

Project design presentation

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Industrial Automated Tank Mixer System Using Siemens PLC

Project objective

Purpose

The purpose of this project is to automate the mixing tank procedure which is currently manually operated through the use of push buttons and valves. The system will be operated using a sequence control method with timers.

The automated system will eliminate human error and provide process information status in real time using a HMI visual interface.

Objective is identified

Project relevance

- This has great relevance to wider industry since the mixing of materials is often an integral part of many industrial processes, with examples being the steel industry and food production sector. The dual valve input will provide ratio control of substances entering the tank.



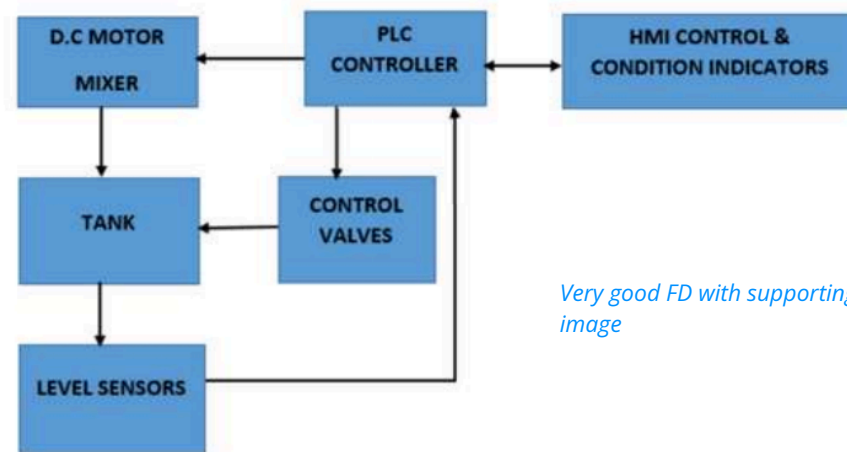
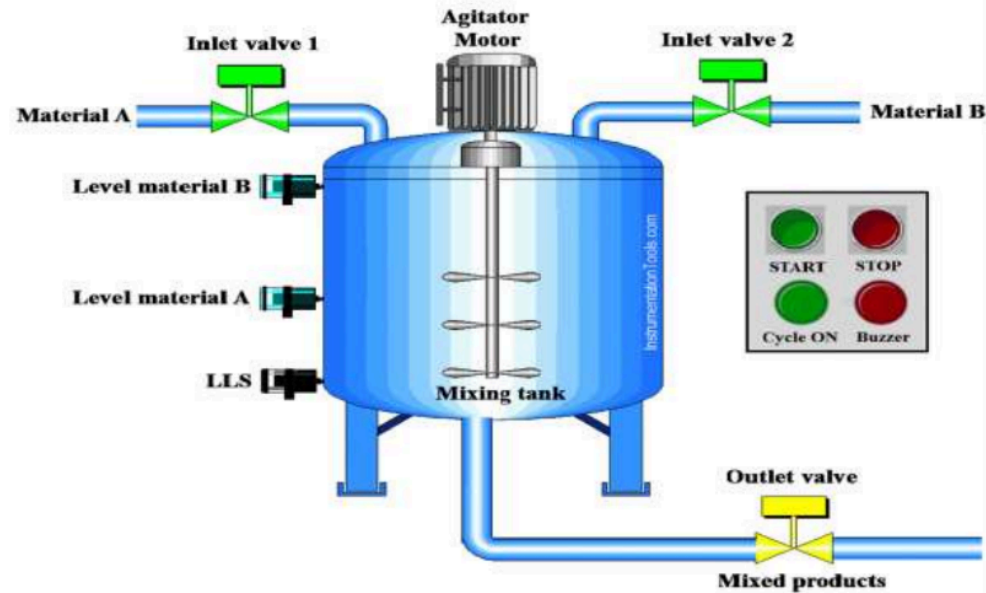
Sinter
Plant



Functional design

The implementation of a PLC with a number of control valves, level sensor, HMI, and auto control over the motor mixer will enable more control over the process.

