Analysis of Manufacturing Device's Real Time Data Using Iot And R Programming To Detect Early Fault

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Abstract- *At present Industries have become more advancement in technology due to development in the field of big data, cloud computing and other technology. In many manufacturing factories the devices are been monitored manually. Therefore this directly affects the service life of industry equipment and its production efficiency will is reduced . Unless we monitor the device health on a daily basis, the device health and production efficiency cannot be made efficient. In this project, we proposed sensors such as temperature sensor, vibration sensor, gas sensor to detect the manufacturing device health and the real sensor data are obtained into systems by using COM port and the obtained data are processed using Net beans platform and saved in SQL database. The saved real data are encrypted using RSA algorithm and stored in public cloud storage which can be viewed by admin and user. The real time data are processed from java Net beam platform as an excel file to R programming studio. In R programming clustering and classification are processed and predicted. The data can be monitored by both workers and admin for efficient production.*

Keywords- Active preventive maintenanca, Rprogramming, RSA algorithm, Clustering, Classification.

I. INTRODUCTION

The main idea of this project is to classify the manufacturing big data into three types namely device data, product data and command data. Using the cloud platform the collected manufacturing big data can be processed for active maintenance. Equipment maintenance plays a important role in production of manufacturing devices and therefore it affects the service and life time of equipment. Current methods for equipment maintenance depend only on system alarms, and an operator need to reports faults to equipment maintenance team. The fault then needs to be exactly located and the problem must be rectified, leading to a shutdown I ann the production process. With the support of manufacturing big data, device data can be collected in real-time, including device alarms, device logs, and device status, in order to evaluate the health condition of manufacturing equipment and preemptively detect breakdowns. Therefore, active preventive maintenance is proactive and can find problems earlier.Active preventive maintenance for intelligent manufacturing is now feasible through data collection and big data analysis. we proposed sensors such as temperature sensor, vibration sensor, gas sensor to detect the manufacturing device health. The sensors sense the data from the manufacturing equipment and the sensed data are obtained by ardunio microcontroller and the processed data are obtained into system using RS232 serial cable into the system . where the collected big data are encrypted using RSA algorithm and stored in the cloud storage with the help of Netbeam platform the analysis are done for obtained data. In analysis phase the given criteria are checked and the data are stored in sql database and stored in an excel file. In R programming clustering and classification are processed and predicted. In clustering K-means algorithm is used and in Classification naive bayes algorithm is used. The data can be monitored by both workers and admin. so we can detect the problem earlier by comparing the real-time active maintenance mode and the traditional maintenance mode to validate its viability and effectiveness.

II. SYSTEM ANALYSIS AND REQUIREMENTS

A. ARDUNIO MICROCONTROLLER

Arduino is an open source computer hardware and software company, project, and user community that designs and manufactures single board microcontroller and microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical and digital world. The Arduino Uno R3 is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter.

B. TEMPREATURE SENSOR

A simple temperature sensor using one LM35 precision Integrated-circuit temperature device with an output voltage linearly-proportional to the centigrade temperature. It can measure temperature from -55c to +150c. The voltage output of the LM35 increases 10mV per degree Celsius rise in temperature. LM35 can be operated from a 5V supply and stand by current is less than 60μA.The purpose of this sensor in this system is to monitor the temperature on the manufacturing .It is designed that whenever the temperature goes beyond certain temperature level and are obtained and stored in the database for future analysis. Temperature sensor LM35 is interfaced to the microcontroller. The conversion of Celsius and Fahrenheit is done by certain formula.

C. VIBRATION SENSOR

The electronics and components within machines begin to move back and forth, the vibration is preventing a smooth flow of energy. The flow is interrupted, hence the noise and the shake. Typically its overload due to some sort of stress, or the components themselves may have reached their useful life—gears, teeth, bearings, or belts may be in the process of failure. Vibration analysis is used as a tool to determine a machine’s condition and the specific cause and location of problems, expediting repairs and minimizing costs. Monitoring vibration on induction motors is at the core of any predictive maintenance program. Typical applications demand vibration measurements in the horizontal, vertical and axial direction on both the inboard and outboard motor bearings. Aside from typical mechanical issues, such as misaligned couplings and unbalance, the vibration analyst can also detect electrical issues that cause mechanical vibrations. Some common electrical faults include air gap variation, broken rotor bars and bearing fluting. The features are input voltage 5V, input voltage 3.3-5V.

