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Programmable Logic Controller (PLC) and Human Machine Interface (HMI) Application for Corrosion Testing Machine

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Abstract-
Main motive of this project is to design corrosion testing machine which is able to identify the corrosion formation in any type of metals and coatings, from this testing process we can improvise the life span of the particular metal job. This test allows us to compare relative corrosion resistance of different coatings in conditions that try to mimic actual corrosive environment. The corrosion testing machine is adapted to be operated in sequence to faithfully reproduce corrosive conditions. Namely, at first the salt spray is produced, and then the specimens are rinsed, then dried by hot or ambient air, and cooled. It will be understood that this cycle of operation, reproducing outdoor conditions, provides a test which has a high degree of conformity with actual corrosion environment. In this project we integrate PLC and HMI on the system thus automative environment is created. This helps in accelerating the testing, improving reliability and efficiency of the corrosion testing. PLC implementation makes it possible for easy interlocking of machine conditions, increases flexibility and safety. It also helps to modify machine sequence . HMI makes it possible to alter machine parameters online as per requirement of specific job and achieve supervisory control like performance monitoring, start up, shut down and other emergency operations.

Keywords- *Corrosion testing machine, PLC, HMI, Salt Spray*

I. INTRODUCTION

The salt spray test is a standardized and popular corrosion test method and is used to check corrosion resistance of materials and surface coatings. Usually, the materials to be tested are metallic and finished with a surface coating which is intended to provide a degree of corrosion protection to the underlying metal. Salt spray testing is a corrosion test that produces a corrosive attack to coated samples in order to evaluate the suitability of the coating for use as a protective finish. The appearance of corrosion products (rust or other oxides) is evaluated after a pre-determined period of time. The salt spray test is an advanced corrosion test used for evaluating the corrosion resistance of materials when exposed to salt fog. The test specimen is placed in an enclosed chamber and it is subjected to a constant flow of salt-laden fog. This flow is maintained during the entire duration of the test. This cost-effective weathering test solution applies a corrosive saline spray to product and material samples in a carefully controlled chamber. The testing chamber can operate in a wide range of humidities, temperatures, and conditions to replicate the various corrosive environments that the product might see over its lifetime. The salt spray test is a standardized and popular corrosion test method used to check corrosion resistance of materials and surface coatings. Main benefits of this testing machine are that the test is relatively inexpensive; duration is short and provides quick result.

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II. LITERATURE SURVEY

The salt spray test is the oldest corrosion test and the most widely used by users of highly corrosion resistant material. It has become a universal test, as it is also multi-material. So it is possible to test a bare material, painted, noble or sacrificial coatings .The test duration is short compared to the natural environment, the cost is limited and a standardized material is required. The salt spray test can also be a combined test of material and surface finish, due to the fact that roughness and wettability play a considerable role in the final result. This accelerated laboratory test was invented at the beginning of the 20th Century. It provides a controlled corrosive environment and has been used to produce relative corrosion resistance information for specimens of metal coatings. The salt spray test has been an industry wide standard corrosion test since its conception in 1914.

A. SOFTWARE SURVEY

1) *Software used for PLC (Mastertool ICE XE) 3.5:*The Windows release of this was developed by Altus Sistemas. Master Tool IEC XE is a complete tool for programming, debugging and performing configuration and simulation of user applications. Based on a concept of being integrated, flexible and easy to use, this application provides six programming languages defined by IEC 61131-3 standard: Structured Text(ST), Sequential Function Chart (SFC), Function Block Diagram (FBD), Ladder Diagram (LD), Instruction List (IL) and Continuous Function Chart (CFC).The MasterTool IEC XE software is the programming IDE of the Nexto Xpress PLC series. To facilitate the development of the projects in Xpress PLC, it is important to have MasterTool's user manual in hand and the IEC 61131 programming manual, which contains information on programming languages, libraries and function blocks.

