

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 7, July 2017

Implementation of PLC Based Automatic Cooking Machine

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ABSTRACT: In our daily life, we see that many people, especially ladies spend hours in kitchen for cooking. In the early days, food was cooked on chulhas. But as the scientific and economical development emerged, the process of cooking also changed. Today people cook on gas stoves, although we can see that the concept of modular kitchen is different altogether. The modular kitchen concept is not affordable to each and every one.

Nowadays, automation is taking place in almost all the fields. Hence, the basic moto behind this project was to make an innovation in kitchen. Such innovation in kitchen will help reducing human efforts. The advantage of the system is that, it is time reducing and the taste of the food cooked will remain same throughout.

KEYWORDS: Delta PLC, Automatic Cooking Machine.

I. INTRODUCTION

Automation is the use of control systems (such as numerical control, programmable logic control, and other industrial control systems), in concert with other applications of information technology (such as computer-aided technologies (CAD, CAM), to control industrial machinery and processes, reducing the need for human intervention. In the scope of industrialization, automation is a step beyond mechanization. Whereas mechanization provided human operators with machinery to assist them with the physical requirements of work, automation greatly reduces the need for human sensory and mental requirements as well. Processes and systems can also be automated.

Many roles for humans in industrial processes presently lie beyond the scope of automation. Human-level pattern recognition, language recognition, and language production ability are well beyond the capabilities of modern mechanical and computer systems. Tasks requiring subjective assessment or synthesis of complex sensory data, such as scents and sounds, as well as high-level tasks such as strategic planning, currently require human expertise. In many cases, the use of humans is more cost-effective than mechanical approaches even where automation of industrial tasks is possible.

Specialized hardened computers, referred to as programmable logic controllers (PLCs), are frequently used to synchronize the flow of inputs from (physical) sensors and events with the flow of outputs to actuators and events. This leads to precisely controlled actions that permit a tight control of almost any industrial process.

Human-machine interfaces (HMI) formerly known as man-machine interfaces, are usually employed to communicate with PLCs and other computers, such as entering and monitoring temperatures or pressures for further automated control.

Currently, for manufacturing companies, the purpose of automation has shifted from increasing productivity and reducing costs. Automation is now often applied primarily to increase quality in the manufacturing process, where automation can increase quality substantially

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II. METHOD OF INTERFACING

The Block diagram consists of following sections as listed below. It consists of PLC, HMI, Inputs and Outputs as major blocks..

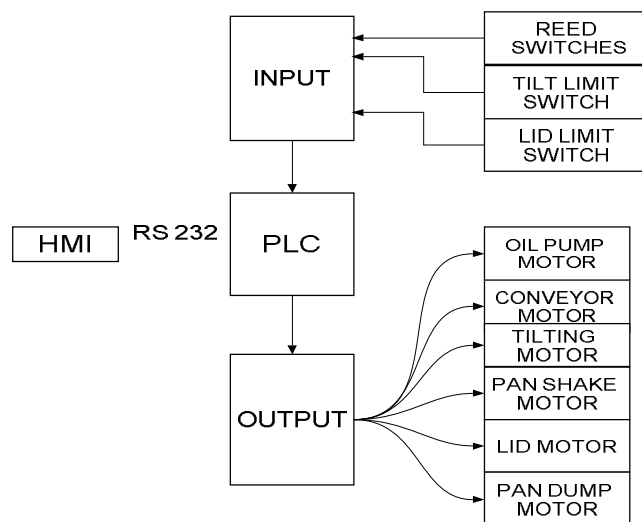


Figure 1 : Block diagram

The proposed system is a smart cooking machine that cooks food automatically in a click of few buttons. Only, the thing is user has to select the recipe and if required can change the inbuilt timers and quantity of ingredients.

