SMELL2S – AI based "Bio-Sense" Solution for Agriculture, Food Processing & Storage

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Abstract - Agriculture& Food Industry annual output worth ~ 6Tril USD, Survey shows: 40% of Global workforce in Agriculture. Food produce (Agriculture), processing and storage is very complex. Farmers face stress due to Climate Uncertainty, pests, low yield crops, Quality produce, storage, sustainability of those products etc. Hazards & Risks increasing due to dependency on GMO, usage of chemical Fertilizers & pesticides. Artificial Food Produce, storage Practices. Faulty Practices at all layers create un-natural demand, Hunger, Price Hike and Wastage, Consumers want to know provenance of the food and more Transparency and reliable naturally processed Food.

Index Terms: SMELL2S – Smell to Sense.

I. INTRODUCTION

SMELL2S applied in Agri, Food Processing & Storage units, where Bio-organisms analyzed using this AI Technology.

New Sustainable Farming Methods: Gives new Farming techniques to farmers for that specific region and for specific crops, producing high yield crops, high demand products processing which are suitable,

End goal is to provide ORGANIC Food by doing organic farming, which is primarily aimed at cultivating the land and raising crops in such a way, as to keep the soil alive and in good health by use of organic wastes (crop, animal and farm wastes, aquatic wastes) and other biological materials along with beneficial microbes (biofertilizers)

II. CHALLENGES

Agriculture is region specific, in one area of the world Apples grow, and other area Sugarcane grows, these agro-produces are processed as Food Products and stored/supplied across the globe for Consumers.

But still there is a food adulteration, sustainability, starvation, hunger problems are arising due to:

Challenges in Sustainable Agriculture practices used (Produce) Challenges in Food Process methods in Processing Units (Process) Challenges in Food Storage Units (Logistics) and machinery failures.
Challenges in Supply chain of these Food Products (Supply) Machine intelligence has emerged as a potential game-changer for Crop Analysis, detection, & prediction of Bio-reaction and soil analysis, and exploration and the synthesis for crops and its materials. SMELL2S Project uses data-driven technologies for analyzing data based on Agro-Food processing tasks, including forward prediction, retrosynthesis, reaction optimization, catalysts design, inference of experimental procedures, and Bio organisms' classification.

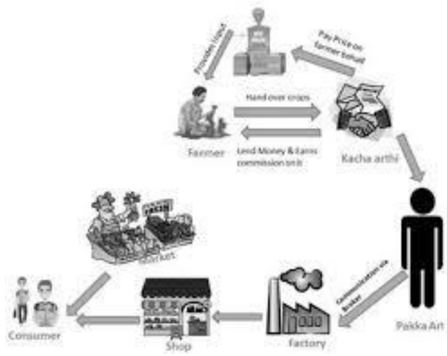

Fig1: Food produce to consumption lifecycle

III. TRADITIONAL APPROACH IN QUALIFYING THE FOOD PRODUCTS

Traditional Approach to Food, Agriculture, Processing and Storage – was involved manual methods. There was no or very less Technology usage in Agriculture and Food Processing & Logistics.

Legacy machinery used in farming and processing of food. Agriculture was done using dangerous Pesticides which are in turn creates sustainability problems.

These methods consume lot of time, energy and effort of human beings. Human expertise was used to identify new pests, bio-organisms that spoil the soil and farms. Though different methods, applied to kill these, weeds that has adverse effect on Organic

Farming. Due to which, there was numerous challenges in Agriculture, Adulteration in Food Products, Chemical preservatives in Storage, wrong methods adapted in Processing of Food., ultimately impacting Storage and Supply chain.

IV. THE NEW APPROACH FOR 1. AGRICULTURE, 2. FOOD PROCESSING, 3. FOOD STORAGE

Artificial intelligence (AI) is revolutionizing multiple sectors, including food, agriculture, food processing, and storage. Here’s how AI can offer solutions across these areas:
1. Agriculture:
AI can improve efficiency, reduce waste, and increase sustainability in farming. Major AI applications in agriculture include:
Precision Agriculture:
AI-powered sensors, drones, and satellite imagery analyze soil quality, crop health, and weather conditions to optimize planting, irrigation, and fertilization. Automated data collection helps farmers make data-driven decisions to increase yields and reduce costs.
Pest and Disease Detection:
Machine learning models analyze images of crops to detect diseases or pest infestations early, enabling timely interventions. AI algorithms can predict pest outbreaks based on environmental data.
Robotic Farming:
Autonomous robots can be programmed to plant seeds, spray pesticides, and harvest crops with high precision, reducing human labor and errors.
Climate Prediction and Adaptation:
AI models predict climate changes, helping farmers make decisions on crop types, planting times, and water usage to adapt to new conditions.
Soil Health Monitoring:
AI tools assess soil nutrient levels and recommend appropriate fertilizers to improve crop productivity without depleting the soil.

