An Undergraduate Internship on Application of RPA in Finance

By

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Dissertation submitted in partial fulfillment for the degree of Bachelor of Science in Computer Science

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Attestation

This is to certify that the report is completed by me, Ahnaf Atef Khan (1730044), submitted in partial fulfillment of the requirement for the Degree of Computer Science and Engineering from Independent University,Bangladesh (IUB). It has been completed under the guidance of Bijoy Rahman Arif. I also certify that all my work is genuine which I have learned during my Internship. All the sources of information used in this project and report has been duly acknowledged in it.

Ahnaf Atef Khan

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Signature   Date

Ahnaf Atef Khan

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Name

Acknowledgement

Letter of Transmittal

May 12, 2022
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Subject: Internship Report Submission Spring, 2022.

With due honor and respect, I, Ahnaf Atef Khan, from Spring 2022, Section 05, would like to submit my Internship report. This report is written to kindly inform you that I have completed my internship program and its report. My internship started on 9th September, 2019, to date. I completed my internship at FernTech Solutions Pvt. Ltd.

This report details my time with FernTech Solutions throughout my internship. Throughout this three-month period, I have worked diligently and to the best of my ability to satisfy the course's requirements and to produce the report according to my supervisor's instructions. This internship program has been extremely beneficial to me since it has provided me with practical experience, which I am confident will help me perform better in my future job.

I'd be delighted if the report I've put together can accomplish its goal. Anytime you have a question about my research, I would be happy to answer it.

Sincerely,
Ahnaf Atef Khan, 1730044

Evaluation Committee

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Supervisor

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Internal Examiner

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Convener

Abstract

This report contains the journey of my internship program with FernTech Solutions, a startup based out of Bangladesh. FernTech offer's products and solutions to enhance not just businesses but also to assist in improving your daily activities. Its services include, but not limited to, Hyper-Automation, Robotic Process Automation, Software Solutions, Industry 4.0 consultancy.

The project was procured from a financial institution, who were eager to implement RPA to offer more streamlined and better services to its customers. They specifically wanted to automate their Account Verification Process. This process was used to acquire new customers by verifying the information they submitted through agent outlets by filling up a physical form. An officer at the agent outlet then had to enter that information into their web application, which would then be reviewed and verified by another officer at the backoffice. This entire end-to-end process required a significant amount of manual labor and was prone to human errors.

To mitigate these problems and increase the rate of new customer intake, the client decided to adopt RPA solutions. We developed a system where every step required to carry out this task in the exact manner was simulated by software robots. This was possible because the steps involved were fixed and repetitive. We offered a dashboard to control and mange these bots. Along with analytics and reports, we also offered provision for a View Live feature which allows the user to view the bots actions in real-time.

Contents

Chapter 1

Introduction

1.1 Overview/Background of the Work

RPA is the use of software to automate repetitive and rule-based tasks using cross-application programs, also called robots. It is used for more than cost savings, as there are several types of tasks in which robots outperform humans - properly programmed robots don't get tired or make mistakes. That is why robots are particularly useful in highly diligent and time-critical tasks.

Financial technology, also known as Fintech, is used to describe new tech that seeks to improve and automate the delivery and use of financial services. In other words, Fintech is the creative application of technology to increase efficiency, reduce costs, and assist the financial industry in its transformation into the digital realm.

The use of robotic process automation (RPA) has many advantages over the traditional workflow in the Fintech industry. However, there are challenges in the implementation of truly integrated systems that could bring business to the next level.

1.2 Objectives

The objective of the project was to automate the Account Verification Process of a financial institution. The as-is process involved repetitive, manual data entry into a web-form which was prone to human errors. Supporting this activity across several branches required a total of 18 FTEs, each of whom took 3-4 minutes. With our solution, we attempted to eliminate the errors, offer high FTE benefits, free the human workforce to allow them to focus on high-priority tasks that require strategic understanding.

1.3 Scopes

Features of the application include but not limited to:

1. Dashboard which can be used as an orchestration tool, allowing full control of deployed bots.

2. Real-time logs generated by bots available on the Dashboard.

3. Bot analytics giving overview of individual bot performance, and process information.

4. View live, which is an application that allows the bots' actions to be viewed in real-time.

5. Software bots that are programmed to replicate human actions according to the specified requirements.

6. License management for each client (organization).

7. Oauth authentication.

8. Report generation by bots, which can be viewed right on the Dashboard and can also be downloaded.

Chapter 2

Literature Review

2.1 Relationship with Undergraduate Studies

1. **CSE 203, Data Structures:** This is the most essential course that helped me understand the concepts and implementations of various data structures, allowing me to design logic and functions for my projects. Among the data structures I learnt included queue, priority queue, and stack. I learned how to design and execute sophisticated sorting and searching algorithms, as well as graphs, through my projects.

2. **CSE 213, Object-Oriented Programming:** Majority of data is perceived as an object. This course has greatly improved in my grasp of object-oriented programming. I studied modularity and abstraction design concepts and patterns in object-oriented programming. I learned about classes, objects, constructors, composition, abstract data types, inheritance, overloading, function chaining, and polymorphism.

3. **CSE 303, Database Management:** This course taught me how to construct and manage databases, which is one of the most crucial components of software development. System Development Life Cycle, Rich Picture, Requirement Analysis, Entity Relationship Diagram, Business Process Model and Notation Diagram, and many more planning and strategy approaches were covered.

4. **CSE 307, System Analysis and Design:** This course reinforced what I had learnt in CSE 303 about the methods and procedures used in the design and analysis of information systems. I learned how to evaluate a system and the many life cycle models for system development. I acquired object-oriented analytical approaches like use-case modeling and unified modeling vocabulary. I also learned how to conduct a feasibility and formal study of a system.

5. **CSE 309, Web Application and Internet:** This is the course where web application development was taught. HTML, CSS, JavaScript, jQuery, View Engines (Handlebars and embedded JavaScript), Node.js, Express.js, and MongoDB were among the technologies addressed.

2.2   Related Works

1. UiPath: UiPath tops the list of RPA vendors, for a myriad of reasons including drag and drop functionalities, support for multiple frameworks, over 300 pre-built automation components, and more. Supporting both web and desktop applications, the UiPath tool is easy to implement and often the first choice for industries, including Banking and financial services. Being amongst the top RPA players, there are hundreds of certified UiPath partners across the globe. Finding the right one for your business isn't easy, as it involves studying and scrutinizing all sorts of features and functionalities.

2. Automation Anywhere: Automation Anywhere offers cloud, and on-premise automation services with advanced security measures, and useful features like real-time analytics. This particular RPA vendor offers a community tool that lets you explore the features, and automate tasks for free- for a certain period of time. Offering a unique combination of intelligent AI components with conventional automation, Automation Anywhere is one of the best RPA tools to work with strings of unstructured data.