Following are the blocks of the system:

- **Inputs:** The input to system consists of reed switches and limit switches. Based on the instructions in the program, reed switch helps the bin to activate in proper given sequence. Reed switch works on magnet mechanism. A micro limit switch, is an electric switch that is actuated by a very little physical force. The tilting limit switch helps to limit the tilting action of the bins and thus supports the proper functioning of tray mechanism. The limit switch used for lid action, supports the proper opening and closing of lid, thus enhancing the further operations.
- **PLC:** The Program Logic Controller is more reliable and has greater functionality as compared to micro-controller. The PLC corresponding with limit switches and sensors helps in automatic cooking. The PLC used for this system is Delta Made DVP14SS11R2 and the language used for programming is ladder diagram.
- **HMI:** The Human Machine Interface is connected to the PLC using serial communication via RS232 cable. It is a Graphical User Interface (GUI) created using Screen Editor 2.00.23 software. The HMI is used to select the recipe and hence control the flow of cooking mechanism.
- **Outputs:** The outputs from PLC are various motors such as conveyor belt motors, bin tilting motor, lid action motor, pan shaking and dumping motor etc. Based on different inputs, corresponding outputs are activated respectively.

III. DESIGNING OF PLC PROCESS

Flowchart of the Proposed System:

The entire system operation is divided into various stages and thus flowcharts of various mechanisms like initialization Stage, Conveyor motion, Tilting and lid action, Pan shaking and dumping actions have been created.

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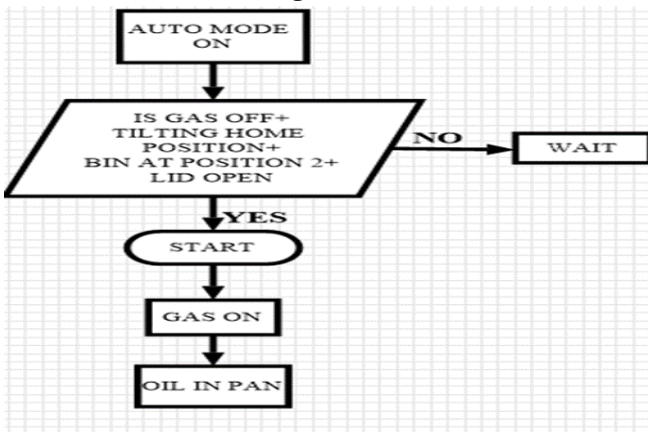
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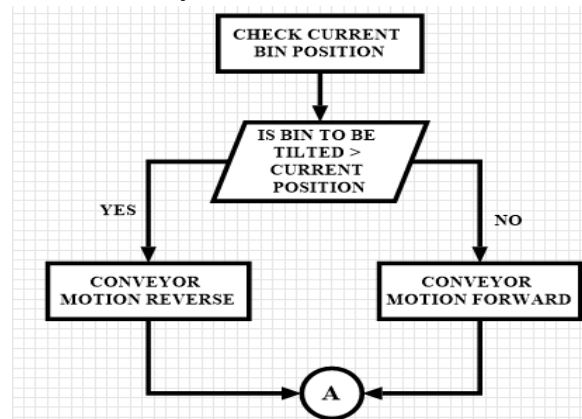
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Various stages are as follows:

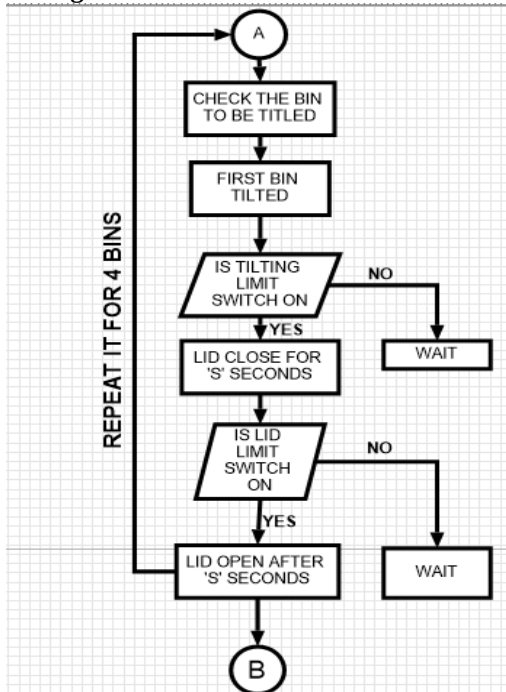
1. Initialization Stage



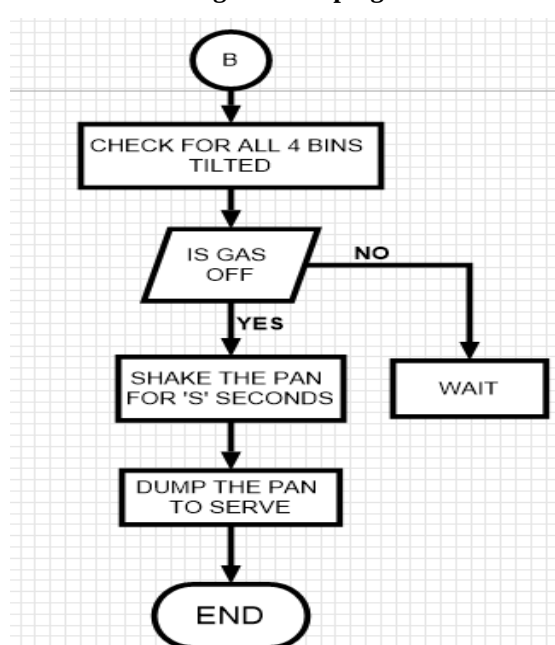
2. Conveyor Motion



3. Tilting and lid mechanism



4. Pan Shaking and dumping Mechanism



IV. HARDWARE IMPLEMENTATION

For the entire assembly of Cooking Machine, we have used mild steel as a base material for mechanism. The Proposed system consists of different mechanisms as follows:

- Tray Mechanism.

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- Conveyor Mechanism.
- Tilting Mechanism.
- Lid Mechanism.
- Pan Shaking and Dumping Mechanism.
- Gas Mechanism.

Following is the 3-D Layout created in Auto Cad Software to build the actual system.

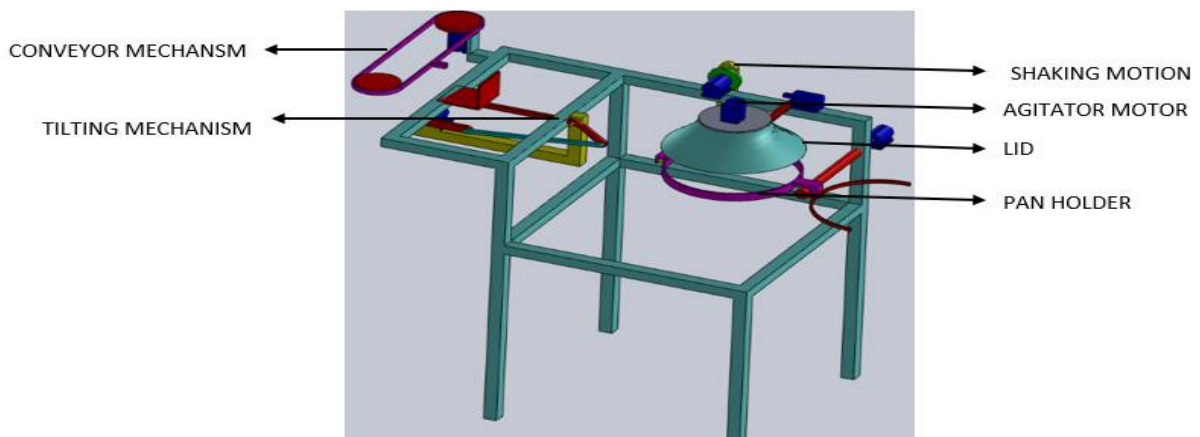


FIGURE18: PROJECT LAYOUT

1. Tray Mechanism:

This mechanism consists of a tray arrangement, which has holders that hold the bins of the assembly. Also reed switch are attached in front of the holder of each bin to sense the bins. These reed switch are activated when come in proximity of magnet. In this proposed system, we have used Normally Open reed switch. Thus, when NO – reed switch comes in proximity of magnet, its lead closes and thus is activated.

2. Conveyor Mechanism:

The conveyor mechanism is so designed that it helps the forward and reverse motion of the tray.



