags, each one starting with < and ending with >. These tags represent markup **elements**.

3.1.2 Applying CSS and JavaScript to HTML

Just about all websites you'll use in the modern day will employ CSS to make them look cool, and JavaScript to power interactive functionality, such as video players, maps, games, and more. These are most commonly applied to a web page using the <link> element and the <script> element, respectively.

1. The <link> element always goes inside the head of your document. This takes two attributes, rel="stylesheet", which indicates that it is the document's stylesheet, and href, which contains the path to the stylesheet file:

<link rel="stylesheet" href="my-css-file.css">

2. The <script> element does not have to go in the head; in fact, often it is better to put it at the bottom of the document body (just before the closing </body> tag), to make sure that all the HTML content has been read by the browser before it tries to apply JavaScript to it (if JavaScript tries to access an element that doesn't yet exist, the browser will throw an error.)

<script src="my-js-file.js"></script>

Note: The <script> element may look like an empty element, but it's not, and so needs a closing tag. Instead of pointing to an external script file, you can also choose to put your script inside the <script> element.

Active learning: Applying CSS and JavaScript to a page

To start this active learning, grab a copy of our meta-example.html, script.js and style.css files, and save them on your local computer in the same directory. Make sure they are saved with the correct names and file extensions.

1. Open the HTML file in both your browser, and your text editor.
2. By following the information given above, add <link> and <script> elements to your HTML, so that your CSS and JavaScript are applied to your HTML.
3. If done correctly, when you save your HTML and refresh your browser you should be able to see that things have changed:

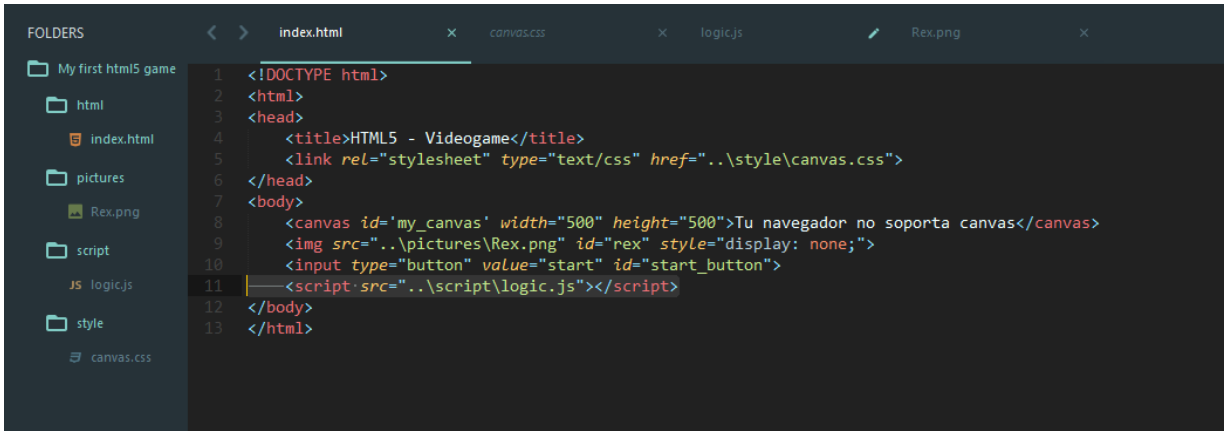


Fig 3.1 Applying CSS and JavaScript to a page

The JavaScript has added an empty list to the page. Now when you click anywhere on the list, a dialog box will pop up asking you to enter some text for a new list item. When you press the OK button, a new list item will be added to the list containing the text. When you click on an existing list item, a dialog box will pop up allowing you to change the item's text.

The CSS has caused the background to go green, and the text to become bigger. It has also styled some of the content that the JavaScript has added to the page (the red bar with the black border is the styling the CSS has added to the JS-generated list.)

3.1.3 Introduction to CSS

Cascading Style Sheets (CSS) is a language used for describing the look and formatting of a website written in a markup language (like HTML). Treat it as make-up for our web page.Cascading Stylesheets — or CSS — is the first technology you should start learning after HTML. While HTML is used to define the structure and semantics of your content, CSS is used to style it and lay it out. For example, you can use CSS to alter the font, color, size, and spacing of your content, split it into multiple columns, or add animations and other decorative features.

CSS handles the look and feel part of a web page. Using CSS, you can control the color of the text, the style of fonts, the spacing between paragraphs, how columns are sized and laid out, what background images or colors are used, layout designs,variations in display for different devices and screen sizes as well as a variety of other effects.

CSS is easy to learn and understand but it provides powerful control over the presentation of an HTML document. Most commonly, CSS is combined with the markup languages HTML or XHTML.

3.1.3.1 Advantages of CSS

1. **CSS saves time** − You can write CSS once and then reuse same sheet in multiple HTML pages. You can define a style for each HTML element and apply it to as many Web pages as you want.
2. **Pages load faster** − If you are using CSS, you do not need to write HTML tag attributes every time. Just write one CSS rule of a tag and apply it to all the occurrences of that tag. So less code means faster download times.
3. **Easy maintenance** − To make a global change, simply change the style, and all elements in all the web pages will be updated automatically.
4. **Superior styles to HTML** − CSS has a much wider array of attributes than HTML, so you can give a far better look to your HTML page in comparison to HTML attributes.
5. **Multiple Device Compatibility** − Style sheets allow content to be optimized for more than one type of device. By using the same HTML document, different versions of a website can be presented for handheld devices such as PDAs and cell phones or for printing.
6. **Global web standards** − Now HTML attributes are being deprecated and it is being recommended to use CSS. So its a good idea to start using CSS in all the HTML pages to make them compatible to future browsers.

3.1.3.2 Adding CSS to our document

The very first thing we need to do is to tell the HTML document that we have some CSS rules we want it to use. There are three different ways to apply CSS to an HTML document:

1. Create a file in the same folder as your HTML document and save it as styles.css. The .css extension shows that this is a CSS file.To link styles.css to index.html add the following line somewhere inside the <head> of the HTML document:

<link rel="stylesheet" href="styles.css">

2. This <link> element tells the browser that we have a stylesheet, using the rel attribute, and the location of that stylesheet as the value of the href attribute. You can test that the CSS works by adding a rule to styles.css. Using your code editor add the following to your CSS file:

```
h1 {
  color: red;
}
```

Save your HTML and CSS files and reload the page in a web browser. The level one heading at the top of the document should now be red. If that happens, congratulations — you have successfully applied some CSS to an HTML document. If that doesn't happen, carefully check that you've typed everything correctly.

3. You can continue to work in styles.css locally, or you can use our interactive editor below to continue with this tutorial. The interactive editor acts as if the CSS in the first panel is linked to the HTML document, just as we have with our document above.

3.1.4 Introduction to JavaScript

JavaScript is a lightweight, interpreted programming language. It is designed for creating network-centric applications. It is complimentary to and integrated with Java. JavaScript is very easy to implement because it is integrated with HTML. It is open and cross-platform. Javascript is a must for students and working professionals to become a great Software Engineer specially when they are working in Web Development Domain. I will list down some of the key advantages of learning Javascript:

Javascript is the most popular programming language in the world and that makes it a programmer's great choice. Once you learnt Javascript, it helps you developing great front-end as well as back-end softwares using different Javascript based frameworks like jQuery, Node.JS etc.

Javascript is everywhere, it comes installed on every modern web browser and so to learn Javascript you really do not need any special environment setup. For example Chrome, Mozilla Firefox , Safari and every browser you know as of today, supports Javascript.

1. Javascript helps you create really beautiful and crazy fast websites. You can develop your website with a console like look and feel and give your users the best Graphical User Experience.
2. JavaScript usage has now extended to mobile app development, desktop app development, and game development. This opens many opportunities for you as Javascript Programmer.
3. Due to high demand, there is tons of job growth and high pay for those who know JavaScript. You can navigate over to different job sites to see what having JavaScript skills looks like in the job market.
4. Great thing about Javascript is that you will find tons of frameworks and Libraries already developed which can be used directly in your software development to reduce your time to market.

5. There could be 1000s of good reasons to learn Javascript Programming. But one thing for sure, to learn any programming language, not only Javascript, you just need to code, and code and finally code until you become expert.

Example:

```
<html>
  <body>
    <script language = "javascript" type = "text/javascript">
      <!--
         document.write("Hello World!")
      //-->
    </script>
  </body>
</html>
```

3.1.4.1 Parallax Slider

The main idea of this slider is to slide the images (obviously) and to animate the three backgrounds differewntly to create some perspective. So, when we, for example, slide to the next image, we will animate the left value of the slider ul to minus the window width will also animate the background div that is visually the top-most background, but the animation will only be half of the window width. The background behind that one will move one quarter of the window width and so on. So the background which is “more far” will move less, just what the parallax principle describes.

3.1.4.2 Sequence Slider

Sequence.js is a JavaScript library that provides a responsive CSS framework for creating unique sliders, presentations, banners, and other step-based applications. The Sequence.js container is made 100% wide and 585px tall, centered, and content is prevented from overflowing its boundaries. A mini-reset is applied to the canvas and its steps for better browser consistency. The canvas and steps are made the same width/height as the container. The steps are made to sit side-by-side (using display: inline-block and white-space: nowrap)

Syntax:

is vertically aligned in the center. Each step is given a different background color. General styles are applied to the text

Sequence.js steps have three phases that they go through when they become active and inactive again.

- Start: The starting position prior to the step becoming active
- In: The animate in position for when the step is active
- Out: The animate out position for when the step is no longer active

When Sequence.js loads, its first step (by default) will be active, and as such, will be given the class seq-in. When the next step is navigated to

Step 1 will be given the class seq-out moving it into the out phase.

Step 2 will be moved to its start phase and then given the class of seq-in which will move it to its in phase. This process will repeat with each step and is reversed when navigating between steps backwards.

3.1.4.3 Owl Carrousel

OWL Carousel is a touch enabled jQuery plugin that lets you create beautiful responsive carousel sliders.

1. Getting Started

Load jQuery(1.7+) and include Owl Carousel plugin files

```
<!-- Basic stylesheet -->
<link rel="stylesheet" href="owl-carousel/owl.carousel.css">

 <!-- Default Theme -->
<link rel="stylesheet" href="owl-carousel/owl.theme.css">

<!-- Include js plugin -->
<script src="owl-carousel/owl.carousel.js"></script>
```

2. Set up your HTML

You don't need any special markup. All you need is to wrap your divs inside the container element . Class "owl-carousel" is mandatory to apply proper styles that come from owl.carousel.css file.

```
<div class="owl-carousel">
  <div> Your Content </div>
  <div> Your Content </div>
  <div> Your Content </div>
  <div> Your Content </div>
  <div> Your Content </div>
  <div> Your Content </div>
  <div> Your Content </div>
  ...
```

3. Call the plugin

Now call the Owl initializer function and your carousel is ready.

$(".owl-carousel").owlCarousel();

4.2 Back End

4.2.1 Introduction to Python

Python designed by Guido van Rossum at CWI has become a widely used general-purpose, high-level programming language. Python has become the language of choice for data science and artificial intelligence—two technology trends essential for global businesses to stay competitive today. In fact, Python is the fastest-growing programming language

Reason for increasing popularity

1. Emphasis on code readability, shorter codes, ease of writing
2. Programmers can express logical concepts in fewer lines of code in comparison to languages such as C++ or Java.
3. Python supports multiple programming paradigms, like object-oriented, imperative and functional programming or procedural.
4. There exists inbuilt functions for almost all of the frequently used concepts.
5. Philosophy is “Simplicity is the best”.

Language Features

- **Interpreted**

There are no separate compilation and execution steps like C and C++. Directly run the program from the source code. Internally, Python converts the source code into an intermediate form called bytecodes which is then translated into native language of specific computer to run it. No need to worry about linking and loading with libraries, etc.

- **Platform Independent**

Python programs can be developed and executed on multiple operating system platforms. Python can be used on Linux, Windows, Macintosh, Solaris and many more.Free and Open Source: Redistributable

- **High-level Language**

In Python, no need to take care about low-level details such as managing the memory used by the program.

- **Simple**

Closer to English language;Easy to Learn. More emphasis on the solution to the problem rather than the syntax

- **Embeddable**

Python can be used within C/C++ program to give scripting capabilities for the program's users.

- **Robust**:

Exceptional handling features

Memory management techniques in built

- **Rich Library Support**

The Python Standard Library is vary vast. Known as the "batteries included" philosophy of Python ;It can help do various things involving regular expressions, documentation generation, unit testing, threading, databases, web browsers, CGI, email, XML, HTML, WAV files, cryptography, GUI and many more.

Currently, there are two versions of Python available Python 2 and Python 3. Many beginners must be wondering with which version of Python they should start. My answer to this question is usually something along the lines "just go with the version your favourite tutorial is written in, and check out the differences later on."

Python Installation and Setup Guide

To get started working with Python 3, first of all You will need to have access to the Python interpreter. There are numerous ways to accomplish this:

1. Python Installation in Windows 10:
2. You can directly obtain it from the Python Software Foundation Youbsite at Python.org.
3. In operating systems like Linux, there will be a package manager which can be run to install Python.
4. On MacOS, to install Python 3, first You have to install a package manager called Homebrew. This will be discussed later in the relevant section of this tutorial.

Install Python on Windows

For Windows operating system, the installation process is as follows:

1. To install Python, firstly You need to go to the Download Python page from its official site python.org/download and click on the latest version

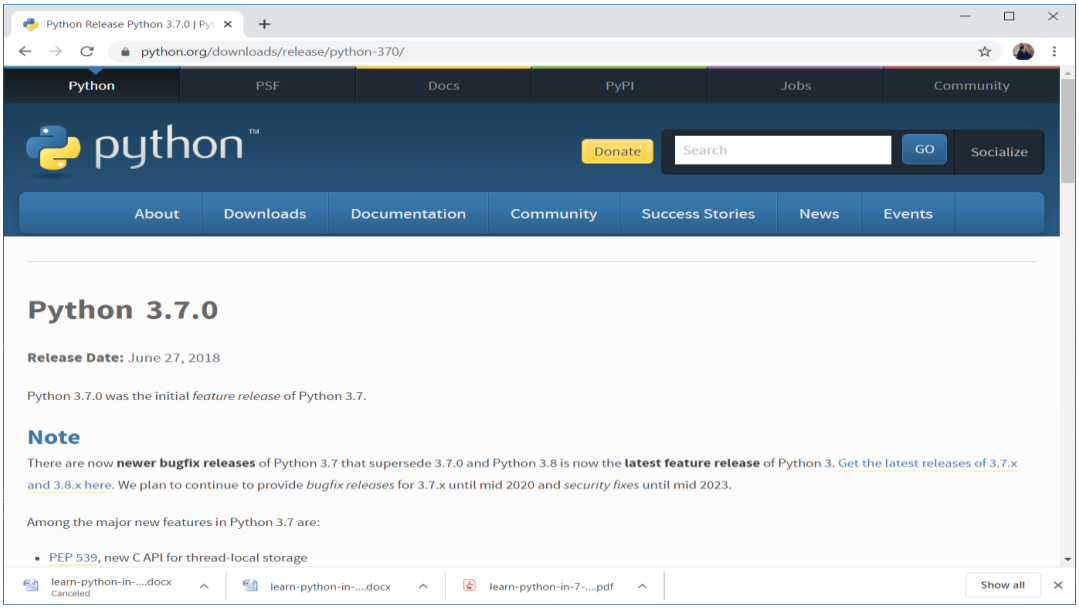


Fig 4.2.1 Download Python page from its official site

Once the Python distribution download is completed, then double-click on the executable downloaded software, and then click on Run

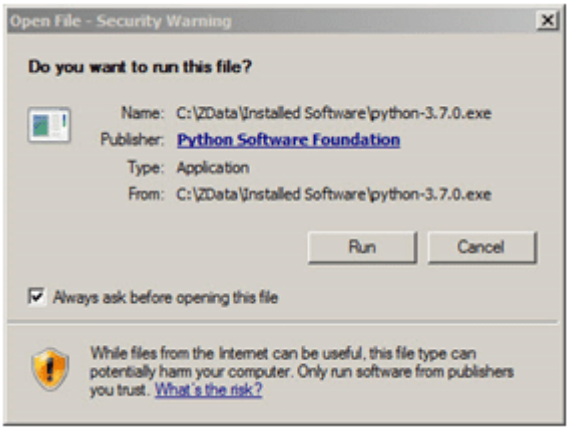


Fig 4.2.2 Python distribution download is completed

Now, once the installation set up starts, You need to follow the below-mentioned installation steps:

Step 1: A pop-up window, Python Version 3.7.0 (32-bit) Setup, will appear. Here, You need to ensure that You have checked the checkboxes for 'Install launcher for all users (recommended)' and for 'Add Python 3.7 to PATH' at the bottom0

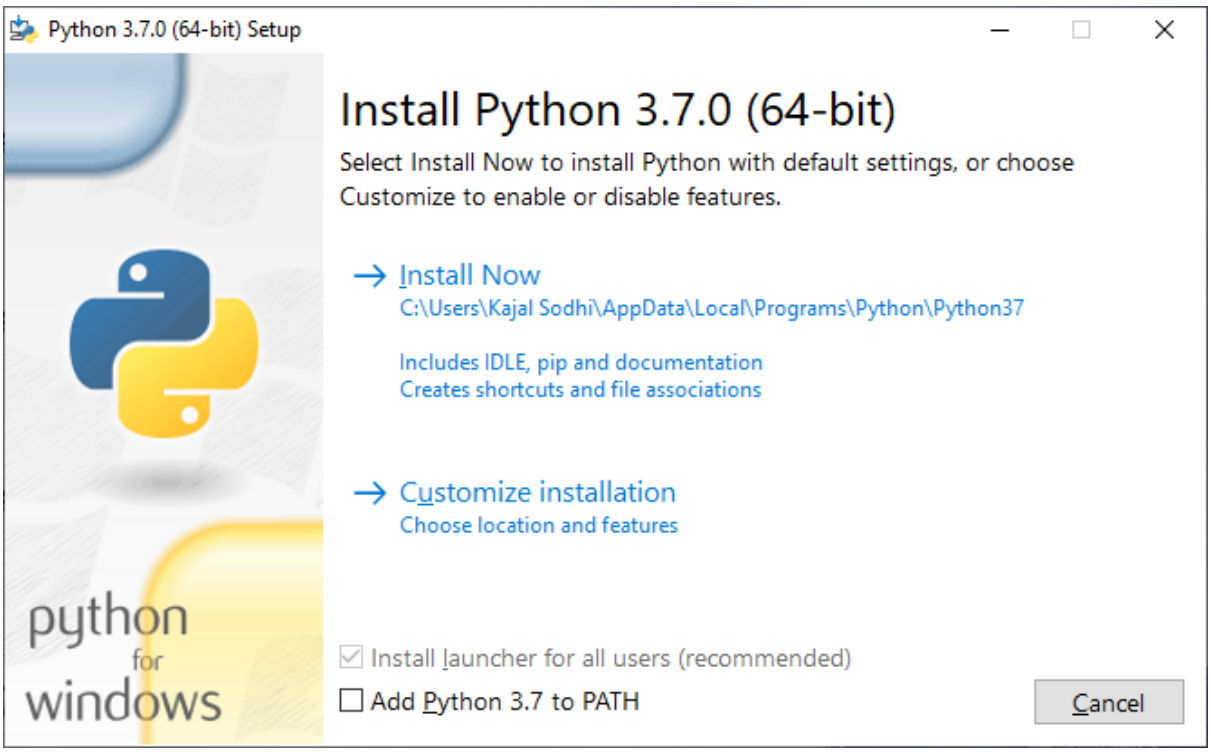


Fig 4.2.3 Add Python 3.7 to path

Step 2: Now, a User Account Control pop-up window will appear, posing the question, 'Do you want to allow the following program to make changes to this computer?' Click on Yes

