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Review Article

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Automated Systems in the World of Food and Agriculture

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ABSTRACT

Food industries used to utilize number of workers all over the world. Depending on the food commodity, food industries have various departments such as quality, packaging, distribution, production and manufacturing and retailing sections which needs a great number of manpower to handle the lines. The hard work by these workers is converted to smart work through automated systems making the lines convenient. Moreover, sometimes human errors could convert into big complications which would be minimized by the use of these technologies. Conventional farming uses the methodology which sometimes time consuming with less yield of produce. In agriculture, methods for irrigation, inspection should incorporate the modern techniques to reach the produce in fresh quality from farm to fork. The present review focuses on the introduction of automated systems, its different portions and some recent techniques used in food engineering and agricultural.

Keywords: *Agriculture, Automation, Instruments, Recent innovations*

INTRODUCTION

Many decades ago, when automation had not been introduced into food industries, number of workers were working day-night to ensure the quality production, inspection, retailing. Though the workers were working efficiently, error could have been happened which would had been resulted into big hazards. Moreover, owing to improper inspection, the food products could exhibit physical, chemical and biological hazards. To minimize these glitches and to reduce the manpower, different kinds of automation systems had been commenced. The automating systems have been like a boon to food industries as well as its overuse is like curse. This article reviews about the various automated systems used in food process engineering and related fields with its benefits and drawbacks. Algorithms such as support vector machine could be used to sort and test the food of good quality. This article also explores advantages and disadvantages of the numerous software systems used in food processing technology and related fields. There are currently available standard industry flow sheeting and development systems that are commonly used by chemical engineers.

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Existing food processing applications programs, however, are limited in their ability to handle the wide range of processes and products found in the food industry. However, the necessity of automation system in food sector is listed below.

Need for automation

- To eliminate off line quality control owing to the need for faster correction of method and quality standards/ specification
- To eliminate highly routine and monotonous activities that have culminated in repetitive strain injury to workers
- To identify the foreign particles and contaminants in food
- To improve quality assurance needed due to consumer complexity, regulatory labelling requirements and limited contents leaflets

Food industries develops many food commodities and to ensure its quality they need forward technology which confirms the food is safe for consumers. Even though the industries are not liable to buy the equipment for the analysis, they send the samples to laboratories to analyse the sample physically, chemically and biologically. Various types of instruments available for the purpose of food safety are described as follows.

Automation in physical analysis of food and agriculture produce

Instruments for physical, chemical and microbiological analysis are widely available. Focusing the food industries, variety of automated equipment are being used by beverage, bakery, confectionaries etc. Different laboratories working on molecular level of food utilize variety of spectrophotometers, colony counters, electronic nose for flavour detection, refractometers, moisture analysers, nutritive compound determination machines such as bomb calorimeter for energy, atomic absorption spectrophotometer for minerals, texture analysers have been used since many years. Latest technologies focuses on ready to eat, ready to serve foods because of fast life of people. Therefore, preservation of these food commodities is of significant value. Nonthermal methods such as dielectric heating, infrared heating, irradiation, freeze drying methods are employed to maintain keeping quality of food. Automation in agriculture is changing from conventional techniques to modern, ensuring to get the maximum good quality of agricultural yield. Internet of things (IoT) devices are the sensors, gauges and machines that are connected across a farm using Bluetooth, a cellular network, or some other type of connection. More IoT devices allow growers to collect more data about the state of their farms, and IoT is showing great promise for optimizing resource delivery and driving precision agriculture to achieve maximum efficiency. The data from these IoT sensors, combined with information about seed, fertilizer, pesticide, rainfall and other factors, presents a compelling use case for software to optimize and predict growing conditions. Running a farm is a complex operation, with dozens of factors affecting every decision. As data collected from farms grows each year, software algorithms can become more complex in their predictive analytics, helping farmers decide when, where and how much irrigation, fertilizer, pesticide or other applications their farm needs.

