Mango Ripeness Monitoring System Schematic Design

Abstract:

Gas sensors have revolutionized the detection of ripeness stages in visually immature mangoes, representing a significant breakthrough in the industry. This cutting-edge technique plays a pivotal role in ensuring impeccable quality, satisfying consumer preferences, and maximizing market value. The objective of this study was to monitor mango fruit ripening stages using MQ135 and MQ3 specifically for visually immature mangoes. Traditional methods for ripeness identification rely on subjective and error-prone tactile and visual clues. Based on the volatile organic compounds (VOCs) that the mango fruit emits during the ripening process, gas sensors provide a non-destructive and objective method to determine mango maturity. To be able to classify the mangoes into three classes, namely unripe, ripe and overripe, the experiment was carried out with the unripe samples for three days. Besides, observation of new volatiles from the unripe mangoes as they were ripening indicated unstable trends of volatiles during mango ripening. A detailed analysis was provided in this report to demonstrate the achievement and limitations of the systems. Further, potential solutions and avenues for future research have been identified for more promising, refined and reliable methodologies in the field.

Introduction:

In this paper, we present a sensor-based system for accurately analyzing mango ripeness. The system utilizes two sensors to detect alcohol and ammonia levels in mangoes, enabling precise ripeness assessment. It incorporates sustainable features such as solar power and a buck-boost converter for efficient battery charging. A charge controller ensures reliable battery operation. The sensor readings are processed using an Arduino Uno microcontroller and displayed in real-time on an I2C LCD display.

To further enhance the system, we propose integrating a Sim900A module for remote monitoring and data analysis over ThinkSpeak. This would enable comprehensive control and analysis of mango ripeness data.

Our sensor-based system offers an innovative and reliable approach to assess mango ripeness, benefiting farmers, distributors, and retailers in making informed decisions regarding harvesting, storage, and distribution. This paper provides detailed design and implementation information, highlighting the system's potential impact on the mango industry and suggesting avenues for future research and improvement.

Experimental Procedure

1. The system was tested for unripe, ripe and overripe mangos using MQ135 and MQ9 sensors. To begin with, the sensors were connected to the Arduino Uno using breadboard and jumper wires.
2. After that, the sensor values were tested for both the MQ135 and MQ9.

3. Later on, the connection was modified separately for both sensors to take average values of the MQ135 and MQ9 individually.
4. The values were averaged in excel file for further analysis.

