UNIVERSITI MALAYSIA PERLIS

DESIGN AND DEVELOPMENT AUTOMATED BOILING, FILLING AND CAPPING MACHINE FOR DADIH

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Technical Report

TECHNICAL REPORT

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INTRODUCTION

1.1 Executive Summary

The UHT processed using heat and high temperatures in a very short time to kill all the microbes, so it has a very good quality.The determining factor for the overall quality of UHT milk is raw materials, manufacturing processes and packaging. The raw material liquid UHT is fresh milk, which has a high quality, especially in nutrient composition. In this proposal, an automated boiling, filling and capping system is proposed for Tam Milk Traders Enterprise due to their problem has been faced.Currently "dadih" is boiling, filling and capping manually.The solution can be able to solve a problem of boiling(heat to 135-150ºC,UHT),filling and capping.

1.2 Problem Statement

During the observation and survey, there are several problems were identified when making "dadih" at Tam Milk Traders Enterprise:

1.) Processing milk at normal temperature (100 ° C)

2.) The life span of dadih only 14 days.

3.) Process of filling "dadih" into bottle, currently using a manual method.

4.) Manually process of capping product.

1.3 Project Objective

The main objective of this proposal is to design and develop a machine that can heat up to UHT process, filling "dadih" automatically and capping bottle automatically using PLC for small scale industries. Our proposed system has the following features:

1- Improved processing of "dadih" products at normal temperature (100 ° C) to technology Ultra High Temperature (UHT).

2- Filling the "dadih" into the bottle automatically.

3- Controlling the flow of "dadih" into the bottle according to the prescribed dosage.

4- Bottle capping can be done automatically.

PROPOSED SOLUTION

2.1 Project Methodology

The propose solution is to develop an automated boiling, filling and capping system for "dadih", shown in Figure 1 and 10 whereby the overall processes are controlled using a Programable Logic Control (PLC). The boiling system was design to heat up the milk to 135-150ºC. Filling and capping is a process where empty bottles are first placed on the conveyor belt. As an empty bottle is brought to the filling station, the conveyor belt stops to let the bottle fill-up with a fixed amount of milk. Milk is kept at an boiler near the filling station. After the bottle is filled-up, the conveyor belt starts again to move away the filled-up bottle and to bring another empty bottle to the filling station. Then the bottles will transfer to the capping station where the sealant and capping process is done automatically.

The major components used in our project are listed below:

1) Mixer bowl
2) PLC module
3) Boiling unit
4) Conveyor unit (Filling station and Capping station)
5) Filling pump
6) Motor up/down for capping station.
7) Capping screw motor
8) Sealant, capping and gripper mechanism – grip the bottle for capping process.

The design of the system can be divided into several parts.

1) The mixer mechanism design with 4 tank to separated for various flavor of milk.
2) The boiling mechanism to heat up milk to 135-150ºC capable to Ultra High Temperature (UHT) technology.The conceptual design and overall system is shown in Figures 4 and 5.
3) The conveyor belt mechanism to move the container/bottles from one end of the assembly line to the other. The conveyor belt mechanism is designed for filling station and capping station.
4) The mechanism for accurate positioning of the bottles under the boiling to be filled up by liquid and capping process.
5) The mechanism for controlling the flow of milk to the bottle.

6) Sealant and capping mechanism to automatically cap the bottle.

All the processes are integrated in one automation system. The conceptual design of the overall system is shown in Figure 1.

