BREAD QUALITY CHECK USING IOT

Innovative Project

PRJCS381

Submitted

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Submitted by

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Abstract

Expiration of bread is a common issue in food logistics. Fungal contamination can cause food poisoning in consumers, leading to nausea, diarrhea, and other health problems. To prevent such outcomes, we developed an intelligent IoT-based system to detect the freshness of bread.

The system uses **Arduino Nano**, **MQ series gas sensors** for CO and CO_2 detection, and the **AMG8833 thermal sensor** to capture infrared images that help detect fungal growth. Collected data is processed using machine learning algorithms. Due to data imbalance, techniques like **SMOTE** and **TOMEC Links** were used. The **Gaussian Naïve Bayes** model achieved the best prediction accuracy of **81.54%**.

Problem Definition

The goal is to develop a system that continuously monitors the environmental conditions affecting bread freshness—humidity, temperature, gas emissions, and thermal activity—to prevent spoilage and ensure consumer safety. Traditional quality checks are reactive and often inaccurate. This system takes a proactive approach using IoT.

Background

Bread, being one of the oldest staple food items, is used by people throughout the world, and therefore has so many methods of ensuring quality control to guarantee consumer satisfaction, safety, and all other attributes like freshness, texture, taste, and safety (i.e., free from mold and other contaminants). Conventionally this quality control process has involved numerous eye inspections, which have been unreliable and usually wrought with human error. Hence, the effective use of IoT technology will be able to deliver enhanced bread monitoring and management from production to consumption.

Block Problem Making

But how does one ensure monitoring and control of such quality of bread in real-time, which eventually leads to problems like spoilage, waste, and even health risks to consumers? Existing means of quality control tend to favor the reactive over the proactive. Hence, bread goes on sale after it is no more fresh, and, worse still, wasted without any satisfactory justification.

Introduction

This project focuses on using IoT-based sensors to monitor the internal environment of bread storage for early detection of spoilage. The system integrates **MQ7** and **MQ135** gas sensors to detect harmful gases such as carbon monoxide (CO) and carbon dioxide (CO_2), which are often released during the decomposition process. The **DHT11** sensor measures temperature and humidity, which are critical factors influencing mold growth and spoilage. Additionally, the **AMG8833** thermal camera captures surface temperature variations, helping identify anomalies that may suggest fungal activity on the bread. By combining data from these sensors, the system aims to provide a comprehensive and real-time analysis of bread quality. Wheat bread is selected as the test subject for this project due to its widespread consumption and vulnerability to spoilage. This approach not only ensures food safety but also helps in reducing food waste by enabling timely intervention during the early stages of contamination or decay.

Objectives:

- Real-time monitoring
- Early Spoilage Detection
- Data Analytics
- Alert System for Deviation
- User-friendly interface

Work Done

Project Planning

- Defined objectives
- Conducted feasibility study

System Design

- Chose sensors: MQ7, MQ135, DHT11, AMG8833

Hardware Development

- Built a working prototype
- Integrated all sensors with Arduino Nano
- AMG8833 used to detect fungal hotspots via thermal imaging

Dataset Information from Bread

Attribute	Sensor	Description
Carbon Monoxide	MQ7	Detects CO and harmful gases
Carbon Dioxide	MQ135	Detects CO_2 and air contaminants
Humidity	DHT11	Measures humidity using capacitive sensing
Thermal Imaging	AMG8833	Captures 8x8 thermal matrix to detect fungal heat anomalies

