Scientific Journal of Impact Factor (SJIF): 5.71

e-ISSN (O): 2348-4470
p-ISSN (P): 2348-6406

International Journal of Advance Engineering and Research Development

Volume 6, Issue 11, November -2019

Smart Kitchen

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Abstract —*With the exponential growth of technology, people's lives are becoming easier over time. The world is moving into the age of technology and everything can be made simpler because of technology. Kitchen is a major area where there is room for improvement. This paper presents a method for the user to prepare food of different cuisines without having much knowledge about various recipes. The user only has to click a picture of the vegetables and the nearest recipe will be procured based on the ingredients. The user will also be provided with the location of the grocery store to buy the unavailable ingredients. This paper also proposes a system to track the usage of spices. An alert will be sent to the user on the mobile application when the spices are below a certain threshold value. This way he can refill the spices on time.*

Keywords- *Image Processing, Internet of Things, Recipe, Kitchen Automation, Weight sensors, Arduino.*

I. INTRODUCTION

Effective management of kitchen inventory is one of the most critical elements in a household. One of the problems that is faced daily is to decide what dish to prepare. With the current work culture, it is difficult to remember when a certain item will need to be replenished. This paper proposes a system that aims to solve this problem. Vision API of Google Cloud is useful in detecting objects from an image. This API is used to detect the different fruits and vegetables from the image captured using camera. Geolocation API is used to get location of nearby grocery stores. Weight sensors are the sensors that can detect the weight of an object placed above it. They are used to measure the weight of spices. The Arduino will send its data to a mobile application. This application will help to check when the spices go below a threshold value and alert the user. The application will have a chatbot which can be used to get recipes of various dishes from different cuisines. The aim is to make this application useful not only for cooking enthusiasts, but also for people who just want to live economically by cooking at home rather than relying on take-outs and also provide a way to manage inventory efficiently.

II. RELATED WORKS

Content-based image retrieval (CBIR) method [1] primarily analyses the content of image, it extracts the features that describes the image and yields image through annotations and labels. Cloud vision API is trained by google so it saves time and give results fast so user does not have to wait for long time. The proposed system helps to send kitchen ingredients in an automated manner. Further, In Smart Kitchen – Measurement System [2], the sensors are being used to transfer data with the help of a Wi-Fi-shield which is used to connect the Arduino board and the data will be presented in the form of an android application to the user. This helps in budgeting income for a month and gives the user an idea how much will be needed for the next month. For example, based object detection by components [3], object detection is done in hierarchical architecture, in which learning occurs at multiple stages which is an adaptive combination of classifiers (ACC). Improvement in performance is due to the component-based approach and the ACC data classification architecture. Since the application is hosted on a server the user is able to view the data from anywhere as the data and the elements are connected using the internet of things stated in Smart Kitchen [2]. Adding on to object detection by incorporating contextual information [5], current state-of-the-art object detection methods mostly adhere to the framework of regions with convolutional neural network (R-CNN) and only use local appearance features inside object bounding boxes. The system is formulated as a fully connected conditional random field (CRF) defined on object proposals and the contextual constraints among object proposals are modeled as edges naturally. Furthermore, a fast mean field approximation method is utilized to inference in this CRF model [5] efficiently. System provides nearest location of all shops but not their products. For this Google Maps API V3 provides a very efficient mechanism to deliver digital cartographic information to the Internet users with fast response time and user-friendly interaction. Using Google Maps standard Map Type control, the user is able to choose one of the two map types: roadmap or satellite imagery as shown in web-based tourist information tools [10].

III. METHODOLOGY

Smart Kitchen as a whole is specialized into three modules which provide different functionalities to the user in an interactive format. The overall flow of the application is as portrayed in the flow diagram shown in Fig 1.

