Modern System for Ship Engine Control using PLC
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Abstract— Automatic control is the use of various control systems for operating equipment such as machinery, processes in factories, boilers and heat treating ovens, steering and stabilization of ships, aircraft and other application with minimal or reduced human intervention. Now days all processes have been completely automated. After fixed interval continuous monitoring and inspections are required for ship. There are possibilities of errors at various stages of measurement and inspection due to human error and also the lack of features of microcontrollers. In this paper we are controlling the various parameters such as fuel level, RPM, water and lube oil temperature etc. with the help of PLC (programmable logic controller) and HMI (human machine interface) to control the other parameters accordingly. The main objective of this system is to monitor and control the various parameters in the ship Engine where human cannot access, for that purpose we had discussed this idea with power control engineers and they provide necessary information. This system includes the feature which set the alarm to notify the operator if any of the monitored values exceeds their normal operating ranges as defined by set points.

Key words: Pressure, Temperature, PLC, HMI, RPM

I. INTRODUCTION
Machinery control system (MCS) on both commercial and military platform have evolved into multi-layer distributed and redundant control system that provides versatile and reliable control and monitoring of ship HM&E equipment. We have choose the PLC Controller for Navy Ship Engine control to overcome the problem of old engine control system (Analog System). In old control system use the mechanical gauges to monitor the parameters of engine like:

- Rotation Per Minute
- Lube Oil Temperature
- Lube Oil Pressure
- Water Temperature
- Water pressure

Etc. these all parameters are very important in engine life cycle. Mechanical Gauges having some Tolerance are Harmful to Engine Life. In ship, engine is the heart of the ship, so it’s very important to monitor and control all this parameters of engine. We use PLC to control and in taking corrective actions against the parameter value. Also we use the HMI to monitor all parameter which is located at in front of ship Capitan.

II. LITERATURE SURVEY
After deciding the parameters to be monitored and control, first we took the plc which include different modules of PLC, WPL Software version 2.30. We find out all the available sensors through market survey, web sites, so that we can get the necessary information about which type of sensors can be for getting required system output.

III. PROPOSED SYSTEM DIAGRAM
A. Block Diagram

![Fig. 1: Block diagram](image)

B. Elements of Block Diagram:
- PLC
- Lube oil pressure (Danfoss MBS 3000)
- Lube oil temperature (Thermistor)
- Water pressure (Danfoss MBS 3000)
- Water temperature (PT-100)
- HMI
- Lamp and Hooter
- Engine and actuator
- Digital push button switch

C. Block Diagram Description:
In this the block diagram it shows whole overview of control system. Important part of the system is power supply. Power supply is redundant type and must be regulated. We have used 24VDC power supply. Second thing heart of control system is controller. We have here used programmable logic controllers. It requires 24Vdc power supply and connected along digital and analog inputs.

Analogue input module is nothing but communication between the programmable logic controller and analog input. Analog input like as:-
- Rotation Per Minute
- Lube Oil Temperature
- Lube Oil Pressure
- Water Temperature
- Water Pressure

Etc. this parameter is nothing but the sensor. It senses the temperature and pressure and gives the signal to the analog input module. Analog input module in this block diagram is having 4 analog inputs.

Digital input module is connected or way of communication in digital switch and programmable logic controller. Digital input like as:-
- Start
- Stop
- Reset
- Acknowledgement
- Emergency

Etc. this are the digital input. In this digital input we use the Push Button Switch to control the parameter and Start the engine manually. In this block diagram we have used the 4 digital inputs. Digital input module is connected to the programmable logic controller.

Digital Output Module is connected between the programmable logic controller and output parameter. The digital output like as:-
- Engine starter
- Actuator
- Lamp
- Hooter Etc.

Human Machine Interface is nothing but the display of the parameter value will also control the all parameter of the ship engine. Sensor gives the some value of the parameter to check this value and taking correct action against the value and it will monitor to Human Machine Interface, HMI is nothing but the digital display. We give the input and observe the parameters. If any error is occurred then lamp is switched “ON” and hooter is “ON”. If HMI stop working then we can operate manually using switch, which is locate at the digital input side.

