Industrial Parameters Monitoring System on Temperature and Speed for Pneumatic Cylinder

Abhinav Singh, A.Alfred Kirubaraj, S.Senith, S.R.Jino Ramson

Abstract: ***The technological evolution in modern industrial production have many variable physical characteristics like variable working temperature and speed change that effects the operating status of equipment used. Hence the above mentioned parameters have to be continually monitored. In this paper, we have taken frequent and continuous operating equipment as pneumatic cylinder which helps the industrial for many operations say pick and place and other manufacturing operations. We designed an Industrial Parameters Monitoring System (IPMS) to monitor parameters like temperature and speed over a Local Area Network (LAN) to improve the efficiency and controllability of the pneumatic cylinder in smart factories. We use Arduino and Ethernet module for processing the real-time data from the respective sensors to have an efficient monitoring of the IPMS. The real-time values obtained from various sensors are stored in the database and processed via Arduino and displayed with help of LabVIEW dashboard (Temperature Monitoring) using LabVIEW interfacing with Arduino (LIFA) library files and webpage (Speed Monitoring) using Hypertext Markup Language (HTML). IPMS exhibits to be a high-yielding and low budget way for secure monitoring of the system. Also, the system is reliable, stable and has very good social prospects.***

***Index Terms*: IPMS, LAN, LIFA, HTML.**

I. INTRODUCTION

In the present-day scenario, Automatic and progressive systems used by manufacturing industries have workers to manually monitor the temperature and speed of the equipment. Due to human error in monitoring the equipment, it might lead to the failure of the whole system and thus causing the delay in productivity. Advancements in Communication technologies have helped in monitoring and controlling the equipment through computers and various other devices over a wired or wireless connection. This method to monitor parameters online via wired or wireless connection can help in reducing workload and human error for monitoring the system. The phrase Smart Industries and the concept of the Internet of Things (IoT) are used by most of the industrial companies because they help to serve and achieve the monitoring of parameters remotely and also to connect with other devices or systems for numerous industrial applications. These help industries to increase the performance of the existing equipment, work efficiently and have improved productivity. To monitor the parameters, various sensors operate and recognize the values which are processed via a microcontroller (Arduino Mega 2560). The resultant values are continuously displayed on the LabVIEW dashboard and webpage in terms of x-y axis graphs..

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II. SYSTEM ANALYSIS

A. DRAWBACKS OF EXISTING SYSTEM

Due to human error in monitoring the system, it might cause many catastrophic failures of the system. To avoid such kind of catastrophic failures of the system, a lot of labour-intensive power is essential to monitor the parameters. Even though using labour-intensive power, it may lead to some of the failures of the system and cause minor accidents. Thus monitoring and controlling of system endlessly is very hard and it also needs more workers.

B. PROPOSED SYSTEM

Industrial monitoring and control is a combination of mechanisms, architectures, and algorithms used in the industrial factory for observing and managing the activities of industrial processes, motors, machines and various other devices employed in industrial premises to achieve the required goal. Though it sounds good enough to have a smart industrial environment in the near future it will also have to face hurdles of handling big data as all the devices will communicate with each other and exchange their information over a common platform. The present project is concentrated on Industrial applications that will be continuously observed through a set of sensors. The sensor module collects the relevant data to decide whether the applications to be monitored are working effectively under certain threshold values. The aim of the project is to develop a prototype for monitoring real-time data by creating a Labview Dashboard and webpage to display and also by using pneumatic cylinder, solenoid valve, PLC.

