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Chapter 1 Introduction

1.1. Overall Description

In simple words, the purpose of a chatbot is to understand your needs and provide answers according to your needs. A simple chatbot searches for common keywords, looks up a predefined list of answers, and allows you to provide answers at your request. Modern Chatbots, on the other hand, use AI, machine learning, and natural language processing (NLP) to understand user requests and their intent so they can provide the right answer. Chatbots are considered a useful technology for facilitating learning in an educational context [1].

Educational institutions are evolving day by day and we want to evolve to provide the best equipment to our users. So they make their campus smarter, it's smarter. Today, smart campuses are challenging and foster an environment where everyone can interact with other students and staff, so you can fully focus on students and their improvements.

The basic principle of a chatbot is to interact with a human user (in most cases) via text messages, understand the conversation, and reply as if they were able to respond appropriately. [2]. The origin of communication between computers and humans is as old as computer science itself. In fact, in 1950, Alan Turing defined a simple test, now known as the Turing test. For each text, tell if it is a computer program [3]. However, the ambitions of this test are much greater than the usual use cases for chatbots. The main difference is the low domain knowledge of the chatbot, but the Turing test assumes that you can talk to the agent on any topic. This is useful for designing conversational agents. Conversational agents do not need to have (potentially) infinite domain knowledge and can therefore focus on certain very specific topics, such as helping users book a table in a restaurant.

1.1.1. Objectives

The use of text classification [4] for the creation of a user-friendly Chatbot, interactive and efficient web application is one of the key motivating factors. The objectives of our project are as below:

- To provide quick response to save the time of student as well as save the resources.
- To provide good and fast web browsing experience.

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- To provide a platform where a student can complain or talk about what they need.

1.1.2. Problem Description

In this modern era of technology, Students want to save their time instead of visiting the Universities to get some kind of information. Because the Traditional ways are, time consuming, as the students have to visit the university personally. It would be much more time saving if the student can obtain that information by staying at home and just visit our web application. Where will be our Chatbot to answer his all questions.

1.1.3. Methodology

This section describes the proposed solution and the datasets and machine learning algorithms used. First, we will collect a dataset, process the data, and use this dataset to train our model. This involves collecting all relative data and extracting important features from the data.

1.1.4. Product Scope

We are going to develop a website that can be student friendly and will be easy to use for every one. This website will provide ease of access to the students who want to join the institution and also help the newly registered students to explore about the institution.

1.1.5. User Classes and Characteristics

➢ **Users**
- Users can access the web application.
- Users can get the information from the chatbot.

➢ **Admin**
- Admin can grant and revoke privileges of user.
- Admin can manage the chatbot.

1.1.6. Operating Environment

Our project has two main modules. For the first module, chatbot. We will first collect the dataset, then train and improve this by applying machine learning algorithm on it, then we will test and improve this system again. The second module (web application) is intended to be user-friendly.

1.1.7.   Assumptions and Dependencies

- Dataset sample size is very important
- Chatbots answer specific questions, not all questions.
- Similarly, the chatbot's language will be English, so users should be able to understand this easily.

1.2.   External Interface Requirements

1.2.1.   User Interfaces

We plan on using JS and Html for the final front-end user interface. Which is user friendly and easy to use and fast as well.

1.2.2.   Communication Interfaces

Rest API

1.3.   System Features

Our project has two main modules. For the first module, chatbot. We will first collect the dataset, then train and improve this by applying machine learning algorithm on it, then we will test and improve this system again. The second module (web application) is intended to be user-friendly.

- Chatbot
- University Web Application

1.3.1.   System Feature 1: Chatbot

It is a user-interacting system where users interact with the system using the latest NLP technology and machine learning algorithms, as well as datasets that solve their questions.

1.3.2.   System Feature 2: University Web Application

The second module allows users to interact with the chatbot. This module is written with HTML JS and it is very fast, providing the user with a quick and interactive interface.

1.4. Nonfunctional Requirements

Non-functional requirements are related to system constraints or limitations. This includes urgent system properties such as reliability, response time, store occupancy, platform, implementation method, and tools. Below are some non-functional requirements.

1.4.1. Performance Requirements

All data used to train the model must be up-to-date and the speed must match the user's requirements.

1.4.2. Safety Requirements

Our project is a machine learning based project. Our goal is to provide the right information to our users.

1.4.3. Security Requirements

Data security is our number one priority, and security is our number one priority when designing our system.

1.4.4. Software Quality Attributes

Real-Time details available

1.5. Report Structure

For Literature Review please read Chapter 2.

For a System Design go through section 3.

For Implementation read Chapter 4.

For Testing read Chapter 5.

For conclusion and Future Work please read chapter 6.

Chapter 2 Literature Review

2.1.   Introduction

The main users of automated chatbots at the university are university administrators, teachers, and students. The system is designed using machine learning and NLP to answer student questions. This is very helpful for students. Students have easy access to information, saving students time and effort.

