



دبلوم تطبيقات التحكم الأوتوماتيكي في نظم القوى الميكانيكية

MEP 599 Diploma Design Project-Spring Term 2017/2018

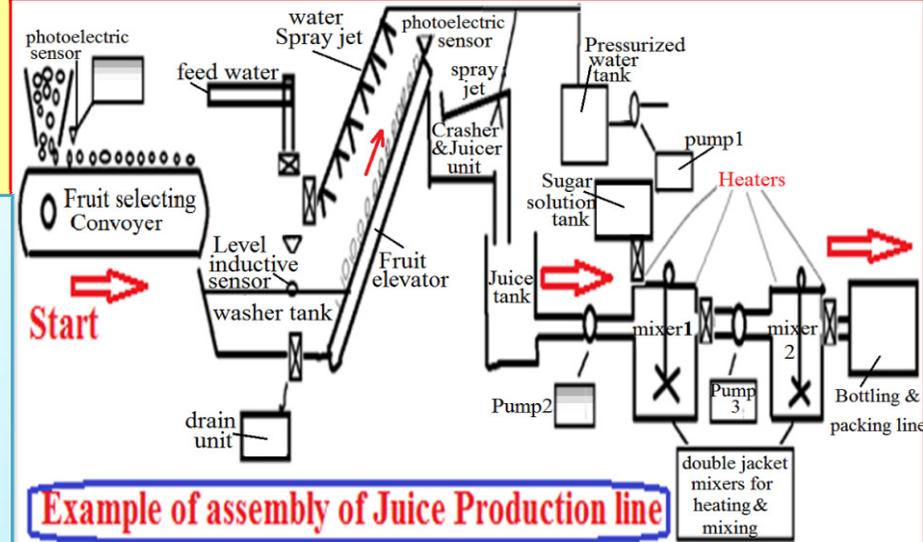
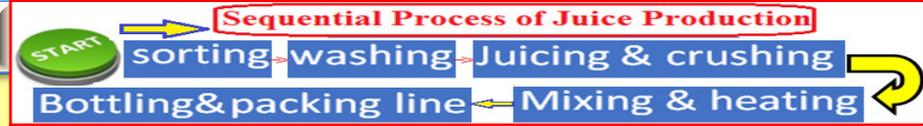
Control of Juice Production Line Using PLC

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Abstract: Using PLC has become an essential tool in many industrial sectors and process applications. Using input signals from sensors & switches, PLC is used to control various machines, pumps & actuators or field devices in order to create an efficient, stable, accurate and safe system. This project is a practical exercise for using PLC to control a group of sequential processes in a juice factory production line. As shown on next figs., the juice production line includes several sequential stations. 1st station is fruit selecting conveyor for sorting input fruit before next washing process in 2nd station which is a combination of conveyor, washer, absorber & drain line. 3rd station is a unit for juicing & crushing fruits and essentially for removing the seeds from the hard seed fruits. 4th station is for mixing & heating where sugar or additives or flavors, etc are added in large mixer and storage tanks. Heaters are used to accelerate mixing and to get the required juice solution. Last station is for bottling and packing the juice as per the requirement of the shape and size of the final product. Each station includes many electronics & electric devices controlled by PLC such as motors, pumps, conveyor belts. Strategic project objectives are to design & execute a program which can control production line of juice using PLC technique & simulates real system using several types of electric digital switches, Relays, LEDs & many input/output I/O devices. Furthermore, in order to practice different aspects of using PLC, the project includes also running and testing practical PLC-Simulation software to diagnose possible errors and trouble-shooting of automatic control PLC systems of sequential programming. Finally, the project includes detailed & carefully prepared documentation procedure report for both SFC, Sequential Function chart, and the LAD program



Example of assembly of Juice Production line



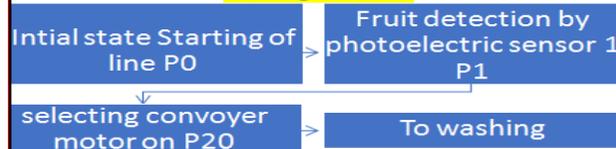
Hardware and Software used in Juice Production line:

- A. Hardware:**
1. PLC controller
 2. HMI
 3. Inverters and electric motors for belts
 4. Thermocouples
 5. Photoelectric sensor
 6. Pushbuttons
 7. Inductive level sensor
 8. Pressure gauges
 9. Solenoid valves
 10. Heaters
 11. Pumps
 12. Spray water jet
 3. Solid relay for heaters
- B. Software:**
1. XG500

