Before Order - A menu information providing chatbot service

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***Abstract*—Globalization attracted many newcomers to South Korea but our restaurant services have not kept up with the needs of foreign customers. Foreigners still have difficulties reading and understanding menus in traditional but also modern Korean restaurants. Therefore, we will develop 'BeforeOrder' by using the 'Facebook Messenger' chatbot API and provide foreigners with a service to conveniently receive information about menus and dishes throughout their journey.**

***Index Terms*—translator, chatbot**

I. Introduction

Many foreigners are often lost and embarrassed when eating out at restaurants as they can neither read the foreign menus nor can they understand what ingredients are used for specific dishes. Those things can make it hard to try and enjoy foreign food especially for people who have allergies and therefore have to ask the staff every time. But staff members, especially in more rural areas, often do not speak or understand English and cannot provide sufficient information. On the other hand, restaurants often simply do not have the space in menus to list the name of dishes and its ingredients in both, the foreign and the English language.

Whenever foreigners face this situation, they have to search and retrieve all the different information manually. However, foreigners who do not know 'Hangeul' will not be able to search directly on Google because they do not understand the dish names in a menu and often also do not have access to a 'Hangeul' keyboard. Even if someone searches for the information, it may not be properly categorized and recognized by a translator as they often do not distinguish dishes and it may happen that they simply translate the individual letters into English. Eventually the user may need to search more and more and ends up leaving the restaurant and eat someplace else.

We will try to solve this problem with 'Facebook Messenger', a chat application that is supported by Facebook. Since 2016, Facebook has provided an Chatbot API through using Facebook Messenger. User can connect to the chatbot through the chatbot's Facebook page to receive various contents, benefits and information. Developers can make own Facebook Page for creating their chatbot, and user can access to the chatbot only by clicking function 'send message' in profile of the page. Using this method, the user can conveniently get the service provided by us and also use the functionality with an intensively tested and user-friendly interface.

A chatbot in general describes an artificial intelligence-based program, that analyzes the conversation with a user. Users of the messenger can naturally send messages or ask questions to a chatbot which in return provides a service that responds to the user and seems to communicate with him. There are multiple reasons as to why Facebook chatbots are getting attention. First, it has a familiar UX design and developing a new UX can be very time-consuming and users may have difficulties adapting to a new design. Second, people tend to be reluctant to download new apps for a variety of reasons. Third, using a popular and well-known messenger improves accessibility. We think using a chatbot will increase the popularity of the service and make it more appealing to customers in our target audience.

Before Order target customers are foreigners that are not familiar with the Korean language and alphabet and therefor having problems eating out. The service is especially aimed at exchange students and employees who plan to stay in Korea in the long term instead of tourists that will mostly eat in international restaurants. *Before Order* follow this process:

Step 1: follow or enter the *Before Order* Facebook Page and click 'send Facebook Message' to send message
Step 2: provide information about the menu to the chat bot in form of images or text
Step 3: receive information about a dish by choosing from the menu list provided by *Before Order*

That way, customers can

- reach the service anytime
- receive information about dishes without searching multiple times
- do not have to register up for any service

TABLE I
USER ROLES

Role	Name	Task and description
User	Choo Yedeun	Assumes user point of view and guarantee a usable and user-friendly software
Customer	Lim Hyojin	Provides detailed software requirements and reviews delivered features
Software Developer	Christian Gärtner	Responsible for writing and developing software features and satisfying the needs of the costumer
Development Manager	Kang Minju	Supervises the development of the service, managing of deadlines and evaluation of software features

II. REQUIREMENTS

A. Functional requirements

A.1 The system will be usable on a smartphone – In order to enable the user to use the provided service while the user is moving around the system has to be reachable from a mobile platform. The user also shall be able to conveniently use a camera to take pictures of the menu without having to type and search for one dish name at a time.

A.2 The system should be usable on notebooks, tablets and stationary computers – The user shall be able to use the service at home or similar environments to be able to gather information about restaurants and dishes and help with the selection of a place to eat.

A.3 The system will run on Android, iOS and Windows 7/8/10 – The system shall run on the most popular operation systems in order to be accessible for as many users in the target audience as possible.

A.4 The system will run within a common third-party software – The user shall be provided with an intensively tested and user-friendly interface. In addition, the user should not have to download a separate application to use the functionalities of this system but instead use this service as an extension to a familiar and popular application.

