6th Semester Mini Project Proposal: Using IoT and ML to improve perishable food storage

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Problem Statement

Using IoT sensors for Real Time Monitoring, efficient tracking and reduction of manual intervention in storage, and Machine Learning to predict stock going stale, optimize stock management, maximize profitability and minimize food wastage.

1 Problem Statement

1.1 Definition

Famine and hunger are both rooted in food insecurity. Chronic food insecurity translates into a high degree of vulnerability to famine and hunger; ensuring food security presupposes elimination of that vulnerability. And tackling the root of the food supply chain, the storage facilities, can greatly improve food security in developing and developed countries where food production is usually large & stable. Proper storage and delivery of food ultimately determines the status of food security in such countries.

1.2 Challenges

The major challenge with this project is the availability of storage facility data. Most of the cold storages do not record any form of data and the very few that do are owned by private firms that do not publicly release their data. Another hurdle we might face would be the accuracy of pest detection.

1.3 Scope

This project aims to improve storage of perishable food articles in cold storage facilities and grain silos by using various sensors to keep environmental conditions inside such facilities in check, and detect & alert the presence pests. It would also eliminate the need for a person to enter and manually inspect. It also aims to use Machine Learning to determine the best temperature and humidity for long preservation of the food articles and predict spoilage.

2 Background and Related Work

- Monitoring carbon dioxide concentration for early detection of spoilage in stored grain
- Managing stored grain profitably with smart CO 2 sensors and AI
- Design and Analysis of a Radio-Frequency Moisture Sensor for Grain Based on the Difference Method

- An AIoT Based Smart Agricultural System for Pests Detection | IEEE Journals & Magazine
- Forecasting of Grain Pile Temperature From Meteorological Factors Using Machine Learning | IEEE Journals & Magazine
- Machine learning in agriculture: from silos to marketplaces

3 Proposed Methodology

In this project we plan to use a wifi based IoT platform. We would use temperature and humidity sensor for facility's climate control. For pest detection we plan to use standard microphones to pick up noises that the pests might make and infrared imaging to further accurately detect pests in the line of sight of the sensor. To detect spoilage of food articles we plan on using CO_2 sensor. All these data will be sent to a web server in the cloud for real time monitoring using a web portal and also long term archival. This communication would be over a low overhead protocol like AMQP or MQTT to ensure minimum data and power usage and allow the whole system to run on poor internet connections and on batteries for longer time. For machine learning we would be using Boosted Tree regression.

4 Experimental Design

4.1 Hardware & Software Requirements

1. Espressif Wifi MCU
2. Temperature & Humidity Sensor
3. CO_2 Gas Sensor
4. IR Sensor
5. Microphone
6. Cloud web server
7. Low overhead communication protocol - AMQP or MQTT
8. sklearn, CatBoost

4.2 Dataset

https://docs.google.com/spreadsheets/d/1Cz8N7z6tJ8FouYnbbn5shy2D71Ln5P0W

4.3 Evaluation Measures

We will use metrics like accuracy of the Machine Learning models, pest detection system and sensors to evaluate the effectiveness of this project.