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Analysis of Damage Handling in The PT Petrokimia Gresik Factory Conveyor Safety System Using The Naive Bayes Method

Analisa Penanganan Kerusakan Pada Sistem Pengaman Konveyor Pabrik PT Petrokimia Gresik Menggunakan Metode Naive Bayes

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Abstract _ *In the industrial world, the speed of the production process plays a very important role in influencing industrial profits. One of the factors that determines production speed is the conveyor. PT. Petrokimia Gresik is one of the industries that uses conveyors, which pays great attention to accuracy and control of material speed. The function of the conveyor is to send raw materials from PT Petrokimia Gresik fertilizer to be processed. Three safety devices are installed on this tool, namely the low speed switch, outlying belt and cable pull switch. However, this complex security system makes it difficult for field technicians to handle conveyor problems. Problems that occur with conveyors, especially in the electrical and instrumentation parts, are sometimes difficult to find. Therefore, the author had the idea to conduct research related to conveyor problem solving analysis using the naive Bayes classification method. The results of the calculation between naive Bayes calculations and expert opinion show 100% agreement, which is an optimal result. It is hoped that these results can help field technicians in diagnosing and resolving problems when problems occur with conveyors.*

Keywords: *Conveyor; Security System; PT. Petrokimia Gresik; Naive Bayes classification.*

Abstrak_ Dalam dunia industri kecepatan proses produksi sangat berperan penting dalam mempengaruhi keuntungan industry. Salah satu faktor yang menjadi penentu kecepatan produksi adalah conveyor. PT. Petrokimia Gresik merupakan Salah satu industri yang memanfaatkan conveyor, yang mana sangat memperhatikan akurasi dan kontrol kecepatan material. Fungsi dari *conveyor* adalah untuk mengirimkan bahan baku dari pupuk PT Petrokimia Gresik yang akan diolah. Pada alat ini terpasang tiga buah perangkat keamanan yaitu *low speed switch*, *outlying belt and cable pull switch*. Tetapi dengan sistem pengaman yang kompleks tersebut membuat teknisi lapangan kesulitan saat menangani masalah pada conveyor. Permasalahan yang terjadi pada conveyor khususnya pada bagian electrical dan instrumentasi nya terkad ang sulit untuk ditemukan. Oleh karena itu penulis memiliki ide untuk membuat penelitian terkait analisa troubleshooting conveyor menggunakan metode naive bayes clasification. Hasil dari perbandingan antara perhitungan naive bayes dan pendapat pakar menunjukkan kesesuaian 100% dimana halini merupakan hasil yang opimal. Dengan Hasil ini diharapkan dapat membantu teknisi lapangan dalam mendiagnosa dan mengatasi saat terjadi troubleshooting pada conveyor.

Kata Kunci: Conveyor; Sistem Pengaman; PT. Petrokimia Gresik; Naive bayes classification.

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I. INTRODUCTION

A conveyor belt is a transport medium for a belt conveyor system which is often used to transport goods or materials automatically and efficiently. One of the companies that uses conveyor belts is PT PetroKimia Gresik, which is a company that works in the field of fertilizer manufacturing. However, the conveyor belt at this company often has damage to its safety system. Safety components that are often damaged are the Belt Outlying Sensor, Low Speed Switch Sensor, Cable Pull Switch Sensor, where this damage can have fatal consequences if not treated immediately. Factors causing this damage include dust, vibration, or friction which damages the sensor. Inadequate work environment conditions mean that field workers often find it difficult to determine the cause of damage when the conveyor suddenly does not function properly. This results in disruption of the production process which then impacts all departments [1][2][3].

To make it easier to diagnose the cause of damage and how to treat it, the author plans to use the naive beyes method. The reason the author uses the naive Bayes method is because this method uses the experience of a previous expert to predict future treatment methods. Therefore, field practitioners can trust the results of this calculation and use it as a reference in future work. The following is some research related to conveyors and the naive beyes method that has been carried out previously[4][5].

