PLC BASED SYSTEM FOR CONTROLLING AND MONITORING PARAMETERS IN SHIP

Mr. Tushar Jamsutkar[1], Mr. Sagar Gore[2], Mr. Pankaj Patil[3], Prof. Ashok Suryawanshi[4]
Dept. of E&Tc, Pimpri Chinchwad College of Engineering, Pune, Maharashtra, India

***Abstract*—Automation or automatic control, is the use of various control systems for operating equipment such as machinery, processes in factories, boilers and heat treating ovens, switching in telephone networks, steering and stabilization of ships, aircraft and other applications with minimal or reduced human intervention. Some processes have been completely automated. Ship requires continuous monitoring and inspection at frequent intervals. There are possibilities of errors at measuring and various stages involved with human workers and also the lack of few features of microcontrollers. In this project we are controlling the various parameters such as fuel level, RPM, obstacle and temperature etc. with the help of PLC (Programmable Logic Controller) and control the other devices accordingly. The main objective of this system is to control and monitor the parameters in the ship using PLC, for that purpose we had discussed this idea with Goa shipyard engineers and they provide necessary information.**

It can also set the alarm to notify the operator if any of the monitored values exceeds their normal operating ranges as defined by set points.

***Index Terms*— *Fuel* level, RPM, Obstacle, Temperature, PLC**

I. INTRODUCTION

INS Sindhurakshak (Sanskrit, for protector of the seas) suffered a minor fire incident in 2010 and a major one on 14 August 2013, which resulted in its sinking at Mumbai's naval dockyard. A fire broke out aboard Sindhurakshak while the vessel was in Visakhapatnam in February 2010. On 14 August 2013, the Sindhurakshak sank after explosions caused by a fire on board when the submarine was berthed at Mumbai. A small explosion occurred around midnight which then triggered the two larger explosions.

A Shipboard Monitoring and Control System (SMCS) can monitor various system parameters and it is capable of setting the alarm based on specified alarming set points. The use of PLC for monitoring and control provides increased efficiency as it automates the routine task.

II.LITERATURE SURVEY

After deciding the parameters to be controlled & monitored, first we took the B&R PLC training which include different modules of PLC, ASBASIC & VISCOM software version 2.7.0.7 We searched about all the various available sensors through websites, datasheet, sensor vendors and market survey so that we can get the necessary information about which type of sensors can be used for getting the required system output.

III. PROPOSED SYSTEM DESIGN

A. *Block diagram*

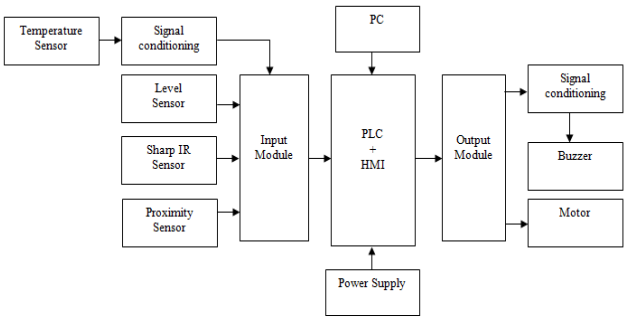


Fig 1. Block Diagram

B. *Elements of block diagram*

1. Power panel (PLC+HMI)
2. Temperature sensor (PT 100)
3. Level sensor
4. Sharp IR sensor
5. Proximity sensor
6. Signal conditioning circuit
7. Buzzer and Motor

C. *Block Diagram Explanation*

A programmable logic controller PLC or Programmable Controller is a digital computer used for automation of electromechanical processes such as control of machinery on factory assembly line, amusement rides or light fixtures. PLC is used in many industries and machines. Unlike general purpose computer, PLC is designed for multiple input and output arrangement, immunity to electrical noise, and resistance to vibration and impact. Programs to control machine operation are typically stored in memory backed up or non volatile memory. A PLC is an example of a hard real time system since output result must be produce in response to input condition within a limited time, otherwise unintended operation will result.

A temperature sensor is a device that gathers data concerning the temperature from a source and converts it into a form that can be understood either by an observer or another device.

ISSN: 2278 – 7798

These sensors come in many different forms and are used for a wide variety of purposes.

The level measurement can be either continuous or point values. Continuous level sensors measures the level within a specified range and determines the exact amount of substance in a certain place, while point-level sensors only indicate whether the substance is above or below the sensing point.