III. IMPLEMENTATION OF IPMS FLOW

The IPMS flow design has three major blocks as shown in Fig 3.1 containing sensor, programming and display block. In this Paper, the sensor block uses temperature sensor, magnetic sensor and light sensor. The temperature sensor senses the temperature directly from the pneumatic cylinder and sends the data as input to the programming block. Fig 3.2 shows The two magnetic sensors A and B are fixed at two points on the cylinder, when the slider of pneumatic cylinder moves forward from A to B and backwards from B to A; it experiences the change in state from higher to lower or lower to higher with respect to sensor A and B. The light sensor is fixed in front of the pneumatic cylinder, which returns value to the

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programming block when the slider moves forward giving high value and returns low value when the slider moves backward. The function of light sensor is to evaluate the speed and compares with the magnetic sensor. The evaluated speed of both the sensors should match on proper functionality. If not, the position of the sensor or the operation of the sensor is not active.

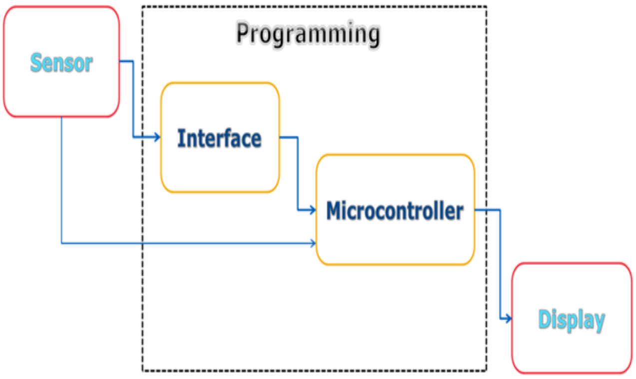

Fig 3.1 Flow of IPMS

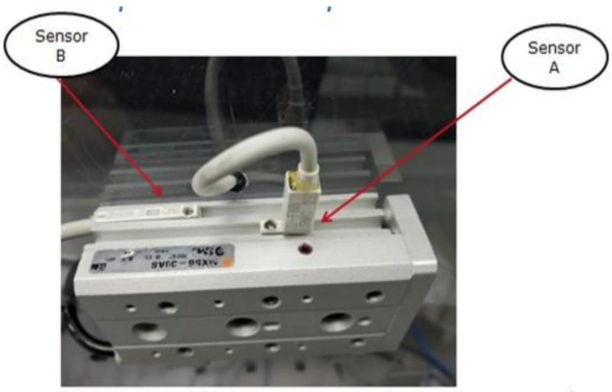

Fig 3.2 Magnetic Sensors A and B

IV. HARDWARE IMPLEMENTATION

Fig 3.3 indicates the prototype of IPMS where all the components are fixed on a hard plastic sheet. The magnetic sensor (BTH KT-50D-QD) along with switch (Push Button), solenoid valve and pneumatic cylinder is interfaced with PLC named KV NC32T through a wired connection to perform a basic forward and backward movement of the cylinder. The output of the magnetic sensors from PLC are stepped down from 24V to 5V using Octocoupler IC (PC817) and are given as input to the Arduino mega for evaluating speed of pneumatic cylinder. The light sensor (LM393) and temperature sensor (DS18B20) are connected directly to the Arduino mega to evaluate speed and temperature. The real-time data is stored to the database on phpmyadmin and updated on the webpage using the Ethernet module. The output is generated in terms of an x-y axis graph which relies on the onset values specified in the program. Temperature sensor which is fixed properly over the pneumatic cylinder senses the value and the sends the value directly to Arduino mega. Arduino is interfaced with LabVIEW using the library file LabVIEW interface for Arduino (LIFA). Testing and debugging of hardware is done to avoid errors.