D. GAS SENSOR

The MQ-2 smoke sensor is sensitive to smoke and to the following flammable gases such as LPG, Butane, Propane, Methane, Alcohol, Hydrogen. The resistance of the sensor is different depending on the type of the gas. The smoke sensor has a built-in potentiometer that allows you to adjust the sensor sensitivity according to how accurate you want to detect gas. The voltage that the sensor output change accordingly to the smoke level that exits in the atmosphere. The sensor output a voltage that is proportional to the concentration of smoke. The MQ-2 sensor has pin, A0, D0, GND and VCC is 5V.

II.I BENEFITS

- Production Efficiency can be made through the analysis of collected big data.
- Active preventive maintenance is proactive so we can find problem earlier.
- Fault can be exactly located and it can be rectified.

II.II CHALLENGES

- How should real-time active maintenance be efficiently analyzed.
- How should an algorithm be designed for prediction and analysis to evaluate the service life of equipment and provide early detection of problems.

III. RELATED WORK

In [1], This article explores data processing of manufacturing big data for active preventive maintenance, from the perspective of the implementation of Industry. There are three main contributions of this paper are cloud-based system architecture for collection of manufacturing big data is designed for industrial environments. Data processing including real-time active maintenance and off-line analysis and prediction in the cloud is provided. The off-line prediction algorithm is then implemented in a machining center to validate its viability and effectiveness. The remainder of this introduces related work regarding data collection, big data and cloud computing in manufacturing, and equipment maintenance.

In[2], This article proposes the concept of smart and connected communities. which is a unified framework integrating smart cities and beyond. Different from big cities, small communities call for culture preservation in addition to revitalization. IoT technologies could potentially serve this need. This article develops an IoT architecture, and choose best IoT enabling technologies, and IoT services, applications, and standards, towards this goal. The purpose of this article is to introduce a novel concept called ”SCC” whose vision is to improve livability, preservation, revitalization, and sustainability, of a community, different from so-called smart cities. In this article, we shed light on the opportunities and challenges of applying IoT and big data analytics to culture preservation and revitalization of SCC. We expect that the intelligent use of IoT and big data analytics could breathe new life into traditional, close-knit culture of SCC. One important application of IoT and big data analytics is smart cities which will use the power of ubiquitous communication networks, highly distributed wireless sensor technology, and intelligent management systems to solve current and future challenges and create exciting new services

In [3], This paper describes the implementation of controlling physical parameters through IoT applications with GSM module. The ever increasing requirements for information being accessible at any time, from any place, regardless the type of remote device or planned operation, together with the need of complete control of a specific scenario or device has paved the way towards the next technological revolution: Internet of Things (IoT). In this project, the parameters are sensed by the respective sensors and are monitored by the individual microcontrollers. Finally, the values are displayed with the help of individual LCD displays. The microcontroller is connected to the PC through zigbee bus and the output will be displayed in that PC with the help of RS232 serial communication. This data is stored in the Pc and uploaded to the cloud. The system is reliable and stable. It is the most effective and most economical means of equipment safety monitoring.

In [4], This paper discusses the limitations of time-based equipment maintenance methods and the advantages of predictive or online maintenance techniques in identifying the onset of equipment failure. The three major predictive maintenance techniques defined in terms of their source of data, are the existing sensor-based technique; the test-sensor-based technique (including wireless sensors) and the test-signal-based technique. Examples of detecting blockages in pressure sensing lines using existing sensor-based techniques and of verifying calibration using existing-sensor direct current output are given.

In [5], The purpose of this paper is to provide a comprehensive solution for industry through research and development of an Internet of Things (IoT) based Cyber Physical System for Industrial Informatics Analytics with the following objectives. This study conducted a review regarding big data analytics in industry and designed a cyber-physical system with the integration of various existing and proprietary data analytics systems based on their business needs so that the modules can be reconfigurable and interchangeable. The paper designs a new context intelligence framework to handle industrial informatics regarding location, sensor and unstructured data for big data mining. A case study is used to illustrate the concept of the proposed cyber physical system. Further study on system integration and migration from existing factories to smart factories should be conducted so as to realize the next industrial paradigm shift.

In [6], Cloud computing is changing the way industries and enterprises do their businesses in that dynamically scalable and virtualized resources are provided as a service over the Internet. This model creates a brand new opportunity for enterprises. In this paper, some of the essential features of cloud computing are briefly discussed with regard to the end-users, enterprises that use the cloud as a platform, and cloud providers themselves. Cloud computing is emerging as one of the major enablers for the manufacturing industry; it can transform the traditional manufacturing business model, help it to align product innovation with business strategy, and create intelligent factory networks that encourage effective collaboration.