2) *Software used for HMI(Jmobile)2.8*: JMobile is a software suite designed to offer a complete HMI solution with client-server architecture. JMobile applies the latest available technology developed for HMI in industrial automation to every situation where a user interface is required. JMobile began developing in 2006 in close cooperation with a group of major clients. This trusting collaboration with the market has continued throughout the subsequent years and as a consequence has led to a unique software package, responding in a secure and stable system. The suite includes commissioning tools, to allow easy maintenance and configuration of multiple remote units, and both desktop and runtime engineering software for application development. HMI development software offer control functions for industrial automation machines using different script and Command It can permit quick editing of mimics or HMI Screen and also communicate with PLC using suitable Protocol like Modbus RS232 / Ethernet IP.

B. HARDWARE SURVEY

1*)PLC Xpress 315 (Brand Messung)*:NX-ERA Xpress is developed by Messung, the preferred PLC automation partner who offers undeniable advantages, such as expertise of a technology pioneer and market leader since 1981 World-class in-house R&D centre Tie-ups with global companies for products & technologies. Nx-era Xpress delivers high-speed processing power in a compact design with embedded I/O. This product portfolio targets small control systems, offering models containing from a few digital inputs and outputs up to options with 43 I/O points concentrated in a single controller, including analog inputs and outputs with temperature support (RTD sensors).Xpress is suitable for small applications and remote distributed I/O. It may be applied in verticals such as infrastructure, building automation, water, wastewater, food, textiles, factory automation, machines and several other OEM solutions. Additionally, it is an ideal solution for complementing big applications along with extending the range of applications using the same technology and

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engineering environment. This is a great advantage for OEMs and systems integrators with needs of small to large applications.

2) *Esmart07M (Brand EX OR)*: The eSMART HMI's from Exor combine state-of-the-art features and top performance. Designed to offer an outstanding price/performance ratio, they are an ideal choice for factory automation and building automation applications. Exor has taken the evolution of the eSMART range and gone much further. The series now includes JM4web, Browser widget, SQL4automation and our cloud-based solutions. These powerful applications open the potential use of the eSMART series. As such they have increased the number of certifications to be used in hazardous conditions. The eSMART series of products combine the power of JMobile – the software inside X Platform with an outstandingly robust design. With very specific applications in mind we have stripped down the eSMART to only the essential components and have created a truly class leading product.

III. PROPOSED SYSTEM

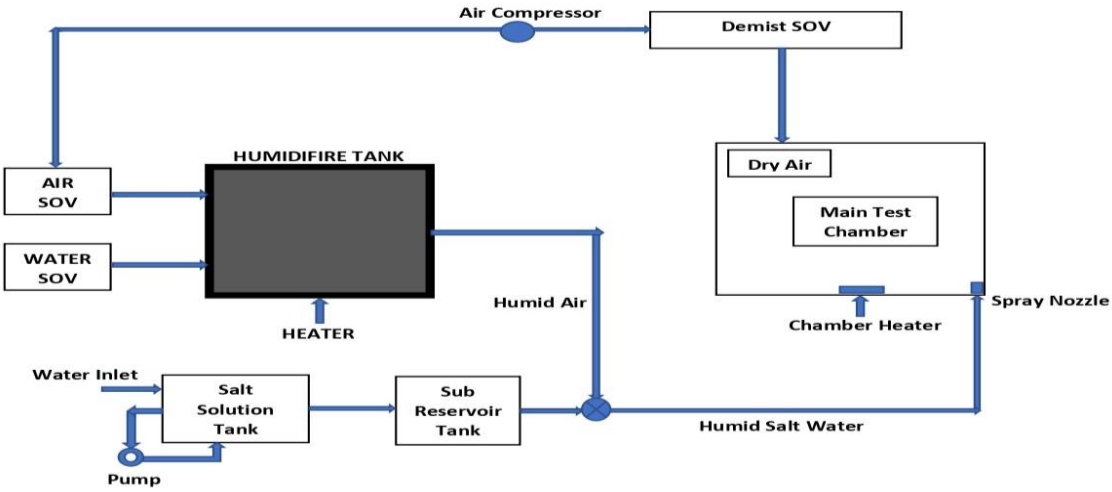

Fig.1 Corrosion testing system

A. Block Diagram Description

1) *Chamber heater:* To evaporate water from a sump tank inside the testing cabinet.