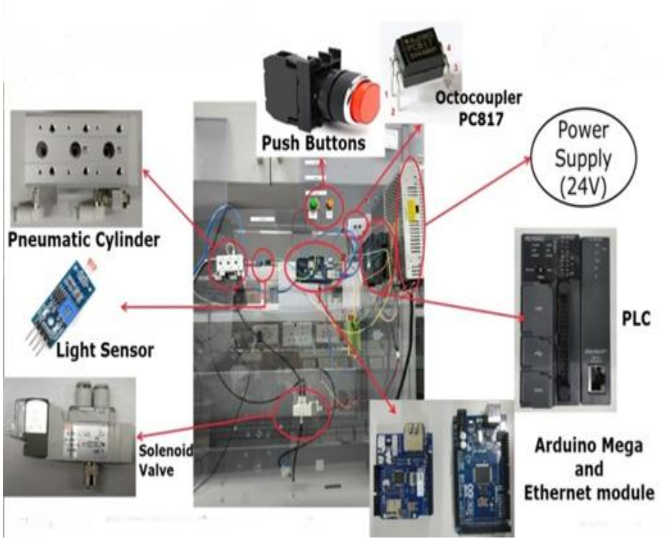

Fig 3.3 Prototype of IPMS

V. SOFTWARE IMPLEMENTATION

Software such as Keyence studio, Arduino IDE, LabVIEW was used to develop this prototype. Fig 3.4 a and b shows Keyence KV studio is used for ladder programming to interface various components like pneumatic cylinder, solenoid valve and switch with PLC to show basic forward and backward movement of cylinder with a 5 Sec delay. LabVIEW VI is designed to monitor temperature of the cylinder on the LabVIEW dashboard. Arduino IDE is used to evaluate the real time data from sensor and display it on a basic html web page.

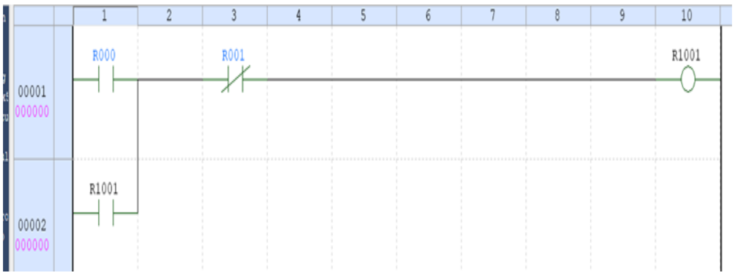

Figure 3.4 (a) Start and Stop of switch

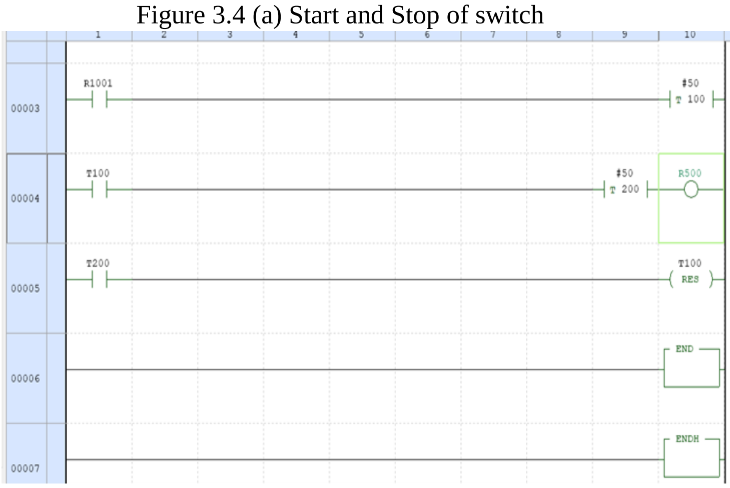

Figure 3.4 (b) Movement of cylinder with delays of 5 Sec Seconds

Fig 3.5 (a) and (b) shows the block diagram of LabVIEW and 3.5 (c) shows

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the front panel of LabVIEW. Create the events, notifier, and queues used for communication between the loops. It consists of four loops. First loop, for Start Button was pressed. Second loop, Initialize - Queue any messages required to start up the system. This loop will then wait for messages such as Start or Exit. Third loop, Acquire - Simulate acquiring data. Since this is a continuous acquisition, this message will always message itself to run again. Fourth loop, the notifier contains acquired data for updating the chart. When the Exit message is processed above, the notifier refnum will be released, which will stop this loop.