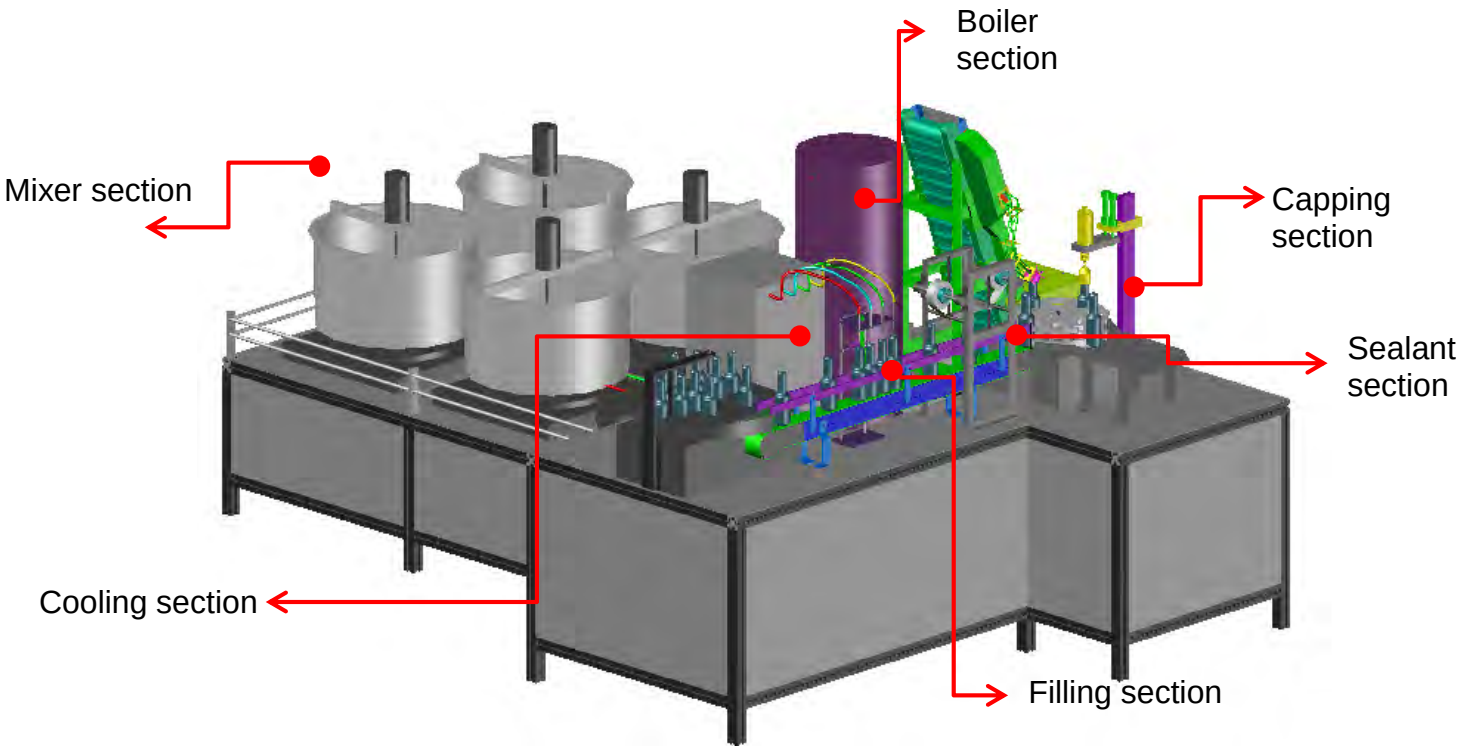

Figure 1. Complete design concept of automated boiling, filling and capping system