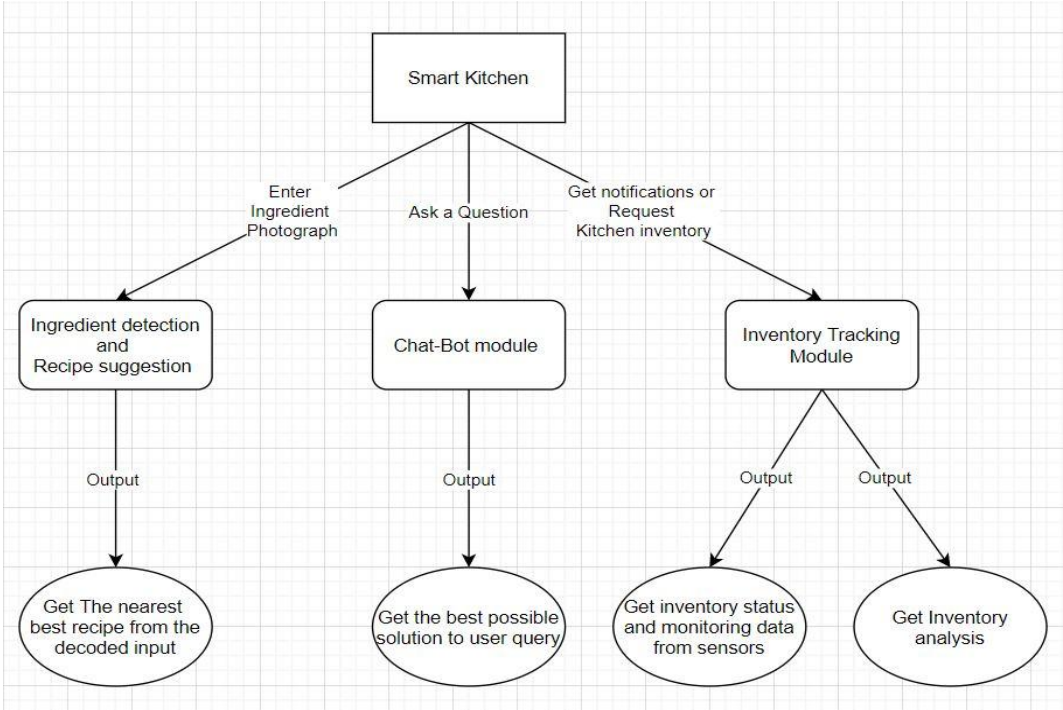

Fig 1: Smart Kitchen overall application flow

Individual modules of the application are explained as follows:
The Image-Label detection phase of the project is run as:

1. The user uploads an image of the ingredients as captured from the camera or an already saved image in the phone storage. The application where as in the background uploads the image to the google Cloud Storage bucket through the API interfaced in the android application.
2. This image gets collected by the Cloud Pub/Sub server which is configured for the push delivery to the App-Engine endpoint,
3. This App-Engine then uploads the image to process it into the googles Neural-Network. The image passes through a number of images and labels associated with them.
4. This App-Engine then returns the image labels thus identified in a JSON format to the app, which is parsed into a Java String and shown to the user on the screen with the probabilities associated to the corresponding label.

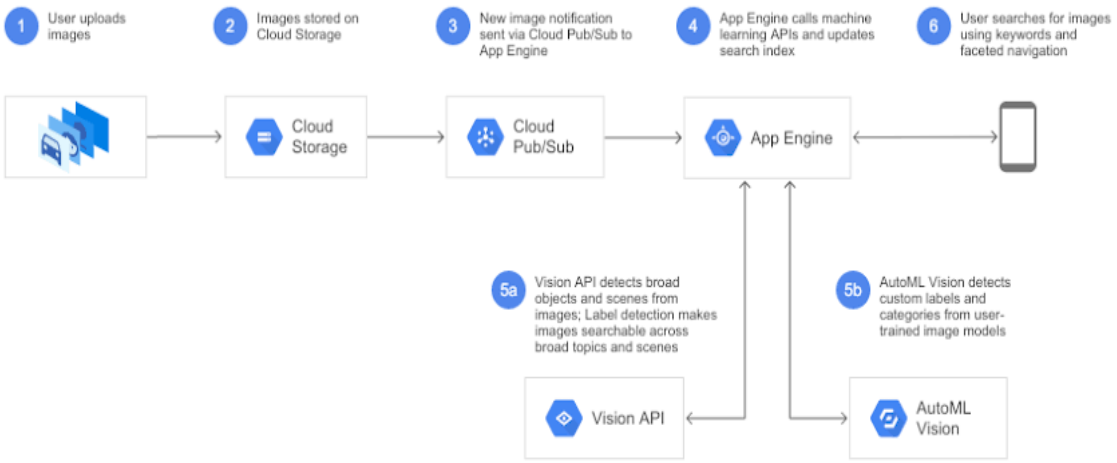

Fig 2: Google Vision Image-Labelling flow [11]

The Chat-Bot Phase of the application runs as follows:

1. The user enters predetermined texts defined in the training-phrases of the Dialogflow console.
2. The user query is received by the Dialogflow console and forwarded to the custom webhook created using python and hosted on the Flask server.
3. This server is designed to return to the user the solution to his query in an interactive card format which has both an image and a clickable link for detailed information about the same.