- Two substances will be input into a tank via control valves. The paddle mixer driver will be a DC motor which will be operated using a timer control.
- Level sensors will be activated for the level of material 1 and material 2 and to indicate the tank is empty. Each substance will be added individually in a sequence.
- Once the two substances are mixed the timer will time out and the outlet valve will be opened to drain the product from the tank.
- Indicators will be implemented for conditions and safety interlocking.
- The process will then repeat continuously.



Very good FD with supporting block diagram and image



Health and safety

- Designing of the program for the PLC will be carried out externally away from the unit in order to prevent accidental download and the code will be peer reviewed in case of major mistakes
- Installation will be done conforming to the current legislation relevant to electrical and industrial safety as well as college standards
- There will be sufficient interlocks present in order to prevent any risk to injury or system.
- Risk assessments will be carried out before any physical work is carried out

Testing and planning

The system will be developed implementing standard procedures previously used with PLC systems and a functional test will then be carried out. Each step of the process will be tested and recorded. A comparison will be carried out against expected results with a pass / fail outcome. Simulated fault conditions will bet set to test the limits and condition indicators.

Sequence	test 1	test 2	test 3	test 4
start				
outlet valve open				
5 second delay				
outlet valve closed				
pipe valve 1 opens then closes on level sensor 1 being reached				
pipe valve 2 opens on sensor 1 being reached then closes on sensor 2 being reached				
stirring motor turns on upon valve 2 closing and runs for set time				
outlet valve opens upon motors conclusion				
5 second delay upon empty sensor being made				
outlet valve closes				
process repeats				

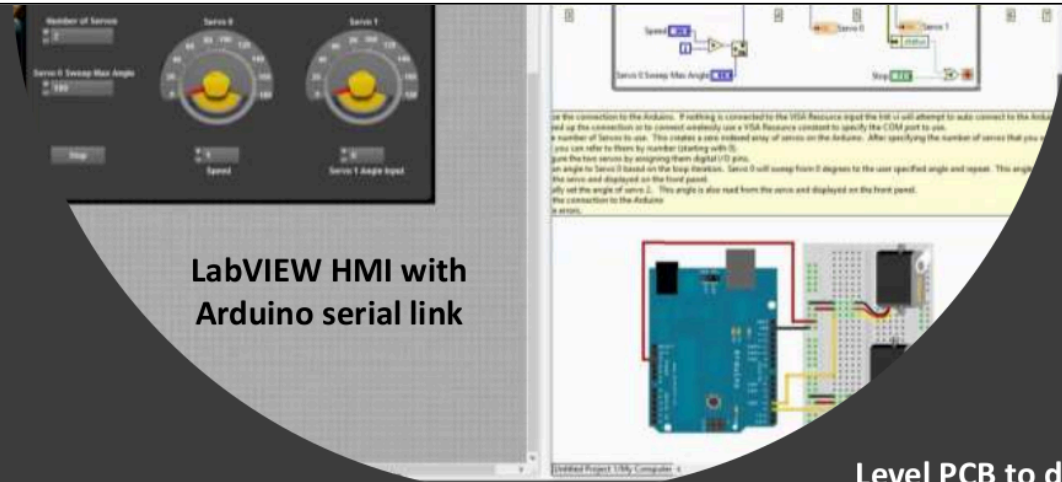
Good plan for testing sequence

Alternative solutions

Solution 2. Alternative controller (Arduino) with alternative level sensors.

The main alternative for the system development is to use a cheaper control MCU such the Arduino. This controller can perform any task the PLC can and is a cost effective alternative due to the cost difference. The HMI display can be linked through LabVIEW using a serial link via the VISA function block as shown in image.

The level sensor can be a strip board (level PCB) as seen in the image, or for a better performance an ultrasonic sensor can be used at very little extra cost.



