PREDICTIVE ANALYSIS FOR PRODUCTION LINE USING RNN ALGORITHM

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Abstract - *Tamil Nadu has 36,000+ factories categorized under the Annual Survey of Industries, which was 16.6% of the total 2,22,120 factories covered under Annual Survey of India. In the long run, all machines will break down due to aging and operating at a higher load than its performance limits, etc. Sometimes a fault in a single machine can halt the operations of all other associated machines assigned for a particular task. In Industries, mostly maintenance has been done periodically. If the breakdown occurs between the intervals, it is left out of no choice, other than Repair and replace. Over 82% of companies have experienced unplanned downtime in the past three years and that unplanned downtime can cost a company as much as $260,000 an hour. To compensate the losses in business and to increase the overall gain, all industries tried to follow a new strategy of running the machines continuously to its limit by making the industry as a functioning one for 24*7. Though, the industries tried a new effective strategy, the industries can't be able to meet their expected profit due to frequent machine failures and increased downtime. When a machine in the Production or Assembly line fails, all other associated machines used for that particular process remain useless though these machines were functioning well. This is where Machine Learning comes into play. In this paper, we implemented a solution for the problem mentioned based on IOT, Data Mining and RNN algorithm.*

Key Words: Industries, Machine halt, Internet Of Things, Machine Learning, Data Mining, RNN.

INTRODUCTION

Frequent unplanned breakdown of machines causes the industrialists unable to reach their Manufacturing targets on time. This affects the Trust of their customer and brand name of the company which results in 30% reduction in transactions between them. Maintenance Engineers can't be able to adopt the existing solution to deploy all over the industry. It is difficult to spot the defect and understand the reason for failure as soon as the machine fails. Research & Development Group won't be able to access large numbers of accurate live data through conventional monitoring systems, which slows them from reaching their results. To overcome the above-mentioned problem, the solution is based on integration with IoT stuff. In general, predictive analysis methods, the solution kit will be only dedicated for a particular machine. It becomes very hard for the small MSME's to implement in their own industries. The current solution is, different solutions for different problems in machines. Our solution idea is to implement the same solution for different problems in machines with different kinds of industrial protocols to transmit data without any loss.

LITERATURE SURVEY:

1. **Method and system for anomaly detection using a collective set of unsupervised machine-learning algorithms.**

An anomaly detection system comprising, one or more distributed sensors for gathering network or log data; one or more generators for generating discovery rules based on a collective set of pattern discovery algorithms including one or more unsupervised machine learning algorithms; one or more detectors for detecting abnormal patterns in the network.

2. **Process and system for monitoring and controlling manufacturing of plastic containers**

A method of manufacturing and certifying operation of a system for producing plastic containers using equipment having at least one controllable action that affects quality of container produced by the equipment includes inspecting raw materials for parameters that affect manufacturability and acceptability of containers produced from materials.

3. **Research on Temperature and Humidity Prediction Model of Granary Based on RNN**

This paper studies the temperature forecasting model of grain bins with short-term or small data set temperature data and time series characteristics in the case of relatively short-term temperature changes or relatively small datasets of stored grain and food conditions. Input three temperature and two humidity, use SPSS for principal component analysis, process the collected data, and use the pre-processed group data to build the model.

METHODOLOGY:

There will be a DAQ (Data Acquisition System) which will be fitted onto machines which collects the vital parameters of machines like temperature, vibration, current and voltage through plurality of sensors which will be stored in .csv file. After Data Mining this .csv file will be sent to RNN algorithm where we will predict the failure of the machine. This predicted data will be sent to firebase and there already we will maintain a threshold value. Based on the threshold limit the user will be notified with SMS whether the machine in safe or unsafe condition. Moreover, we will be displaying the live data through dynamic web application.

MODULES

Dataset and Fields Module:

The dataset comprises four fields namely Temperature, Vibration, Current, Voltage were these are the parameters which majorly impact in a machine failure. Since, this is a time-series data RNN algorithm suits more perfect than any other algorithm. This RNN algorithm belongs to neural networks.

Interaction Module:

Interaction Module contains plurality of sensors that can find the interactions between the customer and the product. These sensors are made to communicate with each other by using Raspberry pi that also contains an inbuilt Wi-Fi module. These interaction data collected are transmitted using raspberry pi.

