

A PROJECT REPORT
On
**“ENHANCED ANALYTIC SYSTEM FOR SMART UNIVERSITY
ASSISTANCE”**
Submitted to
KIIT DEEMED TO BE UNIVERSITY

**In Partial Fulfilment of the Requirement for the Award of
BACHELOR’S DEGREE IN
COMPUTER SCIENCE AND COMMUNICATION ENGINEERING**

BY

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**UNDER THE GUIDANCE OF
PROF. RAJDEEP CHATTERJEE**



**SCHOOL OF COMPUTER ENGINEERING
KALINGA INSTITUTE OF INDUSTRIAL TECHNOLOGY
BHUBANESWAR, ODISHA – 751024**

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CERTIFICATE

This is certify that the project entitled
“Enhanced Analytic System for Smart University Assistance”
submitted by

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is a record of bonafide work carried out by them, in the partial fulfilment of the requirement for the award of Degree of Bachelor of Engineering (Computer Science & Engineering OR Information Technology) at KIIT Deemed to be university, Bhubaneswar. This work is done during year 2019-2020, under our guidance.

Date: / /

(Prof. Rajdeep Chatterjee)

Project Guide

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Index

1	Introduction	1-2
1.1	Mission Statement	1
1.2	Mission Objective	2
1.3	Project Goal	2
1.4	Features	2
2	Literature Survey	3-4
2.1	Summary	4
3	Software Requirements Specification	5-8
3.1	Developers' Responsibility Overview	6
3.2	Environment	7
3.3	Tools Used	7
3.4	System Hierarchy	8
4	Basic Concept / Technologies Used	9-15
4.1	Machine Learning	9
4.2	Flask, RESTful API & WSGI server	9
4.3	UI Tools	9
4.4	MongoDB	10
4.5	Marker Based Augmented Reality	10
4.6	Android	11
4.7	Applications	11
4.7.1	Linux kernel	11
4.7.2	Libraries	12
4.7.3	Android Runtime	12
4.7.4	Application framework	12
4.8	Android Studio	13
4.8.1	Android SDK tools	13
4.8.2	Platform tools	13

4.8.3	Android Emulator	13
4.9	AWS S3 Bucket	14
4.9.1	ACLs	14
4.9.2	IAM User Policies	14
4.10	AWS EC2	14
4.11	PuTTY	15
5	Implementation	16-20
5.1	Data Collection	16
5.2	Data Synthesise	16
5.3	Feature Engineering	17
5.4	Ensemble Training and Model Building	17
5.5	Deep Learning and Model Building	17
5.6	Database Preparation	18
5.7	API preparation and cloud host	18
5.8	Establishment of Storage	19
5.9	Front UI Preparation	19
5.10	System Deployment	20
6	Result and Analysis	21-23
6.1	Classifier Comparison for Synthesized Data	21
6.2	Classification Comparison for AMEO-2015	22
6.3	API Connectivity and Regression Test	22
6.4	Deployment with Version Control and Beta Testing	23
7	Conclusion	24
7.1	Future Prospect	24
Appendix		
	Index	<i>i</i>
	List of Figures	<i>iii</i>
	List of Tables	<i>iv</i>
	Reference	<i>v</i>

List of Figures

- Fig 1 Scrum Flow
- Fig 2 Sprint Burn Down Chart
- Fig 3 System Hierarchy
- Fig 4 Backend Database Connectivity
- Fig 5 Use of AR in Administration Control
- Fig 6 Android Architecture
- Fig 7 S3 Bucket Specific Storage Access
- Fig 8 File Projection in Local and Global System
- Fig 9 Data Visualization and Outliers Determination
- Fig 10 ConvNet Architecture
- Fig 11 Validation Accuracy Curve
- Fig 12 Mongo Atlas JSON View
- Fig 13 S3 Management Console
- Fig 14 UI Frames Data Flow
- Fig 15 Heroku Application Log
- Fig 16 Classification Matrix of Synthesized data
- Fig 17 API Test with Postman

List of Tables

- Table 1 Accuracy Comparison of Synthesized Dataset
- Table 2 Analysis of Decision Tree Accuracy
- Table 3 Accuracy Comparison of AMEO-2015 Dataset
- Table 4 Analysis of Hyper-parameter Tuned Linear SVM Accuracy

ABSTRACT

Due to the increase in the number of enrollments, efficiently managing the overall system, without useless traffic has become a laborious job. “BeFriend” helps the higher up authority to organize the complete process efficiently. It is a user-friendly UX rich system which prioritizes and arranges the available tasks accordingly.

The complete system is based on a Client-Server three-tier architecture, where the server is separated from user access and based on a cloud system. The system also brings an analytical comparison with the details collected from students. A hostel allocation methodology has been integrated into the system to allocate a room of their choice. Two standalone machine learning - ensemble-based analysis is used in the integration to help the students for suggestion and selection of stream and well-structured career path. To avoid accuracy conflict, our proposed architecture shows a set of fuzzy data along with relative choices. A synthesized dataset is developed for the stream selection functionality and a benchmark AMEO-2015 dataset for career guidance. We achieved an accuracy of 98% and 66% in the validation sets.

Additionally, a highly secure admin portal is provided with the system which uses AR to verify admin marker. An alumni chat is there to connect alumnus through the system. For present students, a dashboard and a daily schedule are generated automatically in the student home. Besides, a task management system is provided with the home to manage the tasks daily.

Keywords: Fuzzy valued suggestion, Cloud, Augmented Reality, Ensemble, Analytical System.

Chapter 1

Introduction

Often after higher secondary results students find themselves in a turmoil in deciding what stream of engineering is best suited for them. BEFRIEND aims to be a guide. It will provide students an easy and user friendly platform available in both web and mobile application formats where students can enter their marks and the entrance exam rank. Implementing Data Analytics on the input, it will provide the best choice for the student. Moreover, the pre-final and final year students face difficulty in opting the right field or domain for their career paths to grow. BEFRIEND will help them make this decision.

The classical process of allocating rooms to the borders is completely manual and it takes a lot of time and effort to provide the confirmed rooms to borders due to which the students face a lot of problems. BEFRIEND simplifies the process. Here the students can enter their preferences (2/3 bedded, AC/Non-AC, Attached/Non-attached washroom) and based on the availability of rooms, hostels will be allocated to them.

Its main aim is to be a 24x7 guide for students. To facilitate this, the portal will have an event scheduler where a student can keep track of his/her due academic projects, assignments, quizzes and also non-academic activities. In this way, they can efficiently manage their time between the two. Along with a lot of other functionalities, it will also contain a notice board displaying daily notifications and important announcements so that students can keep track of the latest happenings around the campus.

1.1.Mission Statement

In student life, time management plays a crucial role. With rapid changing needs of a dynamic world market, a student must have lateral development. However, due to lack of planning and relevant information, the student loses track in vast overflowing data present all around him/ her. Being new to college, the first year students are unable to cope up with the unfamiliarity of the new surroundings. This leads to improper utilization of their full potential as a good amount of time is wasted on building faith and checking for the relevance and validity of the information source.

Few years back a computer engineer's task was to manage and deal in hardware and software components. However, with passage of time and advancement of technology, the task has

diversified. Due to the presence of varied domains in the IT sector, many final year students get deviated and are unable to decide on which domain is best suited for them to pursue as a career.

1.2. Mission Objective

Our aim is to build a complete self-adapted system that deals with several problems together without manual interference. Using all sub-systems integrated in a single platform will make it more robust and efficient both in terms of technology and time management. The auto-correlated system we aim to build provides a solution by taking output of a sub-system as an input to the other one.

1.3. Project Goal

- Suggesting freshers the branch that is most suitable for them.
- To simplify the process of allotment of hostel to students
- A virtual static Mentor Bot to reduce workload.
- Career recommendation to under-graduate engineering students for higher education
- To-do list for assignments and other tasks
- Self-monitoring system- to check progress and learning curve after each semester
- Notify students about all latest notices and events hosted by KIIT and KISS
- Daily schedule to keep up the learning pace of students, includes class routines, class tests and quizzes.
- Voice detection to ensure the students emotional state is stable.
- Creation of platform where alumni of KIIT can be participate in discussions with their batch mates.

1.3. Features

1. Completely self-adapted system.
2. Multiple utility platform.
3. Secure and reliable.
4. Reliable tools and platforms are used to get consistent and accurate results every time.
5. User-Friendly interface.
6. Available in both web and mobile application interface.