2. Food Processing:
AI enhances food processing efficiency and quality control. Solutions include:
Automated Quality Control:
AI systems with computer vision can inspect products on production lines for size, shape, color, and defects. This ensures consistency and reduces waste by removing defective products.
Predictive Maintenance:
AI-powered sensors predict when machinery might fail, helping to schedule maintenance and avoid unplanned downtimes.
AI-Assisted Recipe Development:
Machine learning analyzes consumer preferences and ingredient interactions to develop new recipes or improve existing ones.

Robotics in Food Packaging:
AI-driven robots can be used in food packaging processes, increasing speed and reducing human involvement in labor-intensive tasks.
3. Food Storage
AI can help reduce food waste and improve the efficiency of food storage systems:
AI-Driven Cold Chain Management:
AI optimizes the temperature, humidity, and ventilation of storage facilities to extend the shelf life of perishable products like fruits, vegetables, and dairy.
Real-time monitoring and predictive models help in anticipating spoilage and managing inventory.
Inventory Optimization:
AI systems use historical sales data to forecast demand and optimize stock levels, reducing the chances of food waste due to overstocking or under stocking.
Supply Chain Monitoring:
AI tracks products across the supply chain, providing real-time data on food conditions during transit, helping prevent spoilage and contamination.

V. NEW APPROACH – AI SOLUTION

Many companies make claims about their Products, Agri-Food, green, organic or sustainable, but they rarely have measurable clear, credible, or verifiable information to justify, so Technology based assessment of information is necessary to make it more reliable.

Fig2: Drone integration sensors & components

SMELL2S contains several Modules, Models, Uses Wifi, scifi, & Bluetooth remote messaging, Telemetry and Socket Programming techniques.

Programs: Module A - Fertilizer Recommendations, used as a data set to estimate which fertilizer to be used for crop diseases, weed control and to improve end produce food. By doing quality checks with presence of Bio-sense analysis and identifying elements of Bio-degradable organisms and its chemical reactions.

For Example: - Module B – G etc, does train the datasets, learn about the crops of interest, chosen location, for optimum crop, better yield for farmers investment Cost incurred analysis.

Backend Technology: BigData Database, to train the data, mine the data, for ML algorithm to remove dirty data. ML& Robotics, IoT H/W: it can nees to ntegrated to different H/w devises like Bio-sense" device for Physical machines drones, Hyper spectral Devices, GPS/INU, unmanned aerial vehicles, (UFOs), LIDAR, calorimeters, Temperature devices, chemical/mineral detectors etc.

Software: server less Architectures, Kubernetes Clusters, Autonomous Databases, Vector, Image Processing Databases and Python & JavaScript for validation functions, for suitable fertilizers APIs etc. can be used.

Auto-generated data insights, using linear regression in the knowledge-based system, integrated with Data lakes/DWH.

VI. DETAILS OF THE PROJECT

This AI – Based approach help Farmers, Suppliers and Food Processing, Storage & Logistic Units, which addresses issues like Food Adulteration and Logistics problems, for better ROI in a ever increasing climate change problem and its impact.

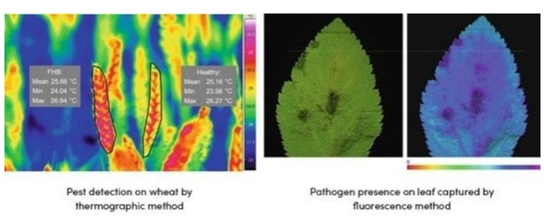

Fig3: Pest detection with thermographic &Flourosce method

SMELL2S gives tremendous outcome for Agri-Food Problems like Adulteration and Food-malpractices in storage & Supply.

Predictions of Crop/leaf Bio-chemical reactivity help 1. Testing methods used for applying Fertilizers 2. detecting – Food Adulteration. Etc., it ultimately helps in farming efficiency and applying right nutrients.

