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.

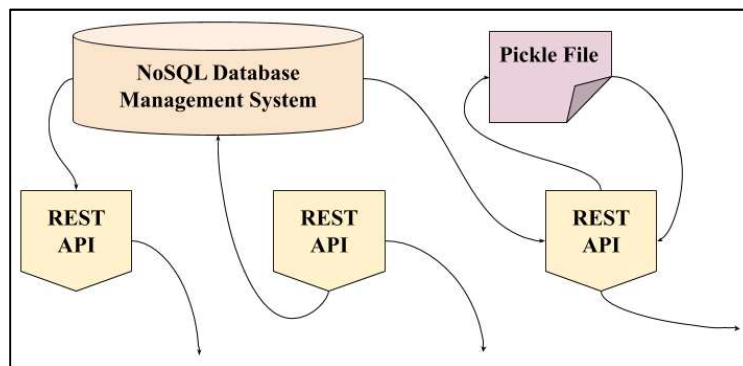Prominent corporates that use MongoDB are Barclays, Bosch, eBay, IBM and HSBC.

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.
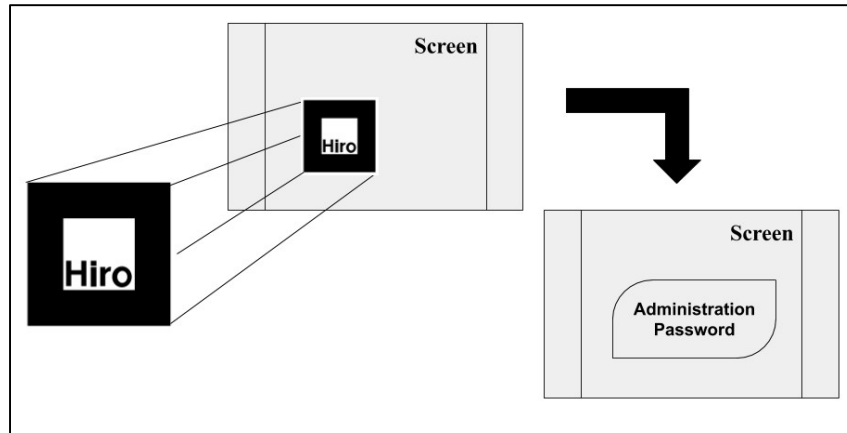
Fig 5. Use of AR in Administration Control

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.
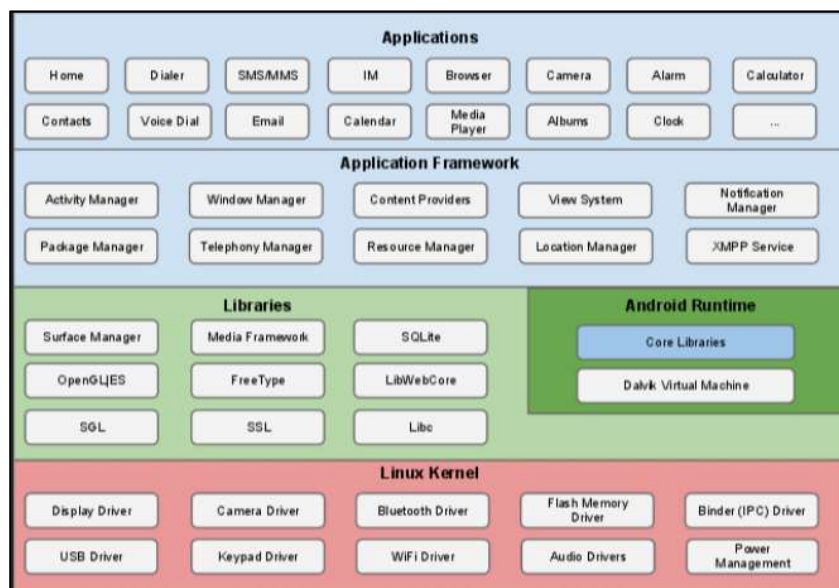

Fig 6. Android Architecture

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.
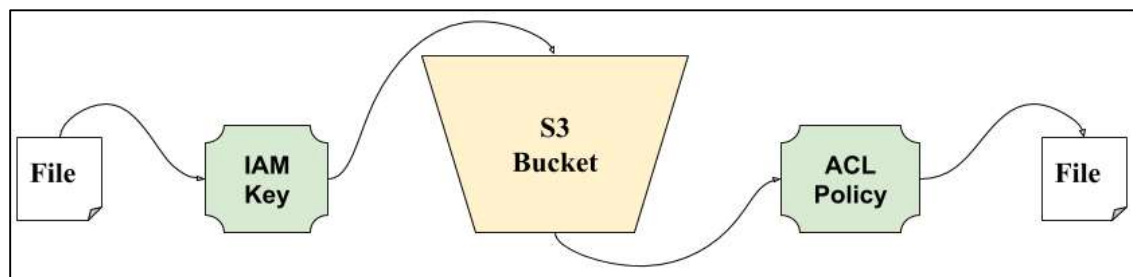

Fig 7. S3 Bucket Specific Storage Access

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).
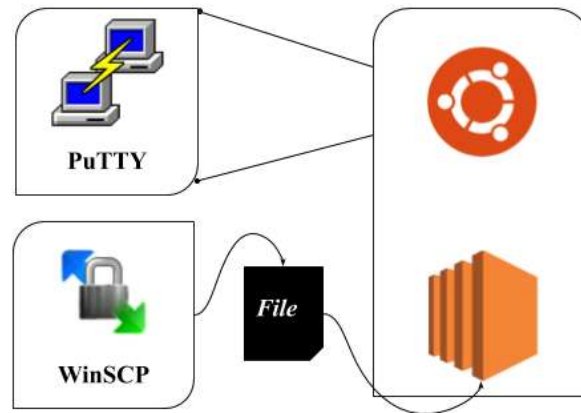

Fig 8. File Projection in Local and Global System