“IoT-Based Meat Spoilage Detecting System”

“MSDS”

Project ID. 2023: 10

Session: BSc. Spring 2020

Project Supervisor: Mr. Shakir Karim Buksh

Submitted By

Syed Hamza Hassan

Mahnoor Hussain

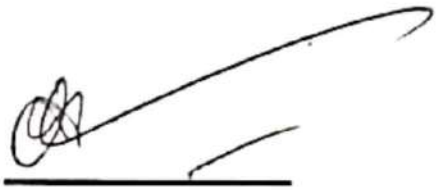
Raheel Saleem

Department of Computer Science & Information Technology

Sir Syed University of Engineering & Technology

Certification

This is to certify that **Syed Hamza Hassan (BSCS-2020-069), Mahnoor Hussain (BSCS-2020-071)** and **Raheel Saleem (BSCS-2020-092)** have successfully completed the final project *IoT-Based Meat Spoilage Detecting System*, at the *Sir Syed University of Engineering & Technology*, to fulfill the partial requirement of the degree **Bachelor in Computer Science**.



External Examiner

[Name of Examiner]

Project Supervisor

Mr. Shakir Karim Buksh

Assistant Professor

Chairman

Department of Department of Computer Science, Sir Syed University of Engineering & Technology

Project Title: IoT-Based Meat Spoilage Detecting System

Sustainable Development Goals

(Please tick the relevant SDG(s) linked with FYDP)

SDG No	Description of SDG	SDG No	Description of SDG
SDG 1	No Poverty	SDG 9	Industry, Innovation, and Infrastructure
SDG 2	Zero Hunger	SDG 10	Reduced Inequalities
SDG 3	Good Health and Well Being	SDG 11	Sustainable Cities and Communities
SDG 4	Quality Education	SDG 12	Responsible Consumption and Production
SDG 5	Gender Equality	SDG 13	Climate Change
SDG 6	Clean Water and Sanitation	SDG 14	Life Below Water
SDG 7	Affordable and Clean Energy	SDG 15	Life on Land
SDG 8	Decent Work and Economic Growth	SDG 16	Peace, Justice and Strong Institutions
		SDG 17	Partnerships for the Goals

Range of Complex Problem Solving			
	Attribute	**Complex Problem**	
1	Range of conflicting requirements	Involve wide-ranging or conflicting technical, engineering and other issues.	
2	Depth of analysis required	Have no obvious solution and require abstract thinking, originality in analysis to formulate suitable models.	
3	Depth of knowledge required	Requires research-based knowledge much of which is at, or informed by, the forefront of the professional discipline and which allows a fundamentals-based, first principles analytical approach.	
4	Familiarity of issues	Involve infrequently encountered issues	
5	Extent of applicable codes	Are outside problems encompassed by standards and codes of practice for professional engineering.	
6	Extent of stakeholder involvement and level of conflicting requirements	Involve diverse groups of stakeholders with widely varying needs.	
7	Consequences	Have significant consequences in a range of contexts.	
8	Interdependence	Are high level problems including many component parts or sub-problems	

Range of Complex Problem Activities			
	Attribute	**Complex Activities**	
1	Range of resources	Involve the use of diverse resources (and for this purpose, resources include people, money, equipment, materials, information and technologies).	
2	Level of interaction	Require resolution of significant problems arising from interactions between wide ranging and conflicting technical, engineering or other issues.	
3	Innovation	Involve creative use of engineering principles and research-based knowledge in novel ways.	
4	Consequences to society and the environment	Have significant consequences in a range of contexts, characterized by difficulty of prediction and mitigation.	
5	Familiarity	Can extend beyond previous experiences by applying principles-based approaches.	

Abstract

Meat production and processing play a pivotal role in human nutrition, but the evolving methods pose increased risks related to meat-borne diseases. In response, we present an innovative IoT-based Meat Spoilage Detecting System (MSDS) designed to enhance food safety and quality control within the meat industry. The system features a user-friendly app, catering to both industry professionals and consumers, enabling informed decisions on meat product safety and quality.

