“WOFO – IOT Based Food Recommendation system”

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FIELD OF THE INVENTION:

This invention relates to the device of IoT for food recommendations for providing a personalized lifestyle to humankind. More precisely the present invention is a wholesome invention in which the team has tried to cover up all the disadvantages of the previous models.

BACKGROUND OF INVENTION:

Amidst the increasing technological development, food recommendation systems are one of the most commonly used systems. There are many food recommendation systems currently available on the market. Some of the recommendation systems are based on the mood of the user in which the system recommends the dish based on the mood of the user also there are some which recommend food based on the likings of the user which uses deep Neural Networks to recommend the food for the user based on the input priorly given to the system.

Some other food recommendation system tries to prevent the wastage of the food by providing the user with the expiry date of the food, this system was named Fridge Inventory Management.

Some others are based on the climate and the area like “ProTrip RS”. This is a system in which the system provides the details of food suitable for the particular area and climate as well as considering the user’s likings and dislikes [1].

Even if there are many systems available there isn't a system that could detect the freshness of the food within the refrigerator. People have the wrong assumption that every food kept inside the refrigerator is fresh in spite of the duration it had been kept inside it. So here the team has tried to develop a system that has an overall functioning that takes care of the easy implementation as well as accurate results. The pre-developed systems have some of the disadvantages like they have load sensors which, based on the weight of the products, detect the name of the product and keep a check on the quantity of those inside the refrigerator [2].

Also, a research study aimed to develop a personalized healthy food recommendation system based on collaborative filtering and the knapsack method. Assessment results found that users were satisfied with the personalized healthy food recommendation system based on collaborative filtering and knapsack problem algorithm which included the ability of the operating system, screen design, and efficiency of the operating system [3].

Another paper in which they proposed a proactive diabetes self-care recommendation system specifically for AI patients. It recommended a healthy lifestyle for users to fight their diabetes. Thanks to the quasi-ubiquitous use of cell phones in most AI tribes, cell phones were chosen as the platform to provide smart personal care for AI patients. By integrating the AI users’ ontological profile with general clinical diabetes recommendations and guidelines, the system can make personalized recommendations (e.g., food intake and physical workout) based on the special socioeconomic, cultural, and geographical status, particularly for AI patients [4].

A paper discussed a model which can help a person get food recommendations based on the type of disease they have. The model will recommend anti-inflammatory ingredients which people can use to make dishes based on various cuisines [5].

Another Food recommendation system mainly enhances the robustness, extends protection against many diseases, and improves the quality of living of an individual. So to automatically suggest the foods based on their health conditions and the level of sugar, blood pressure, protein, fat, cholesterol, age etc. the paper puts forth k-clique embedded deep learning classifier recommendation system for suggesting the diets for the patients [6].

According to another paper's aspect their invention was a system for generating for a client at least one indication of a food product to be purchased is provided [7].

Similarly, a paper proposes a deep learning solution for health base medical dataset that automatically detects which food should be given to which patient base on the disease and other features like age, gender, weight, calories, protein, fat, sodium, fiber, and cholesterol. This research framework is focused on implementing both machine and deep learning algorithms like, logistic regression, naive bayes, Recurrent Neural Network (RNN), Multilayer Perceptron (MLP), Gated Recurrent Units (GRU), and Long Short-Term Memory (LSTM) [8].

In another Paper they tried to improve recommendation systems by combining clustering technology with the Weighted slope one Predictor into a hybrid food recommender system with reduced data and a lower error rate [9].

Another paper a computer vision-based system is proposed in this research to detect the food item and estimate the overall calorie intake using the features extracted from pretrained InceptionV3 algorithm, a process which in machine learning is referred to as transfer learning. Nutritionix database has been webscraped to construct the dataset containing nutritional information of the detected food items. To further enhance the system, K-nearest neighbors algorithm has been implemented to develop a recommender system that suggests alternatives of the detected food items. The proposed image classification model is mainly evaluated against metrics like training and validation accuracy and train and validation loss. These solutions are aimed at addressing the problems of time consumption, imprecision, under reporting etc. which can occur with traditional monitoring processes. [10].