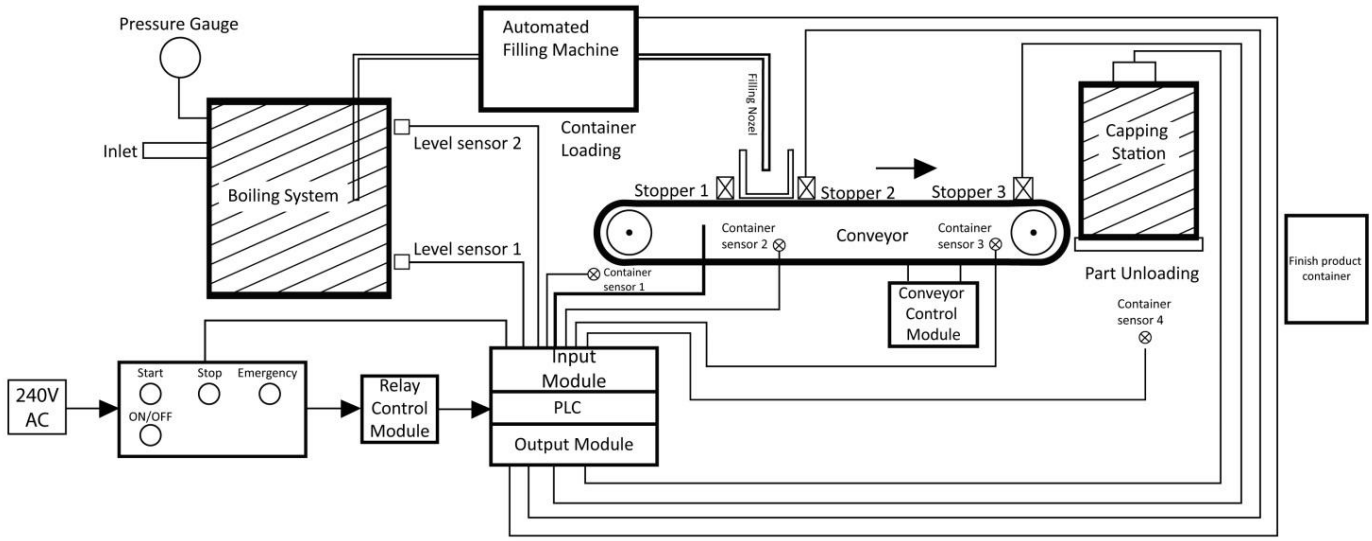

Figure 2. Block Diagram of The Boiling, Filling and Capping Process

2.2 The operation of automated mixer bowl system.

When the system is switch ON, the overall system is activated.The mixer start stairing all ingredients of milk with slow rotation.The mixer bowl is able to operate maximum to 30 litres milk. The stairing process takes place for 10 minutes before boiling. The mixer bowl system was develop for 4 tanks for a various flavor of milk.After the stairing process, boiling section will suction a dadih into a boiler to heat up for temperature 135-150ºC (UHT) technology. All the operation of mixer bowl system is shown in Figure 3.