IV. HARDWARE IMPLEMENTATION

A. Lube Oil Pressure Sensor:

Fig. 2: Lube Oil Pressure Sensor

Pressure sensor measure the pressure of lube oil and it will give the input to analog module. Pressure measured in the bar. If pressure is low at 1.5 Bar then within a 10 sec alaram will be activated and if pressure is goes down to 1.2 Bar then within a 10 sec it will get trip or switch off automatically.
- High vibration stability
- Pressure range : 0-600 bar/0-8700 psi
- Standard output signals: 4-20 mA, 0-5V
- Wide range of pressure and electrical connection
- High degree of EMC/EMI protection
- Fluid temperature up to 125°C/257°F

B. Lube Oil Thermistor Sensor:

Fig. 3: Thermistor sensor

Thermistor sensor measures the temperature of lube oil and it will give the input to analog module. Temperature is measured in the mV. If temperature is high at 115°C then alaram will be activated and if temperature increases upto 120°C then it will get trip or switch getting “OFF” automatically. Thermistor temperature ramge is 0-800°C.

C. Water Temperature:

Fig. 4: PT-100

PT-100 sensor measure the temperature of water and it will give the input to analog module. Temperature is measured in the degree. If temperature is high at 92°C then alaram will activate and if temperature increases upto 98°C then it will get trip or switch getting off automatically.
- Output of PT-100 in Ω.
- Temperature range is 0 to 150°C.
- 100Ω resistance at 0°C.

D. Water Pressure:

Fig. 5: Water Pressure Sensor

Pressure sensor measure the pressure of lube oil and it will give the input to analog module. Pressure measured in the bar. If pressure is low at 1 Bar then within a 10 sec alaram will
activate and if pressure is goes down to 1 Bar then within a 10 sec it will get trip or switch getting off automatically.
- Pressure range : 0-600 bar/0-8700 psi
- Standard output signals:4-20 mA,0-5V
- Wide range of pressure and electrical connection
- High degree of EMC/EMI protection
- Fluid temperature up to 125°C/257°F
- Approved for marine application

V. HARDWARE IMPLEMENTATION

A. Software Tools:
- Delta_WPL soft_v2.30
- Delta_DOP soft 1.01.08

B. Algorithm:

1) Start
2) Scan all condition(Trip or Alarm).
3) Scan Start or Stop / Emergency push button.
4) If start push button is ON then check RPM & Lub oil pressure. If RPM is zero & Lub oil pressure is zero than will give command to Engine starter & Fule pump.
5) If RPM is < 500 than cut-off starter command but Fule pump command will continue.
6) Check RPM for running condition.
7) If RPM is 1500 than running condition is OK.
8) If RPM is > 1300 then it will get alarm. Engine not reach run speed or underspeed
9) Check all other condition like: LOP, LOT, WP, WT.
10) If any condition reaches to alarm set value then it will get alarm & it’s display ON HMI screen.
11) If any value reach to trip set value then Engine stop by giving command to Fule pump & Engine stop immediately & alarm display ON HMI screen.
12) For stop condition check push button. If stop is pressed then engine is stopped normally.
13) Stop

C. Flowchart:

D. HMI Design:
VI. APPLICATION

Marine ship, Navy ship, Post guard ship to control engine parameters. It can also be used in submarines. Some parameters such as RPM, temperature level, pressure level etc. can be used in industry.

VII. FUTURE SCOPE

- Presently our system is only involving four parameters but we can increase monitoring and controlling parameters to avoid ship casualty.
- Various types of set point can be specified on a parameter bases such as low, low-low, high, high-high and rate of change.

ACKNOWLEDGEMENT

We thank our teachers for their continuous support and encouragement in this work. We would especially thank Prof. Bhalchandra Dhokale for guiding through the process and being available for any problem faced.

REFERENCES


Web-sites

[1] www.google.com