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IMPORTANCE OF ELECTRONICS IN FOOD SCIENCE AND NUTRITIONS INDUSTRY

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ABSTRACT:

Food engineering, which became an academic discipline in the 1950s, is a professionaland scientific multidisciplinary field related to food manufacturing that covers the practical applications of food science. The purpose of this evolving field is to advancethe implementation of efficient industrial processing in the transformation of rawmaterials of biological origin into edible forms, which includes packaging, storage, anddistribution. Food engineers are employed in academia by government and industry andas private consultants to assess the problems concerning food production, food quality,process and plant design, and food regulation. They conduct research and develop unitoperations such as sterilization, irradiation, concentration, extrusion, and freezing.Ancient activities like milling, dehydration, and fermentation have been transformedthrough the increasing demand of food supply systems into automatic instalments.Electronics play very important role for automation in food industry. Automated systems in food production come in different functions and sizes, very much depending on the food type and specific requirements of the manufacturers. This paper gives the idea about the role of electronics in food industry. Food industry is dependent upon manual handling, in a wide range of activities. That is largely because of the features of the food products are variable: such as vegetables, fruits, meat, seafood etc. these food products can be divided into very good, good or bad categories on individual unit basis.

INTRODUCTION

Supplying food to an ever-increasing population is one of the largest and oldest businessactivities in the world; it involves planting and harvesting, transportation and handling,storage, processing and preservation, packaging, distribution, and marketing. Over theyears, typically small family-type businesses have been converted into huge,increasingly sophisticated, integrated food supply systems. This transformation has beendictated by

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increasing concentrations of people in urban areas, where large segments ofthe population depend on vast amounts of pretreated, preprocessed, or ready-to-eat, safefoodstuffs. The development of efficient mass production and transportation of foodsupplies is becoming more and more necessary. The food industry has grown from suchdemands, requiring the support of diversified, well-rounded teams of scientists,engineers, economists, and marketing specialists.Food Engineering is a relatively new profession and a scientific field involved with foodmanufacturing and the processing of refined foods. It encompasses the practicalapplication of food science to develop efficient industrial production, packaging,storage, and physical distribution of nutritious and convenient foods that are uniform inquality and safe. The most remarkable difference between food engineering and foodscience is that the former includes the knowledge of unit operations and processes.

Plant automation can improve productivity, quality and profit of the plant as shown in Fig.1. So, automation of food industry is one time investment but in long term cost may be less. Further automation is possible only due to advancement in computer software and hardware.

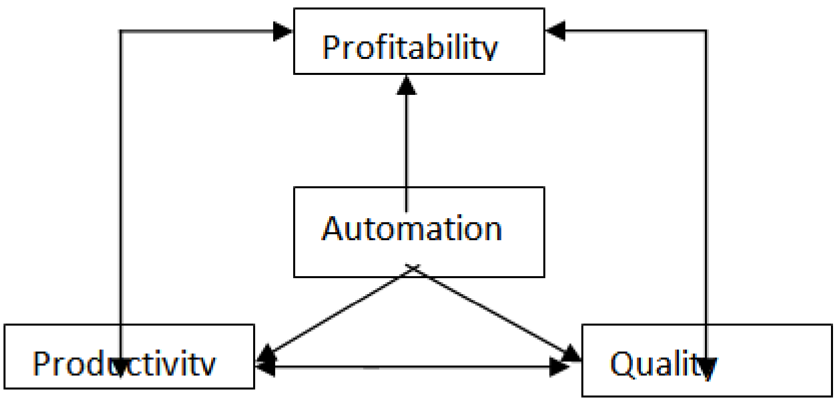

Fig.1: Plant automation [1]

ROLE OF ELECTRONICS IN FOOD INDUSTRY

Electronics plays very important role in food automation industry. Following are some important applications of electronics in food industry.

1. USE OF BIO SENSORS:

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Sensors designed for the detection and identification of contaminants in food. Foods are materials, raw, processed, or formulated, that are consumed orally by humans or animals for growth, health, satisfaction, pleasure and satisfying social needs. Food preservation is an action or a method of maintaining foods at a desired level of properties or nature for their maximum benefits. In general, each step of handling, processing, storage and distribution affects the characteristics of food, which may be desirable or undesirable. So, biosensors can analyze the quality of food [1]. There exists a strong need for rapid and sensitive detection of different components of foods and beverages along with the food borne and water borne pathogens, toxins and pesticide residues with high specificity. Biosensors present attractive, efficient alternative techniques by providing quick and reliable performances.

BASIC PRINCIPLE OF BIOSENSORS

Biosensors act as analytical devices employing a biological material as a recognition molecules integrated within a physicochemical transducer or transducing microsystems. The outcome of this is a digital electronic signal proportional to the concentration of a specific analyse or analysis. Bioreceptors are biologically active materials that interact with the analyse under study, e.g., antibody enzymes, microorganisms, etc. A varied range of naturally produced molecules such as nucleic acids, protein lipids and their derivatives, enzymes, antibodies, cell receptors, etc. can all be used as the sensing element in biosensors. Enzymes catalyse many biochemical reactions and they are vastly used in biosensors as the catalytic component. The key component of a biosensor is the transducer.Transducers are electronic devices that convert one form of energy into another and act as a detecting element. Electrochemical, optical, Piezo-electric and calorimetric are the major transducers used in biosensors that makes use of a physical change accompanying the reaction. Many enzyme catalysed reactions are exothermic, generating heat which may be used as a basis for measuring the rate of reaction and analyse concentration. Transducers those generate heat output by the reaction are called Calorimetric biosensors. Electrochemical biosensors provide an attractive means to analyse the content of a biological sample due to the direct conversion of a biological event to an electronic signal [1, 2]. Optical transducers are based on a number of principles like the effect of the biological activity on absorption of light and on other optical parameters. Optical based sensing systems that measure luminescence, fluorescence, reflectance and absorbance, etc., are some of the areas of applications of optical immune

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sensors. Thermometric transducers measure the change in temperature difference during biological reactions. Piezoelectric transducer follows the principles of change in the significant frequency of wave propagation throughout a piezoelectric material. These principles can be used to measure mass, viscosity or density changes at the sensor surface. Signal processor is used to display the result in the form of electrical signals in a user friendly manner.