A.5 The system shall provide contact information to enable the user to contact the support – The user shall be able to receive help in case of questions or problems with the service. In addition, the user should be able to report any bugs that he finds while using the service or give feedback about it.

A.6 The user shall be able to save information about a dish – The user should be able to retrieve information about dishes that he once searched for without having to query the search again. The user should also be able to read the information after closing and reopening the application.

A.7 The system shall support the Korean alphabet as input

A.8 The system will display information about dishes in the English language and alphabet

A.9 The user shall be able to select a dish in the analyzed menu and receive detailed information for this specific dish The system should provide information about the dishes in form of used ingredients, possible allergies and level of spiciness

A.10 The system shall accept pictures and text as input – The user should be able to manually search for a dish if the analyzing of the picture returns no matches

A.11 The system should distinguish between dish names and random letter clusters – The user may input pictures without a menu or the pictures that include random text in addition to the menu.

A.12 This system must be able to retrieve information from the Database after subtracting the recognized number. The restaurant menus are often displayed along with the price figure and Vision api recognize the price value as part of the successive food name. The system should be able to remove following price figure before searching it on the Database.

A.13 The system shall be able to provide reliable information about the menu

- The system will use Roman alphabet conversion api to provide accurate information about Korean pronunciation. This guarantee user-friendly interface by reducing user's difficulties of ordering food in Korean name
- The system will refer to Wikipedia in the process of registering accurate food information in the Database.

B. Working mechanisms

1) Register service
   User will search for *Before Order* in the Facebook and enter the Facebook Page of the chatbot. Registration process is finished.
2) Input information
   Take a picture of a menu written in Korean alphabet and send it to the *Before Order* chat bot.
3) Recognition process
   The *Before Order* service analyzes the input picture or text and tries to recognize the dishes.
4) Select information
   If the user sent a whole menu he can select a single dish out of the list that *Before Order* provides and receive more detailed information for that specific dish.
5) Retrieve selected food information
   When a user selects a menu from the list, *Before Order* retrieve the information about it from the DB we built.
6) Display detailed information
   Before Order provides the user with detailed information about the requested dish.

III. DEVELOPMENT ENVIRONMENT

A. Choice of software development platform

TABLE II
DEVELOPMENT TOOLS

Tool	Usage
JAVA	We've chosen Java as a overall basic language in developing *Before Order* because it is one of the general, object-oriented language and It is a language our team members are all familiar with.
Github	We decided to use Github because it provides the necessary management functions for software development including the basic functions of the Git such as bug tracking, functional requests, task management and etc. Also, we can easily share and develop program sources together with our team members.
Visual Studio	Visual studio is an integrated development environment(IDE) program made from Microsoft that includes many features as compiler, editor and debugging. We are going to utilize many various necessary functions of visual studio in practical implementation.
Slack	Slack is a collaborative tool that enables more efficient work and communication while developing software. We are going to take advantage of the work messenger functionality of slack and its convenient drag-and-drop format file sharing

B. Software in use

The similar software can be referred to as Samsung *Bixby vision*. *Bixby vision* automatically extracts text messages through camera lens and translate them into user-set languages in real time. In order to use *Bixby vision* menu analysis, we can just bring the camera lens to the menu. However there are two major differences that suggest why our *Before Order* is better than 'Bixby vison'. First, *Bixby vision* only provide literal interpretation of food name. Therefore people are more likely to have difficulties not knowing what exactly it means. However *Before Order* give more clear information as it aims to provide photo, detailed explanation and name of the food/menu in english. Lastly *Bixby vision* is limited to only samsung product but our *Before Order* is available on all platforms and devices since it will be implemented in chatbot.

C. Cost estimation

TABLE III
DEVELOPMENT TOOLS

Tool	Cost
SQL database & server	16870.76 Won for 5GB / 10 DTU
Computer Vision API	2811.63 Won for 1000 transactions

The OS version in which we will develop the program is Window 10, and We will use our own laptop for developing our service.

We will also use cloud computing service using Azure cloud platform. The service we are using for making our service is:

1) SQL Database
2) Azure server : Azure Virtual machine
3) Computer Vision API : OCR api

We will put our bot service in the server using Azure virtual machine. In that virtual machine, we will upload our program for our bot service and Computer vision api. In order to store and manage the menu data, we will connect our Bot service with the SQL Database from Azure. We will make database for storing korean and english name of the menu and the details about menu (picture, ingredients, taste, spicyness, etc). Computer vision api will provide us texts from the picture that users send through the bot.