Chapter 3

Project Management and Financing

3.1 Work Breakdown Structure

The work breakdown structure (WBS) is a method that breaks a project down into a hierarchy of deliverables, tasks, and sub-tasks. For our project we used the work break down structure in project management because WBS visually defines manageable chunks of a project so that our team can understand, as each part of the work breakdown structure gives further detail. In our WBS, we have used the top-down approach.
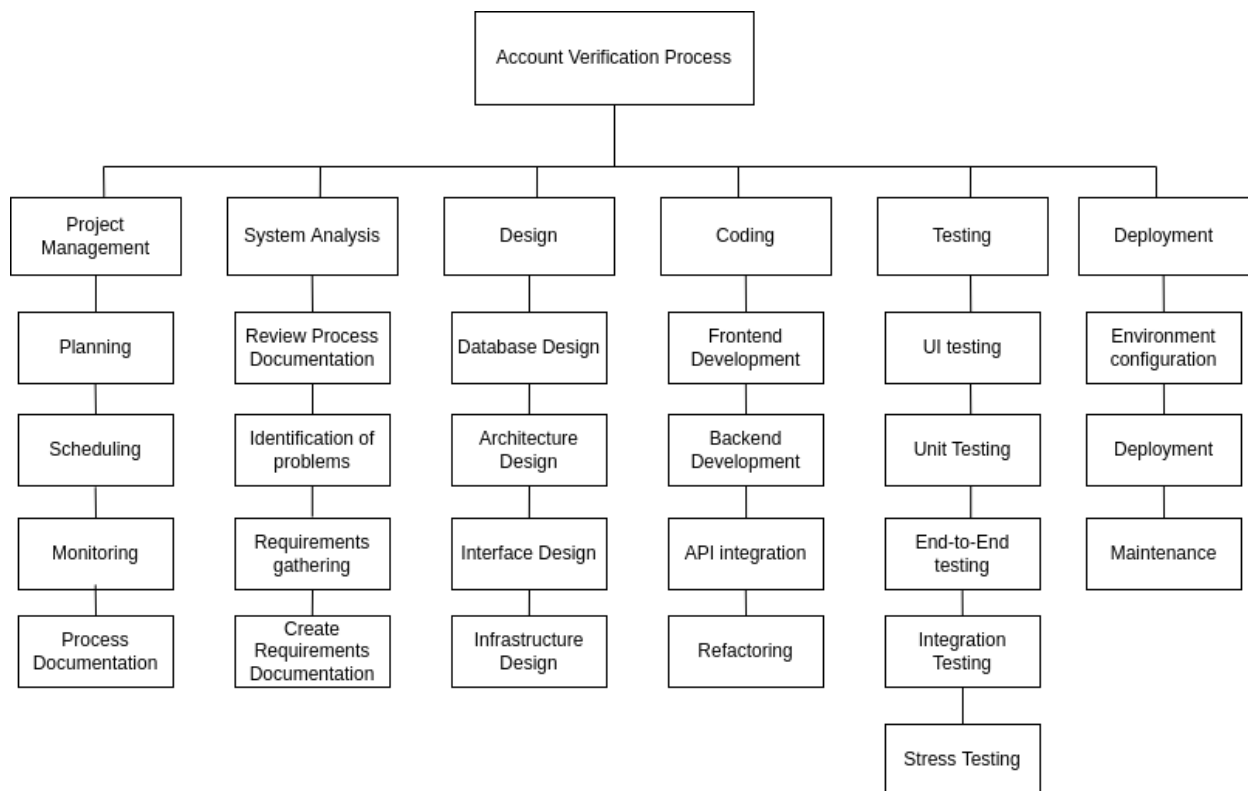

Figure 3.1: Work Breakdown Structure

3.2 Process Activity wise Time Distribution

For each of sub-tasks mentioned in the Work Breakdown Structure time was allocated so that the project completed in the given timeline. This table below shows the time allocations and work percentage of the sub-tasks for the project.

Task	Days	Percentage
Project Management	30	10
System Analysis	20	10
Design	15	30
Coding	30	30
Testing	15	15
Deployment	5	5
Total	115	100

Table 3.1: Work and Time Distribution

3.3 Gantt Chart

The Gantt Chart was used to plan and schedule all the activities that were needed to be done to complete the project successfully in the given timeline.
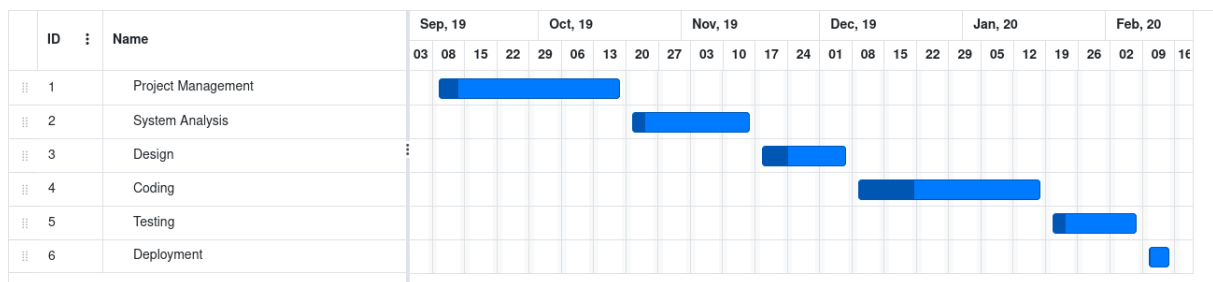

Figure 3.2: Gantt Chart

3.4   Estimated Costing

The application consists of several parts, all of which accounted for a portion of the project's total cost. Besides development cost, there were costs for the usage of third-party services such as, DigitalOcean Droplets, AWS Rekognition, Google Translate API among others.

Area	Cost
Frontend	80,000 BDT/month
Backend	120,000 BDT/month
Servers	3,000 BDT/month
Third-Party Services	Pay-As-You-Go
Total	700,000 BDT

Table 3.2: Approximate Cost Breakdown

Chapter 4

Methodology

A web application, unlike computer-based software programs that run locally on the device's operating system (OS), is software that runs on a web server. The user uses a web browser with an active network link to access web applications.

The Scrum technique was used in the project development process for our project. Agile is an iterative process in which each unit of work should be completed in a limited amount of time (a couple of weeks is ideal). At the end of each iteration, the aim is to provide working functionality to the customer. And, after getting customer input, items are tweaked for the next version. Each of these iterations is referred to as a sprint in Scrum. This is the most important principle in Scrum. Sprints are typically based on the backlog, which is a prioritized list of specifications provided by the product owner.

Throughout the life of a project, the backlog may change. A sprint preparation meeting is held after the backlog is formed to schedule the work to be completed during a sprint. The backlog is dissected and divided into logical units, which are distributed among development team members. To minimize the probability of changes in requirements or priorities, a sprint should last no more than one month. The Scrum master's job is to ensure that everyone on the team is focused and understands their position.

