Chatbot for Clothing Recommendations

By

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ABSTRACT

The use of chatbots is growing rapidly and used as an option to interact with users in the fashion industry. Due to the COVID-19 pandemic, many fashion brands have developed chatbots as their personalized messenger chatbot to provide a better consumer experience. However, some of the chatbots do not achieve customer satisfaction as they are not designed well before developing. Moreover, a lot of consumers cannot go out to try out their favourite clothing in the physical store during this covid situation. To address this challenge, a proposed chatbot for clothing recommendations as a personalized messenger chatbot will be deployed. To achieve that, a theme-based literature review on existing systems was carried out in this paper to find out the weakness of the existing systems. The proposed chatbot will be improved from the evaluation of the existing systems. Research addresses the strength and weakness of the existing systems in this paper as well as proposed solution to solve these weaknesses. The proposed chatbot can recommend suitable clothing based on the user body profiles and clothing image uploaded for female users only. A machine learning model will be trained by using RNN to classify different types of clothes. Several tools will be using in this project such as Anaconda, Jupyter Notebook, Flutter, Visual Studio Code, Firebase Storage.

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CHAPTER 1: PROJECT BACKGROUND

1.1 Problem Statement and Motivation

There is no denying that COVID-19 pandemic is seriously affecting a lot of industries such as hotel, restaurant, fashion and has led to many impacts. As we all can see that the industries are struggling to survive in this difficult situation. Many companies are facing challenges and existential threats due to this pandemic such as temporary closure, no revenue, bankrupt, layoffs and more. One of the industries that has been impacted the most during this pandemic is fashion industry. Most of the fashion brands worldwide are facing a huge challenge in consumer demand in which they can be reliant on to bring profit and revenue for the company. However, most companies changed their business strategy from physical brick-and-mortar stores and department stores to direct-to-consumer online retailers in order to survive. They select and use different types of channels such as Shopee, Lazada, Facebook, etc. Some of the fashion brands have developed their own website for their customers to boost the sales, increase revenue as well as recover the lost.

Majority fashion brands such as H&M, Estée Lauder and Burberry put a lot of efforts on developing an amazing and user-friendly chatbot to achieve customer satisfaction and attract more new customers. However, some of the fashion brands' websites do not provide a chatbot to serve their customers virtually. Many fashion brands' websites offer various ways for their customers to ask questions or seek assistance, such as sending an email to the customer service or contacting a local customer service representative. One of the most pressing issues customers faces is uncertainty about whether the clothes will fit them well. While customers can inquire about the size and length of the clothes from the seller, the seller may not always provide a definitive answer. This uncertainty often leads to hesitation when making a purchase.

Besides that, according to research, 77% of retail businesses in the UK employ AI in e-commerce, primarily through the use of chatbots [1]. Surprisingly, some fashion brand websites have yet to embrace AI in their chatbots, missing out on opportunities to enhance efficiency. Outdated chatbot systems can lead to serious consequences, including unsatisfactory user experiences, decreased sales, and reduced customer satisfaction. These outcomes may pose significant challenges for the company in the long term. It is widely recognized that fashion brands are increasingly relying on AI to maximize consumers' shopping experiences, improve

sales system efficiency through intelligent automation, and optimize sales processes by leveraging predictive analytics and guided sales strategies [2].

The aim of the thesis is to propose a new clothing recommendations chatbot for female consumers. As we can see that there are various types of chatbots had been developed for their users in fashion industries. However, some of them had occurred a lot of problems and it is difficult for the developers to solve these problems due to the limited resources and technologies. Especially during this COVID-19 situation, a lot of challenges are faced by the enterprises and consumers. In order to solve these problems, the enterprises were changing and implementing new strategies. They changed their ways from physical store to online website. Therefore, a well-functioning chatbot is essential for the consumers to their online website. It is because many customers are uncertain whether the clothes are suitable for them or not. This uncertainty often leads them to abandon their purchase intentions. In this thesis, a clothing recommendations chatbot is proposed to address this issue and improve upon existing chatbots. The proposed chatbot can provide suitable clothing recommendations to the customers based on the user body profiles and uploaded images of clothing. This convenience is particularly valuable for customers who enjoy shopping online and cannot physically try on their favorite clothing in a store.

1.2 Project Scope

The title of this project is Chatbot for Clothing Recommendations. It is a form of Artificial Intelligence (AI) used to recognize different types of clothing for the recommender chatbot. The target users are female users who like to shop online, and the recommendations will only be given for female clothing.

The project is divided into three major phases.

Phase 1: Data Collection

- In this project, there are some input data needed to be collected and analyzed. The input data included the image of female clothing and body profiles. All the data will be stored in the database.

Phase 2: Machine Learning & Modeling

- Train a machine learning model using RNN that is able to classify different types of clothing.

Phase 3: Application Development

- Build a chatbot to provide clothing recommendations for the female users by using Flutter.

The proposed chatbot will be developed as a recommender chatbot with prediction results.

1.3 Project Objectives

The main objectives of this project:

i. **To train a classification model to classify different types of clothing by using RNN**
A RNN model which the information cycles through a loop will be developed. The model will identify the current input provided by the users in the conversation. When the user provides her clothing image, the model will learn from the inputs it received previously to make a decision. The chatbot that is developed with a RNN model will provide suitable recommendation for the user once it has done the decision making.

ii. **To create clothing rules tailored to various body types**

Create clothing guidelines tailored to different body types using data obtained from the clothing categories dataset and implement these rules within the system.

iii. **To provide suitable recommendation based on the image of clothing and body type**
The trained classification model will be connected to the proposed application and able to classify uploaded clothing image. The user can choose their own body type and choose an image to upload. Based on the image of clothing uploaded and body type chose, the system will provide suitable recommendation to the user.

1.4 Contributions

The goal of this project is to build a chatbot for clothing recommendations for the female consumers. A RNN model will be developed in the chatbot to classify different types of clothing. These are some of the important phases for implementing a well-functioning chatbot. The data collection is based on the users' input data which will provide their body type and clothing image. In order to achieve the project object that the chatbot can recommend suitable clothing to the consumers, the chatbot should be trained to analyze different types of clothing successfully. The clothing rules that tailored to different body types will be created before implementing to the system.

1.5 Background information

1.5.1 Chatbot

In this present era, chatbot is bringing many advantages in most of the industries. When a chatbot is used to conduct an online chat conversation via text-to-text speech, it replaces the need for a live human agent by providing automated responses to user questions and requestions. A chatbot is a type of software that can assist customers by assisting customers by automating conversations and interacting with them though messaging platforms such as Facebook and Twitter. It is computer program that interpret and process the words or phrases of users and then provide an instant pre-programmed response. A chatbot which can provide female clothing recommendation will be developed in this project. This chatbot will be developed as AI-powered chatbot which can work and "think" like people.

1.5.2 Classification

The process of identifying and categorizing objects or ideas based on their characteristics is known as classification. Classification in data management refers to the process of separating and sorting data based on predetermined requirements of various business or personal goals. Classification is used frequently as classification predictive modeling in machine learning. An extensive training dataset which containing many examples of inputs and outputs from which to learn is required for classification. In general, classification can be divided into two types:

binary classification and categorical classification. In this project, there will be using categorical classification as the output will be showing different types of clothing respectively.

1.5.3 Flutter

Flutter stands as a cost-free and open-source mobile user interface (UI) framework, a product of Google's ingenuity and commitment to fostering a vibrant and collaborative development ecosystem in the mobile app development sphere. This innovative framework, generously shared with the global developer community, serves as a powerful tool for crafting versatile and visually appealing user interfaces for mobile applications. The programming language called Dart will be using to develop with Flutter. In this project, Flutter will be employed to create a user-friendly interface (UI). The trained classification model will be integrated with Flutter to display recommendation outputs within the UI.

1.5.4 Recurrent Neural Network (RNN)

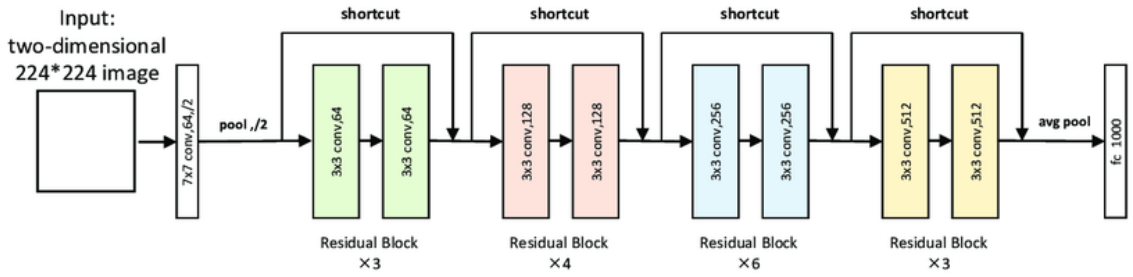


Figure 1.5.4.1: Architecture of ResNet34

Recurrent Neural Network (RNN) is a type of neutral network that evolved from ANN. It is developed to solve the problems which the traditional neural networks could not handle well such as handling sequential data like speech, text, audio, etc and remembering previous input. RNN can memorize the input they received which enables them to predict what will happen next with great accuracy. RNN will work with the information cycles through a loop. It will consider the current input as well as what it has learned from previous input when making a decision. The drawback of RNN is if it carries too much of the past information, it will fail to memorize and process the data. In this project, ResNet34 will be used to train a classification model which is able to recognize different types of clothing.

1.6 Report Organization

The details of the research will be discussed in the following chapter respectively. The report organization is as follows: literature review in Chapter 2; methodology and system overview in Chapter 3; Chapter 4 presenting the system implementation; Chapter 5 presenting system evaluation and discussion and finally a conclusion to wrap up the report in Chapter 6.

CHAPTER 2: LITERATURE REVIEW

2.1 Review of Existing Works

2.1.1 Sephora Chatbot

A well-known global cosmetics company with over 2,300 stores in 33 countries worldwide, Sephora has built a messaging chatbot on Kik Messenger which is a free of charge instant messaging mobile application on both operating systems, iOS and Android and a bot named Sephora Assistant on Facebook Messenger. Sephora chatbot provides various types of services to their customers such as offering personalized make up tips, giving product recommendations, and reviews, allowing customer to try out lipstick colours by using their selfie photos. Sephora chatbot is used to boost their sales and increase the interactions between customers and company. Sephora started to implement the chatbot strategy in 2016 as they found out Kik Messenger was the most suitable application for them to acquire young customers where they received a lot of good feedback from their customers as they were highly interested to interact with the chatbot [4].