2.2.   Related Works

Below are some popular chatbots that are used for the same purpose. Their features and specifications are described for analytical and comparative purposes.

- Agent Bot
- Genie App
- Botsify Chatbot

2.2.1. Agent Bot

Agent bots talk to users like people. Aivo's conversational engine provides user services in multiple languages [5]. Its diverse artificial intelligence technology can interpret informal languages, errors, regionalism, pictograms, and voice messages for unstructured communication.

2.2.1.1 Terminology

The University (Universidad Siglo 21) has implemented a virtual psychological partner to support undergraduates with daily inquiries about life at the university and campus. The administration also supports the second student with inquiries about the content of the course. Arrangement uses AIVO's dedicated bot (agent bot). This is a great example of how to use subjective management to support undergraduates, educators, and groups on the premises.

2.2.2. Genie App

The Genie app is part of Deakin's Digital Frontier for excellence in education [6]. This gives students easy access to their timetables, results, credit information, and various answers to common student questions. This personal assistant in your pocket will make life on campus easier.

2.2.2.1 Terminology

Deakin University (Genie App) has developed an intelligent personal assistant to support student learning. The ability to connect to different terrain datasets enhances Genie's ability to provide on-demand assistance for all terrain surveys. The application also supports discourse-to-content and content-to-discourse collaboration.

2.2.3. Botsify Chatbot

Botsify is an AI-based chatbot where students and teachers interact. Bots simplify the interaction between teachers and students. Students choose from many educational topics to study[7].

2.2.3.1 Terminology

Botsify allows students to learn topics through conversation. This allows you to learn complex topics one step at a time faster. The bot provides images, videos, and text on the topic. Students can then learn and answer quizzes. The grades are presented to the teacher, so the teacher's work will be less difficult.

2.2.4. Categorizing the Existing Techniques/Works/Researches

All features of the related application are described in detail for analysis and comparison purposes. Both AgentBot and GenieApp are artificial intelligence-based bots that cover course content queries and provide students with easy access and convenience, but do not connect students to management. Botsify connects students and teachers to help them learn complex topics step by step, but there may be other questions, so other information that students may need. Will not be explained.

2.2.5. Limitations/Gaps within Existing/Works

After comparative study the limitations of existing applications are as follows:

- AgentBot and GenieApp do not connect students to administrators.
- Botsify provides interaction between students and teachers, but does not provide information about the extracurricular activities that students want to do..

2.3. Proposed Improvements in Existing Works

Chatbots are built using Python with machine learning algorithms and NLP and implemented in web applications using JS and HTML. The goal of our project is to provide students with the maximum amount of information with minimum amount of effort they need to simplify their lives and focus on their studies without worrying about other things, and make their campus experience fun.

2.4. Comparative Analysis

Table 1: illustrates the comparative analysis of existing Chatbots with our Chatbot

Features	Agent Bot	Genie App	Botsify	U.A Chatbot
Artificial Intelligence	✓	✓	✓	✓
NLP	✓		✓	✓
Machine Learning	✓	✓	✓	✓
Text Processing			✓	✓
Integration to messaging platforms		✓		✓

2.5. Summary

The purpose of this document is to provide a detailed analysis and comparative study of chatbots and existing applications related to chatbots. Features and specifications are described for comparison. It also describes the unique features of the chatbot that are focused on, which makes it different from the other chatbots described in the documentation.

Chapter 3 System Design

3.1. Introduction

3.1.1. Purpose

This document highlights the overall design of the student-oriented machine learning-based web application "Chatbot" and goes into more detail aboutthe workingof chatbot and its implementation process.

3.1.2. System Overview

The System has the following features:

The person can access the web application through a browser. Once opened, the person can go to the chatbot and have a conversation. Chatbots are trained using machine learning algorithms and NLP to understand and respond to human needs.
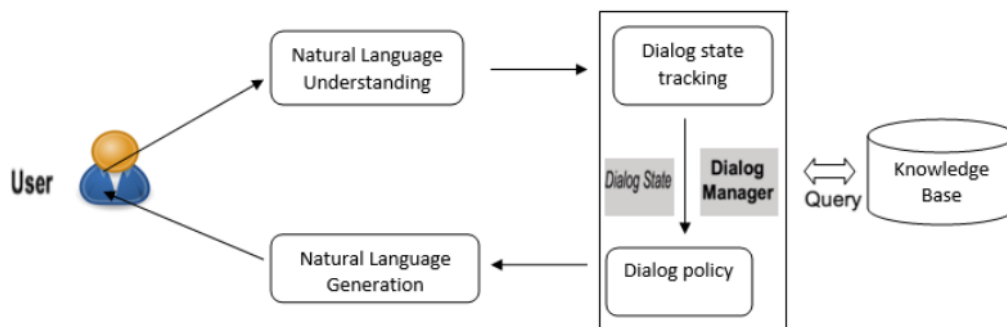
3.1.3. Design Map

Figure 1: System Architecture

3.2. Design Considerations

3.2.1. Assumptions

The system works with any browser. Web applications are basically browser dependent. Web applications do not require a special server to store the database. The user has a mobile phone or laptop and is expected to have a good internet connection enough for the web application to work well. It is assumed that the user has basic operational knowledge of smartphones and laptops.