This groundbreaking app focuses on real-time meat freshness detection and spoilage alerting. It leverages intelligent sensor technology, monitoring temperature and humidity, which triggers alerts and initiates inspections within meat freezers. Any spoiled meat items are promptly identified and removed, while the system generates comprehensive reports for incoming and outgoing meat, ensuring meat hygiene standards are upheld.

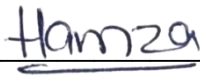
The system's significance is amplified for restaurant and cafe owners, enabling meticulous oversight of meat product quality and hygiene. Given meat's high perishability and cost, even minor temperature fluctuations can result in rapid spoilage, leading to substantial financial losses. By introducing this IoT-based MSDS, we address these pressing challenges and promote a safer and more sustainable meat industry. Future directions may include further sensor advancements and integration with supply chain management to optimize meat product quality control.

Undertaking

I certify that the project **IoT-based Meat Spoilage Detecting System** is our own work. The work has not, in whole or in part, been presented elsewhere for assessment. Where material has been used from other sources it has been properly acknowledged/ referred.

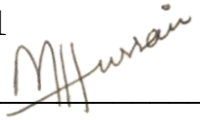
Name: Syed Hamza Hassan

Bscs-2020-069

Signature: 

Name: Mahnoor Hussain

Bscs-2020-071

Signature: 

Name: Raheel Saleem

Bscs-2020-092

Signature: 

Acknowledgement

We truly acknowledge the cooperation and help make by **Mr. Shakir Karim Buksh, Assistant Professor** of **Sir Syed University of Engineering & Technology**. He has been a constant source of guidance throughout the course of this project. We would also like to thank **Engr. Muhammad Nadeem, Assistant Professor,** of\ **Sir Syed University of Engineering & Technology** for his help and guidance throughout this project.

We are also thankful to our friends and families whose silent support led us to complete our project.

Table of Contents

List of Tables

List of Figures

List of Acronyms

MSDS	Meat spoilage Detecting System
PERT	Program Evaluation Review Technique
UML	Unified Modeling Language

List of Equations

NA

Chapter 1

1.1 Introduction:

Meat has always been an important part of human nutrition, but as production and processing methods evolve, so do the risks associated with meat-borne diseases. To mitigate these risks, an IoT-based meat spoilage detecting system (MSDS) has been introduced, with the specific aim of ensuring food safety and quality control for meat products in the area or domain of food production and processing. The system includes a user-friendly app that can be used by both industry professionals and consumers to make informed decisions about the safety and quality of meat products.

The app has been designed to detect the freshness of meat and alert users if any meat is spoiled. This is achieved through the use of intelligent sensor technology that detects temperature and smell, generating alerts and initiating inspections in the meat freezer. Any spoiled meat pieces are then removed, and the system also provides reports on incoming and outgoing meat, ensuring the hygiene of the meat. This app is particularly useful for restaurant/cafe owners who can closely monitor the quality and hygiene of their meat products. As meat is a highly perishable and expensive product, even minor temperature fluctuations can cause it to spoil quickly, leading to significant financial losses.

1.2 Statement of the problem:

Meat is a widely consumed food globally, offering essential nutrients to human nutrition. It is a significant commodity traded in the market, with restaurants and cafes being the primary consumers. Nevertheless, Meat spoilage is a significant problem in the industry due to improper storage and transport conditions, such as temperature and humidity control. It poses a threat to public health and contributes to food waste, which has a negative environmental impact. Additionally, the risk of meat spoilage results in significant economic losses for meat producers and sellers. This issue is particularly challenging for restaurants and cafes, which rely heavily on meat and are vulnerable to food spoilage. Therefore, there is a pressing need for an effective meat spoilage detecting system that can prevent meat spoilage and maintain the safety and quality of meat products.

1.3 Goals/Aims & Objectives:

The aim of this project is to ensure the safety and quality of meat products. The intelligent sensor technology employed in this system detects temperature and odors, and generates alerts that lead to live inspections of the meat freezer and the removal of any spoiled meat. The system also provides real-time updates on incoming and outgoing meat, which is crucial for maintaining hygiene in restaurants and shops.

The project has four main objectives:

1. To maintain live updates about the hygiene of meat.
2. To monitor the meat's temperature and detect any rotten smells.
3. To generate alerts that result in live inspections.
4. To report on incoming and outgoing meat.