A regular Scrum, which is essentially a 15-minute standup meeting to rapidly review current progress and answer any questions, is normally held after the sprint has begun. The sprint analysis and sprint retrospective periods occur at the conclusion of a sprint and before the start of the next sprint. The first is more concerned with the client, while the other is more concerned with the production team. The Scrum team meets with the product owner and any stakeholders during the sprint review to determine which backlog things have been completed and which are still outstanding.

The backlog and goals for the next sprint are normally changed based on the team's success and exchange of ideas. The Scrum team then meets to discuss the previous sprint's strengths and challenges, and to use the knowledge to adjust and develop the work methodology for the next sprint.

Chapter 5

Body of the Project

The Account Verification Process proposed for automation by our client, in the banking industry, is one which has several stages. The goal of this process is to open bank accounts for new customers. It is done so by filling up a paper form found in each of the agent outlets. After the form has been filled up, it has to be manually entered into the system by the agent outlet officer. Once it has been recorded into the system, the information has to go through several stages of verification. We were tasked with automating the final stage of the verification process. It included cross-verification of several pieces of information that were collected via the form. We developed a system that consisted of a dashboard and a bot.

The dashboard acted as an orchestrator, which was used to control and configure the bot. It had a section for displaying logs generated by bots in real-time, and another section for displaying a table which rendered reports saved as output by those bots. These reports had a predefined structure specified by the client. The dashboard also offered one of the most sophisticated features – the ability to view the bot's actions in real-time.

The bot was a browser based program whose task was to simulate predefined user actions. The bot performed a set of tasks for every account that arrived in the system. It completed these activities in the sequence that the client specified. The tasks included logging into the client's banking system portal, solving a captcha challenge, extraction and storage of text data, downloading and uploading of images, performing facial verification using 3rd party APIs, performing OCR on images to extract data, translating Bangla to English, cross-verifying text data collected from one source against text data collected from another source. If the verification of data succeeded, the account would be marked as verified. In case of failure, the reasons for the failure would be noted, attached as remark with that account and finally be submitted for further review.

5.1 System Analysis

5.1.1 Six Element Analysis

Process	Human	Non-Computing Hardware	Computing Hardware	Software	Database	Communication
Add Bot	Admin	N/A	Computer	Web Browser	RDBMS	LAN/WAN
Add User	Admin	N/A	Computer	Web Browser	RDBMS	LAN/WAN
Start Bot	User	N/A	Computer	Web Browser	RDBMS	LAN/WAN
View Report	User	N/A	Computer	Web Browser	RDBMS	LAN/WAN
Download Report	User	N/A	Computer	Web Browser	RDBMS	LAN/WAN
View Live	User	N/A	Computer	Web Browser	N/A	LAN/WAN
View Analytics	User	N/A	Computer	Web Browser	RDBMS	LAN/WAN

Table 5.1: Six Element Analysis

5.1.2 Feasibility Analysis

Because a feasibility analysis assesses a project's chances of success, perceived neutrality is a critical aspect in the study's credibility with possible investors and lenders. It determines whether the idea is morally, logically, and financially viable, as well as whether it is worthwhile to invest in. For this project, five feasibility studies are being examined:-

1. Technical Feasibility: The primary problems identified in the requirements analysis were the captcha challenge, facial verification, availability of signature on document, extracting text from image and transliteration of Bangla text. The core technologies used in solving the problems were websocket, image processing using OpenCV, Py-tesseract, Google-translate API, and AWS Rekognition API. Some of these technologies are open-source while others are premium services. In our proof-of-concept, we were able to solve of the mentioned problems, among others, using, but not limited to, the technologies listed above. We concluded that the project is technically feasible.

2. Economic Feasibility: As most of the supporting services will be hosted on the cloud, there is going to be associated hosting cost. In addition, some of the services or third-party APIs are premium services which means usage of those would incur costs. We incorporated all these the costs in the final price which we charged our clients. This makes the project economically feasible.

3. Legal Feasibility: All the legal constraints have been considered before proceeding with this project which includes data protection acts, social media laws, or zoning laws so that it does not face any legal constraints in the future.

4. Operational Feasibility: The application has 3 main components, the dashboard, the backend, and the bot. It has been structured in a way so that any additional

requirements can be easily accommodated for with minimum difficulty. The user facing component of the application is the dashboard. It provides a very sleek and intuitive User Interface making it very easy to achieve the crucial tasks.

5. Schedule Feasibility: For a project to be successful it is important to deliver it in a timely manner. The project deliverables and deadlines are scheduled strategically so that we can go in production in time as promised.

5.1.3 Problem Solution Analysis

There were several challenges and problems that we ran into while developing the application. Among those were:

1. Captcha Challenge: Logging into their portal required solving an image captcha challenge. We then had to develop a solution that allowed the user to intervene the bot's operations briefly to solve the captcha in real-time. This was achieved using a websocket application that facilitated real-time communication between the Bot and the Dashboard.

2. Facial Verification: One of the use cases involved taking three images of the customer and checking whether the same person exists in both the images. Two out of those three images are present in the portal, the third image has to be download from a different portal, then concatenated with the second image. Then the first image (the source image) and the concatenated image had to be sent to AWS Rekognition for facial verification.

5.1.4 Effect and Constraints Analysis

As our client was a financial service provider, security was of utmost importance to them. As a result we had to develop and test the application on-site. We were given a test environment for development and a production environment for live deployment. Once the pandemic hit, they had to make arrangements for remote development. This had both positive and negative aspects. It was beneficial in the sense that we could now work on projects from home, but the lack of in-person communication caused issues such as not being able to acquire clear guidance in the event that certain business requirements were unclear.
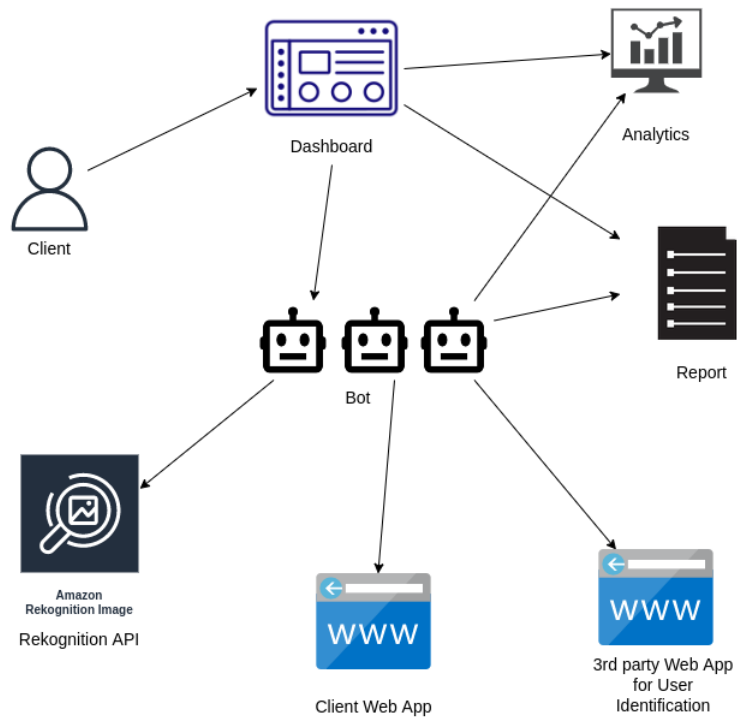
5.2 System Design