Chapter 2

Literature Survey

An integrated software is a software for general use that combines the commonly used functionalities of many other software programs in a single application. Preparation of Technology integrated system has become essential these days to build any proper software product. Especially SaaS (Software as a Service) product focuses more into modern GUI. Since standalone products are often cannot hit the mark, or it become hard to use as well as maintain due to complexity. Thinking about easy accessible UIs J. Road et. al. brought the concept of End-user development tool [11]. Focusing on several Macro Models instead of a complete system at a time is another approach recalled by Mohamadi et. al. [12].

In 1980, first integrated software was introduced by few companies like Vizstar, Jane etc. Android was released first on December, 2014. Since then, several tools for Android Application Development was introduced [7]. Android studio for stable android system development was introduced thereafter [6]. Introduction of virtual emulator to the present stable SDE kit was an efficient step towards smooth development.

From past several years, comparison between several machine learning algorithms for a specific problem was a trend toward better performance architecture [9]. Similar way was followed by Sebastian et. al. for comparative solution of Monk's Problem [13]. Using proper modelling technologies, combining machine learning with full stack development has become an emerging way to solve several problems [10].

To overcome the SQL vulnerable injection, use of JSON formatted NoSQL database not only makes it a safer option, but provides more reliability and reduces delay in channel [8]. Secure non repeatable object id for primary key access is also an advantageous approach toward better development process.

Introduction to Augmented Reality in software development aspect [5] and using in a software product became useful for gaining popularity for fields like advanced gaming, one shot detection procedure, e-commerce sectors. But the introduction of AR in security and privacy protection fields [2] helped a system to achieve an added layer of protection over normal measures.

Starting from simple cloud storage services [3] like google drive, MS One Drive, Mega, now a days several cloud system provides additional computational spaces for several deployment

and heavy works. Which provides faster globally accessible services and secure data transfer pipelines.

Summary

From all the surveyed past works and visualizing workflow of a combined system provided a clear view of several technology integration and how it can be useful for real life implementation.

Chapter 3

Software Requirements Specification

Purpose

The principle reason for setting up this report is to give a general knowledge into the examination and necessities of the current framework or circumstance and for deciding the working qualities of the framework.

Scope

This Document assumes an elementary job in the improvement life cycle (SDLC) and it portrays the total prerequisite of the framework. It is created for use by the designers. Any progressions made to the prerequisites later on should experience formal change in the agreement process.

SDLC

For the most efficient and iterative working principles, the Agile Methodology had been chosen for the complete development purpose. The complete development process was divided into four sprints, and a scrum backlog was prepared. After each sprint, the sprint backlog was being compared with overall development.

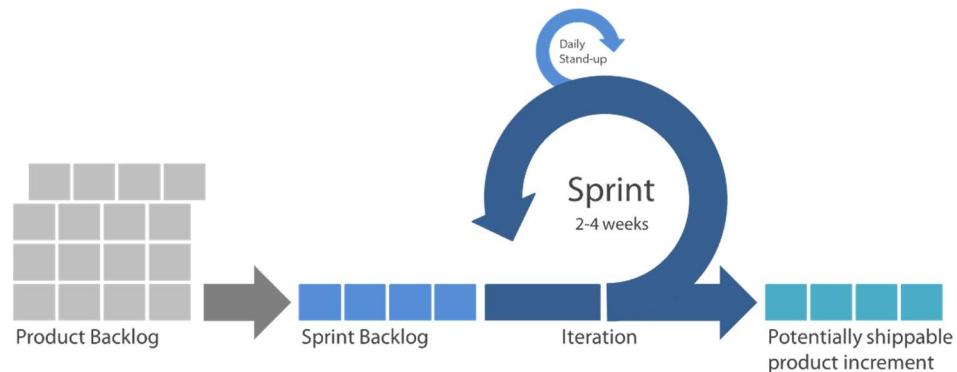


Fig 1. Scrum Flow

Timelines (Scrum Backlog)

Sprint 1				Sprint 2	
Research Features			Product Backlog Preparation	Basic Model Architecture Preparation	
Choose Bestfit Applications & Collecting Necessary Data	Dividing Workloads 01.02.2020 - 16.02.2020		Sprint Review & Sprint...	UI / UX Data Collection	Database Integration 17.02.2020 - 11.03.2020 Rest API preparation
					Sprint Review & Sprint...

Sprint 3				Sprint 4	
Deployment of APIs in Cloud			Simultaneous Regression Testing & Alpha Testing	Integration of Complete System	
Including Minor Functionalities	Model Integration in Backend 12.03.2020 - 21.03.2020		Sprint Review & Sprint...	Removing Bugs and Final Touch	Beta Testing, Portability and System Testing 21.03.2020 - 31.03.2020 Complete Documentation Preparation & Report Generation
					Scrum Review

*Fig 2. Sprint Burn down Chart**3.1. Developers' Responsibility Overview*

The developers are responsible for:

1. Developing the framework, which meets the Software Requirements and understanding every one of the necessities of the framework.
 - a. Taking care of simple but attractive user experience.
 - b. Considering the modularity of each frame for avoiding ambiguity during integration.
 - c. Performing alpha test in every stage of development.

- d. Demonstrating the framework and introducing the structure at customers' areas after the acceptance testing is effective.
- 2. Integrating encapsulated modules which are inaccessible to user.
 - a. Performing regression test while integrating.
 - b. Demonstration of partially developed system to perform beta test.
- 3. Using the new data to reform backbones.
 - a. Keeping models up-to-date.
- 4. Submitting the required client manual depicting the framework interfaces to deal with it and furthermore, the archives of the framework.
 - a. Managing any client preparing that may be required for utilizing the framework.
 - b. Keeping up the framework for a time of one year after installation.

3.2. Environment

For the complete development, systems of two different configurations were used.

- 1. The analysis, classifier preparation has been implemented using Python 3.7.7, and GUI using PHP 7.4 on an Intel(R) Core(TM) i5 7200U CPU 2.50GHz with 8GB RAM and 64 bits Windows 10 Home operating system.
- 2. The deployment has been implemented using Linux kernel and Docker on an Intel(R) Core(TM) Xeon CPU 1GHz with 1GB RAM and 64 bits Ubuntu 16.04 operating system.

3.3. Tools Used

- | | | |
|-------------------|-----------------------|---------------------|
| ○ Semantic Markup | ○ Java SE | ○ WinSCP |
| ○ PHP | ○ Flask & Dart | ○ Chrome DevTools |
| ○ CSS | ○ Pickle Tool | ○ IP Fingerprint |
| ○ JavaScript | ○ Defined Classifiers | ○ Particles.JS |
| ○ Owl Carousal | ○ Tensorflow v1.8 | ○ Express |
| ○ jQuery | ○ Event Control | ○ Docker & Procfile |
| ○ Bootstrap 4 | ○ Heroku Toolbelt | ○ Socket.IO |
| ○ Geocoding | ○ Heroku Cloud | ○ Android Studio |
| ○ Python 3.6.9 | ○ AWS IAM | ○ Google Colab |
| ○ Flask | ○ AWS EC2 | ○ VSCode |
| ○ MongoDB | ○ AWS S3 Bucket | ○ Git Bash |
| ○ Mongo Atlas | ○ Canvas.JS | ○ Anaconda |
| ○ Ajax | ○ Postman | ○ AR.JS |
| ○ XAMPP | ○ PuTTY | |
| ○ XML | ○ PuTTY Gen | |