2) *Humidifier heater:* To heat water inside the humidifier tank to be sprayed in the chamber.

3) *Air solenoid valve:* To introduce compressed air through humidifier tank inside the cabinet using a nozzle

4) *Air solenoid valve:* To introduce compressed air through humidifier tank inside the cabinet using a nozzle.

5) *Water solenoid valve:* To fill water inside the humidifier tank.

6) *Demist solenoid valve:* To bring outside air into the cabinet from a nozzle

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7) *Pump*: For proper mixture of salt and water present inside the salt water tank.

8) *Air Compressor:* To release pressurized air inside the cabinet through demist and air solenoid valves.

IV. METHODOLOGY

A. Wiring and connections

a. Input and output of PLC to machine
b. PLC and HMI wiring
c. Pneumatic connections
d. Safety precautions
e . Connection diagram

B. *Hardware overview*
a. PLC architecture an
b. Sensors ,SOV and relays
c. Tanks(salt water, humidifier, sub reservoir)

C. Software overview

1) Mastertool software version 3.5(PLC):

a. types of languages (ladder, structured list ,functional block)
b. project creation
c. creation of timers, counters
d. study of functional blocks

2) JMOBILE software version 2.8(HMI):

a. Intro to software of HMI
b. graphic creation and standard elements in library
c. operator variable entry
d. mode selection of machine

D. Simulation and Debugging

E. Download and Execute

V. RESULTS

Chamber Heater:

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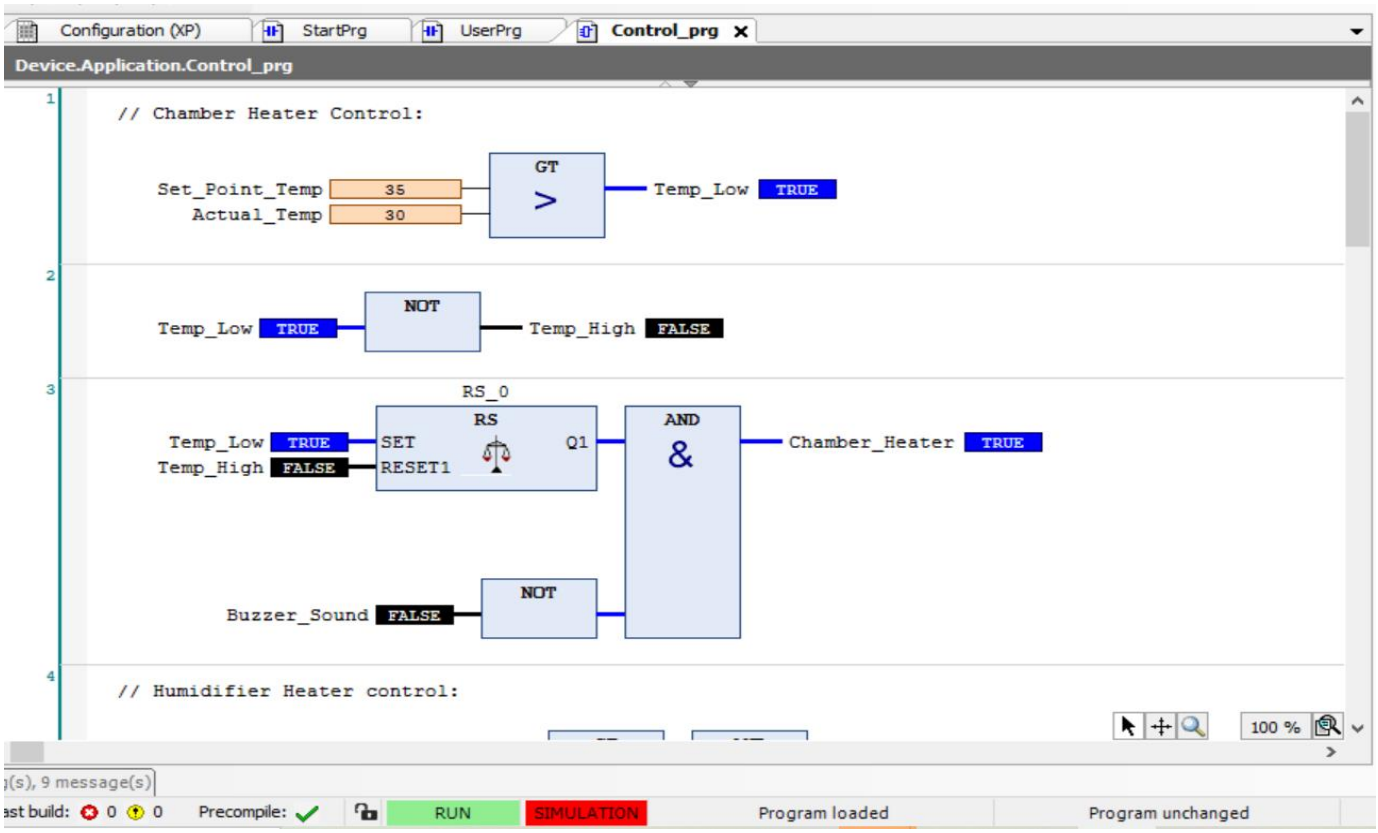