IV. SPECIFICATIONS

A. Facebook Chatbot

The service will be provided to the user by utilizing the Facebook chatbot. The following figure Fig. **??** further details the general design of the system. Requests from the user will be processed by the bot using a text recognition software and our own database with information about various dishes.

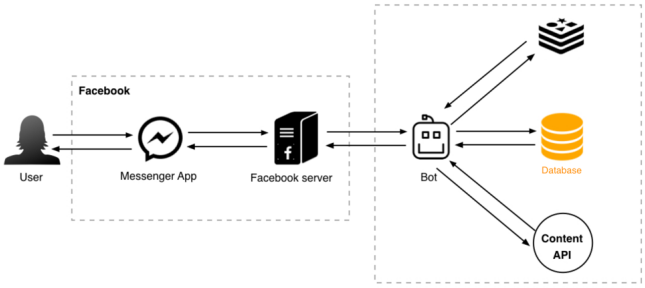

Fig. 1. Overview of the system

Using the Facebook Messenger as interface for our service, the user doesn't have to download a separate application and is already accustomed to navigate within the application and its usage. In order to use the service the user has to search for the *Before Order* page on Facebook and send the profile a message by clicking the *Send Message* button.

Fig. 2. Chatbot profil on Facebook

1) Facebook messenger: Given that the user has sent a message to the *Before Order* service, the chat will be easily accessible from then on in the chatroom section of the Facebook Messenger application.

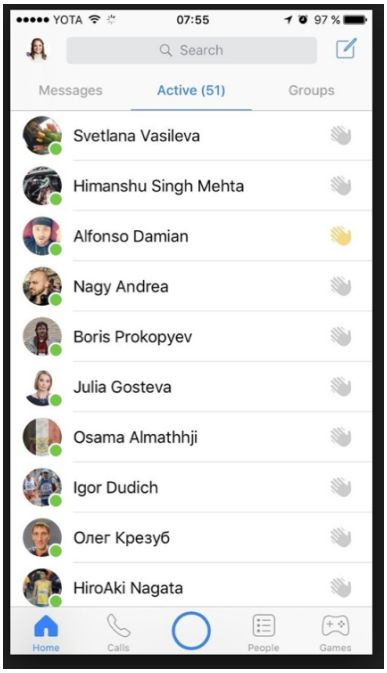

Fig. 3. Homescreen of the Facebook Messenger

By selecting *Before Order* from the list, the user is now able to provide a picture or dish names in the Korean alphabet to the chatbot by sending an image or a text message as shown in Fig. **??**

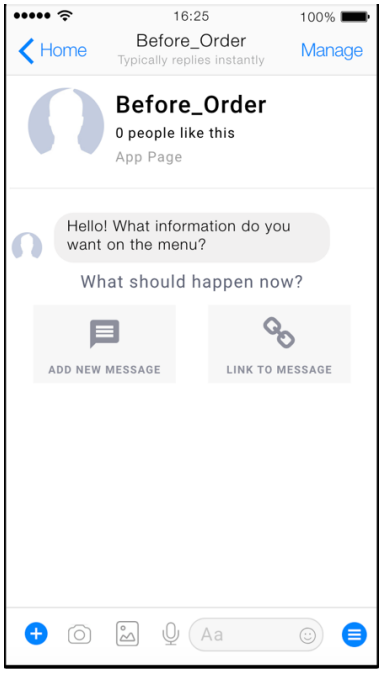

Fig. 4. Chatroom with the *Before Order* chatbot

2) Chatbot input: If the user sends the menu in form of a picture, the dish names have to be spelled out and need to be visible. The user can either send a picture that he took in the past or use the camera function in the Facebook Messenger to capture a picture and directly send it to the chatbot.

Fig. 5. Message to the chatbot including a picture of a menu

Using a text recognition API and analyzing the image we are able to provide a list with all the found and supported dish

names. The user is now able to select a dish that he wants more detailed information about as shown in Fig. **??**.