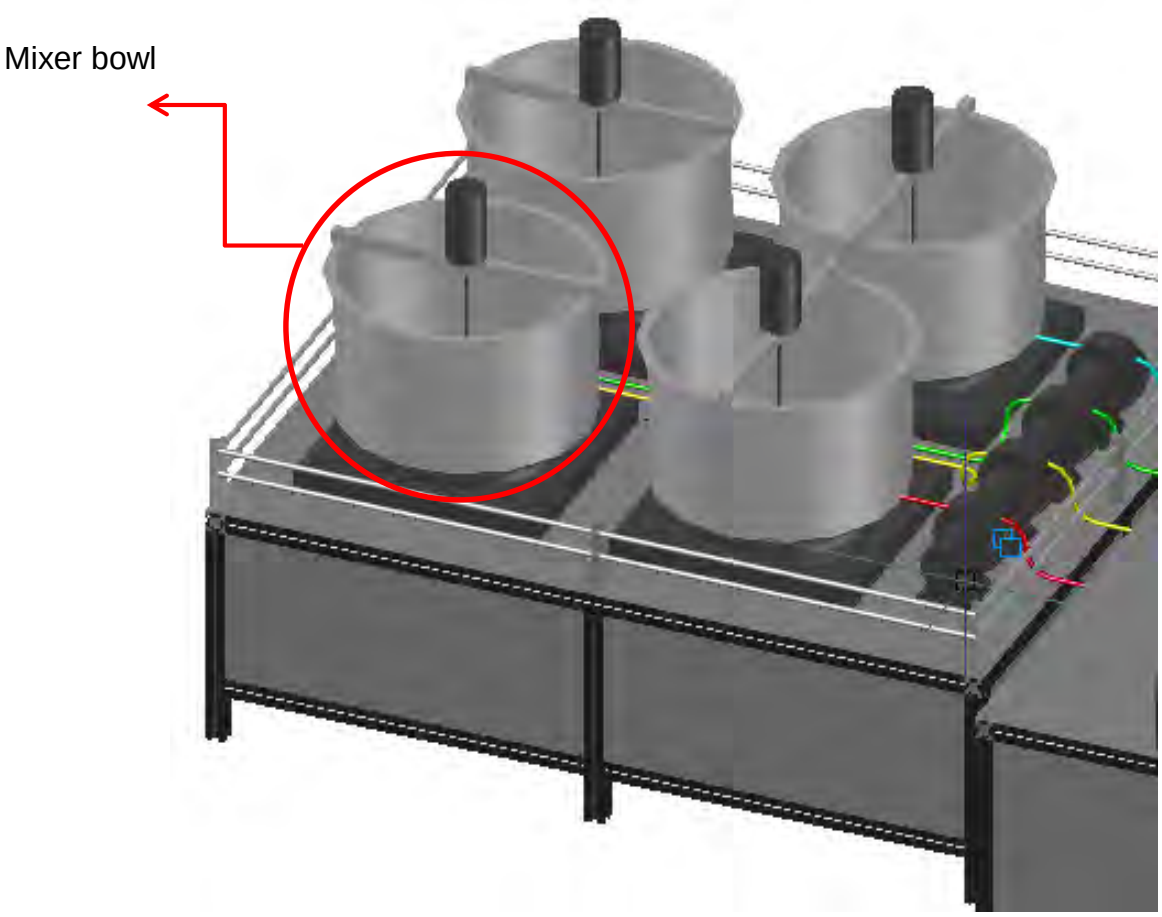

Figure 3. Mixer bowl system

2.3 The operation of automated boiling

The boiling start operating and heat up to 135-150ºC equivalent to UHT technology in 2-3 second. All the operation explains on the boiling system is shown in Figure 4 and 5.The schematic diagram shows the process of heat dadih for temperature 135-150ºC.

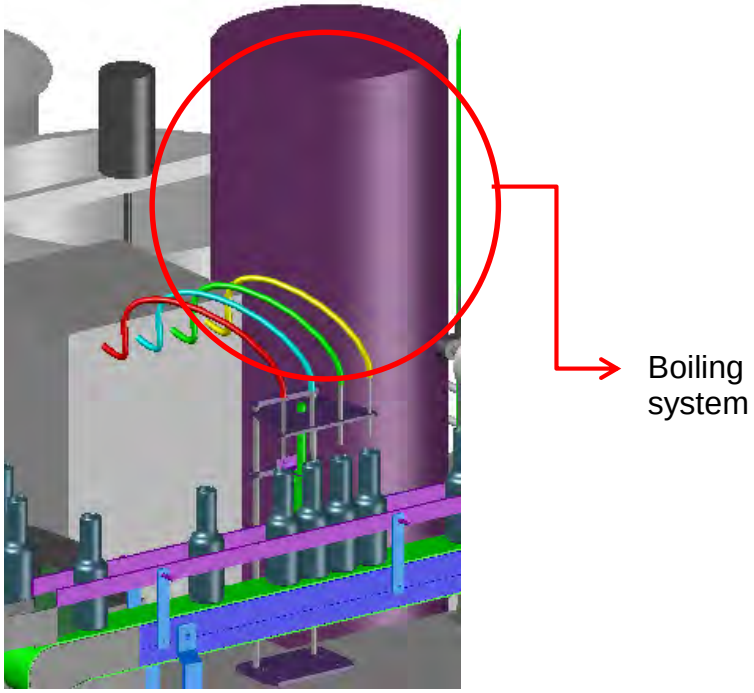

Figure 4. Boiler pressure vessel concept

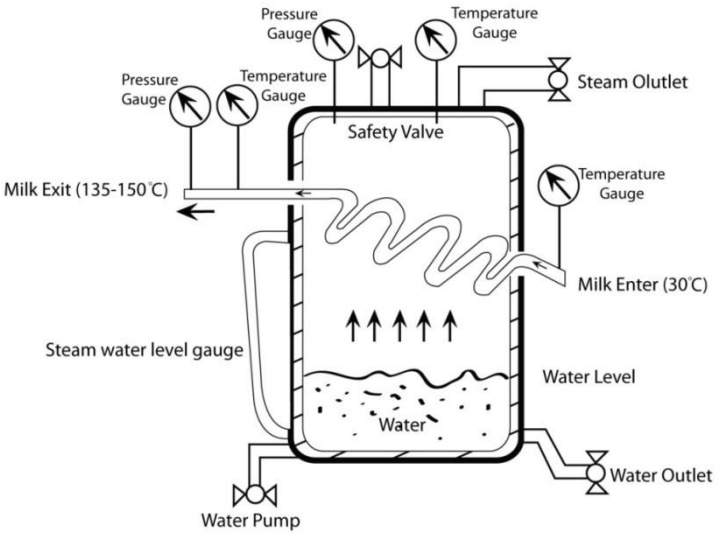

Figure 5. Boiler pressure vessel concept

2.4 The operation of automated Cooling process

The milk out from the boiler will flow through the cooling tank to reduce the temperatures of milk from 135-150ºC to 50-60ºC before filling process.All the process shown in Figure 6.