Sharp IR sensor is a distance measuring sensor unit, composed of an integrated combination of PSD (position sensitive detector), IRED (infrared emitting diode) and signal processing circuit. The variety of the reflectivity of the object, the environmental temperature, the operating duration all these parameters have no influence on the distance detection as the triangulation method has been adopted. The output of this device is in terms of voltage which corresponds to the distance that has been detected.
An inductive sensor is an electronic proximity sensor, which detects metallic objects without touching them.

A DC motor is a mechanically commutated electric motor which is powered from direct current (DC).It is used to rotate the propeller. A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers and confirmation of user input.

IV.HARDWARE IMPLEMENTATION

A. Mercury switch

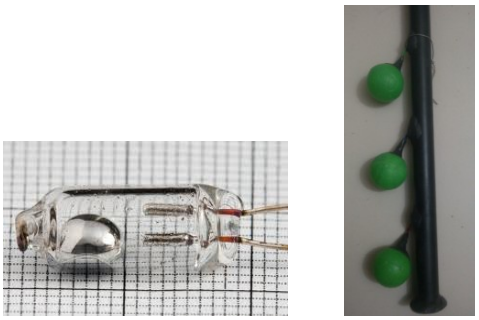


Fig 2. Mercury switch

A mercury switch (also known as a mercury tilt switch) is a switch which opens and closes an electrical circuit through a small amount of liquid mercury. Mercury switches have one or more sets of electrical contacts in a sealed glass envelope which contains a bead of mercury. The envelope may also contain air, an inert gas, or a vacuum. Gravity is constantly pulling the drop of mercury to the lowest point in the envelope. When the switch is tilted in the appropriate direction, the mercury touches a set of contacts, thus completing the electrical circuit through those contacts. Tilting the switch the opposite direction causes the mercury to move away from that set of contacts, thus breaking that circuit. The switch may contain multiple sets of contacts, closing different sets at different angles, allowing, for example, single-pole, double-throw (*SPDT*) operation. The mercury switch is inserted into the hollow sphere shown in fig 11 as the fuel level increases it float on to the fuel and switch is closed and we get the output. It is used to measure the level of the fuel tank.

B. Sharp IR Sensor

1. Distance measuring range: 10 to 80 cm
2. Analog output type
3. Consumption current: Typ. 30 mA
4. Supply voltage: 4.5 to 5.5 V

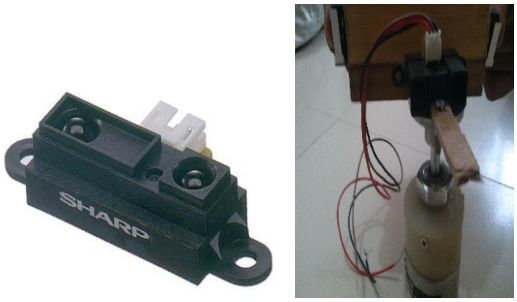


Fig 3. Sharp IR sensor

Sharp IR sensor mounted on to the motor which had long metal strip and two limit switches when the motor will rotate the metal strip will press the limit switches then motor rotate in anticlockwise direction. In this way motor will rotate in 180º and cover the large area for the obstacle detection.

C. Inductive Proximity Sensor

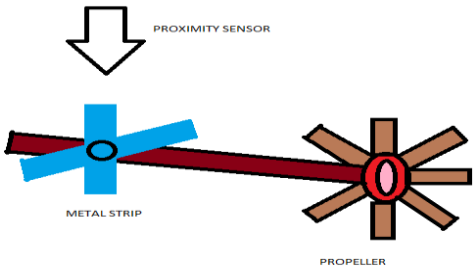


Fig 4. Inductive Proximity sensor

1. Long life cycle and high reliability
2. Red LED status indication
3. Metal sensing distance 8 mm

As shown in fig 4 the motor shaft has four metal plates .The proximity sensor is used to measure the RPM of the propeller. Proximity sensor provide medium or low resolution sensing depending on the number of pulses measured per revolution

D. PT 100

ISSN: 2278 – 7798

Fig 5. PT 100

1. 2" Compact Design for Applications with Space Restrictions.
2. Transitions Directly to Lead Wires (No Transition Fitting)
3.Temperature Range: PFA: -50 to 260ºC

V. SOFTWARE IMPLEMENTATION

A.Software tools required

1. ASBASIC software version 2.7.0.7
2. VISCOM

B. Implemented algorithm

1) START
2) Check the temperature
3) If temperature is greater than 70 ºc then go to step 7
4) Check the speed of propeller displays it on HMI.
5) Checks the obstacle if it is found then go to step 8
6) Checks the fuel level if it is low then go to step 8
7) Fan on
8) Buzzer & Indicator on
9) END