3.4. System Hierarchy

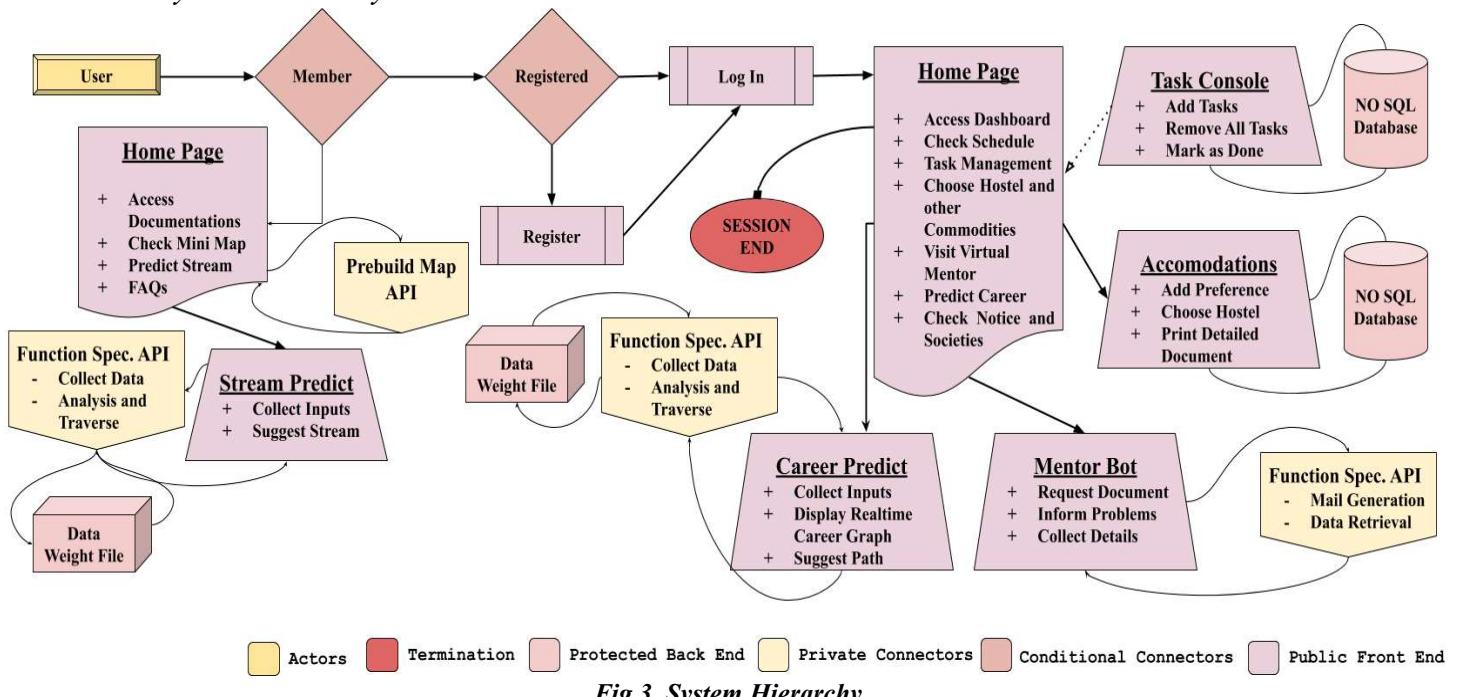


Fig 3. System Hierarchy

Chapter 4

Basic Concepts/ Technology Used

4.1. Machine Learning

Machine learning is the computational implementation for several statistical models. Now a days, in every aspect, we use machine learning in several types. There are three type of approach for predicting or forecasting.

- a. Classification
- b. Regression
- c. Clustering

The problem domain for this project was Classification. The complete process were carried out using python and several Ipython notebooks.

4.2 Flask, RESTful API & WSGI server

Flask is a micro web framework designed and developed by Armin Ronacher in 2010. Based on the python programming Language, it can host web applications both on the World Wide Web and any local host server. The term micro framework is used because it does not contain any specific tools and libraries or any other third party components. Instead it supports a wide range of extensions that can be used to host dynamic web applications with vivid features. Because of its easy to use and light framework, it became very popular within a very short span of time and soon became a popular alternative to Django which required a lot of dependencies and had a rigid structure.

Popular web applications like Pinterest and LinkedIn use Flask framework.

4.3 UI Tools

User Interface (UI) is the series of pages screens and other visual elements which enables a user to interact with the system. User Experience is the degree of interaction freedom. A combination of good UX and UI may enhance the quality of a product and attract user to use it again and again. There are two types of UI.

- 1. Static UI
- 2. Dynamic UI

To design the website several different technologies were used. To provide it a dynamic behavior and more relatable sections, PHP and several JS modules has been used.

4.4 MongoDB

MongoDB is a cross platform document oriented database program. It is a NoSQL database program. It stores data in non-tabular format. Rather it makes use of collections and documents. Documents are the key-value pairs of the database. They form the basic unit of MongoDB. Collections is a set of documents & functions similar to the relational database. The main advantage of NoSQL is that can it can handle large amounts of complex data quite easily because here data need not be split into tables thus reducing storage cost & giving us more flexibility as data is unstructured.

MongoDB uses JavaScript Object Notation document format. An open standard file format, it uses human readable text for storage and transmission of data largely containing attribute-value pairs and array datatypes.

Prominent corporates that use MongoDB are Barclays, Bosch, eBay, IBM and HSBC.

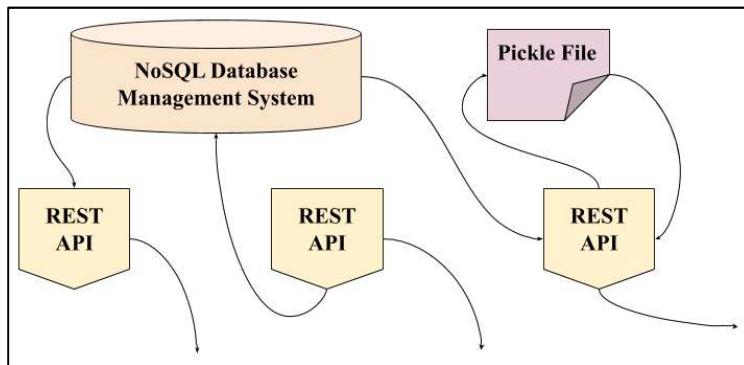


Fig 4. Backend Database Connectivity

4.5. Marker Based Augmented Reality

Augmented Reality (AR) is a widely used technology in these days. To make a system more environment compatible, Real time AR is used. Widely used SaaS products like Snapchat, Instagram and inventions like Amazon Cashierless Store uses AR as their key technology. In the suggested system, AR is used for verification and validation of Administrator.

For implementation of AR in this project, JavaScript and AR Toolkit has been used. Since the complete system is marker based, a predefined **Hiro Marker** helped to implement it successfully. Once the marker is detected by the system, it asks for next step validation. The image is detected using the camera present in the system. The backend is managed by three.js and using JavaScript Events, it immediately jumps to next state.

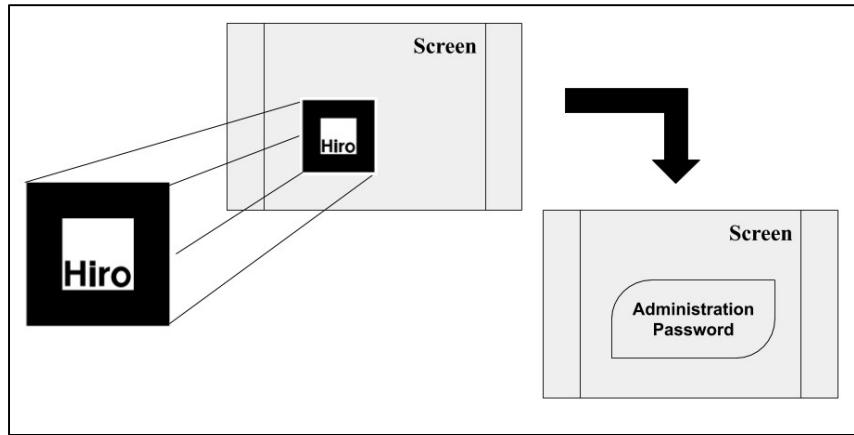


Fig 5. Use of AR in Administration Control

4.6. Android

In the last two decades, the rapid transition from black and white screens on mobile phones to attractive colorful screens has been possible due to Android. Android is a Linux based OS. The Android software was invented in Palo Alto of California in 2003. An Android app or application is a software application running on the Android platform. As the Android platform is built for touch screen mobile devices, an Android app or application is designed for a smartphone or a tablet PC running on the Android Operating System.

In 2008, the first version 1.0 of the android development kit (SDK) was launched.

4.7. Applications

The applications are intended to be user friendly and have more visual representation. The android is an open-source OS. It is free and everyone can access it. The android has a large number of apps available that can assist us to manage our life in one or other way. It is available at low cost in the market. Thus, android is very popular.

Android apps are written in the Java programming language. They use Java core libraries. They are initially compiled to Dalvik executables to run on the Dalvik virtual machine. Dalvik virtual machine is a virtual machine specially designed for mobile devices. The android is an operating system and is a stack of software components which is divided into five sections and four main layers.

4.7.1. Linux kernel

The android uses a powerful Linux kernel. It supports a wide range of hardware drivers. The kernel is the main component of the operating system which manages input and output requests from the software. Basic system functionalities like process management, memory management, device management like camera, keypad, and display are managed by the kernel

handles. Linux kernel itself does not interact directly with the user. However, it interacts with the shell and other programs as well as with the hardware devices on the system.

