TAMPERE UNIVERSITY OF TECHNOLOGY

Discrete Automation Systems

Assignment 01

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Contents

Objective: Design basic PLC program

System:

The system consists of the following:

- Conveyor-the conveyor is used to transfer the empty containers from the input position to the place below the Main tank. After getting filled the containers are then transferred to the output.
- Main tank-this stores the liquid which is to be distributed among the empty containers. The main tank has the capacity to fill 10 empty containers
- Containers-empty containers are filled below the main tank and are transferred to the output.

Design:

The design is based on the following:

Inputs:

- Container_in_place- sensor telling the empty container is under the tank in the filling position.
- Container_full- sensor telling when the container is full.
- Tank_empty_in- sensor telling when the tank is empty.
- Loading- button to signal the input of the container
- Unloading - just a button to signal the removal of the container from the system.
- START - a button to tell system to run.
- STOP - a button to stop the system.
- EMERGENCY - a button to give an emergency signal.

Outputs:

- Motor - the motor to control the conveyor.
- Valve - to open for filling in the container.
- Tank_empty_out - the led to signal that the tank got empty.

Logic & Flow diagram:

The flow diagram is as shown in fig.1, the logic is based on the following:
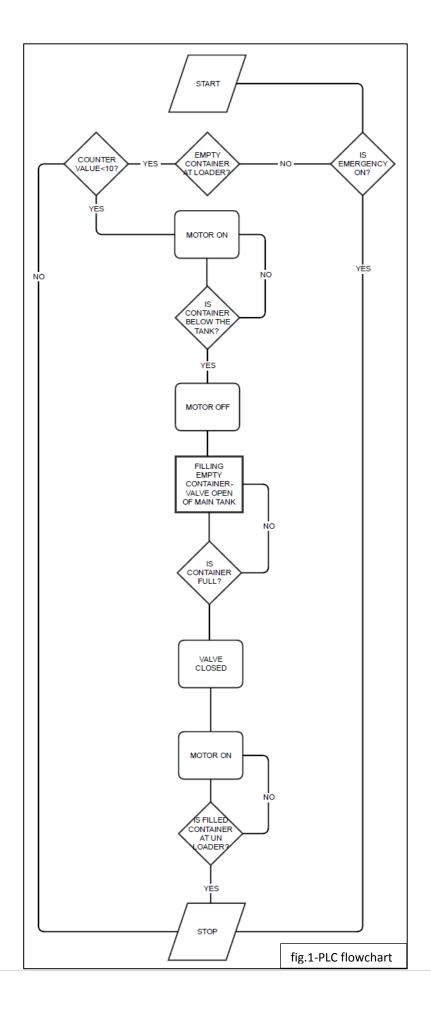
- The three buttons namely, START, STOP and EMERGENCY as mentioned above, are responsible for:
  - START-starts the process.
  - STOP-whenever this is pressed it completes the ongoing job and stops the process after the container has been unloaded from the unloader.
  - EMERGENCY-stops the process completely at moment of pressing EMERGENCY.

- The Main tank has the capacity to fill 10 containers and after that the Tank_empty signal is sent to the operator to refill the Main tank for initiating the next batch.
- The following inter-locking are present as mentioned below:
  - The valve at the main tank will not open until the Container_in_place sensor state is "TRUE".
  - The valve at the main tank will not close until the Container_full sensor state is "TRUE".
  - The motor is responsible for taking the empty tank below the Main tank and then the filled container to the unloader. As such the motor has two step operation as mentioned below:
    - The motor is ON till the empty container reaches below the main tank, i.e. Container_in_place sensor state is "TRUE".
    - The motor is again ON after Container_full sensor state is "TRUE" and the main tank valve is OFF to send the filled container to the unloader.

The PLC-flow chart:

shows the steps of the process

1. START is ON.
2. Checks state of emergency, location of the empty container and the current state of main tank through the "counter value".
3. In case of EMERGENCY being ON it STOPS the user from initiating the process.
4. In case "counter value" is 10, it instructs the user to fill the main tank.
5. The process starts by switching motor ON.
6. When the empty container reaches below the Main tank the motor is switched OFF. And the main tank valve is opened.
7. When the container is filled the motor is switched ON again.
8. The motor is switched OFF after the filled container reaches the unloader.
9. The filled container is then unloaded from the unloader.

fig.1-PLC flowchart

Difficulties :

- The hard part of the coding was satisfying operation of Stop button which solved by assosiating of each step to the former step. For instance, the motor does not work till the start button "y3" or the valve never open till the motor works and etc.
- Defining buttons for each sensor and input variables was the next paroblem we faced, because in the video of TwinCat 3 visualization on Youtube.com did not describe and finally we find it by searching bekhoff's website.

Role of each group member:

- **Farid Khosravi:** Ladder programming and video recording.
- **Mehdi Mahmoodpour:** Viusalization and video recording.
- **Palash Halder:** Visualization and writing report.

Ladder Diagram:

1

```
   stop                                                            y3
   ┤ ├──────┐                                                      (R)
            │
TankEmpty   │                                                      y2
   ┤ ├──────┘                                                      (S)
```

2

```
TankEmpty      start          stop                                y2
   ┤/├          ┤ ├            ┤/├                                 (R)

                                                                  y3
                                                                  (S)
```

3

```
emergency                                                         y1
   ┤ ├                                                            ( )
```

4

```
emergency    S_place       S_full      S_empty      Motor        VALVE
   ┤/├        ┤ ├           ┤/├          ┤/├          ┤ ├          (S)
```

5

```
  S_full      S_place       Motor                               VALVE
   ┤ ├         ┤ ├           ┤/├──────┐                          (R)
                                      │
emergency                             │
   ┤ ├─────────────────────┤
                                      │
 S_empty                              │
   ┤ ├──────────────────────┘
```

6

```
emergency    S_full       S_place                               Motor
   ┤/├    ┌───┤ ├──────────┤ ├────┐                              (S)
          │                       │
          │   y3      S_loading   y2
          └───┤ ├──────┤ ├───────┤/├
```

7

```
  S_full      S_place                                           Motor
   ┤/├──┐      ┤ ├                                               (R)
        │
S_unload │
   ┤ ├───┤
        │
   y1   │
   ┤ ├──┘
```

8

```
                            counter
  valve                       CTU                            TankEmpty
   ┤ ├──────────────────┤CU                              Q├──( )
                        │    [128]
TankEmpty    Filling    │          CV├
   ┤ ├        ┤ ├───────┤RESET
                        │
                  10 ───┤PV
```