Attached1

Graduation Work Proposal

2022 year semester 1

Work/Thesis	○Work(✓) ○Thesis( ) ※ Check the box
Title	Smartphone-based Dietary Assessment using Semantic Ontology and Deep Learning
GitHub URL	https://github.com/amirahnadzri/fypsoftware.git
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Personal food diet preference has been embedded in our culture through the existence of religions, beliefs, and moral values. Current, there is no existing application or tool available that could directly assist the public in choosing and categorizing commercial consumable products that cater to their personal food preference. This project aims to create an application that guides consumers globally on choosing personalized products that suit and complies with their moral beliefs. By utilizing Deep Learning Object Detection, Natural Language Process and Machine Learning-Classification, it would read text, scan through a server of ontology, then classify them based on several major food constrictions that are practised and are fair concerns. The application would serve as a solution and a convenience to the public in ensuring that their preferred diet is obliged.

1.0 Introduction

As human culture and biology evolve, there is much more dietary restriction tied to our physiology and values. Yet the commercial goods that are available all around are still not directly informing their consumers on the ingredients of their products. For instance, people who are lactose-intolerant, vegan, vegetarian, and who complies with religious dietary restrictions often find it inconvenient to shop for goods that consider their personal values. Goods now substitute their ingredients with scientific terms and codes to further cast a filter while corporations are well informed on how they should be transparent to their consumers. The possible cause of this may be because directly revealing ingredients might decrease the size of their current niche.

Currently, there are applications that help you with the most common dietary restriction, such as halal products, vegan products, gluten-free products, and keto products. However, these applications are restricted and only limited to a specific dietary restriction, location, and their available product database. This would force the consumer to use a different application for extra concern. An application where people of more than one category of dietary restriction can utilize, and rather than relies on a database of products, scans the ingredients, and informs users on whether the users should or should not be concerned before buying the goods, is considered a need in this current society.

With the help of multiple Artificial Intelligence and Machine Learning models, this project will directly offer a hand to people around the world to further analyse their preferred goods and get more information on whether the goods being sold are aligned with

their dietary restrictions. By searching through a wide range of ontology in the provided designated server, the application can serve and deliver data to the machine learning classification model and immediately make the users know the desired information about whether their diet is listed among the ones that the product complies with. This would not only be beneficial to users daily but will also serve as a convenience for when users are at a foreign place that the local population do not value the same restriction that the user obeys. This could be of use for users who lives as an ex-pat in a foreign country or people who enjoys travelling.

Additional features that comply with the theory of User Experience and User Interface will also be implemented in the project which ensures the accessibility and marketability of the application globally. An application needs to not only be effective in its function but also must be user-friendly hence the importance of creating the application parallel to what the global users seek.

2.0 Literature Review

Mobile-app development has been improved over the years using Android as its base, however with applications developed in Android SDK cannot be released in the iOS because of the difference in code base. applications in Android. Kotlin and React Native are common frameworks used in building applications which are programmed in Java and JavaScript respectively. Using Kotlin to develop mobile applications will be expensive as the app will require two separate codes, meaning doing the twice the work. JavaScript can easily be integrated into mobile app development, but it lacks a debugging facility. This means that error-detection will be difficult to track and solve.

With the release of the Flutter SDK by Google, building applications that are able to be pushed to both Android and iOS store became easier. Flutter comes with a toolkit that allows developers to custom user interfaces just as if they were developing web applications using a single code base. Flutter also provides a hot reload feature the helps during experimentation, adding features and fixing bugs.

According to a statistic on the cross-platform mobile frameworks used by software developers worldwide from 2019 to 2021 by Statista, Flutter and React Native are two of the most commonly used in mobile app development. However, over the course of those 3 years, there is a steady increase in the number of developers using the Flutter framework, and on the other hand, developers in React Native have reduced. The graph shows that last

year 42 percent of worldwide software developers preferred Flutter over other platforms. [1] Currently, Flutter supports platforms of every type. For Android devices, Android SDK version 19 and above are supported and for iOS devices, iOS 9 and above are supported.

Furthermore, in order to classify an image, the application needs to be able to completely understand the image being processed. This can be performed by implementing an object detection algorithm into the application. Valuable information in terms of semantic understanding of images and videos can be obtained through object detection.

There are 2 processes related to object detection which are required to provide accurate reading for the object detection which are image classification and feature extraction. Image classification is the process of predicting the type or class of an object in an image, meaning labeling objects after object recognition. Feature extraction on the other hand, involves locating the presence of objects in an image and indicating their location with a bounding box. Conventional frameworks for classification of objects makes use of both of these tasks. There are several frequently used feature extraction techniques that are used to extract information from objects for example Histogram of Oriented Gradients (HOG), Gabor filter, Local Binary Patterns (LBP) and so on [2]. Various research has been made to improve the efficiency of feature extraction algorithms.

Recent technologies in object detection have implemented different versions of R-CNN or also known as Regions with Convolutional Neural Network Features. R-CNN is composed of three modules which are region proposal, feature extraction, and classifier. Combining these modules will produce classified regions and the type of object can be determined through selective search on the regions produced. Therefore, R-CNN can be used in providing the framework for initial object detection.

Besides that, the project mainly focuses on applying ontology with machine learning. Utilization of ontology are typically more focused on life sciences, but in this project, it plays a major role in differentiating between animal-based products, plant-based products, and chemical-based products. Studies have shown the correlation of ontologies and machine learning, especially in association prediction [3]. The project intends to create an algorithm that allows the mobile application to retrieve data provided by the object detection in the ontology for classification.