4.7.2. Libraries

On top of a Linux kernel there is a set of libraries including open-source web browsers such as WebKit, library libc. These libraries are used to play, record audios and videos. The SQLite is a database. It is useful for the storage and sharing of application data. The SSL libraries are liable for internet security.

4.7.3. Android Runtime

The android runtime provides a vital component called Dalvik Virtual Machine. It is a kind of Java virtual machine. It is specially designed and optimized for android. The Dalvik Virtual Machine is the process virtual machine in the android operating system. It is a software that runs apps on android devices.

The Dalvik VM makes use of Linux core features like memory management and multithreading which is in java language. The Dalvik VM enables every Android application to run its own process. The Dalvik VM executes the files in the .dex format.

4.7.4. Application framework

The application framework layer provides various higher-level services to applications which includes windows manager, view system, package manager, resource manager.

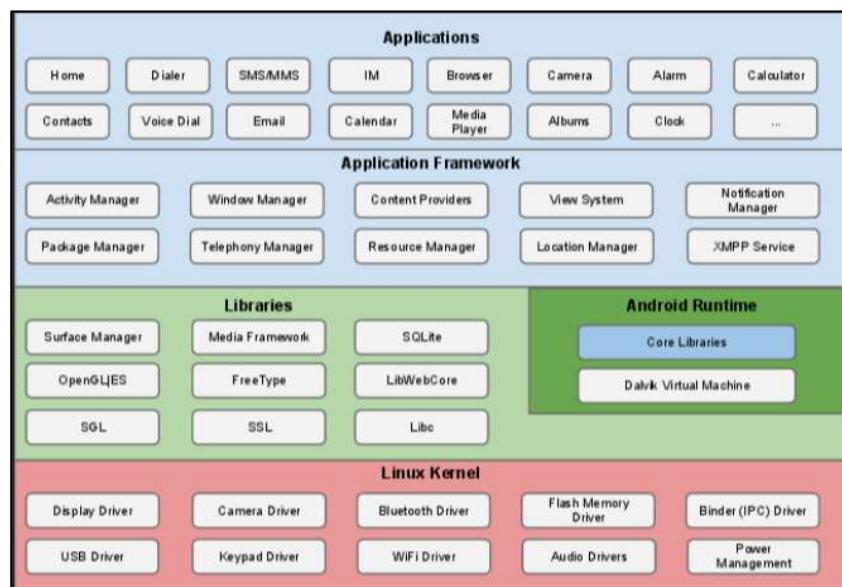


Fig 6. Android Architecture

4.8. *Android Studio*

Android Studio is the official Integrated Development Environment (IDE) for Android app development. Vital command-line tools for development of Android app are grouped into three packages:

4.8.1. *Android SDK tools*

SDK tools are platform-independent and are needed to create any Android app which includes: Build tools, Debugging tools and Image tools, among others. One of the important SDK tools is Android SDK Manager. It provides resources, platforms and other useful components needed to build apps and manage SDK packages.

The Android Virtual Device Manager facilitates a graphical user interface to test the app on a virtual device. The Dalvik Debug Monitor Server (DDMS) to debug your Android apps.

4.8.2. *Platform tools*

Platform tools are customized and used to support new features in the latest versions of Android, also compatible with prior versions. Some of these tools include: Android Debug Bridge, Fastboot or Systrace. Android Debug Bridge (ADB) needs to know how to communicate with the Android version hosted on your device. Thus, it needs the platform-tool component like ADB can be used to install an Android application file on a device. Moreover, additional shell tools can be accessed through ADB, like BMGR and logcat.

Platform tools work along with Build tools for ensuring the following purposes:

- Encryption
- security
- file size

4.8.3. *Android Emulator*

The Android emulator allows you to develop and test your apps without using any physical device. This package is often updated and needed to use the Android Emulator Graphic User Interface (GUI) in Android Studio. This assists Android app developers to debug and test their apps in a run-time environment.

Carrying a laptop on every occasion is not feasible as well as practical. In today's world, almost everyone carries an android smartphone in their pockets. Hence to increase mobility and efficiency of our project, an android app based version of "BeFriend" will be implemented along with the web version. The android application would act as a frontend component giving students a user-friendly and GUI-based platform to work upon. This will allow students to keep track of their activities on-the-go with just a simple tap on their smartphones.

4.9. AWS S3 Bucket

AWS S3 also known as the Simple Storage Service allows us to store arbitrary objects inside of buckets. There are primarily two methods for managing external access to the S3 objects.

4.9.1. ACLs

Through ACLs, one can grant basic read/write permissions to other AWS accounts or predefined S3 groups. If one is granting access to AWS accounts, one wants to be sure to audit those accounts and their levels of access to ensure the principle of least privilege is being adhered to. It must be ensured that the objects are not exposed to anonymous access.

4.9.2. IAM User Policies

It is more complicated than using ACLs. However, it offers more flexibility.

Bucket policy and user policy are access policy options for granting permissions to S3 resources using a JSON-based access policy language. In policies, one can grant access to resources to specific actions for specific principals. Resources will be your buckets and objects. Actions will be the set of operations permitted on those resources. Principals will be the accounts or users who are allowed access to those actions and resources. Where things start getting really complicated is that one can provide wildcards for the resources, actions and principals.

The profile pictures of the registered students are collected and stored using this software component. The objects collected in bucket are securely displayed using S3.

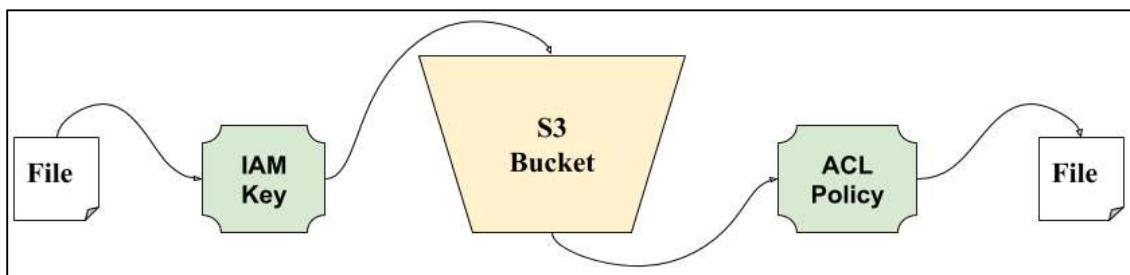


Fig 7. S3 Bucket Specific Storage Access

4.10. AWS EC2

Amazon Elastic Compute Cloud (EC2) provides resizable compute capacity in cloud. It comes with 275 different operating systems like Amazon Linux, Ubuntu, Debian, Open SuSe, Windows Server OS. The system supports AWS Nitro system to virtualize resources and helps to minimize hardware and software attack. Using the accelerate computing of EC2 instance and the broadcast service a restricted and partially isolated backend system can be generated.

In the proposed system, EC2 Ubuntu instance with a t2.micro system has been used. The instance is used to host all used Application program interfaces and pickles. The Domain Name Server (DNS) associated with the system helps to access the public IP of the system. Which leads to accessing broadcast processes with specific port number.

4.11. PuTTY

PuTTY is a software to establish connection between local and global machine with the help of Secure Bash (SSH: Port 22). To establish SSH handshake, a public PuTTY Private Key (PPK) is used. To maintain and successful connection the building architecture uses PuTTY to connect Ubuntu EC2 Instance with local machine. Additionally to generate machine specific key, PuTTYgen had been used. To transfer files between local Windows 10 local system and Ubuntu global one, WinSCP is used which establishes similar File Transfer Protocol Secure (FTPS: Port 443).

