Milk Quality Monitoring System Using IoT And ML

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Overview

Introduction

- Milk is the most important food source and raw material for human health.
- Determining the milk quality by manual methods can result in a high margin of error or loss of time.
- Improving the quality of milk provides many nutrients.
- Low-quality milk contains harmful bacteria like E-coli and listeria which are contaminated with chemicals, pesticides, and foreign matter
- This Leads to a compromised immune system, malnutrition, and gastrointestinal disorders.

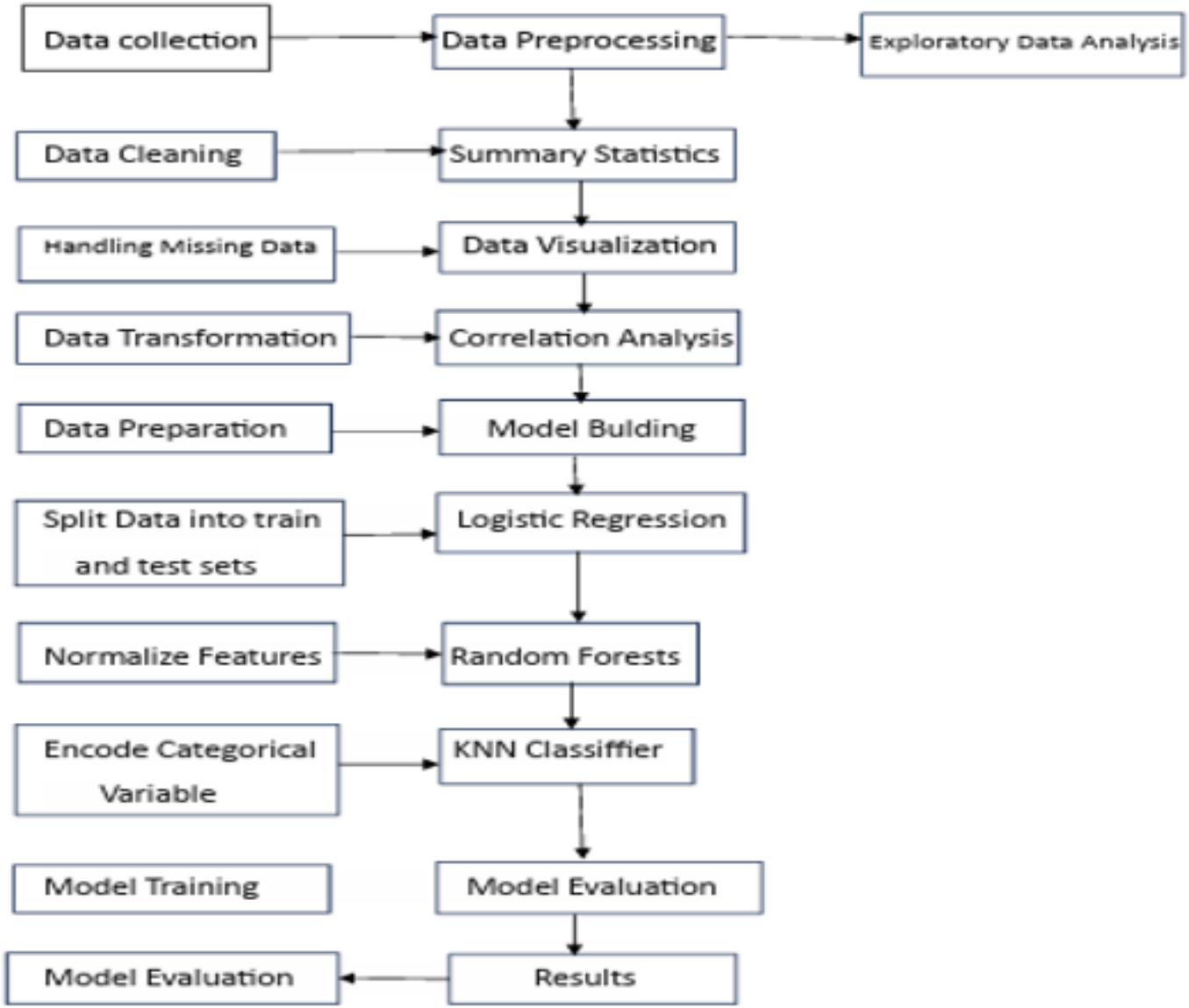
Problem Statement

- Develop a predictive model for assessing milk quality based on various parameters to ensure the accuracy and safety of milk products consumed by consumers.