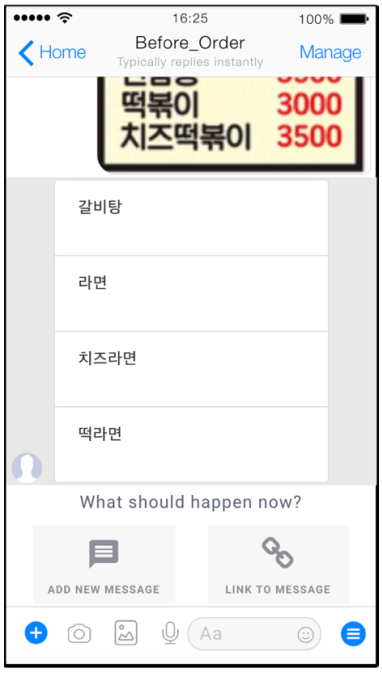

Fig. 6. Response of the chatbot with all the found dishes

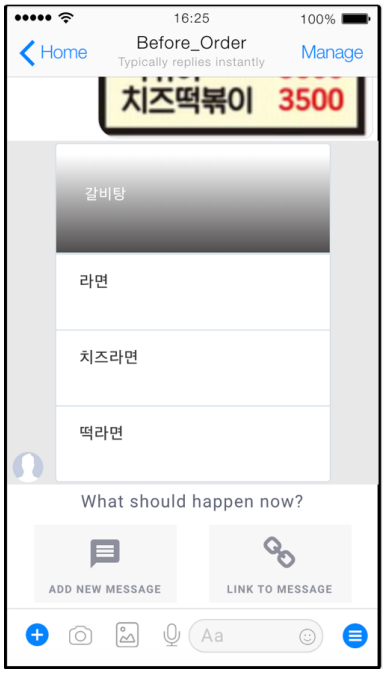

Fig. 7. User selecting a dish from the list

3) Processing of the input:

- Get the information from database
  The information for dishes will be provided by our own database. Instead of using an open-source API for translating Korean words to English we will be using an own mapping between English and Korean dish names as the common translators don't support uncommon dish names or variants of dish names. Therefore each dish will have an English and an Korean name associated with it to make it possible to search for dishes inside the database using Korean letters. Hence most of the processes in and around the database will have to support and communicate using the UTF-8 encoding. The database will also contain a one or two sentence description for each dish, a list with its main ingredients and additional flags, such as *spicy*. Managing and searching for information in this kind of database has the advantage, that:
  - information for every dish is consistent and unlike as in popular search machines, such as *Wikipedia* and *Google*, every entry in the database will have the common information
  - we can be sure information and names in the database refers to a dish, which enables us to filter out random text sequences and unrelated Korean words and sentences
  - we don't have to rely on the authenticity of information from a third party
- Server that can run chatbot and chatbot service
  We will use Azure Virtual Server to run our chatbot. There are three parts in our chatbot service in the virtual machine. First one is a script that is connected with Facebook Chatbot API. This script will have scenarios to answer users' requests and call other scripts to provide information to the users. Second one is to recognize the texts from a picture that users send using Computer Vision API, and the last one is for interacting with the database. When the chatbot gets the input from the users, it will call the script for text recognition. The results will be double-checked with the database to ensure only supported dishes are sent to the user in form of a list. By selecting a dish from the list the user sends another request to the chatbot. The chatbot will then call the script for retrieving data from the database and return the detailed information about the dish to the user.
- Vision api connection
  When chatbot calls the script that is connected with Computer Vision API, it will send the picture to the Computer Vision API and get the results from it in a json format. It includes a request using the key and endpoint of the Computer Vision API. The script also includes a refinement part, where it refines the result text and formats the result of the text recognition as a list. The list will then be returned to the chatbot.

4) Chatbot output:

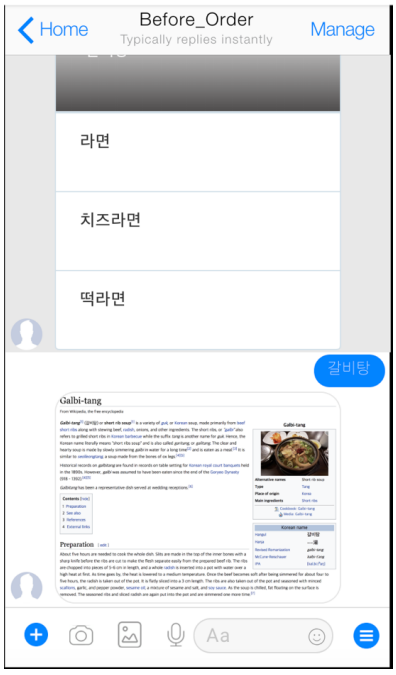

Fig. 8. Detailed informations about the selected dish

Although we can not represent it in this prototype, we plan to provide information from our internal database. Users will be able to receive images of the dishes and a detailed description with ingredients.