1.4 Motivation:

The motivation behind this project stems from the critical need to address meat spoilage, which poses significant challenges in both the food industry and public health. With traditional methods often unable to detect spoilage until it's too late, this project aims to revolutionize meat monitoring. By leveraging IoT and intelligent sensor technology, it strives to prevent food waste, enhance food safety, and provide real-time updates crucial for maintaining quality and reducing potential health risks for consumers and businesses alike.

1.5 Assumption and Dependencies:

The project operates under certain assumptions and dependencies. It assumes consistent internet connectivity for real-time updates, reliability and precision of sensor technology for spoilage detection, user acceptance of the monitoring app, and adherence to food safety regulations. Dependencies include access to reliable technological infrastructure, a proficient development team, availability of accurate data, and support from stakeholders for successful implementation.

1.6 Methods:

The methods employed in this project encompass the utilization of IoT technology integrated with intelligent sensors. These sensors detect and analyze temperature variations and odors in stored meat products. Upon detection of anomalies indicating spoilage, the system generates real-time alerts. Additionally, the project involves the development of a user-friendly application accessible to both industry professionals and consumers. This application delivers crucial information regarding meat freshness, alerts users to potential spoilage, and facilitates live inspections, ensuring timely removal of compromised meat products. Moreover, it includes features enabling reporting on inbound and outgoing meat, keeping stakeholders updated on meat hygiene.

1.7 Report Overview:

The report provides a comprehensive overview of the IoT-based Meat Spoilage Detection System (MSDS) project. It covers key aspects such as the project's motivation, objectives, methods employed, and an in-depth analysis of the innovative system developed. The report outlines the challenges addressed, the technological solutions implemented, and the expected outcomes. It also includes insights into the significance of the project in the context of the food industry and public health, emphasizing its potential impact on reducing meat spoilage, enhancing food safety, and minimizing environmental waste.

Chapter 2

2.1 System Architecture Diagram

2.1.1 Admin:

- The admin logs into the software using their credentials.
- User authentication ensures that only authorized admin can access the dashboard.

2.1.2 Dashboard:

- Upon successful login, the admin is directed to the dashboard.
- The dashboard provides an overview of the freezer and meat statistics. Statistics may include the temperature of the freezer, the weight of total meat.
- The dashboard presents this information in a clear and intuitive manner for easy monitoring.

2.1.3 Spoilage Detection and Alert:

- The system continuously monitors the freezer for any spoilage.
- If spoilage occurs, the system detects it through various mechanisms such as temperature sensors or smell.
- Once spoilage is detected, an alert is sent to the dashboard, notifies the admin and prompts them to take action.

2.1.4 Removal of Spoiled Meat:

- Upon receiving the spoilage alert, the admin can proceed to remove the spoiled meat from the freezer.

2.1.5 Inventory Update:

- After the admin removes the spoiled meat, the system updates the inventory accordingly.
- This ensures that the inventory reflects the most accurate and up-to-date information