Since there wasn't a proper system that could cover up all the features and disadvantages we tried to do the best in order to clear or cover up some of those which could help the users to have a healthy and easy lifestyle.

OBJECT OF THE INVENTION:

To give users a healthy and personalized lifestyle along with their needs and keep them updated about the quality of the food and keep a check on their calorie intake. Make fitness an easy process without compromising time and quality.

Another objective of the product is to openly welcome new changes without requiring any major changes within the system.

Finally, to be a budget friendly product that could be easily accessible and available to all humankind.

BRIEF DESCRIPTION OF DRAWINGS:

In [Figure 1] Circuit Diagram, the ESP32 is used as a microcontroller in our prototype acts as a power supply to the remaining interconnected sensors: MQ4 Sensors, DHT11, and buzzer.

The MQ4 Sensor consists of 4 pins of which Vcc is provided with the input voltage of 5V to 3V as shown in Figure 1. Ground provides 0V. The remaining pins are A0 And B0 out of which the invented device is connected to the A0 pin for the analog signals and B0 supports the digital signal. We aren't using the B0 pin as we don't require a digital signal. The Vcc of ESP32 is connected to MQ4 Vcc. Ground of ESP32 [Figure 1] is connected to the MQ4 ground pin. The buzzer consists of 2 pins Vcc which can also act as input pins that can be programmed and the ground of the buzzer is connected to the ground of ESP32. The breadboard's positive pin is connected to the voltage supply which would provide 5V and negative ground to the buzzer. DHT11 is the input or the Vcc pin through which the input voltage of 3V is provided as shown in Figure 2.1. The Black Ground of DHT11 is connected to the ground of ESP32. The D15 pin which is considered to be the output is connected to the Dout pin of ESP32.

Web application as shown in Figure 4 for displaying recipes based upon available items inside the refrigerator also provides the status of humidity, temperature, and Methane gas.

Finally, all the detailed descriptions along with the temperature, humidity, and gas detection have been depicted in Figure 5 along with the items detected and the recipe list inside the refrigerator.

SUMMARY OF THE INVENTION:

The present system is developed with the help of sensors and this system has object detection which helps with the accuracy of the product quality as well as the health. The description of the sensors and their uses are given:

The system would have a camera as shown in [Figure 3] which would detect the objects or the products within the refrigerator and would provide the recipe based on the detected products and also the user would be provided with detailed calorie consumption.

This system has Esp32 which is being used as the microcontroller which is further connected to DHT11, MQ4 sensor and buzzer. This microcontroller provides the power supply to the rest of the sensors present within the system.

DHT11is a temperature sensor which would detect the humidity within the refrigerator and whenever there's a shift within the humidity the buzzer would be activated and the user would be informed that there's some issue within the refrigerator.

When the quality of the food starts decreasing, there would be a signal passed, via MQ4 Sensor [Figure 3], on to the user based on which the user could take the necessary steps. The Buzzer would be activated once there's some unfavourable condition within the refrigerator or with the food.

All of the above devices are finally connected to the breadboard which is finally connected to a power supply rather it be the laptop or any source to which the whole system is being connected.

The system comprises a web application as shown in [Figure 3] which has all the details regarding the calorific values as well as the read of temperature, humidity etc as well it has a detailed description of the recipes.

DETAILED DESCRIPTION OF THE INVENTION

This invention consists of many features which have been lacking by the other inventors. We have tried to cover up all the disadvantages and tried to develop a whole new concept which would help the users to increase their level of fitness as well increase the consumption of healthy and fresh food without compromising their fitness.

We have used many sensors which are enabling the whole system to perform the above said functions. Some of the sensors used in the system are MQ4, DHT11, ESP32, Buzzer, and Breadboard along with the USB Port which would be used to connect the system further to the power supply according to the user's choice.

