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Industrial Automation of Bakery Products by using Sensors: Review

Dhanashree Saraf[1], Deoyani Mujbaile[2], Rasika Pandharikar[3] & Abhishek Kundu[4]
[1,2,3,4]UG Scholar, Dept. of ECE, RCOEM, Nagpur, India

Abstract— *Food Processing Businesses all over the world have to consider quality of food products as an important factor for their survival. Good quality food products are very important for consumers also. So we proposed a system aimed at providing quality check for food products using microcontroller and sensors in an efficient and economical way. In this approach, experiments are conducted using sensors for quality check of products like toast and muffins.*
Keywords— *Color sensor, Ultrasonic sensor, IR sensor, Proximity sensor, Temperature sensor,food quality monitoring.*

I. INTRODUCTION

Since ancient time, access to good quality food has been man's sincere effort. Safety of food is the basic requirement of food quality. Quality implies control to achieve goals which may be consumer or business oriented[1]. Food quality includes various parameters such as appearance (size, shape and color), freshness, good nutritional value and federal grade standards.

Consumption of poor quality food can cause acute and chronic health problems. Now-a-days rate of consumption of packaged food items is high. So quality check is very essential in industries producing these food items. Quality check can either be done manually or by using automation. The method of manual checking is expensive, less efficient due to human errors and time consuming. Thus industrial automation is more efficient method of quality check.

Computer vision is one of the methods of industrial automation. Computer vision provides results that are limited to the outer appearance only which is insufficient to determine quality. UV rays and X-rays can solve this problem however it is expensive.

Another method of automation is developing a system consisting of sensors. Sensors determine quality of a product by considering outer as well as inner parameters. This method is very effective in case of quality check of packaged products. So in this project we have designed a bakery automation system using sensors and conveyor belt. This system aims at checking quality parameters such as size, color and temperature specifically for packaged food items.

II. LITERATURE REVIEW

1. Dubey & Jalal (2012a cited in Dubey & Jalal 2013) proposed a framework for recognizing and classifying fruits and vegetables. They considered images of 15 different types of fruit and vegetable collected from a supermarket. Their approach was to first segment the image to extract the region of interest and then calculate image features from that segmented region which was further used in training and classification by a multi-class support vector machine. They also proposed an Improved Sum and Difference Histogram (ISADH) texture feature for this kind of problem.From their results, ISADH outperformed the other image color and texture features[1]

2. Omid et al. (2010) used shape, texture and color features to sort tomato fruits according to their circularity, size, maturity and defects. They achieved 84.4% accuracy for defect detection using a probabilistic neural network (PNN) classifier. Color, texture and shape features have been evaluated for fruit defect detection system, also in conjunctions with PNNs.[2]

The image processing gives information about outer structure of product but quality of product cannot be determined only by its outer appearance. Sensors give non destructive method to check quality of product. So we have proposed a system based on sensors.

3. Meenal V. Barsode et al proposed a system consisting of conveyor belt and sensors. This system provides continuous stream of raw material in addition to constant movement of other containers thereby designing a bakery automation system. This system operates on low cost, maintains hygienicenvironment in its production mechanism.[3]

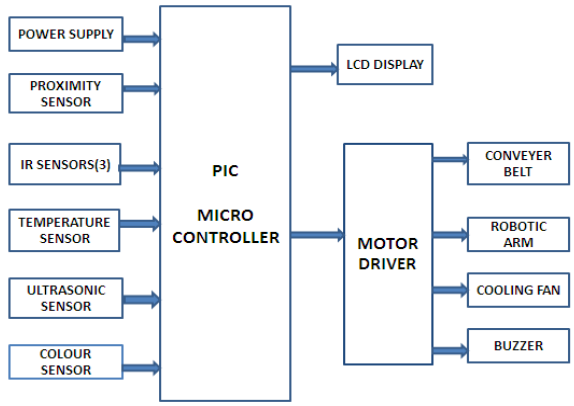
4. Ganesh N. Shende et al represented the automated material handling and quality control in bakery industry. In this system ARM 7 was

interfaced with sensors. Here, IR sensor, Temperature sensor and gas sensors were used to check the quality of the product. This system improved accuracy and speed of manufacturing of various baked products.[4]

5. Ee Lim Tan et al designed a system for monitoring of the quality of dry, packaged food such as cereals. This system used a wireless, passive sensor made up of plant inductor and capacitor. This sensor was embedded inside the food package and its response was detected through the coil connected to a sensor reader. As the food quality deteriorates due to the increasing humidity, the capacitor's capacitance and the sensor's resonant frequency changes. Thus, the taste quality of packaged product could be indirectly determined by measuring the changes in sensor's resonant frequency. The simple fabrication process and low sensor cost made this technology economically viable.[5]

We have studied work of all these people and concluded that we can combine their work to achieve higher accuracy and efficiency. Also we will be improving the speed of system.

