DESIGN AND ANALYSIS OF MILK PASTEURIZATION AND PACKAGING USING MYRIO

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Abstract: Currently, Milk has become an essential thing in our day-today life. Pasteurized milk actually interferes with calcium metabolism… Before heating [pasteurization], milk is a living food rich in colloidal minerals and enzymes necessary for the absorption and utilization of the sugars, fats, proteins and minerals in milk. Raw cream and butter has 'X Factor' that prevents joint stiffness. Eight to ten thousand years ago, raw and fermented milk products began to replace animal bones as a major source of minerals in many cultures. These raw dairy products were known to increase strength, fertility and general health. Present-day cultures whose diets are high in cultured raw dairy products tend to be extremely healthy, long-lived people. (The culturing of raw milk breaks down the lactose, and predigests the milk proteins.) Raw milk that is still warm from the animal has traditionally been used through the centuries for various wasting diseases… Pasteurizing milk kills off all bacteria, including the health-giving lactobacilli. This allows milk to putrefy with bad bacteria over time, rather than sour or ferment from good lactobacilli. Pasteurization also destroys vitamins, especially C, B6 and B12, and denatures fragile milk proteins. It destroys 20% of the iodine, and makes insoluble the major part of the calcium content. Everything has been delivered in packets after a general pasteurization process. Why we do pasteurization is to remove germs and unwanted presence of bacteria to be abolished.So, we are here with a method to Pasteur milk and package it in bottles for large quantity applications. Here we simulate a design used to Pasteur milk and package with use of MyRIO. This simulation describes how pasteurization process occurs and package of milk processed in different diary industries. We designed our UI using MyRIO and Backend as LabVIEW to perform simulation process pasteurization with different packaging conditions.

Keywords: Milk Pasteurization, Packaging and Bottle filling, MyRIO, LabVIEW, Flow control.

I. INTRODUCTION

Joseph Mercola, DO, osteopathic physician and author, in an Apr. 16, 2016 article for Mercola.com titled "Raw Milk and Cheese Are Undergoing a Renaissance as Artisanal Foods Rise in Popularity," wrote: Pasteurizing milk destroys enzymes, diminishes vitamins, denatures fragile milk proteins, destroys vitamin B12 and vitamin B6, kills beneficial bacteria, and promotes the growth of pathogens. Meanwhile, raw milk contains:

- Healthy bacteria that are beneficial for your gastrointestinal tract
- More than 60 digestive enzymes, growth factors, and immunoglobulins (antibodies). These enzymes are destroyed during pasteurization, making pasteurized milk harder to digest
- Phosphatase, an enzyme that aids and assists in the absorption of calcium in your bones…
- Beneficial raw fats, amino acids, and proteins in a highly bioavailable form, all 100 percent digestible
- Vitamins (A, B, C, D, E, and K) in highly bioavailable forms. Also has a balanced blend of minerals (calcium, magnesium, phosphorus, and iron) whose absorption is enhanced by live lactobacilli.

Pasteurizing milk kills off all bacteria, including the health-giving lactobacilli. This allows milk to putrefy with bad bacteria over time, rather than sour or ferment from good lactobacilli. Pasteurization also destroys vitamins, especially C, B6 and B12, and denatures fragile milk proteins.Pasteurization is important because the bacteria naturally found in some foods can make you very sick. Eating unpasteurized foods can lead to fever, vomiting and diarrhea. In some cases it can lead to conditions like kidney failure, miscarriage and even death

So, we created this project to maintain pasteurization process in a proper manner throughout using automation by using LabVIEW

This process design handles storage, heating, condensation and packaging of milk after all the process.

II. BLOCK DIAGRAM

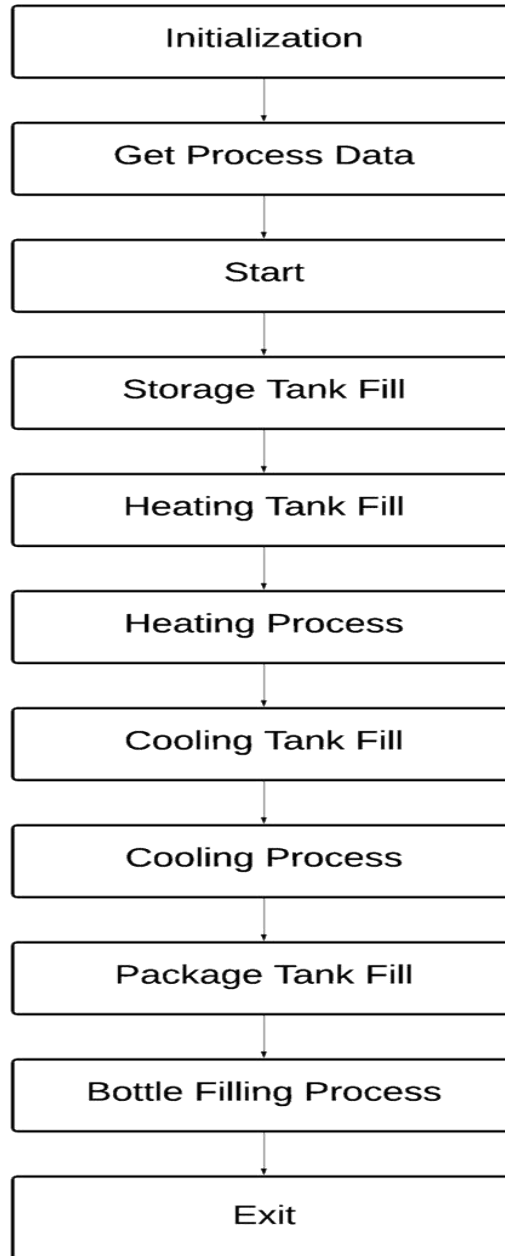The Figure 1 shows Block Diagram of the system,