Graphic design of web applications is also done by skilled designers who have technical know-how and are available.

3.2.2. Constraints

The correct functionality of an application can be seriously affected by the Internet. Web application-based chatbots can be affected by factors such as browsers and user understanding.

3.2.3. Risk and Volatile Areas

The intended system is completely secure and does not cause any user-specific harm. Therefore, at this time, no significant safety precautions need to be taken. The product is absolutely safe to use.

3.3. Architecture

3.3.1. Overview

Web application-based chatbots are machine learning and NLP-based systems. It understand the query and answer the query according to the dataset and trained techniques. All these steps are interrelated and work in harmony.

3.3.2. Subsystem, Component, or Module Web-App

User: A user is someone who interacts with the system. Subsequent operations depend on user input.

GUI Model: It is responsible for how the user interacts with the system. It is the screen which first appears on the browser.

Identification: The System then encompasses the user with the Chatbot.

A **Feed Forward Neural Network**[8] is an artificial neural network in which the connections between nodes do not form a circuit. The opposite of a feed forward neural network is a recurrent neural network in which a particular path circulates. Feed forward models are the simplest form of neural networks because information is processed in only one direction. Data can pass through multiple hidden nodes, but it always moves in one direction, not the other.

3.4. High Level Design

3.4.1. Main View

Our web application is specially designed for new students, so the GUI is kept as simple as possible. Keep it simple, the principle applies. At the bottom of the screen is a chatbot that users can access. We will provide appropriate support according to the needs of users.
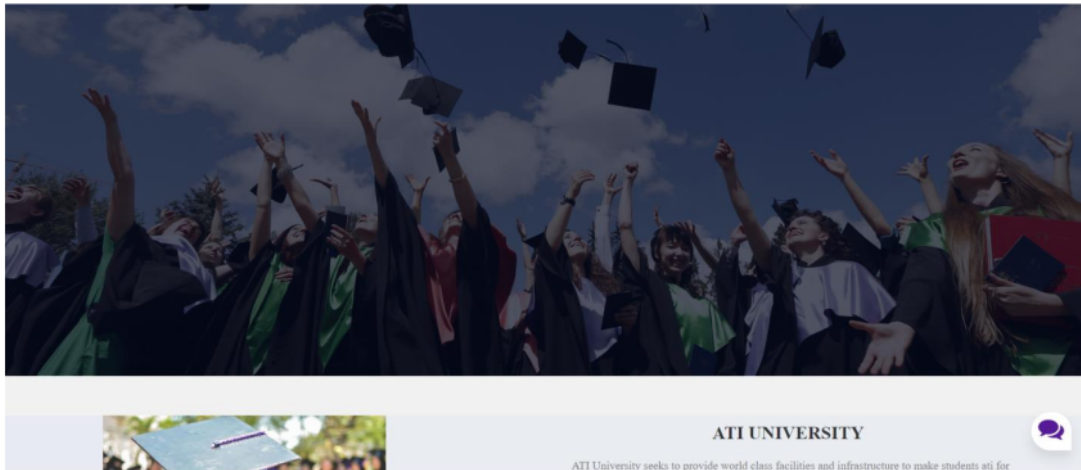

Figure 2: Main View

3.5. Low Level Design

It uses the FFNN and Neural Network [9] for the text classification also it employees the techniques of NLP to understand the queries of user.
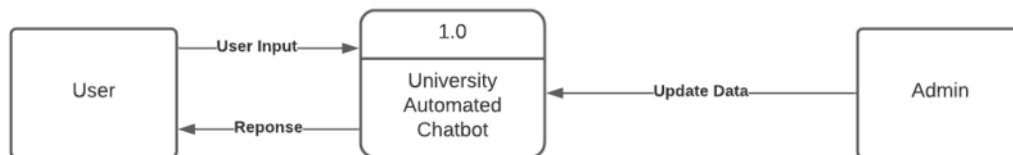
Context Free Diagram:

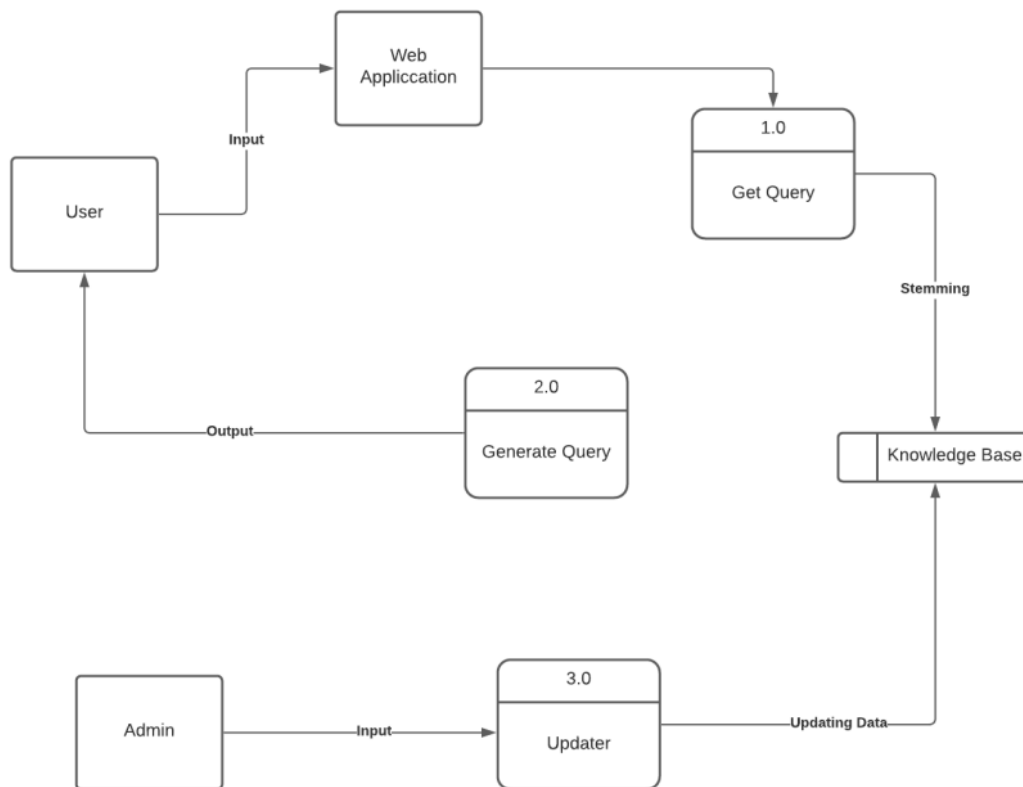**Figure 3: Context Free Diagram**

Dataflow Diagram Level 1:

Figure 4: DFD Level 1 Diagram
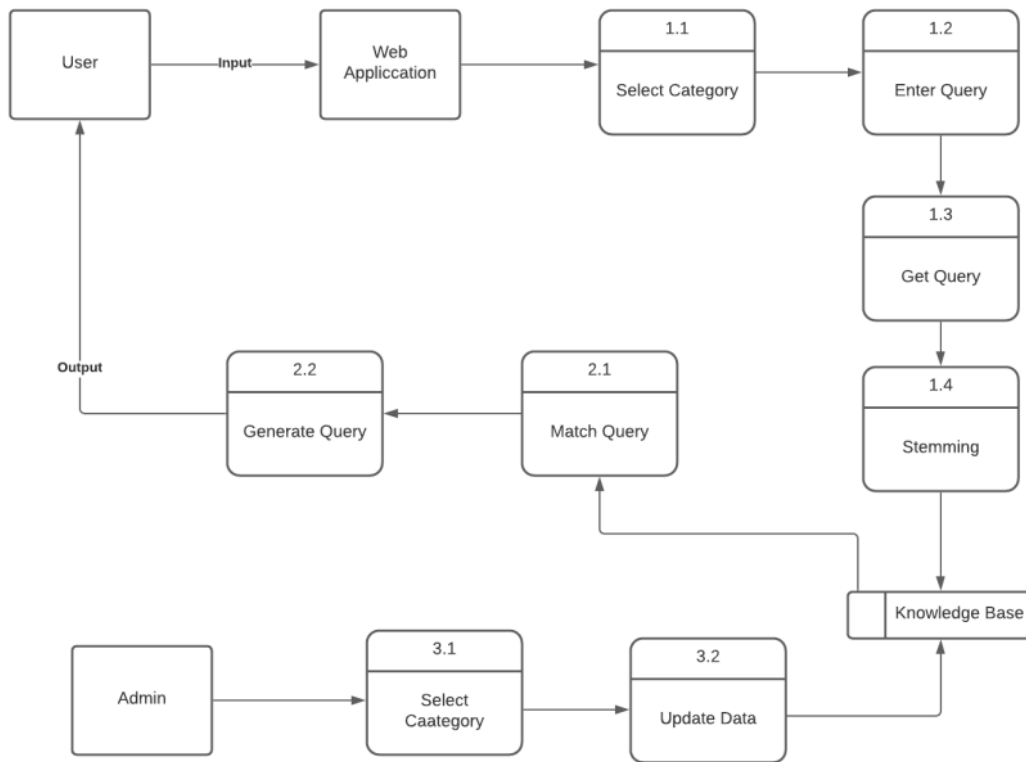
Dataflow Diagram Level 2:

Figure 5: DFD Level 2 Diagram

Usecase Diagram:
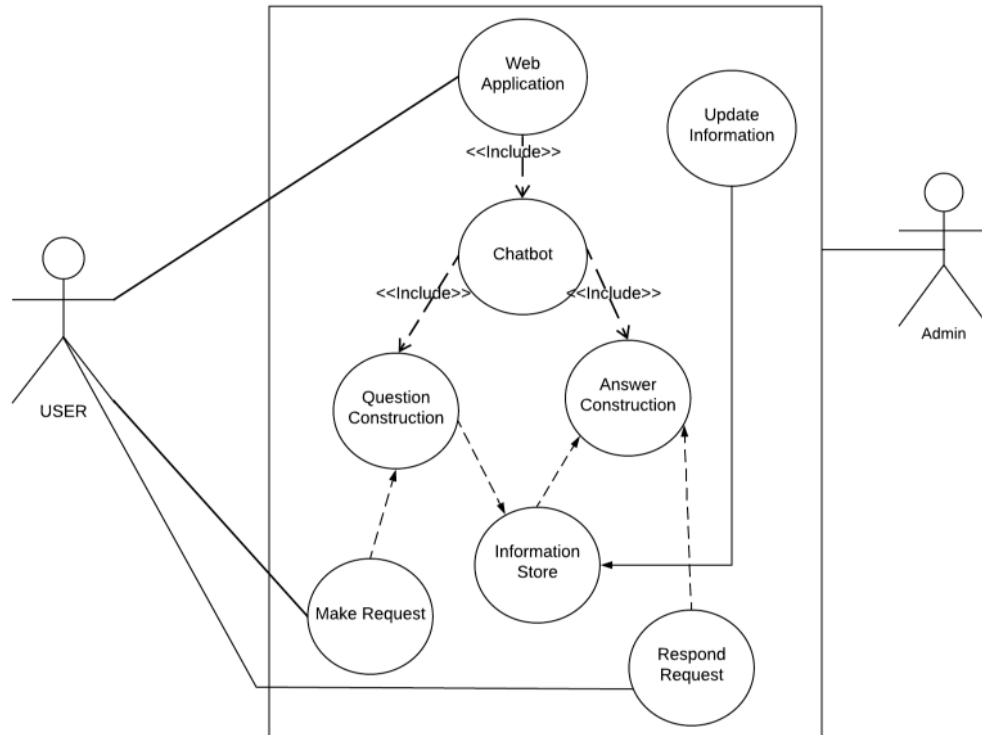
Figure 6: Use Case Diagram

Sequence Diagram:

User   Web Application   Chatbot   Database

Send Request

Process Request

Retrieve Information

Send Information

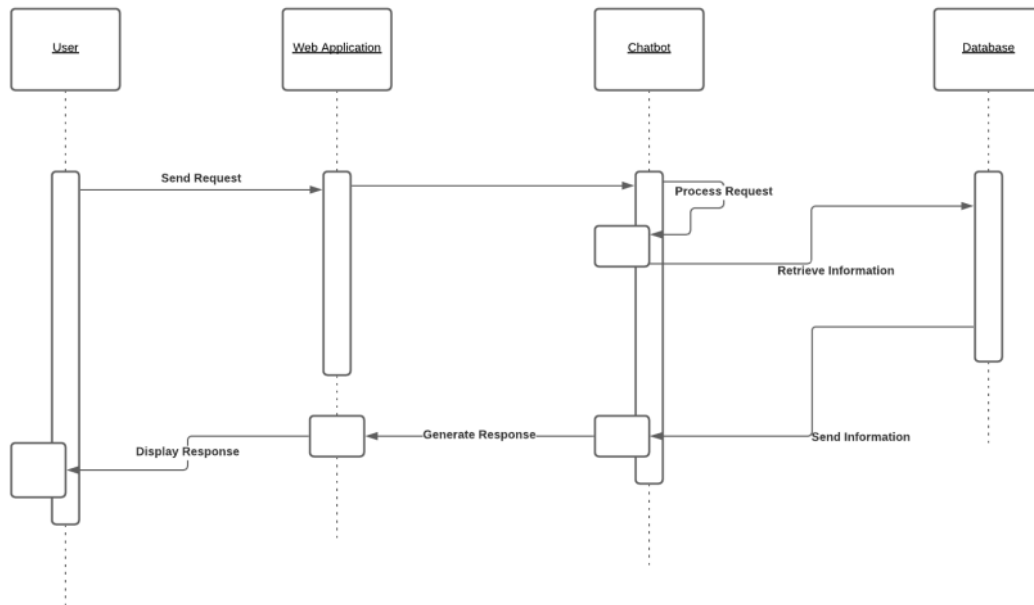Generate Response

Display Response

Figure 7: Sequence Diagram
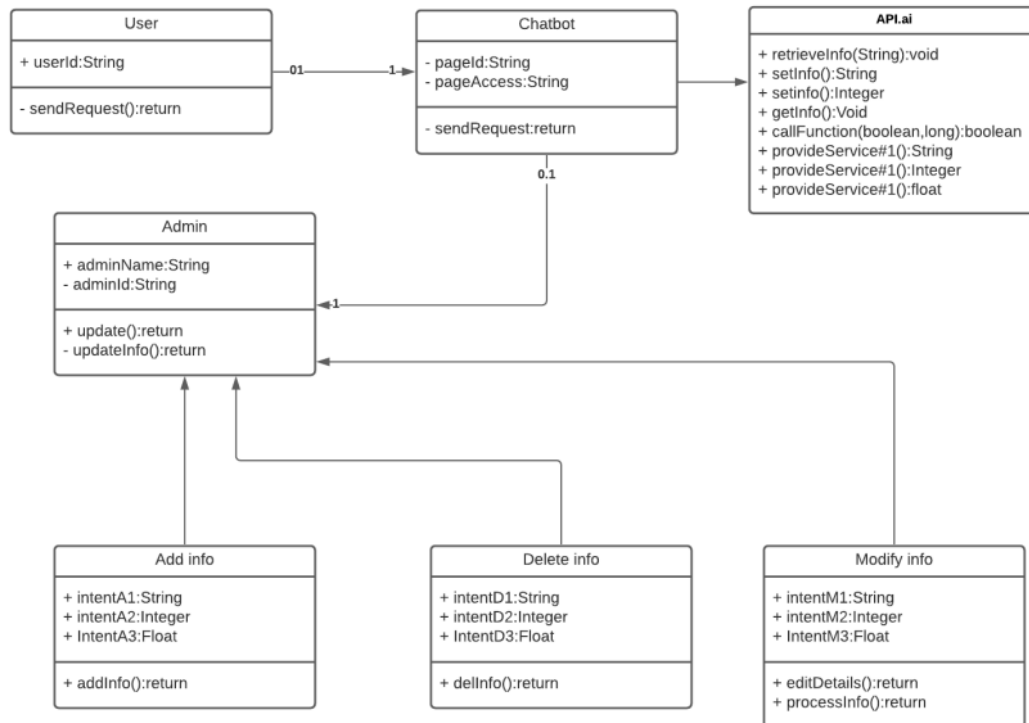
Class Diagram:

Figure 8: Class Diagram

3.6.   User Interface Design

Our web application is real-time based and its user interface is very simple and easy to understand. We interacted with more and more students using interactive images showing the surroundings of the institute. It is also integrated with the chatbot in the lower left corner to answer students questions.
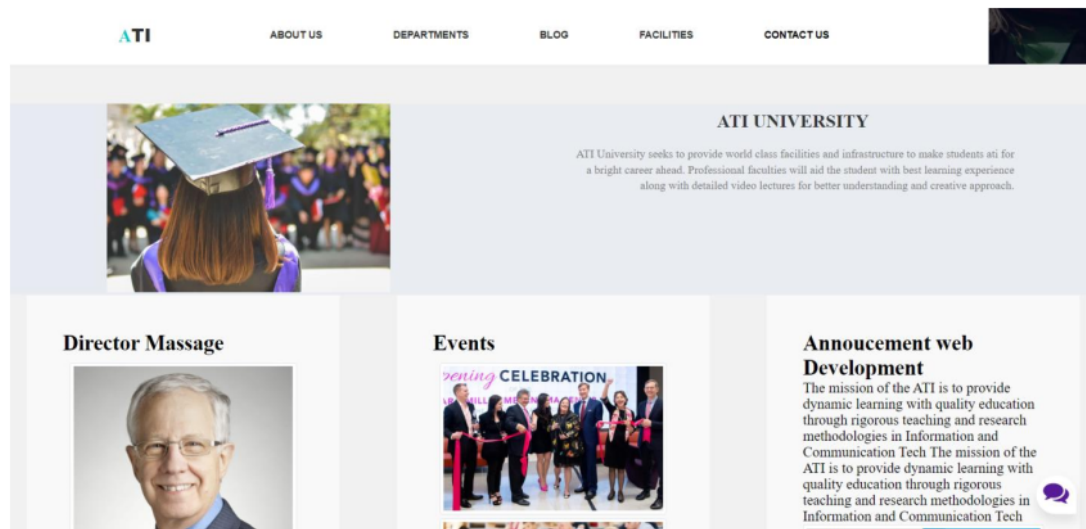
Figure 9: User interface

Chapter 4 Implementation

4.1.   Discussion

The first module is Chatbot using Machine learning and Natural Language Processing. In this module we first made a dataset. We will train the Machine learning model with Machine Learning algorithms to make it more effective. Dataset is of key importance in Machine Learning projects a good dataset can make your life easy so we will focus on making a good dataset to make our model more accurate and reliable we use python as our main language with Pytorch [10], NLTK [11], Flask [12], numpy[13]and other libraries.

The second module is a web app that allows users to interact with chatbots. The user operates the web application through the browser and accesses the chatbot in it. Users can ask the questions that the chatbot answers and we use HTML as the primary language for this section in JavaScript and CSS.