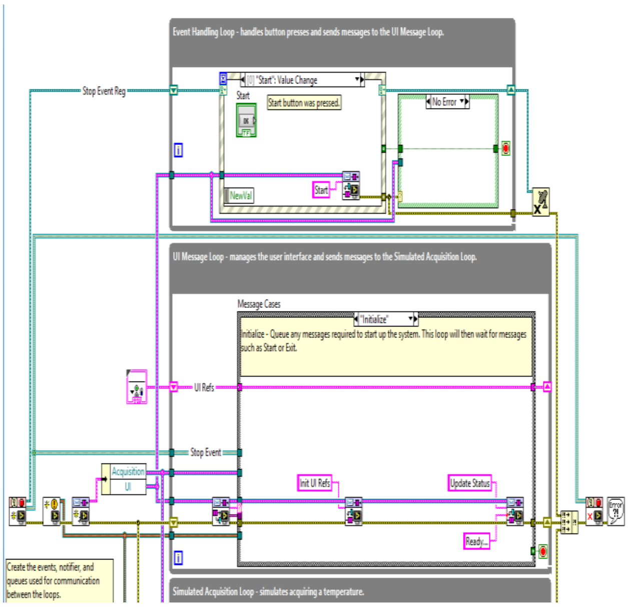

Figure 3.5 (a) LabView BlockDiagram

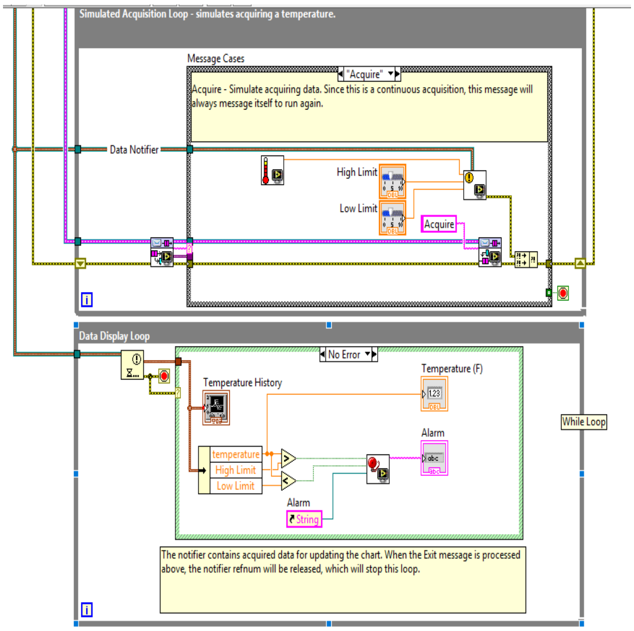

Figure 3.5 (a) LabView BlockDiagram

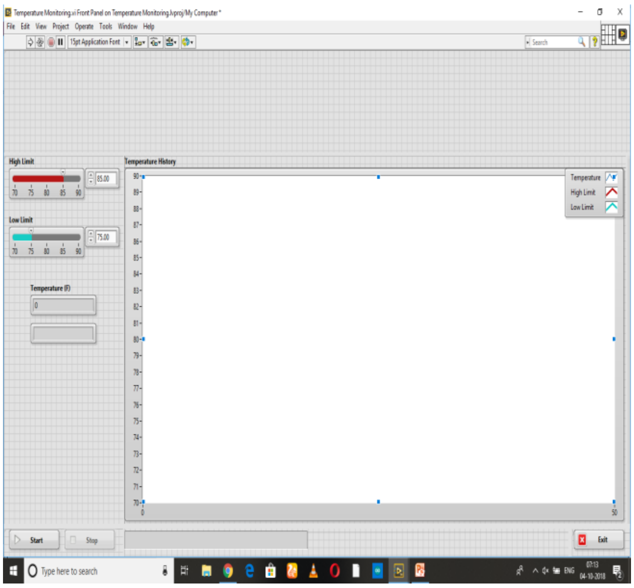

Figure 3.5 (c) LabView Front panel

Below is the overview of algorithm to be followed in programming to evaluate speed by getting sensor data as input and give appropriate output to monitor and control devices. Fig 3.6 shows the basic flowchart used in Arduino IDE.