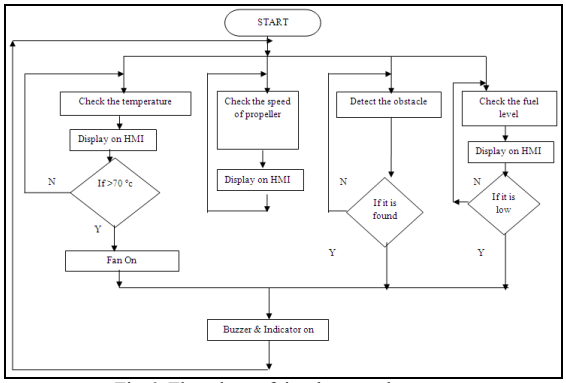
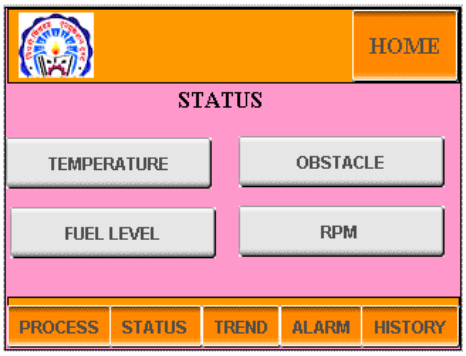


Fig 6. Flowchart of implemented system

C.HMI design



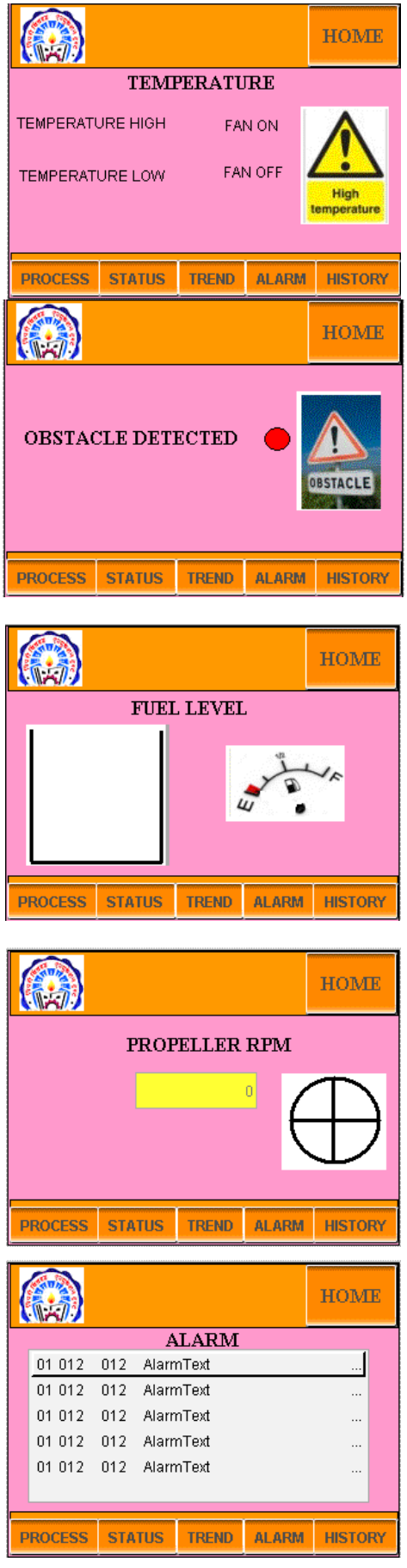


Fig 7: HMI Visualizations

ISSN: 2278 – 7798

VI. RESULTS

A. Testing

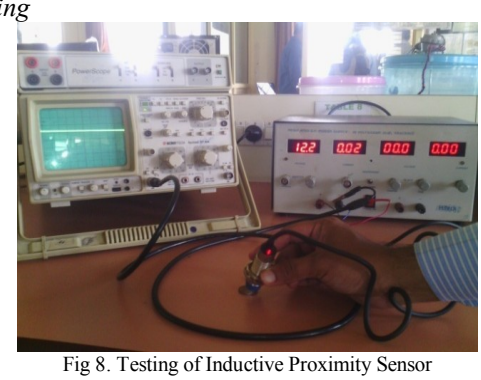


Fig 8. Testing of Inductive Proximity Sensor

Inductive Proximity Sensor has 8 mm metal sensing distance.
Red LED status indication