4.2.   Development Methodologies

4.2.1. First module (Chatbot):

Step 1 Data Preparation:

We made the dataset for this project by ourselves we tried it to make simple and more generic so everybody can understand it easily.

Step 2: Data Transformation:

The dataset is created in a suitable format that can be easily interpreted by the machine learning model.

Step 3: Feature Extraction:

Feature extraction simplifies subsequent training by using datasets that contain informative, non-redundant, and relevant data, and provides better interpretation of results through machine learning models.

Step 4: Implementation of Machine Learning algorithms:

For this project, we chose a machine learning algorithm to train our chatbots. Use a specific algorithm to train the model.

Step 5: Model Creation:

In this project we will be looking at the following algorithms:

- Seq2Seq
- TF-IDF
- FFNN
- K-Nearest Neighbor
- Neural Network Classifier

We will then analyze the result of different algorithms and see which of the following is better suited for our Chatbot.

4.2.2. Second module (Web-App):

Step 1: Setting up the environment

We will use Visual Studio Code for the development of our web-app.

Step 2: Designing UI:

We will then design the frontend User Interface. In this we will use HTML JavaScript UI frameworks to make our user interface.

Step 3: Chatbot Integration:

We will setup up Flask APIand by its help we will integrate our Chatbot in the website.

Step 4: Interaction:

After integration, the user will access the web application through a browser and the chat button will be displayed on the bottom left corner the chatbot screen widget will open when the user click on the button.

4.3.   Implementation Tools and Technologies

Front-End

- Visual Studio Code
- JavaScript
- HTML
- CSS

Back-End

Anaconda

Pycharm

Python

Numpy

Pytorch

4.4. Summary

This project is about technological advances in our field, how it affects everyone by making everyday life much easier, and how the field of machine learning plays a role in it.

Chapter 5 Testing

5.1. Testing Techniques Employed for This Project

In software systems, it is important that they work as expected. A series of tests were run to ensure that the system and its components work as needed. Overview Each unit of the system has been tested to ensure that actual operational results meet our expectations. In addition, if each unit was integrated with another unit during development, it was retested to verify its operation with other system units.

5.2. Test Cases

Unit and integration testing

Testing strategies called unit testing and integration testing were used to ensure that the system was working as expected. The testing strategy was based on the features and requirements of the system. The following test table provides an accurate description of the tests performed.

Table 2: Unit and Integration testing

Test case id	Test description	Expected result	Actual result	Result
TC001	Initiate conversation with Chatbot	Chatbot will initiate	Yes initiated	PASS
TC002	Ask a question	Provide answer	Answer provided	PASS
TC003	Enter an invalid sentence	Sentence parser identified the error	Sentence parser identified the error	PASS
TC004	User satisfied by the answer	Nothing happened	Nothing happened	PASS

TC005	User not satisfied by the answer	A log of the question and answer kept	A log of the question and answer kept	PASS
TC006	Administrator adds new information	Information added successfully	Information added successfully	PASS
TC007	Administrator views information	Information displayed	Information displayed	PASS
TC008	Administrator updates information	Information updated	Information updated	PASS
TC09	Administrator deletes information	Information deleted	Information deleted	PASS
TC010	Administrator views logs	Logs displayed	Logs displayed	PASS
TC011	Administrator deletes a log	Log deleted	Log deleted	PASS
TC012	The system shall respond and reply to any text input it be given	Yes	Yes	PASS

Performance testing

Each developed component is performance tested to ensure that the system meets certain performance requirements. Finally, as each unit was designed and tested, it was integrated with the rest of the system to perform performance tests. The following figure shows the performance testing phase [14].
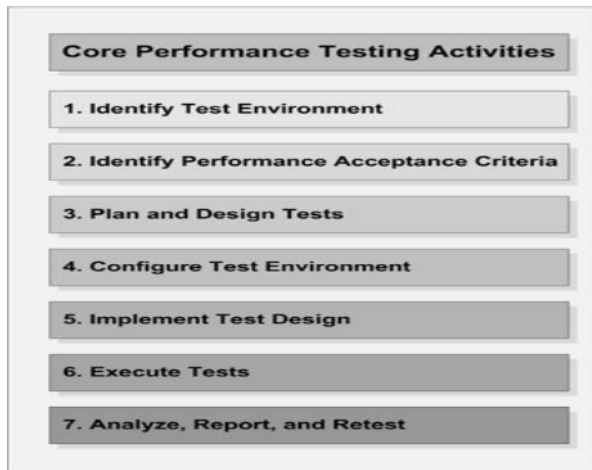
Figure 10: Performance Evaluation

Each component of the system has gone through each stage of the approached methodology. We have found that each unit behaves differently as a single unit and behaves differently when integrated with other units in terms of speed. The test environment plays an important role in system performance. Different results will occur if the system is running in development mode and if the system is deployed. In addition, the technical specifications of the server on which the final system is deployed also play a role.