Research entitled "Problem Solving in Finding Faults (Trouble Shooting) Using the Expert System Method Using Bayesian Theorem on Ship Engines." This research discusses how to solve problems using the expert system method using Bayesian theorem. The Bayesian method calculations are very detailed and can be used as a reference, however the topic that the author raises is not relevant because it discusses ship engines while the author discusses conveyor belts [6].

Previous research entitled "Classification of Impact Damage on a Rubber-Textile Conveyor Belt: A Review" This research discusses the classification of damage that occurs on coal mine conveyors using the Naive Bayes method. This research has been presented well but there is a lack of a table of classification results using the naive Beyes method [7].

From the background above, the author took the initiative to analyze damage to safety sensors caused by dust, environment, vibration and friction on conveyors at PT. Petrokimia Gresik. The aim of carrying out this analysis is to make it easier to handle troubleshooting at the Company.

II. TOOLS AND METHODS

2.1 Tools

The tools needed to carry out a conveyor belt system analysis are:

1. Digital Multimeter
2. Test Pen
3. Notebook
4. HMI Manual
5. Conveyor System Wiring Diagram Book
6. Manual for all Conveyor Sensors
7. Excel Software

2.2 Method

[Figure 1 about here.]

The method used for this research is Naïve Bayes, Naïve Bayes Classifier is a classification method that is rooted in classification using probability and statistical methods proposed by the British scientist Thomas Bayes, namely predicting future opportunities based on previous experience so it is known as the Theorem Bayes. The main characteristic of the Naïve Bayes Classifier is the very strong assumption of independence of each condition/event. The Naïve Bayes Classifier method works very well compared to other classifier models. This was proven by Xhemali, Hinde Stone in his journal "Naïve Bayes vs. Decision Trees vs. Decision Trees Neural Networks in the Classification of Training Web Pages" says that "Naïve Bayes Classifier has a better level of accuracy than other classifier models". On the other hand, with the amount of training data that is not too large, it is quite easy to determine the estimated parameters needed for data classification [8][9].

2.3 Solving the Naïve Bayes Method

Solutions that include the Naïve Bayes Classifier method used in expert systems to diagnose conveyor damage in the field. The following are the steps for completing the Naïve Bayes Classifier method

- Diagnose conveyor damage in terms of overall function.
- Organize these symptoms into the system with questions asked to the user.
- Calculating the highest value or confidence value obtained from each disease symptom using the Naïve Bayes Classifier method.
- The final result is a percentage which is used as the confidence value for each question answered by the user, and then the result determines damage to the conveyor.

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III. RESULTS AND DISCUSSION

In order to complete the accuracy of the expected results, researchers collected several data on symptoms of conveyor damage which were used as research samples. The following are the results of data collection in the field:

[Table 1 about here.]

Table 1 explains the data on conveyor symptoms that occur in the field. Symptoms This data was obtained from operator complaints related to symptoms of conveyor damage and was given a Symptom code to make identification easier.

[Table 2 about here.]

In Table 2 is data regarding damage that may occur within the scope of conveyor instrumentation and electricity. Damage data in this table is obtained from handling by technicians regarding conveyor damage that has occurred and is given a damage code so that it can be identified more easily.

[Table 3 about here.]

Table 3 explains the data on symptoms based on conveyor damage.

[Table 4 about here.]

Table 4 explains the weight of each conveyor damage that occurs. Damage data in this table is obtained from handling by technicians regarding conveyor damage that has occurred and is given a damage code so that it can be identified more easily.

[Table 5 about here.]

Table 5 explains the possibility of each damage occurring with the specified symptoms.

[Table 6 about here.]

In Table 6, data was obtained by the author from interviews regarding expert recommendations for handling damage to conveyors with the symptoms that have been described.

[Figure 2 about here.]