Smart agriculture brings together a variety of advanced and evolving technologies and applications, including UAVs and satellite remote sensing, sensor networks based on the Internet of Things (IoT), digital-based prediction for insects and diseases, mechanized irrigation, light and heat control, soil management and other associated analytical tasks. Amongst all those technologies, Earth observation (EO) plays an important role in all aspects of pre-diagnosis, modelling and prevention.

Data Flow:

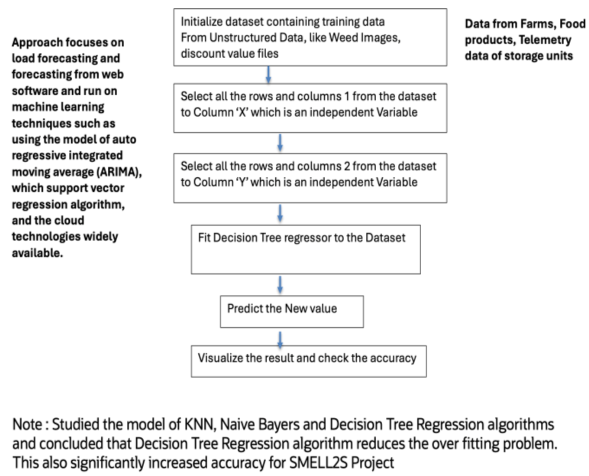

Fig4: Flow chart of Data ingestion and processing

Input process - Sapple, Leaf, crop, soil images, food odor, images Analysis. For Storage units - Temperature, Preservatives content, package materials, transport & Logistics etc. Analysis.

This bio-sensorial data ingested to AI / ML based algorithms produce, better insights, as this framework group's data into segments, with Big Data and mining techniques.

Output process: - Display crop interest based on planting date, month and location information, thereby maximizing crop yield.

Produce insights based on details like temperature, humidity, weather, Weed type, remedy, growth, farm land/ soil extent,etc.,

Provides Analytics reports on Food Transparency, Traceability from Farm to Consumer & processing methods, provides, intelligence to predict cost effectiveness and demand throughout to the Agro-Food industry.

AI/ML Algorithms:

A model of KNN, Naive Bayers and Decision Tree Regression algorithms and concluded that Decision Tree Regression algorithm reduces the over fitting problem.

The results show that we can achieve a classification accuracy of 99.59% using Naïve Bayes Classifier and Hoeffding Tree algorithms.

Moreover, the findings we obtained in this study can also help future farmers detect diseases early, increase crop production efficiency, and reduce prices when the world is experiencing food shortages.

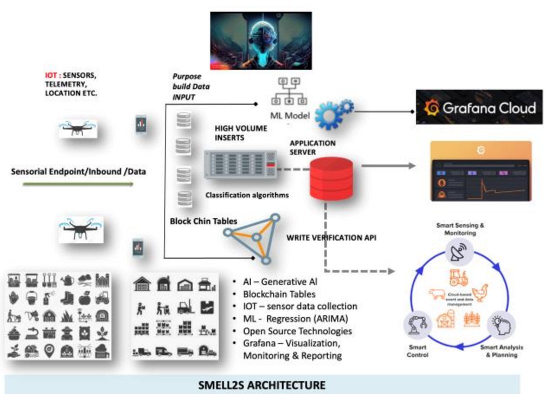

Fig5: Reference Architecture

CONCLUSION

SMELL2S stands for "Smell to Sense" and is designed to address various challenges in agriculture and food processing. It employs AI-driven data analysis and bio-sensing techniques to optimize farming practices, improve food quality, and ensure sustainable storage methods.

For this Project, Different algorithms have been considered to evaluate the most appropriate algorithms to use in agriculture, food processing feature combination classification and regression algorithms are used for SMELL2S.

New Technologies implemented in this segment will help tremendously and this new AI & Blockchain Technologies enables Agro-Food business a new strategic approach towards sustainable Agriculture.

SMELL2S helps to provide:

- Improved quality control and food safety
- Increased traceability in the supply chain.
- Increased Efficiency for farmers.
- To achieve Minimal Health Hazards
- Traces back the Provenance of food.
- Reduce Waste by bio diversified methods
- Growing Organic Farming methods
- Predicts Climate change. Effect and impact before hand
- Analysis and impact of Global Warming
- Creates new approach to Mars or Planet Missions

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