Remote Monitoring DAQ for CNC Machines

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Abstract— Real time monitoring system is the advanced technique used to monitor the current process of various machines. It provides the data to administrators with clear visualization into the data to the administrator, in this paper, we focus on CNC machines to monitor and communicate the data through visual insights. RTDM achieves automatic monitoring of data and provides constant data information, which can be analysed and reviewed, Major developing industries are lagging behind the monitoring process during their production. In order to increase the productivity on monitoring the CNC machines in various operations several parameters are used for this monitoring process to detect the stages such as operating time, ideal time and break down time of the CNC machines can be viewed and monitored at the current environment. In addition, these three timings are calculated as efficiency of CNC machines. For this process, various sensors are used to monitor the stage of operation such as temperature sensor; vibration sensor, limit switches and flow sensors can be used for continuous automation process in real time applications.

Keywords: Efficiency, Availability, Down Time, Wireless Communication

I. INTRODUCTION

Remote monitoring system is very useful for various applications. For this project, I have used this system to monitor the number of CNC machines in Manufacturing industries. This real time monitoring system helps to monitor the critical parameters, alignments of the movements and more parameters. The trending technology IoT's involvement plays the major role in this project. The IoT allows objects to be sensed and/or controlled remotely across existing network infrastructure, creating opportunities for more integration of the physical world into computer-based systems, and result in improved accuracy, efficiency and economic benefit. The IoT is rapidly increasing and promising technology which becomes more and more present in our everyday lives. Major developing industries are focusing to develop such kind of solutions to prevent their machines from breakages.

II. LITERATURE REVIEW

This author creates online monitoring technology in CNC Machining operations to eliminate post process. Vibration, limit switches are the key parameters of this monitoring system. Author mainly focus on surface finishing, tool wear and tear. García Plaza - August - 2019

This author monitors the operators in that manufacturing industry to improve the production rate and other usages. This monitoring system based on wireless communication and RFID attendance to check their presence. Rahul D. Chavhan - July 2013.

This author discussed about flexible manufacturing using IoT. And connected things are working more customized products along with better quality. This paper mostly based on only analytics and communication involved instead of hardware data collection. Ray Y.Zhong - October 2017.

This paper introduces IoT for real time machine status monitoring and shows in a graphical interface. After that, this platform provides a machine availability to plan next orders or raw materials. This is attracted many industries as cloud manufacturing. Ray Y.Zhong - August 2017.

This author uses real time monitoring for Hot stamping process manufacturing process. And it inspects heating, hydraulic flow, uneven tool wear and some other parameters. This system only shows the values to ensure all the parameters are in defined values or abnormal. Robert Vollmer - April 2019.

We conclude monitoring system from above papers is less benefits gained from more investments and more works. Our project monitors various parameters from the machines to take decision either the machine status running or idle. And also store all the values in the database for future analytics.

III. PROJECT FLOW

Data Acquisition system helps to read all the required data from the machine. By using various sensors like vibration senor, flow sensor, accelerometer, limit switches, relays and manual buttons. This system having above mentioned sensors, relays, push buttons, microcontroller, Wi-Fi module and power supply unit. These are the components used in this project as a hardware part. By using above things, the data acquisition system prepared and get values from the machines. The data sent to database through WiFi module with internet access. Based on industry's range of timings, we have assigned the idle time, running time, flow rate of coolant oil and vibration rate.

Fig. 1: Testing of the project

A. Selection of Algorithms

It is an essential process to choose an efficient algorithm which suits all type of CNC based machines and circumstance. The algorithm selection is not limited to single domains. For this application, I choose dynamic programming algorithm, edge detection algorithm. Which is changed the pre-set parameters for current values so accuracy is maintained continuously. And planned to improve the project by using machine adaptive learning algorithms. Yes, adaptive learning algorithms are very useful to predict the breakage issues and analysis, Sudip Misra, December 2012 [4].

B. Implementation

The project will be implemented in the production and manufacturing based industries. Data acquisition system (DAQ) connected to machines. This will collect all the required parameters and send to the main server. Data logging program execute to log data from the DAQ. Also shows the status in graphical interface that access through internet.

C. Edge Detection

All the valuable parameters are needed to send to main server. Other parameters are not required to log. So, Edge detection algorithm cut unwanted values in the data packet. This process saves the memory in server, data traffic, data loss and accurate timing.

D. Testing

This project tested in laboratory machines. And implementing in industry work is ongoing. Sensors, relays, limit switches and major input parts tested in laboratory environment. The first testing of this project photocopy attached below Fig 4.2 Testing of the project. In that picture that shows the control panel of CNC machines, connected our DAQ and personal PCs. The signals are tapped from limit signals, sensors are fixed that positions are important factors to avoid the wrong capturing possibilities.