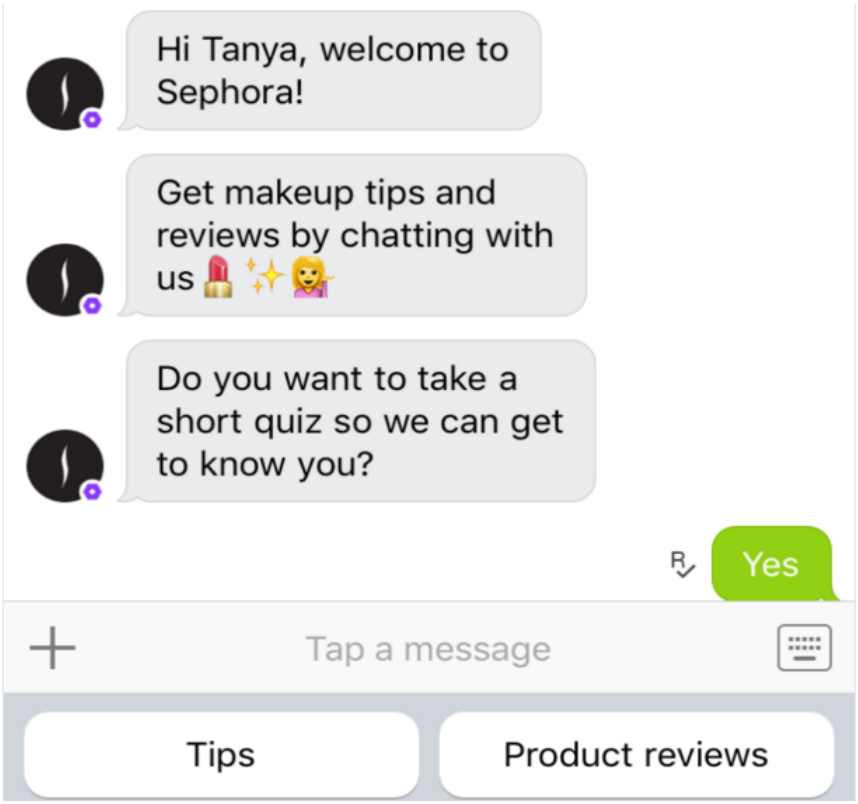


Figure 2.1.1.1: Sephora Chatbot [3]

Strength

Sephora Chatbot acts like a real salesperson to serve their customers online. The chatbot recommends Sephora products to their customers as well as provides some personalized make up tips with a series of emojis which can attract user's attention. The chatbot which is implemented with AI allows their customers to try out their favourite lipstick colours by using selfie photos virtually. This is a good solution that can solve the problem where customers are not sure whether a lipstick colour is suitable for them when they buy products online. The chatbot which uses natural language processing also provides a list of available times to their customers to make appointments with beauty specialists at the nearby Sephora stores. Besides that, a short and simple quiz about the age, brand preferences, and beauty routine will be provided to the users. The chatbot will provide some video content targeted to the user's needs on the topics they are interested in after the chatbot analyses all the answers.

Weakness

Sephora Chatbot does not function well when it comes to more complicated questions asked by their customers or even those that are out of its specific range that the chatbot has been programmed [5]. The customers will feel upset and unsatisfied if the chatbot does not give the appropriate answer towards their questions. The chatbot is not designed correctly and perfectly in the beginning hence it is unable to handle the complex questions in the conversation.

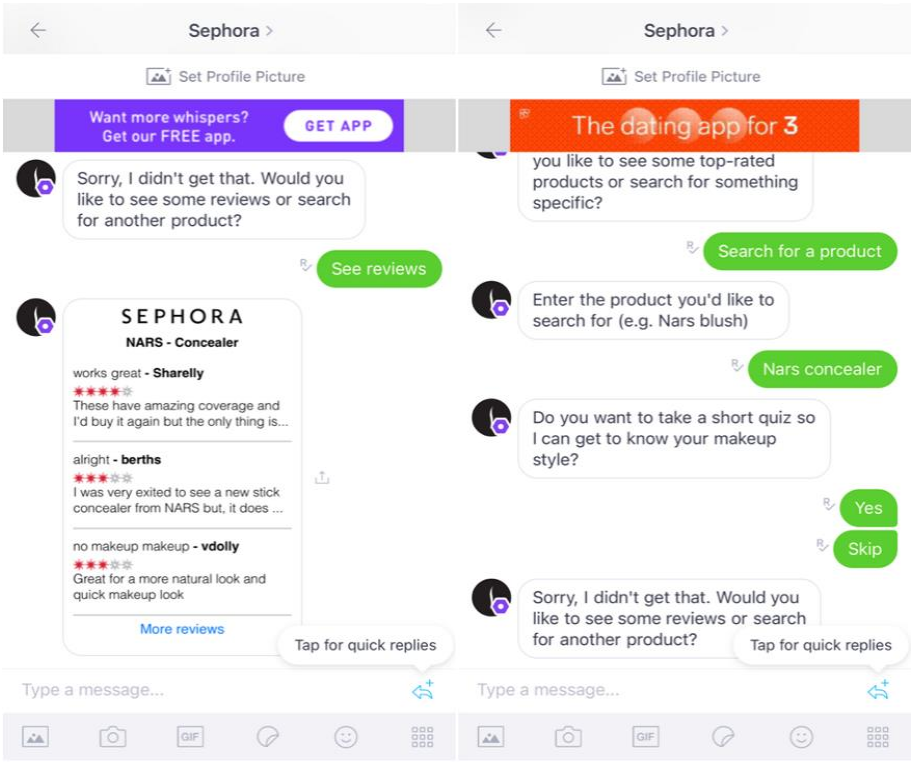


Figure 2.1.1.2: A customer asked Sephora Chatbot some complex questions (Sellman, J., 2021)

Proposed Solution

The developers have to think properly on multiple conversation scenarios for the chatbot. Reading through chat transcripts or conducting surveys to collect more information needed to design a chatbot is essential to avoid this issue. The chatbot has to be trained to learn how to handle different types of scenarios, what terms the customers might use, how the customers talk, etc.

2.1.2 Facebook M

Facebook M, commonly named M, is a personal assistant bot which is released by Facebook. It was released and announced in August 2015. M is the most successful chatbot with full-service among digital trends as it provides a lot of features to the users. For instance, giving various types of recommendations, setting reminders, planning events and even arranging gift deliveries and more. A digital concierge service which allows user to request anything is also applied on M [6]. M uses algorithms to identify what the user wants when they are trying to request for something to M. However, if there is a overly complicated question or request that M can't understand, the conversation will be taken over by a human. The human will continue the conversation and try to answer the user's question or request. Unfortunately, Facebook released an announcement mention M is closed down in January 2018. Despite the fact that M is so innovative and brings a lot of benefits to the users and its company, it was still discontinued due to some issues which the developers realized were more difficult to be solved than they expected.

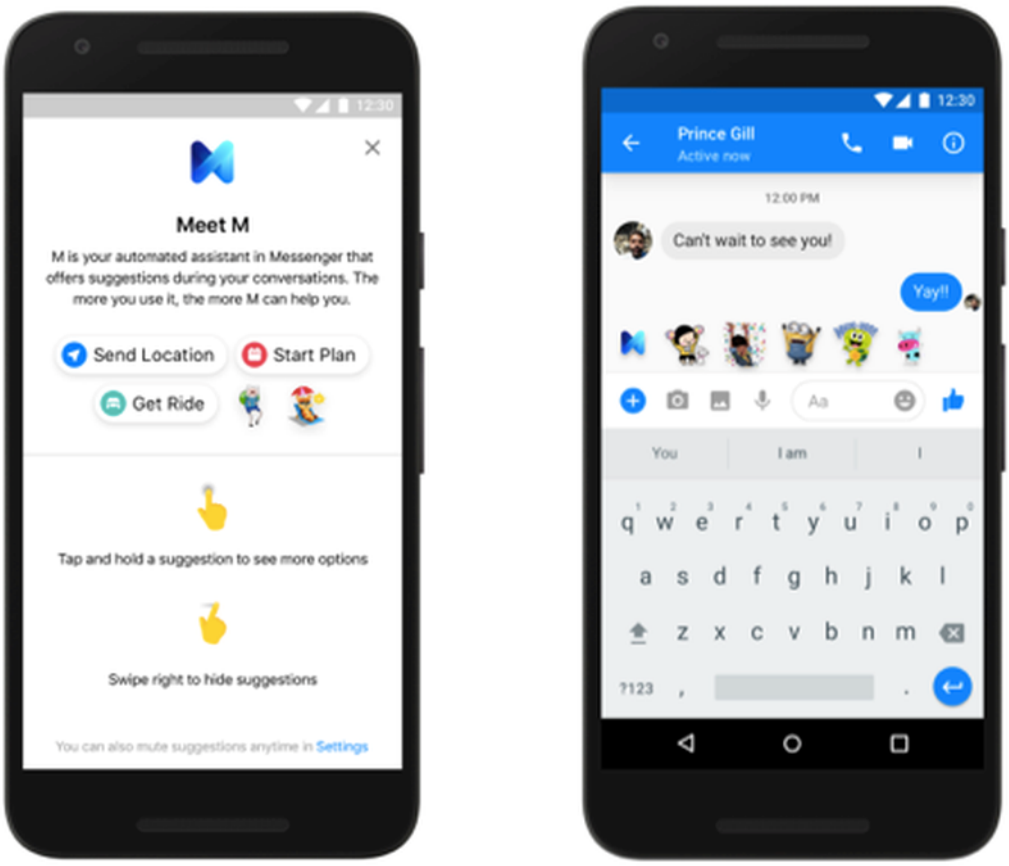


Figure 2.1.2.1: Facebook M chatbot [7]

Strength

Facebook M is developed with the use of algorithms to determine what the users want to achieve customer satisfaction. It fulfils the tasks requested by the users such as sending gift, booking restaurant reservations, sending and requesting money, etc. The full-service features have attracted and gained a huge number of users. The users can enjoy the interaction with the chatbot through the conversation.

Weakness

As Facebook M provides various types of features to the users, the security and privacy issues become a big challenge for the company. For example, there are some features which need the personal information of users such as share location, change flights, bank account number for sending and requesting money, etc. Besides that, Facebook tried to develop artificial-intelligence technology where all the M's tasks can be automated, but M never achieved the goal. M is not a fully automated chatbot as the tasks performed by M that are much beyond what current machine learning technology can handle [8].

Proposed solution

The database of the chatbot has to be protected properly to avoid the data breach as users' details is significant data for a company. The developer should always update the security of the database to prevent this issue. It is better to not to get too much information from the users as they might feel uncomfortable and worried about their data is lost.

2.1.3 Microsoft Tay

Microsoft Tay chatbot, also called Tay, is an AI chatter bot which is designed for human engagement. In March 2016, Tay was developed as a machine learning project and released by Microsoft Corporation via Twitter. Tay was created to provide engagement to the users in conversation through tweets or direct messages while simulating a teenager girl's style and vocabulary [9]. Unlike the chatbot which provides various types of services, Tay is built for giving engagement to the users in social media. For example, the tasks can be done by Tay are sharing horoscopes, telling jokes, and even playing interesting games with the users such as "Two Truths and a Lie [10]. However, Tay has shut down its service only 16 hours after its release due to some problems happened accidentally.

Strength

Tay exhibited capacities for language that sounded un-machine-like, including randomness, humour, and what even individuals who worked on the project referred to as "position on things" by equipping it with complex learning algorithms [10]. Tay is exactly developed as a human-like chatbot and the users will not have the feeling that they are talking to a robot when having conversationw with Tay. Tay is designed to be more humane so it can learn and talk to other users on Twitter.

