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BUILDING A SIMPLE SMART FACTORY

by

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Date & Venue

11:30 AM
Thursday, 23 May 2019
Room 1043 (ME meeting Room), F1 Building

Abstract

This thesis describes (a) the search and findings of smart factories and their enabling technologies (b) the methodology to build or retrofit a smart factory and (c) the building and operation of a simple smart factory using the methodology. A factory is an industrial site with large buildings and collection of machines which are operated by persons to manufacture goods and services. These factories are made smart by incorporating sensing, processing and autonomous responding capabilities. Developments in four main areas (a) sensor capabilities (b) communication capabilities (c) storing and processing huge amount of data and (d) better utilization of technology in management and further development have contributed significantly for this incorporation of smartness to factories. There is a flurry of literature in each of the above four topics and their combinations. The findings from the literature can be summarized in the following way. Sensors detect or measure a physical property and records, indicates, or otherwise responds to it. In real-time they can make very large amount of observations. Internet is a global computer network providing a variety of information and communication facilities and the internet of things, IoT, is the interconnection via the Internet of computing devices embedded in everyday objects, enabling them to send and receive data. Big data handling and provision of data services are achieved through cloud computing. Due to the availability of computing power the big data can be handled and analyzed under different classifications using several different analytics. The results from these analytics can be used to trigger autonomous responsive actions that make the factory smart. Having thus comprehended the literature a seven stepped methodology for building or retrofitting a smart factory was established. The seven steps are (a) situation analysis where the condition of the current technology is studied (b) breakdown prevention analysis (c) sensor selection (d) data transmission and storage selection (e) data processing and analytics (f) autonomous action network and (g) integration with the plant units. Experience in a cement factory highlighted the wear in a journal bearing causes plant stoppages and thus warrant a smart system to monitor and make decisions. The experience was used to develop a laboratory-scale smart factory monitoring the wear of a half-journal bearing. To mimic a plant unit a load carrying shaft supported by two half-journal bearings were chosen and to mimic a factory with two plant units, two such shafts were chosen. Thus there were four half-journal bearings to monitor. USB Logitech C920 webcam that operates in full-HD 1080 pixels was used to take pictures at specified intervals. These pictures are then analyzed to study the wear at these intervals. After the preliminary analysis wear versus time data for all four bearings are available. Now the 'making smart activity' begins. Autonomous activities are based on various analyses. The wear time data are analyzed under different classifications. Remaining life, wear coefficient specific to the bearings, weekly variation in wear and condition of adjacent bearings are some of the characteristics that can be obtained from the analytics. These can then be used to send a message to the maintenance and supplies division alerting them on the need for a replacement shortly. They can also be alerted about other bearings reaching their maturity to plan a major overhaul if needed.

Keywords: smart factories, autonomous, IoT (Internet of Things), Big data, cloud computing, journal bearing.