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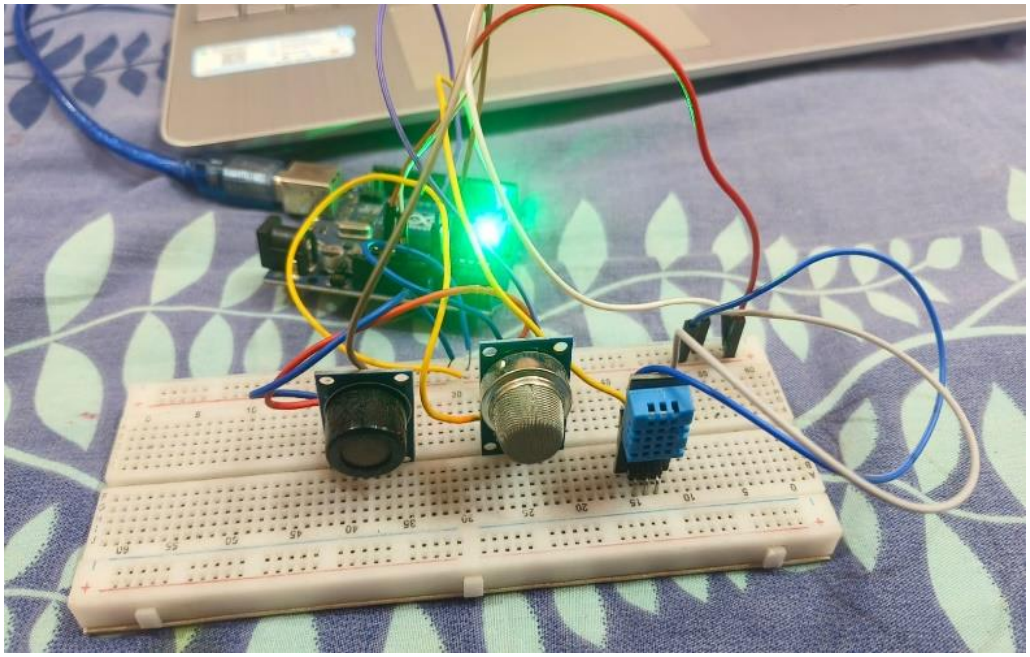
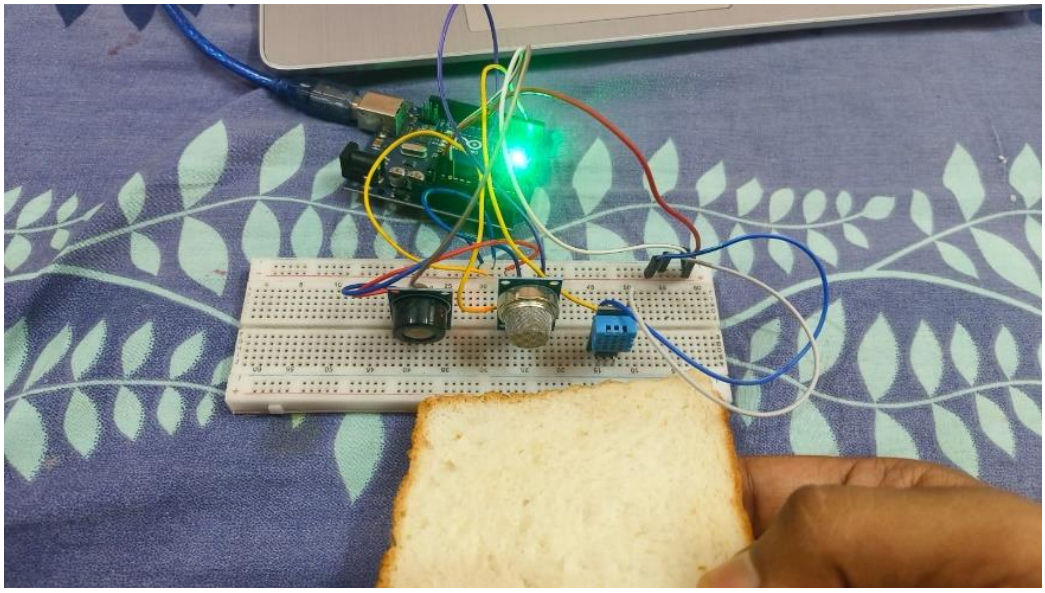
Working prototype





Fungal Growth Observation Table (1-Week Sensor Data)

Day	Humidity (%)	CO_2 Level (ppm)	CO Level (ppm)	Fungal Growth Observation
Day 1	55	410	2	No visible mold
Day 2	58	430	3	No visible mold
Day 3	62	480	5	Slight discoloration starts
Day 4	66	530	7	Small white/green mold patches seen
Day 5	70	600	10	Fungal growth becomes prominent
Day 6	75	680	12	Bread shows visible spoilage
Day 7	78	720	14	Advanced fungal spread, strong Odor

Review of Related Works

Studies show IoT applications in food monitoring are expanding, focusing on spoilage detection through gas levels, temperature, humidity, and ML prediction models. Our system builds on this by adding **thermal imaging**, enabling visual confirmation of fungal activity.

Remaining Work to Be Accomplished

1. **System Design**
    - Finalize architecture and data flow
2. **Hardware Testing**
    - Calibrate all sensors
3. **Software Development**
    - Improve cloud storage and UI
    - Fusion of gas + thermal data
4. **Testing**
    - Functional and User Acceptance Testing (UAT)

Conclusion

This project provides an efficient, low-cost method for detecting fungal contamination in bread using an IoT-based system. It combines environmental monitoring with thermal imaging and machine learning to enhance detection. With 81.54% model accuracy and early-stage detection capabilities, the system offers strong potential for food quality and safety applications.

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