Machine learning has many applications and one of them is to find the right target audience. Cookies containing user information on websites allow artificial intelligence (AI)

to direct consumers to specific products. This functionality can be applied to ensure that every user of the app will be able to retrieve the most accurate information based on their preferences [4].

3.0 Work/Thesis Process Plan and Form

The process plan for this project will mainly be divided into three parts: front-end, back-end and Machine Learning (ML) classification. Combining these three will be crucial to the development of the mobile application for this project.

3.1 Front-end

3.1.1 Flutter

Flutter will be used as our open-source mobile UI framework to build our main mobile application for this project. The camera feature will be added in the mobile application to allow end-users to scan objects in their environment, or in this project specifically, food products. This feature will allow the mobile application to scan and read through the ingredient lists.

Flutter is also chosen due to its ability to be used to build both iOS and Android apps. The Dart language it uses enables the same source code to be used for both platforms and ease the development of the mobile application [5]. This will also reduce code not only development time but also offers excellent potential for UI customization [6]. It will be more flexible and versatile in the process of developing a quality UI/UX.

3.1.2 TensorFlow Lite

TensorFlow Lite, a deep learning framework that converts a pre-trained model in TensorFlow, is to be integrated into this mobile application. This is in order to incorporate Optical Character Recognition (OCR) as a computer vision and machine learning technique that will help in the process of recognizing characters in images or videos that is pertinent to the implementation of the mobile application for this project [7]. It is selected as it uses a text detection model and text recognition model for the recognition of the text characters.

3.1.3 spaCy

SpaCy is an open-source library for Natural Language Processing in Python. It can be used in this project to detect whether the recognized text characters from the OCR exist

and whether it is logical or not for a single or combination of words. It also supports custom models in TensorFlow, among other frameworks; therefore would be easier to integrate both of these models together in this project [8].

3.2 Back-end

3.2.1 Django

To provide a server which is the back-end for this project, Django, a high-level Python web framework that will be used to speed up the development of our mobile application. RESTful Application Program Interface (REST API)s will be added through Django as it is needed for the use of HTTP requests to access and use data. Django also supports multiple databases such as MySQL and Oracle [9].

3.2.2 Ontology

An ontology database is a basic relational database management system that models an ontology and its instances [10]. In this project, the data regarding food ingredients and classification be sorted by the concept ontology. Ontologies can increase the use, reuse and maintainability of the information systems and benefit real-time data access [11] [12].

3.3 ML Classification

Machine Learning classification will be used in this project to classify what specific products belong to which interest group. The classification algorithms such as the decision tree will be used to predict the classification regarding this matter.

4.0 Expected Effect & Improvement Direction

The existence of this mobile application is to help and ease people of minority groups, whether that of ethnic groups, people with following certain religious beliefs or those that follow a special and unique diet, in finding food at unfamiliar places such as when travelling to another country or searching for food products that do not disclose their source of the ingredient. It is inevitable for large food and beverage companies to produce food products that do not cater for all major and minority groups. Also, depending on the country, the food products may only cater to the majority groups who are citizens of that said country.

Therefore, it is inconvenient for the minority group people to shop for food products and find food freely and with ease due to their dietary restrictions.

For example, lactose-intolerant people are able to consume food that does not contain lactose which is a sugar found in milk and milk products, as they are unable to fully digest the sugar, people following religious dietary laws such as the Islamic dietary laws and 'halakha or the Jewish dietary laws where they are only permissible to consume Halal and Kosher food, and people who practice veganism abstain themselves from using any animal products while those who practice vegetarianism does not consume meat.

As there are food and beverage corporations that are not fully transparent with their consumers on their products' ingredients listing on the packaging, relying 100% on the ingredients list stated on the packaging does not guarantee the certainty of what is consumed. Therefore, this application can be used to push aside the uncertainty and help people in purchasing and consuming food products with confidence and less worrying. By scanning the ingredients list at the back of the packaging, the application will show the user each ingredient's origin, whether they contain specific chemicals, meat-based or a plant-based ingredient, in addition to classifying if the product is consumable for particular groups or not.

5.0 ETC

5.1 Dividing Role

5.1.1 Mobile App Developer (Nurlaili Binti Zainal Abidin - 2019313854)

Roles:

a. Develop the mobile application's User Interface and implement the features of other Machine Learning and Natural Language Processing models through Flutter.
b. Ensuring the efficiency of the application and its additional features for when it connects to the server and models.
c. Research on suitable Natural Language Processing models to be implemented in the project.

5.1.2 Machine Learning Model Developer (Aizat Hamizuddin Bin Azlan - 2019313858)

Roles:

a. Work closely with a graduate student to develop and training the model to ensure it aligns with the project's objective.

b. Ensuring model's efficiency to process data and give accurate feedback that the users intended to seek.
c. Gather information major and minority groups as target groups to be implemented in the model.

5.1.3 Back-end Server Developer (Amirah Binti Ahmad Nadzri - 2019313857)

Roles:

a. Develop the back-end server to ensure the efficiency of the data structure.
b. Securing the server's efficiency to process data and give accurate feedback to the model.
c. Research on data related to food in the form of an ontology to be stored in the server.

5.1.4 Team Lead cum Back-end Server Developer (Fatdzirul Izzat Bin Abdul Radzi - 2019313856)

Roles:

a. Lead the team and manage tasks to ensure deadlines are met while progressing the project.
b. Develop the back-end server and ensure the server's efficiency in processing data and giving accurate feedback to the model.
c. Research on data related to food in the form of an ontology to be stored in the server.
d. Brainstorm more additional features to be added to the application as the application is being developed.

6.0 References

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