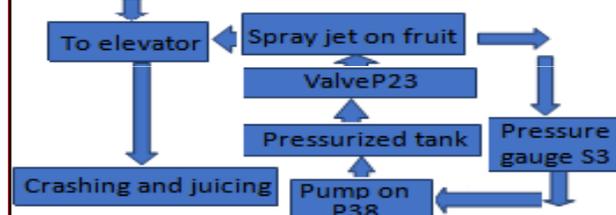
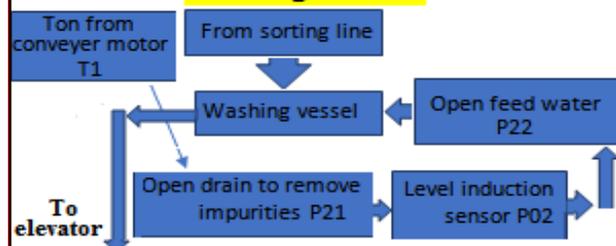
Details of Sequential Processes: The fruits are 1st fed manually in a conical tank to be supplied to fruit selecting conveyer to be selected visual by experts. Fruits are transferred to washer unit to be washed inside washer tank then sprayed on elevator to enter crusher & juicer unit. Fruits are pressed & rolled then juice pulp is extracted & supplied to 1st mixer to add sugar solution & heated to a specific temperature then are supplied to a 2nd mixer for heating of pasteurization & are pumped to bottling line at specific temp. As seen on 1st page, an illustrative drawing is made for production line to identify its machinery, components, and sequential operations done in production line. Then, sequential function chart is made for the juice production line to identify its sequential operations step by step, from a start point to final product passing on several steps such as sorting, washing, juicing, mixing and heating. For each operation a sub sequential function chart is made to identify the process done. Inputs, outputs & marker (or Relays in the LAD) are identified and ladder diagram is made according to desired operation of the line using ladder logic, timers, counters, special and instruction functions. The program is written on XG5000 and simulated successfully and all operations are done sequentially and efficiently.



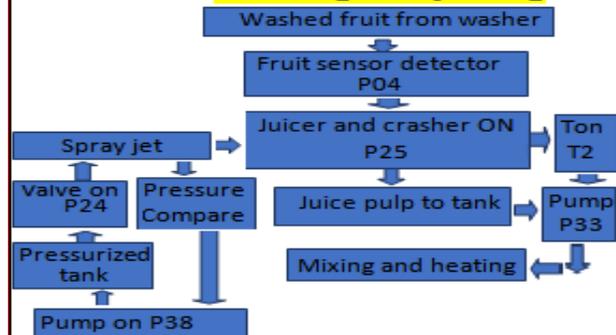
Sorting Process



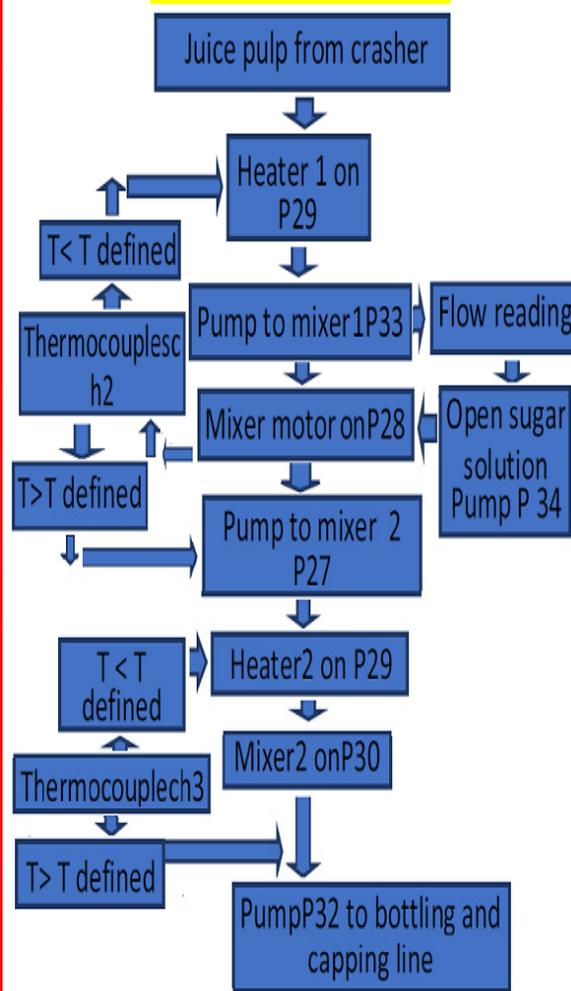
Washing Process



Crashing and juicing



Mixing and heating



All PLC inputs, outputs and relays used in the LAD

Inputs		Outputs		Relays for transition	
Identifier	Address	Identifier	Address	Identifier	Address
E.stop	P10	Conveyer motor on	P20	Estop mon	M11
E.stop	P11	Solenoid valve for drain	P21	Start mon	M12
E.stop	P12	Solenoid valve for feed water	P22	Ton for drain solenoid	T01
Production line start	P00	Spray water jet valve on elevator	P23	Reading of spray jet pressure	M01
Fruit sensor at the start of line	P01	Crasher spray jet valve	P24	Desired pressure for spray jet	M03
Stop button for conveyer and washer	P03	Crasher motor ON	P25	Toff for delaying the stop of crasher	T04
Level induction sensor for washer NC	P02	Heater of mixer 1	P29	Desired Temp in mixer1	M06
Fruit sensor before crasher	P04	Pump to mixer 2 inverter of mixer 1	P27 P28	Reading of real temp of heater1	Ch00
Pressure gauge after crasher	P05	Inverter of mixer2	P30	Desired temp inside mixer 2	M10
		Feed pump from crasher to mixer1	P33	Real reading for flow meter	C01
		Pump for sugar solution	P34	Memory reading of flow meter	D00
		Heater of mixer 2	P31	Real temp of heater 2	Ch01
		Pump for pressure vessel	P38	Desired temp of mixer2	M07
				Real temp of mixer1 solution	CH02
				Real temp of mixer2 solution	Ch03
				Desired temp of mixer 2	M60

LAD diagram for Control of Juice Production Line