Based on the data from Figure 2 above, it can be concluded that the accuracy of the calculation results compared with expert opinion is 100%

IV. CONCLUSION

According to the data presented in Figure 2, precisely in the Bayes Recommendation and Expert Recommendation columns, both of them present the same solution from the 9 trials carried out, which is obtained:

Number of Tests : 9
Number of Matches : 9
Number of Inconsistencies : 0
Percentage : (9/9)*100% =100%

The results above conclude that the percentage of agreement between naïve Bayes calculations and expert opinion is 100%. This is an optimal result so that it can be used as a guideline in overcoming troubleshooting at PT Petrokimia Gresik, specifically on the Factory 2 Production conveyor.

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DAFTAR TABEL

Table 1 Tabel ilustrasi Gejala

Gejala	Kode Gejala
Conveyor Bekerja Tetapi Sabuk Konveyor Miring	G1
Conveyor Bekerja saat Cable Pull Switch sensor ditarik	G2
Conveyor berhenti bekerja	G3
Conveyor berhenti bekerja Motor mendengung	G4
Conveyor berhenti bekerja Motor Tidak mendengung	G5
Conveyor berhenti bekerja Kondisi Seluruh sensor baik	G6
Conveyor berhenti bekerja Kondisi Mekanikal dan sabuk konveyor baik	G7
Conveyor berhenti bekerja Indikator HMI Menyala	G8
Conveyor bekerja Indikator HMI Mati	G9

Table 2 Kode kerusakan dan nama kerusakan

Nama Kerusakan	Kode kerusakan
Conveyor Motor	K1
Kabel Signal sensor	K2
Belt Outlying Sensor	K3
Low Speed Switch Sensor	K4
Cable Pull Switch Sensor	K5
Kabel daya Stanby sensor	K6
System HMI	K7
Kabel Penghubung HMI	K8

Table 3 Data Gejala Berdasarkan Kerusakan

Kode	Gejala	Kerusakan							
		K1	K2	K3	K4	K5	K6	K7	K8
G1	Conveyor Bekerja Tetapi Sabuk Konveyor Miring								
G2	Conveyor Bekerja saat Cable Pull Switch sensor ditarik								
G3	Conveyor berhenti bekerja								
G4	Conveyor berhenti bekerja Motor mendengung								
G5	Conveyor berhenti bekerja Motor Tidak mendengung								
G6	Conveyor berhenti bekerja Kondisi Seluruh sensor baik								
G7	Conveyor berhenti bekerja Kondisi Mekanikal dan sabuk konveyor baik								
G8	Conveyor berhenti bekerja Indikator HMI menyala								
G9	Conveyor bekerja Indikator HMI Mati								

Table 4 Bobot Kerusakan dan jumlah kemunculan

ID	Data Kerusakan	Bobot	Jumlah Muncul
H1	Rusak Pada Conveyor Motor	0,20	3

H2	Kabel Signal sensor Putus atau menjamur	0,11	6
H3	Belt Outlying Sensor Rusak	0,12	3
H4	Low Speed Switch Sensor Rusak	0,12	1
H5	Cable Pull Switch Sensor Rusak	0,11	2
H6	Kabel daya Stanby sensor putus atau menjamur	0,09	4
H7	System HMI Bermasalah atau Error	0,15	0
H8	Kabel Penghubung HMI Putus atau Menajamur	0,10	1
Total		1	20

Table 5 Probabitas kerusakan tiap gejala

GEJALA	ID KERUSAKAN							
	H1	H2	H3	H4	H5	H6	H7	H8
G1	0,00	0,70	1,00	0,00	0,00	0,00	0,20	0,20
G2	0,00	0,70	0,00	0,00	1,00	0,40	0,20	0,00
G3	1,00	0,40	0,40	0,40	0,40	0,30	0,20	0,20
G4	1,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
G5	0,00	0,50	0,40	0,60	0,40	0,50	0,20	0,20
G6	1,00	0,70	0,00	0,00	0,00	0,50	0,20	0,20
G7	1,00	0,90	0,00	0,60	0,40	0,80	0,20	0,20
G8	0,00	0,70	0,50	0,40	0,40	0,50	0,60	1,00
G9	0,00	0,00	0,00	0,00	0,00	0,00	1,00	1,00