Fig 9. Testing of signal conditioning circuit for temperature sensor

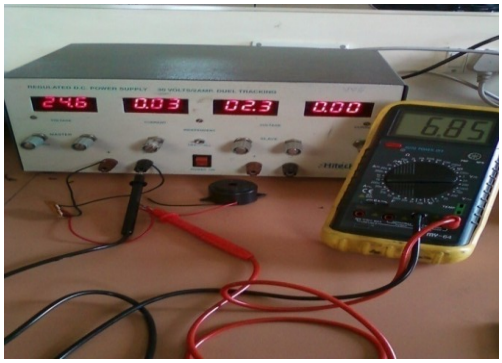


Fig.10. Testing of signal conditioning circuit for Buzzer

Fig.11. Testing of sharp IR sensor

B. Result table

TABLE I. Fuel Level

SR.NO	Mercury switch	Fuel level(ml)
1	Switch 1	250
2	Switch 2	500
3	Switch 3	750

TABLE II. Inductive Proximity Sensor

SR.NO	Input voltage	Output voltage
1	24V	22V

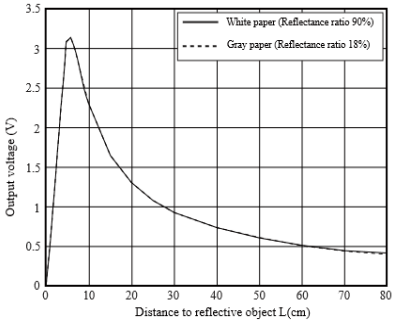


Fig.12 Obstacle detection characteristics

TABLE III. Sharp IR Sensor

SR NO.	Distance (cm)	Output(volt)
1	0	0.03
2	10	2.66
3	20	2.46
4	30	1.93
5	40	1.30
6	50	1.21
7	60	1.27
8	70	1.18
9	80	1.38

VII. APPLICATIONS

It can be used in ship to monitor and display Parameters from the engines, generators, AC and DC electrical systems, tanks and bilge levels. It can also monitor fuel consumption. It can also set the alarm to notify the operator if any of the monitored values exceeds their normal operating ranges as defined by set points.

Parameters of aero plane such as aircraft flight control system, traffic alert and collision avoidance system can be controlled using PLC.

It can also be used in submarines. Some parameters such as temperature, Level, RPM etc can be used in Industry like Thermax for boiler automation.

VIII. FUTURE SCOPE

Presently our system is only including four parameter but we can increase controlling and monitoring parameters to avoid ship accidents. It can monitor fuel consumption and estimate future fuel needs based on the consumption rate. It can also generate alarms to notify the operator if any of the monitored values stray outside of their normal operating ranges as defined by set points. Various types of set points can be specified on a parameter-by-parameter bases such as high, high-high, low, low-low, and Rate of Change (ROC). All alarms and events can be historically logged with time and date.

ISSN: 2278 – 7798

ACKNOWLEDGMENT

We thank our teachers for their continuous support and encouragement in this work, for cultivating new and aspiring ideas in our mind. We would especially thank Prof. Ashok Suryawanshi for guiding through the process and being available for any problem faced.

REFERENCES

A. Reference papers

[1] Hrvoje Dzapol, Zoran Stare, Nenad Bobanac, "Digital Measuring System for Monitoring Motor Shaft Parameter on Ships" I2MTC 2008 - IEEE International Instrumentation and Measurement Technology Conference Victoria, Vancouver Island, Canada, May 12-15, 2008

[2] Vinit Sethi, Vintimar Inc, "Shipboard Monitoring & Control Systems: Selection, Design & Installation Criteria"

B. Training modules of B & R Industrial Automation Pvt. Limited, Austria

a) Automation basics(TM247)
b) Ladder (TM240)
c) The basics of automation studio(TM210)
d) Automation studio diagnostics(TM223)
e) The basics of visualization(TM600)
f) Automation runtime(TM213)
g) Programmable Logic Controller by John Web

C. Web-sites

a) http://www.brautomation.com/enin/downloads/#categories=software
b) http://ieeexplore.ieee.org/xpl/articleDetails.jsp?reload=true&arnumber=4547391
c) http://en.wikipedia.org/wiki/Ship
d) http://en.wikipedia.org/wiki/INS_Sindhurakshak_%28S63%29
e) http://ieeexplore.ieee.org/xpl/articleDetails.jsp?reload=true&arnumber=4547391

ISSN: 2278 – 7798