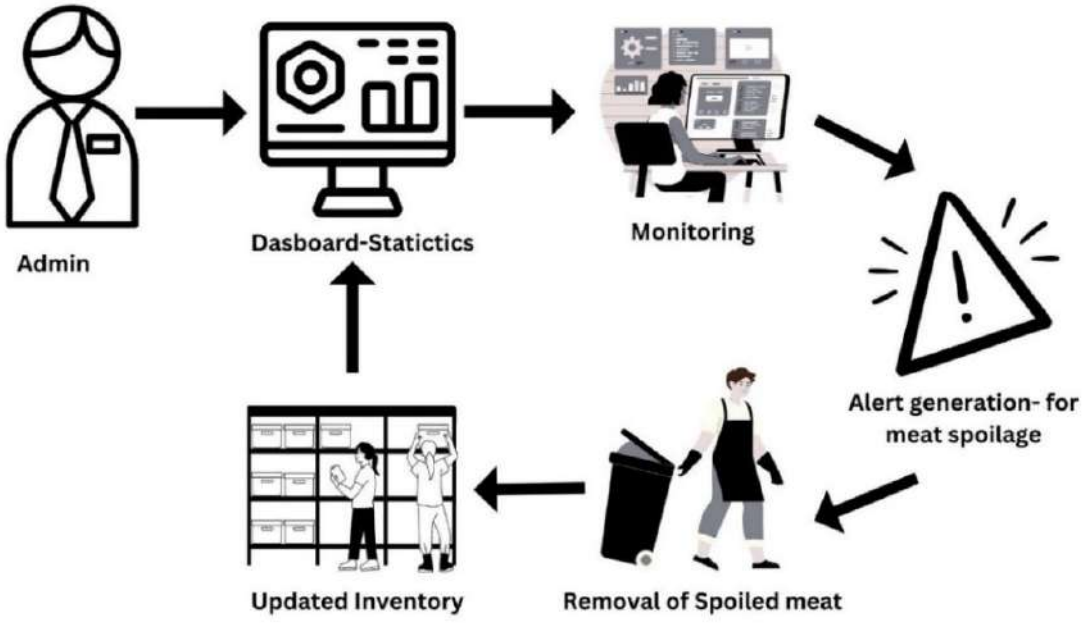


Figure 1: System Architecture Diagram

2.2 System model:

UML allows to abstract complex systems into simpler, visual representations, where one can focus on high-level concepts and relationships without getting bogged down in implementation details. This abstraction makes it easier to communicate and understand the system's structure and behavior.