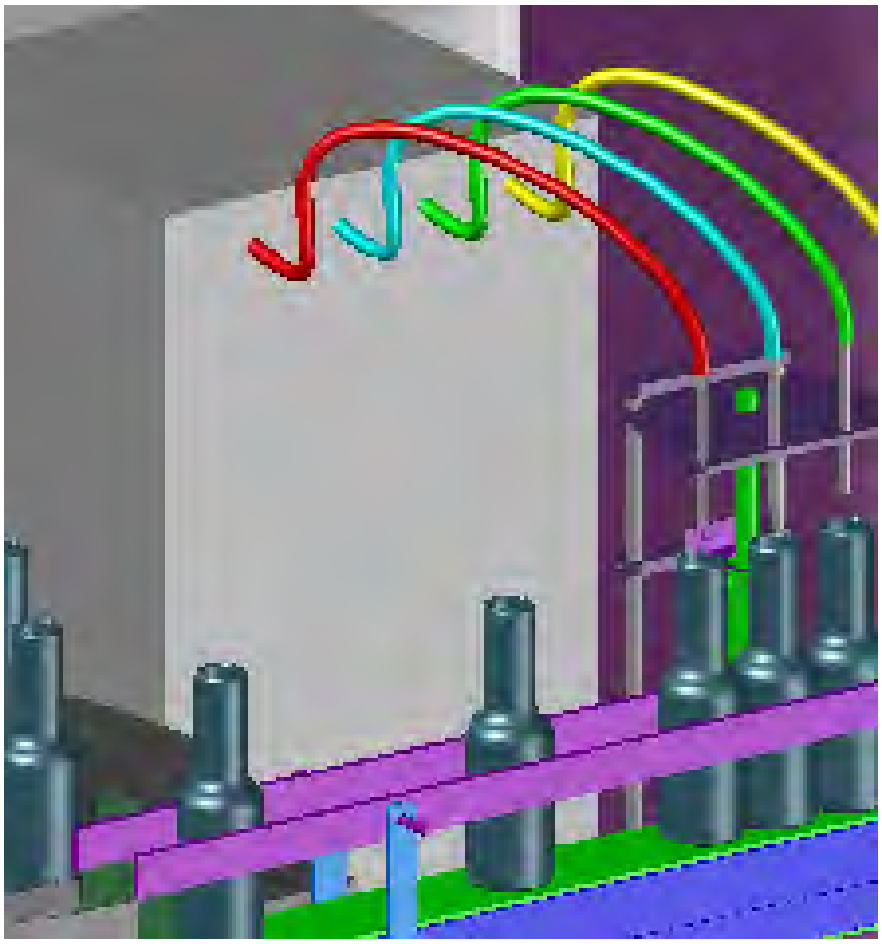

Figure 6. Cooling system

2.5 The operation of Filling process

The conveyor belt keeps running if the sensor 2 (photoelectric sensor) does not detect the presence of any bottle in front of it. If the sensor 2 detects any bottle then the conveyor belt stops, filling pump ON and bottle filling process starts. The filling process is done based on timing. Depending on the preset value of the timer the pump is switched ON for that particular period of time and the filling is done. The volume of milk is determined based on filling time. The filling pump then closes and conveyor belt starts again with the filled bottle and carries the bottle to the other end where the bottle is collected by the operator. All the filling system shown in Figure 7.