We have preferred ESP32 over Arduino because this controller supports Bluetooth, BLE, Wi-Fi, Microcontroller. Finally, the breadboard is the platform in which all the circuits have been integrated. A USB Port has been attached to the system such that it could be connected to the external power supply.

Getting into the code we have imported some dependencies such as -> display, JavaScript, image, eval_js, cv2_imshow, b64decode, b64encode, cv2, NumPy, PIL, io, HTML, time, matplotlib.pyplot. We have used YOLOv4 for the purpose of object detection and also loaded our YOLOv4 architecture network. We got the image ratios in order to convert bounding boxes to proper sizes, ran some tests on random test images to find the accuracy of the detection process. In the next step we created a function to convert the JavaScript object into an OpenCV image, decode the base64 image, convert the bytes to a NumPy array, and decode the NumPy array into an OpenCV BGR image. Also, there was the conversion of the array into PIL image, formatting the bbox into png for return, and formatted return string. Now for the real time detection we will be using code snippets for camera capture which runs the JavaScript code to utilize the computer's webcam or the camera which would be connected to the system. The code snippet for camera capture runs the JavaScript code to run the webcam connected to the system. The code snippet would take a photo and which would then be passed into our YOLOv4 model for object detection. The function used for these steps are:take_photo() which would have the filename, quality and the JavaScript file. Next step is resizing the output to fit the video element. Once the above said steps are completed the system would wait for capture to be clicked, finally once it's captured the photo would be stored as a data and with the help of OpenCV the image would be further formatted. Now, a loop is run through detections and is drawn on a webcam image. The next function named video_stream is used to start up the video stream using similar JavaScript as was used for images. The video stream frames are fed as input to YOLOv4. The system would stream video from the webcam and would provide a label to it, emptying the bounding box would be initialized, converting JS response to OpenCV Image, transparent overlay for the bounding box would be created. A loop would run through detections and would be drawn on the transparent overlay image. Overlay of bbox would be converted into bytes.

The proposed system is developed to identify the items present in the refrigerator and to identify the quality of the products to generate healthy recipes for the user. It consists of four layers.

- The Acquisition layer with the sensor unit
- Processing layer
- IOT gateway
- Cloud Layer
- Flask Server
- GUI

The Acquisition layer consists of two sensors, MQ4 and DHT11, and a camera.

The MQ4 gas sensor can sense the concentration of methane up to a range of 300 ppm to 10,000 ppm.The DHT11 sensor can measure temperature from 0˚C to 50˚C and humidity from 20% to 90%.

The camera is used to detect the objects in the refrigerator and the various fruits and vegetables are identified using the YOLO algorithm in python.

ESP32is a microcontroller that enables Wi-Fi and Bluetooth connectivity to embedded systems. It has two CPU cores and a clock frequency that can be adjusted from 80 MHz to 240 MHz Arduino can be programmed using C language and ESP32 is required to establish the Wi-Fi connection between the Arduino and cloud platform. It reads the input signal from the sensors and sends a signal to the output devices to perform various functions.

In the MQ4 sensor, we use the analog supply to check whether the gas is detected or not. It gets the power supply from the Vcc of ESP32. The green cable from A0 pin is connected to the D34 port (as shown in Fig.2.1) The DHT11 sensor is connected to ESP32's GND and Vcc and the output pin, Dout is connected through the blue cable to the D15 port of the ESP32 (as shown in Fig.2.1). A 5v power supply is given to the esp32 microcontroller to turn it on.

The buzzer is the output device here. The wire from the buzzer is connected to the D23 port on esp32 through a yellow cable (as shown in Fig.2.1) to send the output signal. In the arduino code, we import WiFi.h, HTTPClient.h, DHT.h libraries by clicking Sketch -> Import Library -> Add Library..menu option.

In the void setup function, we give the buzzer as an output pin. We are going to try to connect to the internet and the program is going to wait till an internet connection is available after giving the wifi SSID and password. After the connection is established, the program will print "connected".