IV. PROPOSED SYSTEM

In this project, we proposed sensors such as temperature sensor, gas sensor and vibration sensor to detect the manufacturing device health.

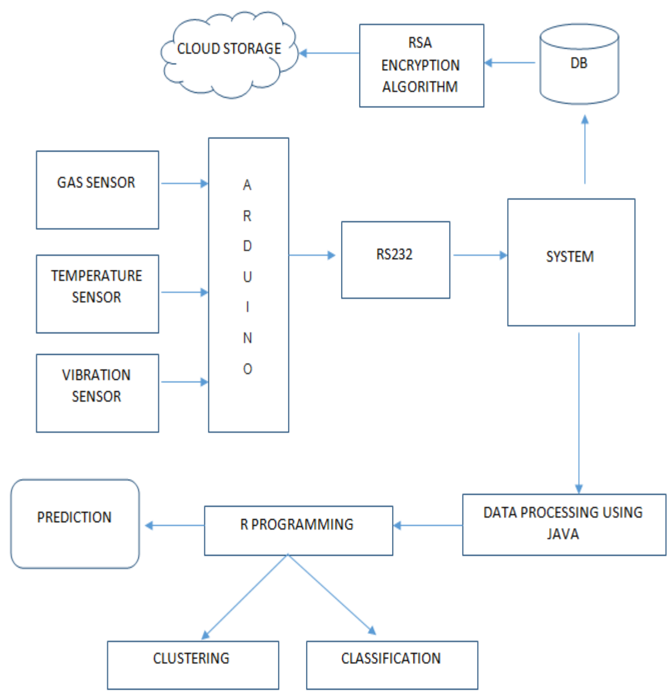

Figure 1.1 Architecture diagram

The sensors collect the real time data from manufacturing device and the data is sensed by ardunio board and it is sent to the system using RS232 serial cable to the system and the real sensor data are obtained into systems using COM port and the real time data are obtained using Net beans where processing is done and saved in SQL database. The real data are encrypted using RSA encryption algorithm and stored in public cloud storage which can be viewed by admin and user. The real time data are processed from Net beans as an excel file to R programming studio. In R programming clustering and classification are processed and predicted. In clustering K means algorithm is used and in classification naive bayes algorithm is used. From the result we can state the manufacturing device health.

A. K-MEANS ALGORITHM

k-means is one of the simplest unsupervised learning algorithms. The procedure follows a simple and easy way to classify a given data set through a certain number of clusters fixed apriori. The main idea is to define k centers, one for each cluster. The next step is to take each point belonging to a given data set and associate it to the nearest center. When no point is pending, the first step is completed and an early group age is done. At this point we need to re-calculate k new centroids as barycenter of the clusters resulting from the previous step. After we have these k new centroids, a new binding has to be done between the same data set points and the nearest new center. A loop has been generated. As a result of this loop we may notice that the k centers change their location step by step until no more changes are done.

$$J(V) = \sum_{i=1}^{c} \sum_{j=1}^{c_i} \left(\| x_i - v_j \| \right)^2$$

<u>Algorithmic steps for k-means clustering</u>

Let $X = \{x_1, x_2, x_3, \ldots\ldots, x_n\}$ be the set of data points and $V = \{v_1, v_2, \ldots\ldots, v_c\}$ be the set of centers.

1) Randomly select *'c'* cluster centers.

2) Calculate the distance between each data point and cluster centers.

3) Assign the data point to the cluster center whose distance from the cluster center is minimum of all the cluster centers..

4) Recalculate the new cluster center using:

$$v_i = (1/c_i) \sum_{j=1}^{c_i} x_i$$

where, 'c_i' represents the number of data points in i^{th} cluster.

5) Recalculate the distance between each data point and new obtained cluster centers.

6) If no data point was reassigned then stop, otherwise repeat from step 3.

B.NAIVE BAYES ALGORITHM

It is a classification technique based on Bayes theorem with an assumption of independence among predictors. In simple terms, a Naive Bayes classifier assumes that the presence of a particular feature in a class is unrelated to the presence of any other feature. Bayes' theorem is a formula that describes how to update the probabilities of hypotheses when given evidence. It follows simply from the axioms of conditional probability, but can be used to powerfully reason about a wide range of problems involving belief updates.

