Development of Real Time Model for Quality Assurance in Fruits and Vegetable

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Abstract- This study aims at developing a non-invasive method of monitoring the quality of fruits and vegetables that are hitherto checked manually. As indications are generally rated, morphologic conditions, such as size, color, softness, or firmness (depending upon the kind of the plant organ that can be harvested) considering also the weather of course during the development phase. After harvest degradations of the quality are to be expected, this can be partly retarded by suitable site conditions (for example, cooling). The proposed project is an attempt to move one step forward in innovating a simple and creative real time model of assuring the quality of fruits and vegetables prior to processing in food industries. This model would eliminate the drudgery of the need to manhandle fruits/vegetables hitherto followed even in small food processing units. It is also proposed to make use of indigenous electronic components in the fabrication of this model.

I. INTRODUCTION

Quality inspection of food and agricultural produce are gaining importance in today's consumer market. The responsibility for food quality and food safety is shared by all segments of the food system, including the various food industry sectors, government regulatory agencies, and consumers in general. In modern food industry, high quality product is the only basis of success. Quality of any product determines its sale value in the market. Today's consumer demands quality food which are safe in every aspect, this has raised the need for enhanced quality monitoring. Generally, food quality is evaluated from its sensory attributes which involves comparison of attributes such flavour, smell, texture, colour and appearance by trained judges. Human inspection is a slow process, has poor repeatability and result varies from person to person which have emphasize the demand of objective system for evaluation of food quality. This has necessitated the introduction of computer-based image processing techniques. Computer vision technology aims to simulate the effect of human vision electronically by acquiring and understanding an image and it constitutes the expression and relevant descriptions of physical objects from images.

II. ORIGIN OF THE RESEARCH PROBLEM

Ever-increasing population, losses in handling and processing and the increased expectation of food products of high quality and safety standards has raised the need for accurate, fast and objective quality determination methods. Manual quality inspection is a slow, costly, unreliable process and suffers from poor repeatability. Computer vision provides one alternative for an automated, non-destructive and cost-effective technique to accomplish these requirements. Quality assurance using developed real time models is a rapid, economic, consistent, objective inspection and evaluation technique. This principle has been successfully adopted for the quality analysis of all perishable food items including, fruits and vegetables with applications ranging from routine inspection to the complex vision guided robotic control.

III. INTERDISCIPLINARY RELEVANCE

The proposed model highlights an engineering technology that integrates mechanics, optical instrumentation, electromagnetic sensing, digital video and image processing technology in the mainstream of food processing and preservation technology. The intention of such real time model system consists of capturing, processing and analysing images, facilitating the non-destructive assessment of various quality characteristics in food products.

Objectives:

- To design and fabricate a real time model with sensors which helps to determine the quality of the fruits and vegetables based on the colour (maturity index)
- To conduct trials to confirm and obtain reproducible results with a different classes of fresh fruits and vegetables.
- To work out the cost economics for technology transfer and commercialization.

IV. REVIEW OF LITERATURE

1 International status

Methods for the assessment of quality parameters were developed over centuries and instrumental analysis could develop fast due to the technical progress in the 20th century. Today, emphasis is put on the development of sensors for non-destructive assortment in real-time mode. The continuous examination of connections or relations between measured variables and quality criteria are of fundamental importance for the application of these new methods (Akimoto 1996). The freshness of vegetables is determined considerably by the water content and the concentration of valuable constituents whereby these items often change rapidly during postharvest decay. The product may already be withered; however, the decay of constituents must not necessarily have progressed far yet. If a product is judged as fresh by optical impression, special expectations about its internal components are created in the consumer (Geyer and others 1999).

2 National Status

Quality inspection of food and agricultural produce are difficult and labour intensive. Simultaneously, with increased expectations for food products of high quality and safety standards, the need for accurate, fast and objective quality determination of these characteristics in food products continues to grow. However, these operations generally in India are manual which is costly as well as unreliable because human decision in identifying quality factors such as appearance, flavor, nutrient, texture, etc., is inconsistent, subjective and slow. Machine vision provides one alternative for an automated, non-destructive and cost-effective technique to accomplish these requirements. This inspection approach based on image analysis and processing has found a variety of different applications in the food industry (Krishna Kumar et al., 2012). Computer vision technology aims to simulate the effect of human vision electronically by acquiring and understanding an image and it constitutes the expression and relevant descriptions of physical objects from images (Singh et al., 2013).

V. ELECTRONIC NOSE BASED APPROACH FOR EGG FRESHNESS DETERMINATION

An electronic nose (EN) based system, which employs an array of four inexpensive commercial tin-oxide odour sensors, has been used to analyse the state of freshness of eggs. Measurements were taken from the headspace of four sets of eggs over a period of 20–40 days. The sensor system comprises four tin-oxide odour sensors from the same manufacturer housed in a sensor chamber. The sensors were chosen on the basis of sensitivity of the sensors to different gases; the selected sensors are designed to respond to gases such as cooking vapours, ammonia, hydrogen sulphide, alcohol, toluene, xylene, etc., which are also specified by the manufacturer.