5) Exit: If you need information about other menus, please feel free to send us a message.

V. Architecture Design & Implementation

A. Overall architecture

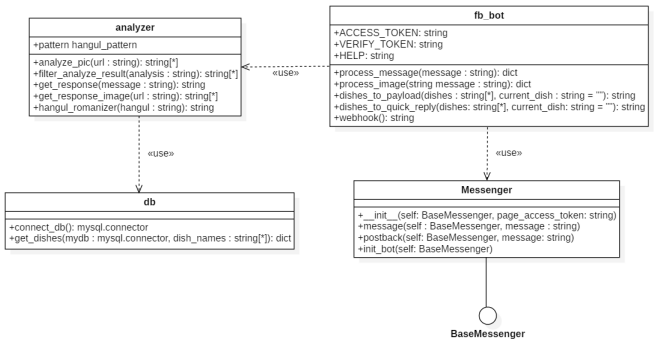

Fig. 9. UML of our overall architecture

B. Directory organization

TABLE IV
Directory organization

Directory	File names	Module names in use
./src	messenger.py	messenger
./src	fb_bot.py	fb_bot
./src	ssl_certificate.pem db.py	db
./src	analyzer.py	analyzer
./tests	test.txt test_db.py test_json.py test.jpg	test
./db	food.mwb	db model
./doc	before_order.tex before_order.pdf	documentation
./doc/content	architecture_design_and_implementation.tex development_environment.tex introduction.tex requirements.tex specifications.tex	documentation
./doc/pictures	facebook_dish_info.png facebook_friends.png facebook_meun.png facebook_message.png facebook_overview.png facebook_profil.png facebook_response.png facebook_response_selection.png uml.png class_uml.mdj	documentation

1) Module 1 - messenger:

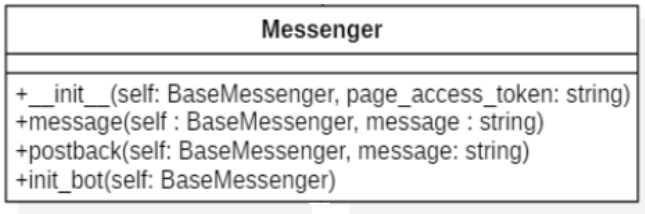

Fig. 10. Class Messenger

- Purpose:
  The Facebook Messenger chatbot needs Facebook Messenger API to interact with the facebook users who need our service. This module can provides a connection with the Facebook Messenger API, so chatbot can send message to users and receive message from users through this module. It is the most important factor that allows the messenger to function.
- Functionality:

This module makes chatbot be able to send messages to the users and receive messages from the users. There is a Facebook server between users and our chatbot server. Facebook provides a webhook function and it gives our chatbot server alerts that user sent a message to our chatbot or other user reaction to our chatbot (entering chatbot chatroom etc.) and messages. Through this module, we can give a response to users immediately and can provide our service. When users send messages, we can implement the appropriate chatbot action and build scenarios in which to communicate with users. It also provides the transmission of text as well as other extension files, such as pictures and files, to enable context-sensitive types of messages to be sent.

- Location of Source Code:
  /project/src
- Class component:
  The messenger module has messenger class. It extends BaseMessenger class, that is provided from the fbmessenger package. fbmessenger is a python library to communicate with the Facebook Messenger API's. It provides various functionality and class to implement the chatbot service. The class doesnt have a variable and it has serveral methods for service. The methods that class has are as follows:
  - __init__(self:BaseMessenger, page_access_token): constructor of the messenger class. it makes messegner object.
  - message(self: BaseMessenger, message): The message function is called when we get a "message" object from the webhook. The webhook can send a few different json messages, and we can specify which message types we want to receive when we set up the webhook. And message() is general when the user sends us a message. So in the message function, when we receive a message we first send an achknowledgment to the user that we received it and computing it.
  - postback(self: BaseMessenger, message): This method can handle a postback webhook. The Facebook Messenger supports the postback meun for users. The users can invoke an action in our bot through the button. When users press the button to invoke some actions in cahtbot, chatbot receives a postback webhook from the Facebook Messenger server. This function can handle this webhook, so can give some responses to the user.
  - init_bot(self: BaseMessenger): the init_bot method initiate our chatbot. It initiate greetings and actions list that the users can select when they start our chatbot. And, it also provides customized buttons function that the users can choose during the scenario.