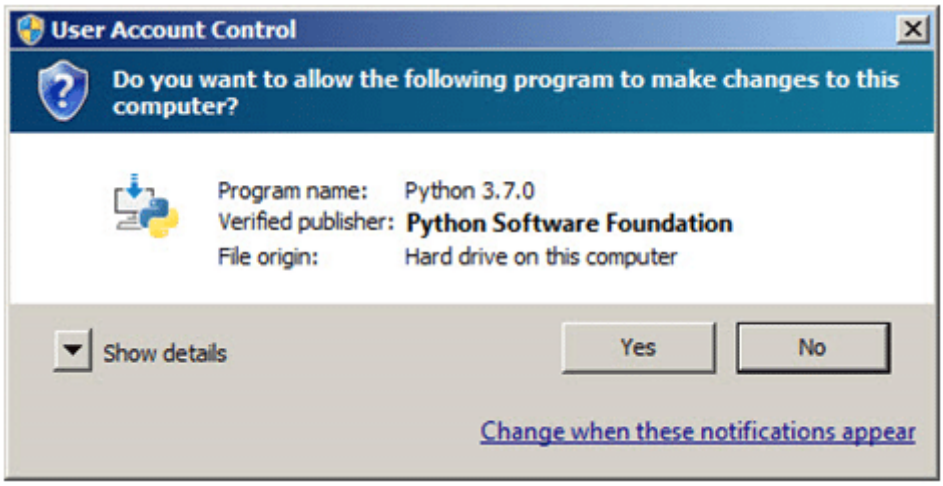


Fig 4.2.4 User Account Control pop-up window

Step 3: Now, a new Python 3.7.0 (32-bit) Setup pop-up window will appear with a 'Setup Progress' message and a progress bar. During the installation, it will show us various components it is installing, and it will move the progress bar toward completion. Soon, a new Python 3.7.0 (32-bit) Setup pop-up window will appear with a 'Setup was successful' message

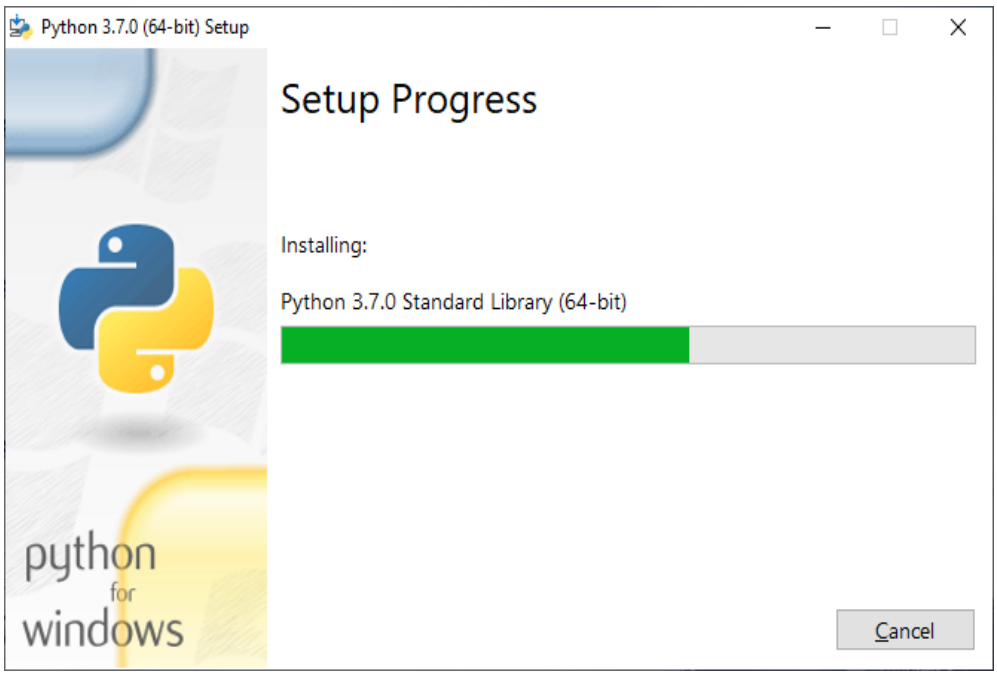


Fig 4.2.5 Setup was successful

Step 4: Once the installation is done, click on the Close button. And now, Python is successfully installed

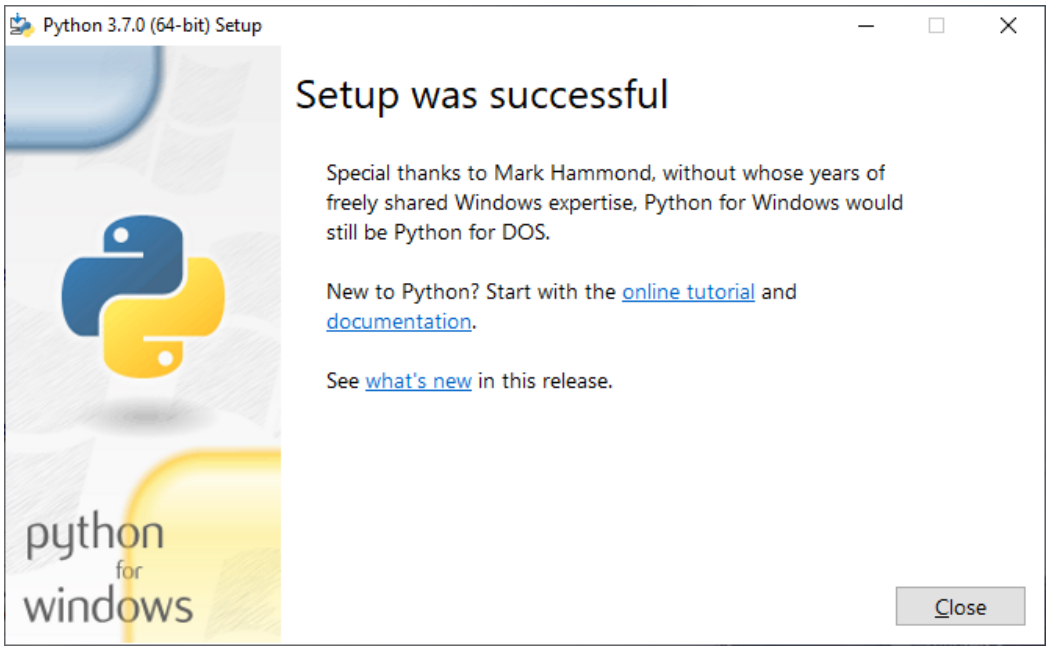


Fig 4.2.6 Python is successfully installed

Step 5: Now, You will try to verify the installation

1. Navigate to the directory:

C:\Users\AppData\Local\Programs\Python\Python37-32

2. or to whatever directory Python was installed (see Step 3 of the installation process)

3. Double-click on the icon/file python.exe

The following pop-up window will appear.

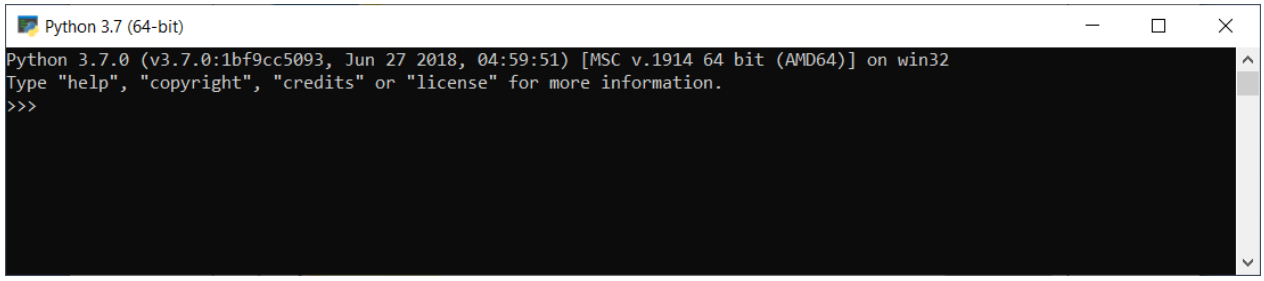


Fig 4.2.7 verify the installation

4. This pop-up window will be with the title, and inside the window, on the first line, You will get a text 'Python 3.7.0…'. From here, You can notice that it also says '64-bit'.
5. Inside the window, at the bottom left, the prompt, '>>>': type exit() to this prompt and press Enter to terminate Python.
6. Now, You should keep the file python-3.7.0.exe somewhere on our computer in case You need to reinstall Python.
7. To write a Python script file, You can use any text editing software. For that, You just have to save it with the .py extension. But, using a Python IDE can make developers' life a lot easier. IDE is a software that provides useful features like hinting code, highlighting and checking syntax, file explorers, etc. to programmers for application development.
8. Some of the popular free Python IDEs are PyCharm, Spyder, Rodeo and Jupyter Notebook. Jupyter Notebook is one of the best among them.

Softwares making use of Python

1. Python has been successfully embedded in a number of software products as a scripting language.

2. GNU Debugger uses Python as a pretty printer to show complex structures such as C++ containers.

3. Python has also been used in artificial intelligence

4. Python is often used for natural language processing tasks.

Current Applications of Python

1. A number of Linux distributions use installers written in Python example in Ubuntu we have the Ubiquity

2. Python has seen extensive use in the information security industry, including in exploit development.
3. Raspberry Pi– single board computer uses Python as its principal user-programming language.
4. Python is now being used Game Development areas also.

Pros:

1. Ease of use
2. Multi-paradigm Approach

Cons:

1. Slow speed of execution compared to C,C++
2. Absence from mobile computing and browsers

For the C,C++ programmers switching to python can be irritating as the language requires proper indentation of code. Certain variable names commonly used like sum are functions in python. So C, C++ programmers have to look out for these.

4.2.2 Introduction to Django

A web framework is a server-side application framework which is designed to support the development of dynamic websites. With the help of a framework, you don't have to handle the hassles of web development and its various components. Therefore, it makes the life of a web application developer much easier as they don't have to code from scratch. There are various web development frameworks available in the market. Some of them are listed below:

- React JS
- Angular
- Ruby on Rails
- Express

One of the highlights of Django is that it is built on python. From several years python has been the most popular programming language and continues to be a favorite among the skilled programmers. Hence, Django delivers transparent and high-quality code writing, making it important for the developers as well as the customers. It has various other advantages as it has an automatic administration interface, Object-relational mapper(ORM).

Django

Django is an open source web framework which was named after Django Reinhardt. It follows the principle of "Don't Repeat Yourself". As the name says, this principal is all about keeping the code simple and non repeating. Django is also a high level, MVT architect which stands for Model View Template.

Features of Django

1. **Fast**: Django is ridiculous fast. It encourages rapid development with a clean and pragmatic design. It is free and open source which helps the developers to complete their app as fast as possible. Django takes care of much of the hassle of Web development without needing to reinvent the wheel.
2. **Tons of Packages**: Django contains set of components that helps you to develop your websites faster and easier. You don't need to download it separately as Django installs all the extras, packages and the related dependencies to handle common web development tasks. It also takes care of user authentication, content administration, site maps and many more.
3. **Secure:** Django is highly secure as lot more work has been done there by the python web community. It helps the developers to avoid many common security mistakes, such as SQL injection, cross-site scripting, csrf and clickjacking. Its user authentication system provides a secure way to manage user accounts and passwords.
4. **Scalable**: Django has a set of good defaults and Python makes it very explicit. Also, Instagram and Disqus are two products that serve millions of users and use Django as their primary backend. So I'd rather say it's pretty scalable.
5. **Versatile** – Django is used to build all sort of things – from content management systems to social networks to scientific computing platforms. Therefore, Django is extremely versatile in all fields.

Django Architecture

Django follows a MVC- MVT architecture.

MVC stands for Model View Controller. It is used for developing the web publications, where we break the code into various segments. Here we have 3 segments, model view and a controller.

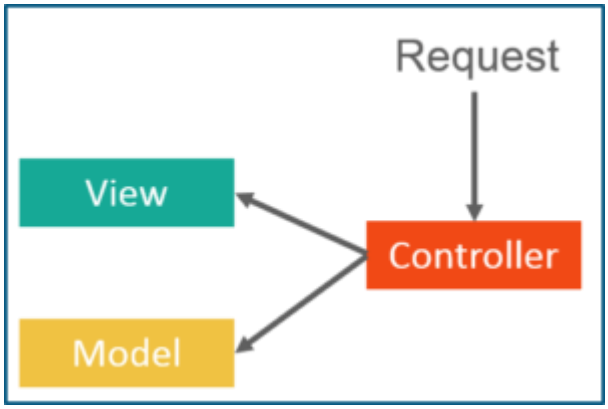


Fig 4.2.2.1 Architechture of Django

1. **Model** – Model is used for storing and maintaining your data. It is the backend where your database is defined.

2. **Views** – In Django templates, views are in html. View is all about the presentation and it is not at all aware of the backend. Whatever the user is seeing, it is referred to a view.
3. **Controller** – Controller is a business logic which will interact with the model and the view.

Now that we have understood MVC, lets learn about Django MVT pattern.

MVT stands for Model View Template. In MVT, there is a predefined template for user interface. Let's take an example, say you want to write several static html forms like hello user 1, hello user2 and so on. With template, you will be having only one file that prints hello along with the variable name. Now this variable will be substituted in that particular template using some jinja logic. That's the magic of template, you don't need to rewrite the code again n again!

In the case of MVT, Django itself takes care of the controller part, it's inbuilt. Internal working:

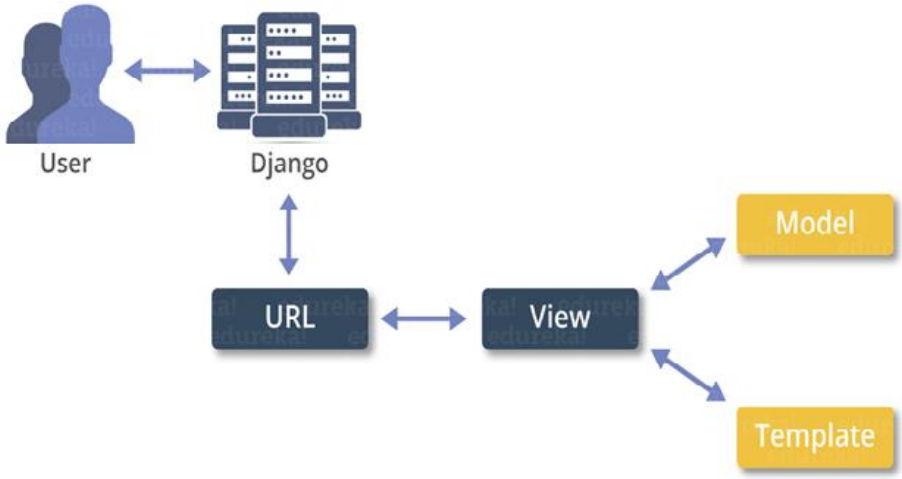


Fig 4.2.2.2 Internal Working of Django Architecture

In the above image, template is your front end which will interact with the view and the model will be used as a backend. Then view will access both the model and the templates and maps it to a url. After that, Django plays the role of controller and serves it to the user.

Now that you understand the architecture or how Django works internally, let's move ahead in Django tutorial and install Django in our systems.

Django Installation

Let me guide you through the process of installing Django on your system. Just follow the below steps:

Step 1: Go to the link: https://www.djangoproject.com/download/

Step 2: Type the pip command on command prompt and installation will get started.

Refer to the below screenshot to get a better understanding.

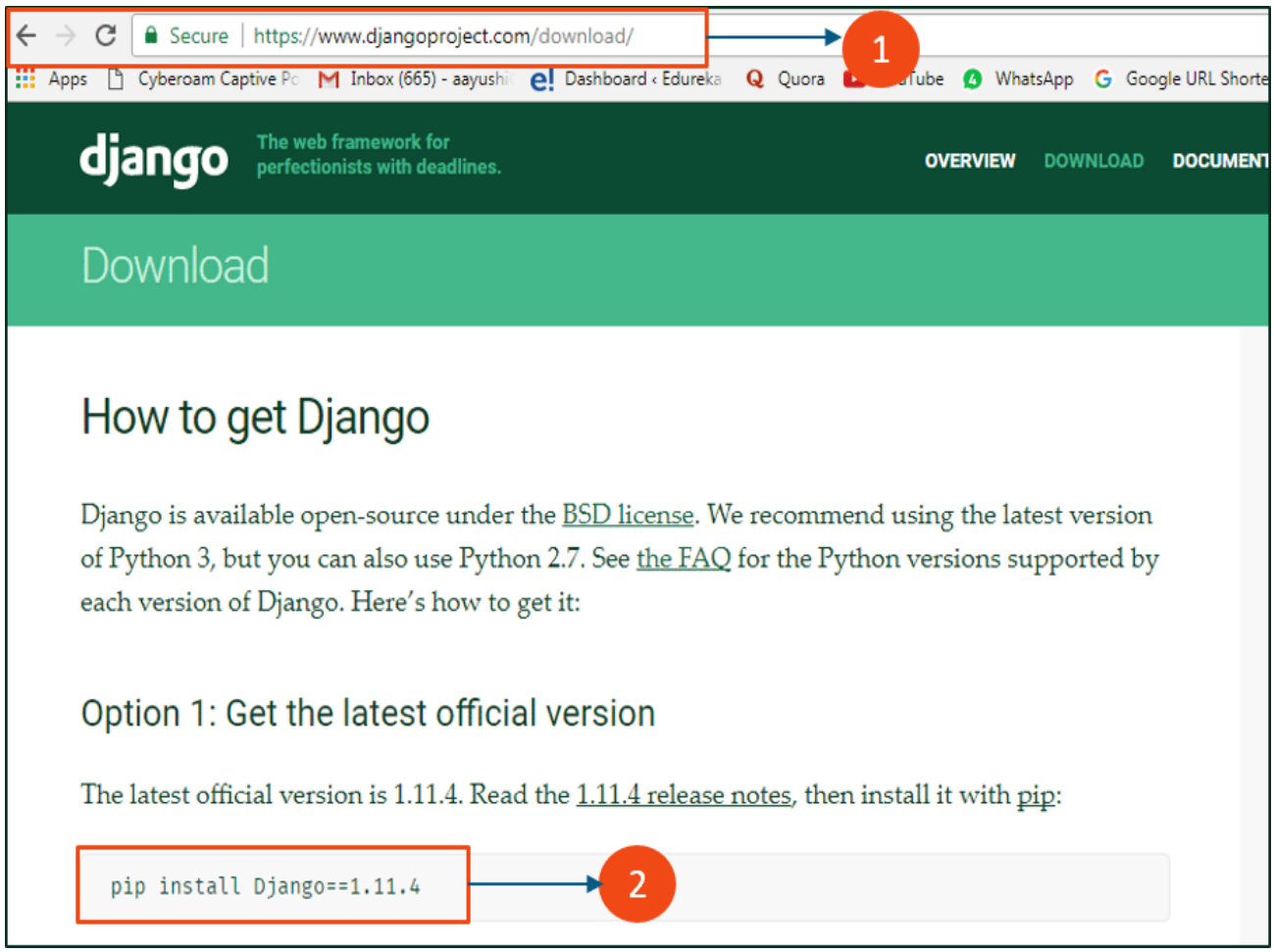


Fig 4.2.2.3 Installation of django

By following the above steps, you are done with the Django installation part. Next, its time we build our own web application.

