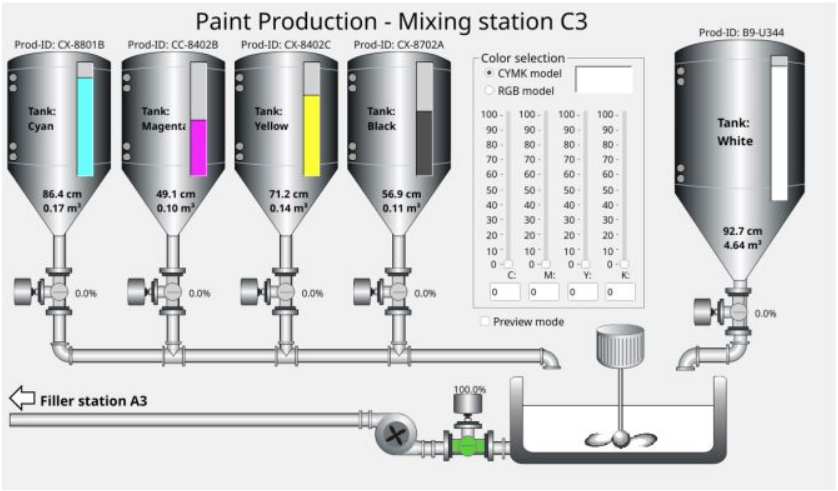
Color Plant Automation

G10 - Rainbow Stew

Thomas M. Leonardo C. Thomas B. Filip S.

Contents

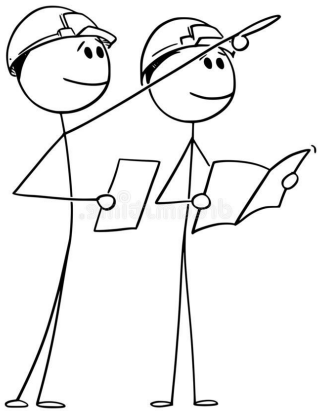
1. How does the plant work ?
2. Supervision and WinCC OA
3. Architecture
4. Components
5. Naming Convention
6. Failure analysis