FIGURE 19: TRAY MECHANISM

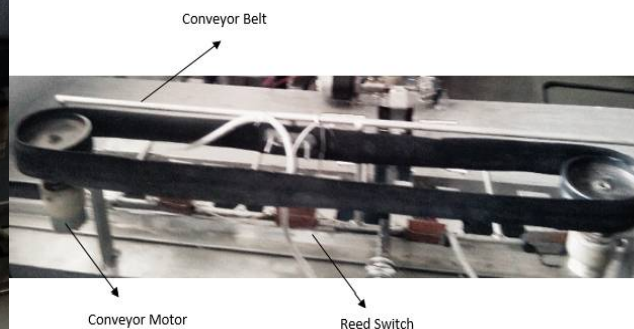


FIGURE 20: CONVEYOR MECHANISM

Tilting Mechanism:

The proposed system consists of a single tilting position i.e. the reference position. Depending on the instructions in the program, the bin to be tilted comes to the reference position and thus tilting action takes place respectively. Also, a limit switch is connected at such a position that it limits the tilting action. The tilting mechanism contains of a bin holder that holds the bin that is to be tilted. The bin to be tilted fixes in that bin holder and then the tilting motor starts

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and then bin lifts up and then ingredient in that bin falls into the pan. Once, the ingredient falls into pan, the direction of tilting motor reverses and holder comes back to initial position.

3. Lid Mechanism:

We have used pan in the system for cooking. That pan consists of lid. According to the timers set in the program, lid mechanism controls the ON and OFF movement of the lid. Also, a limit switch is connected at such a position that it limits the lid action.

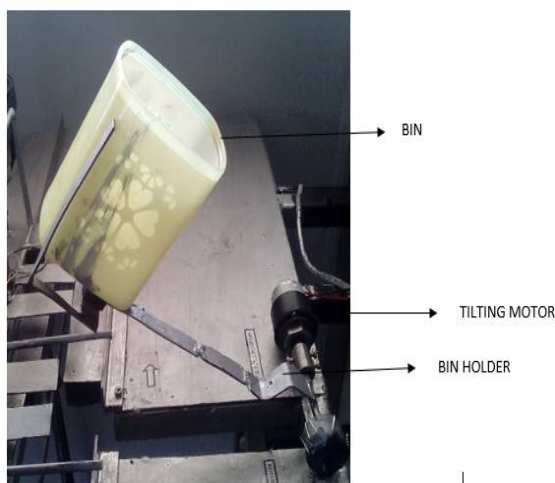


FIGURE 21: TILTING MECHANISM



FIGURE 22: LID AND PAN MECHANISM

Pan Shaking Mechanism:

The elements in the mechanism are assembled such that, this mechanism produces an oscillatory action which helps the pan to shake.

Gas Mechanism:

A motor fixed to an automatic gas igniter, along with the instructions in the program controls the gas ON and OFF action. Thus, the lid mechanism, shaking and dumping mechanism of the proposed system are as follows:

3.3 Software Implementation

We have created a Graphical User Interface (GUI) using Screen Editor Software for Human Machine Interface.

Various created GUI Screens are as follows:

The above Screen consists of menu that has various control buttons such as:

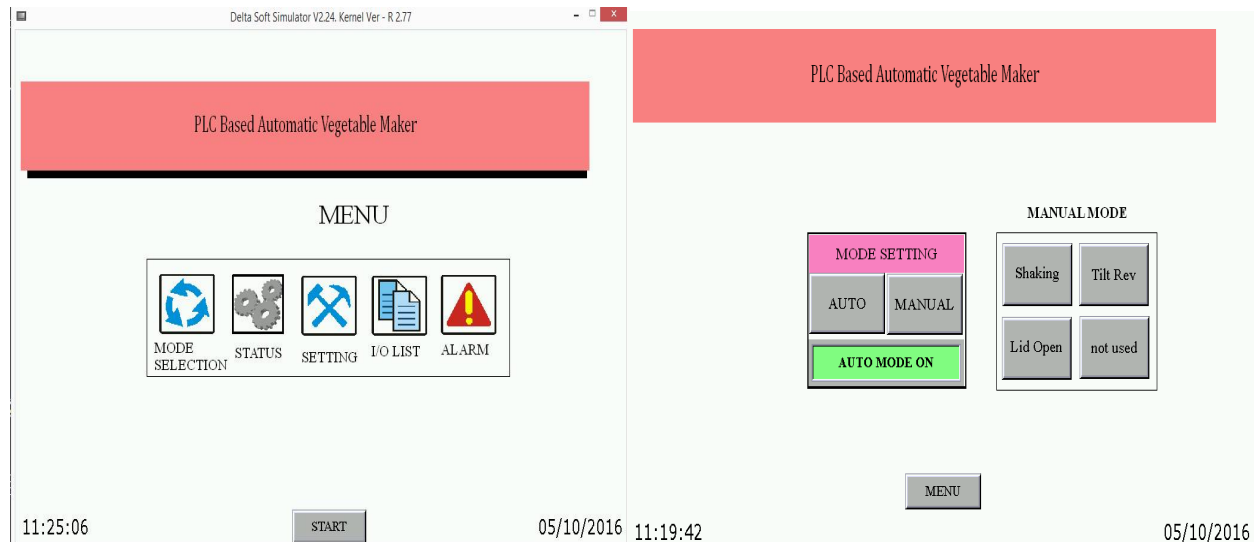
I. Mode Selection: This control button consists of two modes, Auto Mode and Manual Mode. According to the requirement, user can choose any of the one modes.