IV. Working of Data Acquisition System

Data Acquisition system helps to read all the required data from the machine. By using various sensors like temperature sensors, vibration sensor, accelerometer sensor, limit switches, relays and manual buttons. This system having sensors, relays, limit switches, push buttons, microcontroller, Wi-Fi module - ESP device [5] and power supply unit. These above sensors are having more than 1-meter wire to connect various places in CNC machines to collect values of flow, vibration of tool, vibration of motor, vibration of workplace, tool changer movement area.

The data acquisition system consumes energy based on its working and connected sensors. The device working in 3.3v operating voltage. And maximum power consumption rate is <1Watt. So, as a industry don't bother about energy consumption calculation.

V. Design and Implementation

In this section, we present a protocol designed to minimize disruptions in connectivity between machine and server. Because of the communication interruption creates data losses to increase the wrong values and bad decisions. To avoid this data traffic and interruption, we focus on improving the underlying IP based communication and using the standard protocol called HTTP. Each device has static IP instead of dynamic IP. Static is more convenient than dynamic IP. In some environments, providing continuous connectivity to applications may also require higher-layer techniques. In that cases we can use Ethernet communication to increase the speed of data transmission.

VI. Software Development

Software development is useful for data logging remote visualizing and more. Server can work as a master. All the programs are written here which are doing data logging, data-manipulating, conversion, front end design, analysis, graphs, report generation, messaging, mail alerting and more. This part included with cloud server also. IoT software addresses its key areas of networking and action through platforms, embedded systems.

It ensures the necessary cooperation and stable networking between devices. Actually, IoT enables hardware into a software operating method. Same concept applied here [3]. From the database, all the valid parameters are manipulated by programming in software side. That allows plug ins to show the graphical interface to the user. The other parameters are going back to same database. This software interface very helpful for operator and supervisor.

VII. Calculations

Efficiency = (Running Time / Planned Time) x 100

Availability = (Running Time / (Running Time + Idle Time)) x 100.

Production Rate = (Number of components produced/ Number of components calculated) x 100.

VIII. Result

This project explained the status of machine, cycle time, availability, vibration applied and etc. These parameters contained screenshot is shown in Figure 8.1 Result.

Fig. 2: Home Page

This system gives more benefits to CNC based manufacturing industries. Such as,

1) Decrease the down time of the machines.
2) Helped to pre-calculation of availability of the machines.

3) The sensor values are more important parameters for service time. So, based on sensor values the service also calculated.
4) Indirectly monitor the operator's performance based on the production rate.
5) Efficiency gives machine's life and help to decide the machine under productivity or not.
6) After this system installed the industry, the down time reduced. Its graph shows in figure 8.2.
7) Compared same specifications machines are gives same results or not. This graph shows in figure 8.3.

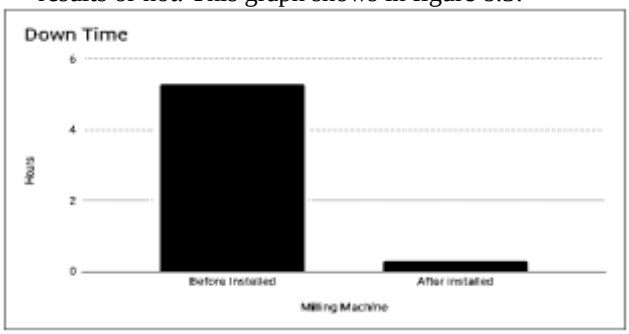

Fig. 3: Down time comparison

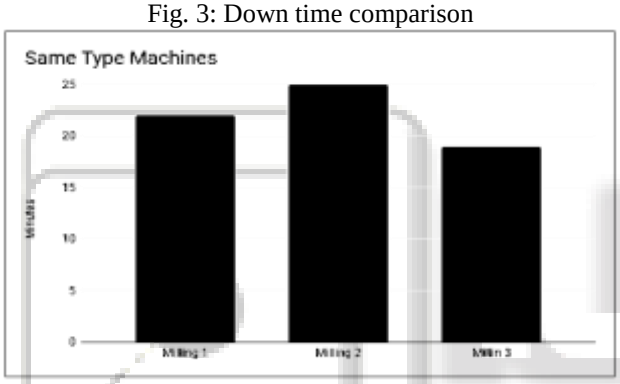

Fig. 4: Same type machine's comparison

IX. CONCLUSION

This project presents a real-time monitoring system based on IoT technology. The proposed idea offers an effective and efficient alternative for acquiring knowledge useful for supporting the decision-making process to evaluate worker behaviour in real time. To achieve the online, real-time, intelligent tracking identification feature, the monitoring system included many functions such as the worker emergency call facility, a track history of what actually happened, and the ability to query what is happening in a specific location. An Internet of Things, where the sensing and actuation functions seamlessly blend into the background and new capabilities are made possible through access of rich new information sources.

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