

Prognostic Based Resource Monitoring System

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Abstract - Data mining is a concept that is taking off in the commercial sector as means of finding useful information and patterns out of gigabytes of data. In this project we are going to use various Data Mining techniques to carry out productive results i.e. predictions about performance of different departments in industry. This will be carried out by recognizing a pattern in the database with the help of data mining Algorithms. This will help in improving overall quality performance of industry. This will provide an application which can calculate overall equipment efficiency of industry. It will be possible to identify problems in manufacturing process and make suggestions for improvements. Resource monitoring focuses on maximizing the use of all resources in an organization, everything from managing people and machinery to office supply.

Keywords- OEE, Prognostic, Data Mining, Resource Monitoring

1. Introduction

This project is going to develop an application which can predict the performance of Marketing, Purchase and Engineering departments of mechanical industry. It will also analyze the data of industry and give prediction using different data mining algorithms. This will help in improving overall quality performance of the industry. This will provide an application which can calculate overall equipment efficiency of the industry. This project will help industry to find out pin point error which leads to huge losses. This project is basically for mechanical industry which is going to develop an application which can predict the performance of Marketing, Purchase and Engineering departments of industry using different data mining algorithms. This will provide an application which can calculate overall equipment efficiency of industry.

2. Present Theory and Practices

Presently, in some industry, calculation of OEE is done with software but small scale industry cannot afford this software. They do calculation manually which leads to

human error. Exact OEE calculation, prediction of industry growth, exact point at which industry has losses can't be predicted by manual work. This project is going to develop a software which can give all this facility in small amount with better efficiency.

3. Proposed Methodology

3.1 Marketing Department

Marketing dept. head has to find out current trends in markets. He has to capture the customers and bring orders for company which can increase the company profit. This software will have database of companies visited previously and companies who have given us order. Database also contains the parts which the company has ordered previously along with their purchase dates. This will help us to obtain patterns for prediction algorithm by which we can predict as to which company we should approach and when. For prediction we are using neural networks data mining algorithm. In short, this product is going to predict the future customers of the company or the future requirements of customers which can be fulfilled by our company.

3.2 Engineering Department

According to the orders placed by marketing department, Engineering Dept. head has to plan the company resources to fulfill the order in given time. He has to plan the manpower, machine power, time for given task which is complicated when company is working on multiple orders at a time.

We will have database of previous completed job containing following attributes -

- No. of jobs completed
- Time given to complete job
- No. of Human resources required
- No. of machines used
- Raw material used
- No. of days of job completion

- No. of days remained after a completing job

Now, we will have input as given time to complete job and No. of parts to be manufactured. According to previous history, Neural Network will predict how many machines and human resources will need to complete given job. Also it will show predicted quantity of raw material required to complete job. This prediction will help to arrange extra human and machine resources if needed before the production process starts. Prediction process will done with the help of Naïve Bayes data mining algorithm.

3.3 Quality Department

Quality department has to take care that production unit is going according to the plan and whether quality work is done or not. For that OEE is calculated and according to that we can know which resource is lacking in its performance. Using OEE we can easily know that which factor is affecting the company performance.

3.3.1 OEE

OEE is a simple tool that will help manager to measure the effectiveness of their human as well as their machine resources. It considers six big losses which usually occur in company and have been tabulated as below. These losses are counted as availability, performance and quality in order to estimate OEE as given below

$$OEE = Availability \times Performance \times Quality \dots (1)$$

Six Big Loss Category	OEE Loss Category	OEE Factor
Equipment Failure	Downtime Losses	Availability (A)
Setup and Adjustment		
Idling and Minor Stoppage	Speed Losses	Performance (P)
Reduced Speed		
Reduced Yield	Defect Losses	Quality (Q)
Quality Defects		

Table No: 1

The factors given in equation (1) are generally calculated as shown in Table. For equipment to operate effectively or to achieve higher OEE, it needs to achieve high levels of performance against all three of these parameters:

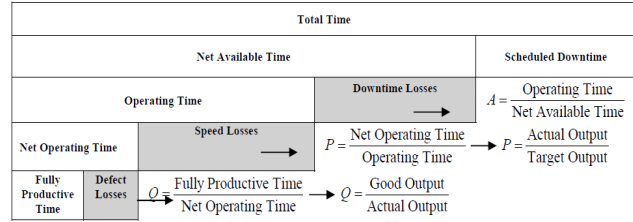


Figure 1

Availability takes into account “lost time” which includes all the events that stop planned production for inappropriate length of time. This is usually because of equipment failures, waiting times, and power loss, etc. Then, availability is determined as follows:

$$Availability = (Net\ Available\ Time - Downtime\ Losses) * 100 / Net\ Available\ Time$$

Performance takes into account “speed loss”, which includes all the factors that cause the equipment to operate at less than the maximum possible speed when running. Reasons for that can be substandard materials, operator inefficiency, and job conditions. Then performance is determined as follows:

$$Performance = (Operating\ Time - Speed\ Losses) * 100 / Operating\ Time$$

Quality takes into account “product loss”, which is determined as follows:

$$Quality = (Net\ Operating\ Time - Defect\ Losses) * 100 / Net\ Operating\ Time$$

The next step after the estimation of OEE is to compare it with the benchmark values. Accepted benchmark value for the manufacturing industries is about 85%. If the estimated OEE is below the benchmark value, then system should be evaluated for improvement. It is also very important to recognize other losses in company which affect the working time and performance of each resource in company.

