AMBIENT-AWARE FOOD RECOGNITION AND MANAGEMENT IN CONTEXT OF SMART FRIDGE

BY

CHRISTINE LAU YUET NING

A REPORT

SUBMITTED TO

Universiti Tunku Abdul Rahman

in partial fulfillment of the requirements

for the degree of

BACHELOR OF INFORMATION SYSTEMS (HONS)

BUSINESS INFORMATION SYSTEMS

Faculty of Information and Communication Technology

(Kampar Campus)

JAN 2020

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Date: 19 APRIL 2020

Date: 23/4/2020

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DECLARATION OF ORIGINALITY

I declare that this report entitled "**AMBIENT-AWARE FOOD RECOGNITION AND MANAGEMENT IN CONTEXT OF SMART FRIDGE**" is my own work except as cited in the references. The report has not been accepted for any degree and is not being submitted concurrently in candidature for any degree or other award.

Signature : CHRISTINE

Name : CHRISTINE LAU YUET NING

Date : 19 APRIL 2020

ACKNOWLEDGEMENT

I would like to express my sincere thanks and appreciation to my supervisors, Dr. Aun YiChiet who has given me this bright opportunity to engage in an image classification project. A million thanks to you. Besides, I would like to thank my course mates, who give me a lot of support and motivation in completing this project. Last but not least, I must say thanks to my parents and my family for their love, support and continuous encouragement throughout the course.

ABSTRACT

Object detection and image classification is one of the modern computer vision technology. Image classification can be defined as the process of labelling images into one of a number of predefined classes or categories. Image classification can be done using several classification techniques such as Faster-RCNN, YOLO and SSD. This project is an image classification project for detecting the life time of a fruit. The project is able to detect the remaining life time of the fruit before it is not edible based on the fruit's current state. In this project, Faster-RCNN was used to carry out image classification.

Food wastage is now causing a big problem to the world. Land has been deforested, animal species has been driven to extinction and soil has been degraded just for producing food that are never to be eaten. If not taken care of, it will cause bigger problems to the world and society. With technology, this project was carried out to reduce food wastage by using image classification with Faster-RCNN. The final product is able to tell the users the remaining days of the fruit to be consumed before the fruit is going bad. The result of the project is expressed in the report.

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LIST OF ABBREVIATION

API	Application Programming Interface
CNN	Convolutional Neural Networks
CPU	Central Processing Unit
Faster-RCNN	Faster Region Convolutional Neural Networks
GPU	Graphics Processing Unit
IoT	Internet of Things
LED	Light-Emitting Diode
RFID	Radio-Frequency Identification
SSD	Single Shot Detector
USD	United States Dollar
YOLO	You Only Look Once

Chapter 1: Introduction

1.1 Problem Statement

Nowadays, food wastage is one of the biggest problem to the world. According to Olio (2018), among all the food that has been produced, about 33%-50% of them is never consumed, and these food costs around 1 trillion USD. Besides, resources were wasted when creating the uneaten food. Land has been deforested, animal species has been driven to extinction and soil has been degraded just for producing food that are never to be eaten.

Therefore, with the advance technologies in this era, food wastage problems can be reduced by the technologies. For example, smart refrigerators are invented to reduce food wastage. According to Techopedia (2018), smart refrigerators are refrigerators that are high-tech programmed which able to sense what kind of products is inside the fridge and able to keep track on the details of package items such as expiry and usage through RFID and barcode scanning. However, the smart refrigerators are more expensive than regular refrigerators, and if an individual has already owned a regular refrigerator and wanted a smart refrigerator, he or she cannot upgrade the refrigerator to a smart refrigerator, unless he or she discards the old refrigerator and buys the smart refrigerator.

1.2 Background and Motivation

Image classification is a type of machine learning that trains the machine to recognize and classify the image classes by providing a set of training data. Classification is an easy task for human being to learn, but for computers or machines, it is a complex task to learn. Image classification is a modern computer vision technology. Image classification is giving an image as an input and the outcome is what the image holds. An image classification algorithm is trained to learn the differences between the classes. In order to train the model, labeling process is a must. Labelled data is needed to train the model, which consists of images with bounding box coordinates and class name.

With the growth of technologies in this era and the improvement in image classification, the idea of keep tracking the groceries inside a refrigerator wherever and whenever with a lower cost can be achieved by developing a smart camera that are placed inside a refrigerator and

connect or sync it with a software application, and users just have to download this application in their mobile phones to keep track what is inside their refrigerator. The smart camera should be also able to detect the expected edible period of the food that is not easily to be labelled such as fruits and vegetables. With this, Users will be able to know which of the products are going bad and consume the products before they gone bad and causes food wastage.

1.3 Project Scope

The goal of this project is to build an algorithm that can be implemented in camera or smartphones, which is able to detect the edible period of a fruit. In this project, the detection only works for grapes, specifically, green grape and red grape. The target detection accuracy for this algorithm is around 75% as the detection with percentage higher than 50% is enough to differentiate between the classes. This algorithms aim to help the users being able to track the edible period of the grapes when they are not physically able to. The key features that this algorithm is able to perform is estimating edible period. A picture of a grape is captured and by using this algorithm, the user is able to know the estimate edible period of the grape based on its current state and its surrounding temperature.

1.4 Project Objectives

In this project, three objectives are proposed:

- To model fruit freshness state for subsequent classification using CNN
    - Having this algorithm helps to reduce the number of food spoilage and wastage by letting the user knows about the edible period of the fruit. This enable user to be aware of the fruit's state and consume it within the time period.
- To develop a fruit freshness estimation system inferring to the CNN model
    - Users able to capture the image of the fruit and based on the image capture, the algorithm will return the edible period of the fruit.
- To integrate ambient-awareness into fruit freshness estimation using IoT sensors
    - With the temperature sensor, the algorithm will estimate the edible period of the fruit based on the surrounding temperature where the fruit is kept.

1.5 Achievement

Here are some highlights what have been achieved in this project:

- Able to detect types of fruit, which in this project are green grapes and red grapes
- Able to detect the edible period of the fruits according to the surrounding temperature that are kept

1.6 Report Organization

This report is organized in few chapters. Chapter 1 is the introduction of the project, which consisting problem statement, background and motivation, project scope and objectives. Chapter 2 is about the literature review done in reviewing the related products available in the market and the comparison between them and the proposed algorithm. Chapter 3 is the system design, where the process of developing the project is described, and also including the implementation issue and challenges in this project. In chapter 4, the methodology used in this project and the tools needed to develop this project is listed. Chapter 5 is about the implementation and testing of the project, where the result of testing the project is recorded. Chapter 6 is the conclusion of this project, which described on what had been achieved and the future improvement on the project.