Description:

i. Start

ii. Initialize the port

iii. Set the threshold values of Temperature, Speed.

iv. Receive the measured values from sensor at an interval of 5 Sec.

v. Display the measured values on the webpage.

vi. Compare the measured values with the threshold values.

vii. If measured value > threshold value, then send alert on display.

viii. If measured value < threshold value, it will go back and continuously check and display the sensor value.

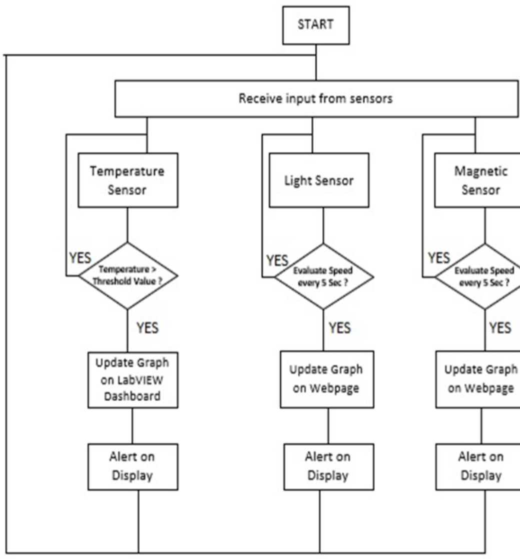

Figure 3.6 Flow Chart

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VI. RESULTS

Scheming and implementing the prototype, the VI's to monitor temperature run concurrently, and the output is detected on the front panel for temperature. In the front panel of the LabVIEW dashboard we can set the high and low limit of the varying temperature. Red and blue line respectively reflects the upper and lower limit of the temperature monitoring system. If the temperature goes beyond the specified high limit, then it gives an alert of "over temp". The real-time data of magnetic sensors are stored on the database through SQL database management on phpmyadmin. The real-time sensor data is displayed on the web page by entering the IP address of the Ethernet module connected to the system through Arduino mega and Ethernet cable on the web browser, which makes it a wired local area network.

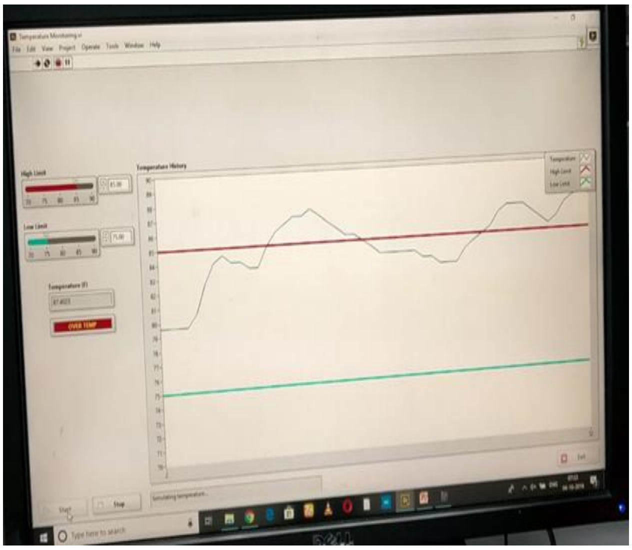


Figure 4.1 Temperature Monitoring (LabView)