Cloud Module:

The data from the Raspberry pi is uploaded to the firebase cloud. The cloud storage contains all the views and interactions done by the users and can be used for analysis.

Analysis Module:

The data from the Cloud module is taken and various algorithms are used to predict the future of the product.

Dashboard Module:

The Maintenance engineer can view all the interaction details in the dashboard. The dash board is developed using html, java script and bootstrap. It is designed in very user-friendly manner and it also displays the views and interactions done to the product in line graphs.

The workflow of the proposed system is presented below,

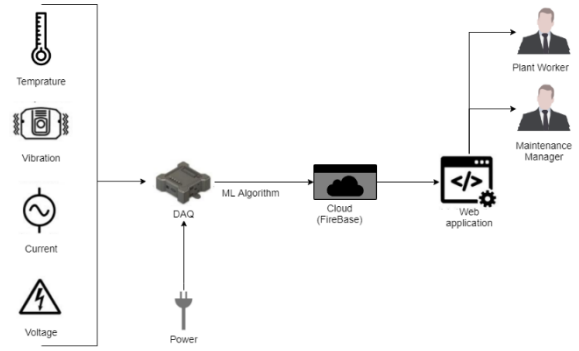

Fig 3.1 MODULE DIAGRAM

ALGORITHM

RNN algorithm is used to predict the failure of the machine. In this algorithm sensors data are used as parameters. The current values are compared with past values to predict the machine failure. The pseudocode of the algorithm is,

- *Input the parameters (sensors data) from the database*
- *Compare the parameters with past values record data*
- *Predicting the values for individual sensor using RNN algorithm*
- *Send the output to the dashboard*

EXPERIMENTAL RESULTS

We have used an actual dataset that collected using plurality of sensors from the machines. This dataset comprises four fields namely Temperature, Vibration, Current, Voltage were these are the major parameters which impact in a machine failure. Since, this is a time-series data RNN algorithm suits more perfect than any other algorithm. This RNN algorithm belongs to neural networks. This takes temperature, vibration, current, voltage as input parameters and predicts individual parameter value using this algorithm. Based on the predicted values we will come to a conclusion whether the machine is in safe or unsafe condition. So, the predicted live data and the overall all safe or unsafe condition will be displayed through web application.

COMPUTATIONAL RESULTS

- In the interaction module, sensors sense the temperature, vibration, current, voltage data then process the data using RNN and sends the output data to cloud module.
- In cloud module, the predicted are stored and send to the dashboard for data visualization.
- In analysis module, RNN algorithm is used based on the temperature, vibration, current, voltage data which are collected using the sensors.

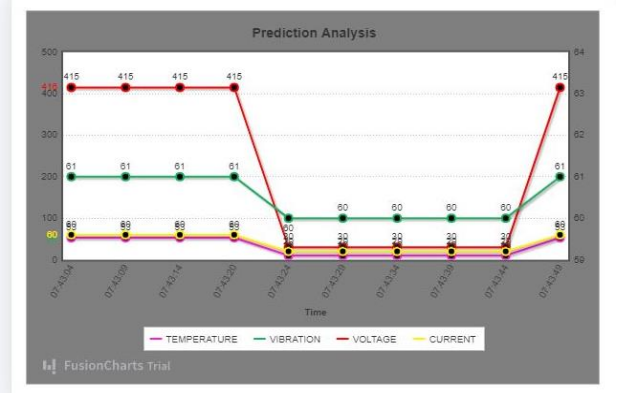

Fig 5.1. Module 1

- In dashboard module, Line graphs and cards are used to display the outputs.

Fig 5.2. Module 2

CONCLUSION

Our main focus and the value we provide is "**modularity**" which means the product will be able to easily integrate with all machines in all over the industries. Through this solution, we will be able to reduce "**5-7%**" loss of overall turnover of an industry. The predictive mechanism ensures in reducing loss for repair of failed machines which we can be identified with the exact location of failure in a machine part.

FUTURE SCOPE

- Using the same product, we can able to monitor CT and MRI machines
- It should be implemented in a machine environment for at least 1 months to obtain the result from the prototype.
- The algorithm can further be developed to improve the efficiency.
- Based on user requirements the dashboard can be improved.

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