Chapter 2: Literature Review

2.1 Related Products

2.1.1 Smarter FridgeCam

Figure 2.1 Smarter FridgeCam

Description

Smarter FridgeCam is the world's first wireless fridge camera that can be mounted inside any type of refrigerator, snaps photo about the contents inside the refrigerator, allowing users to know what is inside their refrigerator. It will take a snap of the interior of the refrigerator every time the refrigerator door is being open and close. The Smarter FridgeCam uses a fisheye lens that helps to see from top of the refrigerator to the bottom and a LED flash is included to ensure the images captured are bright and clear for the users to view. To view the photos, users first have to download the Smarter app on their mobile phones. Once the FridgeCam takes a snap, the photo is sent to the Smarter app on the mobile phone via Wi-Fi. Users can view the content of the refrigerator whenever and wherever they are. The camera is using a rechargeable battery, but it does not need charging very often as it only turns on when snapping photos and sync to the Smarter app.

Besides, FridgeCam has a best before tracker, which will track the expiry dates of the products inside the refrigerator. When the products are close to the expiry date, users will be notified to consume the products in time. The Smarter app also enable users to create shopping list, so when a user is performing grocery shopping, he or she can refer to the shopping list to purchase the desire items.

Figure 2.2 Smarter FridgeCam mounted to the refrigerator door

Figure 2.3 Smarter app view

Strengths

One of the strengths of the FridgeCam is it contains object recognition feature. The software uses this feature to identify the products in the refrigerator and compare them to the database. If they were a match, the products will add to the inventory automatically. The best

before dates of the products can be added to get notified when a product is going off, and user will be alerted when products are being removed. The FridgeCam can be also connected to other smart home devices such as Amazon Alexa. It also uses BlinkUp Technology with simple and secure device pairing that allows one-step setup in seconds.

Weakness

However, the FridgeCam also has its flaw. The object recognition of the FridgeCam sometimes does not work well. According to Bray (2018), the FridgeCam had failed to recognise the items in his refrigerator automatically. Manual work has to be done to record the items placed in the fridge, either by scanning the barcode or add them manually later. The FridgeCam also has its limitation in seeing the areas of the refrigerator. It is completely blind to the items placed in the door section and the vegetable section, which is a separate compartment of most of the refrigerator, and is difficult to see the items that are blocked by a larger item in front. It also do not have the ability to detect the edible period of the food inside the refrigerator.

2.1.2 Samsung Family Hub™ Refrigerator

Figure 2.4 Samsung Family Hub™ Refrigerator

Description

Samsung Family Hub™ Refrigerator contains a lot of smart features that help and manage users' home and life, such as food management, entertainment, family connection and able to connect living capabilities. All of these features can be managed from the touchscreen on the refrigerator door. For this proposal, the food management feature is investigated and reviewed. Samsung Family Hub™ Refrigerator support easy food management, with 3 built-in cameras that enable user to view what is inside the refrigerator anywhere. They snap a photo of your products inside the refrigerator every time time-stamp set. Users have to first download the Smart Thing Classic app in their mobile phones and then with some simple settings done, users will be able to connect to the refrigerator. There is an option for user to add the expiration dates of the items inside the refrigerator to help in keep tracking of the freshness of the items.

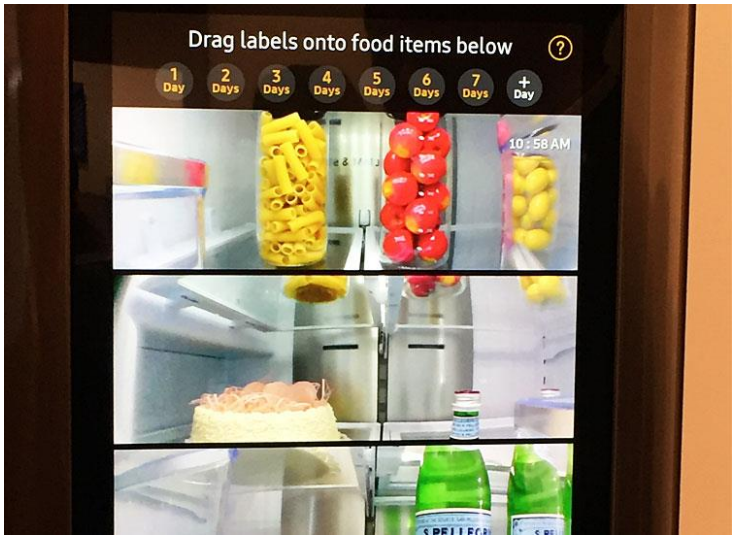

Figure 2.5 Views inside the Samsung Family Hub™ Refrigerator with drag-and drop labels for expiration count down

Strength

Samsung Family Hub™ Refrigerator contains a meal planner for planning meal based on the ingredients available inside the refrigerator, and if some ingredients are not available, they will be automatically added to the shopping list in the app. Besides, it also has a digital assistant named Bixby. Bixby carries out the users' command and enable users to navigate the screen hands-free. For example, user can use voice command to add items to the shopping list.

Weakness

The downside of the Samsung Family Hub™ Refrigerator is that the cameras will not be able to detect the food or the contents of the crisper drawers of the refrigerator. According to Long (2018), he mentioned that when the refrigerator is packed with many products, it is very hard to see all around inside the refrigerator. Besides, for the expiration date tagging, it only stays when the product is not moved. Once the product is being moved, the expiration tag disappears, and this becomes a bit useless as the time goes. Like Smarter FridgeCam, it also do not detect the edible period of a food.

2.2 Summary table

A summary table can be generated to show the comparison between FridgeCam, Samsung Family Hub™ Refrigerator and the proposed algorithm.