4. The server returns the result to the Dialogflow console and the console to the user in JSON format, which is similarly parsed into a Java String to display it back to the user.

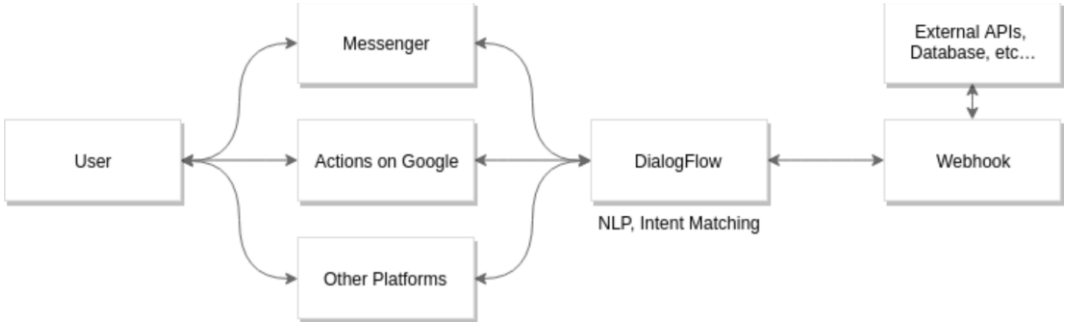

Fig 3: Chatbot flow [12]

The Inventory detection of the same application is proposed to setup as:

1. Hardware Setup: The hardware has two parts:
   a. Sensor Controller – Driven by Arduino UNO, the sensor controller acts as a localized collector of all storage containers which are under the inventory tracking system. It interfaces with the load cells to sense their weight and is connected to an HM-10 BLE module, a Bluetooth module used to transmit the weight data over Bluetooth.
   b. Master Controller – Master controller acts as a gateway for the sensor controller. This is powered by Linkit ONE board. It has an inbuilt Bluetooth module that probes the sensor controller after a stipulated time to get the current weight sensed by the load cells. It also has inbuilt WiFI interface for connecting with ITS (Inventory Tracking System) over the internet to send the weight readings.
2. PubNub setup: PubNub acts as the communication middleware for the entire system. It provides a cloud-based real-time Data Stream Network, such that it can enable any device to communicate with any other device on the Internet.
3. The Server is proposed up by using IBM Bluemix which provides the computing horsepower for the ITS to monitor hardware devices and manages automatic inventory tracking which is in addition to the PubSub server.

Working of Inventory Detection:

1. The hardware detects the change in weight and publishes a new weight value on PubNub channel
2. ITS, setup on the IBM server receives the new weight and daily consumption for the current day.
3. ITS updates the database to record the daily consumption data.
4. ITS publishes the new weight on PubNub channel.
5. The app receives the new weight value and updates the screen display to reflect the new weight value and updates the visual level indicator for the container.

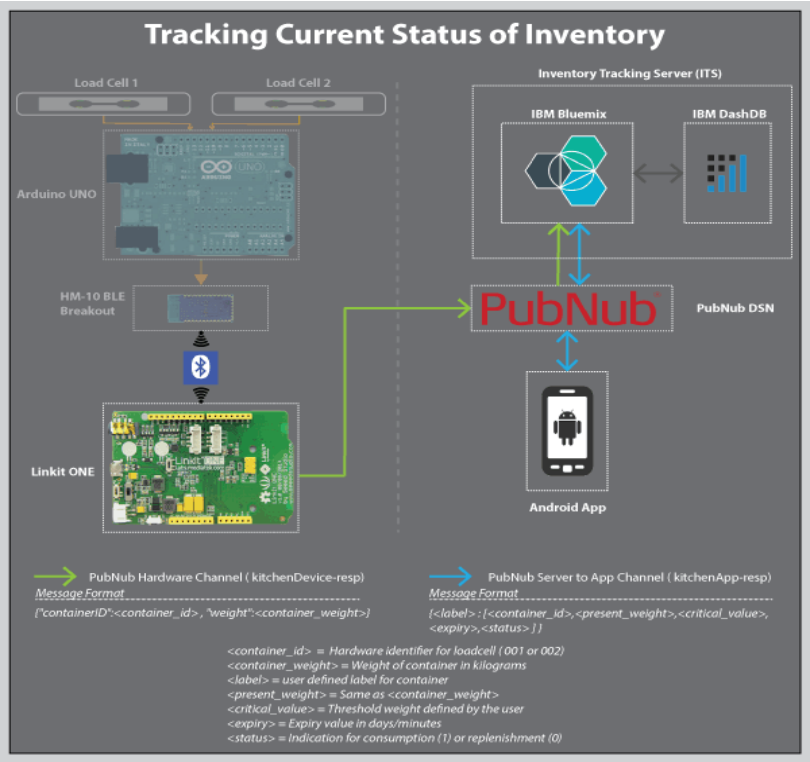

Fig 4: Inventory detection flow [13]

IV. RESULTS

The results of Image-Labeler interaction are as shown in Fig 5.