5.2.1 Rich Picture

Figure 5.1: Rich Picture

5.2.2 UML Diagrams

Use Case Diagram

Figure 5.2: Use Case Diagram
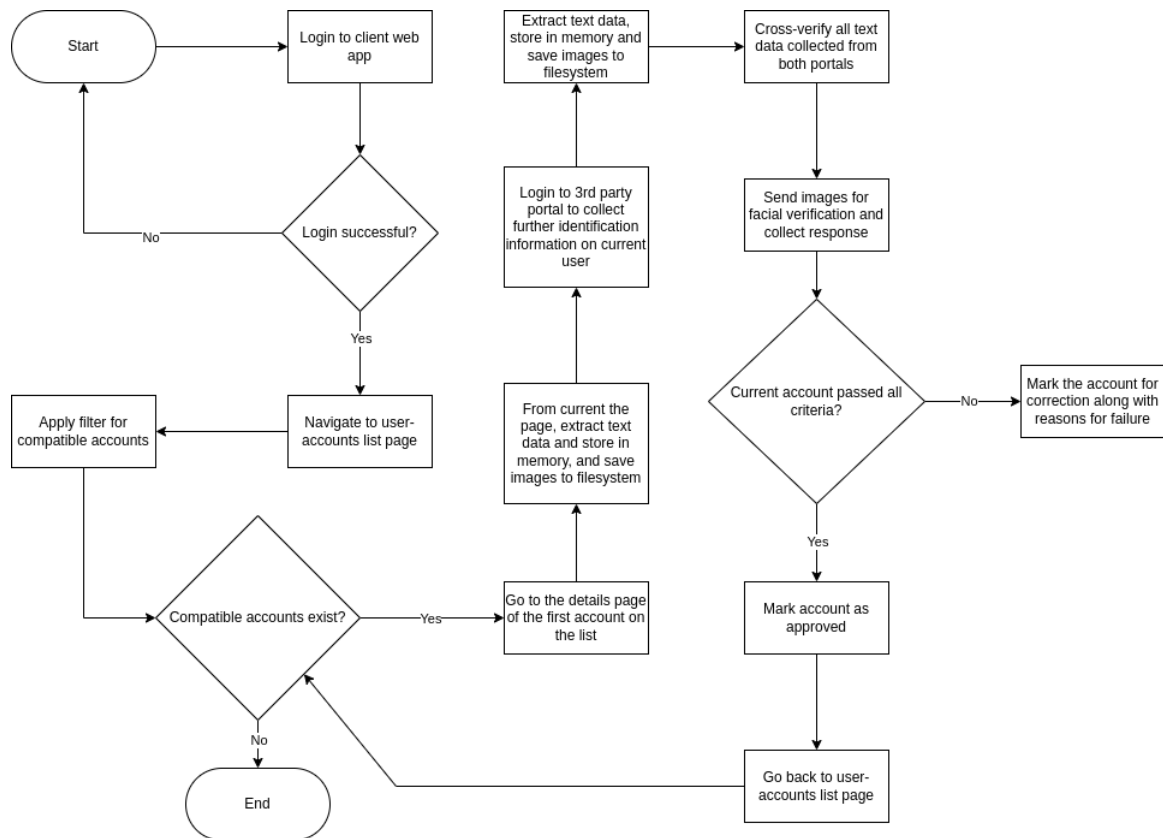
Flow Chart - 1

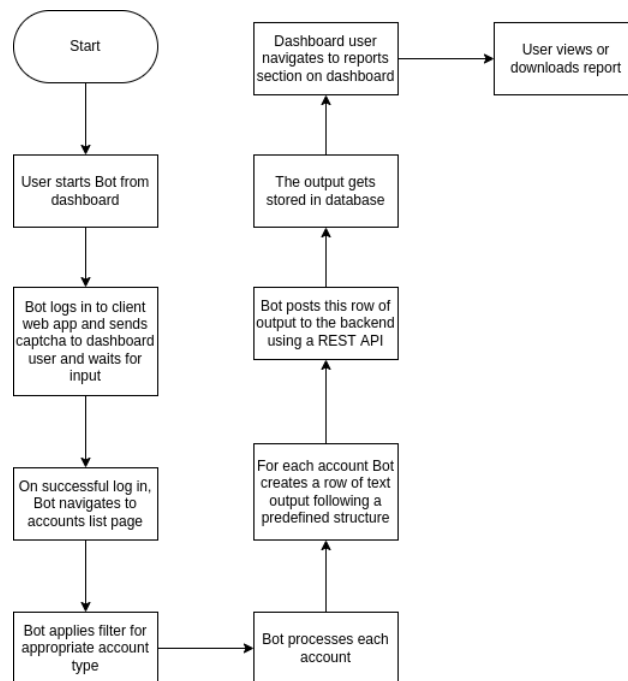Figure 5.3: Account Processing Flow

Flow Chart - 2

Figure 5.4: Report Generation Flow

5.2.3 Functional and Non-Functional Requirements

Function: Add Bot		
Input: Bot name, Organization name	Process: Adding a Bot	Output: Bot shows up on Dashboard
Pre-condition: User must be admin		
Post-condition: Bot should be viewable and interactable from Dashboard		

Table 5.2: Adding Bot

Function: User Login		
Input: Email, password	Process: Signing in user	Output: User is logged in to Dashboard
Pre-condition: User must be registered		
Post-condition: User should be able to view the Dashboard homepage and interact with all its features		

Table 5.3: User Sign in

Function: Start Bot		
Input: Start Button	Process: Starting a Bot	Output: Bot begins taking actions
Pre-condition: User must be logged in and Bot must be registered		
Post-condition: Bot performs predefined actions according to client requirements		

Table 5.4: Starting Bot

Function: View Report		
Input: Date Range	Process: Viewing report for a specified timeline	Output: Render report on Dashboard in a table
Pre-condition: User must be logged in and there must be at least 1 Bot which generates reports		
Post-condition: User should be able to interact with the table which renders the reports		

Table 5.5: Viewing Report

Non-functional Requirements

1. **Performance and Scalability:** The Dashboard has been optimized for fast performance. This was possible due to a good database design since query results were returned fast. The performance of the Bot will only be as fast as the performance of the client web application and network conditions. The core backend is made scalable by deploying multiple instances of the application and placing it behind a reverse proxy such as Nginx, which handles requests concurrently.

2. **Portability and Compatibility:** The application is web-based and it can run on any device, whatever the size. The UI is responsive, it automatically adjusts to the screen size of the viewing device.