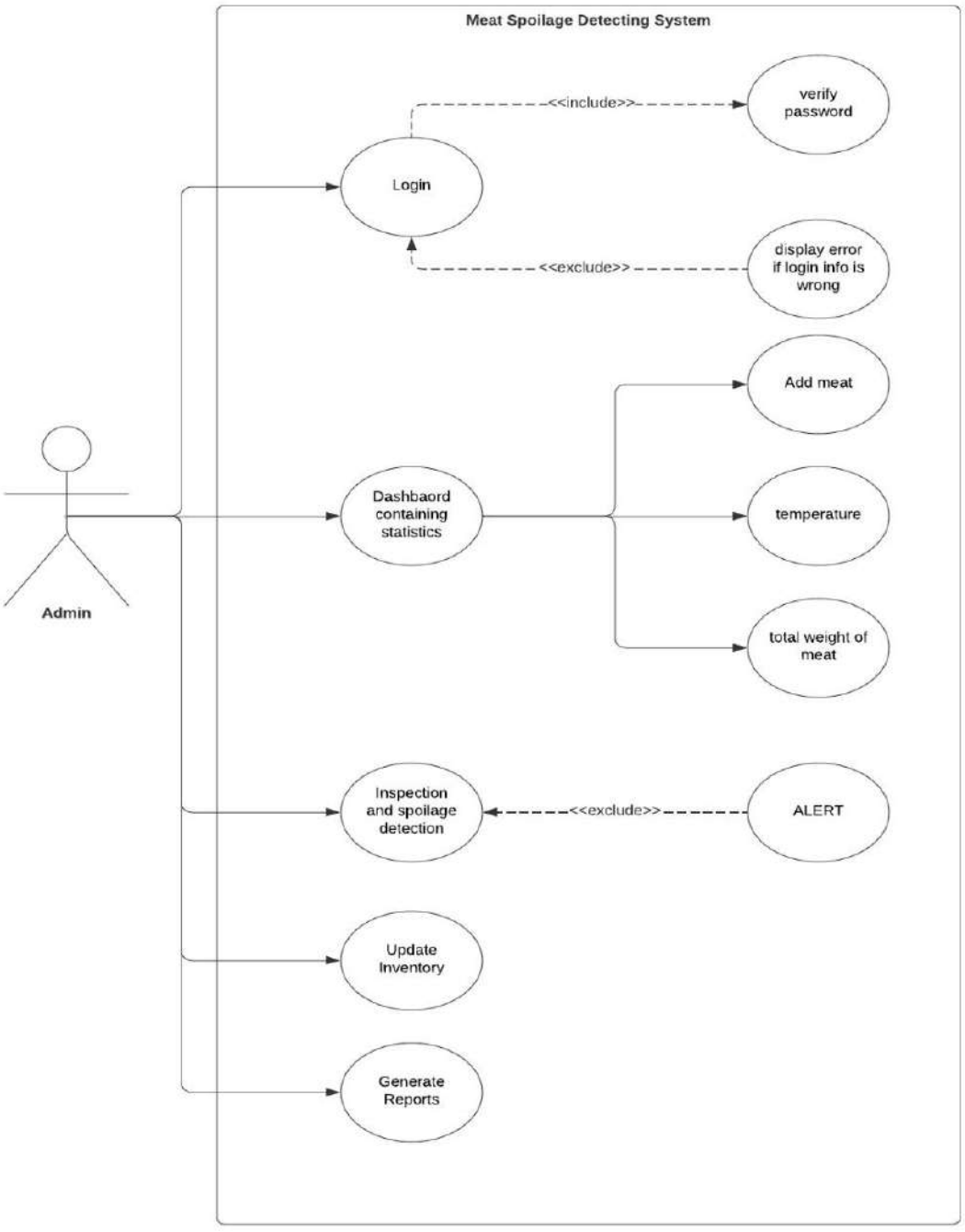


Figure 2: System Model Diagram

Chapter 3 .

3.1 Literature Review with Comparative Analysis

3.1.1 Meat Cuts [1]:

- The **Meat Cuts app** has detailed information about beef, lamb, veal and goat cuts.
- It has information about the meat in one local area.
- It holds the all the details about the shop such as locations, phone number.

3.1.2 Hygiene Meat [2]:

- **Hygiene Meat** is the top farm fresh eggs, chicken and mutton meat delivery app.
- It is a store which holds dairy products as well.
- It delivers throughout the city. And its accessible in India only.

3.1.3Hygiene Management Pro [3]:

- **Hygiene management pro** is based on the digital kitchen management system, which automates and simplifies kitchen, hygiene and quality processes.
- This is an app designed for hygiene purpose only. It guides about the hygiene of the products.

Table 1: Comparative Analysis Table.

Other Applications / Features	Meat Cuts [1]	Hygiene Meat [2]	Hygiene Management Pro [3]	MSDS
Management System	x	x	✓	✓
Meat finding	✓	✓	✓	✓
Alert Generator	x	x	x	✓
Keeps updated	x	x	x	✓

Chapter 4

4.1 Proposed Solution/Results & Discussion

Proposed Solution:

The proposed solution aims to revolutionize the monitoring of meat spoilage by implementing an IoT-driven Meat Spoilage Detection System (MSDS). This system leverages intelligent sensor technology to detect temperature fluctuations and odors in stored meat products in real-time. By promptly identifying spoilage indicators, the system triggers immediate alerts, enabling swift action to prevent the distribution or consumption of compromised meat. Through a user-friendly application accessible to both industry professionals and consumers, the MSDS provides crucial information on meat freshness and facilitates live inspections, ensuring the timely removal of spoiled meat pieces.

Benefits:

The implementation of the IoT-based Meat Spoilage Detection System presents several benefits:

- Enhanced Food Safety: Timely detection of spoilage reduces health risks associated with consuming spoiled meat, enhancing overall food safety.
- Reduced Food Waste: Prevention of meat spoilage minimizes food waste, contributing to more sustainable food practices and reducing environmental impact.
- Improved Consumer Trust: Reliable monitoring ensures higher meat quality, fostering consumer confidence and trust in the products.
- Cost-Efficiency: Swift spoilage detection saves costs associated with potential losses due to spoiled meat, benefiting both producers and consumers.
- Efficient Supply Chain: Streamlined monitoring leads to a more efficient and reliable meat supply chain, ensuring better quality control and management.

