Machine Health Monitoring and Control System using LabVIEW

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Abstract— Automation is the need of today's world. In this paper we are going to propose a real time monitoring and control system to improve and maintain health of machines in huge industries. As health monitoring of machine is very important to increase performance and quality of products with reducing maintenance cost. Entire plant can be monitor on single HMI. This system is intelligently designed to control and gives error and security alarm indications. It can improve performance and provides flexibility. This system provides simple and low cost solution with graphical representation. With the advances of electronics and software technologies monitoring and control systems are widely used and popular in industries. LabVIEW provides easy solution for this system. Various sensors inputs are connected to microcontroller board and using MODBUS in rtu mode data get transfer to LabVIEW installed on pc which can be connected to HMI. This system consists of master slave configuration.

Key words: LabVIEW, MODBUS RTU, Web Publishing, Database, Real Time

I. INTRODUCTION

The conventional methods for plant monitoring may be Uneconomical due to high cost, so integrated automation and control has become the solution for making it efficient and cost effective. Normally, an automated system improves the system efficiency, plant monitoring, productivity and the operation management of the plant. The main objective of system is to give the means to the human operator to control and to command a highly automated process [2].It provides an efficient tool to monitor and control machines. This project deals with the developing the real time virtual platform. All parameters are obtained, processed and display on HMI. Also they can be logged into database of Microsoft office access. The complete system can be controlled in both local and Remote modes by using a simple Internet connection. Real-time results can publish on web page using to be viewed and controlled The proposed software has been designed under a LabVIEW environment which gives the possibility to remotely control setups by using an Internet access [7]. System can easily log data to the built-in networked historical database and if anyone of vital parameter goes out of normal range then alarm alerts generated by the system. System also provides SMS and E-mail notification to authorized person.

II. HARDWARE IMPLEMENTATION

We are developing microcontroller based monitoring and control system using flexible and powerful graphical programming language tools of LabVIEW with hardware interface Hardware contains microcontroller board and Sensor board. Entire setup of system is shown in block diagram of fig 1.

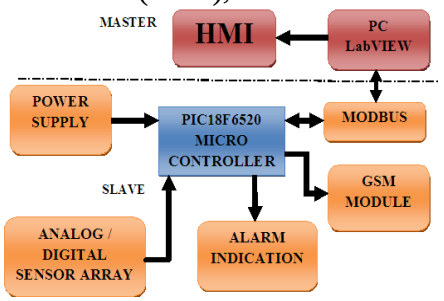

Fig. 1: Block diagram of control system

A. *Microcontroller*

Microcontroller gives fast, reliable, cheap solutions therefore widely used in industry. Microcontrollers are similar to computer in many ways, only difference is they are designed to perform small and dedicated tasks. These are application specific devices. Here we are using PIC18F6520 microcontroller with TQFP package for hardware interfacing with LabVIEW.

B. *Input Sensors*

Data acquisition involves gathering signals from measurement sources and digitizing the signal for storage, analysis, and presentation on a PC. Here various analog as well as digital sensors are used. To measure motor temperature and panel temperature LM35 temperature sensor is used as shown in fig. 2 below.

Fig. 2: Temperature sensor

To measure humidity present in external environment DHT11 humidity sensor is used. This is single wire, ultra-low cost digital temperature and humidity sensor as shown in fig 2.

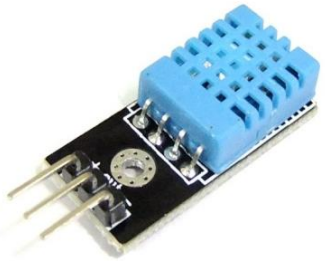

Fig. 3: Humidity Sensor

The single-wire serial interface makes system integration quick and easy. Its small size, low power consumption and up-to-20 meter signal transmission making it the best choice for various applications, including those

most demanding ones. It uses capacitive humidity sensor and thermistor for temperature.

Fig. 4: Vibration sensor

Vibration sensor shown in fig 4 is used to monitor vibrations of machines. If frequency of vibration is more than set pint value then it gives indications.

Fig. 5: ultrasonic sensor

To monitor oil level of machine on regular basis we used mechanism of ultrasonic sensor to detect oil level. Ultrasonic sensor shown in fig 5 gives measurement of distances and accordingly oil level can be measure.

C. Safety

Plant safety is very important factor in industry. To protect from damage people can get warning alarms. We used fire detection sensor.A flame detector is a sensor designed to detect and respond to the presence of a flame or fire as shown in fig 6 below. Some parts of machine are dangerous or harmful to human therefore there is need to detect human presence and alert them. We used PIR sensor as shown in fig 7 to detect human presence.

D. Alarm Indications

Alarm indications are given for safety purpose. If any parameter value is increase than set point or goes beyond limit or if any error occurs in system then it generates alarm indication.

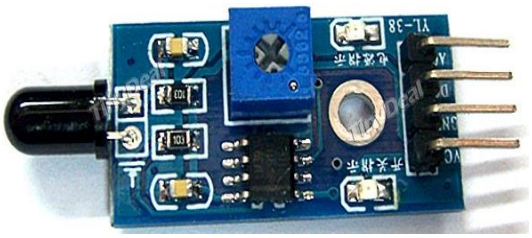

Fig. 6 fire detection sensor

Fig. 7 PIR Sensor

E. GSM Module

At each alarm generation, system also sends relevant error information viaSMS. The SIM900 is a complete Quad-band GSM solution in a SMT module which can be embedded in the customer applications.