Fig .1 Block Diagram of the System

Figure 1. So, for the process of our system we designed with a structure of block diagram. Where it consider the steps we followed to complete the setup.

Initialization begins the process with process UI diagram as an user interface point of contact. Then Block 2 Get Process Data gets data to take over the process from the User interface and start the process by start block.

Start block receives process data & starts the process. Then Block 4 Storage Tank Fill, This process block consists of Valves and Storage tank, which gets turned on after start process and starts filling the tank. After Storage Tank Fill Block 5 Heating Tank Fill takes place and this block works on Heating and Temperature control setup to perform boiling of milk to get pasteurized. When the heating tank got filled then Block 6 Heating Process occurs and this block works on Heating and Temperature control setup to perform boiling of milk to get pasteurized. After the milk got

heated to the boiling point then Block 7 Cooling Tank Fill starts to process, This block works on Valve control and Cooling tank filling process. When, the cooling tanks gets filled then the Block 8 Cooling Process comes into picture and This block works on Cooling and Temperature control setup to perform cooling of milk to the normal room temperature. After when the milk attains room temperature Block 9 Package Tank Fill and this block consists of valve from tank 3 and storage tank to store pasteurized milk. Then Block 10 Bottle Filling Process, This block works on valve control for bottle filling with conveyor belts to move the bottles and finally Block 11 Exit, This block exits the program simulation after execution.

III. HARDWARE DESCRIPTION

1. myRIO:

myRIO is a portable device and students can easily use it for the design and control of robots and may other systems quite efficiently. It operates on the frequency 667 MHz.myRIO has dual core ARM cortex A9 programmable processor. It has a Xilinx Field Programmable Gate Array (FPGA). FPGA support in myRIO helps the students to design real life developing systems and to solve real problems quite faster as compared to the other micro controllers. Using FPGA support we can avoid the complicated syntax used in C language and in many other. We just have to create logic instead of writing the complicated code with the proper syntax. So, it has reduced the student's difficulties while designing complicated systems. It is student friendly device and is very easy to use. The processing speed of myRIO is quite higher than the standard micro controllers. So, it can be used t solve real life problems and it can be easily used in efficient systems which need a quick output response. It supports different languages e.g. C, C++ and graphical language (FPGA). The further detail about NI myRIO will be provided later in this article.
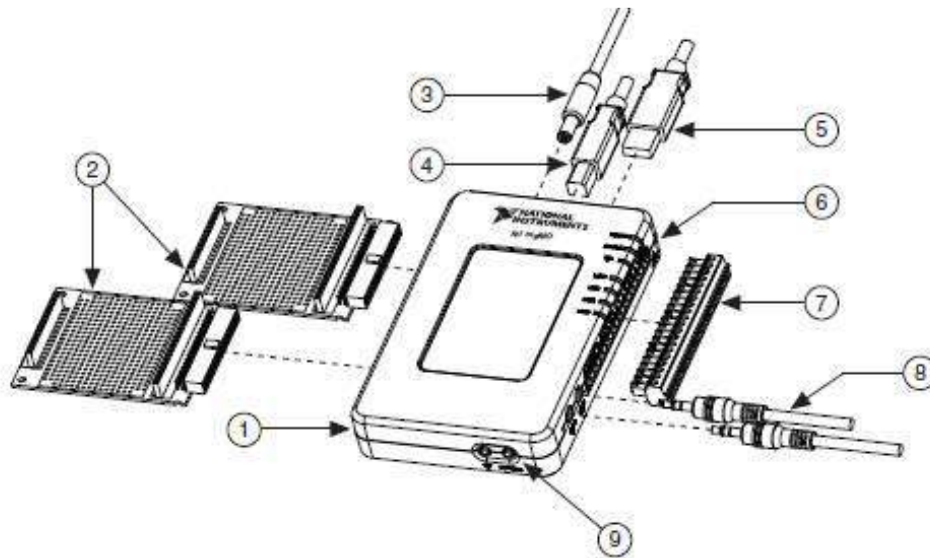

Fig.2 myRIO pin out Diagram

The NI myRIO-1900 has one UART receive input line and one UART transmit ouput line on each MXP connector. The UART lines are electrically identical to DIO lines 0 to 13 on the MXP connectors.