1. Build Your First Web Application in Django

2. For creating a web application, first let's create a project. To create a project, just enter into a directory where you would like to share your code, then run the following command:
   "django-admin startproject myproject"
3. Once your project has been created, you will find a list of files inside the project directory. Let's discuss each one of them.
   - **manage.py** – It is a command-line utility that lets you interact with this Django project in various ways.
   - **myproject/** – It is the actual Python package for your project. It is used to import anything, say – myproject.urls.

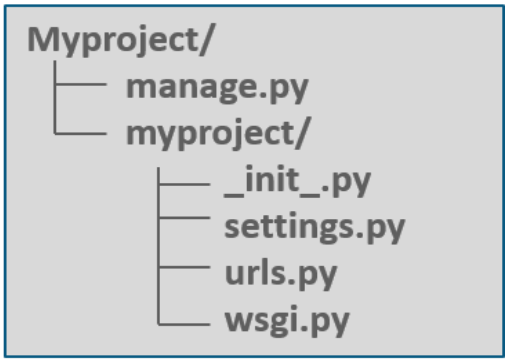


Fig 4.2.2.4 importing python packages

- **init.py** – Init just tells the python that this is to be treated like a python package.
- **settings.py** – This file manages all the settings of your project.
- **urls.py** – This is the main controller which maps it to your website.
- **wsgi.py** – It serves as an entry point for WSGI compatible web servers.

Note: To create your application, make sure you are in the same directory as manage.py and then type the below command:

```
python manage.py startapp webapp
```

4. Now if we look at the 'webapp' directory, we have some extra things from the original myproject. It includes model, test which are related to your backend databases.
5. Next in Django tutorial, you need to import your application manually inside your project settings. For that, open your myproject/settings.py and add your app manually:

```
INSTALLED_APPS = (
    'webapp',
    'django.contrib.admin',
    'django.contrib.auth',
    'django.contrib.contenttypes',
    'django.contrib.sessions',
    'django.contrib.messages',
    'django.contrib.staticfiles',
)
```

6. Once you have installed your app, let's create a view now. Open your webapp/views.py and put the below code in it:

```
from django.shortcuts import render
from django.http import HttpResse
def index(request):
 return  HttpResponse("<H2>HEY! Welcome to Edureka! </H2>")
```

7. In the above code, I have created a view which returns httpResponse. Now we need to map this view to a URL. We need a URLconf in our application. So let's create a new python file "urls.py" inside our webapp. In webapp/urls.py include the following code:

```
from django.conf.urls import url
from . import views
urlpatterns = [
 url(r'^$', views.index, name='index'),
]
```

8. In the above code, I have referenced a view which will return index (defined in views.py file). The url pattern is in regular expression format where ^ stands for beginning of the string and $ stands for the end.
9. The next step is to point the root URLconf at the webapp.urls module. Open your myproject/urls.py file and write the below code:

```
from django.conf.urls import include, url
from django.contrib import admin
urlpatterns = [
   url(r'^admin/', include(admin.site.urls)),
   url(r'^webapp/', include('webapp.urls')),
]
```

10. In the above code, I have added my webapp and included the webapp.urls. Now don't forget to import django.conf.urls.include and insert an include() in the urlpatterns list. The include() function allows referencing other URLconfs.

Note: that the regular expression doesn't have a '$' but rather a trailing slash, this means whenever Django encounters include(), it chops off whatever part of the URL matched up to that point and sends the remaining string to include URLconf for further processing.

11. We are now done with the coding part! Let's now start the server and see what happens. To start the server, type the below command:

```
python manage.py runserver
```

12. After running the server, go to **http://localhost:8000/webapp/** in your browser, and you should see the text "HEY! Welcome to Edureka!", which you defined in the index view.

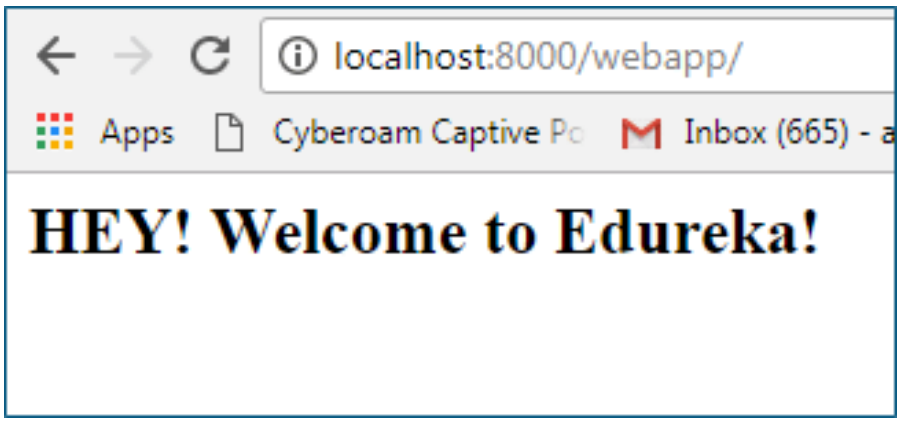


Fig 4.2.2.5 Django is successfully installed

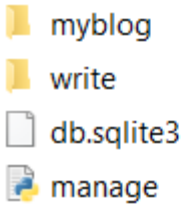
4.2.3 Introduction to Database

Whenever we are creating a web project or any kind of project, we want some kind of input by our end-users or consumers. All that data/ input is handled by a Database. In today's scenario, whenever we are developing a website, we will need a database, whether it's a blog site or highly interactive ones like Instagram which is based on Django.

To achieve that you would need some software, which can store that data efficiently and also some middleware which can let you communicate with the database.

Connecting Databases with Django Project

By default, when we made our first app and started the server you must have seen a new file in your project directory, named as 'db.sqlite3'. The file is database file where all the data that you will be generating will be stored. It is a local file as Django is a server-side framework and it treats your computer as the host when you actually run the server in command line/terminal.



This file is generated automatically because Django has a default setting of the database set to the SQLite, which is although fine for testing and provides lots of features but if you want your website to be scalable, you need to change it to any other efficient database.

1. **Databases Dictionary Indexes**

Firstly, open the settings.py file of your web-application/ project and there find this part.

```
# Database
# https://docs.djangoproject.com/en/2.1/ref/settings/#databases

DATABASES = {
    'default': {
        'ENGINE': 'django.db.backends.sqlite3',
        'NAME': os.path.join(BASE_DIR, 'db.sqlite3'),
    }
}
```

Fig 4.2.3.1 Databases Dictionary Indexes

1. This partition has information regarding the connection to the database.
2. Databases is a pre-defined dictionary in Django Framework with the 'default' as an index having the value for the main database where all the data is to be stored.
3. There can be multiple databases as we need data backups too but there is only one default database, although we won't be adding multiple databases now.

The default is holding a dictionary where there are 2 indexes:

- **Engine**

It specifies the library to be used when connected to a certain website. In the value, we have to put the file, "django.db.backends.sqlite3", which is the python library for sqlite3 database and will translate your python code to the database language.Thus, you won't need to learn any new database language, every code is in Python.

- **Name**

Here you will have a name of the database that you are using and the location of your database. This parameter changes according to the type of database you are using. Here you can experiment with the database file.

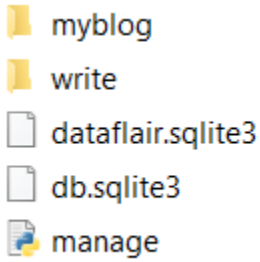
In this, we are also passing the name of the database file or if the file is not present, this will create the db.sqlite3 file. If you change the name to db1.sqlite3 or anything of your choice it will create that file in your root directory every time you run server again.

Here, in this, we have changed the name to 'dataflair.sqlite3'.

Now execute these two commands:

python manage.py migrate

python manage.py runserver



As we can see, a new database file is created and it is such an easy process to create a database with Django framework. Just like this, every database has some attributes which actually become the default dictionaries indexes which you can change/ create according to the database you are connecting to.

We will be connecting the MySQL database with our project.

2. MySQL and Django – Connecting MySQL Database with Django Project

MySQL is a very powerful database providing you with tons of features and flexibility. We are not going to discuss its functionality now, we will just integrate it with our project.

Here are the steps to integrate Django project with MySQL:

Step 1: Install Xampp

Xampp is a free opensource tool which provides you with the Apache server and phpMyAdmin which is the best source for beginner programmers to work with MySQL.

Step 2: Run Xampp Control Panel

Now, after installation, you will have to run the Xampp Control Panel and just start 2 services there, Apache and MySQL.

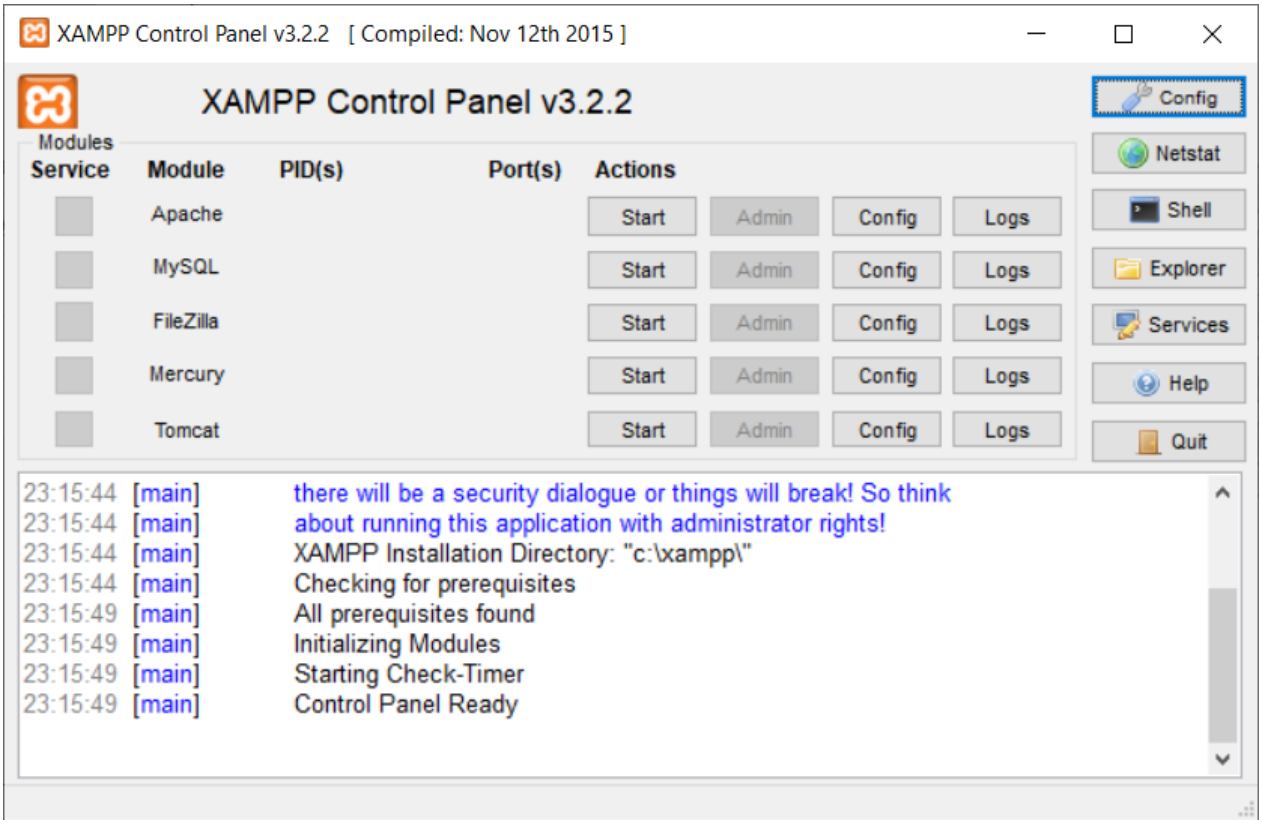


Fig 4.2.3.2 Run the Xampp Control Panel and just start 2 services

- Start the Apache Server First and then the MySQL server.
- Just click on start action, and after starting it should look like this image.

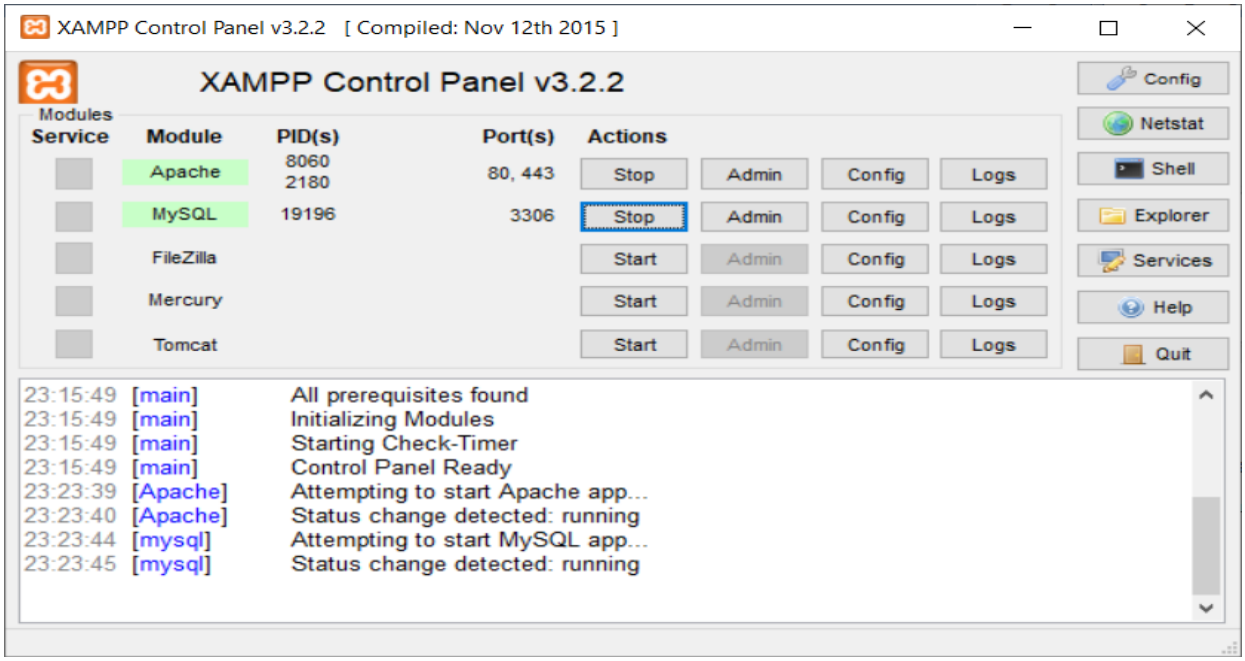


Fig 4.2.3.3

Now, click on the Admin of the MySQL Service, that should open a webpage(offline) looking like this.

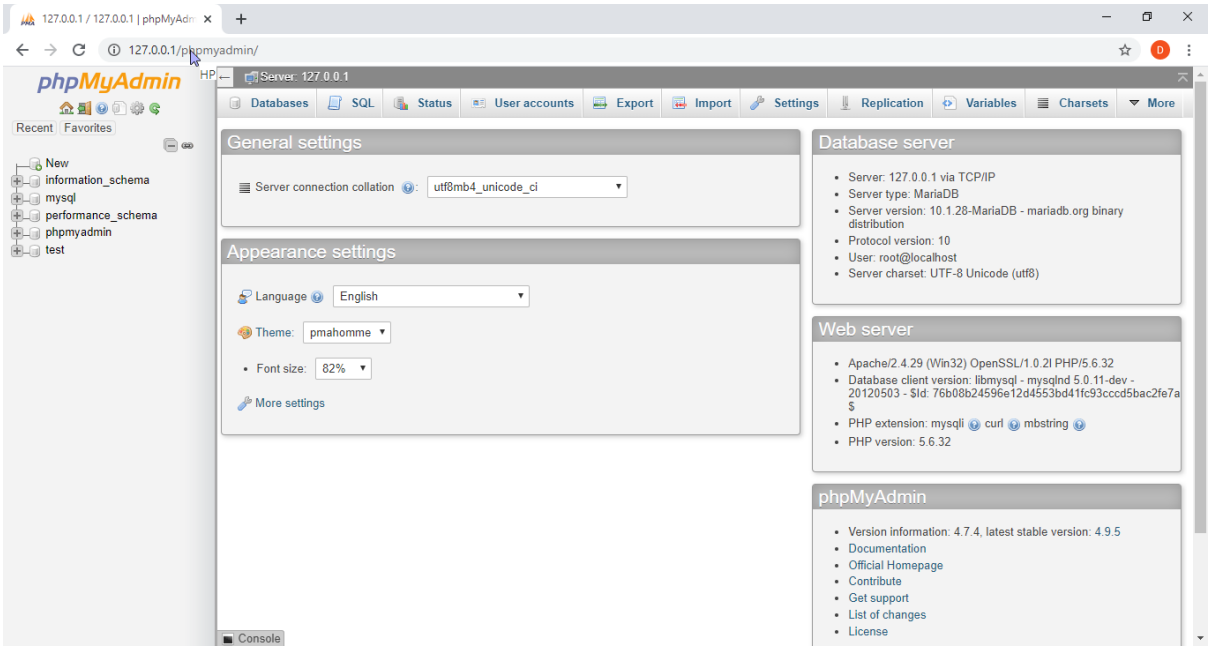


Fig 4.2.3.4

This is the main page where we will be observing our database.

The main advantage of Xampp is that it provides you a very interactive environment and when we will be deploying our models, that too will be done in this.

Step 3: Creating a SQL database:

On the webpage phpMyAdmin, we will have to create a database for our project. That's very easy.

