

Application of machine learning technique to the small, medium enterprise (SMEs) food industry to optimise the food that is being produced.

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1. Problem Statement:

Food Optimization is one of the primary concerns of the food industry in recent years. The goal is to avoid problems of under-production as well as over-production that can lead to shortage or wastage accordingly. The level of the tolerance of the people in such a sensitive matter is very low, and strict actions are taken to avoid wastage.

2. Market / Customer / Business need assessment:

Customer demand changes rapidly. It needs to be determined who the targeted audience is and what exactly they want. People prefer eating chicken and eggs mostly, but sometimes, when there is a rise in bird flu, many individuals don't buy or eat such items. This affects the production factory adversely as the leftover items are sent back to them.

Hence, food officials must keep their eyes on customer needs to create products and according needs. It is also wise to take feedback from the customers and ask what they prefer more. Producing the items that will be purchased more will help optimise the selling rates. Waste products will also be in less quantity. This will benefit the entire facility production.

3. Target Specification and Characterization

In order to maximise profitability while complying with government regulations regarding net package content, food manufacturers and package managers must achieve an optimal balance.

Consistent overfilling to minimise risk is inefficient and sacrifices profitability, while aggressive filling practice results in significant risk of non-compliance with net contents regulations leading to potential patients, loss of reputation, impaired customer relations.

Statistical process control and process capability methods may be utilised to determine optimal targets for products for a given process. Subsequent focused efforts to minimise variation will allow the target to be further optimised, resulting in less waste without compromising risk.

4. External Search

The sources I have used as reference for analysing the need such a system for local business and how Food Industry giants have been using the technique to optimise food production, have mentioned below:

- [Usage of Python and Machine Learning in Food Industry](#)
- [Optimising Product Target Weights of Foods and Beverages](#)
- [Improving food processing using modern optimization methods](#)
- [ML & AI in food industry sustainable approach](#)

5. Branch marking alternate products

Indian Food Industry giants like Kissan, LT FOODS LTD, REI AGRO LTD, MODERN DAIRIES, BRITANNIA, PARLE AGRO, NESTLE INDIA have been using the models to analyse food optimization

6. Applicable Patents

- [A food recognition system for diabetic patients based on optimised basis of features](#)
- [Optimising Patient Care in Egg Allergy Diagnosis and Treatment](#)
- [Properties in the development of specialised food products with optimised composition for patients with type 2 diabetes mellitus.](#)
- [APPLICATIONS OF OPTIMIZATION FOR THE FOOD INDUSTRY](#)

7. Applicable Regulations

- [Streamlining Food Safety compliances Ecosystem in India](#)
- Food Safety and Standard act 2006 (FSS Act)
- Food Safety and Standards (Licensing and Registration of Businesses) Regulation 2011
- Food Safety and Standards (Food Product Standards and Food Additives) Regulation, 2011
- Food Safety and Standards (Prohibition and Restriction on Sales) Regulation, 2011
- Food Safety and Standards (Packaging and Labelling) Regulation, 2011
- Food Safety and Standards (Contaminants, Toxins and Residues) Regulation, 2011

- Food Safety and Standards (Laboratory and Sampling Analysis) Regulation, 2011
- Food Safety and Standards (Food or Health Supplements, Nutraceuticals, Foods for Special Dietary Uses, Foods for Special Medical Purpose, Functional Foods and Novel Food) Regulations, 2016
- Food Safety and Standards (Food Recall Procedure) Regulation, 2017
- Food Safety and Standards (Import) Regulation, 2017
- Food Safety and Standards (Approval for Non-Specified Food and Food Ingredients) Regulations, 2017
- Food Safety and Standards (Organic Food) Regulation, 2017
- Food Safety and Standards (Alcoholic Beverages) Regulations, 2018
- Food Safety and Standards (Fortification of Foods) Regulations, 2018
- Food Safety and Standards (Food Safety Auditing) Regulations, 2018
- Food Safety and Standards (Recognition and Notification of Laboratories) Regulations, 2018
- Food Safety and Standards (Advertising and Claims) Regulations, 2018