MyRio Control and Apparatus: -

1. NI myRIO-1900
2 .myRIO Expansion Port (MXP) Breakouts (One Included in Kit)
3. Power Input Cable
4. USB Device Cable
5. USB Host Cable (Not Included in Kit)
6. LEDs
7. Mini System Port (MSP) Screw-Terminal
8. Audio In/Out Cables (One Included in Kit)
9. Button 0

Signal Name	Reference	Direction	Description
+5V	DGND	Output	+5 V power output.
AI <0..3>	AGND	Input	0-5 V, referenced, single-ended analog input channels. Refer to the *Analog Input Channels* section for more information.
AO <0..1>	AGND	Output	0-5 V referenced, single-ended analog output. Refer to the *Analog Output Channels* section for more information.
AGND	N/A	N/A	Reference for analog input and output.
+3.3V	DGND	Output	+3.3 V power output.
DIO <0..15>	DGND	Input or Output	General-purpose digital lines with 3.3 V output, 3.3 V/5 V-compatible input. Refer to the *DIO Lines* section for more information.
UART.RX	DGND	Input	UART receive input. UART lines are electrically identical to DIO lines.
UART.TX	DGND	Output	UART transmit output. UART lines are electrically identical to DIO lines.
DGND	N/A	N/A	Reference for digital signals, +5 V, and +3.3 V.