The electrical conductance of the sensors varies in the presence of reducing/oxidizing gases. In general, the sensor conductance was found to increase as the EN systems appear to be very promising for non-destructively determining egg freshness for a number of reasons. The main ones are that EN systems are based on inexpensive, non-specific solid-state sensors, which are sensitive to the gases which are emitted by eggs. Furthermore, once an EN has been ‘trained’, it does not require a skilled operator and can potentially obtain results in times of the order of a few tens of seconds. In the EN system, a pattern recognition engine enables the system to perform complex aroma analysis of the sensor signals (Dutta and Hines, 2005).

VI. MICROCONTROLLER – ATMEGA8A

ATmega32 is capable of handling analogue inputs. Port A can be used as either digital I/O Lines or each individual pin can be used as a single input channel to the internal ADC of ATmega32.

- High-performance,
- Low-power AVR 8-bit Microcontroller,
- Advanced RISC Architecture.

VII. PRESSURE SENSOR

Pressure sensors convert input pressures to electrical outputs to measure pressure, force and airflow. Most pressure, force and airflow sensors are fabricated using silicon-processing techniques common in the semiconductor industry. Therefore, much of the same terminology used in the semiconductor industry also applies to pressure sensor technology.

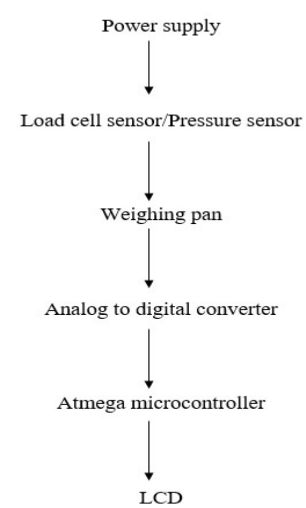
Piezo resistive ion implanted semiconductor technology dominates the component market for pressure sensors for many good reasons. Piezo resistive pressure sensors (strain gage sensors) are often referred to as IC (integrated circuit) sensors, solid-state sensors, monolithic sensors (formed from single-crystal silicon) or just silicon sensors. They are processed in wafer form, where each wafer will contain a few hundred to a few thousand sensor die, depending on the size of the sensor die. A typical sensor chip measures 80 × 80 mils or 2 mm × 2 mm. Piezo resistive (silicon) pressure sensors contain a sensing element made up of a silicon chip with a thin, circular silicon diaphragm and four piezo resistors. These nearly identical solid-state resistors are buried in the surface of the silicon. The piezo resistance of a semiconductor refers to the change in resistance caused by strain when pressure or force is applied to the diaphragm. Pressure causes the diaphragm to flex, inducing a stress on the diaphragm and also on the buried resistors.

Pressure sensors are produced first by ion implanting the four piezo resistors into the silicon. Ion implantation is used increasingly to provide improved performance over sensors produced by diffusion. After the four piezo resistors are formed, the diaphragm is created by chemically etching a controlled shape in the silicon from its backside (on the surface opposite the piezo resistors). The unattached portion of the silicon slice provides a rigid boundary constraint for the diaphragm and a surface for mounting it to some other member.

VIII. METHODOLOGY

In this system the sensor is mainly used to determine the quality of the perishable food items. A sensor is used that converts a physical phenomenon into an electrical signal. The fabrication material includes power supply, Load cell sensor, Microcontroller, Liquid Crystal Display (LCD), Pressure sensor, and Light Emitting Diode (LED). First the physical quality characteristics of the fruit/vegetable are determined by using the weight. The circuit includes materials like Atmega microcontroller, load cell sensor, Liquid Crystal Display (LCD), etc. This preliminary kit is used to determine the quality for only one fruit/vegetable at a time.

An improved version is done with inclusion of more quality parameters like color& weight used to determine the quality of the fruit/vegetable. In the improved version the quality can be determined for more number of fruits and vegetables involving the use of a conveyor belt. The proposed kit is likely to consist of fabrication materials like PIC microcontroller, load cell sensor, infrared sensor, liquid crystal display (LCD). Both the circuit needs power supply.



Process for Determination of Quality of Fruit/Vegetables

IX. SUMMARY AND CONCLUSION

The rising cases of food deterioration calls for an effective technique to alert consumers of spoilt or stale food items. The sensors are able to detect spoilage of common household items like dairy, meats and fried items. The development of real time model for quality checking in Fruits and vegetable provides a direct and convenient means to monitor the quality of eggs to address food safety. The kit will be in compact size and weight, which can carry to anywhere and any place. Load and pressure sensors are used which helps to analyse the weight of the eggs. The system ultimately alerts consumers regarding the status of their food item accurately and conveniently. The design is compact and can be built efficiently using low cost components. A cheap and efficient design enables the kit to be affordable for all sections of the society. The display system accurately displays the freshness level of the food, enabling consumers to be well aware of the quality of food. This design is simple, effective, feasible and cost effective.

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