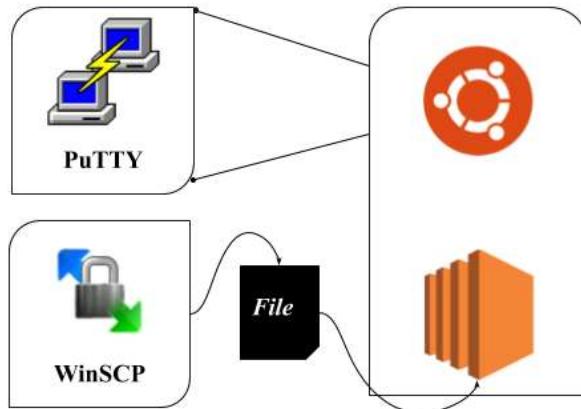


Fig 8. File Projection in Local and Global System

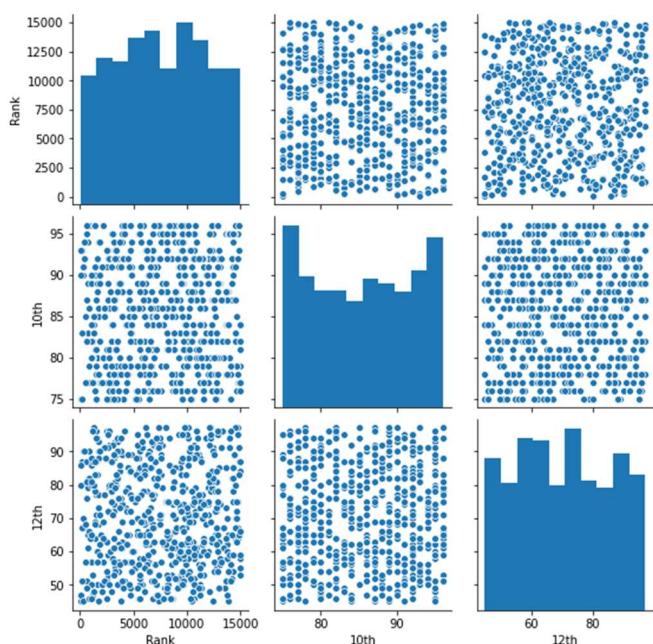
Chapter 5

Implementation

5.1. Data Collection

To find out what are the problems that the students really faced. An online survey via google form was done and also personal interaction with students was done, especially freshmen. It was found that the one of the major problem that they faced was the dilemma of selecting the most suitable engineering stream for them. Apart from that many students complained that some of the processes like hostel allocation took a long time and often led to unwanted scenarios. Many students also stated that they are unable to keep track of all the events and seminars around the campus and therefore sometimes would miss those that they were interested in. Apart from freshmen and juniors, some final year students were also interacted with to know about their problems, if any. It was noticed that because of the varied domains such as ML, IOT, Web Development present in the IT sector, they were confused which to pursue as a professional career.

5.2. Data Synthesise



To utilize the most useful information, from the complete dataset, data was plotted in several ways and tried to extract the best portions from the dataset. Along with that, some portion of data were synthesized based on the architecture of another dataset.

Fig 9. Data Visualization and Outliers Determination

5.3. Feature Engineering

In both datasets, the columns with high covariance were removed. Also to build a better classifier, Gaussian transforms were applied to those data columns without normal distributions. Moreover using Forward Feature Selection procedure, best columns were searched for Output labels.

5.4. Ensemble Training and Model Building

Ensemble methods involve a group of predictive models to achieve a better accuracy and achieve a better accuracy and model stability. Some of the commonly used ensemble methods are bagging and boosting

In this Project, Bagging classifier Random Forest is being applied on the model. Bagging stands for Bootstrap Aggregation. The essence is to select bootstraps that fit a classifier on each of the created samples, train the models in parallel and then consider the average of the results.

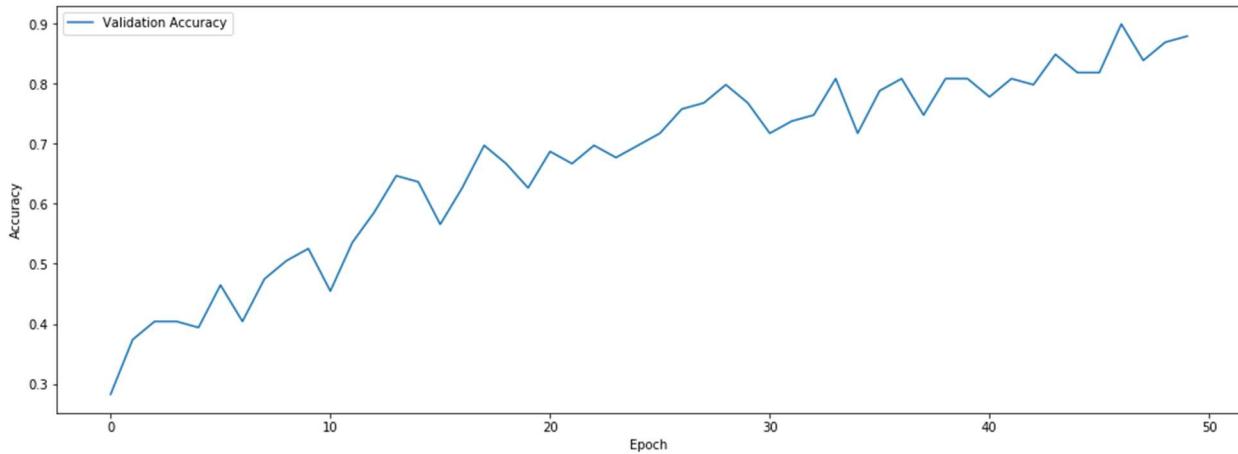
5.5. Deep Learning and Model Building

To prepare a model on synthesised data, the MLP, RBM and CNN were used. Among which CNN provided the best result. The CNN was prepared of a architecture containing 3 one dimensional convolutional layer, treated with both 1D average and max pool layers among

which, maxpooling1D led to better result. For a relative faster convergence, Rectified Linear Unit (ReLU) had been used. Having all values in positive scale, there were less chance of leakage. Being multiclass classification problem, output layer activation us kept as “Softmax”. An Adam optimizer with categorical_crossentropy type loss measurement function has been used for training phase. The ultimate weight files are stored to pickles.

Model: "sequential_8"		
Layer (type)	Output Shape	Param #
conv1d_17 (Conv1D)	(None, 5, 128)	512
conv1d_18 (Conv1D)	(None, 5, 128)	49280
max_pooling1d_7 (MaxPooling1D)	(None, 1, 128)	0
dropout_4 (Dropout)	(None, 1, 128)	0
conv1d_19 (Conv1D)	(None, 1, 32)	12320
flatten_5 (Flatten)	(None, 32)	0
dense_9 (Dense)	(None, 32)	1056
dense_10 (Dense)	(None, 7)	231
<hr/>		
Total params:	63,399	
Trainable params:	63,399	
Non-trainable params:	0	

Fig 10. ConvNet Architecture

**Fig 11. Validation Accuracy Curve**

5.6. Database Preparation

For cloud database system, MongoDB Atlas was preferred over any SQL RDBMS

The screenshot shows the MongoDB Atlas interface for a collection named 'User.Befriend'. The top bar displays 'COLLECTION SIZE: 1.12KB TOTAL DOCUMENTS: 5 INDEXES TOTAL SIZE: 36KB'. Below the bar are tabs for 'Find', 'Indexes', 'Schema Anti-Patterns', 'Aggregation', and 'Search BETA'. There is also an 'INSERT DOCUMENT' button and a 'FILTER' input field containing '{filter: "example"}'. Below these are 'Find' and 'Reset' buttons. The main area is titled 'QUERY RESULTS 1-5 OF 5' and shows a single document:

```

_id: ObjectId("5e5d3ff1e7238d69c8ec438")
fname: "Arpan"
lname: "Rc"
email: "arpanrc9@gmail.com"
pass: "a4ac91ac09d7c097fe1f4f96b897e625b6922069"
sec: "1"
stream: "CSCE"
roll: "17299016"
sem: "6"
tagline: "ML Enthusiast"
  
```

system. MongoDB cloud is easy to integrate with most of the programming languages. For the complete development procedure, Befriend collection had been created containing different Databases for different purpose. MongoDB supports JSON type data, so all transferred data was JSON encoded.

Fig 12. MongoDB Atlas JSON View

5.7. API preparation and cloud host

WSGI server was established in the local system and REST APIs were prepared using Python Flask. Necessary methods like "GET" and "POST" were used considering the size of transferred data chunks and status codes were used accordingly. Using the pickle, weight files were connected to the Flask Files. Pre-prepared database were connected where necessary. And after sufficient test, APIs were deployed in cloud and performed one more test.

5.8. Establishment of Storage

To store files in cloud storage, a S3 bucket with an ARN “arn:aws:s3:::befriendminor” was established.