Fig.3 MyRIO pin out Diagram

IV. FLOWCHART

Hereby, I imported the flowchart of the process and proceeded with two different parts. Part 1 describes the outer work and Part 2 describes the interior works.
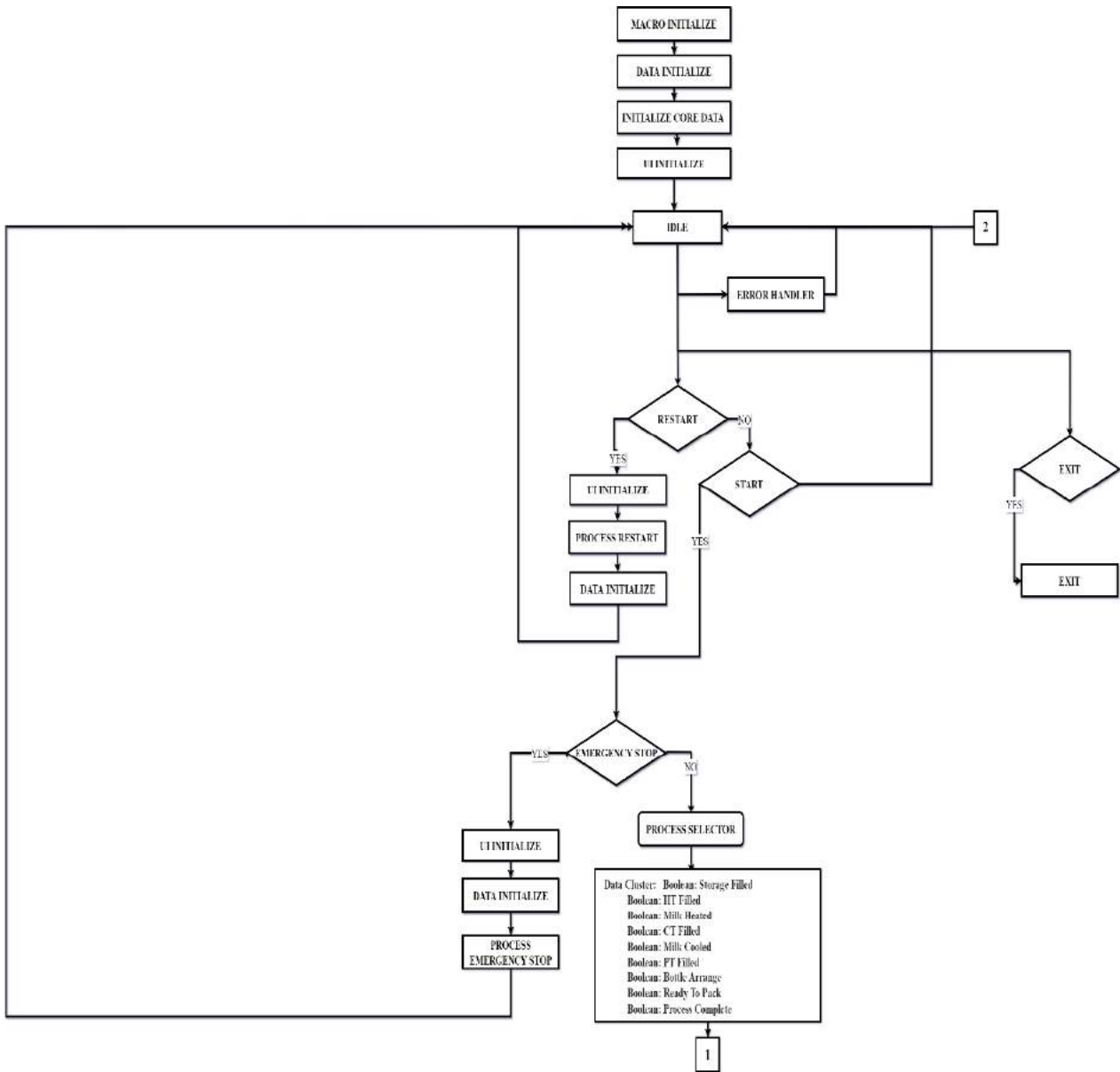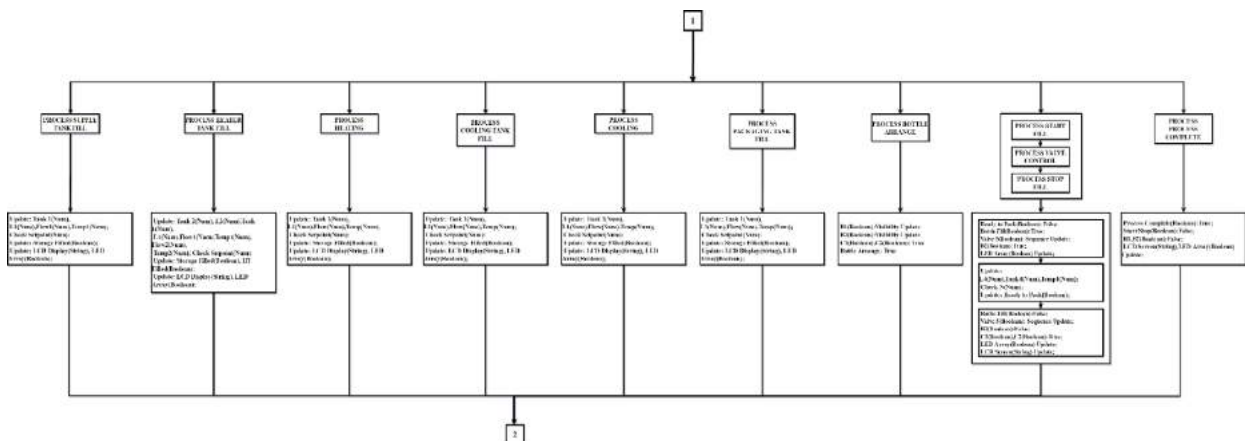
Fig.4.1 Flowchart part 1

Fig.4.2 Flowchart part 2

V. SOFTWARE DESCRIPTION

1 . LABVIEW:

LabVIEW (**Lab**oratory **V**irtual **I**nstrument **E**ngineering **W**orkbench) is a graphical programming environment which has become prevalent throughout research labs, academia, and industry. It is a powerful and versatile analysis and instrumentation software system for measurement and automation.It's graphical programming language called G programming is performed using a graphical block diagram that compiles into machine code and eliminates a lot of the syntactical details.LabVIEW offers more flexibility than standard laboratory instruments because it is software-based. Using LabVIEW, the user can originate exactly the type of virtual instrument needed and programmers can easily view and modify data or control inputs. The popularity of the National Instruments LabVIEW graphical dataflow software for beginners and experienced programmers in so many different engineering applications and industries can be attributed to the software's intuitive graphical programming language used for automating measurement and control systems.
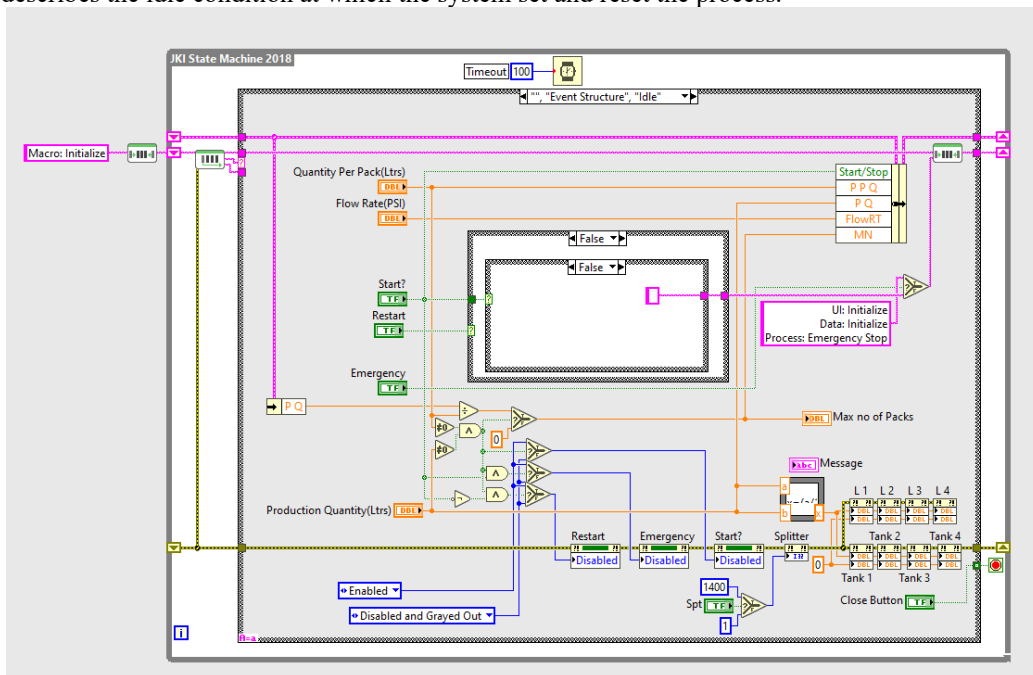Figure 5.1 describes the idle condition at which the system set and reset the process.

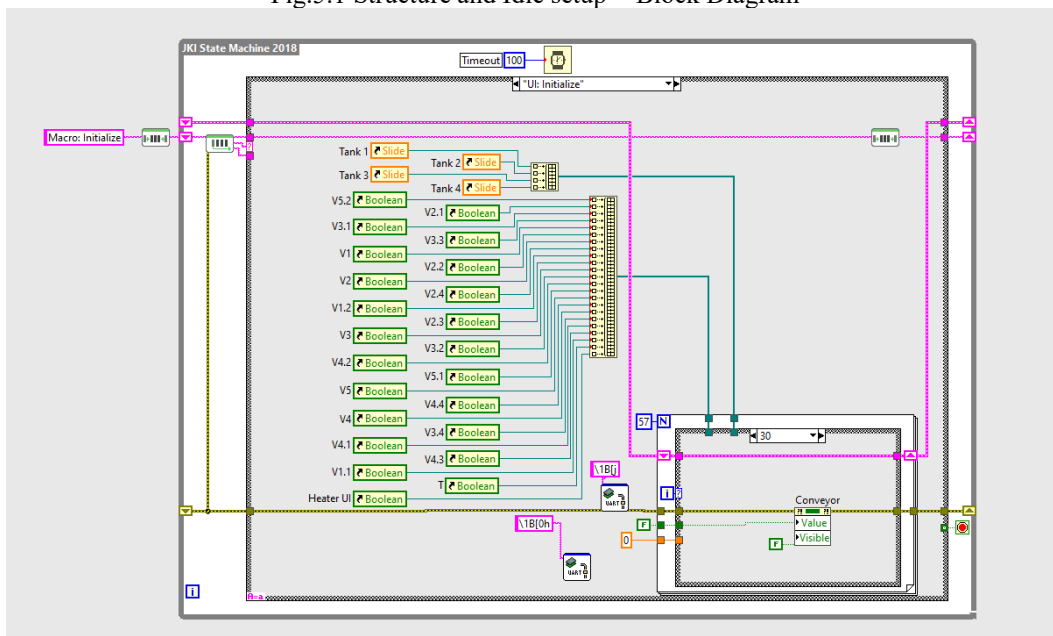Fig.5.1 Structure and Idle setup - Block Diagram