2. USE OF IMAGE PROCESSING

Now a day, digital image processing techniques have been increasingly used for quality analysis of food material. Through image processing fruits and vegetables can be easily categorized according to their size, shape, color etc. Huge postharvest losses during handling, processing as well as increased demand for food products of high quality have generated the methods for accurate, fast and objective quality determination of food and agricultural products [5]. Size is the parameter that can be estimated using machine vision by measuring projected area, perimeter or diameter. The shape is one of the important visual quality parameters of fruits, vegetables, etc easily comprehended by humans but difficult to be quantified or defined by the computer, but using image processing this work can be handled by machine. Image processing technique is very helpful in analyzing the color and size of the food product easily without human intervention. Image processing consists of a series of image operations that improve the quality of an image by removing various defects like improper focus, repetitive noise, geometric distortion, non-uniform lighting and camera motion. Charge coupled device camera, ultrasound, magnetic resonance imaging, computed tomography, and electrical tomography are used for image acquisition. Pixel and local pre-processing approaches are image pre-processing methods. Image analysis is defined as a process that distinguishes the objects from the background by providing quantitative information that is used in the subsequent control systems for decision making. Image processing/analysis can be classified in three levels like low-levelprocessing, intermediate-level processing and high-level processing by suppressing undesired distortions or by the enhancement of important features of interest. Intermediate-level processing includes image segmentation, and representation and description. Image segmentation is an important step that divides an image into regions that have a strong correlation with objects or areas of interest, methods like thresholding-based, gradient-based, region-based, and classification are

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used image segmentation. Representation is used to examine features like size, shape, image, texture and defects. Image description is used to extract quantitative information from the segmented images. High-level processing includes recognition and interpretation by using statistical classifiers or multilayer neural networks of the area of interest [1]. These steps provide the necessary information for process/machine control for quality sorting and grading. Communication with an informative database at all steps of the whole process is important for more accurate decision making and looks as an integral part of the image-processing process. The operation and effectiveness of intellectual decision-making is based on the condition of a complete knowledge base that in machine vision is incorporated into the computer. Algorithms like neural networks, fuzzy logic and genetic algorithms are some of the techniques involving image understanding and decision-making capacities thus providing system control capabilities.The most recent advances in food engineering have provided a strong basis for makingmajor improvements in processing operations throughout the food chain. Foodengineers are seeking new approaches that include synergistically combined processes.Innovations are expected in transforming bench-scale processes into industrial-scalemanufacturing of foods while maintaining desirable quality attributes. However,processing efficiencies related to the use of resources such as energy and water in anumber of food operations will require dramatic improvements.

Some outstanding achievements in food engineering include:

- Continuous bread-dough making and forming
- Manufacture of low-cost, high quality prepared mixes
- Development of instant coffee and tea processes
- Dehydration of potatoes to produce an instant mashed product
- Production of precooked frozen convenience foods
- Continuous butter churning
- Freeze-drying or sublimation
- Extrusion processing
- Preservation of beer and wine by micropore filtration
- Pneumatic bulk handling of dry and liquid raw materials
- Aseptic filling of packages
- Automatic control processes

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- Controlled atmosphere and modified atmosphere storage of fruits and vegetables
- Ohmic heating
- Irradiation of foods
- High hydrostatic Pressure

Recently, there has been a growing interest in the area of nonthermal processing offoods. Emerging technologies using pulsed electric fields and high pressure haveencouraged food engineers to seek new materials for equipment, to determine processconditions for high-quality foods, and to ensure the safety and reliability of the process,such as generation of membranes. These materials will significantly enhance a range ofapplications in food processing, from minimizing water use in processing plants, toimproving efficiency in separating high-value components in foods that have desirablefood and non-food applications. An area of major change in the food field is that ofbiotechnology or "genetic engineering" as sometimes called. For example, new plantgenome initiatives will bring improved vegetable oils.In the future, food engineering will enhance computational techniques to provide abetter mechanistic understanding of food process design. At a molecular level,knowledge of food properties and reaction kinetics will provide the required basis forcreating desirable food structures and functions that can be scaled to a manufacturinglevel. A quantitative understanding of food properties and advances in sensingtechnologies, such as ultrasonic and magnetic resonance imaging, will enhance thedevelopment of advanced online sensors for use in food manufacturing.These advancements will require food engineers to use highly creative approaches indesigning food-packaging systems, including the use of edible coatings for increasingshelf life to deliver a high quality product to consumers.

CONCLUSION:

In the era of modern technology, food industry is lagging behind due to uses of conventional methods to analyse the food product quality. So there is need for efficient biosensors and image processing techniques to provide rapid, economic, hygienic, consistent and objective assessment. The adoption of this emerging technology in improving quality inspection of food products will be of immense benefit for the food industry.Employers of food engineers and food scientists include academia, government andindustry, consulting

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firms, entrepreneurial endeavours of various sorts, and privateconsultants. Crucial to almost any profession is the education its members receivedprior to entering that profession.

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