The screenshot shows the AWS S3 Management Console interface. At the top, there's a header with 'Buckets (1)' and several buttons: 'Copy ARN', 'Empty', 'Delete', and 'Create bucket'. Below the header, a message states: 'Buckets are the fundamental container in Amazon S3 for data storage. For others to access the objects in your buckets, you'll need to explicitly grant them permissions.' A 'Learn more' link is provided. A search bar labeled 'Find bucket by name' is present. Below the search bar is a table with columns: 'Name', 'Region', 'Access', and 'Creation date'. The table contains one row for the bucket 'befriendminor', which is located in the 'US East (Ohio) us-east-2' region, has 'Public' access, and was created on '2020-04-02T21:07:01.000Z'.

Fig 13. S3 Management Console

5.9. Front UI Preparation

After being established with quality standard tools and APIs, the UI has been prepared. The UI comes with specific session, starts when a user logs into the system. The session is destroyed when user logs out. User may access the dashboard from the member index page. Other necessary workflows start from that page. The attached backend is prepared with multiple PHP layers.

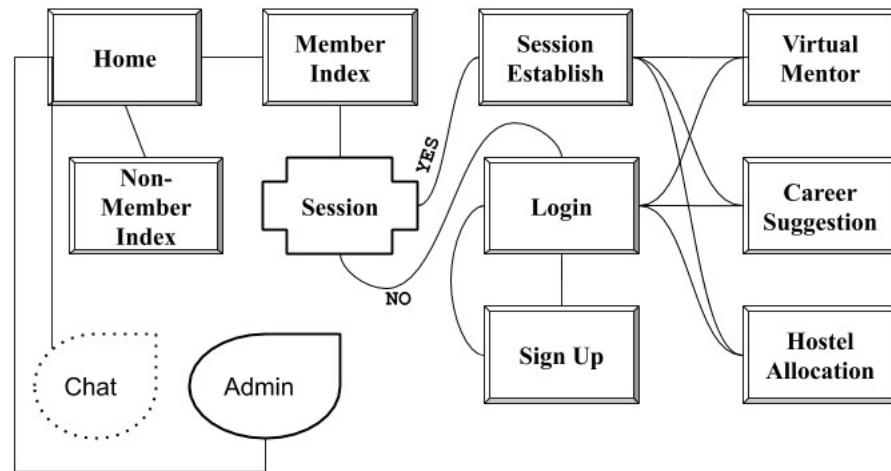
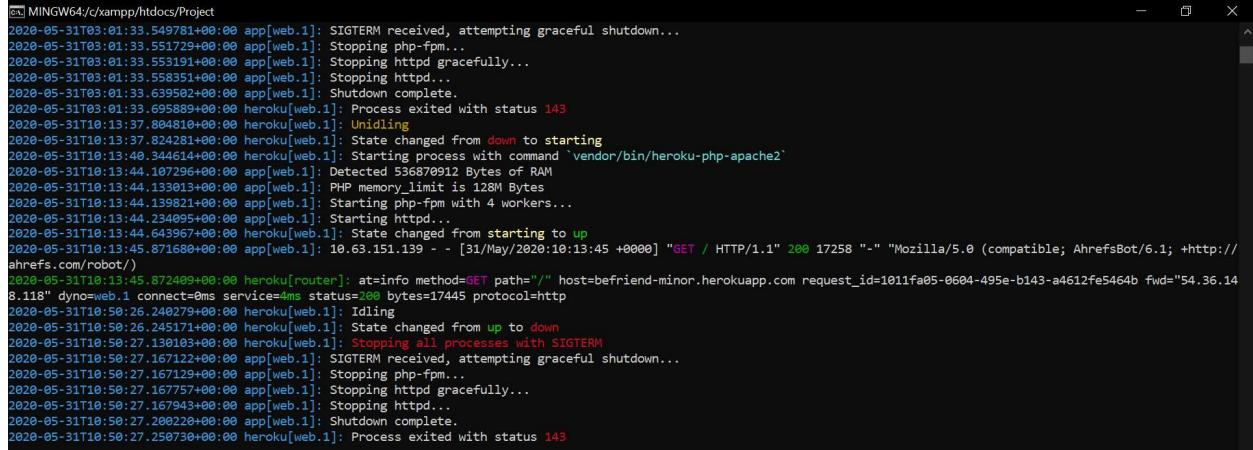


Fig 14. UI Frames Data Flow

5.10. System Deployment

The system is deployed in Heroku Cloud using version control git. A Procfile was set up with **heroku-php-apache 2** server and **Nginx reverse proxy**.



```

[1] MINGW64:/c/xampp/htdocs/Project
2020-05-31T03:01:33.549781+00:00 app[web.1]: SIGTERM received, attempting graceful shutdown...
2020-05-31T03:01:33.551729+00:00 app[web.1]: Stopping php-fpm...
2020-05-31T03:01:33.553191+00:00 app[web.1]: Stopping httpd gracefully...
2020-05-31T03:01:33.555351+00:00 app[web.1]: Stopping httpd...
2020-05-31T03:01:33.559592+00:00 app[web.1]: Shutdown complete.
2020-05-31T03:01:33.695889+00:00 heroku[web.1]: Process exited with status 143
2020-05-31T10:13:37.604810+00:00 heroku[web.1]: Unidling
2020-05-31T10:13:37.624281+00:00 heroku[web.1]: State changed from down to starting
2020-05-31T10:13:40.344614+00:00 heroku[web.1]: Starting process with command `vendor/bin/heroku-php-apache2`
2020-05-31T10:13:44.107296+00:00 app[web.1]: Detected 5368769912 Bytes of RAM
2020-05-31T10:13:44.133813+00:00 app[web.1]: PHP memory_limit is 128M Bytes
2020-05-31T10:13:44.139821+00:00 app[web.1]: Starting php-fpm with 4 workers...
2020-05-31T10:13:44.234095+00:00 app[web.1]: Starting httpd...
2020-05-31T10:13:44.643967+00:00 heroku[web.1]: State changed from starting to up
2020-05-31T10:13:45.871680+00:00 app[web.1]: 10.63.151.139 - - [31/May/2020:10:13:45 +0000] "GET / HTTP/1.1" 200 17258 "-" "Mozilla/5.0 (compatible; AhrefsBot/6.1; +http://ahrefs.com/robot/)"
2020-05-31T10:13:45.872409+00:00 heroku[router]: at=info method=GET path="/" host=befriend-minor.herokuapp.com request_id=1011fa05-0604-495e-b143-a4612fe5464b fwd="54.36.148.118" dyno=web.1 connect=0ms service=4ms status=200 bytes=17445 protocol=http
2020-05-31T10:58:26.240279+00:00 heroku[web.1]: Idling
2020-05-31T10:58:26.245171+00:00 heroku[web.1]: State changed from up to down
2020-05-31T10:58:27.130103+00:00 heroku[web.1]: Stopping all processes with SIGTERM
2020-05-31T10:58:27.167122+00:00 app[web.1]: SIGTERM received, attempting graceful shutdown...
2020-05-31T10:58:27.167129+00:00 app[web.1]: Stopping php-fpm...
2020-05-31T10:58:27.167757+00:00 app[web.1]: Stopping httpd gracefully...
2020-05-31T10:58:27.167943+00:00 app[web.1]: Stopping httpd...
2020-05-31T10:58:27.200220+00:00 app[web.1]: Shutdown complete.
2020-05-31T10:58:27.250730+00:00 heroku[web.1]: Process exited with status 143

```

Fig 15. Heroku Application Log

Chapter 6

Result and Analysis

6.1. Classifier Comparison for Synthesized Data

Several algorithms were used to achieve the best classifier for the synthesized data of suitable stream prediction among which, Decision Tree Classifier provided an accuracy of **97.64 ± 1.47%** in 10 fold cross validation.