Weakness

Tay is lack awareness or understanding of the possible harm that modern technologies might do, as well as how to prevent it. When it comes to getting information from the users, it will provide incorrect information or something illegal. It also means that Tay has evolved into an uncontrollable database which does not filter the questions and answers. Tay was developed with AI tools but missed out some critical parts which are inspection on potential harms of the technology, and the developers should put protocols in place to prevent this.

Proposed solution

The developer has to put more effort and time on mapping out more detailed conversation tree for the chatbot. This diagram allows the chatbot learns to understand more in the context of the conversation. The chatbot can give a meaningful conversations if the conversation flow is planned and detailed properly. Through this solution, the chatbot can give a reply accurately and correctly based on the user's replies.

2.1.4 Tommy Hilfiger Chatbot

Tommy Hilfiger is an American premium clothing brand that was founded in 1985. Tommy Hilfiger also developed its chatbot for its users with a Facebook chat during New York Fashion Week. It brought a lot of convenience to its customers as they can choose and try out their favourite outfits virtually instead of taking time to go to the physical store. The chatbot will immediately bring the users into a vivid conversation and a simple introduction of itself as a chatbot will come out in the conversation. Then the users will be provided with a variety of options such as TMY.GRL – womenwear, TMY.BOY – menwear, customer service and more. The chatbot will ask a few questions related to the preferences of the user and it will gather all the information provided by the user once it received the details. One of the interesting parts of Tommy Hilfiger chatbot is the customer can get an idea of his/her new Tommy Hilfiger look immediately through the conversation after the chatbot put together the entire outfits chosen by the customers.

Strength

Tommy Hilfiger Chatbot was developed with some options buttons for the users. For instance, a few buttons such as customer service, women or men outfits, etc will pop out in the conversation when the users open up the conversation with the chatbot. It lets the users know what they should do with the chatbot. The chatbot also can determine the users' preferred outfits as well as putting with some accessories together. It offers the users with different looks based on a few simple questions provided to the users.

Weakness

Tommy Hilfiger Chatbot is still lacking in handling some complicated questions. The chatbot still doesn't have the ability to handle the question related to the refund policy. When the chatbot is facing those kind of questions, it will suggest the users to contact the local customer service representative or send an email to the customer service. The users cannot get the complete information they wanted in the conversation.

Proposed solution

In order to solve this problem, multiple conversation scenarios must be determined properly by the developers. It can help the chatbot to handle various types of scenarios when it has a conversation with a user. Reading through chat transcripts and conducting surveys are also the

essential tasks to do which can solve the problem of unable to deal with complicated questions from the users.

2.1.5 IKEA Chatbot

IKEA which is a furniture retail brand that designs and sells ready-to-assemble furniture, provides home services, different types of home accessories, etc has developed its first chatbot named Anna. Anna is designed as a human-like bot which can handle different types of questions. For example, providing product recommendations, checking delivery status, handling complaints, checking product's prices and more. However, IKEA decided to shut down its chatbot Anna after a decade due to the customer dissatisfaction. The developer of the chatbot did not give a vertical focus on the chatbot. This issue becomes the major reason of shutting down the chatbot.

Strength

Anna, the IKEA chatbot can handle various types of tasks such as deliveries, orders, payments, returns and more. It brings convenient to their customers as the customers do not need to go to the physical store to complete these requests. The chatbot also can handle complex sentences in the conversation like typos, parameterized answers or different slangs in the sentences. Moreover, the chatbot supports to answer open-ended questions which is more comfortable for the customers as they can ask from a wide range of topics instead of selecting an answer from a list. The chatbot is designed to answer the customers' questions immediately 24/7 [11]. This can help the IKEA hotline by reducing the load so that the hotline will not be too busy and also the customer does not need to wait for too long.

Weakness

The design of the IKEA chatbot is too human-like which makes it forget its own purpose. The customers are putting more expectations on the chatbot as they found out there are a lot of tasks can be done by the chatbot. It is getting more difficult to achieve the customer satisfaction. The chatbot has to be monitored and updated constantly to always be the latest chatbot for the customers. It is time-consuming and resource-consuming. These become a huge challenge for the company if they continue to own the chatbot.

Proposed solution

The aim of developing this chatbot has to be clarified clearly before the implementation of the chatbot starts. It is important to clarity because there might come out a lot of outcomes if the chatbot does not design and develop well. Moreover, the project objectives also have to be stated properly in the project proposal to avoid the confusion when implementing the chatbot.

2.2 The Summarized Comparison of Existing Works with Proposed Solution

Existing system/works	Strength	Weakness	Proposed Solution
Sephora Chatbot	- provides some personalized make up tips - allows users to try out lipstick colour virtually - allows users to make appointment - provide short quiz to understand the user's needs	Unable to handle complicated question	- determine multiple conversation scenarios - read through chat transcripts - conduct a survey
Facebook M	- provides full-service features - have interaction with the users	- have security and privacy problems - perform too much tasks	Update the security of the database frequently
Microsoft Tay	- developed as human-like chatbot - have interaction with the users	- lack awareness or understanding of the possible harm - does not filter the questions and answers	Map out more detailed conversation tree
Tommy Hilfiger Chatbot	- designed with several options buttons - determine the users' preferred outfits	Unable to handle complicated question	- determine multiple conversation scenarios - read through chat transcripts - conduct a survey
IKEA chatbot	- handle many tasks - handle complex questions	- time-consuming and resource-consuming	- clarify the purpose

	- answer open-ended questions -24/7 online		- state out the project objective

Table 2.2.1: Comparison of Existing Works with Proposed Solution

CHAPTER 3: System Design

3.1 Methodology

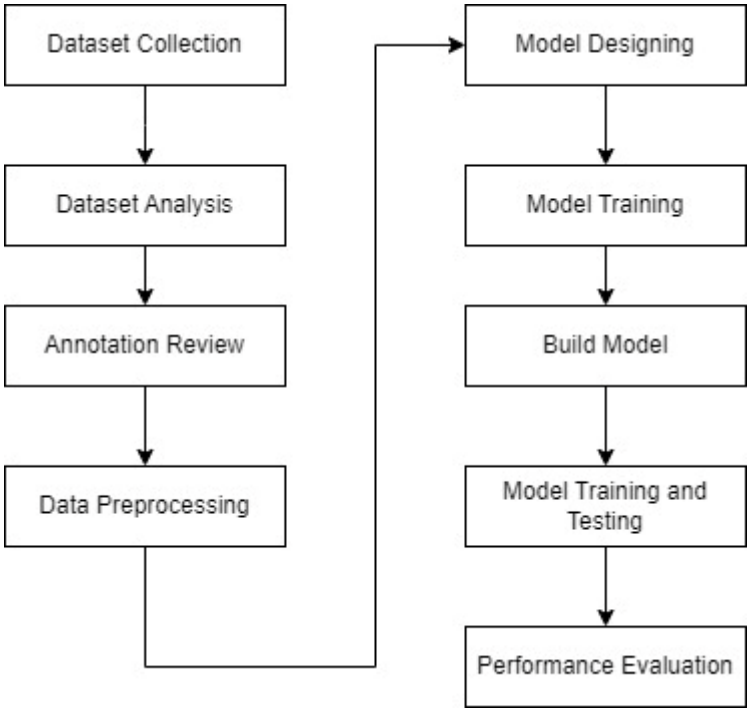


Figure 3.1.1 General Methodology

In the figure 3.1.1, it is a general methodology for the overall project. Project 1 has covered until third stages while Project 2 has done other stages to achieve the three project objectives. During the early phases of project methodology, the dataset preparation process which consists of dataset collection, data analysis and dataset annotation is done respectively. The dataset which contains different types of clothing is downloaded from the Internet. The details of this dataset are explained in the 3.2 Dataset in Chapter 3. The second stage is dataset analysis which is used to make sure where they fir the training data criteria or not. Before the dataset is finalized, the results of the annotation process are reviewed again.

Next, the process comes to the machine learning model creating. The first step is the data preprocessing is done to improve the quality of the data for the machine learning model. The strategy used in this process called presizing which reduces the image size to a smaller square shape facilitates the execution of subsequent augmentations on the GPU. The next step is to design and train the classification model. The model will be designed and trained by using ResNet34. The classification categories in the dataset are not the same as the original classes in the ImageNet dataset that ResNet34 was trained on. The network's final layer with a fresh

linear layer which having an identical number of activations as the classes in the dataset to enable successful transfer learning. There are 46 clothes categories which means there have 46 activations in the new layer. In the final phases of project methodology, the model will be built and trained using the best hyper-parameters and model architecture together with the whole collection of training and validation data. After putting the model to the test on a training set of previously unobserved data, performance evaluation will be carried out. Before being utilised to assess the model, the testing dataset must first go through the stage of normalizing. Lastly, the model will perform on test data and show the accuracy of the classification.

3.2 Dataset

The dataset that used to train the classification model in this project is DeepFashion Dataset. It is a vast clothing database, intended for Clothing Category and Attribute Prediction, was gathered by the Multimedia Lab at The Chinese University of Hong Kong. The most recent benchmark, released in 2016, assesses the FashionNet Model's effectiveness in predicting 46 clothing categories and 1000 attributes. There are several datasets contain in the DeepFashion Dataset. The Category and Attribute Prediction Benchmark was used for this project. Within this dataset, there is a collection of 289,222 diverse clothing images spanning across 46 distinct categories.

Figure 3.2.1 Category and Attribute Prediction Benchmark Dataset [12]

3.3 Data Preprocessing

Out[3]:

	image_name	category_name
0	img/Sheer_Pleated-Front_Blouse/img_00000001.jpg	Blouse
1	img/Sheer_Pleated-Front_Blouse/img_00000002.jpg	Blouse
2	img/Sheer_Pleated-Front_Blouse/img_00000003.jpg	Blouse
3	img/Sheer_Pleated-Front_Blouse/img_00000004.jpg	Blouse
4	img/Sheer_Pleated-Front_Blouse/img_00000006.jpg	Blouse

Figure 3.3.1 Data Loading Output

After download the appropriate dataset online, some data preprocessing methods are applied before training and building the classification model. In figure 3.3.1, data loading method which can load data from CSV files (train_lables.csv) is applied at the beginning of model training. The CSV file contain information regarding the dataset, such as the file paths to the images and the labels that correspond to them. This method is necessary for preparing the dataset for evaluation and training in that it will help organize the data and get it ready to be used.

The next method is data augmentation. It is a process that applies a number of different modifications to the original images in order to produce new variants of those images. The model is able to become more resilient and to generalize better to a wider variety of input data as a result of these adjustments. In this stage, the image are resized to a square format with dimensions of 300 pixels on each side by using the Resize(300) function. This resizing is carried out so that following augmentation procedures can be carried out on the GPU without wasting any time. Besides that, Random Augmentations are also applied to the images such as random rotation, zooming and flipping. These augmentations are carried out with the aid of aug_transforms with the parameters size=224 and min_scale=0.9. The size=224 parameter makes certain that the photos are scaled down to a standard size so that they are compatible with the model.