	FridgeCam	Samsung Family Hub™ Refrigerator	Proposed algorithm
Detect edible period of crops	No	No	Yes
Accuracy in detecting edible period of crops	Unavailable	Unavailable	High
Image capture interval	Every time a refrigerator door is open and closed	Time-stamped	When needed
Techniques	Object recognition	Image processing	Image processing with scripts to estimate edible period
Types of food detectable	Packaged food labelled with barcode	Manually label	Grapes
Best before tracker	Manually enter	Drag and label using screen	Capture image and estimate based on current state
Temperature aware	No	No	Yes

Table 2.1: Comparison of existing products with proposed algorithm

Chapter 3: System Designs

3.1 Model Training Process

TensorFlow Detection API is used in this project. TensorFlow is an open source machine learning library that support several object detection neural networks used in image processing. Neural network is a set of algorithm modeled loosely after human brain to recognize pattern. They interpret data through machine perception, labelling and clustering raw input. Convolutional neural network is neural network used to classify images, grouping image by similarity and perform object recognition.

Before starting the training process in computer, the virtual environment had to be set up in order to have all the requiring packages to train a detection model. Then, deciding neural network architectures according to the hardware used to train the model, which Faster-RCNN is chosen as it is the better option to train the detection model out of many of the neural network architectures.

After setting up the virtual environment, in order to train the model, labeling process is a must. Labelled data is needed to train the model, which consists of labelled images with bounding box coordinates and class name. Image with different angle is preferred to ensure higher accuracy of the model.

Next, when the environment setting and picture labelling process is finished, the training process can be started. The training process duration will differ according to the power of the hardware used. Then, the detection models can be used to perform fruit's edible period estimating.

To be ambient aware, three models are trained, which is room temperature, refrigerator temperature and freezer temperature. Temperature sensor is needed to detect the surrounding temperature of the fruit and use the trained model accordingly to estimate edible period. The temperature sensor is coded and the detected value is included in the captured picture's name.

3.2 Implementation Issues and Challenge

During the implementation, for image classification, the more powerful the hardware acquired, the faster and accurate the model you trained. For this project, even though GPU and Faster-RCNN is used to train the model (which is both the better option for image processing), however it is still not in the best performance to train the model. Therefore, more time is used to train the machine and this makes the completion of this project on time a challenge

3.3 Timeline

No.	Task	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14
1	Development														
	Prototype Development	/	/	/	/	/	/	/	/	/	/	/	/	/	
	Weekly Meet Up with Supervisor	/	/	/	/	/	/	/	/	/	/	/	/	/	
2	Research														
	TensorFlow				/	/	/	/	/	/	/	/			
	Faster-RCNN				/	/	/	/	/	/	/	/			
3	Data Collection														
	Image Capturing			/	/	/	/	/	/						
4	Model Training														
	Image Labelling			/	/	/	/	/	/						
	Training Process									/	/				
	Evaluate the model performance									/	/	/	/		
5	Report Writing														
	Documentation report											/	/		
6	Presentation														
	Planning													/	/
	Presentation														/

Figure 3.1 Gantt chart

Chapter 4: Methodology and Tools

4.1 Chosen Methodology

System Development Life Cycle (SDLC) is a conceptual model which define a series of steps and task involved to develop a system (Rouse, 2018). The general approach of SDLC is requirement, analysis, design, coding, implementation and maintenance.

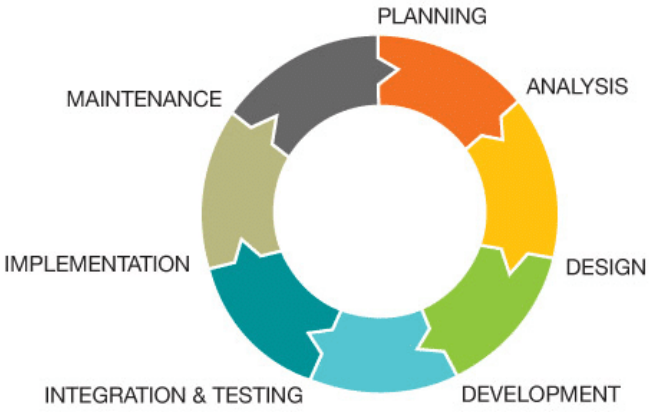

Figure 4.1 System Development Life Cycle (SDLC)

The development approach that will be used is Extreme Programming (XP) methodology. This methodology includes 5 stages: planning, design, coding, testing and deliver.

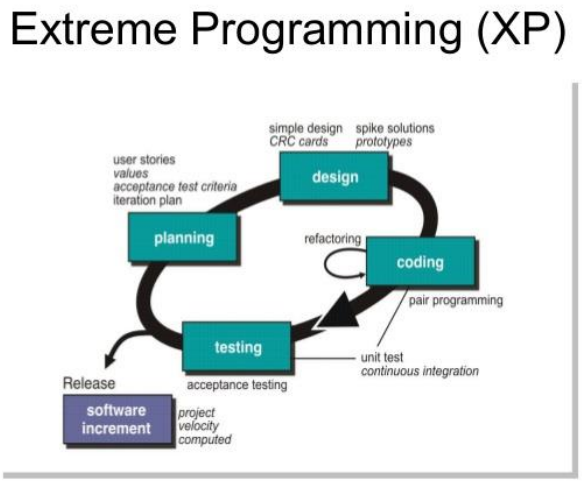

Figure 4.2 XP methodology

XP is chosen because of the flexibility on the development life. XP helps in building system quickly and it has the ability to adapt to changing requirements at any point during the project cycle. After planning, project simply perform analysis, design and implementation phases iteratively. Testing and efficient coding practices are important and XP is suitable for small projects like this projects.

4.2 Tools to use

LabelImg is used to label image to build data set. It is a process which is defining bounding box for the images captured to train the model. For image classification, coordinate of the bounding box is needed (x_min, x_max, y_min, y_max) for the image dataset. This will create an xml file for every images labelled to generate image dataset.

