NATIONAL INSTITUTE OF TECHNOLOGY, ROURKELA

Project Report

Analytical Instrumentation Techniques

Methane Gas Emission Based Fruit Freshness Monitoring System

Team Cosmos

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Submitted By: -

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Introduction

In today's fast-paced world, ensuring the freshness and quality of perishable fruits is crucial, as it directly impacts consumer health and reduces waste in the food supply chain. Fruits emit specific gases, such as ethylene, during ripening, which can indicate freshness levels. This project aims to design an IoT-based system to monitor these gas emissions using Arduino Nano and sensors. By detecting gases like methane and ethylene, as well as environmental conditions such as temperature and humidity, this device provides real-time insights into fruit freshness, making it an ideal solution for various stakeholders, from individual consumers to large-scale food industries.

Prescribed Solution & Problem Statement

Problem Statement: The main challenge lies in non-invasively monitoring the freshness of fruits through cost-effective means. Traditional methods either lack precision or require invasive testing, making them unsuitable for continuous monitoring in the supply chain.

Proposed Solution: This project utilizes an Arduino Nano microcontroller combined with gas sensors (MQ3 and MQ5) and a DHT11 sensor for temperature and humidity monitoring. The device continuously measures gas concentrations, primarily ethylene, which signals ripening. By setting threshold values for freshness indicators, the system warns users through an LCD display and a buzzer if the fruit's condition deteriorates, ensuring quality control from farm to fork.

Uniqueness of the Project

This project stands out for its simplicity, affordability, and ease of implementation, allowing real-time freshness monitoring without direct contact with the fruit. By integrating multiple sensors into a compact design, the system can be deployed across various environments, from homes and markets to restaurants and warehouses. Additionally, the device's threshold-based alerts provide timely notifications, making it ideal for preventing premature spoilage and reducing waste.

System or Concept Level Block Diagram

- Arduino Nano 33 IoT: Acts as the central microcontroller, processing data from all sensors.
- MQ3 Sensor: Detects ethylene gas to assess the ripeness level.
- MQ5 Sensor: Monitors natural gases like CO_2.
- DHT11 Sensor: Measures temperature and humidity, essential for optimal storage conditions.
- LCD Display: Displays freshness status and sensor readings.
- Buzzer: Provides audio alerts when freshness thresholds are exceeded.

Diagram Outline:

1. Input: Sensors (MQ5, MQ3, DHT11)

MQ 5 Sensor

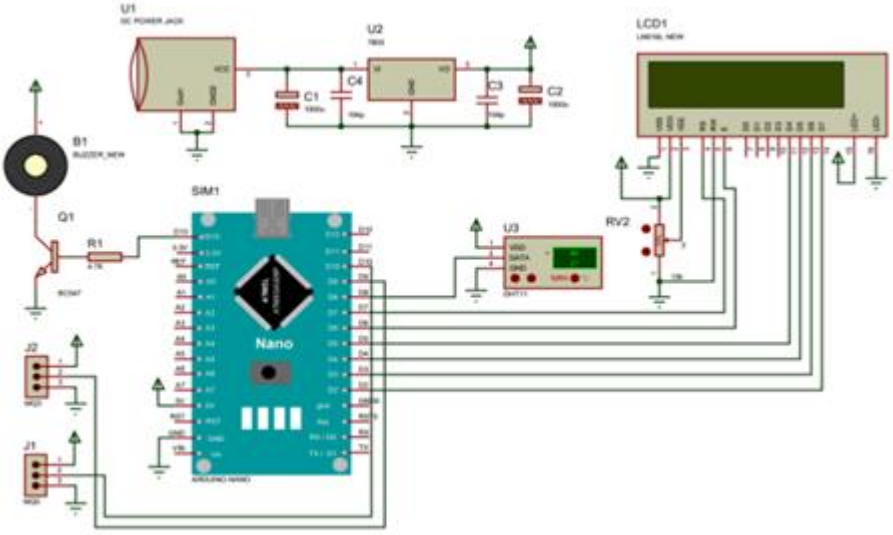
MQ 3 Sensor

DHT 11 sensor

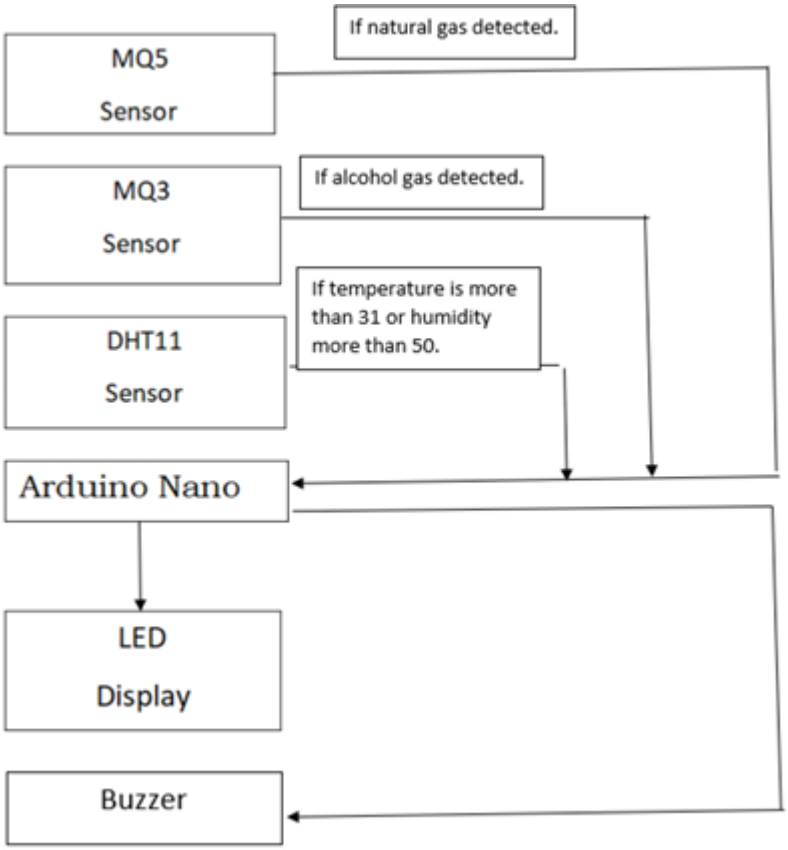
2. Processing: Arduino Nano 33 IoT

3. Output: LCD display for data

Design :- Circuit diagram of proposed system



Flowchart:- Flowchart of IOT based Fruit Freshness Detector Using Arduino Nano



Future Perspective / Long-Term Plans

The device has significant potential for expansion, including integration with cloud platforms for remote monitoring and automated storage adjustments. Future versions could incorporate additional sensors to measure other ripeness indicators and apply machine learning algorithms to predict optimal storage conditions for different fruit types. Furthermore, creating a mobile app interface could make it user-friendly and more accessible to small vendors and consumers alike.

Limitation of the Project

While the device provides effective real-time monitoring, it currently has limitations:

- Limited detection range, as the sensors must be relatively close to the fruit.
- Sensor sensitivity may vary based on environmental conditions, requiring periodic recalibration.
- The device currently only supports a fixed set of fruit types, such as apples and bananas, which produce measurable levels of ethylene.

Hardware, Software, Tools

- Hardware: Arduino Nano, MQ3 sensor, MQ5 sensor, DHT11 sensor, LCD display, buzzer, 5V power supply.
- Software: Arduino IDE (programming environment)
- Tools: Soldering tools, multimeter for calibration, breadboard for prototyping

Estimated Budget

Item	Quantity	Cost (INR)
Arduino Nano 33 IoT	1	₹2500
MQ3 Gas Sensor	1	₹150
MQ5 Gas Sensor	1	₹150
DHT11 Sensor	1	₹100
LCD Display (16x2)	1	₹200
Buzzer	1	₹50
Total		₹3150

References

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