The program is then going to read from the analog sensor i.e., the output pin of MQ4.If the value from the analog sensor is greater than 2500, then it shows that a large amount of methane gas is emitted which means that the fruits or vegetables are getting rotten and a signal is sent to the buzzer and it starts beeping. Here, we've given the buffer value of

2300 since the value keeps changing and it can't be set precisely. Then we read the humidity and temperature from the DHT sensor and print the output.

We get the values from the MQ4 and DHT11 sensors and send them to the API where we will be displaying the resultant values. Finally, the bbox is updated so that the next frame gets an overlay. The system is also connected to a web app that shows all the details about the product, its quality, calorific values of the dishes, humidity, temperature, and release of methane along with delicious recipes.

For the User interface, we are developing a web application using HTML, CSS, JavaScript AJAX for the front-end, and for the back-end we are using flask, which is a python framework.

While working on the back-end we are installing multiple modules in a flask like JSON requests, time, and many more. Then using Post request, send the data to the API server to update the personalized recipe. Using EDAMAM API, we generate the recipes for the food items detected by the camera.

Our website currently comprises HTML documents and a Python script. The Python script is in charge of communication between the web server and the web client, whereas the HTML documents are in charge of page content structure.

WE CLAIM:

1. An improvised version of the food recommendation system "WOFO" with utmost perfection keeping the user's priorities at the top without compromising the expenses as well as quality and fitness.

2. The device claims detection of quality of food

3. It claims to detect the calorific value of dishes prepared.

4. It claims to detect the change in humidity or temperature within the refrigerator or of the surrounding in which it has been installed.

5. It claims to alert the user whenever there's a hike in the level of temperature.

6. It claims to alert the user whenever there's a release of methane gas or whenever the quality of the food or product starts decreasing.

