Freshness of Food Detection using Internet of Things and Mobile Application

Pooja Sanap[1], Nilima Gunjal[2], Rutuja Markande[3], Aditi Patil[4], Shraddha Shinde[5]

[1,2,3,4] Student, Department of Computer Engineering, Late G. N. Sapkal College of Engineering, Nashik, INDIA

[5] Professor, Department of Information Technology, Late G. N. Sapkal College of Engineering, Nashik, INDIA

ABSTRACT

In today's world, food spoilage is a crucial problem as consuming spoiled food is harmful for consumers. Our project aims at detecting spoiled food using appropriate sensors and monitoring gases released by the food item. A micro controller that senses this, issues an alert using internet of things, so that appropriate action can be taken. This has widescale application in food industries where food detection is done manually. We plan on implementing machine learning to this model so we can estimate how likely a food is going to get spoiled and in what duration, if brought from a particular vendor. This will increase competition among retailers to sell more healthy and fresh food and create a safe world for all consumers alike. We also developing a digester. The digester is designed in a such a way that biomethenization process will take place and food waste will be converted to methane and liquid manure. Liquid manure can be used as bio fertilizer by diluting it with equal quantity of water.

Keywords—food safety, machine learning, IoT

I. INTRODUCTION

We are in the 21st century and food sector is very big part of our economy. One of the biggest problems that it faces is food spoilage, i.e. food items, more specifically meat items or fruits and vegetable going stale. The bigger problem is these spoilt items going undetected and onto the hands of the consumer. In all fruits and vegetables industries, the process of checking of quality of items is done manually, mostly by a person sitting across a conveyor belt as the items pass by. Hence, if an automated process is brought into place, it would not only increase the accuracy of spoilt food detection, but also reduce manual manpower required. Fresh food is easily contaminated, and spoiled. Contaminated food is mostly responsible for food-borne illnesses that affect 48 million people annually in the US alone. The issue in a nutshell is that it’s a pain to manually test food that needs to stay at a certain temperature, but if you can monitor it constantly and wirelessly, you can save time and energy. Although transportation and distribution pipelines already include some level of temperature and quality monitoring at intermediate points., in this paper, a fine-grained, continuous monitoring of the products' quality. Assisted by centralized data collection and analytics, our proposed mechanisms can substantially reduce food waste, improve transportation efficiency, and support quick removal of contaminated or spoiled food from the supply chain. Food spoilage can be mitigated by improved tracking and sensing.

To automate this process, we plan on using a collection of smart sensors with microcontroller like the NodeMCU. On detection of a spoilt or stale food item, a sound buzzer can be ringing to draw attention, moreover this data will be sent to the cloud, as an application of IoT. This enables appropriate authorities to view how often they get spoilt food items and create transparency.

II. LITERATURE REVIEW

The detection of whether a food item is spoilt or not is made using the following two principle:

- *Oxygen Level Detection*: The underlying theory is that if food item ,say fruits or meat , is inhabited by germs ,the oxygen levels in the immediate surrounding is going to be lower than it normally is .The reason being that the germs inside the food item are consuming the oxygen , and this change in the level is what we plan to detect.

- *Ammonia Gas*: Meat items like fish, are known to release ammonia gases when they go stale. A gas sensor captures the readings of the ammonia levels near the food item and sends an alert to the microcontroller when abnormal levels are detected. Alternative work going on the field of food freshness detection:

- *Artificial Intelligence Approach*: An alternative approach is using artificial intelligence, on which some work is being done currently. The concept is basically using computer vision and analyzing the image of a food item to conclude if it is spoilt or not. However, the problem is, by capturing images we can only get hold of an idea of the exterior of the food item and not its interior.

- *MIT research*: A MIT team has done research on this field by developing a sensor that detects spoilt meat items. But since it only detects a particular gas, it can have a lot of false negatives.

- *What our system proposes*: To maximize accuracy of detection, instead of relying on value of one sensor, we plan on using cumulative value of both oxygen and ammonia sensors to arrive at a decision. This reduces the possibilities of false negatives. Also, by incorporating an oxygen sensor, our smart sensor can be used to detect germ infection on practically any food item.