3. **Reliability and availability:** The core backend has been deployed on DigitalOcean which is one of the leading providers of Infrastructure as a Platform. The responsibility of being reliable and ensuring availability has been delegated to DO.

4. **Security:** Any connection made to the Dashboard is encrypted using TLS protocol. Encryption makes it difficult for unauthorized people to view information traveling between computers. All communications between the Bot and the backend service is also encrypted using asymmetric encryption. Therefore all data exchange is secure.

5. **Usability:** The Dashboard is made intuitive in order to ensure maximum user satisfaction.

5.3 Product Features

5.3.1 Input
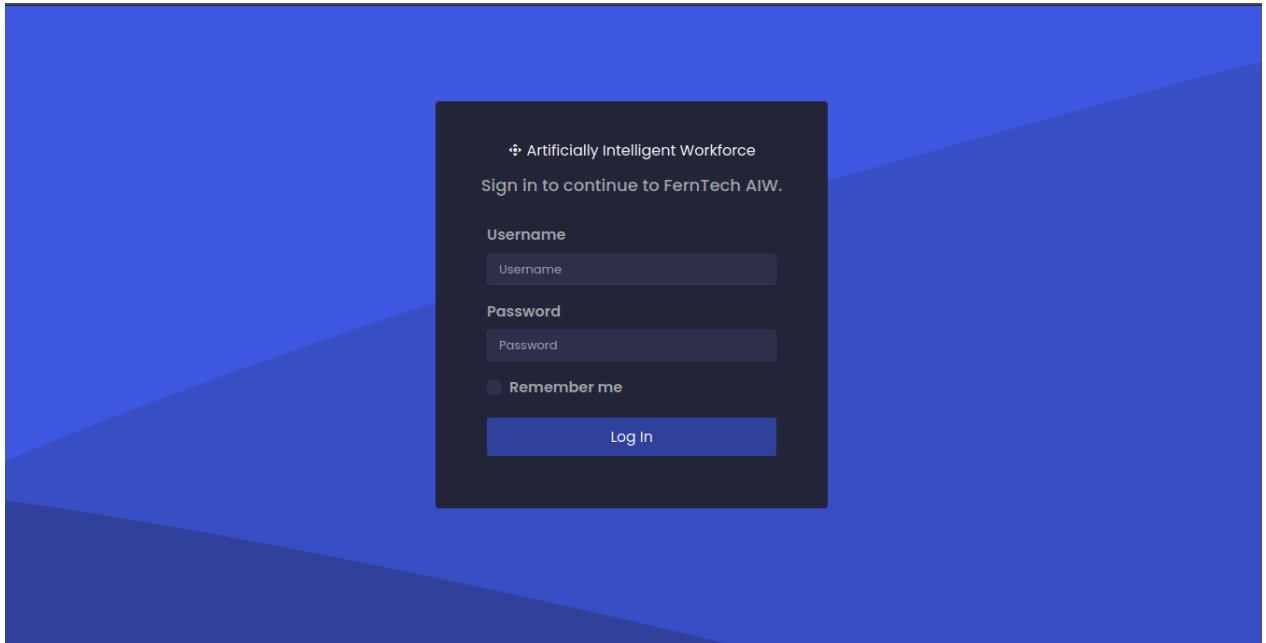
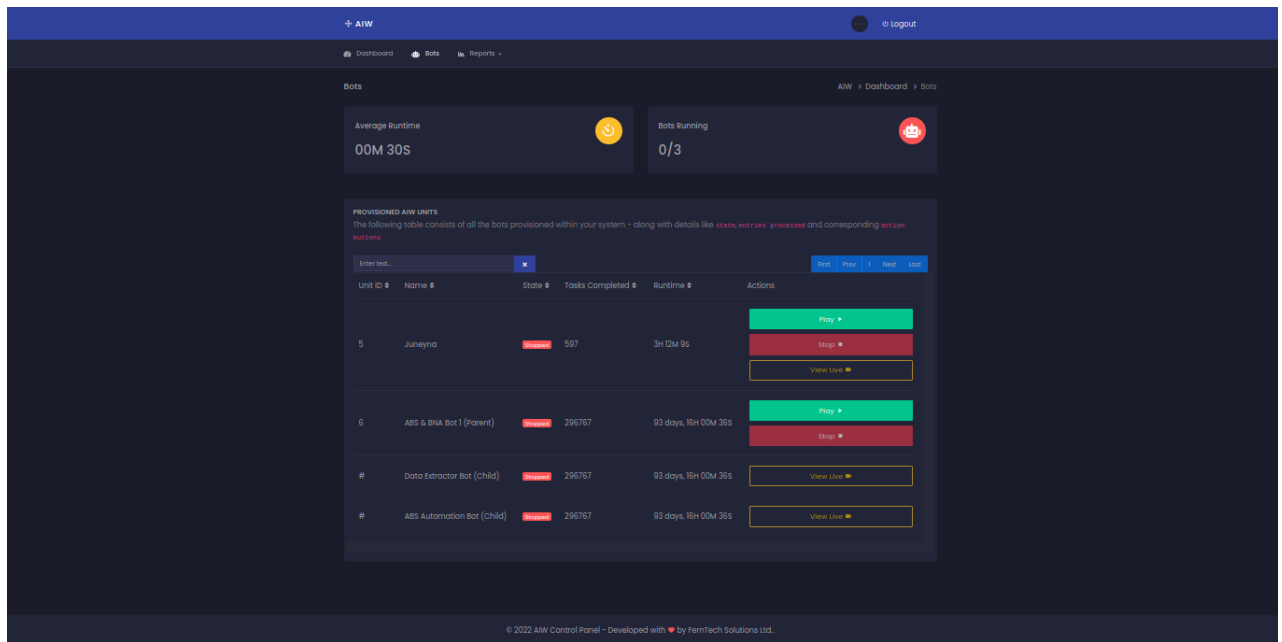Figure 5.5: Login Screen
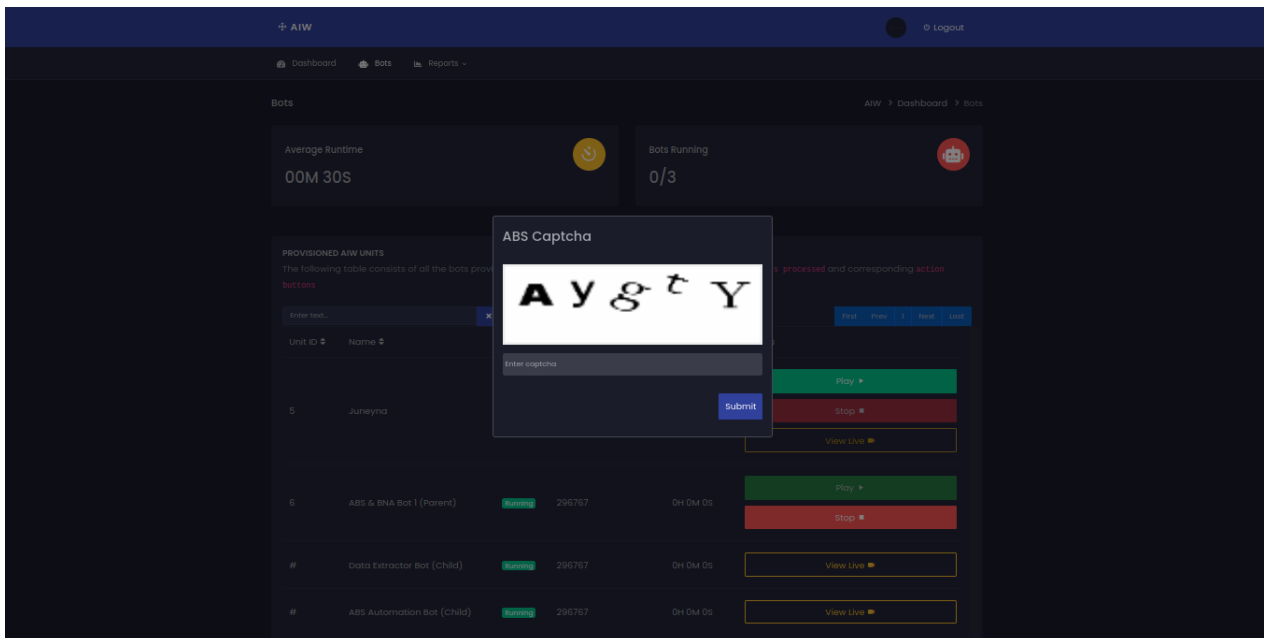
Figure 5.6: Captcha Input
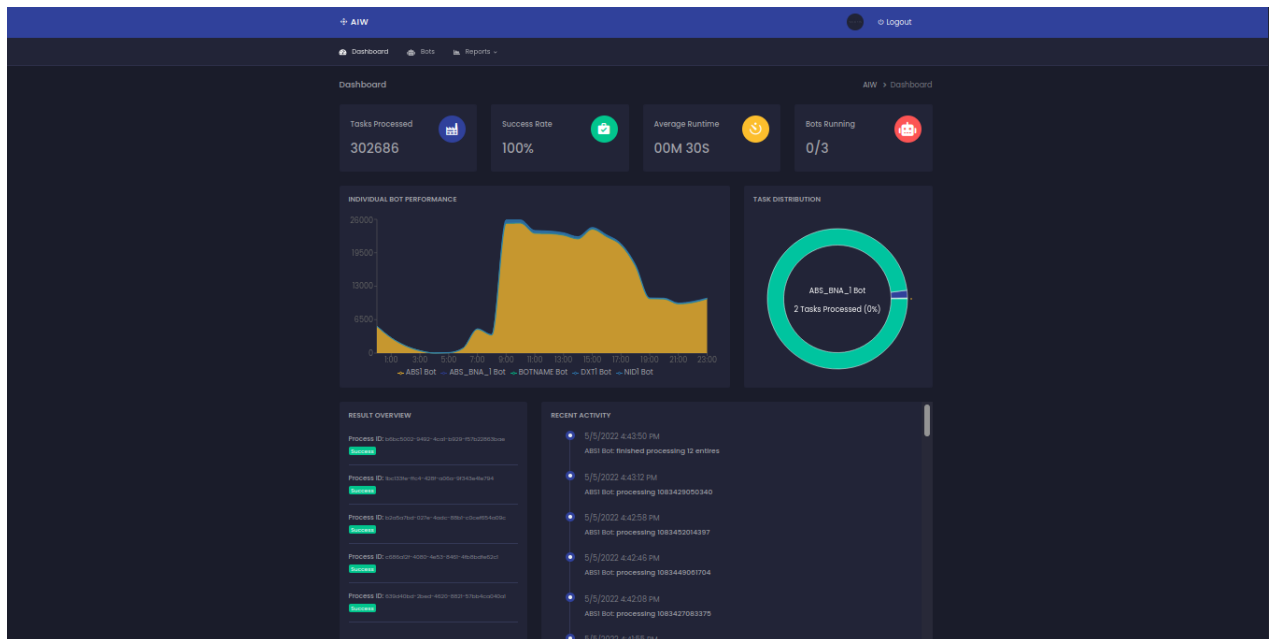
Figure 5.7: Bots Page