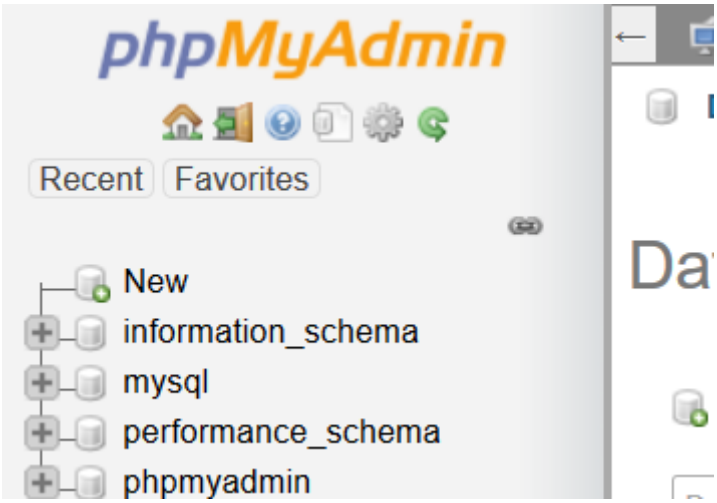


Fig 4.2.3.5 Creating a SQL database

Just Click on the New button as shown here. Then, just fill the desired name of your database and click on create button.

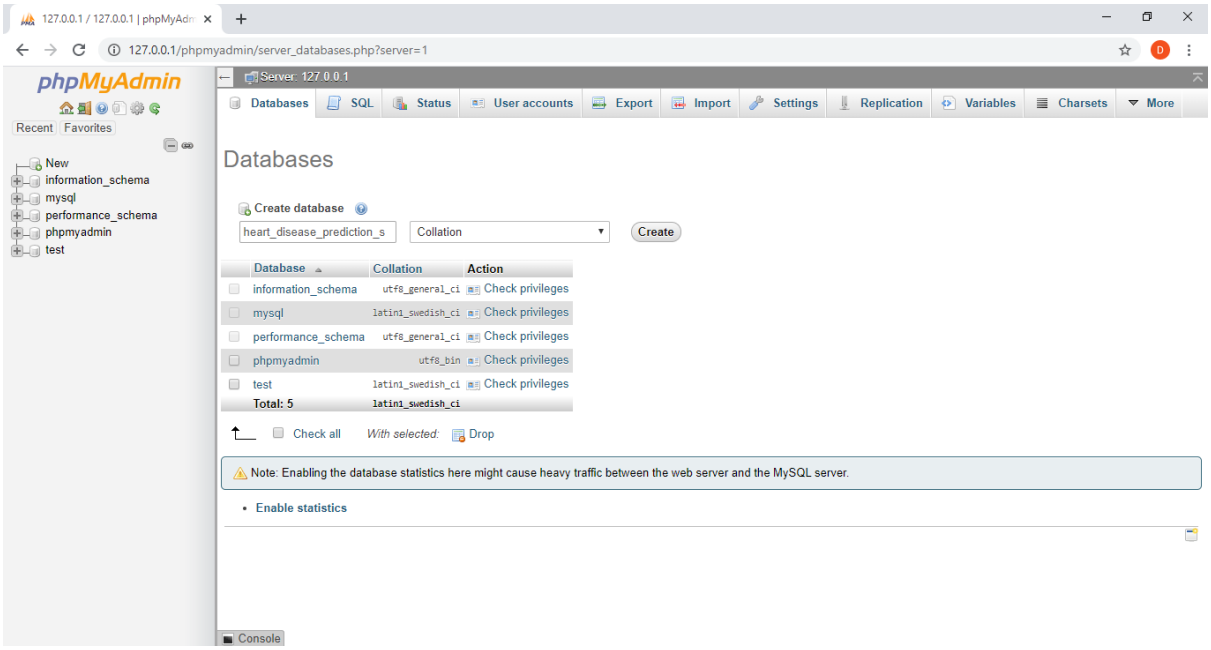


Fig 4.2.3.6 Database is created

That will add your database in the list.

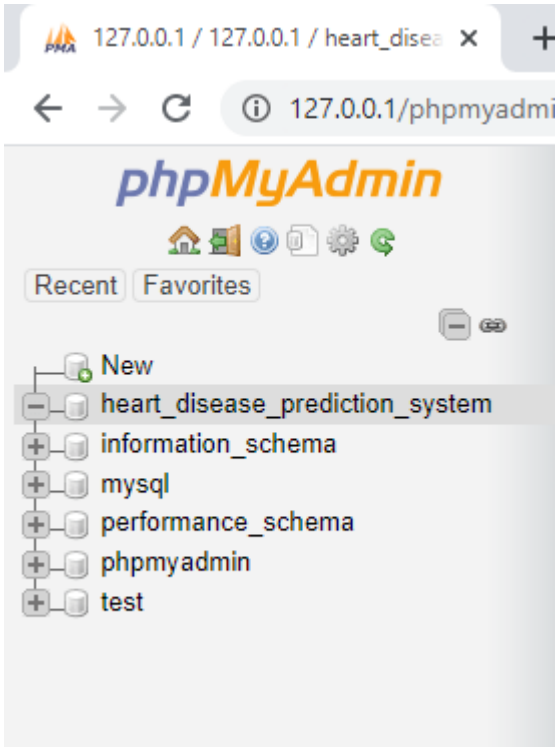


Fig 4.2.3.7 Database will be added into list

That's it, now we don't need to do anything here. We will be only interacting with python and the models component of Django will prepare everything for us.

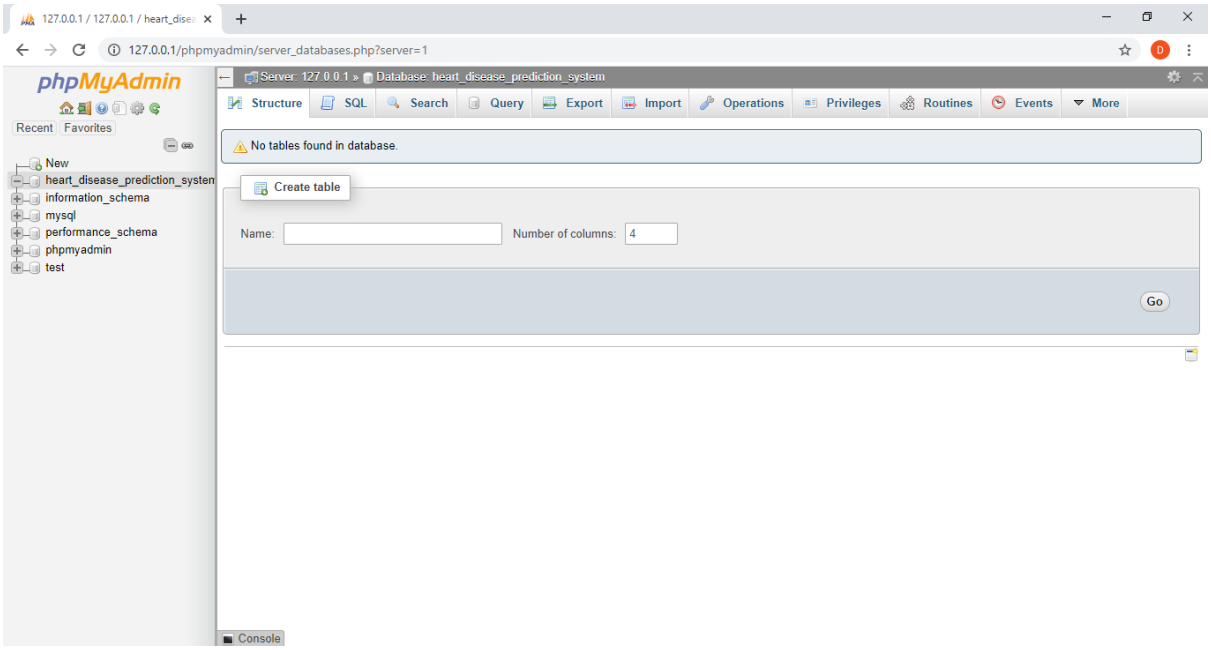


Fig 2.1

The database we created is empty right now. After the 4th step, there will be lots of tables here holding different information.

Step 4: Modifying settings.py

In this last step, we will be changing the DATABASE dictionary in our main projects settings.py. First, install this file via command line:

pip install mysqlclient

It will install the Django code for connecting the MySQL Database.

After that exchange this code with the DATABASE dictionary in settings.py.

```
DATABASES = {
   'default': {
      'ENGINE': 'mysql.connector.django',
      'NAME': 'heart_disease_prediction_system',
      'USER':'root',
      'PASSWORD':'',
      'HOST':'',
      'PORT':''
   }
```

}

Here the attributes greater in number as MySQL provides us more features from the sqlite3. The Engine here is “django.db.backends.mysql” which as the name suggests is a python library for MySQL.

Note: That you should keep the PASSWORD empty as filling it can produce an error for some users.Here, the HOST is the host server, but left blank means by default is localhost.

The OPTIONS is a bit interesting attribute, in this, we are actually passing the SQL as a string through Python which then the SQL server parses itself.

SET sql_mode = ‘STRICT_TRANS_TABLES’

It is essentially SQL, being passed on as a string.

Step 5: For the last steps just run these two commands:

- python manage.py migrate
- python manage.py runserver

Now, refresh the phpMyAdmin page and you will get some tables created with just doing this much.

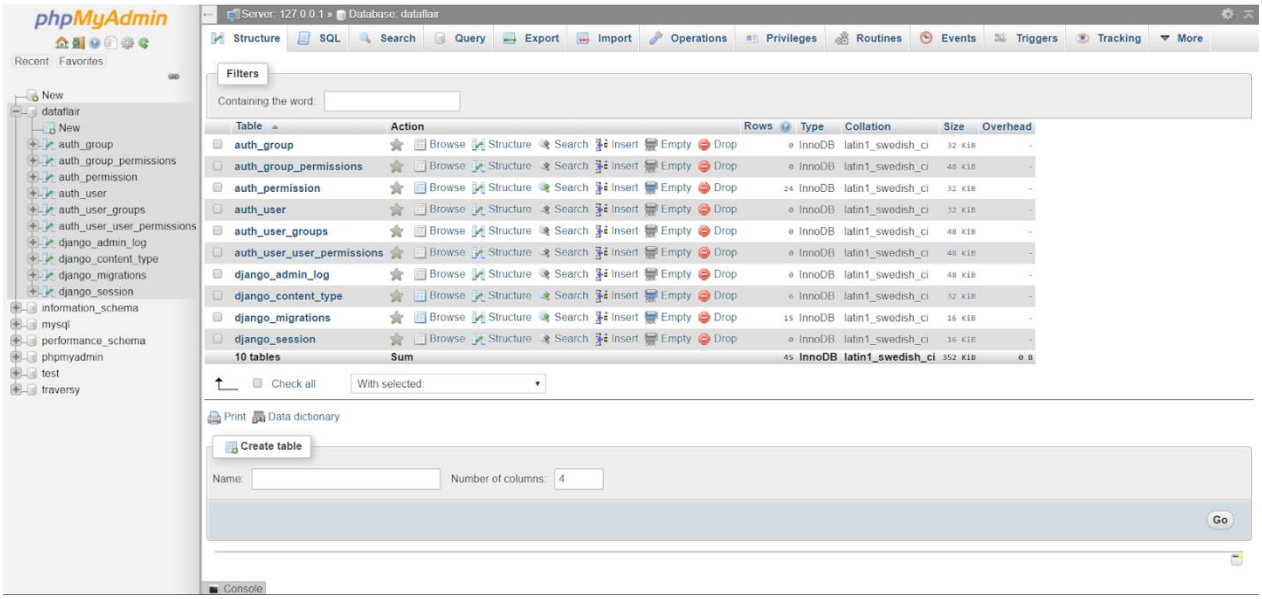


Fig 4.2.3.8 Tables will be created

4.3 Source-Code Editor

4.3.1 Visual Studio Code

The Visual Studio integrated development environment is a creative launching pad for Python (and other languages) that you can use to edit, debug, and test code, and then publish an app.

An integrated development environment (IDE) is a feature-rich program that can be used for many aspects of software development. Over and above the standard editor and debugger that most IDEs

provide, Visual Studio includes code completion tools, interactive REPL environments, and other features to ease the software development process.

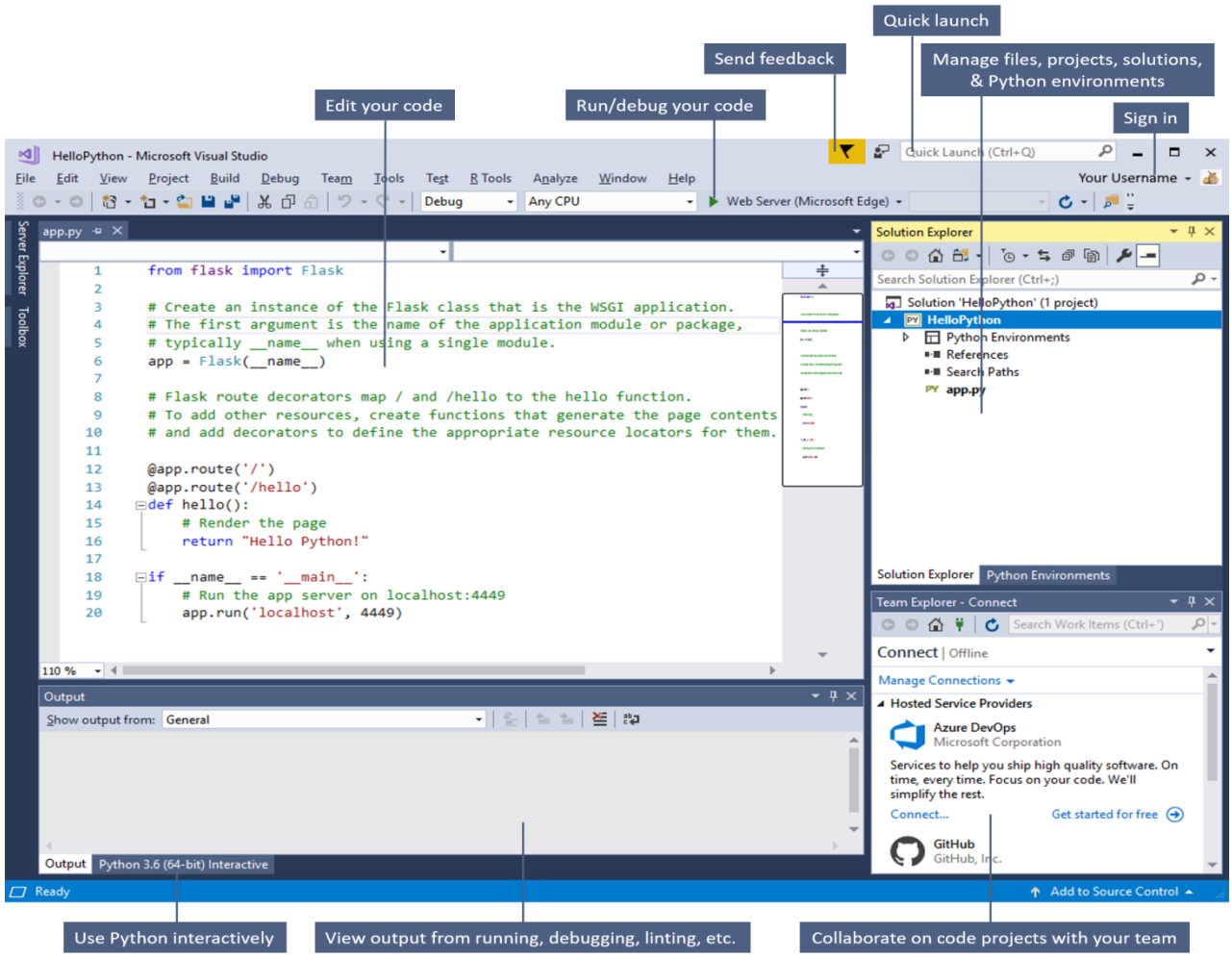


Fig.4.3.1 Demo of printing Hello World in VS Code

Powerful features for Python

- Run code without a project

Starting in Visual Studio 2019, you can open a folder containing Python code to enjoy features like IntelliSense and debugging without having to create a Visual Studio project for the code.

- Collaborate using Visual Studio

Visual Studio Live Share enables you to collaboratively edit and debug with others in real time, regardless of what programming language you're using or app types you're building.

- Python Interactive REPL

Visual Studio provides an interactive read-evaluate-print loop (REPL) window for each of your Python environments, which improves upon the REPL you get with python.exe on the command line. In the Interactive window you can enter arbitrary Python code and see immediate results.

- Debugging

Visual Studio provides a comprehensive debugging experience for Python, including attaching to running processes, evaluating expressions in the Watch and Immediate windows, inspecting local variables, breakpoints, step in/out/over statements, Set Next Statement, and more. You can also debug remote Python code running on Linux computers.

- Interacting with C++

Many libraries created for Python are written in C++ for optimal performance. Visual Studio provides rich facilities for developing C++ extensions, including mixed-mode debugging.

- Profiling

When using a CPython-based interpreter, you can evaluate the performance of your Python code within Visual Studio.

- Unit Testing

Visual Studio provides integrated support for discovering, running, and debugging unit tests all in the context of the IDE.

5 System Requirements

This guide covers how to deploy your project behind a server with a gunicorn daemon running as Debian system service. All python requirements will be contained in a dedicated virtual environment.

5.1 Hardware Requiremnts:

- 1 GB RAM.

  RAM is a form of memory that holds temporary data when your site is running multiple processes at the same time, such as when your site's scripts have to execute. The more processes that run at once, the more RAM this will take up.

- 1 CPU Core.

  Web site is housed on has one or multiple central processing units, or CPUs, just as your home PC does. These are basically the brains of the computer, that handle information requests and execute programs. The bigger the CPU capacity, the more information the server can process before losing performance.

  This "time slicing" ensures that each process is handled relatively quickly, rather than some sitting in the queue longer than others. With small loads, this will not degrade performance, as the CPU can handle multiple requests.

- Network

  A network host is a computer or other device connected to a computer network. A host may work as a server offering information resources, services, and applications to users or other hosts on the network

- 24 GB SSD Storage.

  SSD stands for Solid State Drive. They are the latest type of computer storage device. These days you will find them in many high end desktops & laptops & they are increasingly being used in the hosting industry & by large corporations to store data within their server infrastructure.

- 2 TB Transfer.

  Bandwidth refers to the amount of data you can transfer to and from your server; most is conducted by external traffic to the site, although it also involves activity on the site by employees, affiliates, etc..

- Raspberry Pi

  The Raspberry Pi is a low cost, **credit-card sized computer** that plugs into a computer monitor or TV, and uses a standard keyboard and mouse. It is a capable little device that enables people of all ages to explore computing, and to learn how to program in languages like Scratch and Python. It's capable of doing everything you'd expect a desktop computer to do, from browsing the internet and playing high-definition video, to making spreadsheets, word-processing, and playing games.