Sensor Technology:

Sensors are used to monitor and evaluate the quality of food and agricultural products, in particular post-harvest storage and handling in the Indian food industry. Nowadays, the application of sensors extends from the assessment of the quality of soil used for cultivation to the detection of a specific microorganism causing damage or to the electronic tongue used for sensory evaluation. Sensors are often used for the detection of food adulterations and the processing and marking of products. Newer innovations are amalgamated in food sensors from time to time. For instance, the introduction of nanoparticles increases the operation of a wide range of sensors used in food. Over the last 15 years, yield sensors research has focused mainly on the development of reliable grain

flow sensors for combine harvesters to measure grain yield during harvesting.

Although many sensors have been sug gested, only a few have proven viable for com mercial usage due to the severe performance re quirements placed on the sensors, the most sig nificant of which are:

- The sensor should be able to measure the grain flow with sufficient accuracy so that the measurement errors are less than 5%.
- Machine motion and vibration should not interfere with the accuracy of the sensor. Evaluation of the calculation signal before it becomes ideal for the drawing of yield maps should be simple and straightforward.
- The accuracy of the sensor must remain independent of variations in its bulk properties. Parameters for the configuration and maintenance of the sensor should be minimal.
- The sensor should have a correct configuration for easy integration into combinations. A yield sensor has been developed that satisfies the above-mentioned performance requirements extensively.

Many industrial sectors have recently adopted automation, both in terms of computer-aided modelling approaches (e.g. production optimization, product and service life cycle measurement, eco-efficiency, etc.) and management development methods (e.g. monitoring and data acquisition, automated control systems, etc.) with the goal of promoting a strong regulation of raw materials and energy usage. The food industry will follow similar policies and promote the use of robotics to lead to sustainability. Processes involved in food production require high energy consumption for freezing, cooling, heating and sterilizing procedures which mostly originates from fossil fuels and is rarely recovered for further utilization.

Robotics

Smart robots are included in each section of the food supply chain, from agriculture to food processing and delivery. Intelligent farming techniques and precision farming, which operate with the help of automation, are gaining importance among Indian farmers and agricultural researchers. Robotics is already established in food processing, in particular in butchering, mixing and sorting applications, as well as in food packaging at different levels. Repetitive and arduous functions are performed with accuracy by robotics. Some Indian restaurants even have robot chefs and automated food service facilities that attract customers. India ranks third in the world in implementing robotic automation in its core business processes. According to the Chartered Institute of Management Accountants (CIMA), the majority of financial executives agree that artificial intelligence helps to improve the productivity and quality of companies. CIMA is a UK-based organization that undertook a regional study through Western, African and Asian countries (Economic Times, 2016).

Automation in chemical analysis

Soxhlet apparatus

The Soxhlet extractor is a piece of automated fat extraction laboratory equipment invented in 1879 by Franz von Soxhlet. It was originally designed to extract lipid from a solid material. Typically, Soxhlet extraction is used when the desired compound has a limited solvent solubility and the impurity is insoluble in the solvent. Requires unmonitored and unmanaged processing thus effectively using a small amount of solvent to remove a greater amount of material. (Jensen, William 2007).

Spectrometry

The basic function of any spectrometer is to take light, break it into its spectral components, digitize the signal as a function of wavelength, and read it out and display it via a computer. In the first step of this process, the light is directed through the fiber optic cable to the spectrometer through the entrance slit, which is a narrow opening. Mass spectrometry is an empirical tool for the calculation of the molecular mass of the substance and has indirectly helped to confirm the identification of the isotopes. Mass spectrometers are used for a variety of applications, including gas

analysis, catalysis, thermal analysis, surface engineering and surface analysis.

Fibro Tron

Crude fiber was organic residue that persisted after the food sample was processed under uniform conditions with standard boiled acid and alkali solutions. Fibro-Tron was a very advanced tool for the study of crude fiber with standard boiled acid and alkali solutions. (Satwase 2012).