7. Buzzer within the system always alerts the user whenever there's a hike in either of the above-mentioned criterions.

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FIGURES

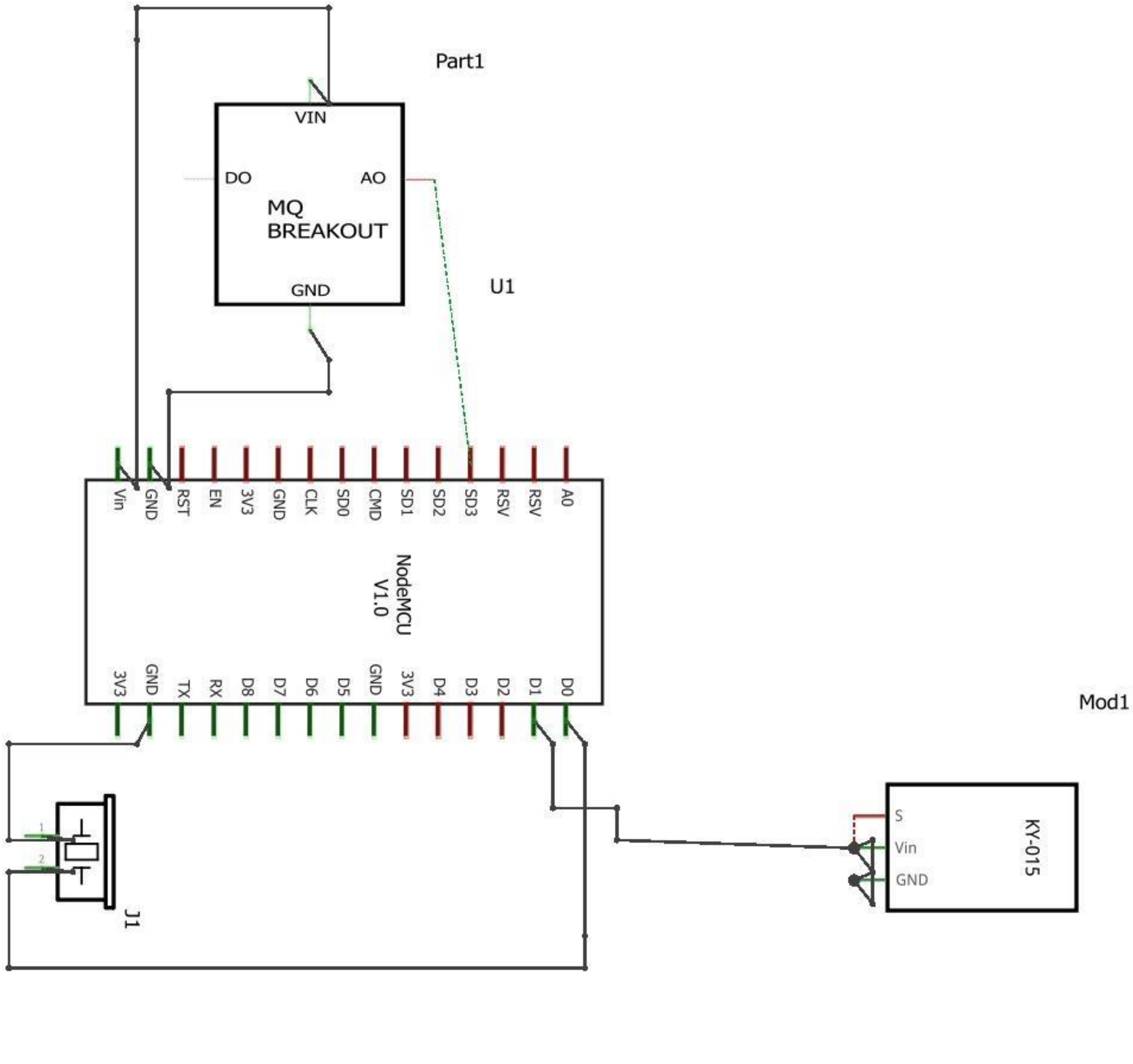