Fig.5.2 UI initialize - Block Diagram

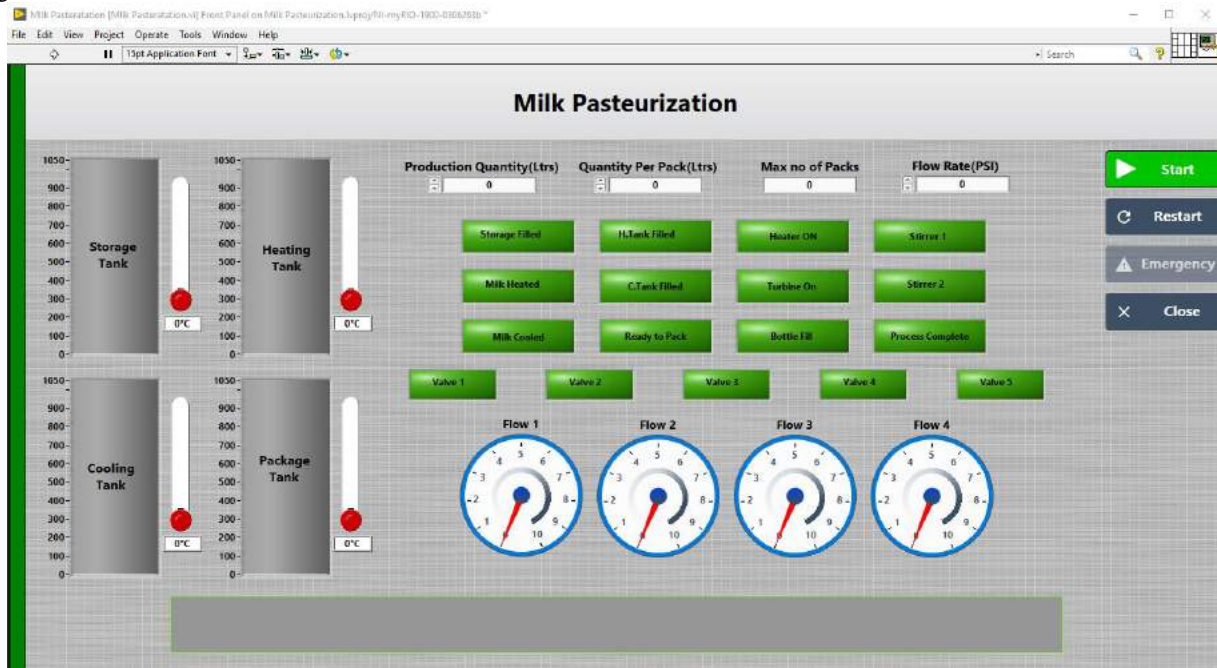Fig.6 LABVIEW Front Panel of Hill Assist and Black Box in Four Wheelers

Fig.6 LABVIEW Front Panel of Milk Pasteurization and Packaging

VI. EXPERIMENTAL SETUP / HARDWARE PROTOTYPE

The below figure depicts the hardware prototype that has been developed to realize the proposed methodology. The tests were conducted using the below experimental setup.
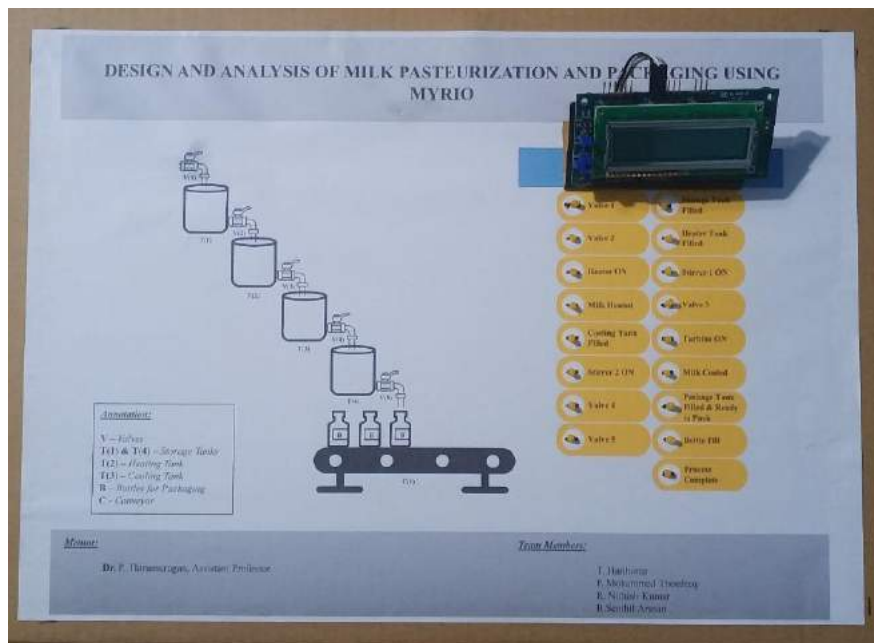

Fig.6 Experimental Setup.

VII. PROCESS DESCRIPTION

Macro Initialize, To initialize the general data and the UI design. This creates the general look of User interface and provides an industrial front panel to make it crisp and clear.

Data Initialize initializes user provided data and initializing all variables with its data types.

Initialize Core Data To initialize the VI and the user interface as a combined process to provide a perfect result.

Idle starts the process from set zero and receive user details to start the process and run through the setup with the provided data. This consists of the Production Quantity, Quantity per bottle, Max no of packets and User controlled Flow of different valves

Error Handler performs error identification while a process is done and set back the system into set zero when it finds and error, and continues with a flow through the process.