3.4 Rules for Different Clothing Based on Different Body Types

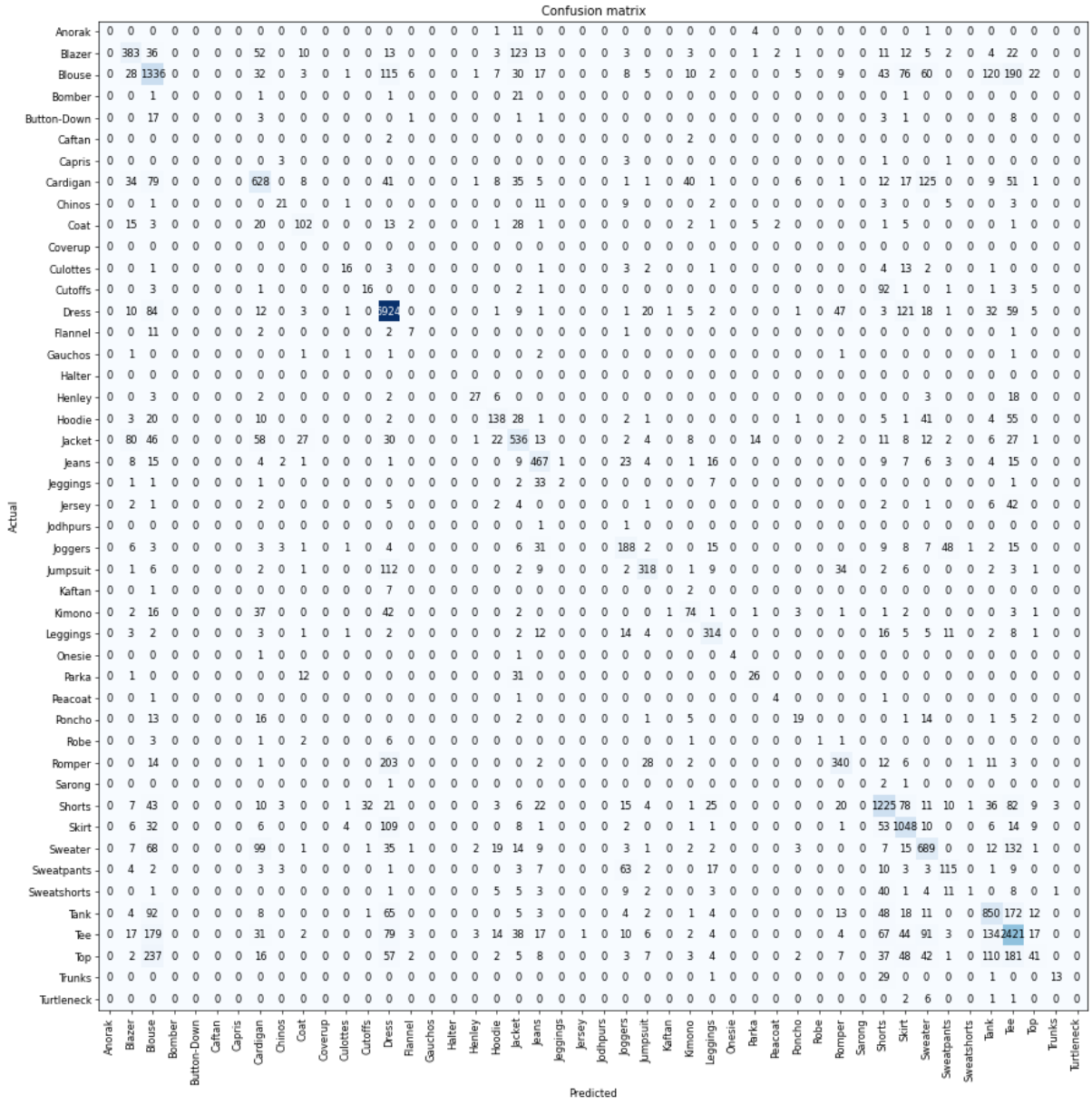


Figure 3.4.1 Confusion Matrix of 46 clothing categories

The rules for different clothing based on four body types are created through research. The 46 clothing categories are derived from the confusion matrix in figure 3.4.1. There are four body types which are pear shaped body type, hourglass shaped body type, apple shaped body type, athletic shaped body type. The rules are showed below:

- **Pear shaped body type:** Top, Tee [15], Sweatpants, Skirt, Sarong [17], Robe, Poncho, Parka, Kimono [11], Kaftan [24], Jersey, Jeggings [26], Jacket, Hoodie, Gauchos [28], Flannel, Coverup, Coat, Capris, Caftan, Button-Down, Bomber [30], Blouse

- **Hourglass shaped body type:** Turtleneck [13], Tee [15], Sweatshorts, Sweater, Shorts, Sarong [17], Romper [18], Poncho, Parka, Leggings [21], Kimono [23], Kaftan [24], Jumpsuit [21], Jeggings [26], Jeans, Henley, Halter [27], Flannel, Dress [21], Cutoffs, Caftan, Button-Down, Bomber [30], Blazer
- **Apple shaped body type:** Trunks, Tank [16], Sweater, Skirt, Sarong [17], Poncho, Leggings [20], Kimono [23], Kaftan [24], Joggers [25], Jodhpurs, Jeggings [26], Jacket, Hoodie, Gauchos [28], Flannel, Dress [20], Cutoffs, Culottes, Coat, Chinos, Capris, Caftan, Button-Down, Bomber [30], Blouse
- **Athletic shaped body type:** Turtleneck [14], Trunks, Tank [16], Sweatpants, Shorts, Sarong [17], Peacoat [19], Onesie, Leggings [22], Kimono [23], Kaftan [24], Jumpsuit [22], Joggers [25], Jodhpurs, Jeggings [26], Jeans, Henley, Halter [27], Flannel, Dress [22], Chinos, Cardigan [29], Caftan, Button-Down, Bomber [30], Anorak

3.5 System Design Diagram

3.5.1 System Architecture Diagram

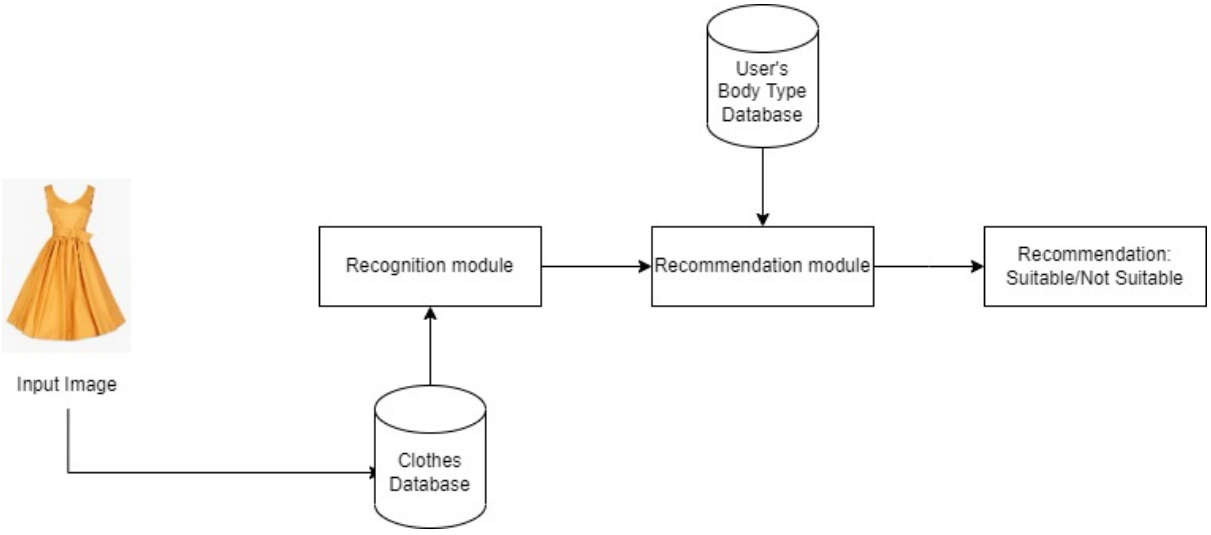


Figure 3.5.1.1 System Architecture Design for the proposed system

Diagrams of system architecture provide a visual illustration of the numerous components that make up a system and show how those components communicate with one another and interact with one another. In the figure 3.5.1 above, it shows how the proposed system works with each

module and database. There are three main components in the system architecture design which are input image, modules, and databases. The user will upload a clothing image to let the model make predictions. After the user uploaded a clothing image, the clothing image will store in the clothes database. The recognition model will retrieve the clothing image from the clothes database. The model is trained and built by using ResNet34 that can do classification of images based on previous training on the ImageNet dataset. The model will make prediction on the clothing image through the 46 clothing categories. Then, the prediction output will pass to recommendation module. For the user's body type database, it will store the user's body type selection. When the user chooses her own body type, the body type selection will save as text and store in body type database. After that, the recommendation module will give suitable recommendation based on the body type selection and the prediction output. The rule for different clothing based on different body types will apply to the system. Lastly, the recommendation which is suitable or not suitable will show at the user interface (UI).

