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Rapid Detection of Adulteration in Refining Ghee and Edible Oil Based on Arduino

Dr. Narendra Bawane[1], Ms. Urvashi Agrawal[2], Mr. Gaurav T. Khandate[3]
Professor, Department of Electronics & Tele. Comm. Engg / Principal[1]
Asst.Professor, Department of Electronics & Tele. Comm. Engg[2]
PG Student, Department of VLSI[3]
Jhulelal Institute of Technology, Nagpur, Maharashtra, India
narendra.bawane@yahoo.com[1], urvashi.agrawal2000@gmail.com[2], gaurav.khandate@yahoo.in[3]

Abstract: *Food adulteration occurs when the quality offood is purposely diminished through the introduction of unnatural or unnecessary ingredients or through the elimination of beneficial ones. This is commonly done to enhance a food item's volume or decrease its price. Indicators of the quality of edible oils include their fatty acid composition and content. Using quantitative measurement of palmitic acid, stearic acid, arachnidan acid, and behenic acid, this study set out to establish a quick determination method for quality detection of edible oils. The Arduino-based food detection system presented here forms the basis of this paper. The suggested system relies on a combination of detection and recognition algorithms. The algorithm's primary utility is in determining whether or not food has gone bad and alerting the user accordingly. The usage of Arduino, a microcontroller board, in conjunction with programming and sensors is the focus of this article.*

Keywords: Arduino uno, MQ3 sensor, LDR, DHT11 sensor

I. INTRODUCTION

Due to rising demand, both global production and consumption of ghee and other edible oils have been on the rise. As a source of both flavour and nutrients, edible oil has various uses. It may be used to cook with and provides the body with a variety of nutrients, including fatty acids, energy, and critical trace elements. Edible oil and ghee quality is linked to food safety and public health, and the oils and fats people consume can shift their bodies' nutrient profiles.

Testing has a vital role to play in the production process. Also referred to as 'clarified butter, ghee is a dairy staple used in kitchens globally. However, there have been a lot of cases regarding the adulteration of ghee and edible oil.

However, considering the importance, use, and benefits of pure ghee and edible oil, keeping a thorough check on its purity becomes exceptionally vital. That said, the ghee and edible oil testing works on checking the purity, quality, ingredient, and shelf-life of ghee and edible oil.

II. LITERATUREREVIEW

We conducted an extensive literature analysis using the search phrases adulteration practice, Detection technique of Ghee and oils, and adulteration scenario to compile relevant scientific information from sources like Google and the Medline database. This brief narrative review only includes information that was found to be directly applicable to our primary research question after it was culled from the massive body of data originally collected.

The Smart Plate is a gadget proposed in the paper [1]; it has a number of sensors that are triggered with the presence of a certain food item. Place this plate in any dishware and use the panel to pick the meal type.

The research [2], explores the analytical features of various sensing designs and their practical applications for assessing freshness markers, allergies, viruses, adulterants, and toxicants.

The author of the paper [3] described a system for storing food and kitchen supplies that restocks itself automatically. Force sensitive resistors (FSRs) are used to determine if a particular pantry box is empty. The value from the sensor is read by an Arduino UNO.

The author of the paper [4] proposed For data transmission over long distances. The system takes advantage of the public GSM/GPRS wireless network. Combining Internet of Things (IoT) technology, GSM/GPRS open remote system technology, and the Internet significantly reduces the cost of the system while simultaneously driving an infinite amount of follow-up acknowledgement, hence improving the system's efficiency. The framework was very wellexecuted overall.

In paper[5], the authors propose a number of factors as essential to achieving smart bundling, including small gas sensors, minimal effort customised to the type of food packaging, and a specialised device for transmitting caution yield to the consumer.

The author of paper[6] made use of biosensors in their research. The development of new biosensors is garnering increasing interest due to their superior specificity, adaptability, and speed of response.

According to the study[7] monitoring perishable food goods and early identification of deterioration can save loss due to food waste and also assure the freshness of food. In this case, the quality of fruit can be guaranteed through remote monitoring as it is being transported from the field to the store shelf. In this project, we developed a wireless sensor network to track fruit from the time it's picked until long after it's been put away for storage.

According to the research presented in paper [8], the author presented an external interrogator that communicates with a pH sensor to assess the safety and freshness of food.

Electronic noses were first proposed in paper [9], which argues for the use of a variety of electronic gas sensors with intermediate specificity and appropriate example acknowledgment strategies for detecting both simple and complex odours.

The topic of battery-free RFID sensors for monitoring food safety and quality is discussed in detail in a recent research publication [10]. In order to detect spoilage and bacterial development in food with great sensitivity and selectivity, the author suggested using passive (battery-free) radio frequency identification (RFID) sensors.

III. BLOCK DIAGRAM

In this project, we developed an Arduino-based device to track changes in food quality. In this case, the Arduino has acted as an Internet of Things board. The Arduino can communicate with the DHT-11, MQ3, and LDR sensors, the ESP8266 Wi-Fi Modem, and the character LCD.