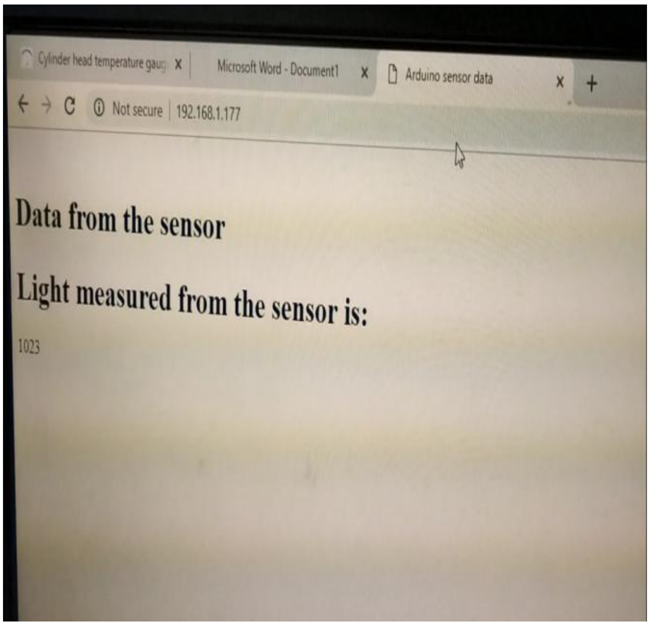


Figure 4.2 Displaying real-time data on webpage (Arduino IDE)

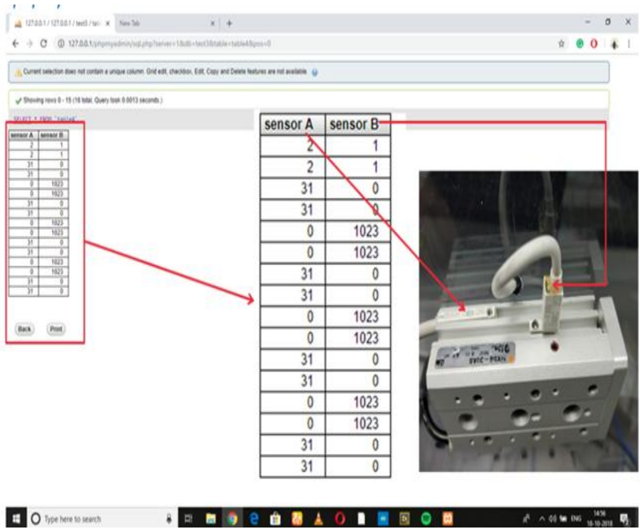
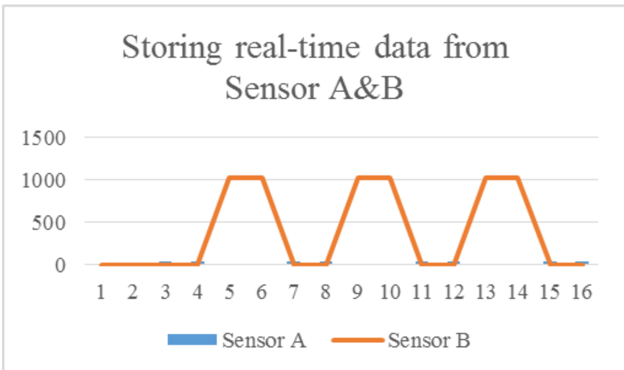


Figure 4.3 Storing real-time data in database (phpmyadmin)

Table 1: The Run-time analog values from the magnetic sensors A and B

Sensor A	Sensor B
2	1
2	1
31	0
31	0
0	1023
0	1023
31	0
31	0
0	1023
0	1023
31	0
31	0
0	1023
0	1023
31	0
31	0



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VII. CONCLUSION

This design and execution of the prototype to monitor the parameters in manufacturing industries by wired connection technique (Arduino mega and Ethernet module) will support in constantly observing the manufacturing systems and to regulate the system if they are passing outside the onset values. This set forth an important framework for implementation into the smart factory systems for live monitoring of the systems and helped workers operate the machines appropriately based on their temperature and speed monitoring, and would help detect any catastrophic failure before it occurs. The proposed work can be improved by adding features like replacing Arduino with raspberry pi, shifting Wired Network (Ethernet) to Wireless Network (Wi-Fi) and add more parameters in future to create an unfailing smart Manufacturing monitoring and controlling system.

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