Security testing

Security testing is to ensure that your system protects your data from unauthorized access and changes and continues to work as expected. Various security concepts have been used to ensure the security of the system. Authentication was used to verify the identity of someone who is either a user or an administrator. Authorization was used to ensure that users could access the pages they were supposed to visit and that the administrator had total control over the system. Access control was used to achieve this. Several tests have been run and listed below to protect the system from attacks such as SQL injection and XSS.

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Table 3: Security testing

Test case id	Test description	Expected result	Actual result	Result
TC001	The user knows the exact link on the view info page and tries to send it directly	System redirects to the main page	System redirects to the main page	PASS
TC002	User attempted to send an XSS attack script from the text area	The system skips the relevant characters and stops the attack	The system skips the relevant characters and stops the attack	PASS
TC003	User tries to submit an SQL injection attack script through the text area	The system skips the relevant characters and stops the attack	The system skips the relevant characters and stops the attack	PASS
TC005	The user gains access to the business logic and tries to execute certain methods	The user is not authorized to do that and it is rejected	The user is not authorized to do that and it is rejected	PASS

5.3. Test Result

Table units and integration tests show the results of simulated "typical" interactions with chatbots via command line tools. The simulated phrases were derived from user surveys, the user interaction with the chatbot was observed, and the chatbot dialog was developed during the design phase. It is clear that response time depends on the basic functionality that users need to reach their goals. Overall, chatbots can match their intent with the majority of utterances, with only 10% of the utterances disagreeing. Misspelling is also taken into account. The total number of successfully matched intents from 20 user phrases was 80%. These results show that chatbots can understand most sentences. This guarantees the quality of the conversation.

5.4. Summary

The results gathered throughout the testing phase support the research of the prevalence of Chatbots within industries, particularly within the education sector. The findings prove that the

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Chatbot is a very suitable method for adopting technology as a means to distribute a service. The developed Chatbot allows users to interact with their institute through natural language interaction, granting users more convenient and efficient access to the required information

Chapter 6 Data Analysis and Results

6.1. The Empirical Study Methodology

6.1.1 Empirical Study Structure

Empirical study [15]is a phenomenon used these days to guideconventionalstudiesstrategies and processes. This is a method that consists primarily of acquiring knowledge through direct or indirect observation and experience. We used a quantitative approach suitable for our case and performed a human-based assessment.

Our goal was to develop a chatbot that would help students answer their questions. To this end, we experimented with different models and, after a lot of effort, came up with a chatbot that would be useful to future students.

6.1.2. Question Categories

For analysis purposes, the types of questions that users may ask are grouped into four main categories.

Related Questions: Related questions link to valid questions. The answer exists in the database and the algorithm can get it.

Unrelated Questions: Unrelated questions are questions that are not related to the admission process and are not included in the database.

Unanswered Questions: Unanswered questions are valid questions, but the answers are not currently in the database.

Incorrect Question: An incorrect answer is that the answer is in the database, but the algorithm does not get it and returns an incorrect or irrelevant answer.

6.1.3. User Evaluation

This system was evaluated by asking current applicants also from other members and friends to test our web application.About 20 people used the system and provided feedback. Both positive and negative messages have been received from the user. Most of the messages were about chatbot knowledge and some questions could not be answered because there was no answer in the database. Also, the chatbot was unable to answer a small number of questions because the algorithm was unable to get an answer. Other answers pointed out that once accepted, the chatbot was unable to answer a particular question and the user interface was unsatisfactory.

6.2. Statistical Evaluation

The answer is a total score of 3.53 out of 5 calculated based on the evaluation. In addition, other suggestions have been submitted to further improve the system. Twenty-two messages were received, including only suggestions about the system. An assumption was made based on the feedback received and the number of logs from 20 people who used it. The following table shows the categories and the number of questions the system could not answer for each category. There were four cases where the user was not satisfied with the correct answer.

Table 4: Empirical Analysis

Relevant	Irrelevant	No response	Poor response
4	51	67	26

6.3. Summary

The UI should be more interactive and contain details. After the first use, it was clear that the information in the database was inadequate and more data needed to be added. Many related admission questions and answers have been added, but many have not yet been added. Our answer also needs to be more specific and more detailed. The color of the question and answer should also be different in the text area of the chatbot.

Chapter 7 Conclusions and Future Work

7.1. Findings

In this project, we introduced a student information chatbot that allows you to interact with faculty members and students. This chatbot can answer queries with textual user input. The main goal of the project was to develop an algorithm used to identify the answer to a question submitted by a user. Web interface development to interact with the user. The developed web interface had a simple One Piece user. Evaluation was performed from the collected data. After receiving feedback from the initial deployment, additional requirements were introduced and implemented.

Advantages of:

- This application saves time for both students and educational and non-educational staff.
- Users do not have to go directly to the university office to make a request. • Get an immediate response.
- Easy communication

7.2. Future Work

We will improve our Linguistics and conversation skills. We will add voice interface. We want it to be faster in problem solving so we will perform better insights and consumer analysis.

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