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BAKERY AUTOMATION SYSTEM

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Abstract-*This paper presents the automated material handling in the bakery industry to improve the accuracy and the speed of manufacturing of products. Most of the bakeries are still operating manually which results into unhygienic environment and also requires large manpower and cost. In order to address these problems, we are designing the Bakery automation system using conveyors and its production cycle provides a continuous stream of ingredients, dough and baked product, in addition to the constant movement of troughs, pans, lids, baskets and other containers. Initially we are designing the conveyor belt which is used to drive the assembly of containers. We are using IR sensor, temperature sensor, gas sensor and level sensor for efficient working of system.*

I. INTRODUCTION-

Computer vision systems which operate at high speed reliably perform quality control in industrial food manufacturing. However, many of these inspection stations are to be tuned manually and perform well only on specific products. This research integrates machine learning techniques in the process to automate the initial tuning of real-time vision-based inspection systems for bakery products. The feature selection techniques combined with machine learning are assessed in terms of classification performance. The data from industrial inspection stations is introduced and experimentally evaluated using a formal automated tuning methodology. The work demonstrates that the proposed technique tuned automatically with the inspection system can systematically achieve 98% accurate classification when compared with the classification generated by the manually tuned system.

In wholesale bakeries, the key to run an efficient operation is automated material handling. The production cycle requires the constant movement of troughs, pans, lids, baskets and other containers along with a continuous stream of ingredients, dough and baked products. For example, dough must be filled in the trough, stored during fermentation and is retrieved for final mixing. Meanwhile, storage contains stacked pans and lids until brought to the production line on an as-needed basis. At the end of the line,the finished goods are loaded into baskets or other containers for shipment to distribution centers and retail outlets.

The trend is moving away from viewing machinery and pieces of equipment in isolation towards arriving at an integrated automation solution. This new direction is embodied by the Totally Integrated Automation. The unrivaled range of software and hardware enables you to automate your entire production line, from goods receipt and process/production-related activities right to goods issue.

The production process does not limit the integration. Totally integrated automationcovers all relevant areas along with a standardized engineering environment, continuous and open communication tools, as well as intelligent management systems and IT solutions. Also from building automation, energy management and the production control level to maintenance and servicing. Energy costs are becoming increasingly relevant. That‘s why it‘s good to know that we can bring considerable savings using integrated power distribution solutions, with Totally Integrated Power.

Totally Integrated Automation works for the baking and confectionary industries. Manufacturers of bakery and confectionary products boost productivity in the long term using an integrated automated production process. All products and systems interact smoothly and can realize integrated automation concepts as more cost-basis of Totally Integrated Automation, making it effectively and run them more economically

Thus we are designing a bakery automation system using conveyors for continuous movement of vessels towards the oven and from the oven to containers.

II. SYSTEM DESCRIPTION:

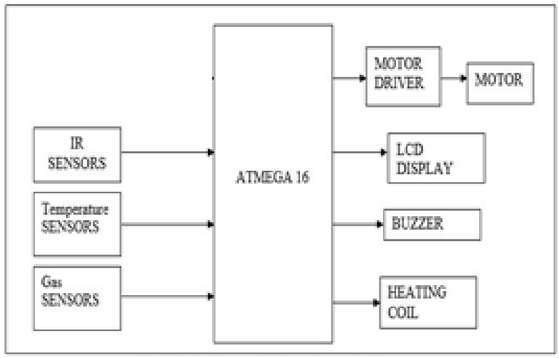

Fig 1: Block diagram of Bakery Automation System

We are using ATMEGA 16 microcontroller interfaced with LCD display and stepper motor to drive the conveyor belt.

IR sensors are used to check availability of vessel. Level sensors are used to check if the appropriate amount of material is present in the vessel or not. Temperature sensors are used to check if the machine is over heated or not. If yes then the machine will be tripped off. Gas sensor will be used for safety of the machine and detect if the machine has any faults. Conveyer belt is used to drive the assembly. Buzzer is used to indicate the process field. LCD to display the status. Motor driver to drive various motors. Motor to run various applications according to our requirement (e.g. door opening and closing, movement of vessels.)

HARDWARE DESIGN:

- ATMEGA 16 Microcontroller.
- IR Sensor.
- LM 35 temperature sensor.
- MQ02 gas sensor.
- LCD display.
- Dispenser assembly.
- Conveyer Design.
- Heating assembly.

Why ATMEGA 16?

1. Our requirements: UART, ADC, LCD, Relay, Motor driver. All these require 8 bit control.
2. Temperature and gas sensor require 10 bit resolution which is in-built in ATMEGA 16.
3. We require 16 KB RAM which is in-built.
4. Open sourcing is available.
5. ATMEGA 16 programming is compatible of any another ATMEGA IC using the same driver where as in PIC, the program also changes with the driver.
6. AVR programmer is cheaper than PIC.
7. ARM is costlier 4times as compared to AVR.
8. Serial communication uses 1UART which is available in AVR. ARM has 2 which is wasted so we are using AVR.
9. We can take the required program from AVR studio so easily programmable.
10. AVR is useful for next generation. For ex: Nowadays smartphones like Samsung, Sony etc. also use AVR.
11. We are using 16MHz for greater speed.
12. ATMEGA 16 is cheapest in all aspects comparatively and meet all our requirements accurately. Hence we are using it.