Classifier	Accuracy	Standard Deviation
Random Forest	97.2%	1.47%
Logistic Regression	87.5%	3.74%
SVM (rbf)	86.4%	4.03%
SVM (Linear)	92.89%	1.94%
KNN	80.44%	5.24%
Decision Tree	97.64%	1.47%
GaussianNB	95.56%	2.43%

Table 1. Accuracy Comparison of Synthesized Dataset

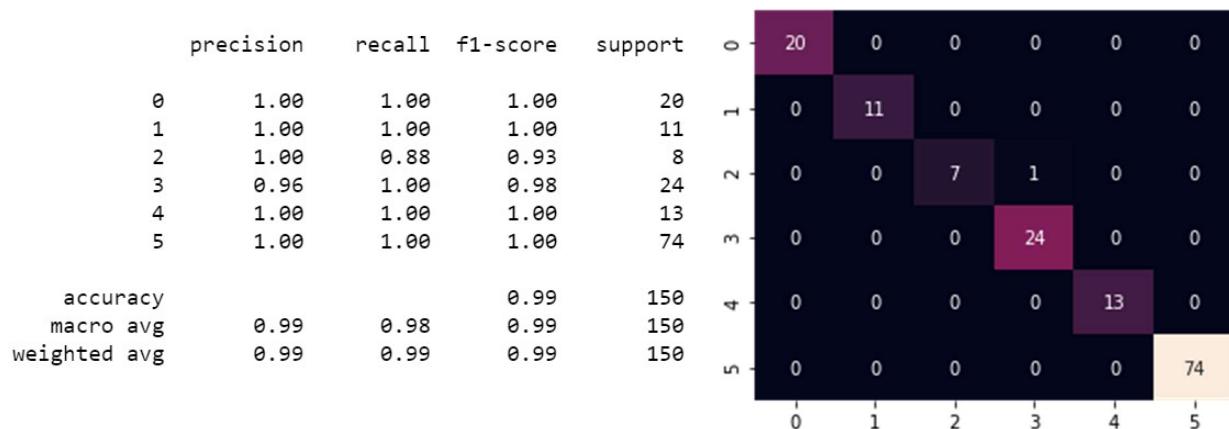


Table 2. Analysis of Decision Tree Accuracy

Fig 16. Classification Matrix

6.2. Classification Comparison for AMEO-2015

To predict the most suitable job profile and several other suggestions for a student, our proposed architecture uses Linear SVM for Hyper-parameter tuned values. The classifier led to $71.25 \pm 4.19\%$ accuracy.

Classifier	Accuracy	Standard Deviation
Random Forest	65.55%	3.54%
Logistic Regression	65.34%	4.28%
SVM (rbf)	65.94%	3.60%
SVM (Linear)	65.35%	4.19%
KNN	64.73%	4.26%
Decision Tree	54.13%	6.09%
GaussianNB	57.33%	6.53%
XGBoost	62.33%	4.79%
Linear SVM with Tuning	71.25%	4.19%

Table 3. Accuracy Comparison of AMEO-2015 Dataset

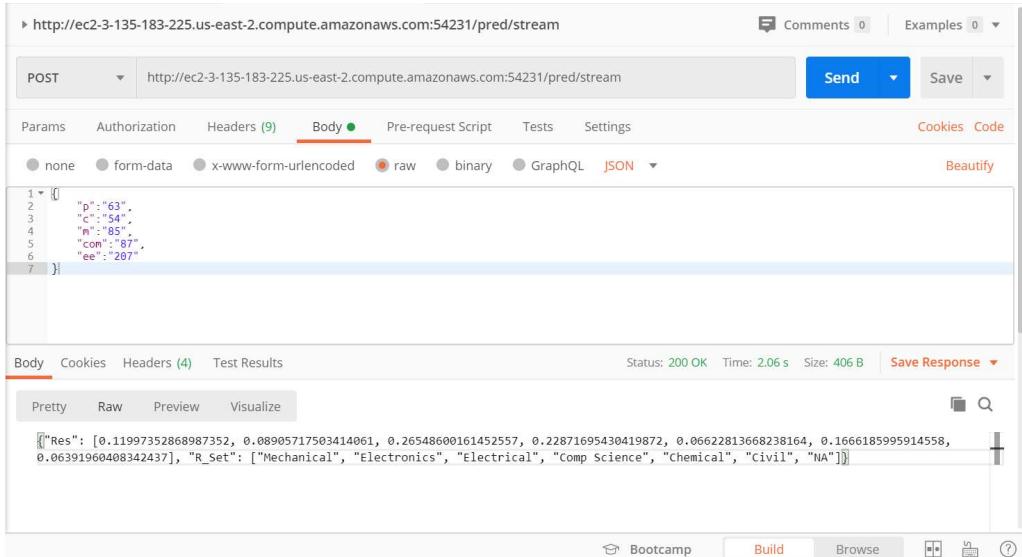
	precision	recall	f1-score	support
0	0.74	0.98	0.84	119
1	0.25	0.08	0.12	12
2	0.00	0.00	0.00	2
3	0.80	0.12	0.21	34
accuracy			0.73	167
macro avg	0.45	0.30	0.29	167
weighted avg	0.71	0.73	0.65	167

Table 4. Analysis of Hyper-parameter Tuned Linear SVM Accuracy

6.3. API Connectivity and Regression Test

All REST APIs were tested using both **Postman** and **cURL**. For each API, two tests were performed. One with loopback IP (127.0.0.1) one with cloud deployment. Sample test cases are shown as below

```
// Stream:
{
  "p": "63",
  "c": "54",
  "m": "85",
  "com": "87",
  "ee": "207"
}
// Career:
{
  "10": "86.28",
  "12": "72",
  "sp": "14",
  "gpa": "9.04",
  "eng": "41.6667",
  "logical": "55.001",
  "quant": "49.444",
  "domain": "37.496",
  "prog": "-1.0",
  "conscientiousness": "0.7",
  "agreeableness": "0.79",
  "extraversion": "0.67",
  "nueroticism": "0.593"
}
```

**Fig 17. API Test with Postman**

6.4. Deployment with Version Control and Beta Testing

The complete deployment is done with version control git and heroku toolbelt. The complete system was tested by all the team members and non-member technology enthusiasts. All remarks and suggestions were noted manually and most of the bugs are fixed accordingly.

Chapter 7

Conclusion

The **Enhanced Analytic System for Smart University Assistance** will provide students an easy and efficient way to manage their time around the campus allowing them to focus on both the academic and non-academic aspects of their life in an organized manner. The main features of this system is that it is unique, easy to use and has a high content quality and interactivity.

And as for us as developers, making this project was indeed a very enriching and fruitful experience. It was realised how with a little effort and innovation technology can be put to good use for the society. As a varied number of technologies were used in developing this project, the technical skills and knowledge of each and every member was tried and tested along with their problem solving and social co-operation skills. This gave us an opportunity to learn from each other and also taught how to solve any problem as a team.

We sincerely hope this system will be able to help students as much as possible and we hope with proper feedback and reviews, we will be able to add many more new features and functionalities as per the needs and the requirements of the student community.

7.1. Future Work

This project has the potential to become the official portal of the university. A lot more functionalities can be added (Bus routes and bus timings for day boarders etc.). Basically it could be an upgraded version of currently used product. The connection established with alums can be tapped for future mentorship programs and guidance. For maintenance purposes, once a specification is being brought into action, it is valid for both Android and IOS environments. Further changes if required is needed only to be done once for a single environment it gets automatically incurred in other one.

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Enhanced Analytic System for Smart University Assistance

Navonaya Brahmachari
1729037

Abstract: A short description of the aim and objective of the project work carried out in 3-4 lines. This part should be common to all students in the group. The font size and style will remain same from this point onwards. The font size will be 12 and font style will be Times New Roman. The line spacing will be 1.5.

This report should be prepared in A4 page format with ‘default’ option under ‘Margin’ of the ‘Page Layout’ tab in Microsoft Word. Word limit for this section is 80.

Individual contribution and findings: With the initiation of the minor project, my role was to perform the requirement analysis, requirement prioritization, planning of the wireframe, building the android application from scratch and handling the S3 platform.

Requirement Analysis:

Using Pareto Analysis, the root cause of the problems in the existing system was found. Through a clear understanding the reason behind a potential suggestion recorded during data collection was analysed.

Requirement Prioritization:

Q-Matrix Framework was developed and all the requirements were prioritised into the following categories:

- Easy Problem with High Value Result
- Difficult Problem with High Value Result
- Easy Problem with Low Value Result
- Difficult Problem with High Value Result

Planning of the wireframe:

A detailed outlook of the project screens displayed in web application and android application was considered.