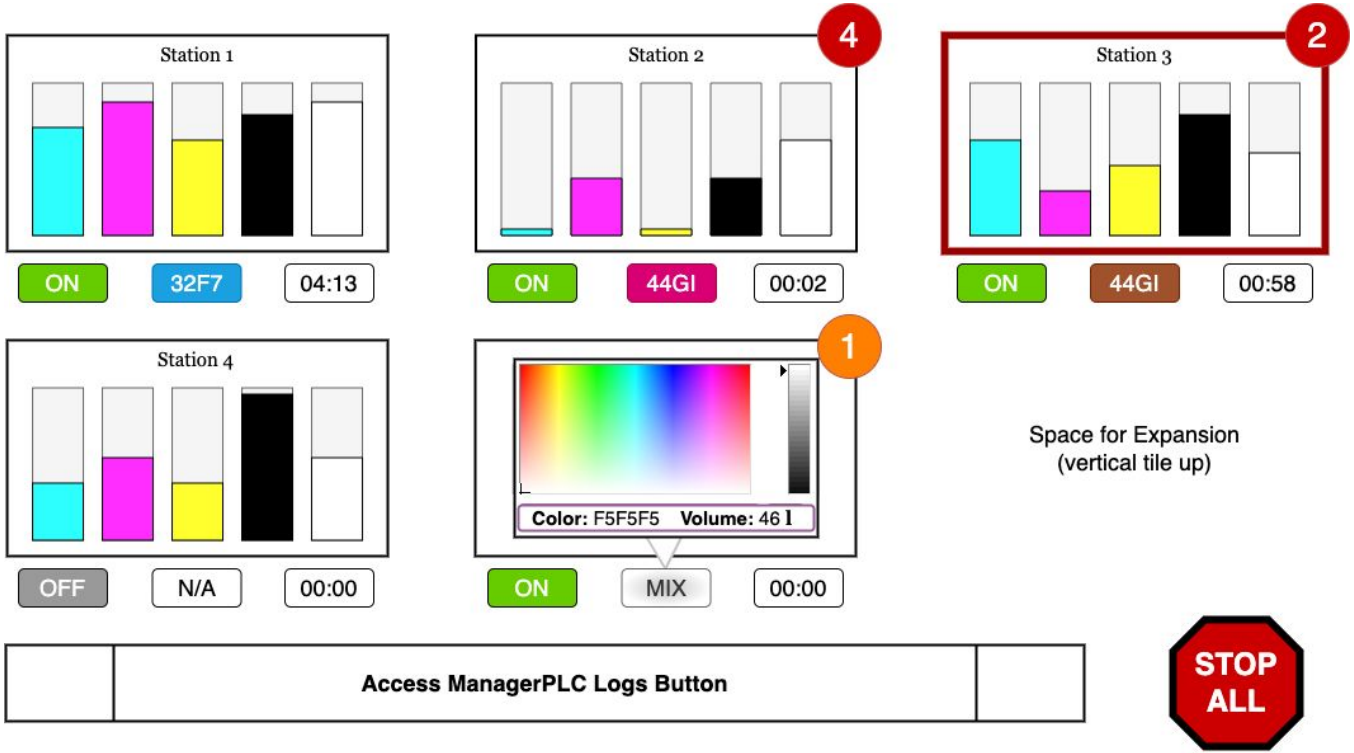


How does the plant work ?

- Operator receives paint job orders and enters them in the system
- Design choices aim to minimise need for intervention and enable expansion
- Assumptions:
  - The mixing tank and the color pipes are frequently cleaned
  - No need of quality control of the paint
  - All color valves can be opened at the same time
  - No gravity influence on the flow
  - Mixing velocity is irrelevant