Figure 1: Block Diagram Wofo hardware device

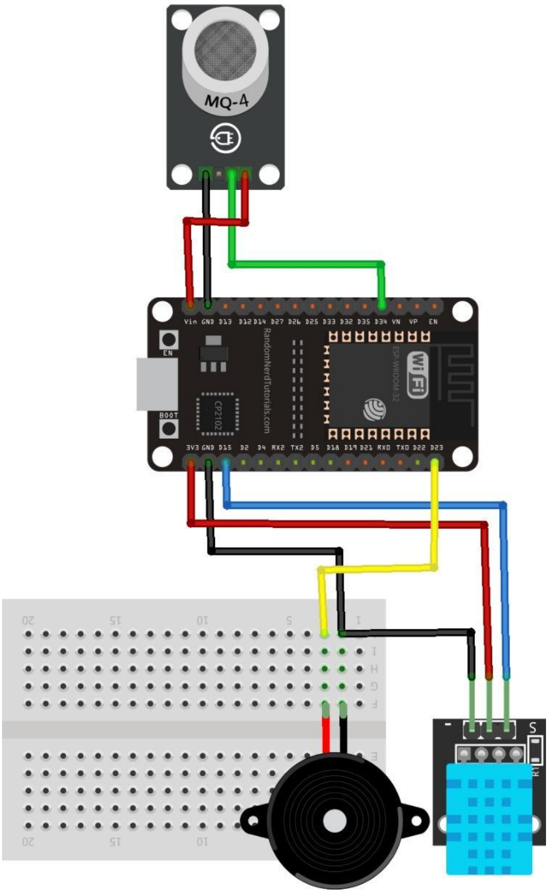

Figure 2.1:Circuit Diagram of WOFO device

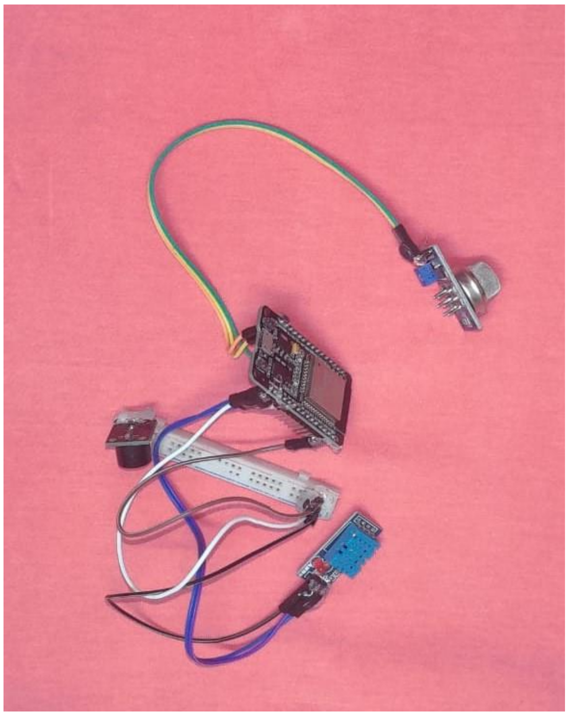

Figure 2.2: WOFO Device Connection