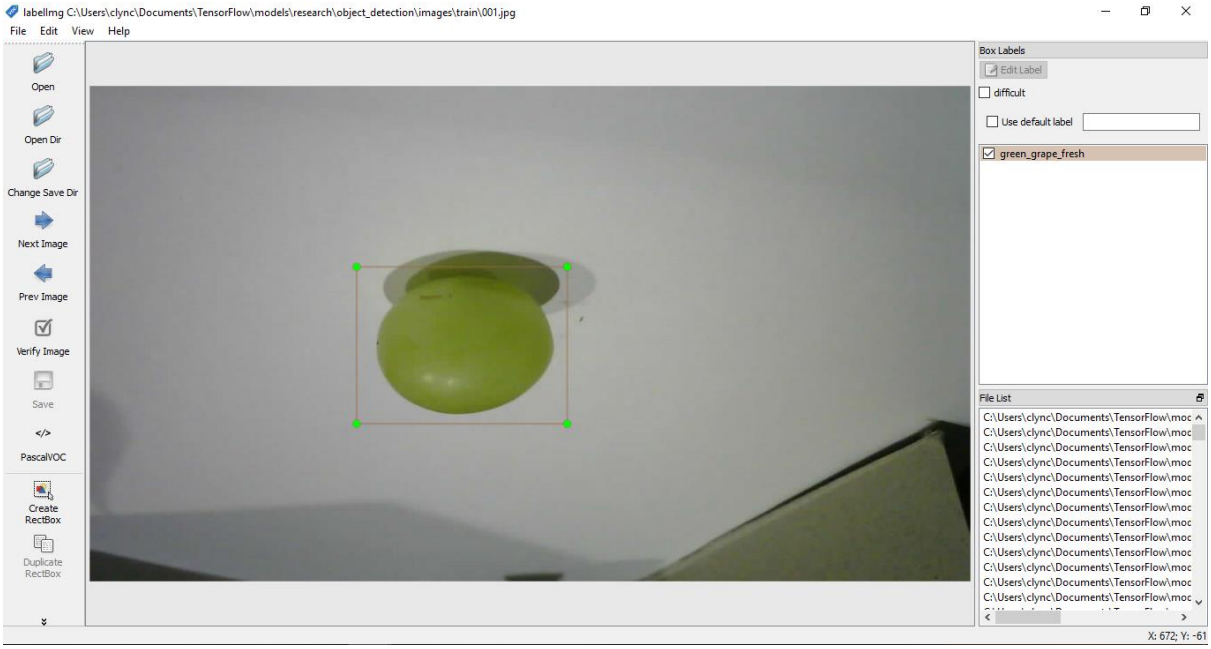

Figure 4.3 LabelImg

Anaconda is an open source distribution used to run the python code. In this project, Python version 3.6 is used to train the model. Its Anaconda Prompt is generally used to deal with all the process of image classification, such as running the code and training the model.

Figure 4.4 Anaconda Prompt

Jupyter Notebook is used to test and verify the result of the model trained. It consists of *kernels* which will run the written python code cell by cell to obtain the reults.

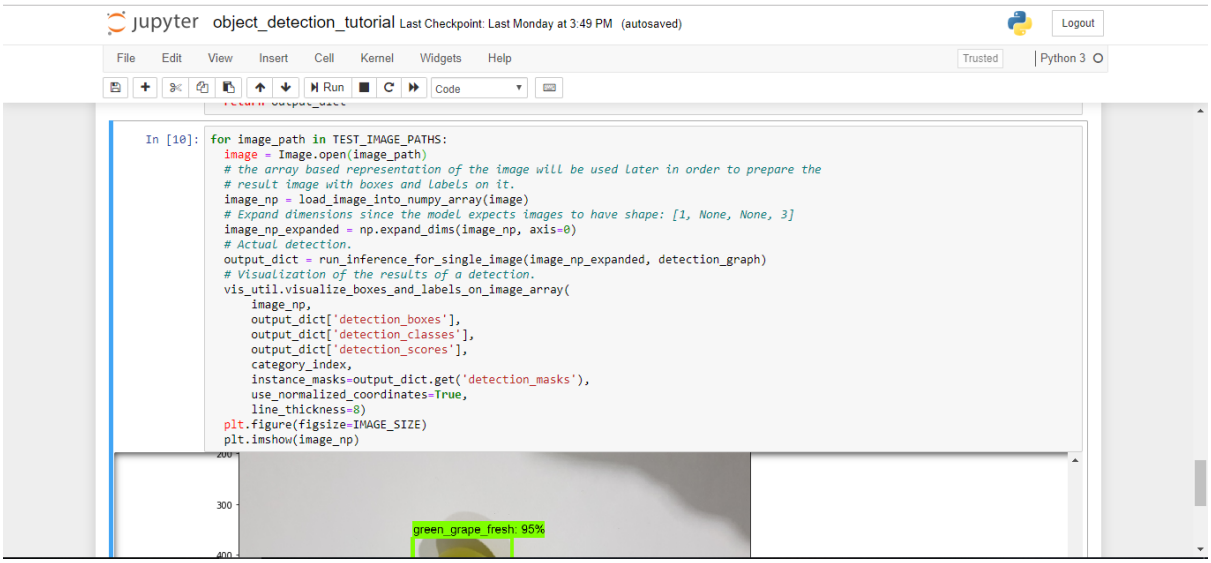

Figure 4.5 Jupyter Notebook

To detect the surrounding temperature, the DHT11 Temperature sensor is used. The detected value is included into the name of the captured picture. The value is then retrieved and used to decide which model to use to estimate edible period.

Figure 4.6 DHT11 Temperature sensor

Chapter 5: Implementation and Testing

5.1 Result

The grapes are kept in the various temperatures and pictures were captured in different time period. Here are some of the results during testing:

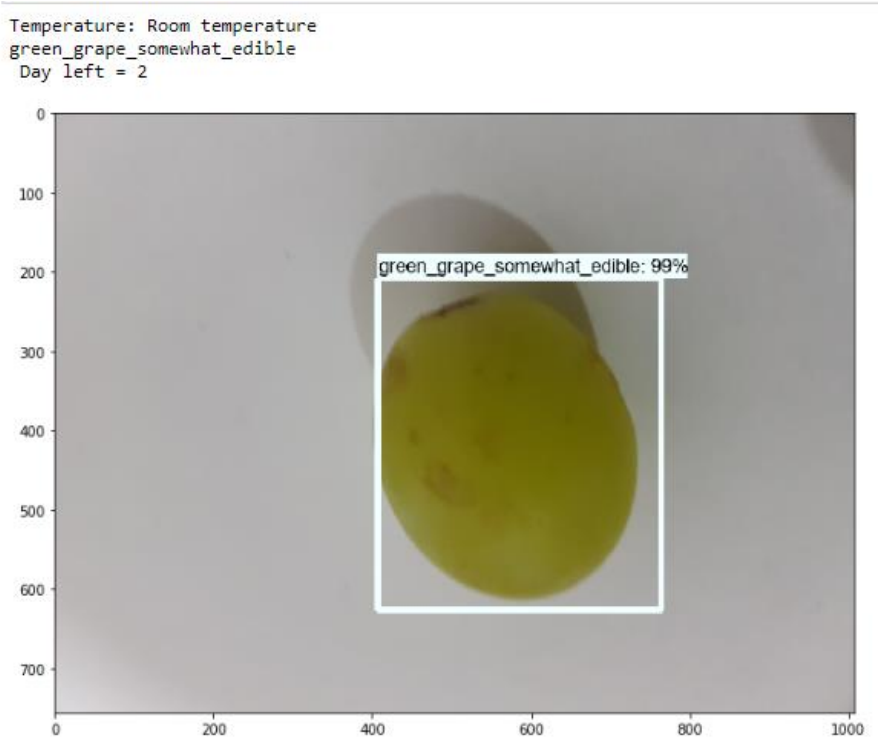

Figure 5.1 Result using image of green grape kept in room temperature for 3 days

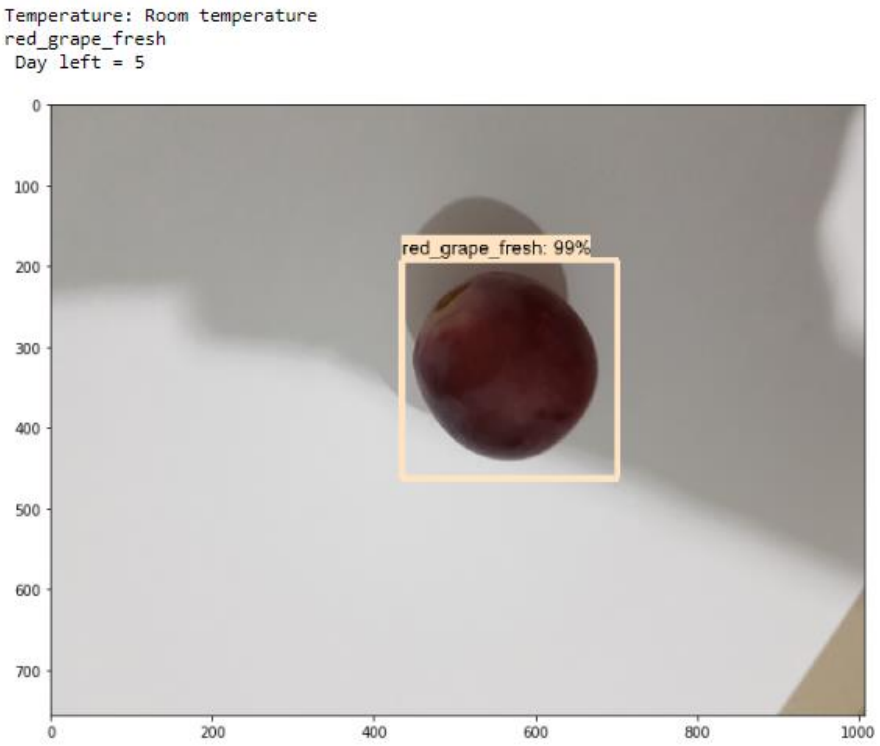

Figure 5.2 Result using image of red grape kept in room temperature in the first day

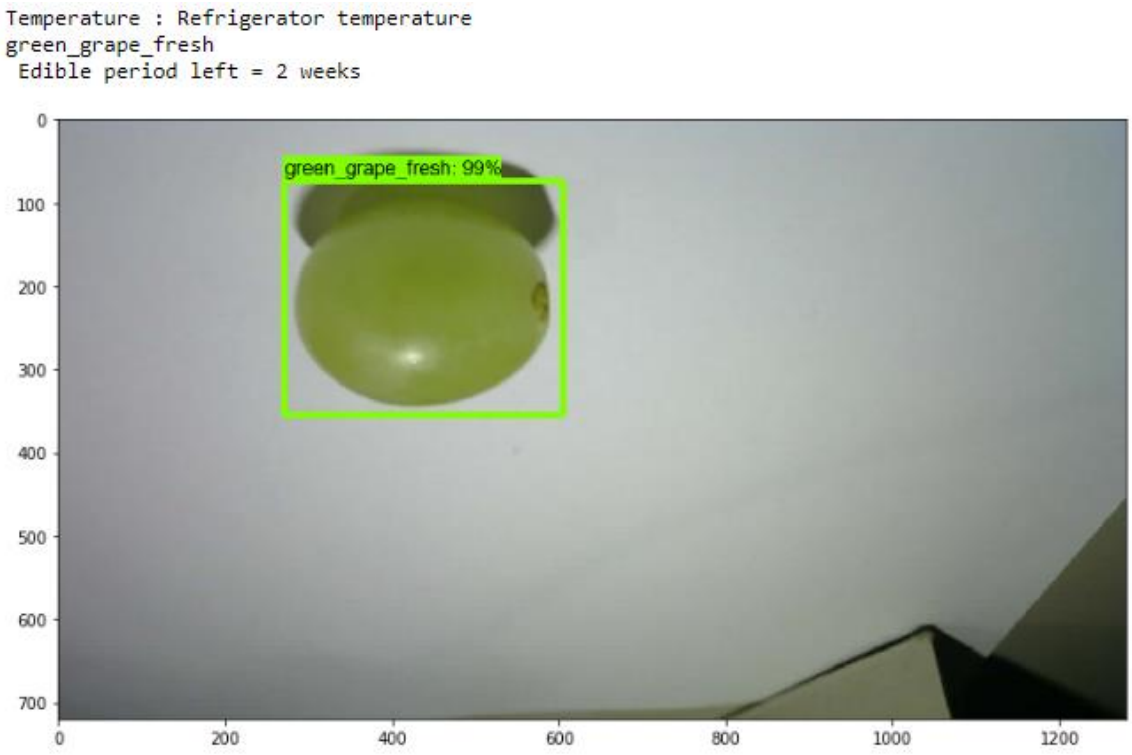

Figure 5.3 Result using image of green grape kept in refrigerator temperature for 5 days

```
Temperature : Refrigerator temperature
red_grape_somewhat_fresh
 Edible period left = 1.5 weeks
```

Figure 5.4 Result using image of red grape kept in refrigerator temperature for 1 week

Chapter 5: Conclusion

Food wastage had always been a problem to the earth and if not taken seriously, it would bring more harm to the society. Many steps can be carried out to solve the problem. SmartFridge and FridgeCam are invented to record the expiry date of food that had given expiry date such as canned food or packaged food, and notify the users when the expiry date is near. However, they cannot detect the freshness or edible period of crops such as vegetables and fruits.