Table 2: PERT Activity Time estimate table

Activity	Optimistic (a)	Most Likely (m)	Pessimistic (b)
Frontend Dev - dashboard	3 days	5 days	2 weeks
Backend Dev	2 days	1 week	2+ weeks
Database Setup	1 day	2 days	4 days
IoT Device Integration	2 days	4 days	1 week
Graphics Designs	4 days	1 week	2+ weeks

Chapter 5

5.1 Summary and Future work

Summary:

The project centers on implementing an IoT-based Meat Spoilage Detection System (MSDS) aimed at enhancing meat quality monitoring. It examines the detection of spoilage in stored meat products by utilizing intelligent sensor technology, primarily focusing on temperature and odor analysis. The project aims to provide real-time alerts through a user-friendly application accessible to industry professionals and consumers. The methods employed involve sensor data analysis, live inspections, and immediate action upon detecting spoilage. Results reveal a significant advancement in timely spoilage detection, promoting food safety by reducing potential health risks associated with consuming spoiled meat. The conclusions underscore the project's contribution to minimizing food waste and maintaining meat quality standards in the food industry. Recommendations include wider implementation of such technology for improved food safety practices.

Future Work:

The future work section offers potential directions for advancing the project. It suggests exploring enhanced sensor technology for even more accurate spoilage detection and expanding the application's features for a more comprehensive meat quality monitoring system. Additionally, further research could focus on integrating predictive analytics to anticipate potential spoilage based on historical data. Collaborations with regulatory bodies and industry stakeholders might facilitate the development of standardized protocols for meat quality assurance. Exploring scalability and cost-effectiveness for broader implementation in various food sectors could also be a future avenue of research. Overall, these potential directions aim to refine the system's capabilities and expand its impact on ensuring food safety and reducing meat spoilage across different domains.

Chapter 6

6.1 Conclusion & Recommendation

In this research, the primary focus was to address the challenges associated with meat spoilage in the food industry. The study aimed to develop an innovative IoT-based Meat Spoilage Detection System (MSDS) to enhance meat quality monitoring and minimize spoilage risks. The implementation of the MSDS system exhibited significant progress in real-time spoilage detection, contributing to improved food safety. The intelligent sensor technology effectively identified temperature variations and odors, triggering prompt alerts and enabling swift actions to prevent the distribution or consumption of compromised meat products. As the study concludes, the implications of these findings extend beyond academia. The developed system not only enhances food safety practices but also reduces food waste and promotes sustainability in the food supply chain. The integration of such innovative technology serves as a pivotal step towards ensuring consumer trust, cost-efficiency for industry stakeholders, and a more secure and sustainable food industry overall.

This conclusion underlines the importance of the research outcomes and emphasizes the significant strides made in addressing meat spoilage challenges while urging contemplation on the broader implications and potential future applications of this innovative system.

References

1. https://www.australianbeef.com.au/apps/meat-cuts/
2. https://play.google.com/store/apps/details?id=com.hygienemeat.www&pli=1
3. https://play.google.com/store/apps/details?id=com.rational.connectedcooking.hqm&hl=en&gl=US

Annexure

NA

General Guidelines for Writing Project's Thesis

For convenient upload on PEC's e-Library

Page Setup

Page Size:	A4
Top margin:	1.00 inch or 2.54 cm
Bottom margin:	1.00 inch or 2.54 cm
Left margin:	1.00 inch or 2.54 cm
Right margin:	1.00 inch or 2.54 cm

Fonts and Styles:

Use a standard font such as Times New Roman, Arial, or Calibri

Font size should be 12 points for the main text.

Use consistent font sizes and styles (bold, italics) for headings, subheadings, and content.

Footer: Each page shall have a footnote "Page number, right align".

Header: Each page shall have a header "Project/Thesis Title".

Chapter Startup: Each chapter shall be numbered as Chapter 1, Chapter 2, etc.

Paragraph Formatting:

Single-spaced, Line entered paragraph, left align or justified.

Line Spacing:

1.5 spacing is required for the text. Only footnotes, long quotations, bibliography entries (double space between entries), table captions, and similar special material may be single spaced.

Maintain consistent spacing between paragraphs

Images, Figures, Hyperlink:

Ensure that images, figures, and hyperlink are of high quality and are properly labeled.

Tables and Equations:

Format tables with clear column and row headings.

Provide captions for each Table.

Label equations and provide clear explanations.

Citations and References:

Follow a standardized citation style (e.g., APA, MLA, PEC etc.) for references.

Include a separate references section at the end of the document.

File Naming Convention:

Submitted files are named with a clear and concise title that reflects the content of the paper or thesis.