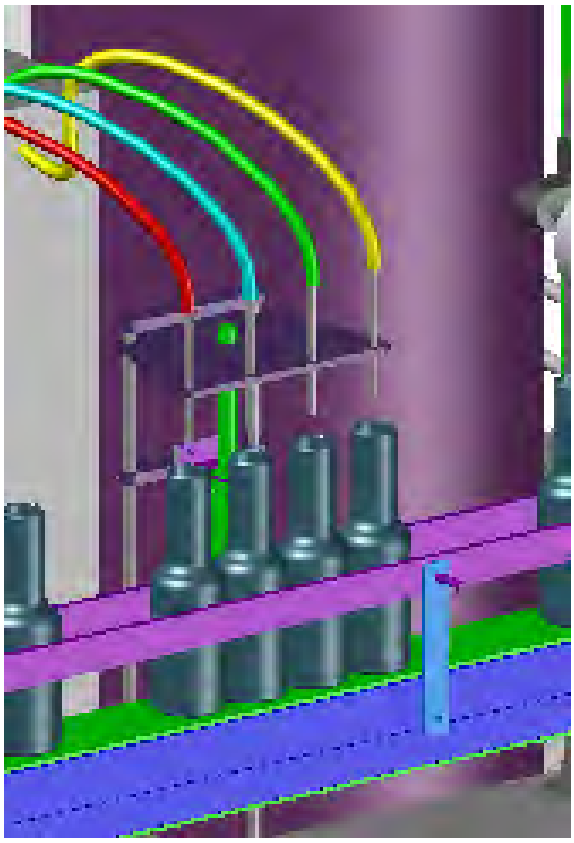

Figure 7. Filling system

2.6 The operation of automated sealant process

After the bottle filled by milk, the bottle will move to capping station by conveyor. When the sensor 3 detects the bottle, the heating element will move down to seal the bottle using aluminium foil which has been placed into two rollers.All the sealant system shown in Figure 8.

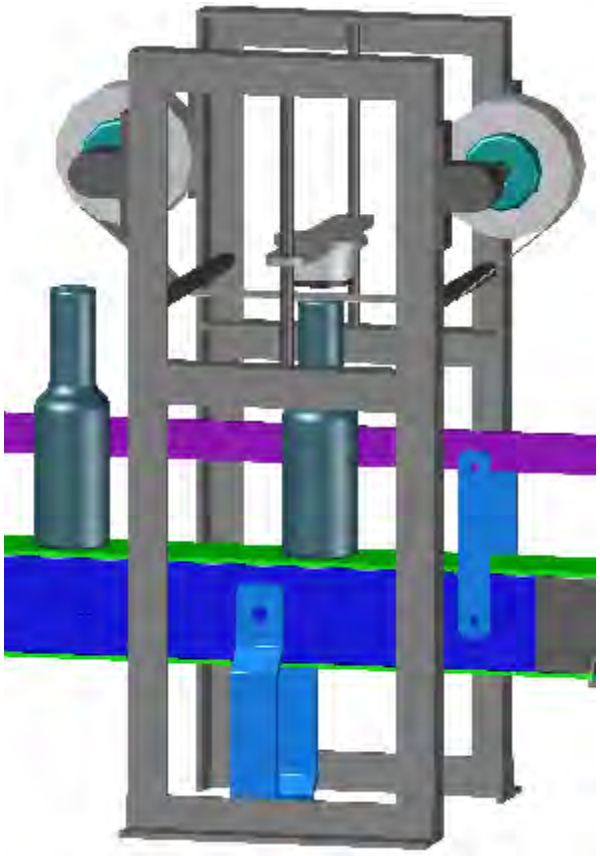

Figure 8. Sealant system

2.7 The operation of automated capping process.

When sensor 4 detects the bottle, then, the capping process starts running. The capping mechanism consists of a UP/DOWN motor, capping screw motor and bottle gripper. The capping mechanism can move up and down in with PLC control. When sensor 5 detects the bottle, bottle gripper grips the bottle and UP/DOWN motor moves down the capping screw motor to rotate the cap with appropriate force. Once the above mentioned processes (i.e. the filling and the capping processes) have been completed, labeling and packaging shall take place. Figure 9 shows the flow chart of the operation overall process.