In this project, the algorithm is able to detect the types of fruits and also the surrounding temperature, and then continue to estimate the edible period of the fruits. The objectives are achieved. There are some future improvement that can be included for this project, which is developing more fruit types and make this into an application for people to use this algorithm.

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FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Jan 2020	**Study week no.: Week 1**
Student Name & ID: Christine Lau Yuet Ning 1603254	
Supervisor: Dr. Aun YiChiet	
Project Title: AMBIENT-AWARE FOOD RECOGNITION AND MANAGEMENT IN CONTEXT OF SMART FRIDGE	

1. WORK DONE

Analyze past project

2. WORK TO BE DONE

Discuss more detail about project to be developed

3. PROBLEMS ENCOUNTERED

No problem encountered

4. SELF EVALUATION OF THE PROGRESS

Few requirement has been decided

Supervisor's signature

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Jan 2020	**Study week no.: Week 2**
Student Name & ID: Christine Lau Yuet Ning 1603254	
Supervisor: Dr. Aun YiChiet	
Project Title: AMBIENT-AWARE FOOD RECOGNITION AND MANAGEMENT IN CONTEXT OF SMART FRIDGE	

1. WORK DONE

Research about the improvement to be done in project II

2. WORK TO BE DONE

Research more related work

3. PROBLEMS ENCOUNTERED

No problem encountered

4. SELF EVALUATION OF THE PROGRESS

Amazed about new findings

Supervisor's signature

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Jan 2020	**Study week no.: Week 3**
Student Name & ID: Christine Lau Yuet Ning 1603254	
Supervisor: Dr. Aun YiChiet	
Project Title: AMBIENT-AWARE FOOD RECOGNITION AND MANAGEMENT IN CONTEXT OF SMART FRIDGE	

1. WORK DONE

Knowledge about the project is further enhanced

2. WORK TO BE DONE

Start gathering image for image labelling

3. PROBLEMS ENCOUNTERED

Fruits kept in lower temperature will rot slower and make the image collecting process longer

4. SELF EVALUATION OF THE PROGRESS

Have to perform labeling process along with image capturing process

Supervisor's signature

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Jan 2020	**Study week no.: Week 4**
Student Name & ID: Christine Lau Yuet Ning 1603254	
Supervisor: Dr. Aun YiChiet	
Project Title: AMBIENT-AWARE FOOD RECOGNITION AND MANAGEMENT IN CONTEXT OF SMART FRIDGE	

1. WORK DONE

Image capturing and labeling

2. WORK TO BE DONE

Research about image classification

3. PROBLEMS ENCOUNTERED

No problem encountered

4. SELF EVALUATION OF THE PROGRESS

Progress is in own expectation

Supervisor's signature

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Jan 2020	**Study week no.: Week 5**
Student Name & ID: Christine Lau Yuet Ning 1603254	
Supervisor: Dr. Aun YiChiet	
Project Title: AMBIENT-AWARE FOOD RECOGNITION AND MANAGEMENT IN CONTEXT OF SMART FRIDGE	

1. WORK DONE

Images of grape going through phases is captured and labelled

2. WORK TO BE DONE

Research about image classification and usage

3. PROBLEMS ENCOUNTERED

No problem encountered

4. SELF EVALUATION OF THE PROGRESS

Time is not fully utilized during image capturing

Supervisor's signature

CHRISTINE

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Jan 2020	**Study week no.: Week 7**
Student Name & ID: Christine Lau Yuet Ning 1603254	
Supervisor: Dr. Aun YiChiet	
Project Title: AMBIENT-AWARE FOOD RECOGNITION AND MANAGEMENT IN CONTEXT OF SMART FRIDGE	

1. WORK DONE

Image capturing and labelling process is done

2. WORK TO BE DONE

Label Image using LabelImg

3. PROBLEMS ENCOUNTERED

Might need longer time to train model as one model is being trained one time

4. SELF EVALUATION OF THE PROGRESS

Problem solving skill needs to be enhanced

Supervisor's signature

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Jan 2020	**Study week no.: Week 8**
Student Name & ID: Christine Lau Yuet Ning 1603254	
Supervisor: Dr. Aun YiChiet	
Project Title: AMBIENT-AWARE FOOD RECOGNITION AND MANAGEMENT IN CONTEXT OF SMART FRIDGE	

1. WORK DONE

First model is trained

2. WORK TO BE DONE

Prepare images to test the algorithm and train the next model

3. PROBLEMS ENCOUNTERED

No problem encountered

4. SELF EVALUATION OF THE PROGRESS

Have to work fast to catch up with the plan

Supervisor's signature

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Jan 2020	**Study week no.: Week 9**
Student Name & ID: Christine Lau Yuet Ning 1603254	
Supervisor: Dr. Aun YiChiet	
Project Title: AMBIENT-AWARE FOOD RECOGNITION AND MANAGEMENT IN CONTEXT OF SMART FRIDGE	

1. WORK DONE

Second model is trained

2. WORK TO BE DONE

Prepare more image to increase accuracy

Prepare report draft to be review by supervisor

3. PROBLEMS ENCOUNTERED

Accuracy of the model is not as in expectation

4. SELF EVALUATION OF THE PROGRESS

Trying to catch up with the plan as the time used is taking longer than expectation

Supervisor's signature

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Jan 2020	**Study week no.: Week 10**
Student Name & ID: Christine Lau Yuet Ning 1603254	
Supervisor: Dr. Aun YiChiet	
Project Title: AMBIENT-AWARE FOOD RECOGNITION AND MANAGEMENT IN CONTEXT OF SMART FRIDGE	

1. WORK DONE

Increased models' accuracy

2. WORK TO BE DONE

Prepare temperature sensor and camera

3. PROBLEMS ENCOUNTERED

Limited knowledge about how the hardware works

4. SELF EVALUATION OF THE PROGRESS

Have to enhance report writing skills

Supervisor's signature

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Jan 2020	**Study week no.: Week 11**
Student Name & ID: Christine Lau Yuet Ning 1603254	
Supervisor: Dr. Aun YiChiet	
Project Title: AMBIENT-AWARE FOOD RECOGNITION AND MANAGEMENT IN CONTEXT OF SMART FRIDGE	