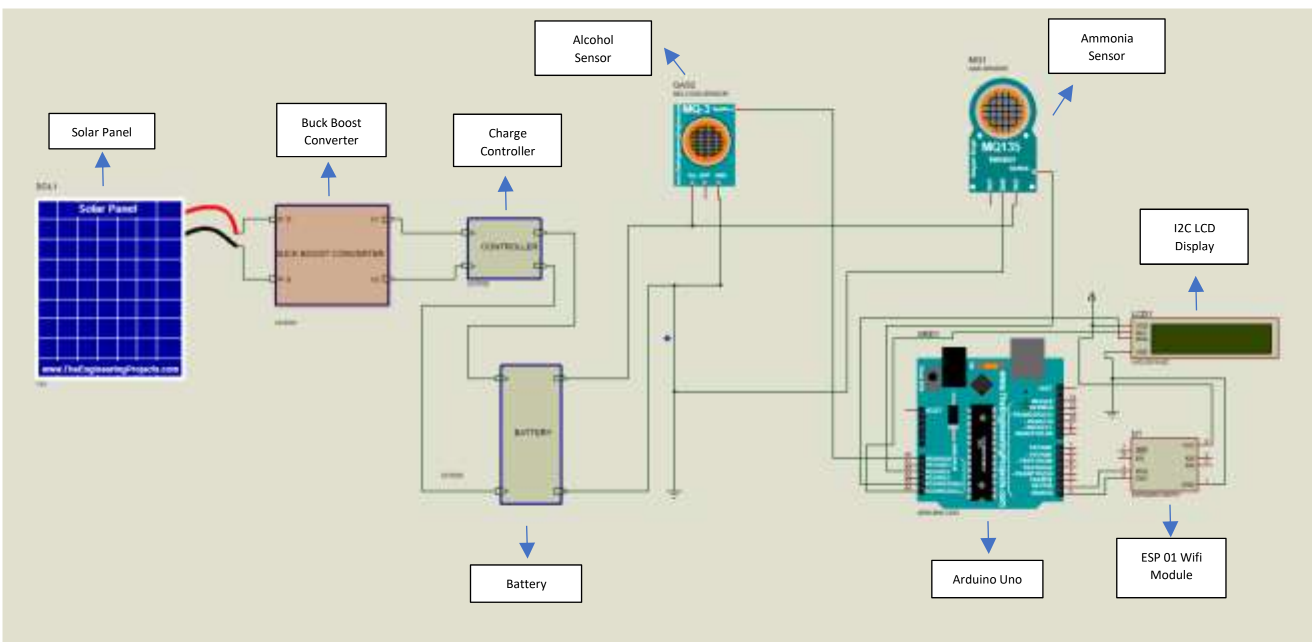

Figure01: Mango Ripeness Monitoring system circuit design

The system requires two sensors to detect alcohol and ammonia level in mango to analyze the ripeness stage of the fruits. The system can be solar powered for better sustainability. A buck boost converter then need to be used to step up and step down the voltage to match the battery charging requirements. A charge controller should be attached to the system to prevent over charging or over discharging of the battery. The first sensor can be used to detect alcohol and the second sensor can be used for Ammonia (NH3) detection released from the ripped mangoes. If the alcohol sensor reading remains between 250 and 420, the mangoes are termed ripped. The same is true for the Ammonia sensor; if the value varies between 180 and 190, the mangoes are deemed ripe. The sensor values will be taken and processed by the Arduino Uno. The I2C LCD display will show the sensor readings. Later on an ESP 01 Wifi module can be used to monitor the data on internet for proper analysis and control.

Block Diagram of the Proposed System:

A block diagram of the mango ripeness monitoring system shows that two IoT-controlled sensors and one microcontroller (Arduino Uno) serve as the major testing components. The primary power source in this system is a solar panel and a charge controller regulates the charge from the solar panel. The battery which is charged via the charge controller is the basic source of power for the microcontroller (Arduino Uno).