3.5.2 Use Case Diagram

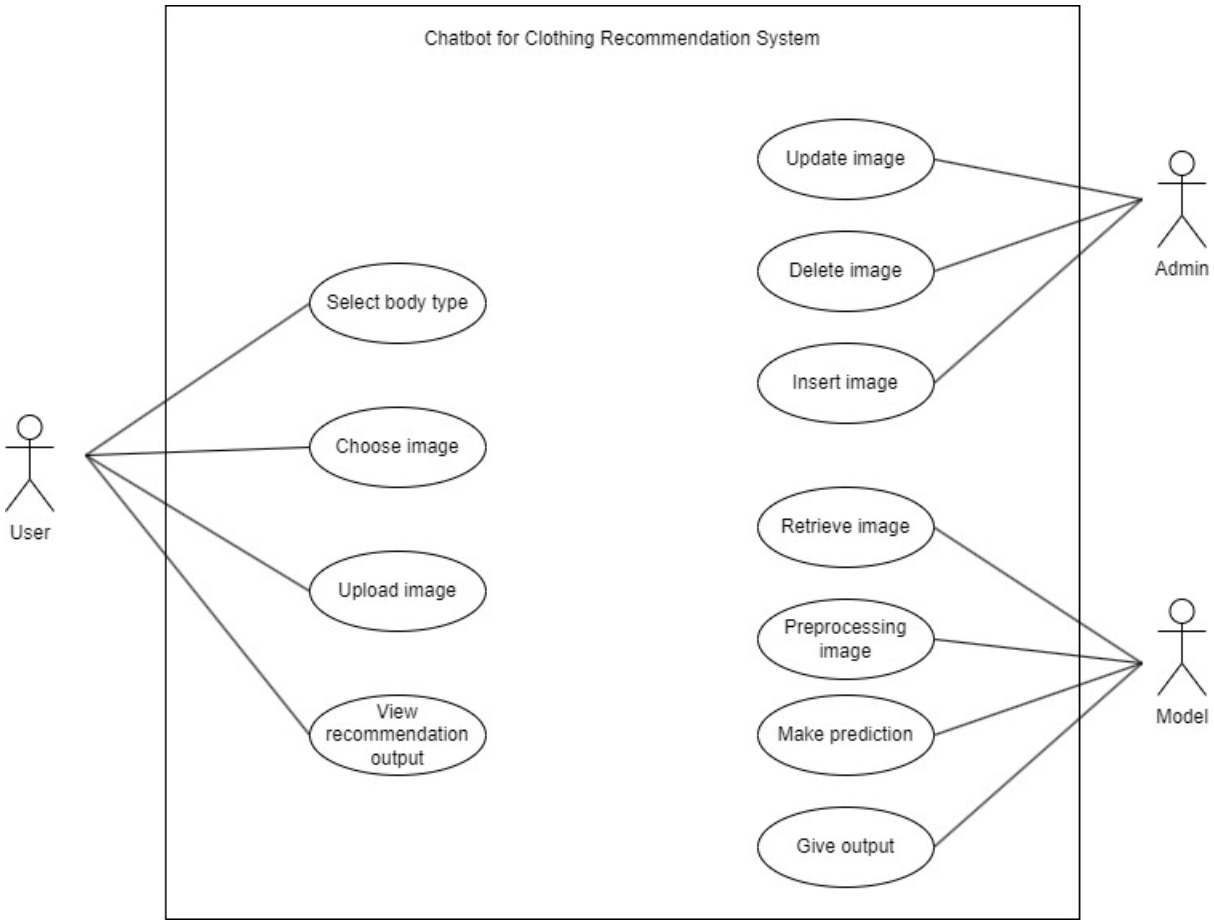


Figure 3.5.2.1 Use Case Diagram for the proposed system

From the figure showed above, there are two actors which are user and admin in the user case diagram for the project. The two different actors can handle different use cases in this project. At the user side, the user can select her own body type. At the user interface (UI), the user can choose between four different body types, such as apple shaped body type, athletic shaped body type, pear shaped body type, or hourglass shaped body type. Apart from that, the user can choose a clothing image from the phone gallery and upload the clothing image to the system. The body type selection and the clothing image will store in the database. The user can also view the recommendation output after uploading the clothing image, which will indicate whether the recommendation is suitable or not.

The second actor is admin which can handle three use cases. The admin can manage the information stored in the database such as update image, insert image, and delete image. If the user wants to manage the image that stored in the database, she can only inform admin to do so.

Lastly, model becomes the third actor in the use case diagram. The model can handle four use cases in this project. The classification model will be applied to the system and makes prediction on the input image given. Before the model makes prediction, it will retrieve the input image from the database and do image preprocessing to fit the model's input requirements. At the end, the model will give prediction output to the system.

3.5.3 Activity Diagram

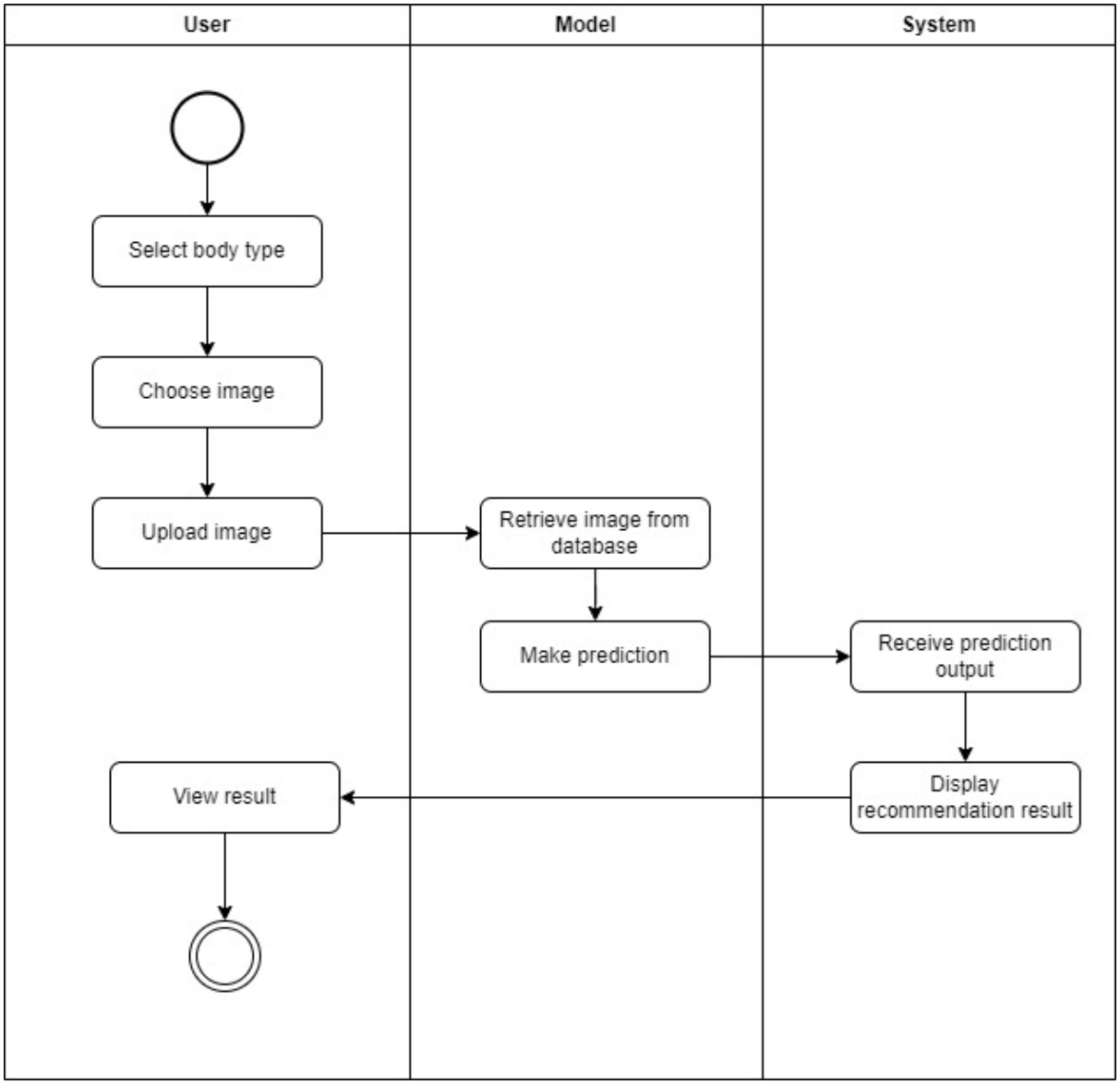


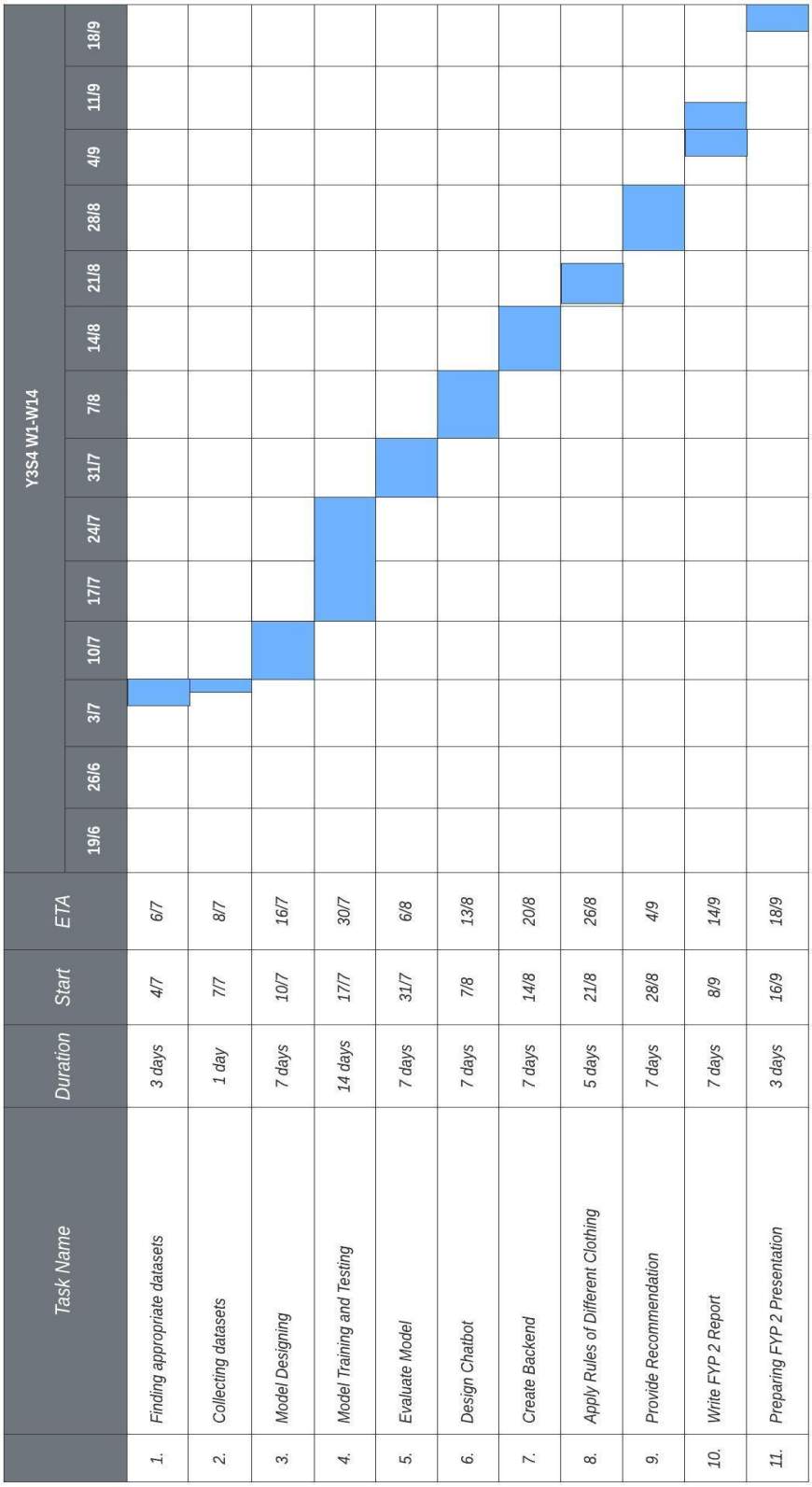
Figure 3.5.3.1 Activity Diagram for the proposed system

The figure 3.5.3.1 showed the activity diagram for the proposed system. There are three persons in this diagram which are user, model and system. At the beginning, the user can select her own body type at the body type selection page. Four body types of selection provided for the user such as pear shaped, hourglass shaped, apple shaped and athletic shaped. After the user done choosing, she can navigate to the next page by clicking the save button. The user can choose image and upload image. Then, the image will save in the database. The model will retrieve the input image from the database and make prediction. The prediction output will pass to the system and the system will receive it. Once the system receives the prediction output, the system will display the recommendation result based on the body type selected for the user. Lastly, the user can view the recommendation result at the user interface.

3.6 Expected Output

The expected output of this model is on different clothing image. The model has a good understanding of the many categories of clothing. When the user uploads a clothing image to the model, the model will make a prediction based on it. The model will find out the clothing image belongs to which clothing categories. At the evaluation part, Top-3 and Top-5 accuracy is used in the original paper so we are going to stick with the same measures. The Top-3 accuracy in the original paper is 82.58 while Top-5 accuracy is 90.17 [12]. Therefore, the expected Top-3 and Top-5 accuracy of our model should be higher than the benchmark accuracy.