8. Applicable constraints

- Farm Level
 - Low yield and inadequate quality of food product
 - Conventional method of farming
 - Rain dependent farming
 - Lack of proper logistic and handling facilities in the farm
 - Lack of proper cold and storage near the farm
 - Unaffordable modernization
 - High advertising cost
 - Improper grading sorting
- Distribution level
 - High cost modern transportation facilities
 - High cost of the cold chain
 - Inadequate information technology and communication support
 - High cost packaging
 - Limited market support
 - Lack of government support
 - Poor coordination between farmers and food processing unit
- Consumer level
 - Lack of awareness
 - Lack of standardisation and quality in processed food
 - Conventional food habits

9. Business Model

Application of ML in Food Industry

Area	ML Techniques
Food security management	(i) ANN (ii) Data mining (iii) Data analysis (iv) Intelligent optimisation techniques
Food quality management	(i) Genetic algorithm (ii) Predictive models (iii) Tree decision-making
Food production	(i) ANN (ii) Decision tree (iii) Gaussian mixture models (iv) Data mining
Food logistics	(i) ABS techniques (ii) Robot programming (iii) Simulated annealing (iv) Automated planning
Food supply chain	(i) Bayesian network (ii) Stochastic simulation (iii) ANN (iv) Fuzzy logic
Food processing industry	(i) Decision-making data analytics (ii) Predictive models (iii) Forecasting models of AI and ML

10. Concept Generation

Food processing is a demanding task. Sorting farm food and raw materials, as well as maintaining machinery and various forms of equipment, are all part of the job. Finally, when a product is ready to ship, people evaluate it for quality and assess whether it is fit for shipment. However, AI is automating this procedure in many food processing companies. The top five AI applications for food processing companies that have an immediate impact on revenue and customer experience are given below

(1) Sorting products and packages: the first operational challenge that food processing companies face is the sorting of feedstock. Every potato, tomato, orange, and apple is different, demanding careful sorting. To be competitive, every food processing company must maintain a certain degree of quality. If not automated with AI and other modern technologies such as IoT, this method requires a significant amount of human effort.

(2) Food safety compliance is a big issue in the food processing sector. Even the smallest amount of contamination in food can be lethal. Factories have begun to deploy AI-based cameras to determine whether or not an employee is adequately suited.

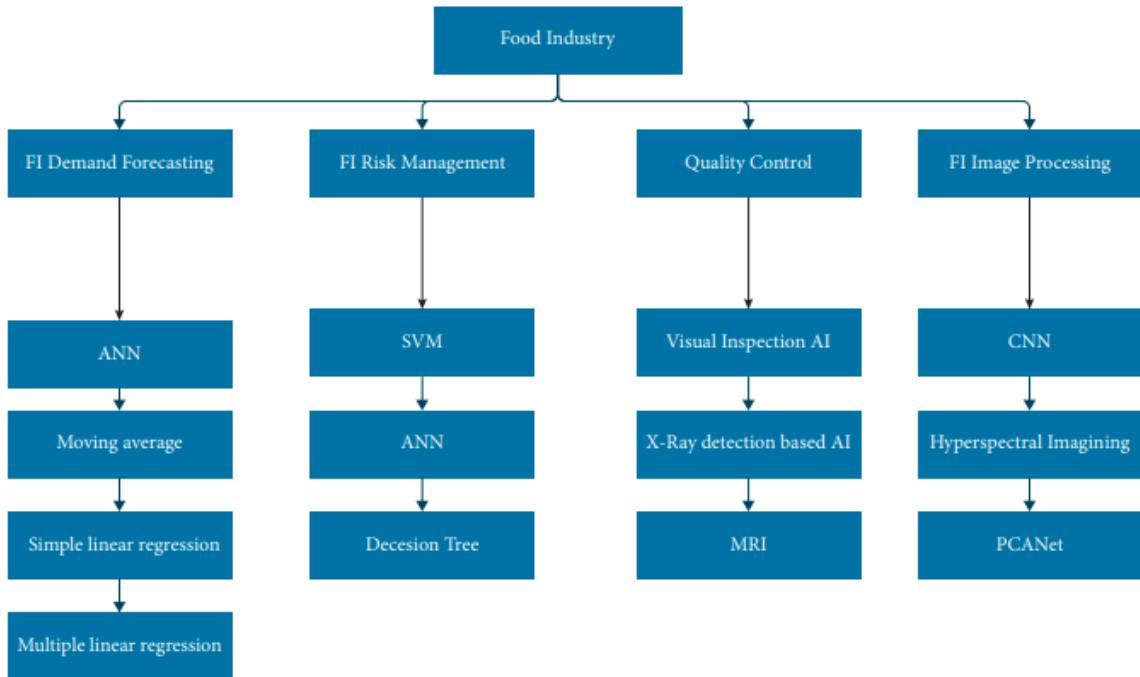
(3) Maintaining a clean environment: in food processing plants, cleanliness is a crucial issue. Many companies claim to be as pure as ice since all of their processes are automated and undisturbed by human interaction.