5.2 Software Requiremnts:

- Operating System

An operating system is a system software program that manages and distributes the server's resources. It prioritizes program and user requests and ensures that users' content on the server doesn't interfere with other users. Without an operating system, your server simply wouldn't work. It is the backbone that enables the server to run software and programs.

There are many different types of operating systems, but the two most popular for Web hosting plans are Windows or Linux. Which operating system best fits your needs is the first decision you must make when ordering Web hosting.

- Python

Python is an interpreted, object-oriented, high-level programming language. Choosing a good host requires careful vetting. To start with, you'll need shell access and the Apache installation needs to support CGI and mod_wsgi. You'll want to make sure that any frameworks you plan to use — such as Django or Flask — are supported by the host. Finally, you need to make sure the right version of Python is supported.

- Django

Finding the best Django hosting to suit all of your requirements might be quite a big deal, but it's definitely worth the effort. Moreover, it's also worth trying different options and seeing what will be the best fit for you. Some engineers prefer using paid and highly functional servers, while others find more benefits in (relatively) free services, and both options have their own benefits. We have chosen the top 6 small, mid, and large-scale Django hosting services with various functions that certainly deserve consideration.

- phpMyAdmin

phpMyAdmin is one of the most popular applications for MySQL database management. It is a free tool written in PHP. Through this software you can create, alter, drop, delete, import and export MySQL database tables. You can run MySQL queries, optimize, repair and check tables, change collation and execute other database management commands.

6 Screenshots

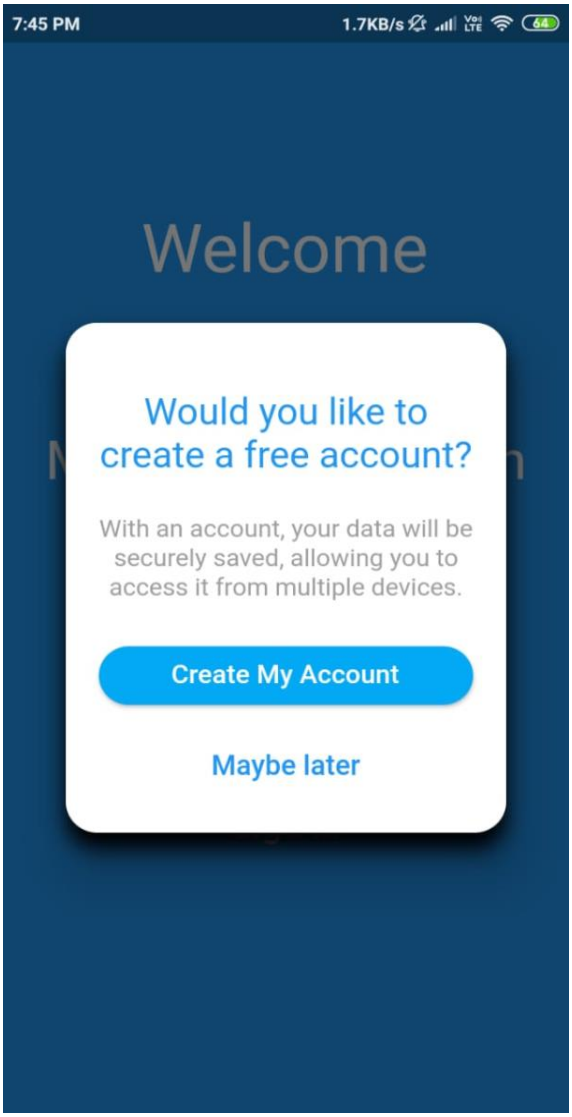


Fig. 6.1 Main Page(for Both Admin and User)

Fig. 6.2 Create Account

This is the Mayank Foundation App Main Page with Get Started and Sign In Button. Admin and User both can login into the app with Sign In button.After clicking on Get Started Button,the above dialog box pop up.The new user can create the account or click on May be Later for later making an account.

When the user clicks on Maybe later then the page loads as follows:

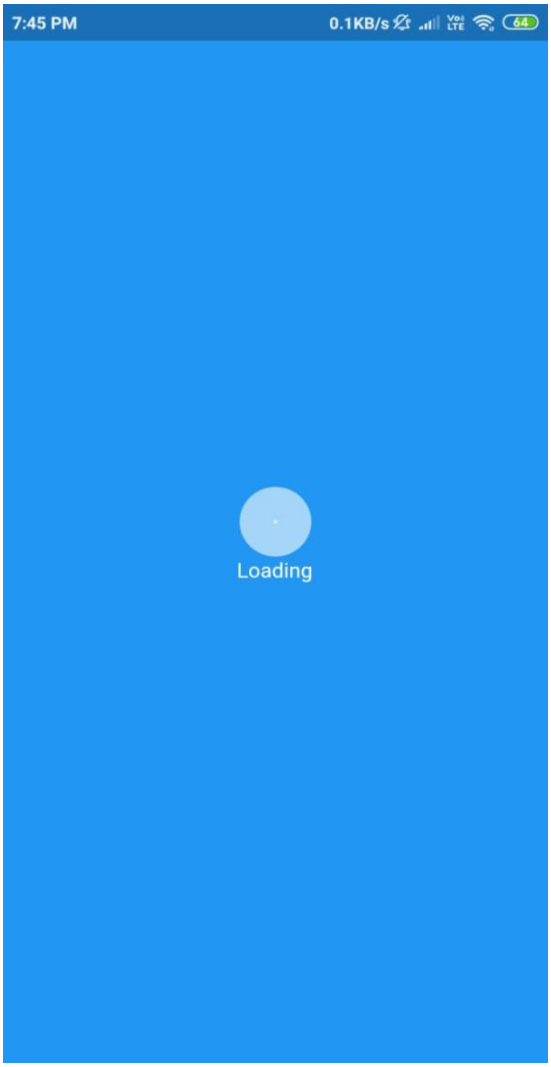


Fig. 6.3 Loading Page

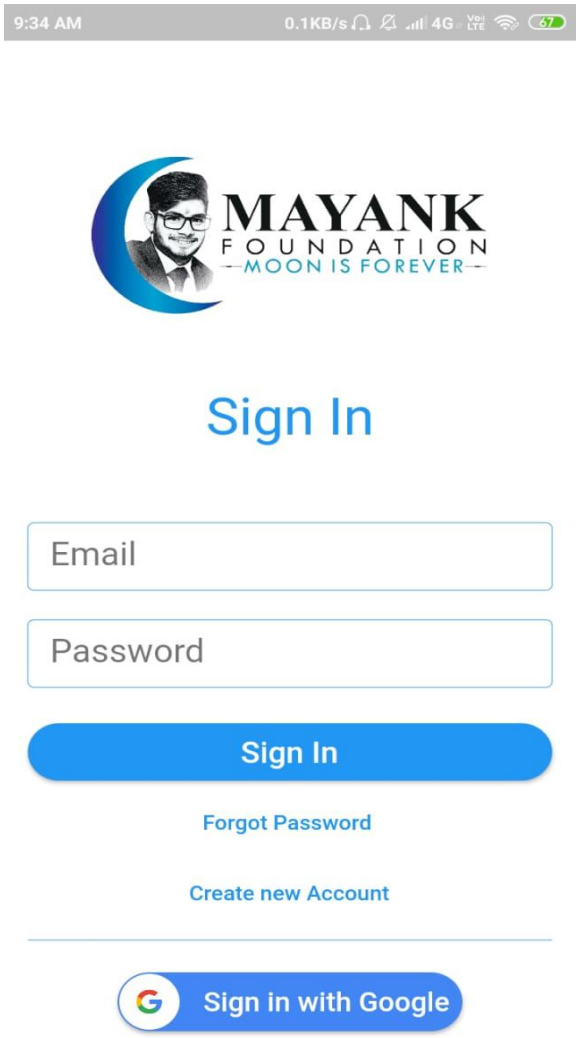


Fig. 6.4 Sign in page

The above Figure is the Loading Page a Sign In Page for the exiusting user

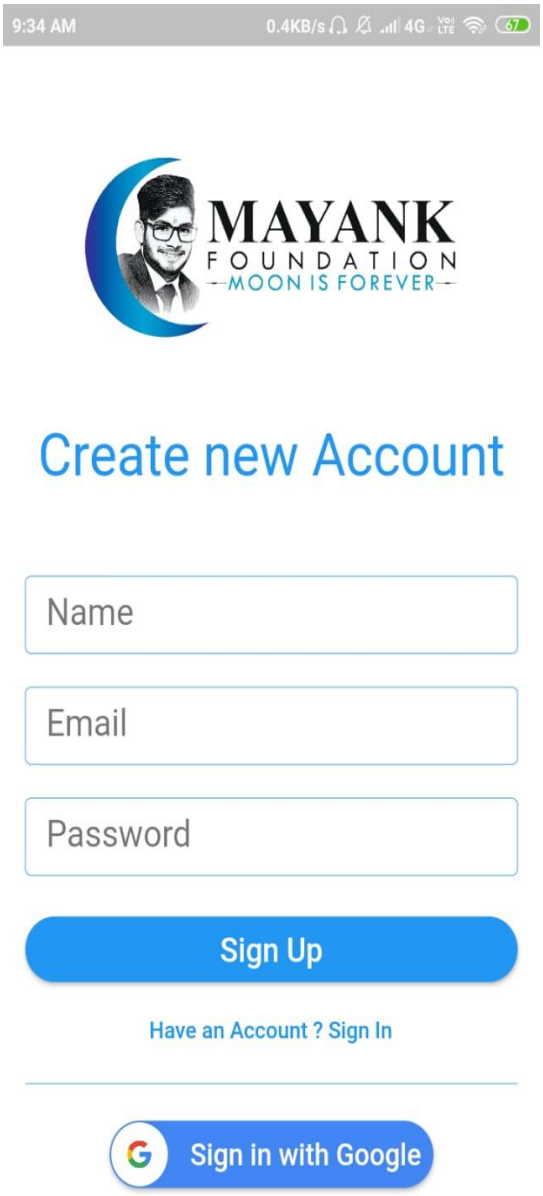


Fig. 6.5 Sign up page

Fig. 4.6 Admin Main Page

The abover figure is the Sign Up page for the new userAdmin Main Page include all the upcoming events to be conduced in coming time and Admin can also add new post related to other new events to occur.

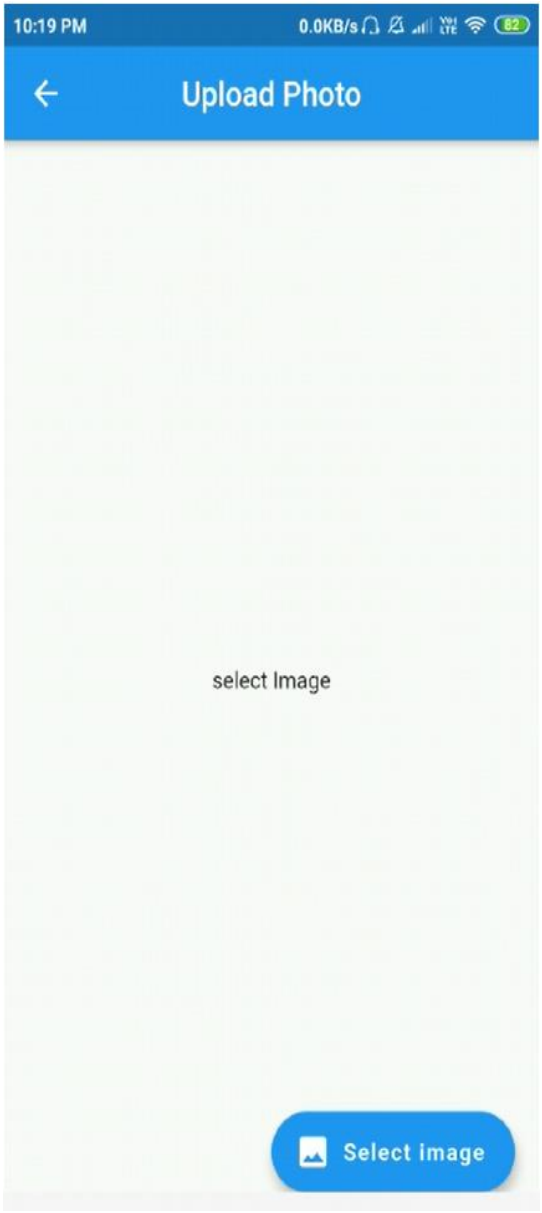


Fig. 6.7 Upload post photo

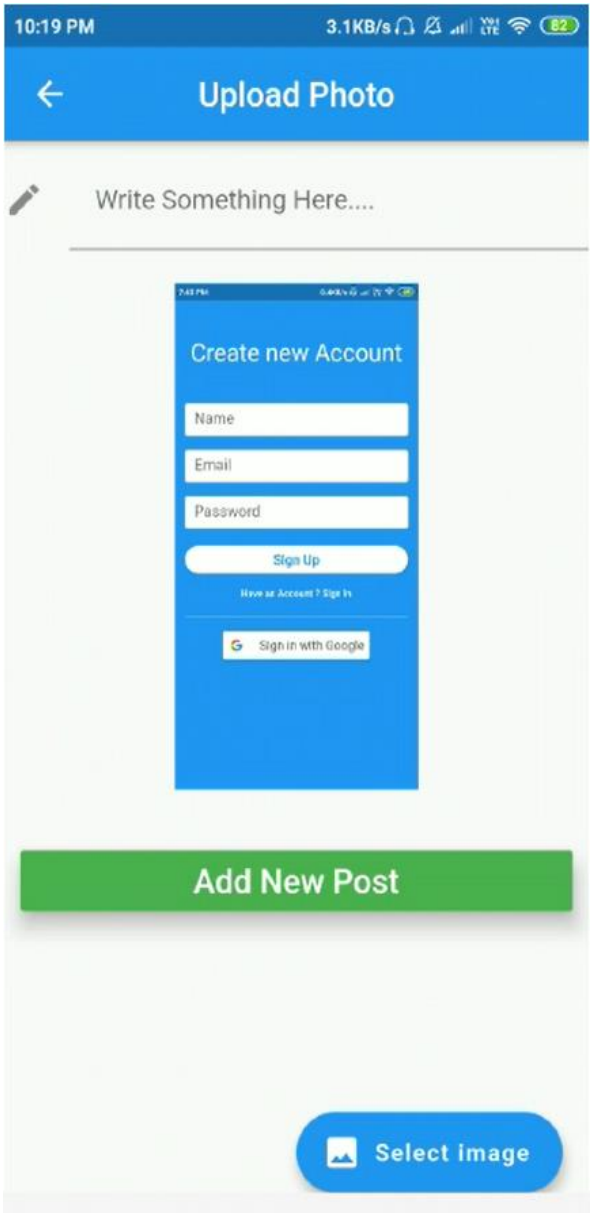


Fig. 6.8 Add New Post

Image is select for the new post to be uploaded.New Post of events to be occurred in coming time is added and loaded on main page of both user and amin.

Fig. 6.9 User Main Page

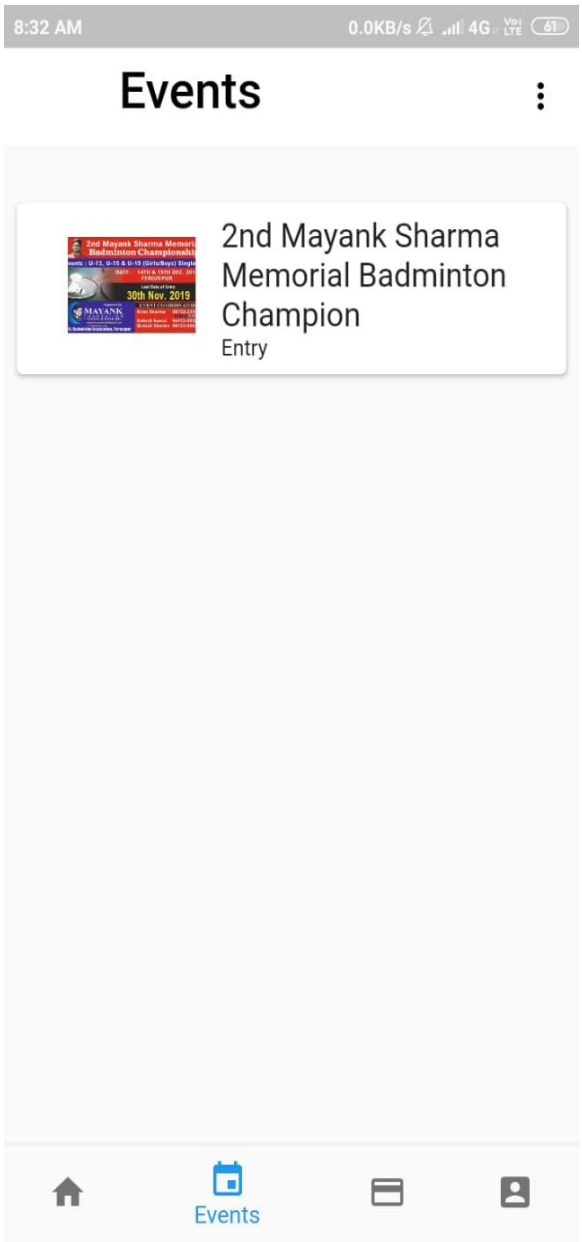


Fig. 6.10 Event Page (for user)

User Main contains all the events to be occurred and the event page contain all the details of the upcoming events.