It is recommended that this Arduino-based IoT device be placed in a grocery store. After being set up and turned on, it communicates with the internet through Wi-Fi modem and begins collecting data from the DHT-11 temperature and humidity sensor, MQ3 sensor, and the LDR sensor that are interfaced with it. The DHT11 is a digital sensor that includes a capacitive humidity sensor and a Thermistor for measuring temperature and humidity. It sends a new temperature and humidity report every 2 seconds straight from the sensor. The sensor's input range is 0 to 50 degrees Celsius, and its output range is 20 to 95% relative humidity on a 3.5 to 5.5 V supply.

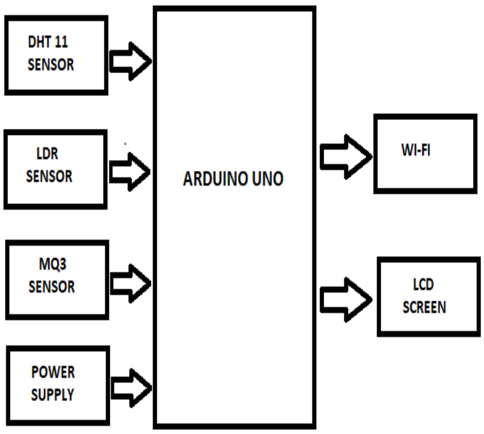

Fig.1 Block Diagram of Rapid Detection of Adulteration in Refining Ghee and Edible Oil Based on Arduino

Since the sensor uses a 1-wire protocol that can only be supported in software, it cannot be connected directly to the board's digital pins. A start signal is first sent to the data pin once it has been set to input mode. The start signal consists of an eighteen millisecond LOW, followed by a twenty to forty microsecond HIGH, an eighty microsecond LOW, and

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an eighty microsecond HIGH. Once the start signal is sent, the pin is switched to digital output, and the temperature and humidity reading, which together take up 40 bits of data, are latched out. The first two bytes provide an integer and decimal part of the relative humidity reading, the third and fourth bytes represent an integer and decimal component of the temperature reading, and the fifth byte is a checksum.

The DHT-11 sensor has a standard library for Arduino. A simple call to the read11() function of the DHT class makes the sensor data readily available. The voltage from the LDR sensor is sent into the controller's analogue input pin through a potential divider circuit. The onboard ADC channel reads the voltage and converts it to a digital signal.

IV. HARDWARE

4.1 Arduino Uno

The microcontroller board on which the Arduino UNO is based is an ATmega328. It is widely considered to be a top prototype board. The board has an Arduino boot loader already installed. There are 14 general-purpose input/output (GPIO) pins, 6 pulse-width-modulation (PWM) pins, 6 analogue inputs, UART, SPI, and TWI interfaces, a reset button, pin header mounting holes, and an on-board resonator. The board may be powered by the USB connection to the computer, making it ideal for use throughout the programming process. The Arduino UNO comes equipped with 32 Kb of Flash memory, 1 Kb of EEPROM, and 2 Kb of SRAM. The board is compatible with the vast majority of IoT systems, and its connectivity options (Ethernet, Bluetooth, Wi-Fi, ZigBee, and Cellular) are expanded by the use of several Arduino Shields.

Figure 2: Arduino

4.2 MQ3 Sensor

Because SnO2 has a lower conductivity in clean air than it does in the presence of ethanol, the MQ3 alcohol sensor module can be used to detect its presence. The higher the ethanol gas concentration, the higher its conductivity. It reacts strongly to alcoholic beverages but is relatively unaffected by other environmental disturbances including smoke, mist, and gasoline. Digital and analogue signals can be extracted from this module. It's really sensitive and reacts quickly.

Figure 3: MQ3 Sensor

4.3 LDR

The light dependent resistor (LDR) measures how bright an object is. The Arduino board's A1 pin is where the sensor is connected. A potential divider circuit is used to connect the sensor to the outside world. The analogue voltage from the LDR is transformed to a digital signal by the onboard ADC.

Figure 4: LDR

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4.4 DHT11 Sensor

The DHT-11 is a sensor for both heat and moisture. The DHT11 has two major parts: a humidity sensor and a thermistor (or Thermistor). In reality, the Thermistor is a variable resistor whose resistance varies with temperature. They both collect data on the ambient temperature and humidity and send it to the integrated circuit (which is placed on back side of sensor).

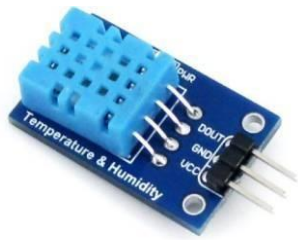

Figure 5: DHT11 Sensor

V. CONCLUSION

This research employed an electronic nose made from eight metal oxide semiconductor sensors to identify fake cow ghee from the real thing (mixed with margarine). Artificial neural networks (ANN) and principal component analysis were used to study the data (PCA). Algorithms like principal component analysis and artificial neural networks produce results that are helpful in classifying data.

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