- The model should accurately predict milk quality attributes based on color, turbidity, fat, pH, taste, temperature, and odor, etc.
- The predictive system will enable stakeholders in the dairy industry to preemptively identify potential issues, maintain high-quality standards, and ensure consumer satisfaction and health.

Summary of stage 1

- In stage 1, we detected key milk quality parameters from the input data.
- Now, we've identified critical quality indicators and recommended corrective measures to maintain optimal milk quality.
- The data is trained with different models like Logistic Regression, Random Forest and detected the quality of Milk

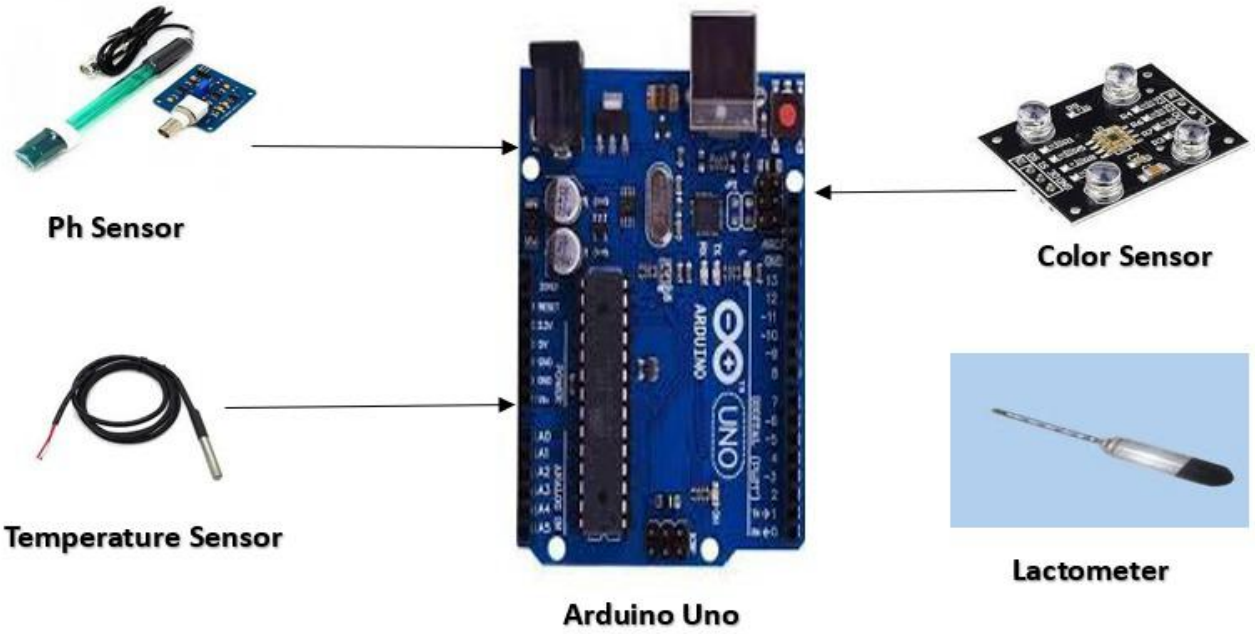
Project Architecture



Modules

- **Sensor Module**
- **Data Acquisition Module**
- **Data Transmission Module**
- **Data Storage Module**
- **Machine Learning Module**