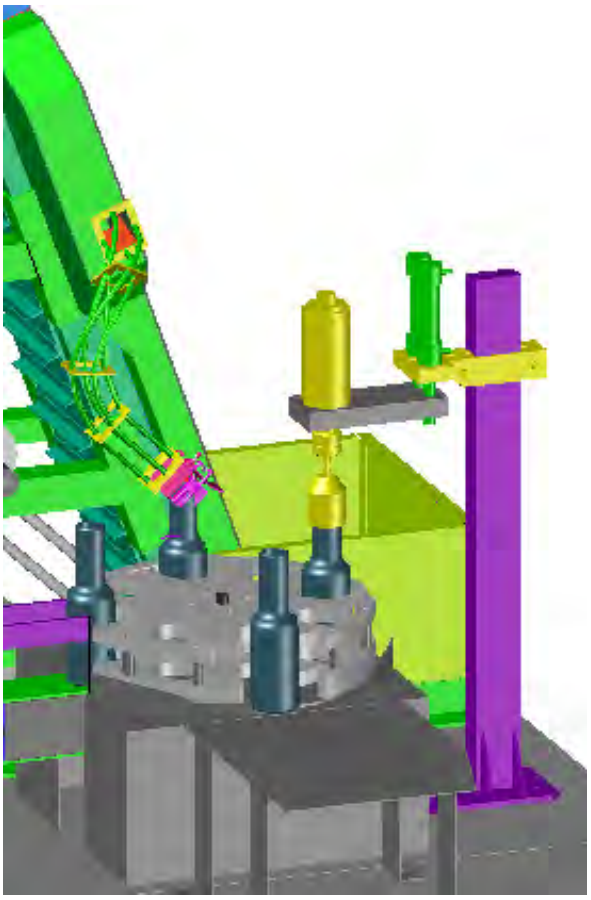

Figure 9. Capping system

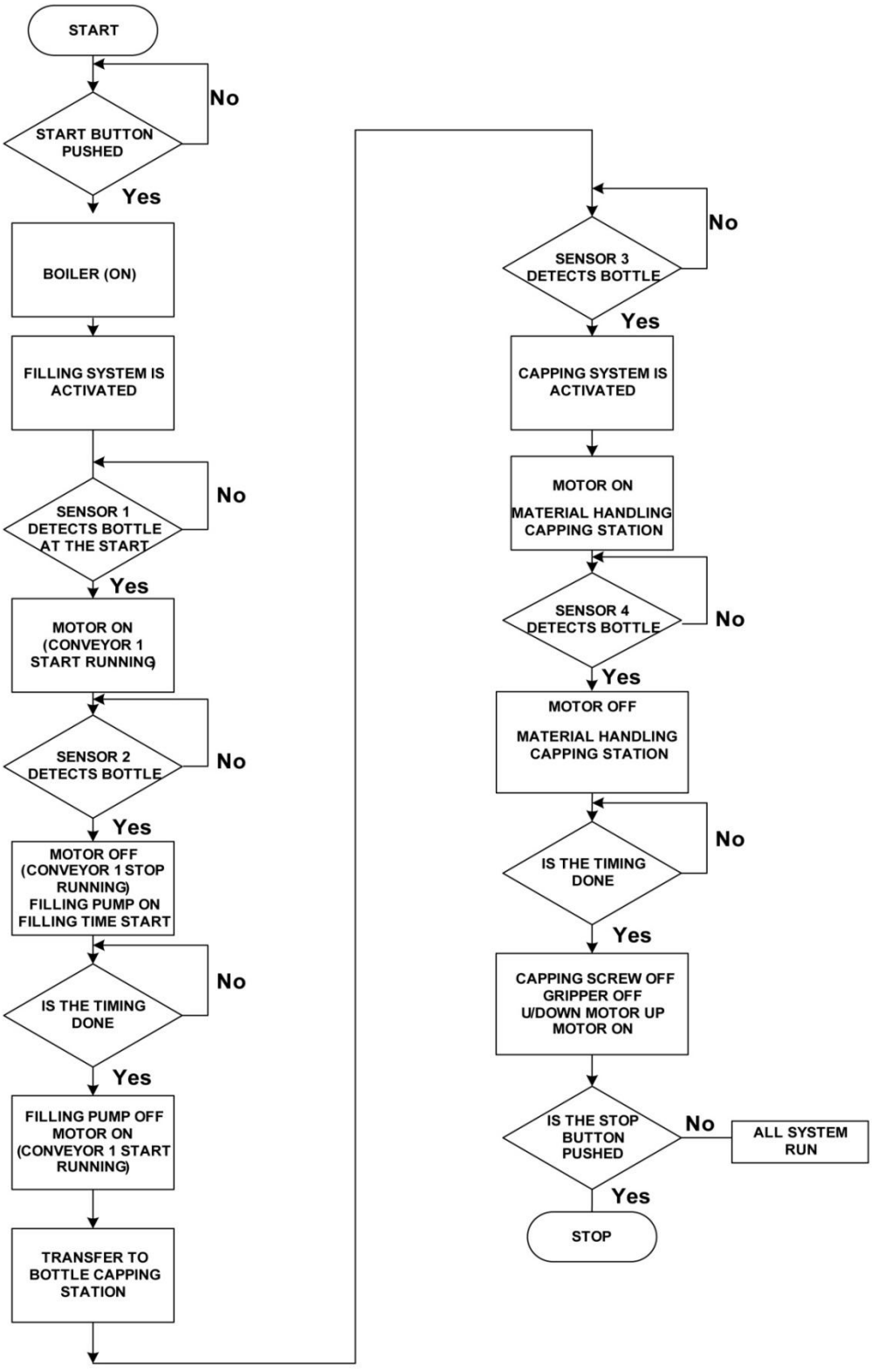

Figure 10. Flowchart operation of the automated boiling, filling and capping system

PROJECT SCOPE

The project scope for implementation this project is:

1) Design a mixer has 4 various types, capable to running at the same time.
2) Design a boiling, filling and capping system for milk products.
3) The boling system is designed to capable of heating up the milk to 135-150ºC.
4) Design a cooling system before filling dadih into the bottle to cool down temperature up to 50-60ºC.
5) The filling station is designed into 3 sections;
    a. Conveyor section
    b. Filling section
    c. Path divider section
6) Filling station is designed using pump and flow control.
7) The capping station consists of UP/DOWN motor, capping screw motor and bottle gripper.
8) Fabrication of mechanical system based on the final design concept.
9) Design automation system – consists of sensor selection, actuator (electrical dc motor, pump, flow control valve, etc.), PLC controller.
10) Integration of automation system – installation of sensors, actuator, PLC programming.

3.1 Milestone

Table 1 : Milestone of project.

Phase	Milestones
Phase 1 Mechanical Design	Mechanical design – Mixer bowl design
	Mechanical design – Boiling design
	Mechanical design - Conveyor design
	Mechanical design - Filling station design
	Mechanical design – capping station
	Purchasing Mechanical parts
Phase 2 Electrical Design	Selection of sensor and actuator
	Purchasing PLC, Sensor and Actuator
	Electrical Wiring design
	PLC wiring input/output interface and programming
Phase 3	Fabrication of parts and structures according to drawings and specifications