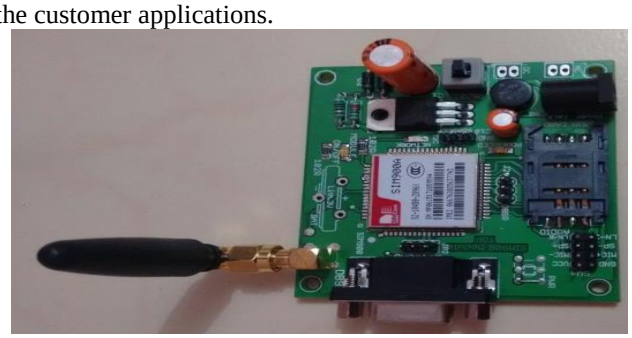

Fig. 8 GSM module

F. MODBUS

MODBUS is well known communication protocol used in master slave configuration. Here MODBUS is used in RTU mode. Coding System Modbus RTU is an open, serial (RS-232 or RS-485) protocol derived from the Master/Slave architecture. It is a widely accepted protocol due to its ease of use and reliability. Modbus RTU is widely used within Building Management Systems (BMS) and Industrial Automation Systems (IAS). In this project MODBUS is used to connect physical world with physical world. Data can be send and receive using rtu mode.

III. SOFTWARE DEVELOPMENT

MODBUS is the communicating media between hardware and software. Input sensor data is transmitted to the personal computer. In this case microcontroller is acts as slave and monitoring system works as a master. LabVIEW is a graphical programming platform that helps engineers scale from design to test and from small to large systems. It offers unprecedented integration with existing legacy software, IP, and hardware while capitalizing on the latest computing technologies. The LABVIEW provides an easy-to-use graphical environment that permits the system operators to process easily the collected data, using complex data-processing algorithms, without detailed knowledge of the data-acquisition system design. LabVIEW (short for Laboratory Virtual Instrumentation Engineering Workbench) is a platform and development environment for a visual programming language from National Instruments.

Fig. 9: block diagram of software parameters

The NI LabVIEW Real-Time Module is a complete solution for creating reliable, stand-alone embedded systems with a graphical programming approach. In this project LabVIEW software tool is used for various purposes [5]. It displays all input parameters of entire plant machines on a

single screen. These parameters are logged and stored into database. If any parameter goes beyond set limit or if any machine gives error then alarm indication is displayed on the screen. Also relative error information or warning messages will trigger through email and sms gets delivered to the authorized person. System is designed to change settings for acquisition period, recipient's email id. This monitoring screen can be published on web using server link of that particular pc. In emergency case system gives facility of remote controlling.

IV. RESULTS

LabVIEW tool is used for graphical representation of system. HMI can be used as a display.

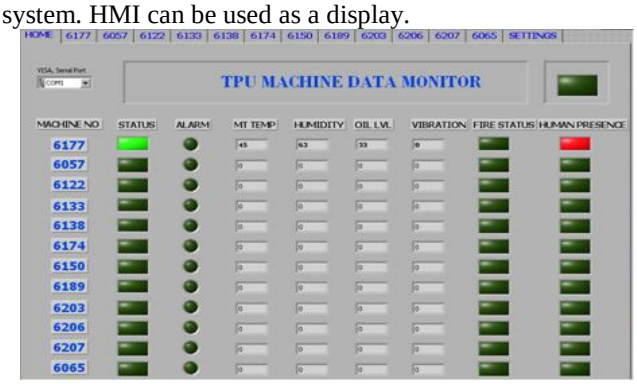

Fig. 10: Home screen of machine monitor

We can display parameters of number of machines on a single screen as shown in fig 10 below. Here we are showing how the data of 12 machines can be represented. In our demo we are using one slave board which is connected to PMT internal Grinder machine. So that this machine is showing online status and other are offline. In fig 11 grinder machine data is monitored. In this panel temperature, Relative humidity, machine oil levels, vibration of machine are displayed on monitor. For safety fire alarm and human presence is detected.

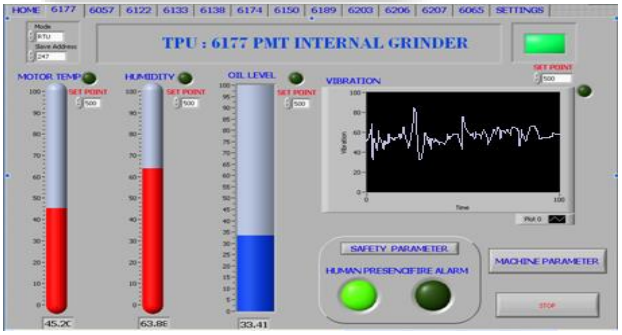

Fig. 11: Display of machine monitoring in normal

A. Conditions

Fig. 12: Display of machine in error conditions

In fig 12 parameters are goes beyond their set limit so that alarm led are displayed. Here acquisition period of 2 second is set. That can be change using settings on screen. Entire database gets stored into the system using Microsoft access.

V. CONCLUSION

In this project a graphical development environment with built-in functionality for simulation, data acquisition, instrument control, measurement analysis, and data presentation is discussed. LabVIEW gives one the flexibility of a powerful programming language without the complexity of traditional development environments. LabVIEW delivers extensive acquisition, analysis, and presentation capabilities in a single environment, so one can seamlessly develop a complete solution on the platform of your choice.

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