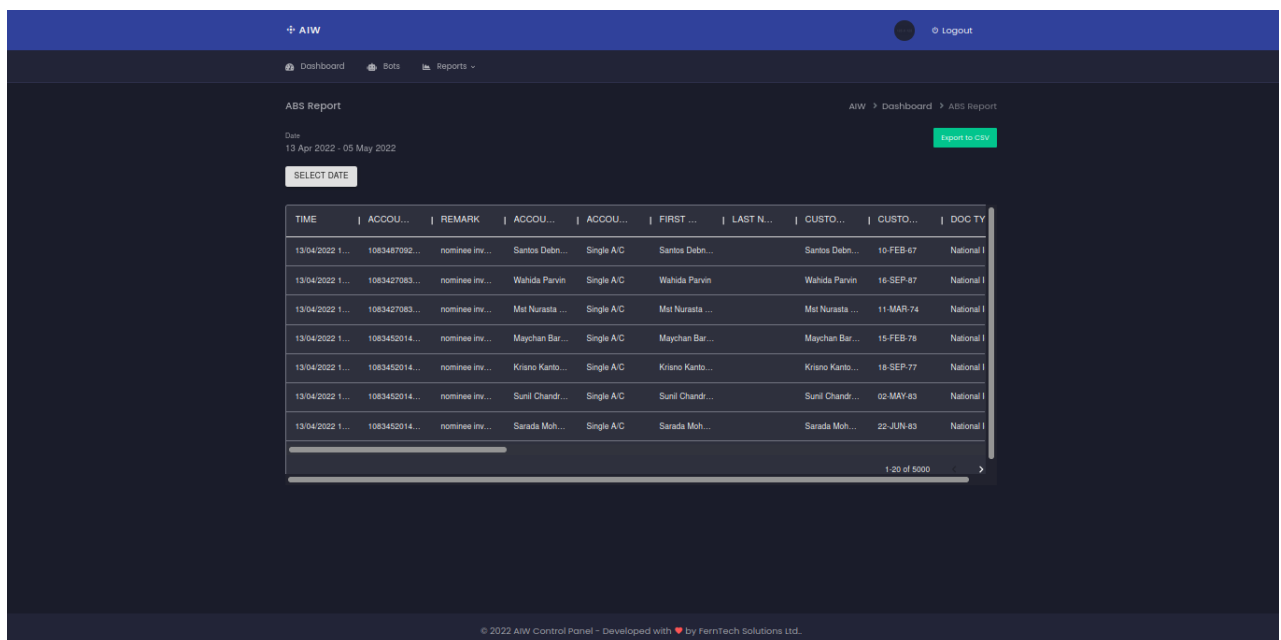## 5.3.2 Output

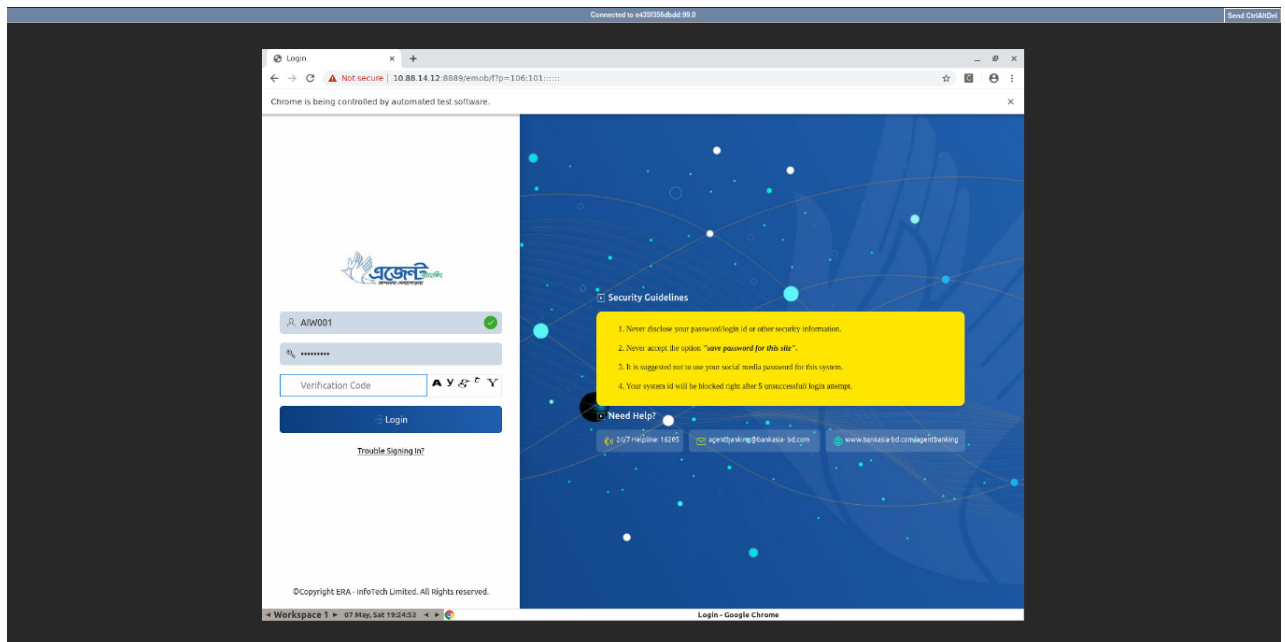Figure 5.8: Dashboard - Homepage

Figure 5.9: Reports

Figure 5.10: View Live

5.3.3 Architecture

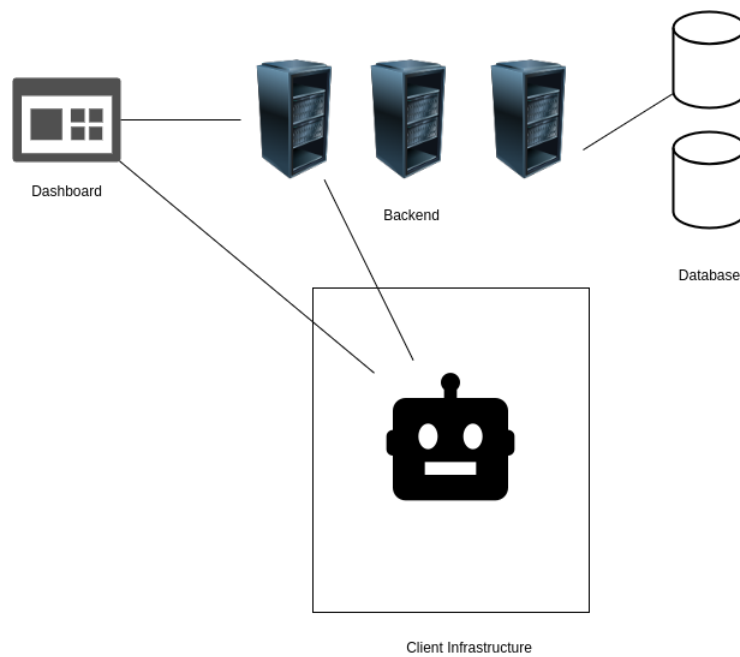

Figure 5.11: Application Architecture

Chapter 6

Results and Analysis

The finished product is an end-to-end system that enables its users to carry out the Account Verification Process in an automated manner. The bot that carries out the tasks is attended, which means it operates on the basis of human-bot collaboration. In other words, this class of bots are used as a means to boost productivity by helping an individual employee with their tasks. A user of the system first logs in to the Dashboard using their credentials. They land on the homepage which displays sections containing analytics, real-time logs generated by bot, number of currently running bots, graphs and charts giving a visual sense of the data, and links to other parts of the dashboard. There is a screen where all the bots can be found in one place. This is the screen where the bot is controlled from. The View Live feature, which gives real-time visuals of the bots' actions, is available for each deployed bot. There is also a report section where output reports generated by bots can be viewed and downloaded.