1. WORK DONE

Research about hardware used in this project

2. WORK TO BE DONE

Connect the hardware to the project

3. PROBLEMS ENCOUNTERED

No problem ecountered

4. SELF EVALUATION OF THE PROGRESS

Attempt to catch up with plan

Supervisor's signature

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Jan 2020	**Study week no.: Week 12**
Student Name & ID: Christine Lau Yuet Ning 1603254	
Supervisor: Dr. Aun YiChiet	
Project Title: AMBIENT-AWARE FOOD RECOGNITION AND MANAGEMENT IN CONTEXT OF SMART FRIDGE	

1. WORK DONE

Temperature sensor and camera is prepared

2. WORK TO BE DONE

Enhance report quality with testing result

3. PROBLEMS ENCOUNTERED

No problem encountered

4. SELF EVALUATION OF THE PROGRESS

Report arrangement and writing skill has improved

Supervisor's signature

CHRISTINE

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Jan 2020	**Study week no.: Week 13**
Student Name & ID: Christine Lau Yuet Ning 1603254	
Supervisor: Dr. Aun YiChiet	
Project Title: AMBIENT-AWARE FOOD RECOGNITION AND MANAGEMENT IN CONTEXT OF SMART FRIDGE	

1. WORK DONE

Added testing result to the report

2. WORK TO BE DONE

Record demo and finalize report detail

3. PROBLEMS ENCOUNTERED

No problem encountered

4. SELF EVALUATION OF THE PROGRESS

Report arrangement and writing skill has improved

_____ CHRISTINE _____

Supervisor's signature Student's signature

AMBIENT-AWARE FOOD RECOGNITION AND MANAGEMENT IN CONTEXT OF SMART FRIDGE

Introduction:

-Food wastage is one of the bissgest problem to the world

-With advanced technologies, this problem can be reduced

Scope and objectives:

Scope:

-Build an algorithm that estimates food edible period

-This model only works for red grape and green grape in 3 temperature (Room,Refrigerator,Freezer)

Objectives:

-To model fruit's freshness state for subsequent classification using CNN

-To develop a fruit freshness estimation system inferring to the CNN model

-To integrate ambient-awareness into fruit freshness estimation using IoT sensors

Methodologies involved:

-SDLC process

~Extreme Programming

-Tools to use

~LabelImg

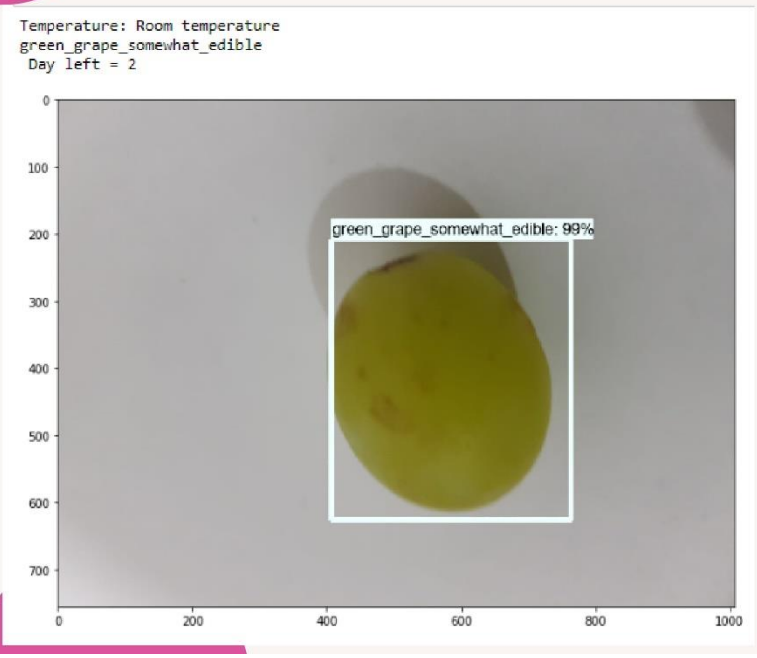
~Anaconda

~Jupyter Notebook

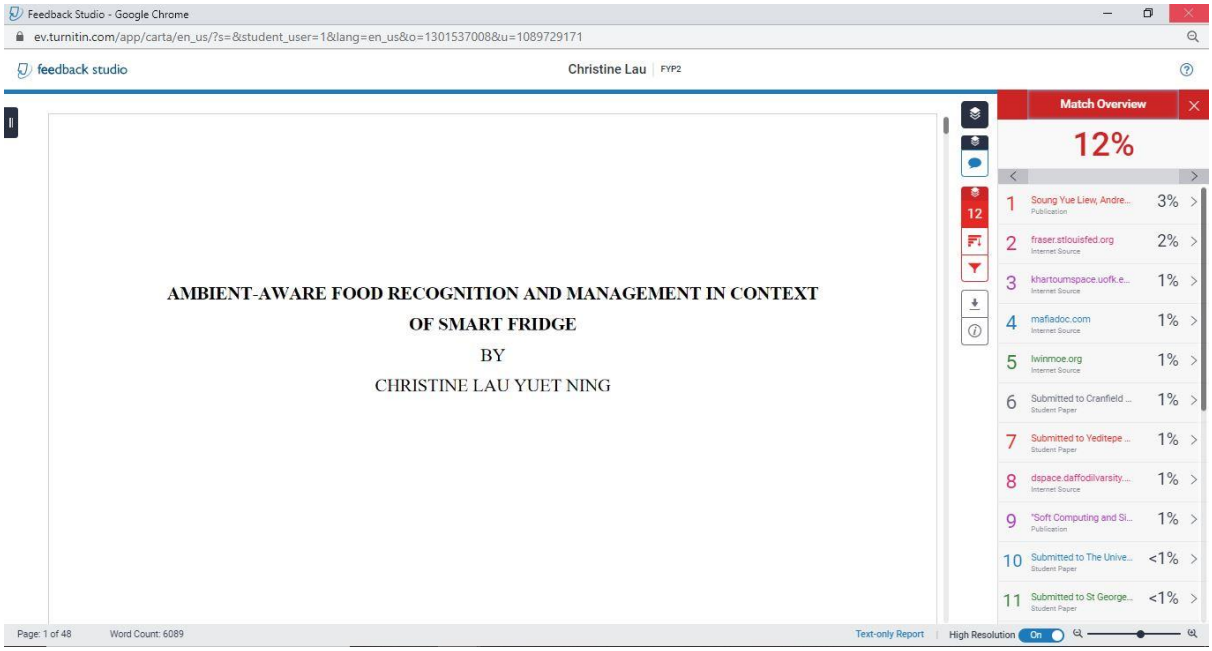
Results:

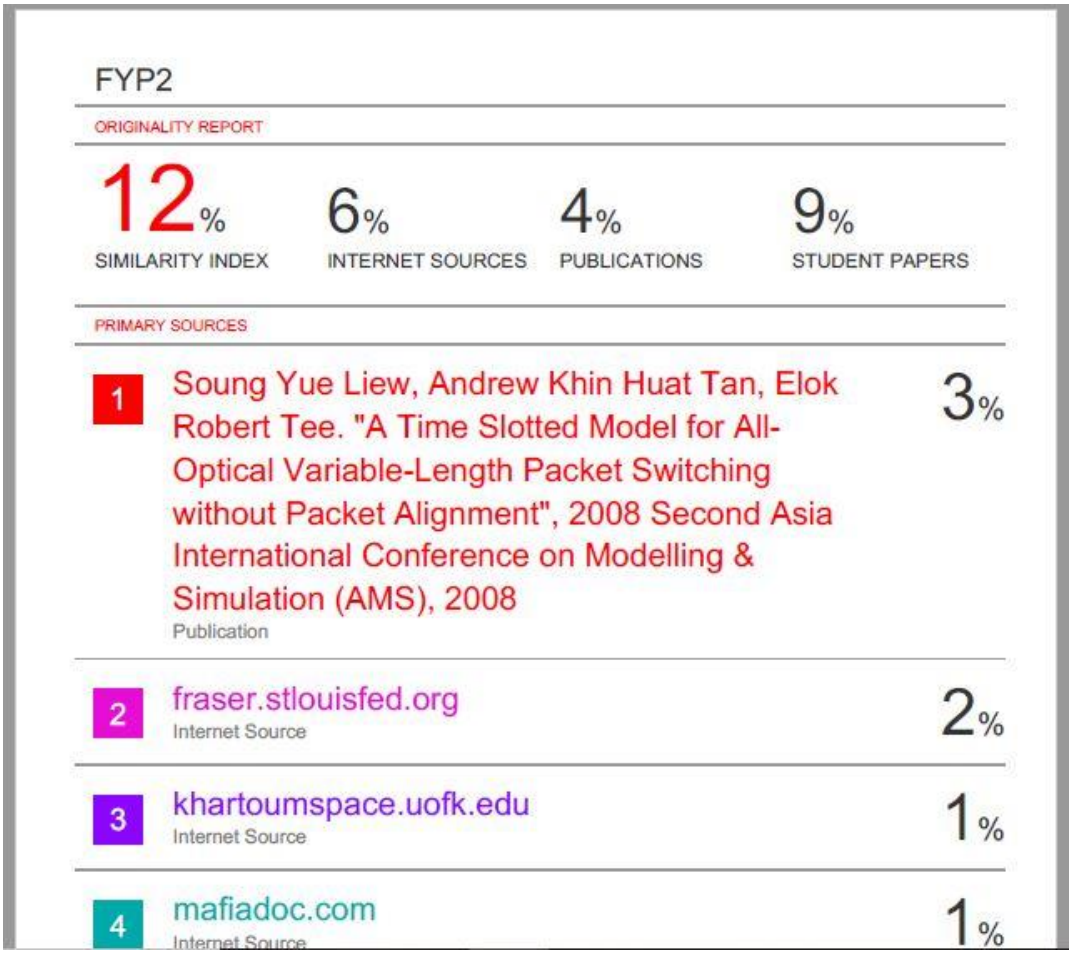
-An algorithm which can detect surrounding temperature and estimate food's edible period based on temperature is developed

Sample output:



TURNITIN SIMILARITY REPORT





FACULTY OF INFORMATION AND COMMUNICATION TECHNOLOGY

Full Name(s) of Candidate(s)	CHRISTINE LAU YUET NING
ID Number(s)	1603254
Programme / Course	BUSINESS INFORMATION SYSTEMS(IB)
Title of Final Year Project	AMBIENT-AWARE FOOD RECOGNITION AND MANAGEMENT IN CONTEXT OF SMART FRIDGE

Similarity	**Supervisor's Comments (Compulsory if parameters of originality exceeds the limits approved by UTAR)**
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(ii) Matching of individual sources listed must be less than 3% each, and

(iii) Matching texts in continuous block must not exceed 8 words

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Note Supervisor/Candidate(s) is/are required to provide softcopy of full set of the originality report to Faculty/Institute

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: 23/4/2020

Signature of Co-Supervisor

Name: _____

Date: _____

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FACULTY OF INFORMATION & COMMUNICATION TECHNOLOGY (KAMPAR CAMPUS)

CHECKLIST FOR FYP2 THESIS SUBMISSION

Student Id	1603254
Student Name	CHRISTINE LAU YUET NING
Supervisor Name	DR. AUN YICHIET

TICK (√)	DOCUMENT ITEMS Your report must include all the items below. Put a tick on the left column after you have checked your report with respect to the corresponding item.
√	Front Cover
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√	Abstract
√	Table of Contents
√	List of Figures (if applicable)
√	List of Tables (if applicable)
√	List of Symbols (if applicable)
√	List of Abbreviations (if applicable)
√	Chapters / Content

√	Bibliography (or References)
√	All references in bibliography are cited in the thesis, especially in the chapter of literature review
√	Appendices (if applicable)
√	Poster
√	Signed Turnitin Report (Plagiarism Check Result - Form Number: FM-IAD-005)

*Include this form (checklist) in the thesis (Bind together as the last page)

I, the author, have checked and confirmed all the items listed in the table are included in my report. CHRISTINE _____ (Signature of Student) Date: 19 APRIL 2020	Supervisor verification. Report with incorrect format can get 5 mark (1 grade) reduction. _____ (Signature of Supervisor) Date: 23/4/2020