3.7 Timeline



	Task Name	Duration	Start	ETA
1.	Finding appropriate datasets	3 days	4/7	6/7
2.	Collecting datasets	1 day	7/7	8/7
3.	Model Designing	7 days	10/7	16/7
4.	Model Training and Testing	14 days	17/7	30/7
5.	Evaluate Model	7 days	31/7	6/8
6.	Design Chatbot	7 days	7/8	13/8
7.	Create Backend	7 days	14/8	20/8
8.	Apply Rules of Different Clothing	5 days	21/8	26/8
9.	Provide Recommendation	7 days	28/8	4/9
10.	Write FYP 2 Report	7 days	8/9	14/9
11.	Preparing FYP 2 Presentation	3 days	16/9	18/9

Figure 3.7.1 Timeline for this project

CHAPTER 4: System Implementation

4.1 Hardware Setup

The hardware involved in this project is a laptop to implement the system as stated:

Description	Specifications
Model	Huawei MateBook D15
Processor	AMD Ryzen 5 3500U with Radeon Vega Mobile Gfx
Operating System	Windows 10
Graphic	AMD Radeon™ Vega 8 Graphics
Memory	8 GB DDR4
Storage	256 PCle NVMe SSD

Table 4.1 Specifications of laptop

4.2 Software Setup

i. Anaconda

Anaconda is a distribution of the Python and R programming language that is commonly used for data science and machine learning applications. A desktop graphical user interface (GUI) tool called Anaconda Navigator is included in Anaconda distribution. It allows users to set up applications and handle conda packages, environments and channels without applying command-line commands. It is the recommended distribution when installing Jupyter.

ii. Jupyter Notebook

Jupyter Notebook is an open-source web application that is working with Python inside a virtual “notebook”. It can be deployed for various types of use cases and user stories. It allows the users to do data cleaning and transformation, numerical simulation, statistical modelling, data visualization, machine learning and more. The users also can create and share documents which consists of live code, equations, visualizations and narrative text. There are few libraries used for the

machine learning model in this Jupyter Notebook. The associated libraries are as follow:

- numpy (version 1.20.3)
- pandas (version 1.3.4)
- keras (version 2.8.0)
- tensorflow (version 2.8.0)
- fastai (version 2.7.12)
- pytorch (version 2.0.0)

iii. Visual Studio Code

A streamlined code editor, Visual Studio Code offers support for development tasks such as debugging, task running, and version control. It seeks to provide just the tools a developer needs for a short code-build-debug cycle and leaves more sophisticated workflows to fuller featured IDEs, such as the Visual Studio IDE. This allows the developer to work more efficiently. Visual Studio Code is used as a platform to setup Flutter and use Flutter to design user interface and connect the classification model.

iv. Flutter

Flutter is a software development kit (SDK) focused on creating high-performance mobile applications that can run seamlessly on multiple platforms. Flutter is used to design a user-friendly user interface (UI) for the clothing recommendation system. The programming language used in Flutter is Dart. The version of Dart that used in this project is version 3.1.0.

v. Firebase Storage

Cloud Storage for Firebase enables users to upload and share user-generated information like as photographs and videos, which paves the way for developers to include rich media content into their applications. The Firebase Storage is used to store the image uploaded from the user.

4.3 System Operation (with Screenshot)

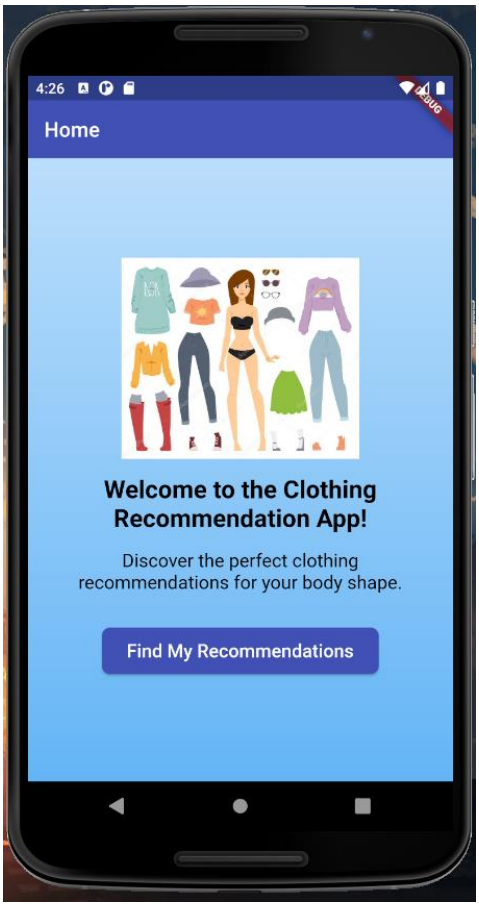


Figure 4.3.1 Homepage

From the figure 4.3.1 showed above, this is the homepage of the system. The user can click the "Find My Recommendations" button to go to the next page.

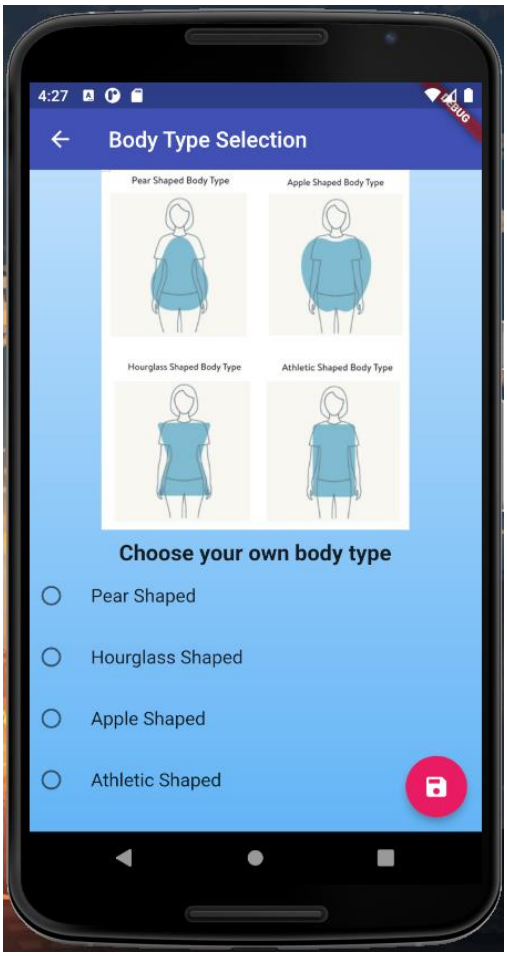


Figure 4.3.2 Body Type Selection Page

From the figure 4.3.2 showed above, this is the body type selection page. There is a picture showed in the user interface as some users do not know what type of body shape it is. The picture can give a good understanding of each body type for the user. The user can select her own body type in this body type selection page. Once the user done selecting, she can click the save button at the bottom right. The selected body type will save as text.

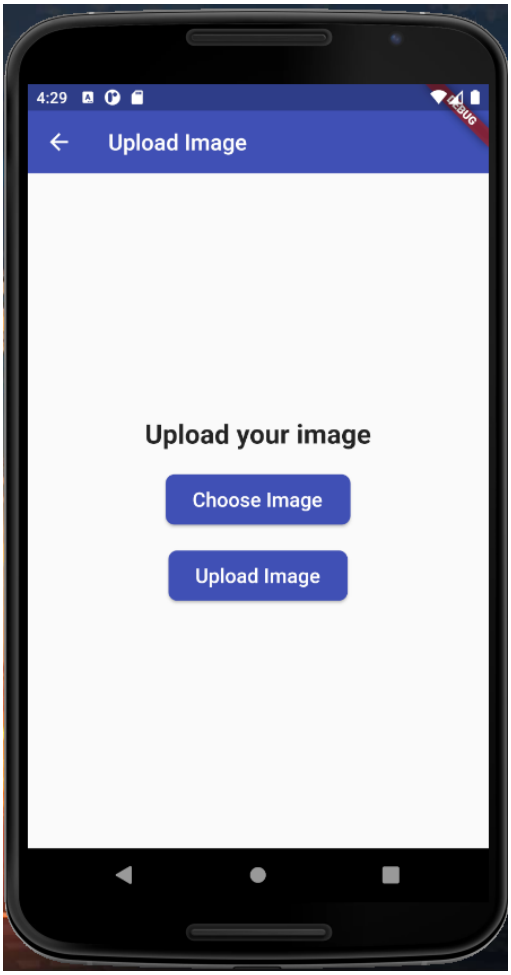


Figure 4.3.3 Choose and Upload Image Page

From the figure 4.3.3 showed above, the user can choose a clothing image from the gallery. After the user chooses the image, she can press the “Upload Image” button to upload the image to the firebase. The image will store in the Firebase Storage.

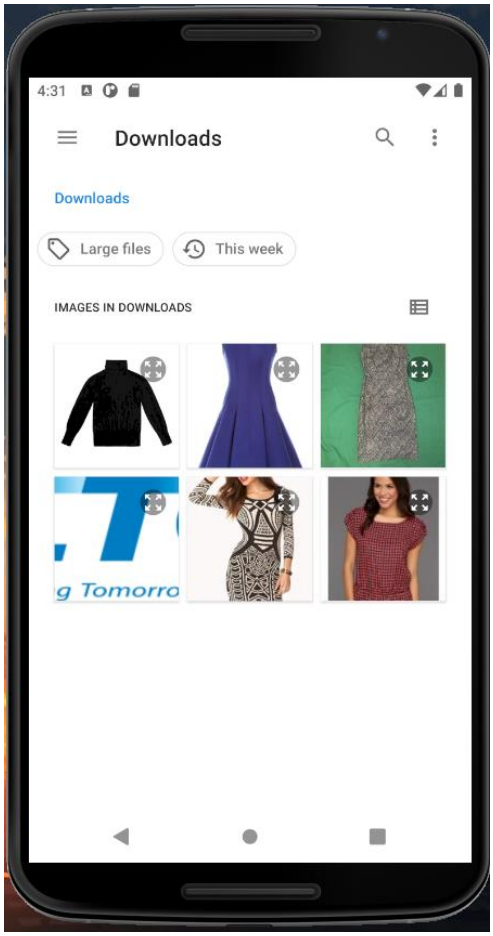


Figure 4.3.4 User's Phone Gallery

From the figure 4.3.4 showed above, this is the user's phone gallery where she can choose the clothing image. When the user clicks the "Choose Image" button, it will navigate to this page.