Table 6 Data Pengujian Rekomendasi Pakar

Data Pengujian	Gejala	Rekomendasi Pakar
UJI KE 1	G1,G8	H3
UJI KE 2	G2,G8	H5
UJI KE 3	G3,G4,G6,G7	H1
UJI KE 4	G3,G5,G6,G7	H2
UJI KE 5	G3,G6,G7,G8	H8
UJI KE 6	G5,G7,G8	H4
UJI KE 7	G1,G2	H2
UJI KE 8	G3,G7	H7
UJI KE 9	G8	H8

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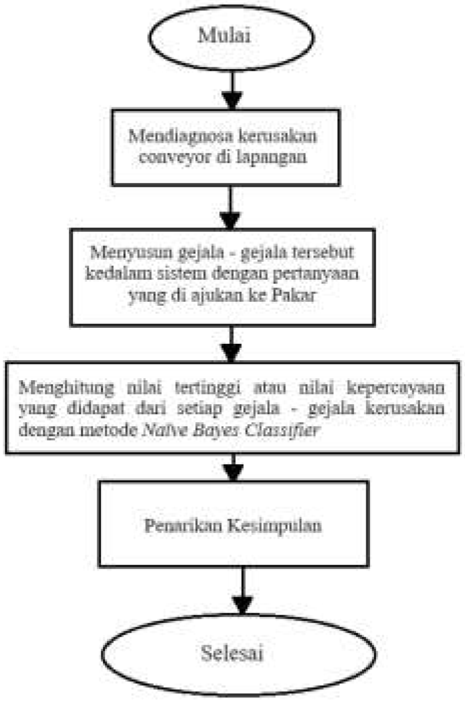

Figure 1 Metode Naive Bayes

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TABEL PERHITUNGAN NAÏVE BAYES																						
ID	FAKTA	P(H1|F)	P(H2|F)	P(H3|F)	P(H4|F)	P(H5|F)	P(H6|F)	P(H7|F)	P(H8|F)	∑P(F|Hk)*P(Hk)	H1	H2	H3	H4	H5	H6	H7	H8	100%	Rekomendasi Bayes	Rekomendasi pakar	Status
U1	G1,G8	0,0	0,0	0,2	0,0	0,0	0,0	0,0	0,0	0,2	0,00	0,00	1,00	0,00	0,00	0,00	0,00	0,00	1,00	H3	H3	Benar
U2	G2,G8	0,0	0,0	0,0	0,0	0,5	0,0	0,0	0,0	0,5	0,00	0,00	0,00	0,00	1,00	0,00	0,00	0,00	1,00	H5	H5	Benar
U3	G3,G4,G6,G7	0,5	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,5	1,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	1,00	H1	H1	Benar
U4	G3,G5,G6,G7	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,00	1,00	0,00	0,00	0,00	0,00	0,00	0,00	1,00	H2	H2	Benar
U5	G3,G6,G7,G8	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,5	0,5	0,00	0,00	0,00	0,00	0,00	0,00	0,00	1,00	1,00	H8	H8	Benar
U6	G5,G7,G8	0,0	0,0	0,0	0,1	0,0	0,0	0,0	0,0	0,1	0,00	0,00	0,00	1,00	0,00	0,00	0,00	0,00	1,00	H4	H4	Benar
U7	G1,G2	0,0	0,9	0,0	0,0	0,0	0,0	0,0	0,0	0,9	0,00	1,00	0,00	0,00	0,00	0,00	0,00	0,00	1,00	H2	H2	Benar
U8	G3,G7	0,0	0,0	0,0	0,0	0,0	0,0	1,0	0,0	1,0	0,00	0,00	0,00	0,00	0,00	0,00	1,00	0,00	1,00	H7	H7	Benar
U9	G8	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,9	0,9	0,00	0,00	0,00	0,00	0,00	0,00	0,00	1,00	1,00	H8	H8	Benar

Figure 2 Tabel Perbandingan Hasil Pehitungan naïve bayes dan rekomendasi Pakar