Restart – Condition confirms condition with the user while processing the process, when he/she/them wishes to turn the system run back due to lag in process. When Restart is pushed ON while the process is ON, it runs back to Data initialize, and initializes core data and initializes the UI. When Restart is OFF, it acts as Start and starts the process from the beginning.

Start – Condition condition carries two solutions, where if it is yes, then enter the process selector and start the process. If the condition is no, then set back to idle.

Emergency Stop – Condition receives the output YES of the Start Condition and performs two conditions. If YES, it performs UI initialize, Data initialize and Process Emergency stop. The Process emergency stop performs a quick stop in reaction as in the state where the conditions of all parameters gets stopped with set-zero. If NO, it performs Process selector and continues the start condition process flow.

Select Process Multiple process flow, where it switches from one section to another as a relay by switching after each successful completion.

Process Supply Tank Fill Valve 1 gets Turned ON and Supply tank gets filled.

Update: Tank 1(Num), L1(Num),Flow1(Num),Temp1(Num);

Check Setpoint(Num):

Update: Storage Filled(Boolean);

Update: LCD Display(String), LED Array(Boolean);

Process Heater Tank Fill, After the supply tank gets filled, we receive an update to turn on the valve 2 automatically and it turns on.

Update: Tank 2(Num), L2(Num),Tank 1(Num), L1(Num),Flow1(Num),Temp1(Num),Flow2(Num),Temp2(Num);

Check Setpoint(Num): Update: Storage Filled(Boolean), HT Filled(Boolean);

Update: LCD Display(String), LED Array(Boolean);

Process Heating, When the heating tank gets filled, it turns on the heater and the stirrer and heats it to the boiling point of milk (100 deg celsius) and equally spreads temperature for milk to get heated.

Update: Tank 1(Num), L1(Num),Flow(Num),Temp(Num);

Check Setpoint(Num):

Update: Storage Filled(Boolean);

Update: LCD Display(String), LED Array(Boolean);

Process Cooling Tank Fill, After the heating tank reaches the boiling point, it updates valve 3 to turn on and fill the cooling tank.

Update: Tank 1(Num), L1(Num),Flow(Num),Temp(Num);

Check Setpoint(Num):

Update: Storage Filled(Boolean);

Update: LCD Display(String), LED Array(Boolean);

Process Cooling, When cooling tank gets fill, it performs refrigerator principle to cool down through turbine condensation. The process gets stopped when it reaches the room temperature.

Update: Tank 1(Num), L1(Num),Flow(Num),Temp(Num);

Check Setpoint(Num):

Update: Storage Filled(Boolean);

Update: LCD Display(String), LED Array(Boolean);

Process Package Tank Fill After Cooling process gets completed, the valve 4 gets turned on and the package tank starts to fill.

Update: Tank 1(Num), L1(Num),Flow(Num),Temp(Num);

Check Setpoint(Num):

Update: Storage Filled(Boolean);

Update: LCD Display(String), LED Array(Boolean);

Process Bottle arrange arranges the bottle as per time assigned to fill, and process the following

B1(Boolean):Visibility Update

B2(Boolean):Visibility Update

C1(Boolean),C2(Boolean): True

Bottle Arrange: True

Process Bottle Fill, fills the bottle with a proportionate flow by the following,

Process Start Fill

Ready to Pack(Boolean): False;

Bottle Fill(Boolean):True;

Valve 5(Boolean): Sequence Update;

B2(Boolean):True;

LED Array(Boolean) Update;

Process Valve Control

Update: L4(Num),Tank4(Num),Temp4(Num);

Check N(Num);

Update: Ready to Pack(Boolean);

Process Stop Fill

Bottle Fill(Boolean):False;

Valve 5(Boolean): Sequence Update;

B2(Boolean):False;

C1(Boolean),C2(Boolean):True;

LED Array(Boolean) Update;

LCD Screen(String) Update;

Process Process Complete

Process Complete(Boolean):True;

Start/Stop(Boolean):False;

B1,B2(Boolean):False;

LCD Screen(String),LED Array(Boolean) Macro Initialize, To initialize the general data and the UI design. This creates the general look of User interface and provides an industrial front panel to make it crisp and clear.

Data Initialize initializes user provided data and initializing all variables with its data types.

Initialize Core Data To initialize the VI and the user interface as a combined process to provide a perfect result.

Idle starts the process from set zero and receive user details to start the process and run through the setup with the provided data. This consists of the Production Quantity, Quantity per bottle, Max no of packets and User controlled Flow of different valves

Error Handler performs error identification while a process is done and set back the system into set zero when it finds and error, and continues with a flow through the process.