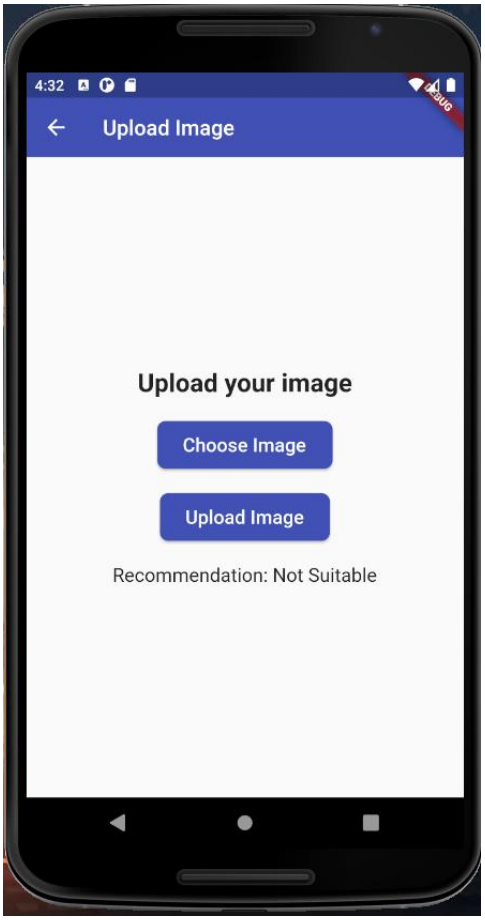


Figure 4.3.5 Final output of this project

From the figure 4.3.5, when the user uploads the image successfully to the Firebase Storage, the model will retrieve the image from the Firebase Storage and make prediction. After that, the system will give recommendation based on the body type selected and the prediction output. There are some clothing rules applied based on each body types in the system.

4.4 Implementation Issues and Challenges

Several issues arose during the implementation phase of this project. An error keeps occurring when attempting to upload a clothing image for the model's recognition. There is a shape or size mismatch between the input tensor and the image data that trying to feed into the model. The expected input image size for the TensorFlow Lite model is 602,112 bytes, which is significantly larger than the actual size of 8,064 bytes. The solution to solve this problem is to do image preprocessing for my input image. It is necessary to resize the image so that it corresponds to the form that the model anticipates receiving as input and check that the image's pixel values have been suitably normalized so that they conform to the specifications of the model. It is quite difficult to match the expected size as the image preprocessing process keeps failing to match the model's requirements.

The challenge that I faced during the project implementation was converting the model file type to a file type that was suitable for connecting to the Flutter application. The original model file type is .pkl file while the file type that is suitable for connecting to the Flutter app is .tflite file. However, the .pkl file type cannot convert directly to .tflite file as these two different file formats are used for different purposes and have distinct organizational formats. The way to do this process is to convert the .pkl file to .onnx file format first, and then convert .onnx file to .tflite file format. After that, have to make sure that the .tflite file format can be used in the Flutter application.

CHAPTER 5: System Evaluation and Discussion

5.1 Testing Setup and Result

There are some testing setups to see the result. The preparing of the test data is the first step in setting up the testing environment.

```
In [22]: test_img_data = ImageDataLoaders.from_csv(PATH, csv_fname=TEST_PATH,
                                    item_tfms=Resize(224),
                                    #batch_tfms=Normalize.from_stats(*imagenet_stats),
                                    num_workers=0)
```

Figure 5.1.1 Test Data Preparation

The ImageDataLoaders.from_csv() function is used to load the test dataset. This method reads the image file paths and labels from the CSV file that is supplied in the TEST_PATH environment variable. As demonstrated by the item_tfms=Resize(224) command, the pictures are scaled down to a standard size of 224 pixels by 224 pixels.

For the purpose of evaluation, the trained model that was previously saved as 'stage-1_resnet34.pkl' is loaded. The model has been trained and fine-tuned using the validation datasets in addition to the training datasets. After that, the learn.validate() function is used to conduct the evaluation of the model using the test dataset. This function determines how effectively the model generalizes to data that it has not before encountered by calculating the validation loss and accuracy on the test data.

```
In [23]: learn.data = test_img_data
         learn.validate()

Out[23]: (#2) [1.0105234384536743,0.704197108745575]
```

Figure 5.1.2 Evaluation on Test Dataset

From the figure 5.1.2 showed above, the output stated that the validation loss is 1.0105 while the accuracy is 0.7041 which approximately 70.4%. Based on this result, it appears that the model attained a top-1 accuracy of roughly 70.4% when applied to the test dataset. This indicates that the model accurately predicted the top-1 class, which corresponds to the class with the highest likelihood, for 70.4% of the test samples.

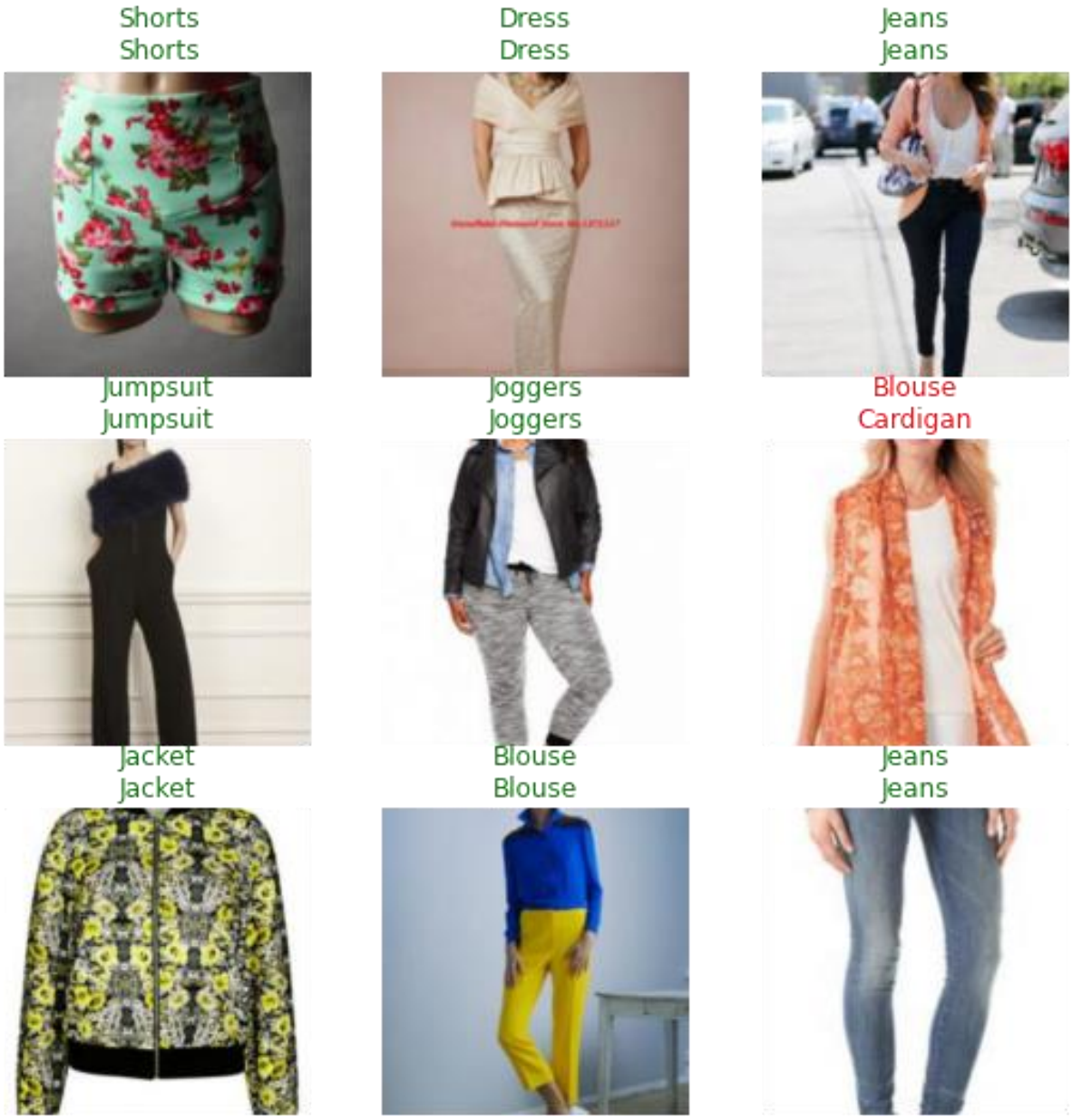


Figure 5.1.3 The result showed by using learn.show_results()

5.2 Objectives Evaluation

Objectives evaluation is performed for the three objectives in this project at the final stage. The three objectives are:

i. **To train a classification model to classify different types of clothing by using RNN**
ii. **To create clothing rules tailored to various body types**
iii. **To provide suitable recommendations based on the image of clothing and body type**

The three objectives in this project have been achieved at the end of the project. For the first objective, to train a classification model to classify different types of clothing by using RNN, the classification model was trained by using ResNet34. The classification model is checked by how it works with the user-specified image. The image is loaded and check whether the model can classify the image provided correctly or not. From the figure showed below, the output stated that the accuracy of the trained classification model is 62% which is a good prediction for a 46 classes classification model. It is because the user-specified image provided only shows a clothes item, while the DeepFashion dataset images depict a human wearing an item, making it easier to scale the outfits.

```
In [37]: print("Accuracy :", 1-len(missclassified_list)/len(test_dict))
         Accuracy : 0.6236559139784946
```

Figure 5.2.1 The accuracy of the trained classification model

For the second objective, to create clothing rules tailored to various body type, the rules had been created by doing research. The rules for each body types are stated respectively in Chapter 3.4. After that, the rules are applied to the system so that the system can provide suitable recommendations based on the rule and the prediction output.

For the third objective, to provide suitable recommendations based on the image of clothing and body type, the appropriate recommendation output will be showed at the user interface. Once the user selects her own body type and upload a clothing image, the model will make prediction on the image and pass the output to the system. Then, the system will give a recommendation output that is either suitable or not suitable for the user.

CHAPTER 6: Conclusion and Future work

6.1 Conclusion

This project title is Chatbot for Clothing Recommendation. The aim of this project is to give a clothing recommendation based on the person's body profiles and the clothing image provided. Few problems occurred in the fashion industry in this present era so that this project is proposed. For example, most of the fashion brands have been impacted by the COVID-19 pandemic and they have changed their business strategy from physical brick-and-mortar stores and department stores to direct-to-customer online retailers. The industries have suffered by the government restrictions due to the pandemic. As we can see that, many fashion brands have developed a chatbot for their customers to solve their customers' questions and problems quickly. However, some of them are failed to develop a satisfied chatbot or do not provide a chatbot to serve their customer. The failure of a chatbot is decreasing the customer's satisfaction as several issues are occurred with chatbots include interface design, too chatty and not able to understand questions.

Moreover, the motivation of this system is that developing a chatbot which can provide clothing recommendation is needed for fashion industry because it will bring convenient for their customers. This chatbot is proposed as a clothing recommendation chatbot to solve the problem of the existing system. Many customers would like to try on their favourite clothing in the physical store, but they cannot make it due to the government restriction. A useful and amazing chatbot is proposed in this project to provide suitable recommendation to the user based on their own body type. It can serve its customers efficiently and effectively.

To solve the problem of the existing system is to develop a user-friendly chatbot to provide suitable clothing recommendations for the customers by RNN. The model is able to learn to classify different types of clothes before it provides clothing recommendations. RNN allows the trained classification model to recognize different types of clothes. The model will be trained and developed by using the 46 classes clothes categories dataset which is downloaded on the Internet. After the classification model is trained well, the model will be connected to the system with some virtual interfaces. At the end, the user can view the recommendation result at the user interface.