Given a hypothesis *H* and evidence *E*, Bayes' theorem states that the relationship between the probability of the hypothesis before getting the evidence *P(H)* and the probability of the hypothesis after getting the evidence *p(H/E)* is

$$P(H \mid E) = \frac{P(E \mid H)}{P(E)} P(H).$$

V. MODULES DESCRIPTION

A. IMPLEMENTING AND INTERFACING SENSOR

In this phase sensor senses values from the manufacturing devise. Sensor such as temperature, vibration, gas read the data from the manufacturing device health and records the data and sent the value to the ardunio microcontroller as the input. Sensor read the value continuously and checks it.

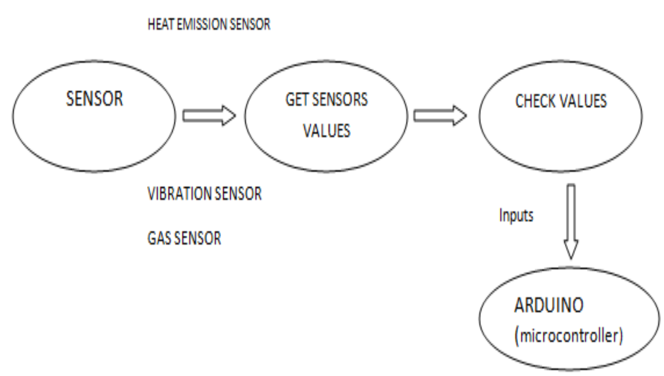

Figure 1.2 Dataflow Diagram for sensing value

B. PROGRAMMING MICROCONTROLLER AND DATA COLLECTION USING

In this phase ardunio microcontroller get the input from the sensor devices and it reads the data. Through RS232 Serial cable the value are sent to the system. Where data processing is done in Net beam platform it processes the data and the processed data are stored in cloud storage.

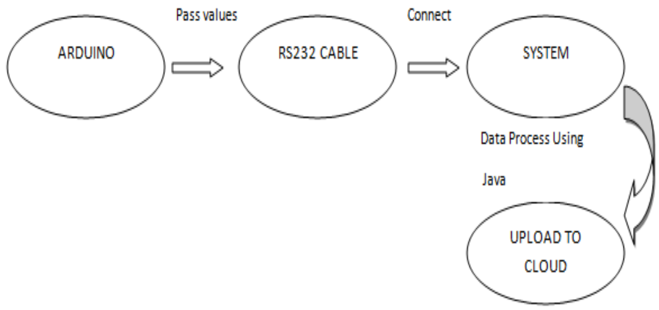

Figure 1.3 Data flow diagram for data processing

C. R PROGRAMMING ANALYTICS

In this phase clustering and classification are done for bigdata. The data collected are analysed and processed. In R programming the processes are done and the result can be viewed by the user or admin. In clustering phase K-means algorithm are used the main idea is to define k centers, one for each cluster. The next step is to take each point belonging to a given data set and associate it to the nearest center and in the classification phase Nave Bayesian algorithm are done. It is a classification technique based on Bayes theorem with an assumption of independence among predictors it follows simply the conditional probability functions.

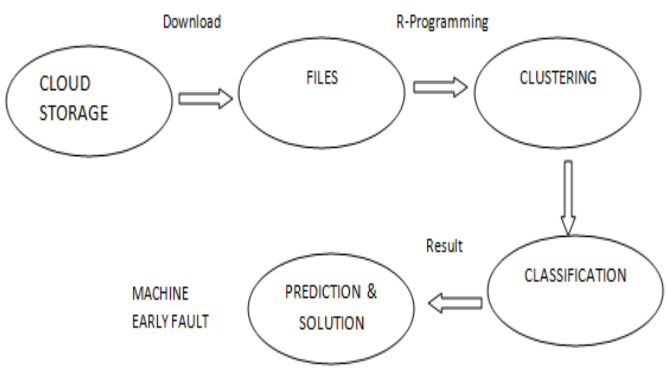

Figure 1.4 Data flow diagram for prediction

VI. CONCLUSION

Implementation of early fault detection in industry can be done by big data analytic. The sensed values are processed in arduino and stored in the cloud storage where the data can be accessed easily. The big data are processed in r programming studio where the clustering and classification are done. From the processed result we can detect early fault in devices. The result can be viewed by admin/user through their devices.

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