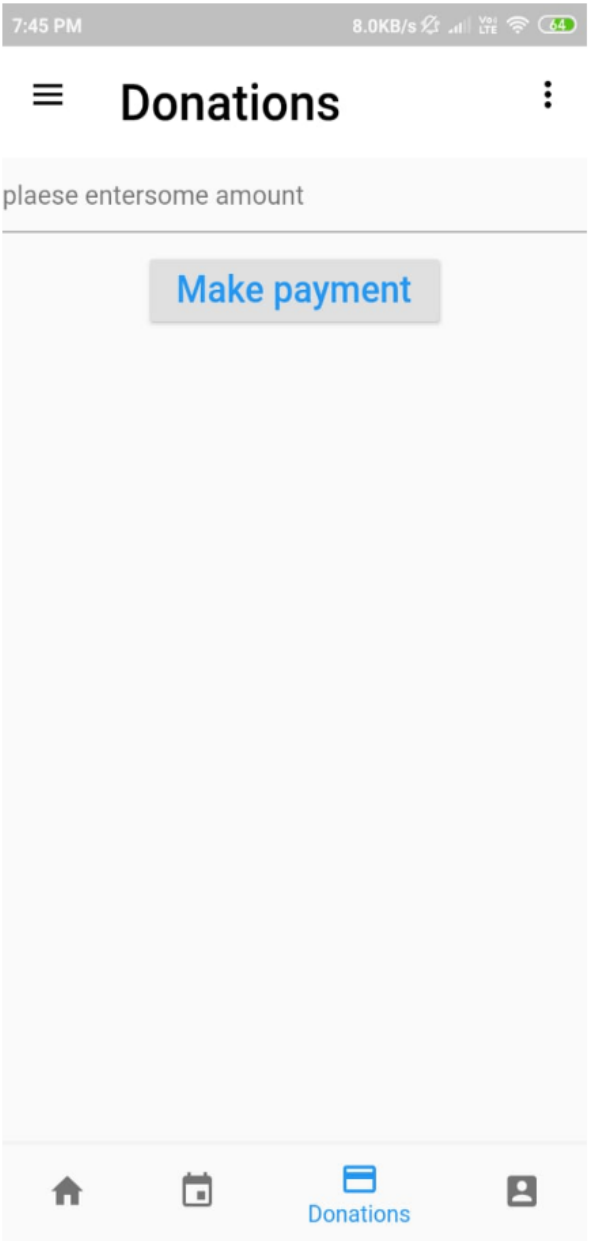


Fig. 6.11 Donation Page (for user)

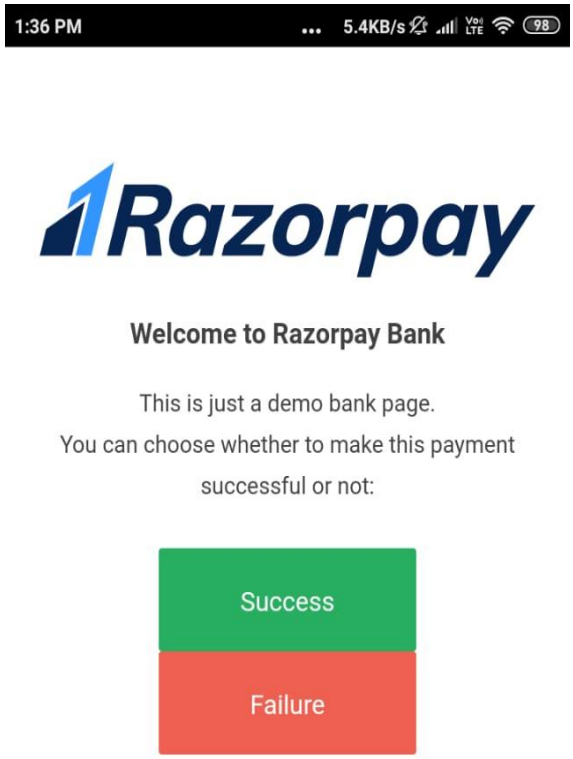


Fig. 6.12 Razorpay payment Method

User can donate certain amount to the Ngo With Razorpay, you have access to all payment modes, including credit and debit cards, UPI, and popular mobile wallets.

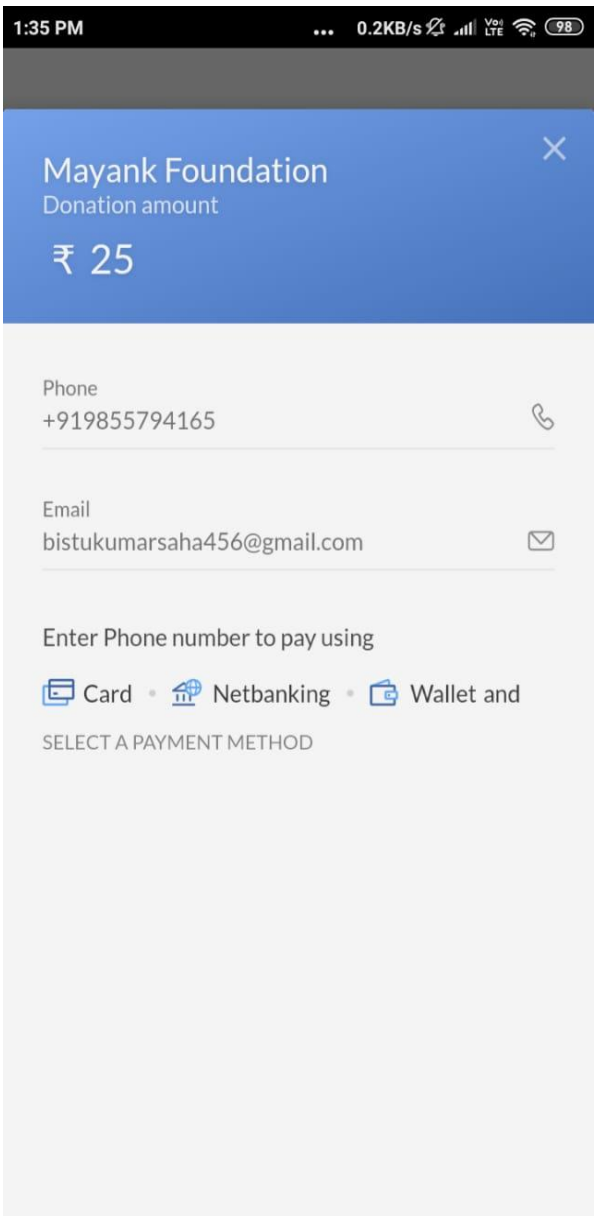


Fig. 6.13 Donation amount

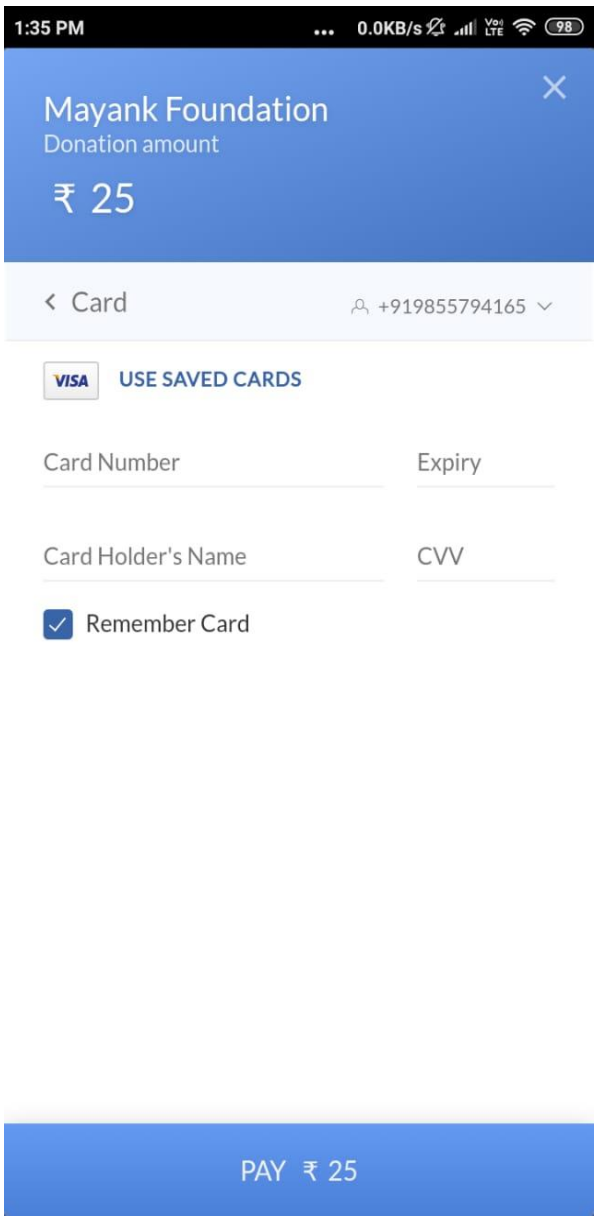


Fig. 6.14 Card Payment

Password can be reseted by admin as well the user in case password not remembered.Payment is done through Card.

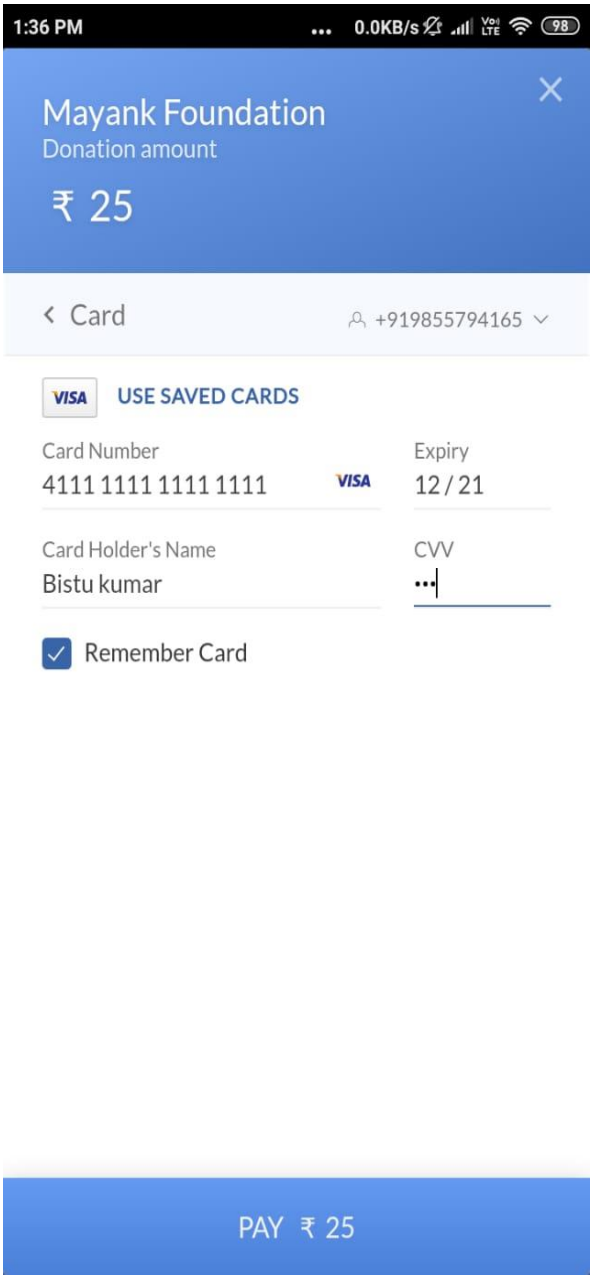


Fig. 6.15 Card Details Entered

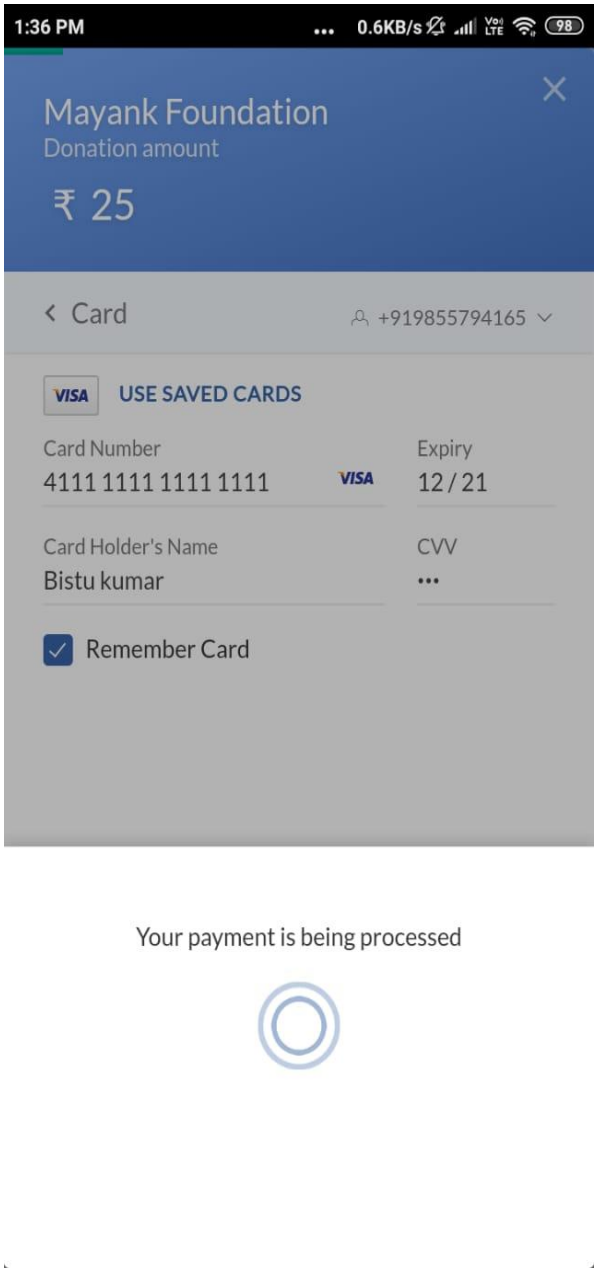
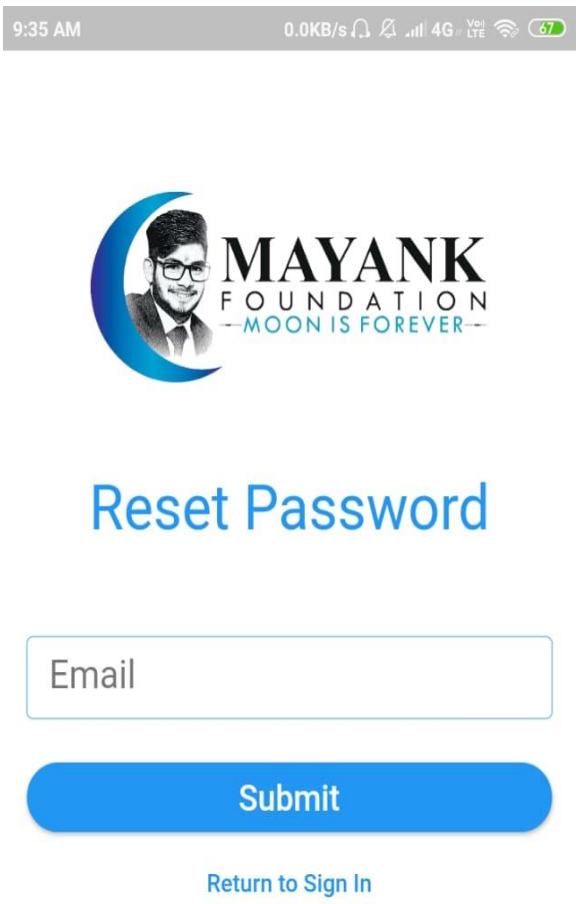


Fig. 6.16 Payment being processed

Afetr selecting card as a payment gateway, card details are entered. After entering card details, payments is being processed.



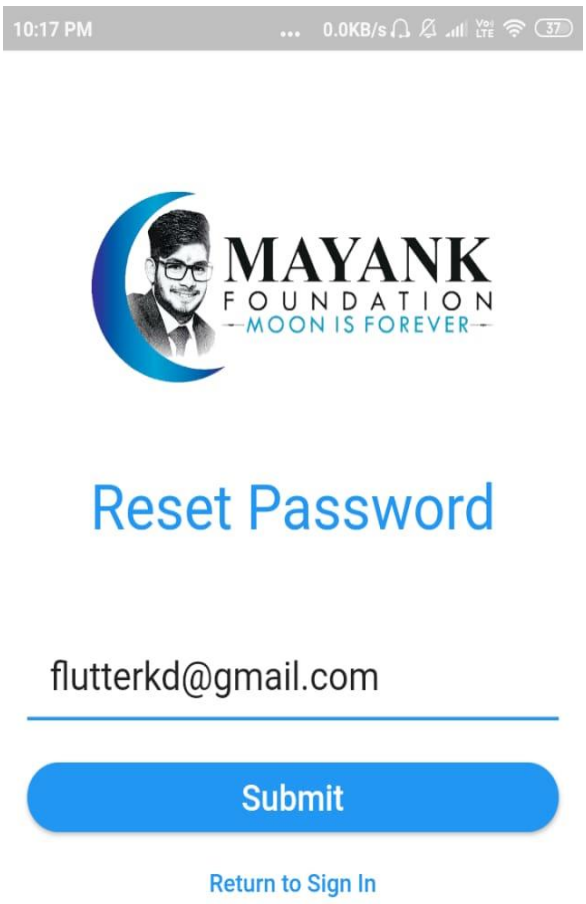


Fig. 6.17 Reset Password(1)

Fig. 6.18 Reset Password(2)

Password can be reseted by admin as well the user in case password not remembered.

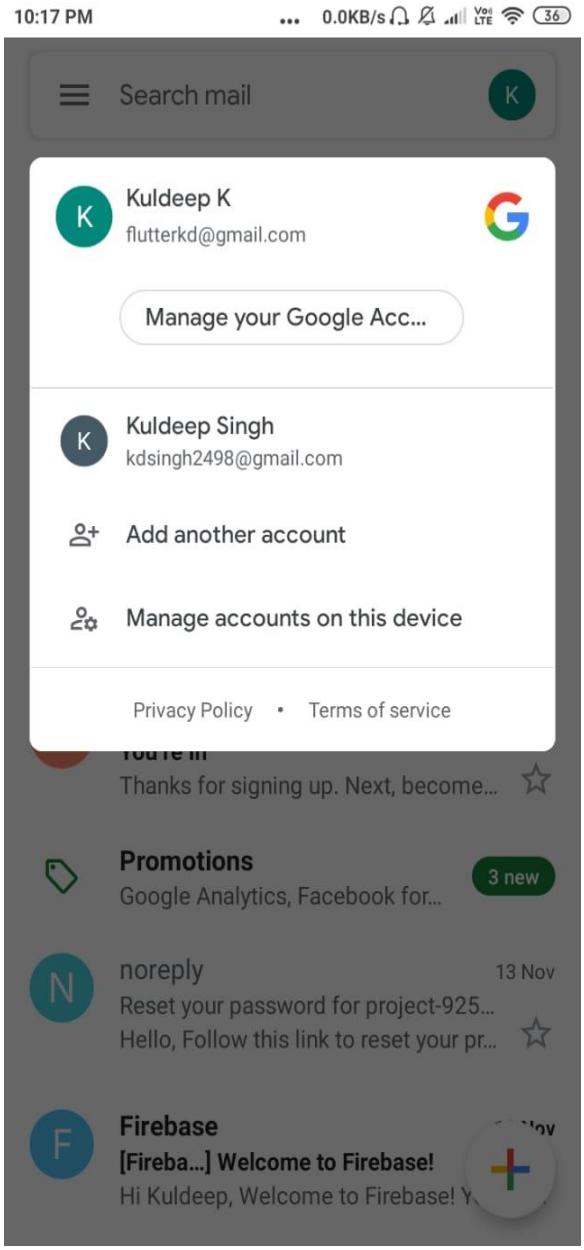


Fig. 6.19 Account Opened

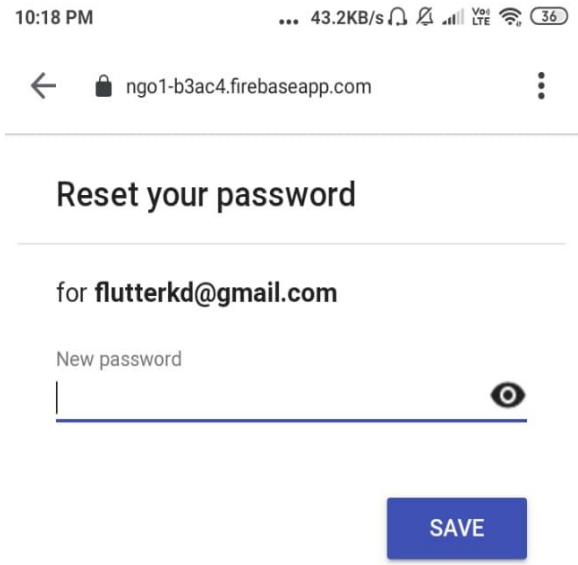


Fig. 6.20 New password

Reseting of password occurs by opening the google account linked .