DISPENSER ASSEMBLY

We are using a funnel arrangement using the principle of gravity for the mixture to pour down from the funnel. The funnel arrangement is made using wooden stand. To stop the flow of the mixture as and when required we are using a stopper clamp to obstruct the flow. The clamp opens and closes using a simple DC motor.

CONVEYOR DESIGN

While designing the conveyor we are using metal steel to design the outer as well as inner infrastructure. We are using thin metal net as the conveyor belt. The layout of the conveyor design is given as follows:

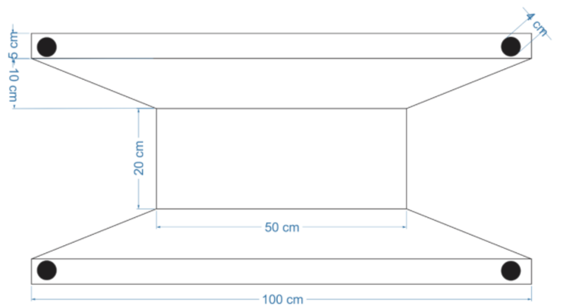

Fig.2: Layout of conveyor assembly

HEATING ASSEMBLY

We are using domestic electric coil for heating of the product. The coil is wounded in a solenoid form and attached to a ceramic plate. The coil range is given as 0-200^{0}C.

The product is baked appropriately using this coil. The switching of coil is made using relay circuit.

SOFTWARE DESIGN

Software used include, 'AVR Studio 4.0', for programming purpose. 'Proteus 7', for software simulation, 'sinaprog' for downloading program in the chip and eagle for PCB layout.

METHODOLOGY

When we enter the command for respective product from serially communicating computer, the conveyor will be ON by default. The vessel gets detected by IR sensor and the process of dispensing the material starts. The display will show the message "DISPENSOR ON, MONITORING OFF". After the predefined time, dispenser is made OFF and vessel on the conveyor belt moves towards the heating mechanism. Again by the IR sensor placed in heating assembly, vessel gets detected. This leads to the start of actual heating process showing the temperature sensed by the temperature sensor LM35 and the gas detected by gas sensor MQ02 on LCD display. After the predefined time and maintaining the temperature, heating process ends with the start of conveyor belt. The baked product is taken out of the system. If in case, the product is burnt the smoke is detected by gas sensor and product will be taken out immediately.

RESULTS

At the preliminary level, we have interfaced temperature sensor i.e. LM 35 and gas sensor i.e. MQ02 with ATMEGA 16 microcontroller. We tested the change in voltage with respect to temperature and gas respectively and recorded the readings accordingly. Following tables show overall analysis.

Table 1: Experimental results for Temperature Sensor

Sr. No.	Voltage (mV)	Temperature (^{o}c)
1	288	29
2	310	31

3	318	33
4	389	37
5	454	41

Table 2: Experimental results for Gas Sensor

Sr. No.	Voltage (mV)	Gas (%)
1	0	0
2	70	1
3	148	3
4	238	5
5	478	10
6	708	15

We also tested various products with their respective baking temperatures and time in the microwave system. The products were also tested in the heating coil assembly designed by us. There is temperature and time difference as compared to the microwave due to the radiation principle used in microwave there is less heat loss so time required to bake theproduct is less comparatively. We are designing a prototype for the bakery system so we require the following temperature and timings for the baking of various products.

Table 3 :Baking time and temperature in our system.

PRODUCT	BAKING TIME (SECONDS)	BAKING TEMPERATURE (DEGREE CELCIUS)
1) Cupcake	210	110-130
2) Papad	90	80-90
3) Water	60	100

We also studied the baking techniques along with specifications in the microwave. They are as follows:

Table no.4:Baking time and temperature in microwave oven.

PRODUCT	BAKING TIME (SECONDS)	BAKING TEMPERATURE (DEGREE CELCIUS)
1) Cupcake	90	100
2) Biscuits	600	150
3) Cake	1800	180
4) Bread	1800	200
5) Papad	30	100

ADVANTAGES

1) The total system is comparatively a low cost system.
2) Hygiene maintenance is the key advantage of this system.
3) The total labor required is less which results in less labor cost as well.
4) The total time required for actual production is less compared to the large scale bakeries and manually operating small scale bakeries.
5) The total power consumption of the system is lesser compared to the large scale industries.
6) Due to serial communication human interference is avoided once the input is given. This is due to total automation of the system.
7) The gas sensor is used to detect the smoke if there is a problem in the system, which hence is used to reset the system. This reduces the total failure of the system.

DISADVANTAGES

1) The hardware (belts, heaters, etc.) is very costly on large scale, as this is a prototype the hardware cost is reduced by us.
2) The system requires more space due to the conveyor assembly.
3) Suckers are not added in the dispenser assembly due to high cost.

APPLICATIONS & FUTURE SCOPE

1) The system can be used in small scale as well as medium scale bakeries.
2) The system is used not only in bakeries but also in electronics industries for PCB baking.
3) The system can be used by large scale bakeries also by increasing conveyor size and other increments.
4) The system can also be made controllable from cellphones through Bluetooth and GSM.
5) Zigbee can be used for wireless distant communication.

CONCLUSION

This study is a system overview of Bakery Automation. A general idea about all the schemes that ascertain this project is stated.

This project is meant to be a prototype to automate the bakery process on small as well as large scale. With this project, we are baking products precisely with good hygiene and consuming less labor, hence reducing the labor cost and overall cost of the system. The main feature of this project is it is user friendly, relatively cheaper in cost and applicable in daily life.

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