Restart – Condition confirms condition with the user while processing the process, when he/she/them wishes to turn the system run back due to lag in process. When Restart is pushed ON while the process is ON, it runs back to Data initialize, and initializes core data and initializes the UI. When Restart is OFF, it acts as Start and starts the process from the beginning.

Start – Condition condition carries two solutions, where if it is yes, then enter the process selector and start the process. If the condition is no, then set back to idle.

Emergency Stop – Condition receives the output YES of the Start Condition and performs two conditions. If YES, it performs UI initialize, Data initialize and Process Emergency stop. The Process emergency stop performs a quick stop in reaction as in the state where the conditions of all parameters gets stopped with set-zero. If NO, it performs Process selector and continues the start condition process flow.

Select Process Multiple process flow, where it switches from one section to another as a relay by switching after each successful completion.

Process Supply Tank Fill Valve 1 gets Turned ON and Supply tank gets filled.

Update: Tank 1(Num), L1(Num),Flow1(Num),Temp1(Num);

Check Setpoint(Num):

Update: Storage Filled(Boolean);

Update: LCD Display(String), LED Array(Boolean);

Process Heater Tank Fill, After the supply tank gets filled, we receive an update to turn on the valve 2 automatically and it turns on.

Update: Tank 2(Num), L2(Num),Tank 1(Num), L1(Num),Flow1(Num),Temp1(Num),Flow2(Num),Temp2(Num);

Check Setpoint(Num): Update: Storage Filled(Boolean), HT Filled(Boolean);

Update: LCD Display(String), LED Array(Boolean);

Process Heating, When the heating tank gets filled, it turns on the heater and the stirrer and heats it to the boiling point of milk (100 deg celsius) and equally spreads temperature for milk to get heated.

Update: Tank 1(Num), L1(Num),Flow(Num),Temp(Num);

Check Setpoint(Num):
Update: Storage Filled(Boolean);
Update: LCD Display(String), LED Array(Boolean);
   Process Cooling Tank Fill, After the heating tank reaches the boiling point, it updates valve 3 to turn on and fill the cooling tank.
Update: Tank 1(Num), L1(Num),Flow(Num),Temp(Num);
Check Setpoint(Num):
Update: Storage Filled(Boolean);
Update: LCD Display(String), LED Array(Boolean);
   Process Cooling, When cooling tank gets fill, it performs refrigerator principle to cool down through turbine condensation. The process gets stopped when it reaches the room temperature.

Update: Tank 1(Num), L1(Num),Flow(Num),Temp(Num);
Check Setpoint(Num):
Update: Storage Filled(Boolean);
Update: LCD Display(String), LED Array(Boolean);
   Process Package Tank Fill After Cooling process gets completed, the valve 4 gets turned on and the package tank starts to fill.
    Update: Tank 1(Num), L1(Num),Flow(Num),Temp(Num);
Check Setpoint(Num):
Update: Storage Filled(Boolean);
Update: LCD Display(String), LED Array(Boolean);
Process Bottle arrange arranges the bottle as per time assigned to fill, and process the following
      B1(Boolean):Visibility Update
B2(Boolean):Visibility Update
C1(Boolean),C2(Boolean): True
Bottle Arrange: True
   Process Bottle Fill, fills the bottle with a proportionate flow by the following,
     Process Start Fill
      Ready to Pack(Boolean): False;
Bottle Fill(Boolean):True;
Valve 5(Boolean): Sequence Update;
B2(Boolean):True;
LED Array(Boolean) Update;
     Process Valve Control
      Update: L4(Num),Tank4(Num),Temp4(Num);
Check N(Num);
Update: Ready to Pack(Boolean);
     Process Stop Fill
      Bottle Fill(Boolean):False;
Valve 5(Boolean): Sequence Update;
B2(Boolean):False;
C1(Boolean),C2(Boolean):True;
LED Array(Boolean) Update;
LCD Screen(String) Update;
   Process Process Complete
      Process Complete(Boolean):True;
Start/Stop(Boolean):False;
B1,B2(Boolean):False;
LCD Screen(String),LED Array(Boolean) Update; Update;

VIII.RESULT

XI.CONCLUSION

Pasteurization is a process that kills harmful bacteria by heating milk to a specific temperature for a set period of time. First developed by Louis Pasteur in 1864, pasteurization kills harmful organisms responsible for such diseases as listeriosis, typhoid fever, tuberculosis, diphtheria, and brucellosis. So, this technique helps us to Pasteur and pack milk in a particular temperature of heating and cooling to reduce time and increase efficiency. By this simulation we do understand how we can Pasteur milk and pack with different flow control. Providing a healthy milk by efficient product seems to be good in day today life of everyone. Finally, we understood different flow, level and temperature control system using LabVIEW and it seems to be a good outcome of this project.

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Thank You