Implementation



Implementation

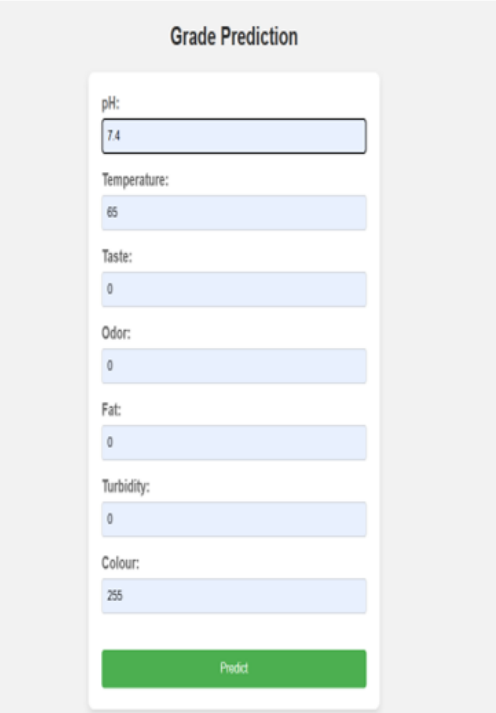
Figure: 1

Figure: 2

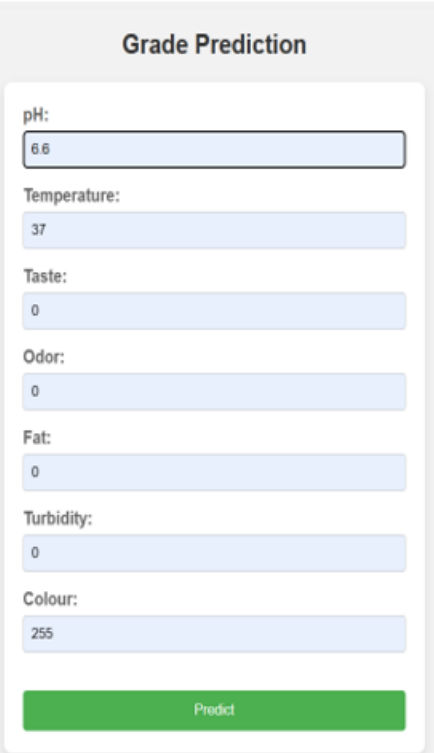
Implementation

- Figure 1 illustrates the connections between the Arduino Uno and the Ph Sensor.
- The quality of milk is checked using a Ph Sensor in Figure 2.

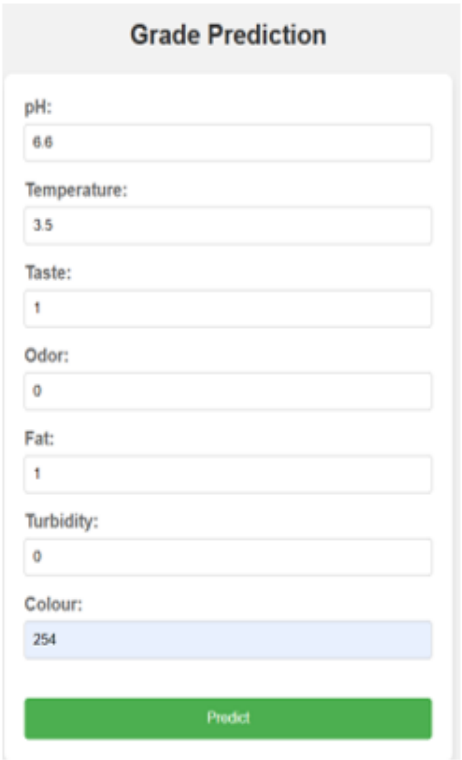
Interface result



Interface result



Interface result



Results

Analysis of used methods:

Method	**Accuracy**
Logistic Regression	85.2 %
Random Forest	99.8 %
Decision Tree Classifier	99.3 %
K-nearest neighbour (KNN)	99.3 %

Results And Discussion

- The study utilized various machine learning models such as Logistic Regression, Random Forest, KNN, and Decision Tree for milk classification.
- The Random Forest model was found to be the most effective after a thorough evaluation, achieving an accuracy rate of 98%.
- Choose Random Forest due to its superior performance in accurately identifying and classifying milk quality parameters, leveraging its ensemble learning technique and ability to handle large datasets with high dimensionality.
- A Flask-based web application was created to deploy an ML model, allowing real-time monitoring and analysis of milk quality parameters through a user-friendly interface.
- The ML model for MQMS has shown potential in improving food safety assurance, quality control, milk production monitoring, and fostering trust in the dairy industry.