III. PROPOSED ARCHITECTURE

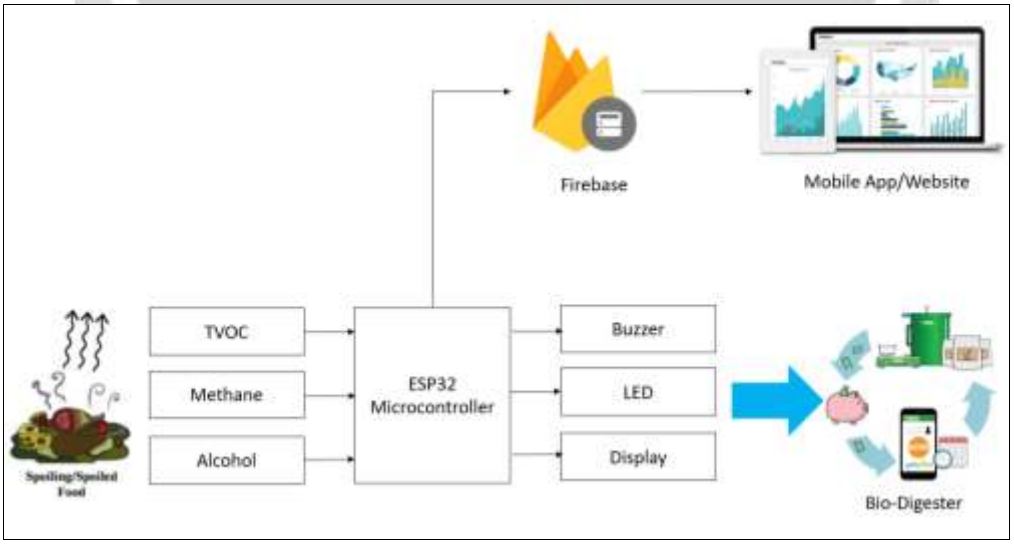

Figure 1 System Architecture

- Sensor monitors the food quality. TOVC(CCS811) and ammonia sensors measure the volatile organic compound content for food item.
- Machine learning model uses trained model to predict if the given food item is spoilt or not based on the TVOC and ammonia content.
- ESP32 (microcontroller) sounds a buzzer when it encounters a spoilt food item. This data is sent to a cloud platform.
- Number of spoilt food occurrences can be monitored, and machine learning model can be deployed again to predict average shelf life of given food items.

Cloud Platform Integration Popular Cloud platforms like Amazon AWS can used for cloud analysis of data. For applications in food industries, we can obtain insights like:

- Occurrences of spoilt food items in a day.
- Peak time duration, in which most food items are found spoilt (day, afternoon, evening).
- How may spoilt food items are successfully separated.
- A sample plot on Amazon AWS is shown below, which shows the number of spoilt food items on different days of the month, providing easy analysis.

IV. CONCLUSION

An exhaustive research has led us to conclude that the food industry can be revolutionized by a simple combination of sensors, IoT and machine learning. After integration, this model will create a competition between food manufacturers to sell more healthy food and create awareness among consumer to purchase more healthy food.

V. REFERENCES

[1] Fatima Mustafa and Silvana Andreescu, "Chemical and Biological Sensors for Food-Quality Monitoring and Smart," Phil. Trans. Roy. Soc. London, vol. A247, pp. 529–551, 16 October 2018.
[2] Neethirajan, S.; Jayas, D.S. Nanotechnology for the food and bioprocessing industries. Food Bioprocess Technol. 2011, 4, 39–47. I. S. Jacobs and C. P. Bean, "Fine particles, thin films and exchange anisotropy," in Magnetism, vol. III, G. T. Rado and H. Suhl, Eds. New York: Academic, 1963, pp. 271–350.
[3] Eissa, S.; Zourob, M. 'In vitro selection of DNA aptamers targeting - lactoglobulin and their integration in graphene-based biosensor for the detection of milk allergen' Biosens. Bioelectron. 2017, 91, 169–174.
[4] Archer DL, 'Freezing: An underutilized food safety technology?' International Journal of Food Microbiology,2004
[5] Gunders D, "Wasted: How America is Losing 40% Percent of its Food from Farm to Fork to Lanfill", Naturals Resources Defense Council, 2012