6.2 Future work

There are still a great number of things that may be done to improve not only the evaluation but also the performance of the model. Due to the time limit, the user interface is not pretty and awesome enough. In the future, the user interface of the system can be designed to be more attractive and user-friendly. A good user interface is important as it can give a big competitive advantage by attracting and acquiring new customers. The performance of the model can be improved too, so that the prediction of different clothes can be more accurate. It means that no matter if the image provided to the classification model is single clothes or a person wearing the clothes, the model can still make prediction by giving accurate output.

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APPENDIX

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Y3S4	**Study week no.: 3**
Student Name & ID: Wong Qin Yi & 19ACB02316	
Supervisor: Dr. Aun Yichiet	
Project Title: Chatbot for Clothing Recommendations	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

2. WORK TO BE DONE

- Finding appropriate datasets and Collecting datasets

3. PROBLEMS ENCOUNTERED

- The dataset size is too big, and it takes time to download

4. SELF EVALUATION OF THE PROGRESS

- The dataset file is downloaded successfully.

Supervisor's signature

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Y3S4	**Study week no.: 4**
Student Name & ID: Wong Qin Yi & 19ACB02316	
Supervisor: Dr. Aun Yichiet	
Project Title: Chatbot for Clothing Recommendations	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

- Done downloading dataset

2. WORK TO BE DONE

- Designing model

3. PROBLEMS ENCOUNTERED

- Unable to design well

4. SELF EVALUATION OF THE PROGRESS

- Learning more to design the model

Supervisor's signature

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project I)

Trimester, Year: Y3S4	**Study week no.: 5**
Student Name & ID: Wong Qin Yi & 19ACB02316	
Supervisor: Dr. Aun Yichiet	
Project Title: Chatbot for Clothing Recommendations	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

- Done model designing

2. WORK TO BE DONE

- Training and testing model

3. PROBLEMS ENCOUNTERED

- Need time to do training and testing

4. SELF EVALUATION OF THE PROGRESS

- Learn more on training and testing

Supervisor's signature

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Y3S4	**Study week no.: 6**
Student Name & ID: Wong Qin Yi & 19ACB02316	
Supervisor: Dr. Aun Yichiet	
Project Title: Chatbot for Clothing Recommendations	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

- Done training the model

2. WORK TO BE DONE

- Continue to do testing on the model

3. PROBLEMS ENCOUNTERED

- Need time to learn how to do testing

4. SELF EVALUATION OF THE PROGRESS

- Learn more on training and testing

Supervisor's signature

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Y3S4	**Study week no.: 7**
Student Name & ID: Wong Qin Yi & 19ACB02316	
Supervisor: Dr. Aun Yichiet	
Project Title: Chatbot for Clothing Recommendations	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

- Done training and testing the model

2. WORK TO BE DONE

- Evaluate the model

3. PROBLEMS ENCOUNTERED

- Need time to figure out how to evaluate

4. SELF EVALUATION OF THE PROGRESS

- Learn how to evaluate the model

Supervisor's signature

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Y3S4	**Study week no.: 8**
Student Name & ID: Wong Qin Yi & 19ACB02316	
Supervisor: Dr. Aun Yichiet	
Project Title: Chatbot for Clothing Recommendations	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

- Done evaluating the model

2. WORK TO BE DONE

- Designing the user interface

3. PROBLEMS ENCOUNTERED

- Need time to figure out how to use Flutter

4. SELF EVALUATION OF THE PROGRESS

- Have a good understanding on how to use Flutter

Supervisor's signature

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Y3S4	**Study week no.: 9**
Student Name & ID: Wong Qin Yi & 19ACB02316	
Supervisor: Dr. Aun Yichiet	
Project Title: Chatbot for Clothing Recommendations	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

- Done designing the user interface

2. WORK TO BE DONE

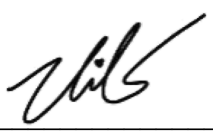
- Creating the Firebase storage to store image

3. PROBLEMS ENCOUNTERED

- A bit difficult to connect the Firebase with Flutter

4. SELF EVALUATION OF THE PROGRESS

- Learn how to connect Firebase with Flutter



Supervisor's signature

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Y3S4	**Study week no.: 10**
Student Name & ID: Wong Qin Yi & 19ACB02316	
Supervisor: Dr. Aun Yichiet	
Project Title: Chatbot for Clothing Recommendations	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

- Done creating backend

2. WORK TO BE DONE

- Apply rules of different clothing

3. PROBLEMS ENCOUNTERED

- Too many clothes categories and need to do research one by one

4. SELF EVALUATION OF THE PROGRESS

- Have a good progress

Supervisor's signature

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Y3S4	**Study week no.: 11**
Student Name & ID: Wong Qin Yi & 19ACB02316	
Supervisor: Dr. Aun Yichiet	
Project Title: Chatbot for Clothing Recommendations	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

- Done applying rules

2. WORK TO BE DONE

- Provide suitable recommendation

3. PROBLEMS ENCOUNTERED

- A bit difficult to write the code

4. SELF EVALUATION OF THE PROGRESS

- Good learning for this progress

Supervisor's signature

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Y3S4	**Study week no.: 12**
Student Name & ID: Wong Qin Yi & 19ACB02316	
Supervisor: Dr. Aun Yichiet	
Project Title: Chatbot for Clothing Recommendations	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

- Done providing recommendation

2. WORK TO BE DONE

- Write FYP2 report

3. PROBLEMS ENCOUNTERED

4. SELF EVALUATION OF THE PROGRESS

- Still on track

Supervisor's signature

Student's signature

Appendix B: Poster

CHATBOT

FOR CLOTHING RECOMMENDATIONS

INTRODUCTION

- Unsafe for consumers to try on clothes in-store during pandemic, which affected company revenue
- AI program can help company to optimize consumers' virtual shopping experience during pandemic
- Chatbots can help with recommendations, payment and delivery
- Propose to design chatbot that provide suitable recommendation based on body type

CONCLUSION

A user-friendly chatbot is developed to provide suitable clothing recommendations for the customers by RNN. The model can classify different types of clothes and the user can view the recommendation result at the user interface

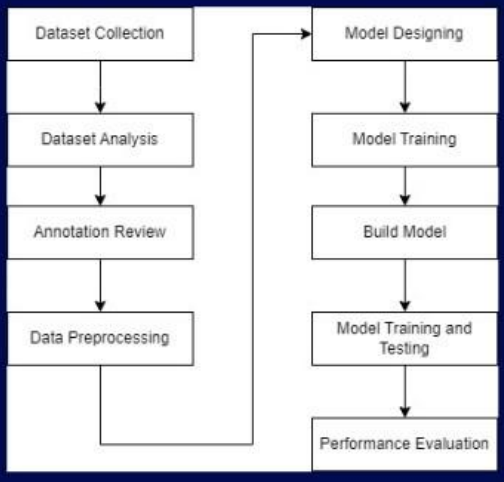
OBJECTIVES

- To train a classification model to classify different types of clothing by using RNN
- To create clothing rules tailored to various body types
- To provide suitable recommendation based on the image of clothing and body type

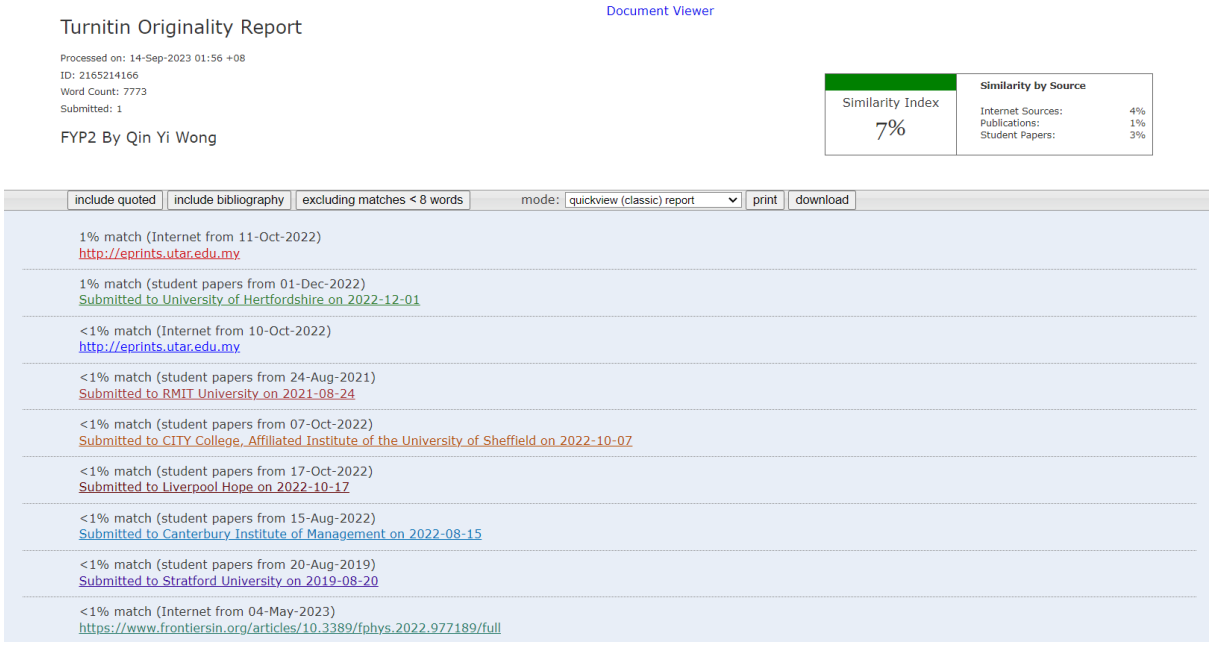
RESULT

The output with the test dataset is approximately 70.4%. The system can provide suitable recommendation result to the user.

METHODOLOGY



Appendix C: Plagiarism Check Result



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CHAPTER 1: PROJECT BACKGROUND

1.1 Problem Statement and Motivation

There is no denying that COVID-19 pandemic is seriously affecting a lot of industries such as hotel, restaurant, fashion and has led to many impacts. As we all can see that the industries are struggling to survive in this difficult situation. Many companies are facing challenges and existential threats due to this pandemic such as temporary closure, no revenue, bankrupt, layoffs and more. One of the industries that has been impacted the most during this pandemic is fashion industry. Most of the fashion brands worldwide are facing a huge challenge in consumer demand in which they can be reliant on to bring profit and revenue for the company. However, most companies changed their business strategy from physical brick-and-mortar stores and department stores to direct-to-consumer online retailers in order to survive. They select and use different types of channels such as Shopee, Lazada, Facebook, etc. Some of the fashion brands have developed their own website for their customers to boost the sales, increase

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APPENDIX

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Full Name(s) of Candidate(s)	Wong Qin Yi
ID Number(s)	19ACB02316
Programme / Course	FICT BACHELOR OF INFORMATION SYSTEM (HONOURS) BUSINESS INFORMATION SYSTEM
Title of Final Year Project	CHATBOT FOR CLOTHING RECOMMENDATIONS

Similarity	**Supervisor's Comments (Compulsory if parameters of originality exceeds the limits approved by UTAR)**
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Based on the above results, I hereby declare that I am satisfied with the originality of the Final Year Project Report submitted by my student(s) as named above.

Signature of Supervisor

Name: Aun Yichiet

Date: 14 Sep 2023

Signature of Co-Supervisor

Name: _____

Date: _____

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