Video Demonstration

For the project execution video click here.

Publication Details

Hello,

The following submission has been created.

Track Name: 7thICICC2024

Paper ID: 293

Paper Title: MILK QUALITY MONITORING SYSTEM USING IoT AND ML

Abstract:
The dairy industry maintains consistent milk
product quality to meet consumer demands and ensure food
safety standards. To address this concern, a Milk Quality
Monitoring System (MQMS) integrates “The convergence of the
Internet of Things (IoT) with Machine Learning technologies”.
By deploying IoT sensors throughout dairy farms and
processing facilities, the MQMS continuously gathers data on
critical milk quality parameters such as temperature, pH, fat
content, and color. These data streams are transmitted in realtime to a central server for analysis. Unlike conventional
methods that rely solely on taste, temperature, and turbidity,
which often yield inaccurate results, incorporating additional
parameters like fat content and color enhances milk quality
testing efficiency. The MQMS guarantees consistent milk quality,
mitigating the risk of sub-standard products reaching consumers
and thereby bolstering food safety standards and consumer
confidence through accurate classification of milk quality.
Furthermore, the system’s capabilityto detect contamination and
adulteration leads to cost savings fordairy owners.
Index Terms—Milk, Quality, MQMS, Parameters, Safety,
dairy, temperature, fat, color, food.

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Submission Questions Response: Not Entered

Thanks,

R & D Showcase Display

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R&D SHOWCASE 2024

MILK QUALITY MONITORING SYSTEM USING IoT AND ML

ABSTRACT

The Milk Quality Monitoring System(MQMS) integrates IoT sensors to track milk quality parameters like temperature, pH, fat, and colour in real-time. Incorporating additional factors and leveraging advanced analytics, it achieves higher accuracy in detecting contaminants and adulterants. This ensured not only consistent quality but also strengthened food safety measures.

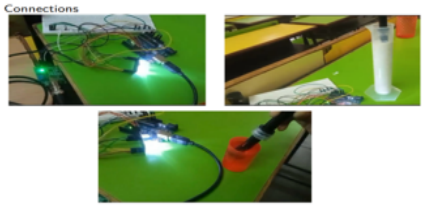
UNIQUENESS

- Real-time Monitoring
- Predictive Analysis
- User-Friendly Interface
- Consumer Trusts

METHODOLOGY

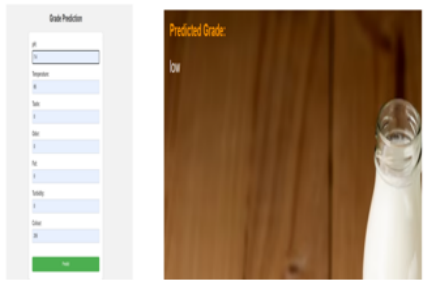
The project used IoT sensors for real-time data collection. ML Analyzed and trained models to predict quality. An intervention system addressed issues. Validation, through dairy facility testing, ensured accuracy. Versatility was evaluated, showcasing cross-industry quality capabilities.

Sensors connection



Results & Analysis

Web Page



SOCIETAL USE

This innovative project utilizes advanced technology to predict and promptly resolve milk quality concerns guaranteeing the production of safe, high-quality products, by enhancing transparency and traceability in the food supply chain. It safeguards public health but also encourages sustainable practices, ultimately fostering healthier communities worldwide.

CONCLUSION

The project developed an IoT and ML-based solution to predict milk quality, enabling proactive issue detection and timely interventions. Its adaptability spans beyond dairy, ensuring quality and safety across sectors. This innovative approach demonstrates IoT and ML in enhancing product quality assurance across various industries.

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Conclusion

- In conclusion, the Milk Quality Monitoring System (MQMS) using ML and IoT presented here employs advanced technologies for quality assurance in dairy production. Leveraging machine learning algorithms and IoT sensors, it offers innovative methods for real-time monitoring and analysis of milk quality parameters, contributing to the assurance of food safety and sustainability in the dairy industry.

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Thank you