LabVIEW HMI with
Arduino serial link

Level PCB to detect
liquid level only



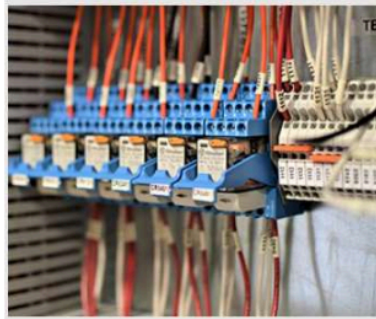
Ultrasonic sensor to detect
liquid or solid substances



Solution 3. Using relays and timers

This alternative solution involves standard relays implemented in relay banks that are auto switched using pre-set timers. The timers can include pre conditioned interlocks for safety and sequence control purposes.

Industrial relays
banks



Industrial bluetooth
timer relays



Industrial relays



Industrial timers



This is a good relevant alternative solution

Critical choice

When comparing all the solutions on offer there are three main choices, below is a table constructed to better compare them:

Solutions	pros	cons	notes
PLC	powerful, multiple inputs and outputs, room for expansion, relatively durable	expensive, fairly large, infrastructure required	knowledgable in TIA which is the software used for this system
arduino board	flexible, cheap, small, highly modifiable	requires external compenets, needs to be constructed	requires knowledge of labview LabVIEW
Relays and timers	relatively simplistic, cheap and easy maintenance, no software required	will take up considerable space, design may be complicated, not very flexible, fine adjustments may be required	requires medium amount of knowledge of electrical circuit design and logic

Good use of table for comparison

Costs

The decision is to use the PLC set up for this project as it has the most benefits, the costs have been calculated below:

PLC and TIA software - £400

Laptop PC with min 8G RAM - £1000

Valves - £300

Level sensors x3 - £300

DC motor – £200

Mix paddle - £100

Total cost of project - £2300

Good detailed budget

Time management

[illegible]

Questions

Project design presentation

GRADEMARK REPORT

FINAL GRADE

GENERAL COMMENTS

77 /100

PAGE 1

PAGE 2

Text Comment. Objective is identified

PAGE 3

Text Comment. Good argument for project

PAGE 4

Text Comment. Very good FD with supporting block diagram and image

PAGE 5

Text Comment. Good codes of practice recognised

PAGE 6

Text Comment. Good plan for testing sequence

Text Comment. Good relevant alternative solutions

Text Comment. This is a good relevant alternative solution

Text Comment. Good use of table for comparison

Text Comment. Good detailed budget

Text Comment. Very good plan

FFION JOLLY

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RESEARCH-INFORMED LITERATURE



Good project background and explained the theme very well. 8/10
Good evidence of research including the components critical to the project. 8/10

16/20

KNOWLEDGE AND UNDERSTANDING



Clear explanation of project task and purpose with relevant arguments for project. 4/5
Project constraints were discussed with an action plan. Codes of practice and standards were industry policy and explained for the project including intellectual property. 3.5/5
Environmental and sustainability were explained as part of the project purpose in the question section. 3.5/5
The functional design was explained clearly with a good understanding of the proposed system components. 3.5/5
Response to questioning was very good. 7.5/10

22/30

ANALYSIS



The problem was clearly defined and linked with good examples from industry to support argument for the project. 4/5
Functional design was clear and critical points identified. This was aided with a good block diagram. 7.5/10
Good argument for the choice of final solution with the aid of comparison table. 3.5/5

15/20

PRACTICAL APPLICATION AND DEP.

 Design specification included good relevant detail and a good block diagram. The explanation was very clear and relevant to the research. 3.5/5
Argument for critical choice of final solution application was clear and critical points in the application process were identified and compared. 8.5/10
Project plan is clear with a good work breakdown structure. 4/5

16/20

SKILLS FOR PROFESSIONAL PRAC.

 Slides were very informative and contained relevant detail from research. 4/5
Overall delivery was very good and demonstrated a good understanding of the task. 4/5

8/10