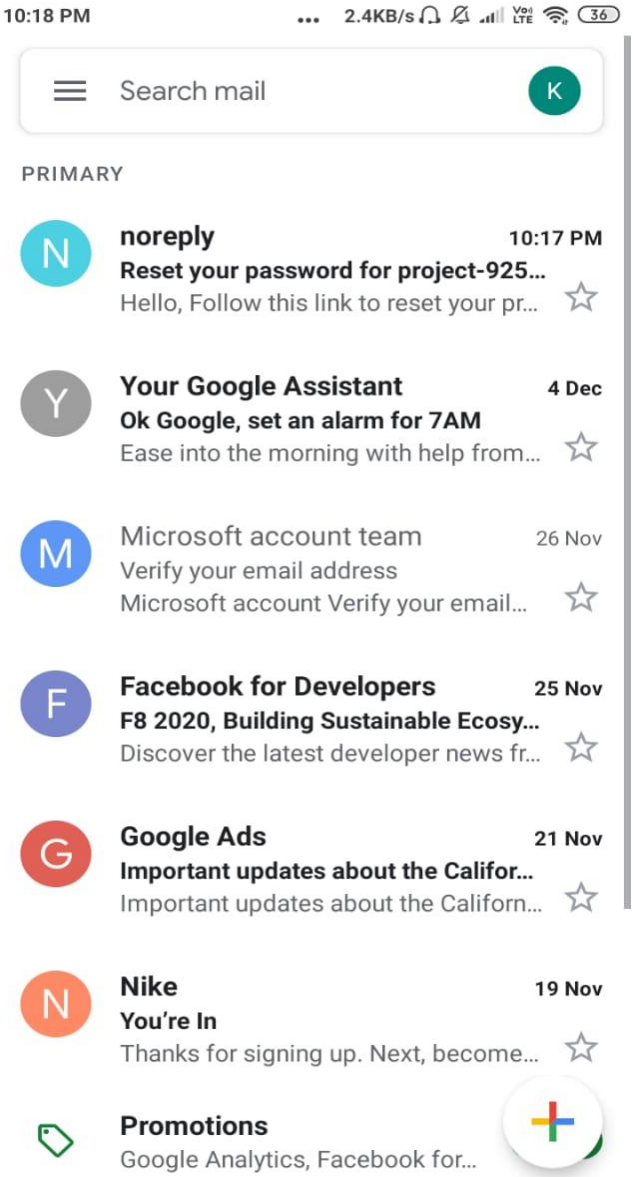


Fig. 6.21 Password reset mail

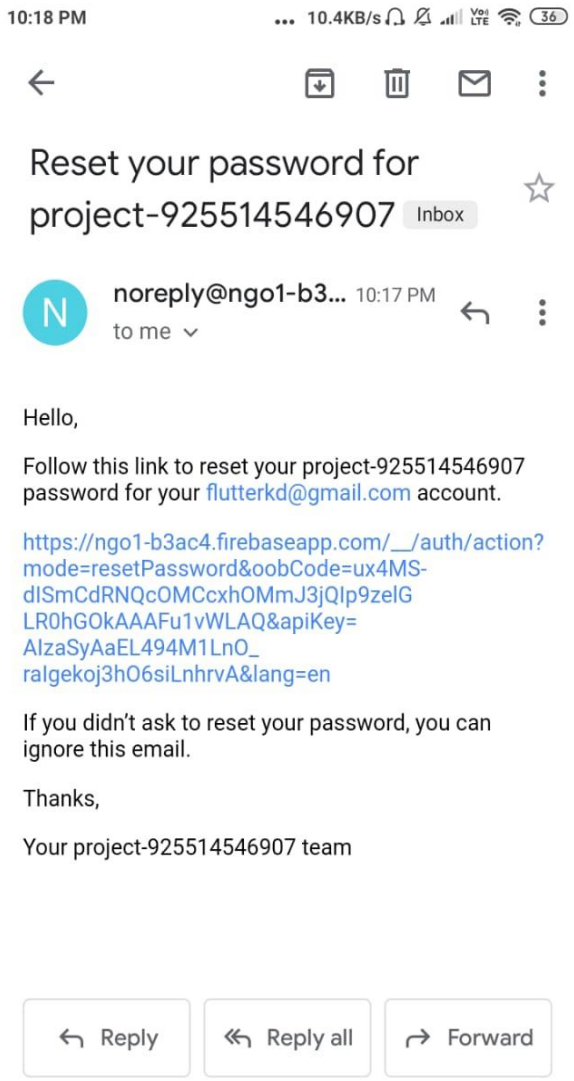


Fig. 6.22 Reset Password mail opened

After reset of password mail is sent to the user google account .

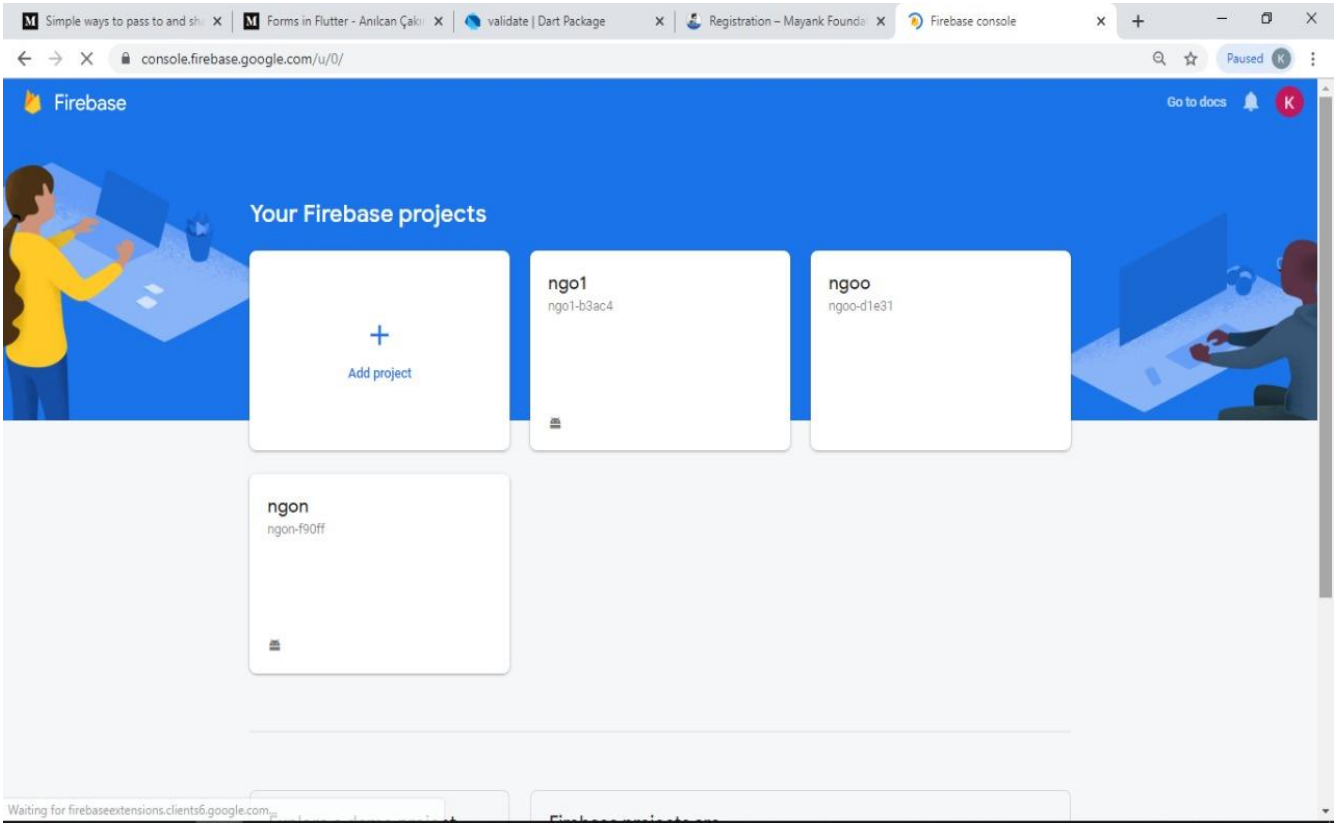


Fig. 6.23 Firebase Database

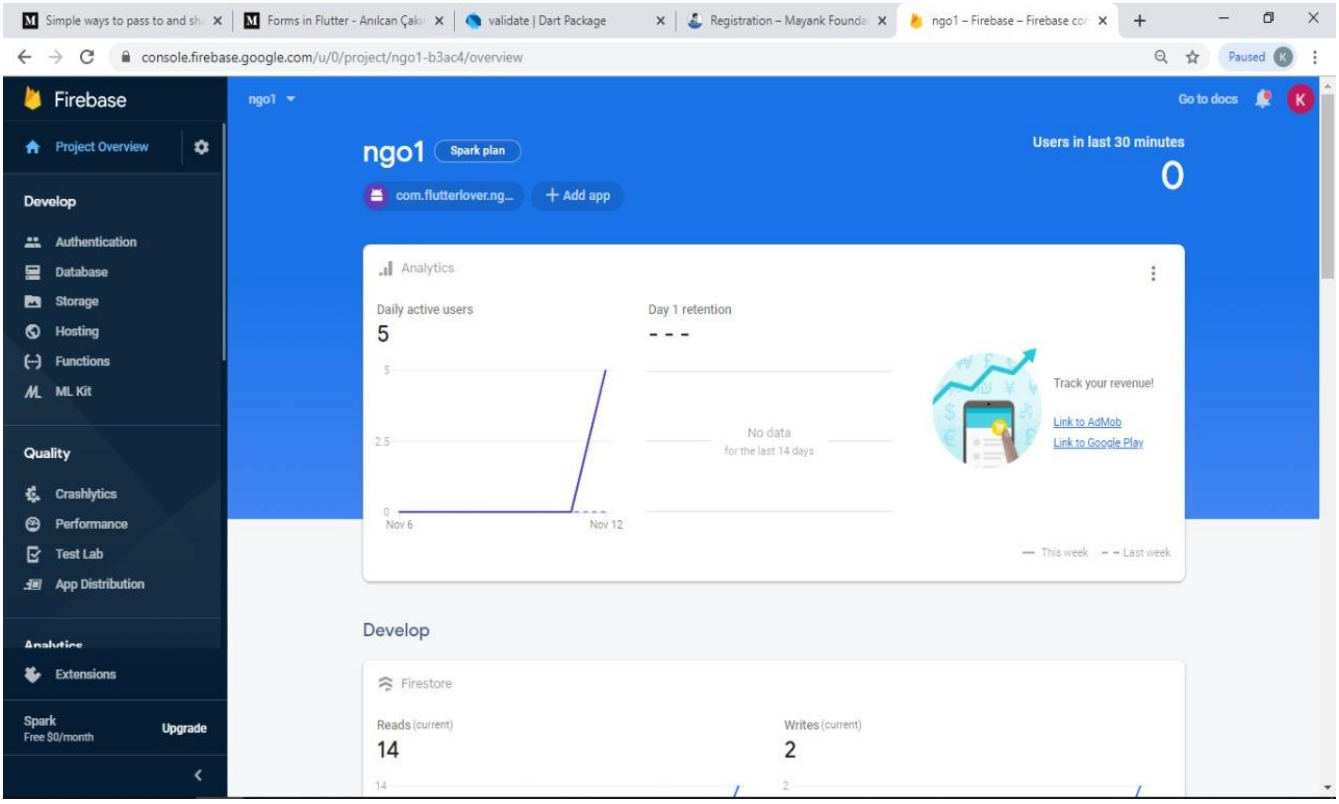


Fig. 6.24 Project working

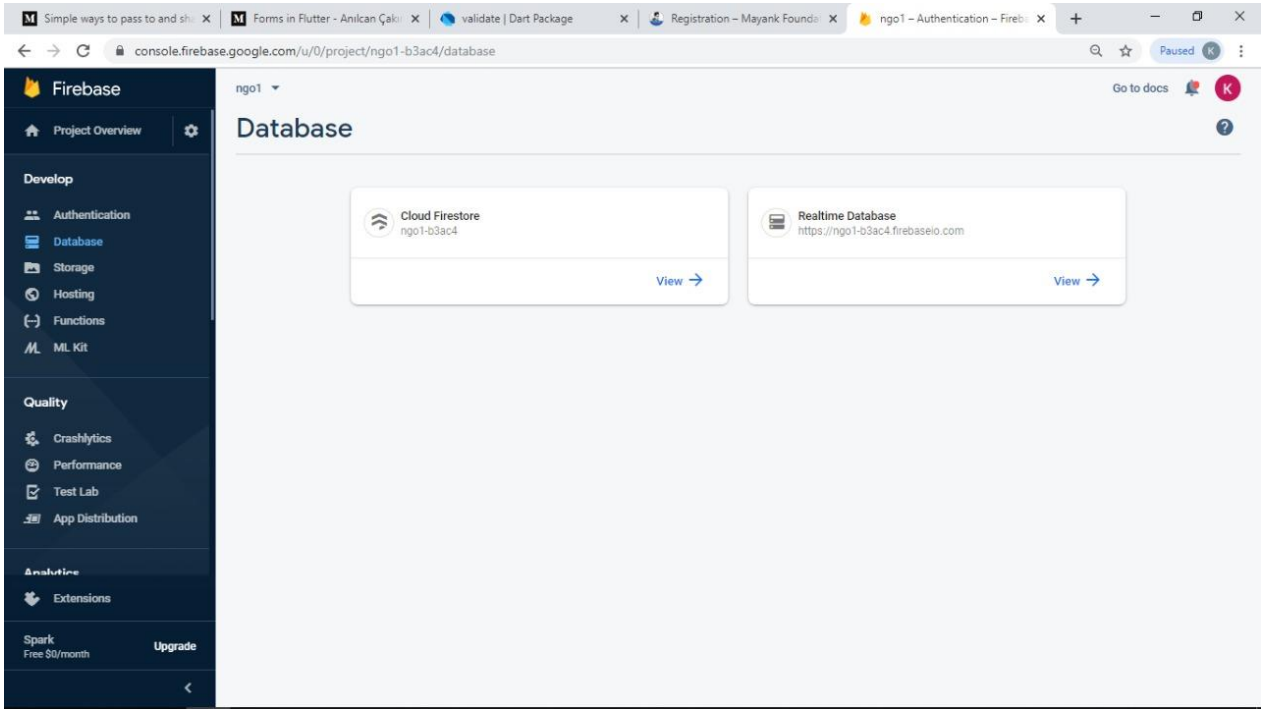


Fig. 6.25 Database used

Firebase provides a realtime database and backend as a service. The service provides application developers an API that allows application data to be synchronized across clients and stored on **Firebase's** cloud.

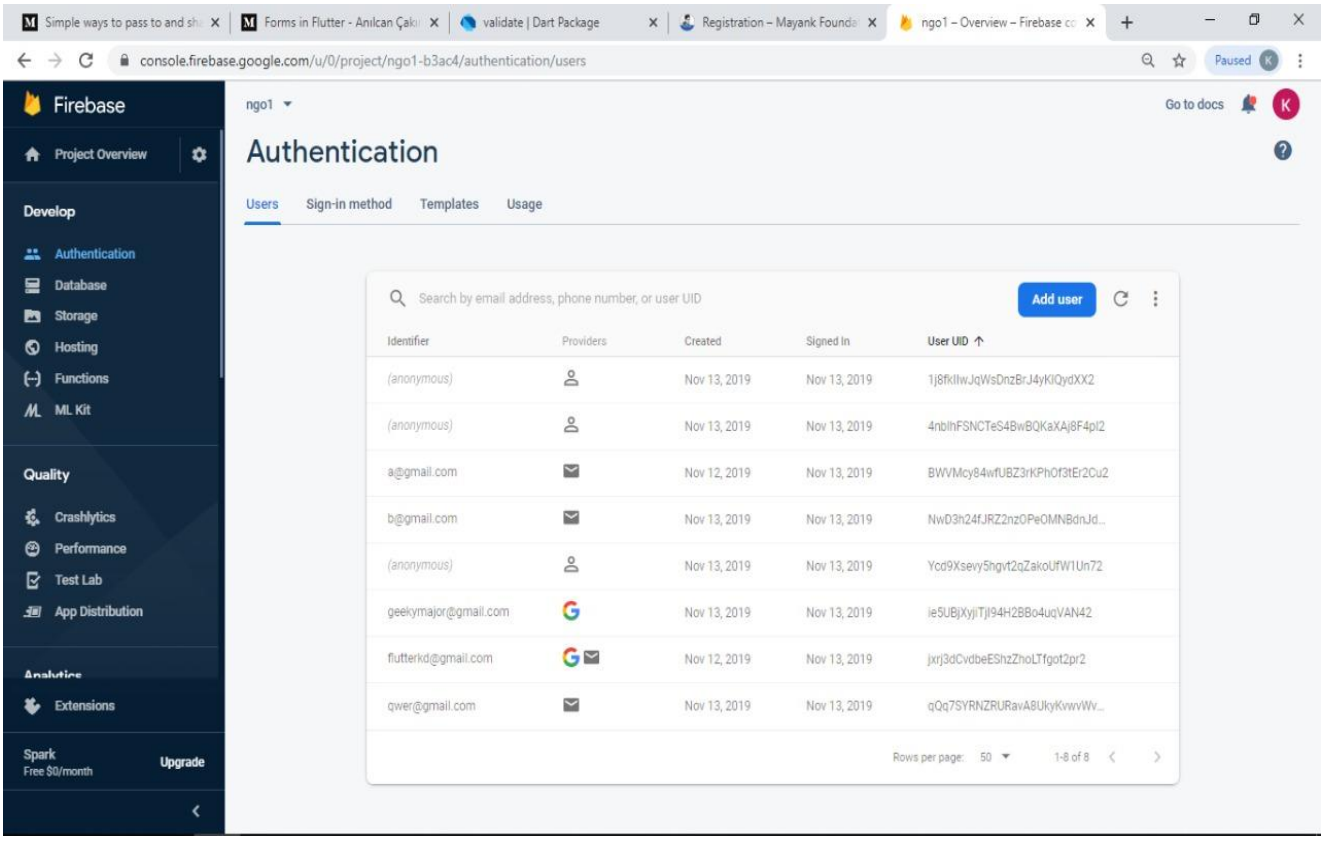


Fig. 6.26 Users Details(in Database)