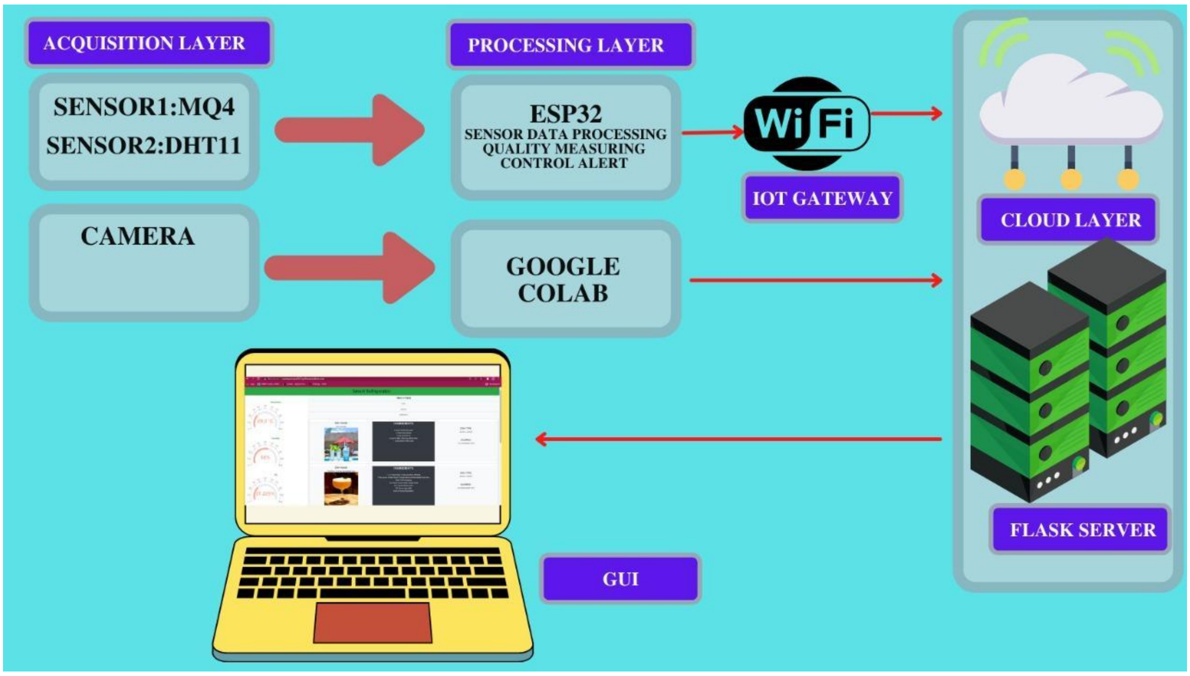

Figure 3: Workflow architecture for data transfer

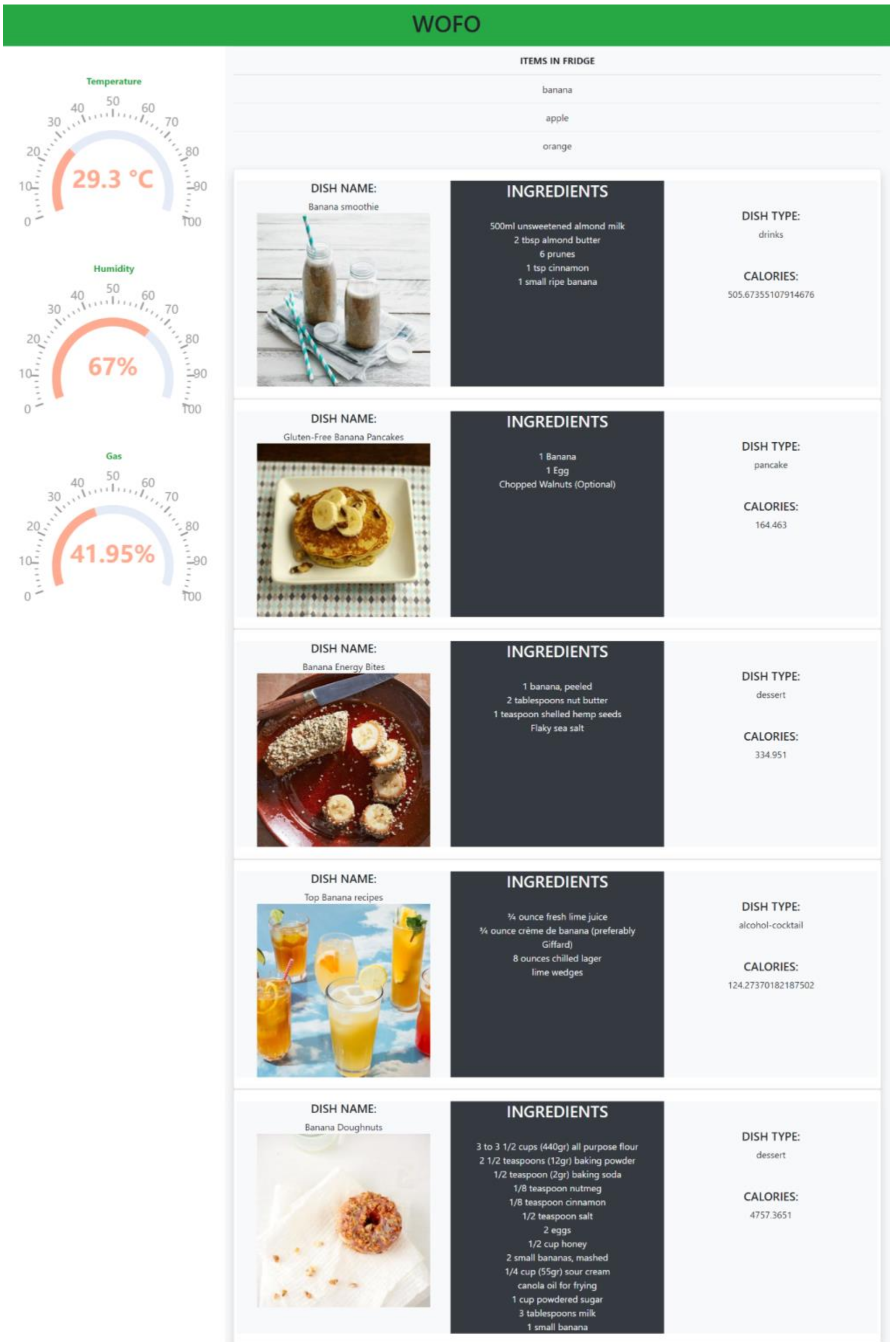

Figure 4: Web application recommending food recipes from leftover

Figure 5: Wofo Output