Fig.2 Functional Block of chamber heater control

Chamber Heater Control:

If set Point Temp > Actual Temp & Buzzer Of (HEATER ON)

Demist and Pump:

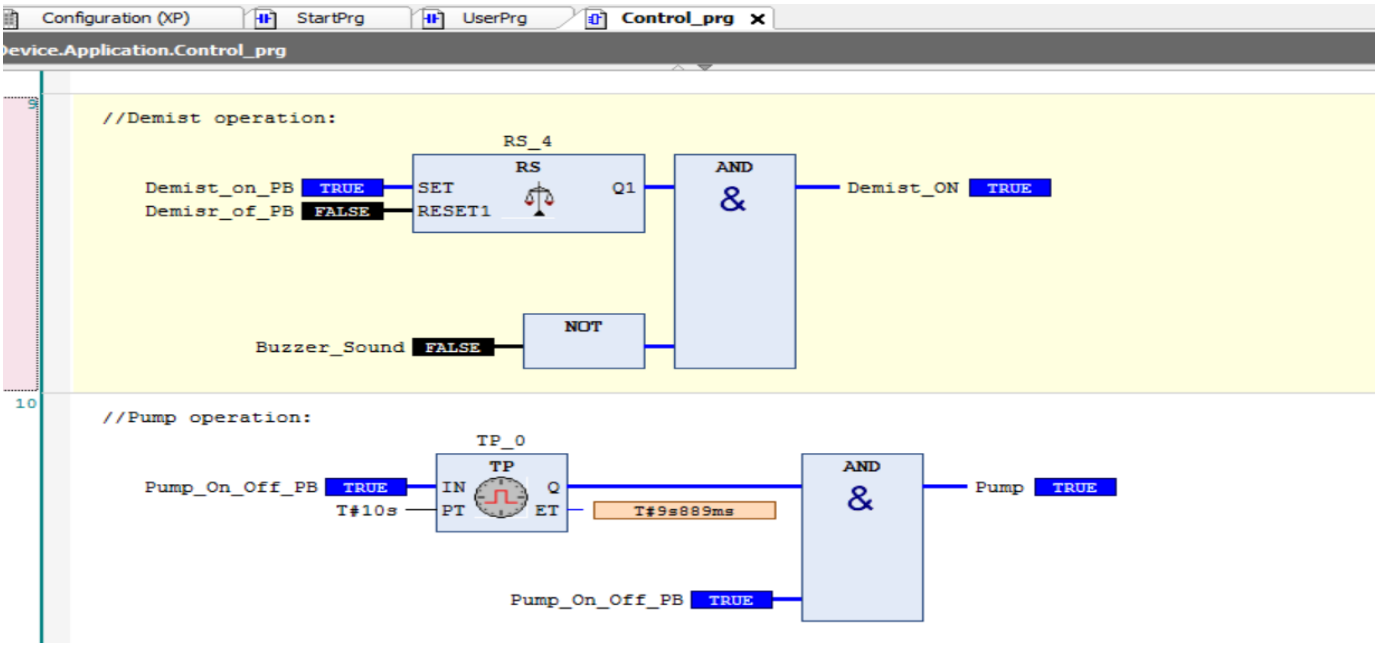

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Fig.3 Functional Block of Demist operation

Demist Operation:

If Demist Push Button ON & Buzzer OFF (DEMIST ON).

Pump Operation:

If Pump Push Button ON (PUMP ON for 10 seconds).