The system is used on a daily basis, even beyond working hours, since the dashboard can be viewed from anywhere and any device. The bot can be controlled at anytime of the day. Even on weekends.
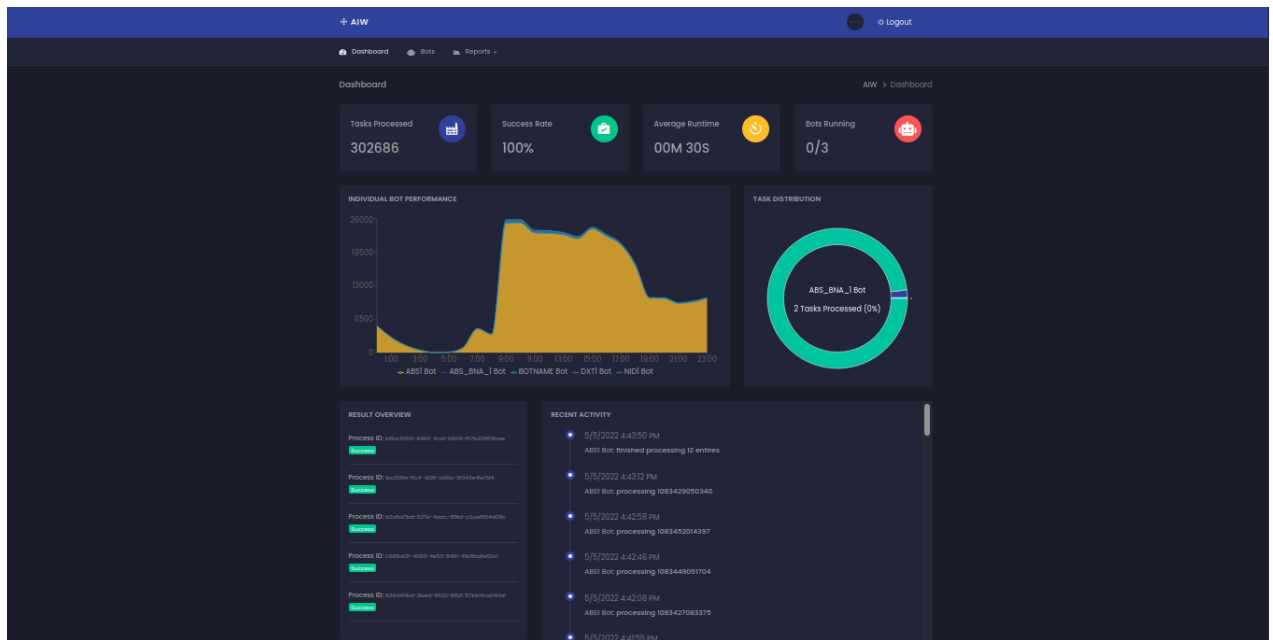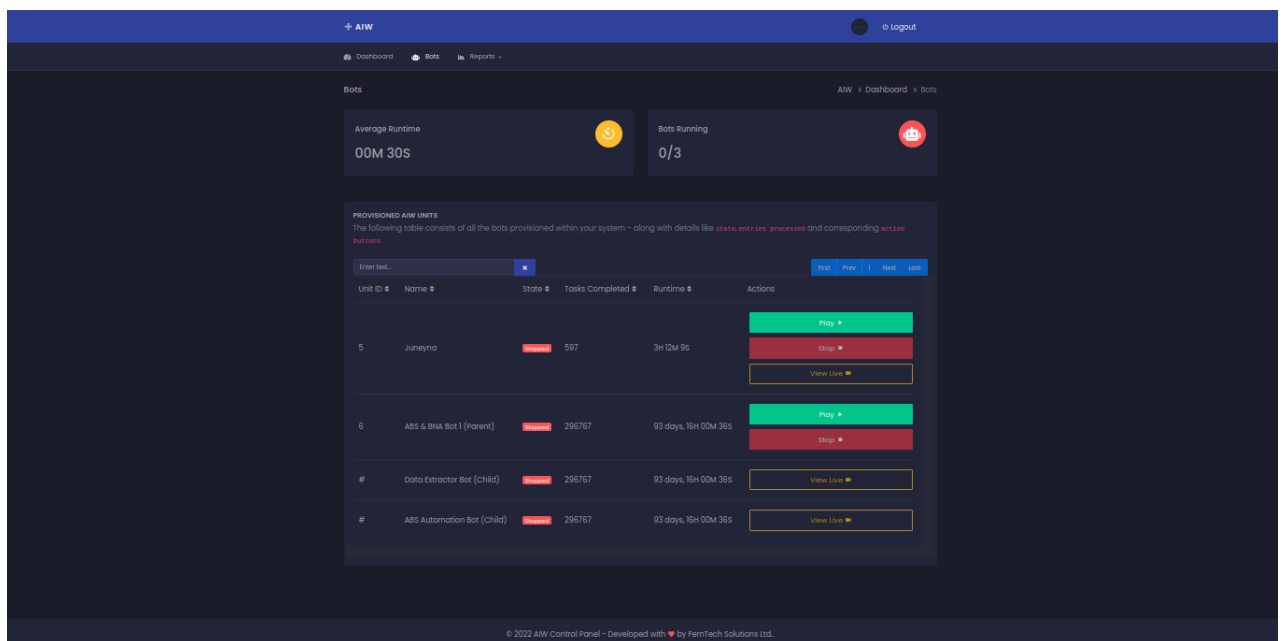
Figure 6.1: Homepage

Figure 6.2: Bots

Figure 6.3: Reports

Chapter 7

Project as Engineering Problem Analysis

7.1   Sustainability of the Project/Work

The sustainability of the product refers to its ability to be maintained and updated. In the modern world, every application or website being released needs to be maintained and continuously updated for its user base.

The Dashboard is made in a user friendly way and easy to navigate. The Dashboard's aesthetics are added to provide the ultimate viewing satisfaction to user.

Even though the bot logic is built-in and not modifiable, through a change request the bot can be updated to reflect the new requirements.

7.2   Social and Environmental Effects and Analysis

The application allows its users to operate it from anywhere as long as they have decent internet connectivity. In light of the pandemic, a provision as such has immensely benefited the clients and helped maintain their business growth and customer retention rate.

7.3 Addressing Ethics and Ethical Issues

In the world of smartphones with so much data collection, hacking, cybercrime, etc. there are some unspoken rules and ethics guidelines that need to be followed when working on creating and releasing an application of this scale. The developers made sure there was no breach of conduct and all the points were taken into serious consideration. Some of them are as follows:

1. **Collecting only relevant User data:** The application only collects user data that is needful, like the name and email address.

2. **Data Storage Security:** Only the admin has access to the backend server and database. Since they are hosted in the cloud and can only be accessed via the admins login credentials; the data stored can be deemed safe and secure.

Chapter 8

Lesson Learned

8.1 Problem Faced During this Period

The biggest challenge I had was dividing my time between university coursework and the internship. I had tight deadlines for my tasks at work and very tight deadlines for coursework. On top of that I had to commute from home to university to work and back. This was very tiring as the traffic was always high.

Apart from that, the application we were developing had several components. The bot component was required to simulate user actions on their internal web application. This was not publicly reachable, it was only hosted on their intranet. Initially, we went to their premises and from within their network, downloaded the web pages so we could develop and test the bot from our office. However, this was not a sustainable approach as we later discovered that a web page hosted on a server works quite differently from one that is saved to the disk.

We then continued to go to the client's premises to develop and test the bot.

8.2 Solution of those Problems

When the pandemic hit, all operations had to be halted as per the government's directive. This was a major setback as we could no longer go to their premises to work. Later arrangements were made to allow access to their intranet application through remote ssh access. This allowed us to continue to develop from the comfort of our office and later our home.

Chapter 9

Future Work and Conclusion

9.1 Future Work

We have re-branded ourselves as Artificially Intelligent Workforce (AIW) and we are building our very own automation platform with its own ecosystem powered by blockchain technology. Our platform aims to enable users to create their every day process flows once and then replay it as many times as needed. We have a dashboard as an orchestration tool, within which can be found a myriad of other services that can be utilized together to solve an organizational automation problem.

9.2 Conclusion

FernTech has been the breeding ground for my ideas. It is where my passion collided with opportunities, where the key metric for growth is innovation. I got the chance to work with bleeding-edge technologies while working here. I've gained knowledge about software engineering principles and best practices, enhanced my professional communication abilities, and developed a sense for problem solving.

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