Building the Android application:

Using Android Studio, the android application named BeFriend was created. The screen view is attached below:

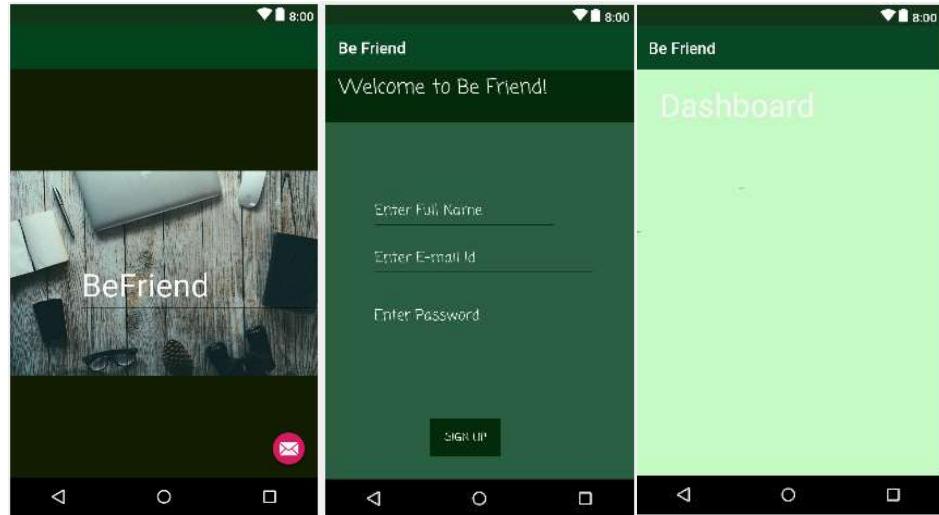


Fig x. XML View of Android App

AWS S3 storage was used to collect the display profile photograph for registered students. My role also included the handling S3 console partially.

Individual contribution to project report preparation: In the group project role, I was instrumental in preparing the following parts:

- Requirement Analysis
- Android Development
- S3 Bucket Preparation
- Future Scope Writing

Individual contribution for project presentation and demonstration: I've contributed towards the overview part of Android, its applications and steps being followed, transformation and partially cloud tools being used in the project presentation.

Prof. Rajdeep Chatterjee
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Full signature of the student

Enhanced Analytic System for Smart University Assistance

Rahul Bordoloi
1729048

Abstract: A short description of the aim and objective of the project work carried out in 3-4 lines. This part should be common to all students in the group. The font size and style will remain same from this point onwards. The font size will be 12 and font style will be Times New Roman. The line spacing will be 1.5.

This report should be prepared in A4 page format with ‘default’ option under ‘Margin’ of the ‘Page Layout’ tab in Microsoft Word. Word limit for this section is 80.

Individual contribution and findings: My Major Contribution/Role in the project group was creating, developing and fine-tuning of Machine Learning Models. I've adopted the professional way of developing step-wise and section-wise Machine Learning Models which helps in debugging errors, editing and implementing modifications where-ever necessary. After discussing the goals and needs of our Project, it was my goal to select the type of model and the direction to proceed to create and build a successful Machine Learning Model. After studying and much research on the project objective, I've implemented two models for two purposes - Branch Allocation Model and Career Counselling Guidance Model. For Branch Allocation, I didn't find any sort of dataset to work on, so the synthesis of dataset was done and then the method of Transfer Learning was implemented on the gathered dataset. The Final Model Accuracy of Branch Allocation model was found out to be 97.2 % using Decision Tree Algorithm. This model predicts the probable branches a candidate can opt from during branch allocation given his entrance rank and other parameters. The second model I've worked on is Career Counselling Model which predicts the type/line of work one should pursue after completion of college according to his aptitude scores, reasoning parameters etc. The Final Model is using Linear-SVM with an accuracy of 71.2%.

The Sequential Steps I've followed in developing both the models are -

Importing Datasets and Libraries -> Working on Train set and performing feature engineering and selection -> Performing Visualizations to creating a better overview of the nature of data-> Mapping Train and Test to maintain consistency of features in both datasets-> Splitting the train set into a train-validation set for development of model-> Performing hyper-parameter tuning and model optimization for better performance-> Saving the Model for future use and deployment-> Creating a ML Pipeline to compact data pre-processing and modeling-> Generation of Requirement file for dependencies.

Individual contribution to project report preparation: I've contributed towards writing down the technical and overview part of Machine Learning and its applications and steps being followed in the project report.

Individual contribution for project presentation and demonstration: I've contributed towards the overview part of Machine Learning, its applications and steps being followed, transformation and various tools being used in the project presentation.

Prof. Rajdeep Chatterjee

Full Signature of Supervisor

Rahul Bordoloi

Full signature of the student

Enhanced Analytic System for Smart University Assistance

Ritwik Das
1729054

Abstract: A short description of the aim and objective of the project work carried out in 3-4 lines. This part should be common to all students in the group. The font size and style will remain same from this point onwards. The font size will be 12 and font style will be Times New Roman. The line spacing will be 1.5.

This report should be prepared in A4 page format with ‘default’ option under ‘Margin’ of the ‘Page Layout’ tab in Microsoft Word. Word limit for this section is 80.

Individual contribution and findings: As the main motive of this project was to be an aid to students, it was necessary to find out what are the problems that the students really faced. Thus I undertook this task. Through online survey via google form and through personally interacting with students, especially freshmen, it was found that the one of the major problem that they faced was the dilemma of selecting the most suitable engineering stream for them. Also many students complained that some of the processes like hostel allocation took a long time and often led to unwanted scenarios. They said it would be of great help if rather than the conventional method, it would be digitalized. Many students also stated that they are unable to keep track of all the events and seminars around the campus and therefore sometimes would miss those that they were interested in. Apart from freshmen and juniors, I contacted some final year students to know about their problems, if any. I noticed that because of the varied domains such as ML, IOT, Web Development present in the IT sector, they were confused which to pursue as a professional career. With these observations in mind, when all the functionalities of our project were finally ready, I took the task of integrating them into a single module and was actively involved in the testing procedure of our final deliverable.

Individual contribution to project report preparation:

In the project report, I was part of

1. Documentation of the Machine Learning part of the tools and technologies used
2. Forming the basic structure of the overview.
3. Framing the problem statement with the help of another team member.
4. Chalking out the future scope of our project.
5. Listing what more functionalities can be added to it to make it more robust and more efficient.

Individual contribution for project presentation and demonstration: I've contributed towards the overview part of System Integration, and Database Connectivity portion.

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Ritwik Das
Full signature of the student

Enhanced Analytic System for Smart University Assistance

Saptarshi Mazumdar
1729058

Abstract: A short description of the aim and objective of the project work carried out in 3-4 lines. This part should be common to all students in the group. The font size and style will remain same from this point onwards. The font size will be 12 and font style will be Times New Roman. The line spacing will be 1.5.

This report should be prepared in A4 page format with ‘default’ option under ‘Margin’ of the ‘Page Layout’ tab in Microsoft Word. Word limit for this section is 80.

Individual contribution and findings: My contribution to the project was to creating the User Interface and connect the other components with the system. Also managing the security portion for admin console using Augmented Reality application was one more task that I’ve done. The complete procedure worked simultaneously. The system tests and subsequent alpha tests of programs in the project life cycle was managed by me. At last, collecting reports from the beta tester and maintaining the taking care of proper workflow was my final task.

Individual contribution to project report preparation: I’ve contributed towards writing down the technical and overview part of UI creation, AR related discussions and steps being followed in the project report.

Individual contribution for project presentation and demonstration: I’ve contributed towards the overview part of UI creation, AR related discussions and steps being followed, transformation and various tools being used in the project presentation.

Prof. Rajdeep Chatterjee
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Saptarshi Mazumdar
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Enhanced Analytic System for Smart University Assistance

Suranja Bakshi

1729228

Abstract: A short description of the aim and objective of the project work carried out in 3-4 lines. This part should be common to all students in the group. The font size and style will remain same from this point onwards. The font size will be 12 and font style will be Times New Roman. The line spacing will be 1.5.

This report should be prepared in A4 page format with ‘default’ option under ‘Margin’ of the ‘Page Layout’ tab in Microsoft Word. Word limit for this section is 80.

Individual Contribution and Findings: My main contribution or role in the project group was system deployment in cloud. After discussing the main agenda of the project, the other team members initiated their work. Half way through it, I received the APIs and used Elastic Compute Cloud instance in AWS for its deployment. I used Putty for connecting the local machine with the global machine. I used WinSCP for uploading the .py and .sav files from the local machine to the global machine. After the completion of the website, I received the project folder and used Heroku for the deployment of the website

Individual Contribution to project report preparation:

In the project report I was part of

- ❖ Analysis of the requirements.
- ❖ Documentation and diagram of Cloud-related sections.
- ❖ Figuring out the future scopes along with other team members.
- ❖ A part of the overall work of the report.

Individual Contribution for project presentation and demonstration:

In the project presentation I was part of

- ❖ Overview part of Cloud-related sections.
- ❖ Description of Cloud-tools used.

Prof. Rajdeep Chatterjee

Full Signature of Supervisor

Suranja Bakshi

Full signature of the student