Supervision





ON OFF Toggle State

Order Background is Ordered Color

MIX MIX Mix Order Interface

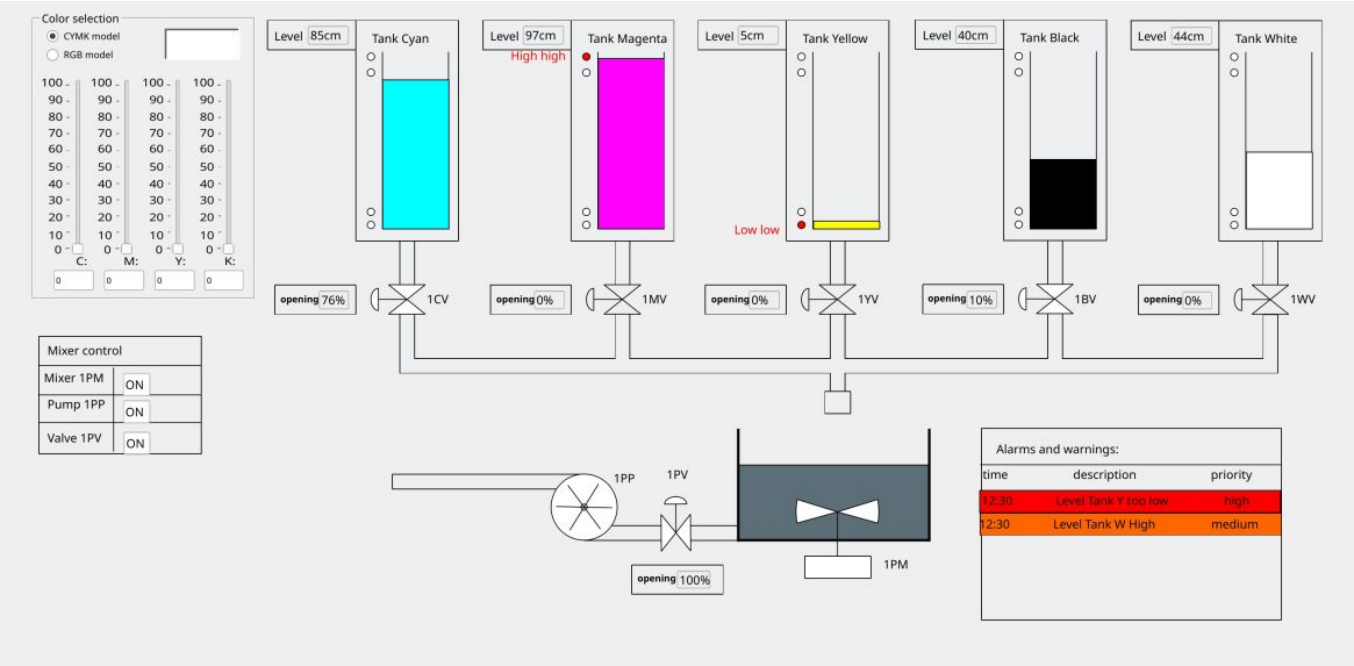
hh:mm Time Remaining

X Notification / Warning

X Alarm

Manager PLC Intervened

WinCC OA Implementation

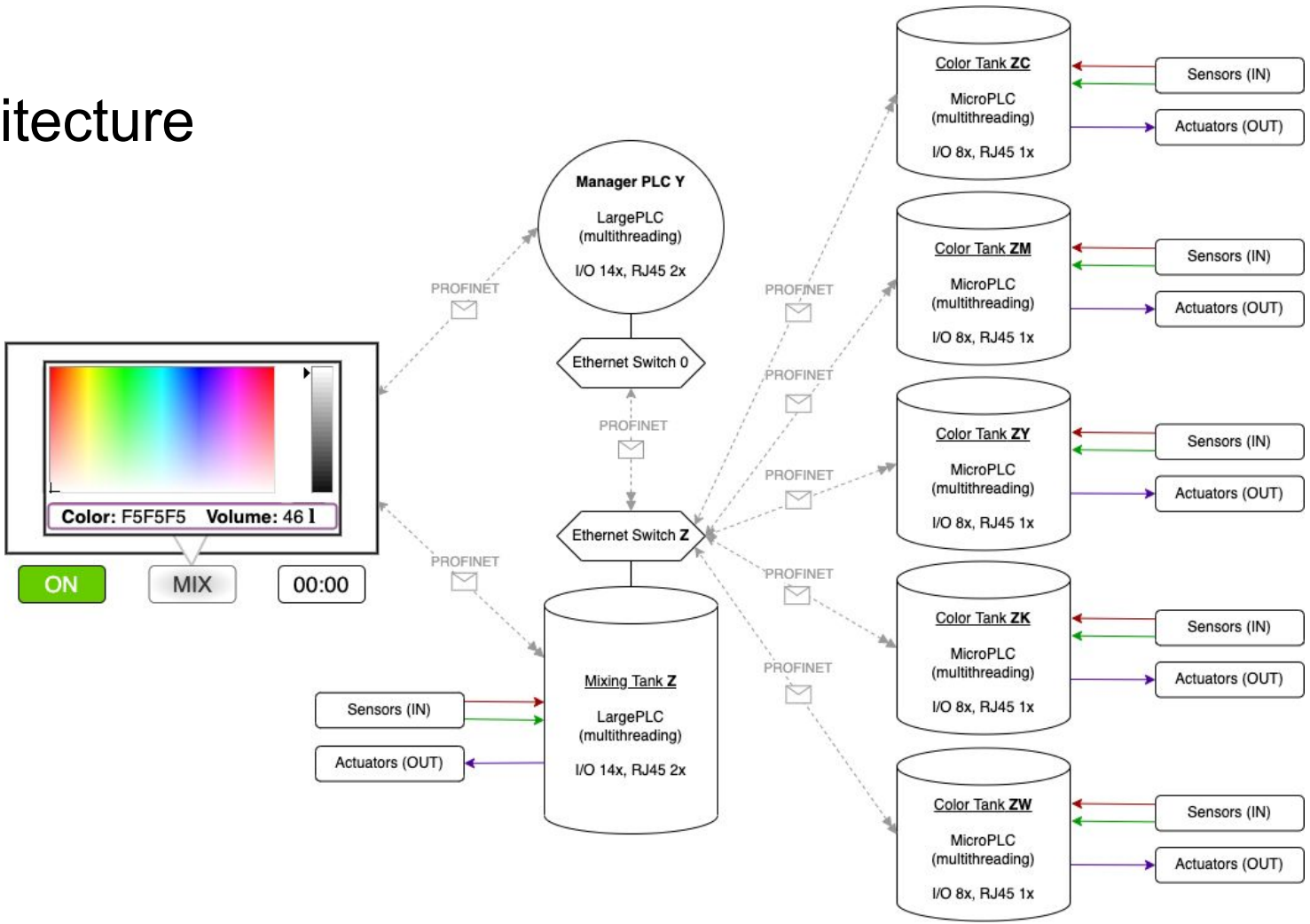


Mixing station 1

Tank	Level(0-100)	Trend
Cyan	85cm	=
Yellow	5cm	↘
Magenta	97cm	↘
Black	40cm	=
White	44cm	↗

Valve	State	Percentage-Open
1CV	Open	76
1YV	Closed	0
1MV	Closed	0
1BV	Open	10
1WV	Closed	0

Architecture



Main components of choice

S7-1200

S7-1200 is the ideal choice for an automation system of medium dimension:

- Low price
- Integrated PROFINET interface
- The selected model 1217C has two integrated ethernet ports
- Compact design

LOGO 8

LOGO 8 is a micro PLC that operates on the single tank

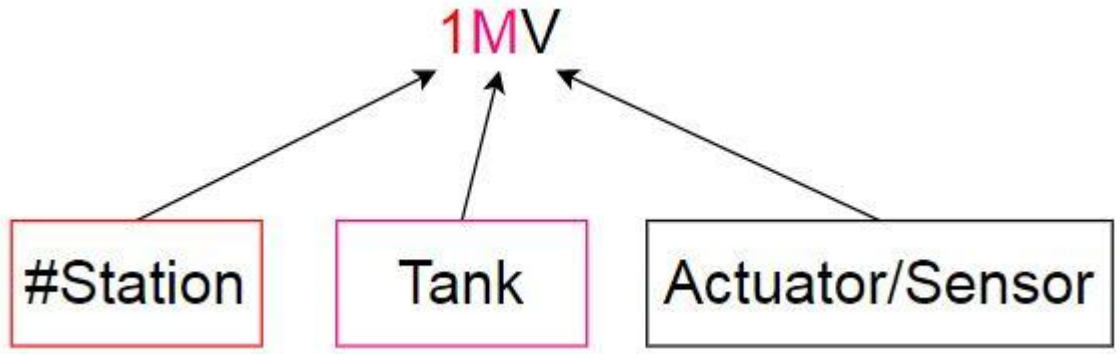
- Low cost and small dimension
- Integrated ethernet port and PROFINET interface
- Enough I/O to cover the signals of a single tank (no extension I/O cards)
- Easy to implement Client-Server configuration with the S7-1200

PROFINET is the obvious choice given the selected PLC

- Communication through TCP/IP protocol on ethernet cables
- High flexibility and reliability
- Higher speed than PROFIBUS and easy installation
- Future proof

Naming Convention for Signals and Alarms

Designation	Actuator type	function	Signal type	Signal range
1CV	Valve	control output of cyan paint	Analog	0-100
1MV	Valve	control output of Magenta paint	Analog	0-100
1YV	Valve	control output of yellow paint	Analog	0-100



1MV: Signal to open/close the valve (V) of the magenta color tank (M) of station 1

Failure Analysis

Area	Component name	Function	Failure mode	Failure cause	Failure effect - local	Failure effect - global	Failure detection	Other provision	Remark
Color tank	Tank	holds the color	leakage	Contact with object	Tank leaking	Color everywhere, damaging equipment and need for a extended maintenance	Analog and digital sensors, visual inspections	Establish routine inspections	Critical failure
	Valve	releases the color from the tank	fails to open	Hardware error	Tank not providing color	Color mix not accurate	Flowmeter feedback		
			fails to close	Hardware error	Color pouring endlessly into the pipe	Color everywhere, damaging equipment and need for a extended maintenance	Flowmeter feedback	Add a security valve at the end of the color pipe	Critical failure

- FMEA to identify system failure points
- Provides insight into areas of improvement
  - Decided to add security valves and sensors
  - Suggested routine inspections

Closing Joke