III. SYSTEM OVERVIEW



The given block diagram explains the overall working of our project. The sensors shown are given as an input to the microcontroller. The outputs obtained from microcontroller are given to LCD and driver IC. Motor driver is used to drive conveyor belt and robotic arm.

The brief introduction of various blocks is given below:

1. IR sensors: Three IR sensors are used here for determining length, width and sample count.
2. Ultrasonic sensors [HCSR-04]: Using Ultrasonic sensor presence of an object and its height can be determined. This sensor releases ultrasonic wave. When the wave collides with any object in front of the sensor, the wave bounces back to the sensor. The time difference between the transmission of the ultrasonic wave and the reception of the reflected wave is calculated. Since we know the speed of the sound wave we can calculate the distance of the obstacle.

Distance = speed Xtime.

3. Proximity Sensor: Inductive type Proximity sensor is used here. This sensor is used to detect if metal is present in an object. It has one transmitter and one receiver. Transmitter emits infrared rays, which bounces after hitting any metal component and is received by the receiver.
4. Temperature Sensor [LM35]: Temperature sensor detects the temperature and gives value in degree Celsius. Output voltage Vout is determined here. It has sensitivity of 10mv/c.
5. Color Sensor [TCS3200]: It detects the texture and color and compares it with standard threshold values. It checks whether the sample is undercooked or overcooked.
6. LCD: The status of sensors is displayed on LCD.
7. Microcontroller [PIC1845K22]: Peripheral Interface Controller (PIC) is an 8-bit microcontroller. It has advanced RISC architecture, thus it has highest performance and lowest power consumption in all 8-bit PIC families. All the input and output units are connected to microcontroller. This system consists of a 40 pin PIC.

IV. SOFTWARE

MPLABIDE, Dip trace, Terminal

V. WORKING

The product to be tested is placed on the conveyor belt. It goes through various tests performed by sensors. A threshold value is decided and fed into each sensor for comparison of different samples.

In first stage, length of the sample is detected and compared. For detection of length two IR sensors are connected in parallel. If output of both of the sensors is high then sample has appropriate length.

Next height of the sample is detected using ultrasonic sensor.

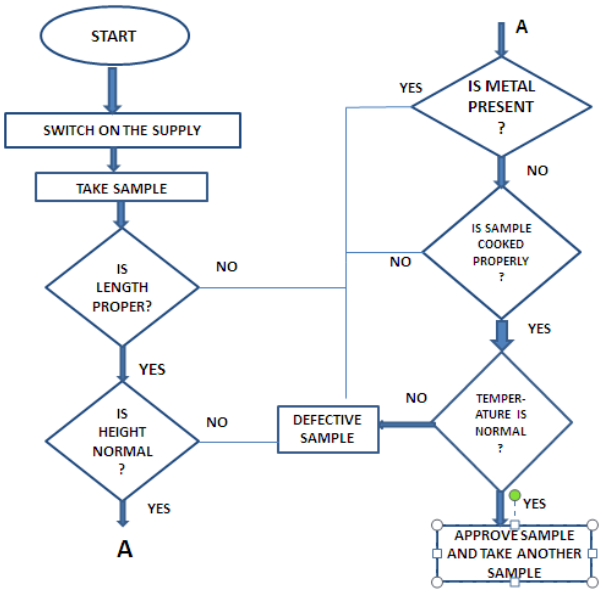
The sample is than passed though the proximity sensor which detects if metal content is present in the sample.

Then the sample is passed though the temperature sensor which ensures that the sample has appropriate temperature for packaging. Cooling fan is provided here to maintain the temperature of the sensor.

Lastly the sample is passed through the color sensor to check if the sample is overcooked or undercooked.

If the sample passes through all the sensor's tests, the sample goes further for packaging. If the sample fails any of the above tests, the robotic arm will remove the sample

VI. FLOW CHART



VII. CONCLUSION

As mentioned above, there is need for industrial automation in the field of quality check of bakery products. So we have designed a system which can be used in bakery industries for quality and standard check. This system uses microcontroller and sensors which provides accuracy, good speed and low cost.

VIII. FUTURE WORK

We will be assembling all the sensors mentioned above along with conveyor belt and will create a proto type of the system. Also we will be adjusting delays to obtain appropriate results.

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