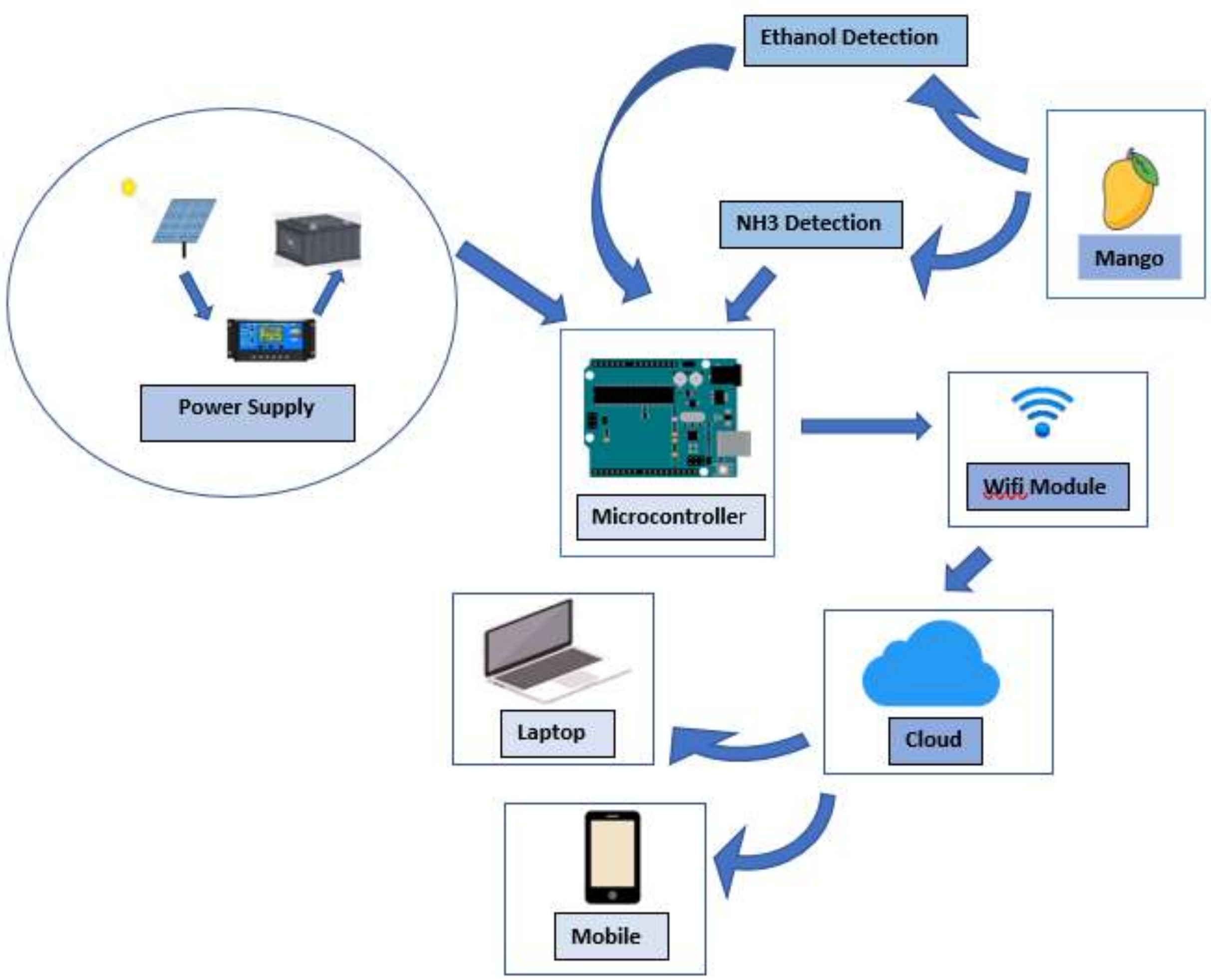

Figure 1: System block diagram of the mango ripeness monitoring system

The amount of ethanol and NH3 gas increases as the mangoes ripening starts. Two sensors, MQ3 (used to detect ethanol) and MQ135 (used to detect NH3 gas), can measure the amounts of ethanol and NH3 gas. Following detection, the data will be saved in a microcontroller, where the code will be used to determine the stage of ripening based on the values of ethanol and NH3. Finally, using a WiFi module, the data will be transmitted to the cloud, where it may be accessed on a laptop or mobile device.

Flow chart of the Proposed System:

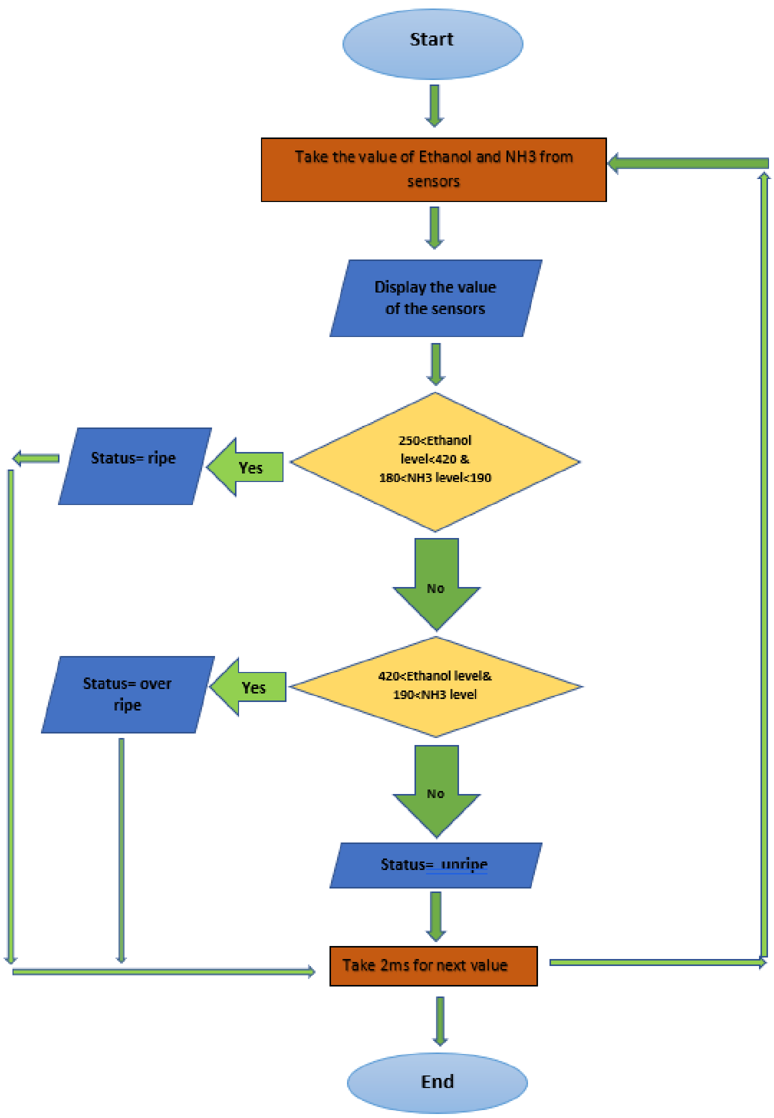

Figure 2: Flow chart of the mango ripeness monitoring system

The two sensors will take the value of the Ethanol and NH3 into the arduino. The LCD display will show the level of the sensor results. The mangoes are considered ripe if the alcohol sensor (MQ3) value remains between 250 and 420. The Ammonia sensor (MQ135) works similarly; if the value is between 180 and 190, the mangoes are considered ripe. For the condition of 250<Ethanol Level <420 &&180< NH3 level <190 if the result is yes then the display will show status as “Ripe”. Again, for 420<Ethanol Level && 190< NH3 level condition the display will demonstrate result as “Over Ripe”. Else the result will show “Unripe”.

	Reading :01			Reading :02				Reading :03	
	high	low		high	low			HIGH	LOW
mq135_2	330	293		334	328		MQ135_1	358	332
mq135_1	383	358		370	359		MQ135_2	324	300
	356.5	314.6667		352	343.5			341	316

	Reading :04	
	High	LOW
MQ135_1	450	367
MQ135_2	485	401
	467.5	384

Here, Table 01 to Table 04 all the average values of MQ135 is shown for ripe mangos. Its evident from the tables that the values are not merging from a certain range. As example, the values from table 01 to table 03 seemed stable within 310 to 350. On the other hand in table 04, the higher threshold value raised from 350 to 467.5 . There was no fixed ratio observed to approximate the threshold range.