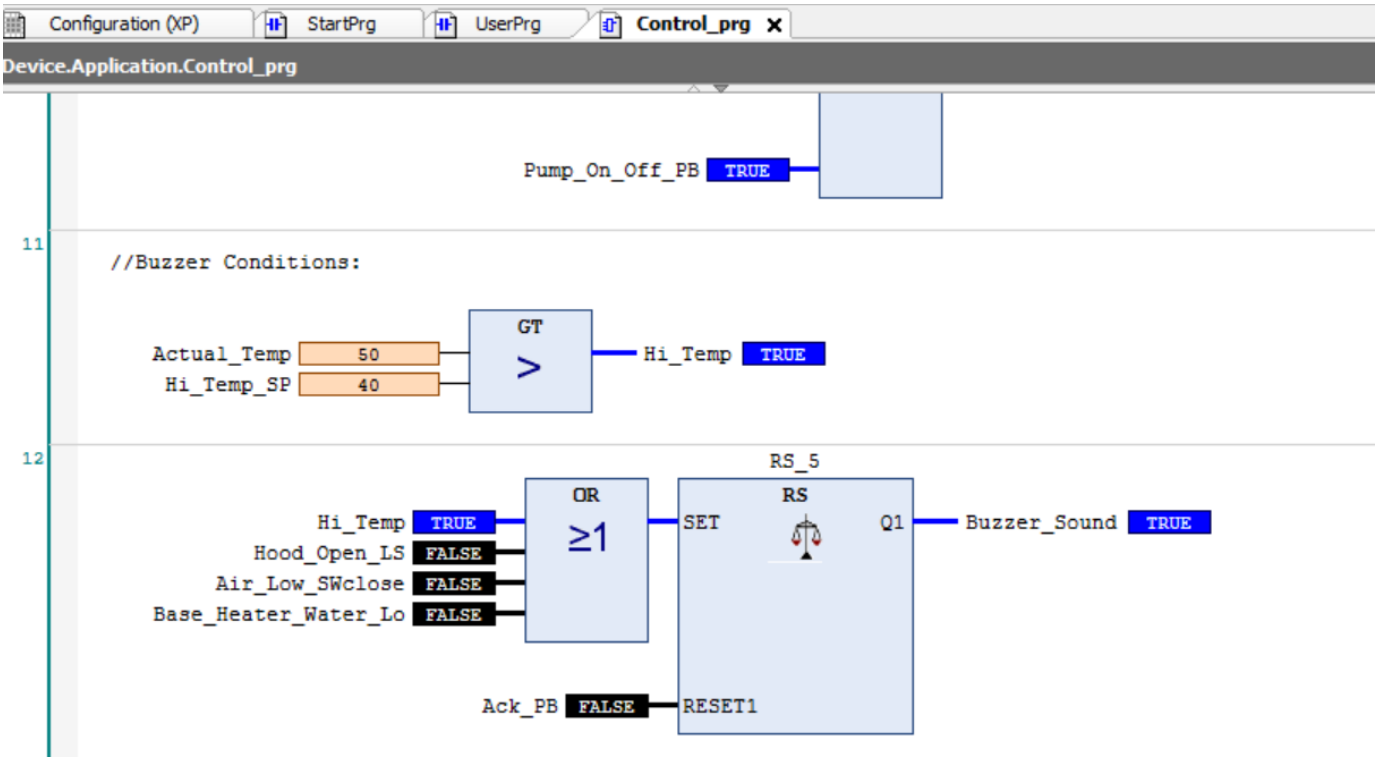

Fig.4 Functional Block of Buzzer

Buzzer Operation:

1) If Actual temp > High temperature set point (HIGH TEMP ON)

2) If High temp on OR Hood Open OR Air Low OR Heater water Low THEN (BUZZER ON)

HMI Screen Result:

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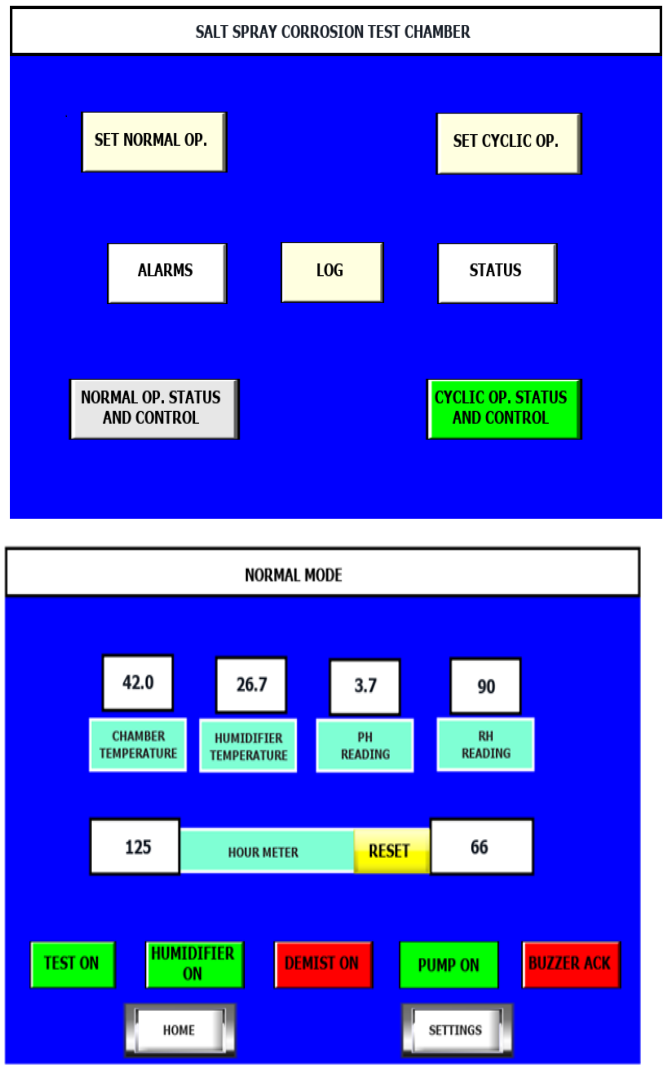

Fig.5 HMI Screen Results for Normal mode Parameter

VI. CONCLUSION

PLC and HMI are efficiently integrated to built a corrosion testing chamber system. According to the requirements Automation technique based PLC is successfully implemented on hardware. This test allows us to compare relative corrosion resistance of different coatings in conditions that try to mimic actual corrosive environment.Hence proper material selection can be done and durability of protective coatings can be measured. It is very efficient, less human errors, time and cost effective as well as highly preferred for industrial equipment cleaning and testing process.

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