2) Module 2 - fb_bot:

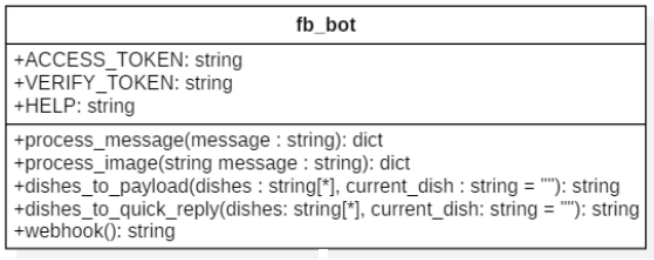

Fig. 11. Class fb_bot

- Purpose:
  We need an intermediary between our chatbot and functionality of our service. A module fb_bot plays such a role. The module fb_bot allows each module to be grouped and became a bridge that enables our services to be delivered to users.
- Functionality:
  The fb_bot module handles messages from the module messenger to reply to users. When the messenger gets text from the users, the module processes a message in condition of the text. If a messenger gets a picture type file from the users, the module fb_bot calls a module analyzer to analyze picture that gets from user and get information of dishes from our database. And It process our data that is from module analyzer agian, and sends back to the module messenger to give results to the users. The module fb_bot has several functionalties to interact with other modules.
- Location of Source Code:
  /project/src
- Class component:
  The class fb_bot has three member variables. They are as follows:
  - ACCESS_TOKEN:string : ACCESS_TOKEN is for accessing to the the chatbot messenger. Each chatbot has an unique ACCESS_TOKEN. A module fb_bot can get messages from the bot using the token. We need it everytime we send a message to facebook.
  - VERIFY_TOKEN:string : it is used when facebook senta a first message to check if the server exists. the VERIFY_TOKEN can be anything we want to, we just have to specify it when setting up the webhook.
  - HELP:string : When user write 'help' or type some messages that is not related to request for our service, chatbot sents this string.

  The methods that class fb_bot has are as follows:
  - process_message(message):dict :
  - process_image(message):dict :
  - dishes_to_payload(dishes, current_dish):string :
  - dishes_to_quick_reply(dishes, current_dish):string :
  - webhook():string :

3) Module 3 - analyzer:

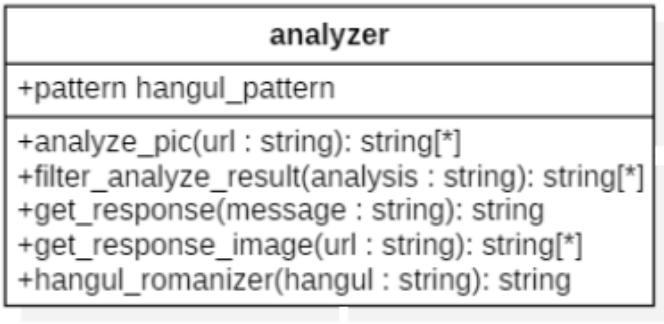

Fig. 12. Class Analyzer

- Purpose:
- Functionality:
- Location of Source Code:
  /project/src
- Class component:
  –

4) Module 4 - db:

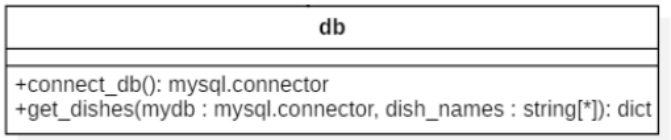

Fig. 13. Class db

- Purpose:
  The module db is used to get information of dishes from the database server.
- Functionality:
  We have own MySQL database that stores description of the dishes. The module makes a connection with the MySQL database server and it can send queries to the database server and get results of the query.
- Location of Source Code:
  /project/src
- Class component:
  The class has no member variable, and the class methods are as follows:
  - connect_db():mysql.connector : It makes a connector object to connect with our MySQL server to send the query to it. It includes the connection information to connect to database. It uses mysql.connector library to get the mysql.connector class.
  - get_dishes(mydb: mysql.connector, dish_names):dict : It sends a query for getting dishes information to the database server using the connector object. The query is for getting descriptions of specific dish name that the module analyzer gives as a parameter. And it returns the results from the database as dictionary.