Fig 5: Results of Ingredient Detection

The results for Chatbot interactions are as shown in Fig 6.

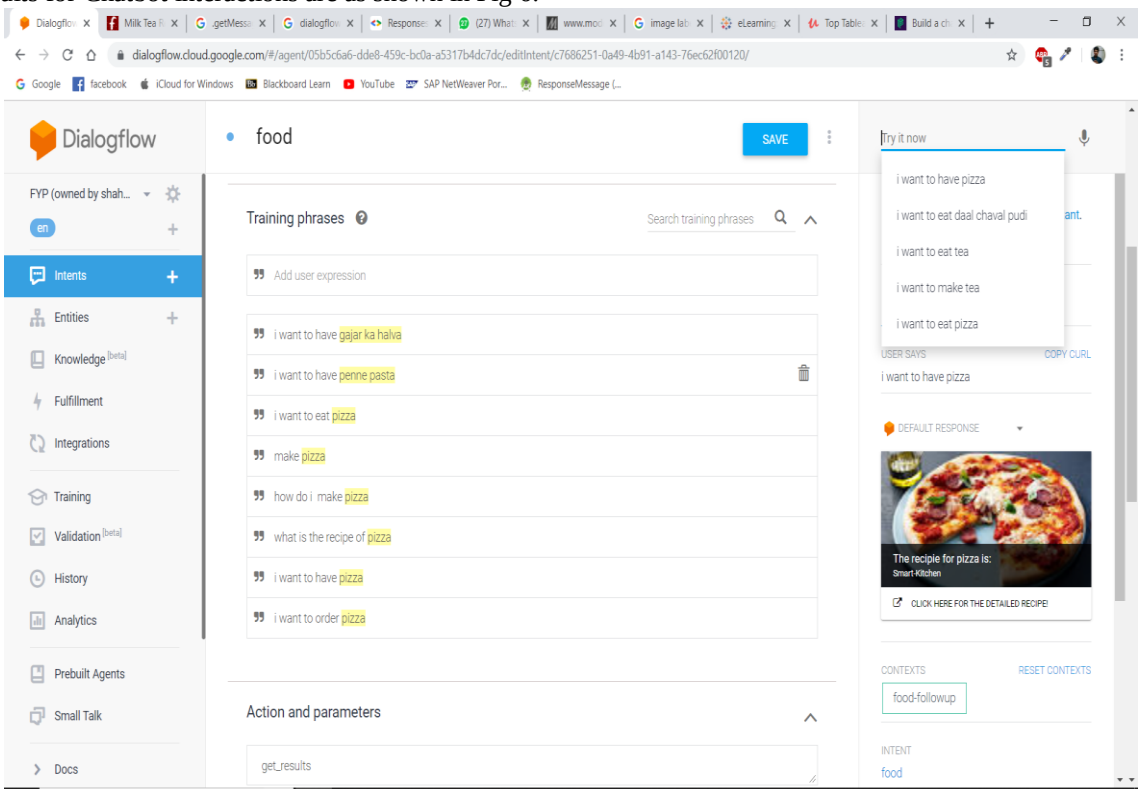

Fig 6: Chatbot interaction

V. CONCLUSION AND FUTURE WORK

Rapid population and industrial development have increased the need for development in home automation. Smart Kitchen tries to provide an application that will ease the hectic lives of people. It provides recipe to the user based on the available ingredients. A chatbot is implemented for the user to get recipes quickly. Also, the tracking system reduces workload on the user to manage the inventory.

Additional features that can be added to this project include allowing the user to post his doubts related to cooking on an online forum and getting it answered by experts. Moreover, chefs could post various blogs about cooking tips. Another feature could be that the user selects the dish that he wants to prepare. All the unavailable ingredients would be automatically ordered from BigBasket or some other platform that delivers fruits and vegetables. This way, the user can prepare whatever dish he wants without worrying about having the required ingredients.

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