Fabrication	1) Mixer bowl mechanism 2) Boiling system mechanism 3) Conveyor system 4) Filling system and capping station mechanism. 5) Structure support the system
Phase 4 Mechanical and Electrical Assembly	Installation of all system (Mixer bowl,conveyor,boiling system, filling system, overhead tank, and capping station mechanism)
	Installation electrical sensor and actuator
Phase 5 Operational test	Testing and validation for functional of the complete prototype
	Delivery and commissioning on production site.
	Expected Finish Date

3.2 Deliverable /Expected outcome

An automated boiling, filling and capping system can work successfully based on the proposed solution. The working machine is expected to provide a great deal in increasing the production milk for Tam Milk Traders Enterprise via automated boiling (UHT), filling and capping system. With the increase the total production output; this also can yield significant financial benefits and savings also extend the life span product. Expected features for this machine:

1) Able to boil up the milk to 135-150 degree temperature.
2) Able to fill milk automatically into the bottle.
3) Able to automate the sealant process.
4) Able to automate capping process.
5) Easy to clean and maintenance of the system.

CONCLUSION

In conclusion, the project has been successfully completed and delivered safely to the industry. Throughout the manufacturing process of this machine, some difficulties some of the difficulties encountered can be implemented perfectly. The industry satisfied with the quality and output obtained compared to the old methods used. Production output increased with the result of this machine.

APPENDIX

Appendix : Design concept of automated boiling,filling,sealant and capping system