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1. **Auto Mode:** This mode allows the system to run automatically i.e. without human interference.

2. **Manual Mode:** This mode allows the user to control the system manually. This mode consists of 3 options i.e. Shaking, lid open and tilt reverse etc through which the user can check the specific operation of system respectively.

II. **Status:** This control button consists of bin sequence selection, Forward and Reverse action of various motors.



III. **Input/ Output:** This control button consists of input and output lists. Through this window user can keep watch on various mechanisms of the system.

Following is the screen shot of program of proposed system.

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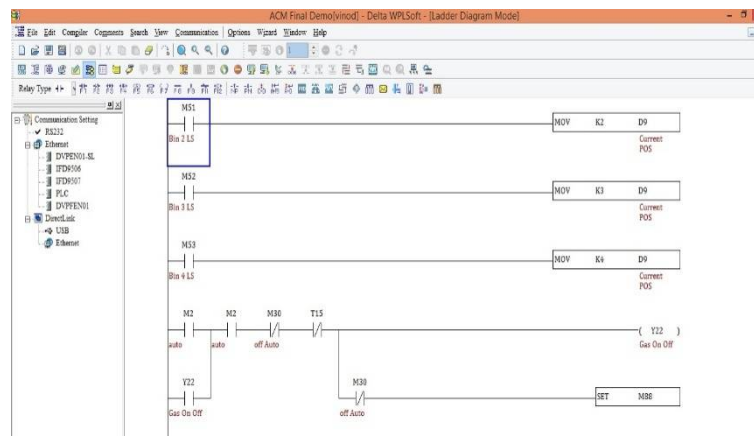


FIGURE 23: LADDER PROGRAM OF PROPOSED SYSTEM

IV. RESULTS

Following is a screen shot of the system implemented. It displays the entire system along with HMI. We can control system by few clicks on HMI. Also, we can observe current status of machine on HMI screen.

4.1 Result of Proposed System:



RESULT OF PROPOSED SYSTEM

Application Details

Mass Quantity Cooking:

Generally, everyone can manage small quantity cooking. But when question of mass quantity cooking arises, then such Automatic Cooking Machine proves helpful. Use of such machine helps minimize the labour cost, time.

Maintains Quality and taste of food:

Generally, the quality and taste of the food differs from person to person, who cooks it. When food is cooked in Automatic Cooking Machine, quality and taste of the food remains the same, as recipe and its timing are set in the machine itself with the Chefs advice.

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Helpful in Hotel Industry and food Chain:

Industrial Units of such Systems can be used in hotel industry to reduce the labour cost and serve the customers variety of food in less time.

V. CONCLUSION

In the 21st era, Automation has become the prior necessity of every human being as well as industry. Automation possess best role in various sectors like Automobile, Banking, Hoteling and education etc. Nowadays, Automation in kitchen has crossed boundary of invention like Microwave Oven, Mixer, and Grinder. It not only blooms the hotel industry, but domestic units of such machine also helps in minimizing the time that cooks helps in cooking.

In short, the entire system is stable, operation simple, easy maintenance, moderate cost and has broad market prospects.

Thus, such system enables complete automation of the cooking process. Thus, saving time of millions, while maintaining the same traditional cooking process and taste. This is achieved by controlling the quantity and timing of ingredients, temperature.

Such cooking machines are also ideal solutions for students or working individuals living away from home who can now enjoy the taste of home like food with just few clicks on HMI.

We have implemented an automatic text detection technique from an image for Inpainting. Our algorithm successfully detects the text region from the image which consists of mixed text-picture-graphic regions. We have applied our algorithm on many images and found that it successfully detect the text region.

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