(4) Assisting customers with decision-making: artificial intelligence, like food processing corporations, assists customers in making more informed purchasing decisions. Kellogg's introduced Bear Naked Custom, which allowed customers to create their own granola from a menu of more than 50 ingredients and many more uses of AI and ML in the food industry.

11. Concept Development

- The first category is smart farming. AI has various major uses in the food business, such as soil monitoring, robocropping, and predictive analysis
- Smart transportation is the second category. Artificial intelligence is transforming the transportation business. It has already been employed in a number of sectors, including helping automobiles, trains, ships, and planes, as well as smoothing traffic patterns. It has the potential to transform all modes of transportation, as well as the food industry, safer, greener, smarter, and more efficient. Artificial intelligence-assisted autonomous mobility may, for example, help to remove the human mistakes that cause so many traffic accidents. These possibilities, however, come with real hazards, such as unintended consequences and abuse, such as cyberattacks and distorted transportation decisions. There are further employment consequences, as well as ethical questions concerning artificial intelligence's liability for decisions made in the absence of humans.
- The third category includes smart processing. Artificial intelligence (AI) is attracting the attention of enterprises across a wide range of disciplines and industries, including food processing and handling (FP and H). AI has a direct and indirect impact on the FP and H business. Indirectly, it aids farmers with weather forecasting, which in turn aids farmers in producing high-quality raw materials for food processing industries, allowing them to save money on product sorting
- The last category of FI is smart distribution and consumption. The name itself indicates the end use of the farming product in FI. Machine learning (ML) can assist in efficiently solving problems such as determining delivery routes, supplying raw materials, forecasting demand for specific food items, and logistics planning. Distribution way problems can be resolved with ML by optimising the place of the delivery agent in relation to present or upcoming traffic conditions and then notifying them about the best route in a synchronous manner. There are numerous apps in the food service industry nowadays that assist in anticipating the amount and kind of food orders, as well as the relevant inventory. These data can be used to do statistical analyses of visitor traffic and the food products that will be required over time. These data are compiled by combining information from previous interactions with consumers, such as their meal preferences, habits, and complaints, as well as the supply of essential commodities during that time period

12.Final Product Prototype with Schematic diagram



13.Conclusion

Various multidisciplinary systems are governed by AI to assess many metrics depicting quality, appearance, texture, overall consumer acceptability, and so on. This unique strategy entailed studying data patterns and adjusting the process to provide output that is correct, reliable, takes fewer humanoid incomes, is competent, and helps the operator forecast upcoming circumstances over time

The use of AI and ML in food production and restaurant operations is already putting AI in charge of food safety. Artificial intelligence has taken the food safety industry to a new level by reducing human errors in manufacturing and, to a lesser extent, unused goods. It provides lower packing and delivery costs, more customer satisfaction, faster services, voice searching, and more personalised orders. Large food companies can also profit from these business advantages, which will provide a clear gain in the long run.