Instrument in biological analysis

Automation Colony Counting reduces counting time from minutes to seconds, eliminates recording errors, and standardizes counting across different users. Many microbiology laboratories offer the widest range of colony counters, from basic manual to semi-automated to fully automated robotic colony counters. Automated colony counters can be upgraded as they grow and adapt to the specifications and needs of the microbiology laboratory. They will make it possible to achieve:

1. Extraordinary consistency
2. Precise repeatable count results within minutes
3. Advanced user management and audit trail
4. Management of results and protocol c ustomization

Food Packaging:

Food packaging is an ancient procedure. Nonetheless, newer developments are developing in the food packaging industry with a particular focus on nutritious, biodegradable and eco-friendly containers, often manufactured from food waste or by-products. New changes are also found in flexible and advanced nano-based packaging to increase the shelf life of items. Intelligent containers are often equipped with sensors markers or radio frequency recognition devices that can communicate with packaged foods in order to distinguish, detect and record changes that occur. 3D printing is an automated production process where food is produced layer by layer on the basis of computer-aided drawings. 3D printing is an additive manufacturing process where food is produced layer by layer on the basis of computer-aided drawings. When food is printed in 3D, we get intricate designs and custom-made meals with the possibility of automated cooking and mass production. It also helps to convert nutrient-rich products to tasty foods in a short time and thus attracts children.

Indian scenario in agricultural automation system

Agriculture is the backbone of India's economy, and the villages are the lifelines of India's growth. Agriculture is a very important sector for the continued growth of the Indian economy. Approximately 70% of rural households and 8% of urban households still depend mainly on agriculture for employment. As some three-quarters of the population live in rural areas, the majority of households therefore depend mainly on this sector.

Gramophones:

Gramophone, based in the Indian state of Madhya Pradesh, claims to leverage the power of image recognition and soil science to help farmers with timely knowledge, technology and inputs to achieve better yields (Baruah, 2019).

Automation in harvesting

Several companies are facing the challenge of automating the harvesting of fruit and vegetables that has been difficult. The use of agricultural robotics is a revolutionary practice that has made it easier for humans to farm fresh produce. Abundant Robotics has developed an early version, an apple picker robot that is gentle and precise.

Trends in food technology in the Indian scenario

Earlier, food processing in India was limited to food preservation, packing and transport. Over the last two decades, however, certain sections of the industry have evolved to meet global standards through technological advancements. Developments such as the development of cold storage facilities, food parks, processing centres, irradiation centres and modernized abattoirs have allowed the sector to make significant progress, but still

account for a small fraction of food production.

No surprise is that when it comes to the food and beverage sector, technology leads to higher sanitation, cleanliness and food safety. In reality, robots have now also been rescued in order to improve the development, packaging and distribution of raw food such as fruit and vegetables, which is often tedious and labour-intensive, especially when it comes to packing. Automation, though, comes at a cost, but at the same time reduces labor costs. This is also done on the basis of cost benefit analysis. When today's market needs healthier, better food and labour costs are increasing exponentially, the need for automation in the food and beverage industry is also rising. Food processing is a crucial connection between agriculture and manufacturing. In a developing economy like India, it contributes as much as 9 to 10% of GDP to the agriculture and manufacturing sector. Growth in the food processing industry would have to be a major component of the second green revolution, given its possible role in achieving improved agricultural production by ensuring better remuneration for farmers. The food processing sector makes it possible not only to ensure better market access for farmers, but also to reduce high levels of waste.

CONCLUSION

As agriculture plays a vital role in India's economy, more than 58% of rural households rely on agriculture as their primary means of subsistence (IBEF, 2019). India is expected to meet the ambitious goal of doubling farm income by 2022. The agricultural sector in India is expected to generate stronger traction in the coming years due to increased expenditure in agricultural infrastructure such as irrigation, warehousing and cold storage. In order to make it easier for producers, industrialists by salaries and their bread and butter and customers to access a healthy food commodity, further advances in the agricultural sector are required with great efficiency.

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