3.4 Data Mining

Data mining is a collaboration of database and artificial intelligence technologies. Although the AI field has taken a major dive in the last decade, this new emerging field has shown that AI can add major contributions to existing fields in computer science. In fact, many experts believe that data mining is the third hottest field in the industry behind the Internet, and data warehousing. Data mining is really just the next step in the process of analyzing data. Instead of getting queries on standard or user specified

relationships, data mining goes a step farther by finding meaningful relationships in data.

3.4.1 Neural Networks

3.4.1.1 Neural Network Topologies

Feedforward neural network: The first and simplest type of artificial neural network topologies known as feedforward Neural network . In this topologies , the information travels in one particular direction, forward from Input nodes, through the hidden nodes if there present and to the output nodes. There are no cycles or loops in the network. The data processing can extend over many different units, but feedback connections are not present, that is, connections extending from outputs of units to inputs of units in the same layer or previous layers.

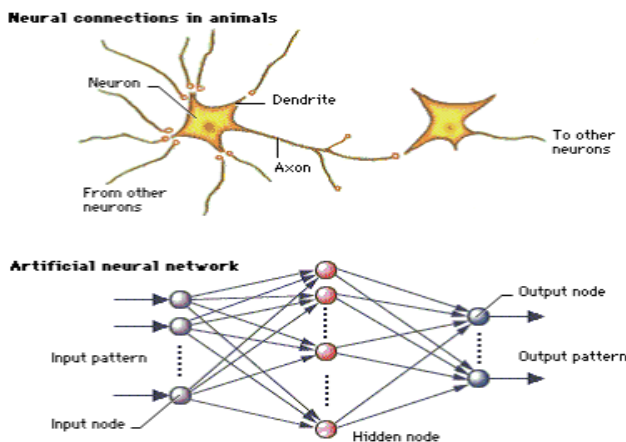


Figure2: Feedforward Neural Network

Recurrent network (RNs): In this network, feedback connections are present. Compare to feedforward networks, recurrent neural networks are models with data flow in both direction i.e., bi-directional. While a feedforward network propagates data linearly from input to output, RNs also propagate data from later processing stages to previous stages.

3.4.1.2 The Back Propagation Algorithm

Backpropagation, or propagation of error, is a Common method of teaching artificial neural networks how to perform a given task. In layered feedforward network, the back propagation algorithm is used. This means it organizes artificial neurons in layers and send their signals “forward”, and then the errors are propagated backwards. The back propagation algorithm uses supervised learning,

which means that we provide the algorithm with set of the inputs and outputs that will compute by network, and then the error is calculated. Error means difference between actual and expected results. The idea of the back propagation algorithm is developed for reducing these errors, until it processing the training data.

3.4.1.3 Hopfield Algorithm

The Hopfield net consists of nodes associated with the every other node as shown in figure. We also called it as fully connected. It is also symmetrically weighted network that means every node function as both input and output node. The logic behind this is that, depending on the weights, some states are unstable and the net will iterate a number of times till the state becomes stable state. The net is initialized to have a stable state with some known patterns. Then, the function of the network is to accept unclassified pattern as input and produce the known, learnt pattern as output.

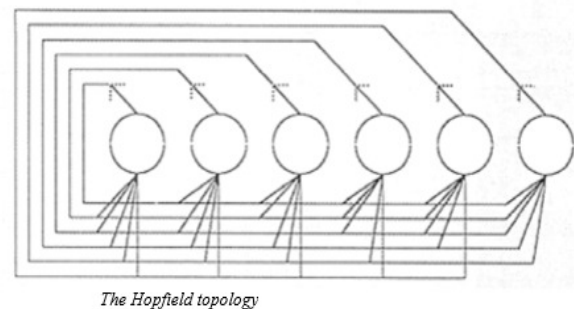


Figure 3: Hopfield Topology

The energy function for the network is minimized for each of the patterns in the training set, by adjusting the connection weights. An unknown pattern is presented for the network. The network iterates until pattern is recognize.

3.4.2 Naive Bayes Prediction Algorithm

It is one of the oldest formal classification algorithms, and it is simplest but more effective algorithm in data mining. The naive Bayes model is useful and efficient because of its simplicity, elegance, and robustness. It is mostly used in text classification and spam filtering. A large number of modifications have been introduced because of machine learning, data mining, statistical, and pattern recognition communities, to make algorithm more flexible. But this modifications causes complications which disturbs the simplicity of algorithm.

4. Future Scope

This system can be designed for all types of industries like IT industry by developing same system with different attributes. Android application can be prepared for this system which will show the current status of company. We can create alerting system through email or message.

5. Conclusion

In this paper we are representing a system which can monitor performance of Marketing, Quality, and Engineering departments of mechanical industry. This system can give alerts/ suggestions/ findings based on pattern found in database. It can specify area of improvement. Neural network is very efficient algorithm to find out patterns in database which can give observations very specifically to user. Naïve Bayes algorithm is sufficient enough to predict the result using different types of conditions available in naïve Bayes theorem. This system can be efficiently implemented in JAVA.

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