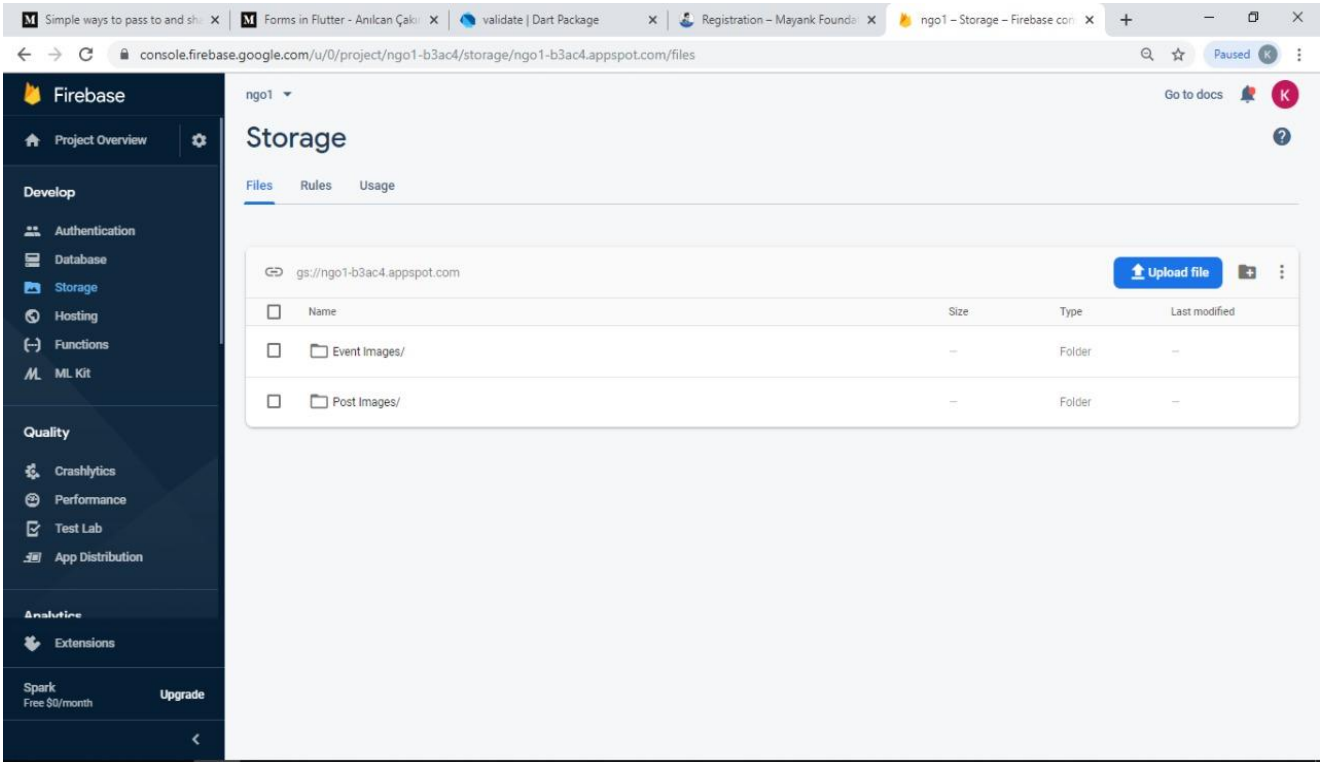


Fig. 6.27 Database Files

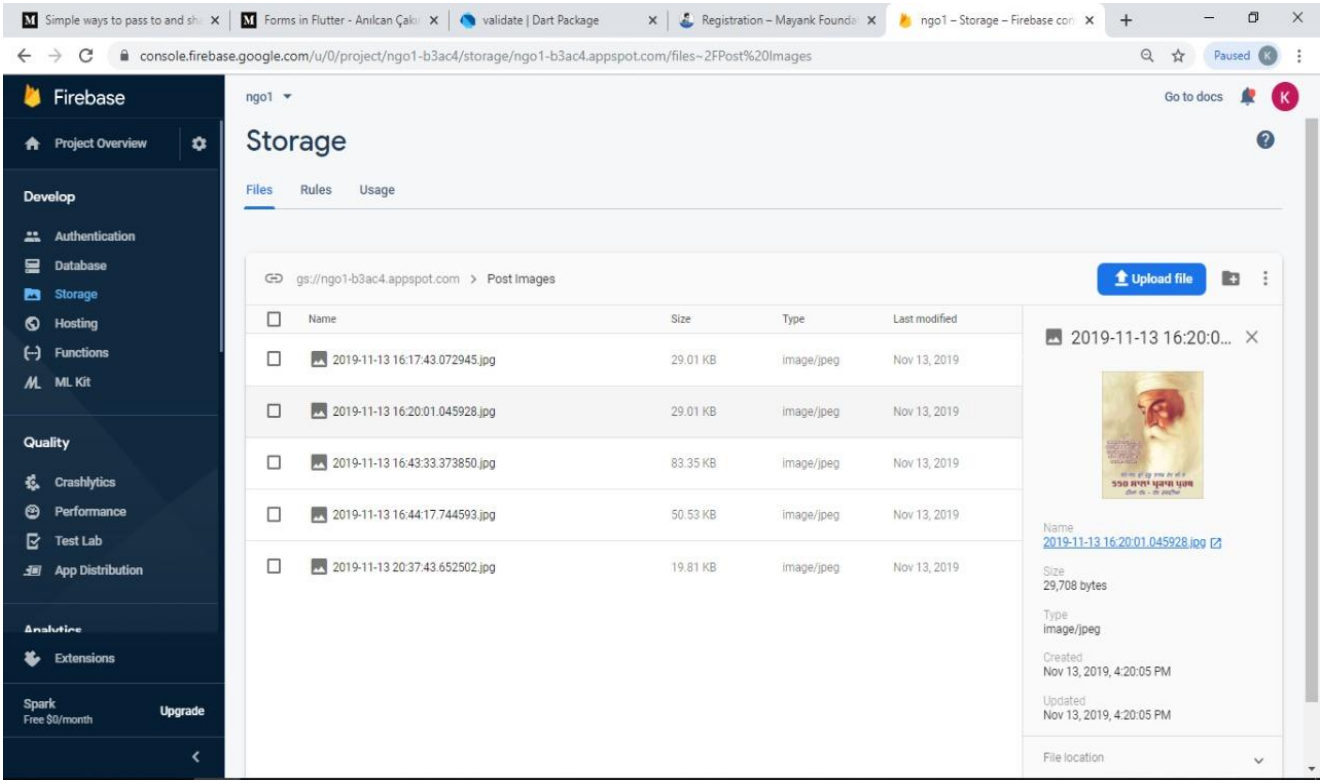


Fig. 6.28 Event and post storage details

The above page contains the event and post details.

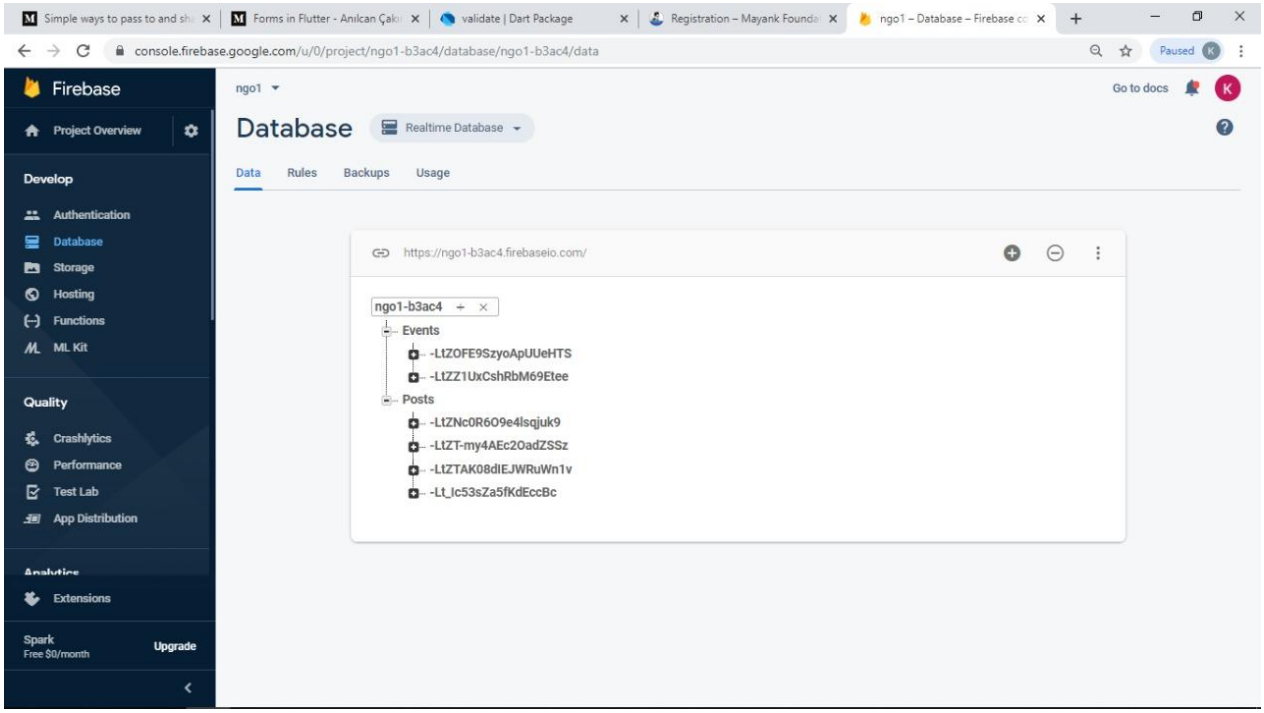


Fig. 6.29 Event and Post

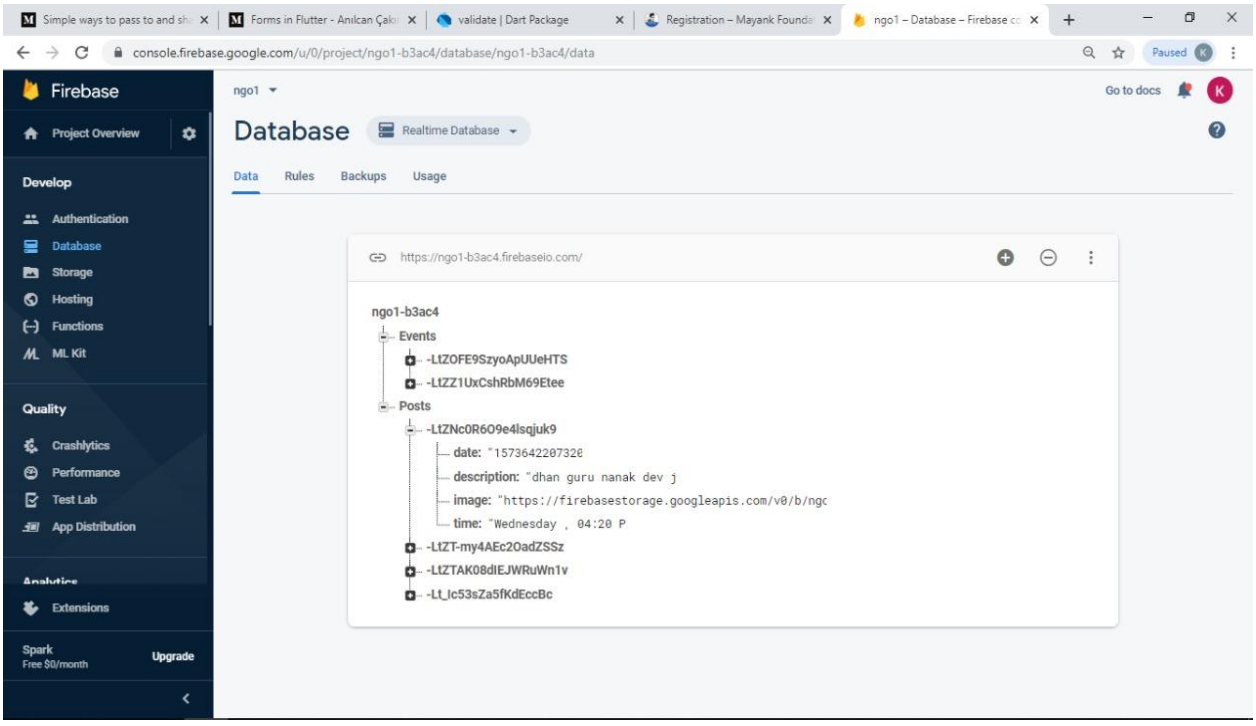


Fig. 6.30 Events and Post Details(in Database)

Events and post are mentioned in details with the time the post was uploaded by the admin.

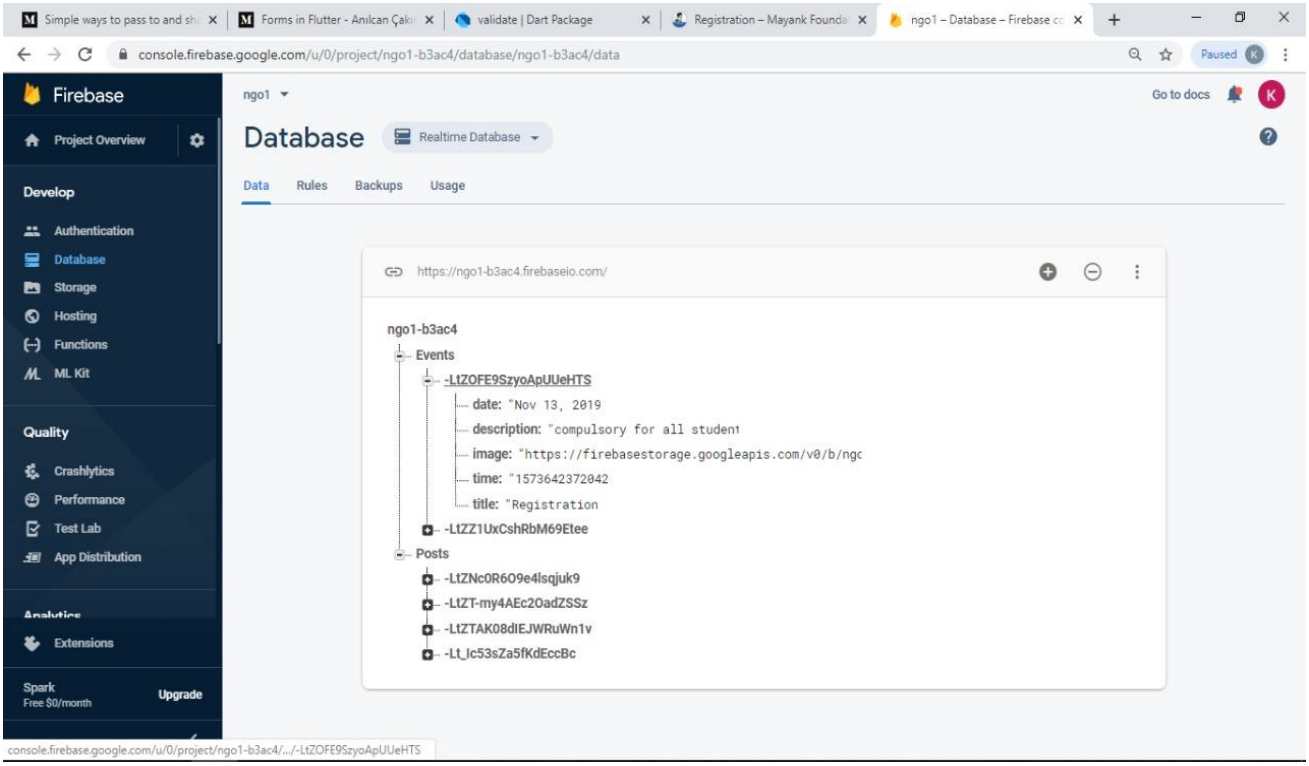


Fig. 6.31 Event Details (in Database)

All the details related to events and post are stored in the database.

7. Result and Discussion

As we know, The healthcare industry collects huge amounts of health care data which, unfortunately, are not mined and analyzed in a proper manner to discover hidden information, to take decisions effectively, to discover the relations that connect patterns. The aim of this paper is to develop a decision support in Heart Disease Prediction System (HDPS) using machine learning's effective algorithms. Using medical profile of the patient (age, gender, blood pressure, blood sugar, cholesterol, chest pain, ECG graph etc.), it can predict the likelihood of patient getting a heart disease. The likelihood (class label) may be of 5 stages: no, low, medium, high and very high. If an unknown sample comes, then the system will predict the class label of the sample. Machine Learning is used across many spheres around the world. The healthcare industry is no exception. Machine Learning can play an essential role in predicting presence/absence of Locomotor disorders, Heart diseases and more. Such information, if predicted well in advance, can provide important insights to doctors who can then adapt their diagnosis and treatment per patient basis.

8. Conclusion and Future Scope

The proposed system is GUI-based, user-friendly, scalable, reliable and an expandable system. The proposed working model can also help in reducing treatment costs by providing Initial diagnostics in time. The model can also serve the purpose of training tool for medical students and will be a soft diagnostic tool available for physician and cardiologist. General physicians can utilize this tool for initial diagnosis of cardio-patients. There are many possible improvements that could be explored to improve the scalability and accuracy of this prediction system. As we have developed a generalized system, in future we can use this system for the analysis of different data sets. The performance of the health's diagnosis can be improved significantly by handling numerous class labels in the prediction process, and it can be another positive direction of research. In DM warehouse, generally, the dimensionality of the heart database is high, so identification and selection of significant attributes for better diagnosis of heart disease are very challenging tasks for future research.

- The speed and accuracy are maintained in the proper way.
- The user friendly nature of the app is very easy to work with..
- The project was verified with valid as well as invalid data in each manner.
- The project is run with an insight into the necessary notifications that may be required in the future.
- This project has a very vast scope in future.
- The project can be updated in near future as and when requirement for the same.

9. References

[1]. Chaurasia, V., & Pal, S. (2013). Early prediction of heart diseases using data mining techniques. Caribbean Journal of Science and Technology, 1, 208-217.

[2]. Sultana, M., Haider, A., & Uddin, M. S. (2016, September). Analysis of data mining techniques for heart disease prediction. In 2016 3rd International Conference on Electrical Engineering and Information Communication Technology (ICEEICT) (pp. 1-5). IEEE.

[3]. Srinivas, K., Rani, B. K., & Govrdhan, A. (2010). Applications of data mining techniques in healthcare and prediction of heart attacks. International Journal on Computer Science and Engineering (IJCSE), 2(02), 250-255.

[4]. Kaur, B., & Singh, W. (2014). Review on heart disease prediction system using data mining techniques. International journal on recent and innovation trends in computing and communication, 2(10), 3003-3008.