RESEARCH ON USING IMAGES TO MONITORING CONVEYOR BELT

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Abstract: This paper addresses the study possibility of monitoring conveyor belts using images taken by inspection cameras and analysis of the information accuracy collected by this way reported the real situation.

Keywords: conveyor belt, images, monitoring, visual inspection

1. GENERAL CONSIDERATIONS

Overall demand for natural resources is increasing, so the need for increased production resources grows similarly.

Coal is an energy source highly competitive given that most European countries are forced to resort to imports to meet energy needs. Getting a competitive price of energy produced by coal is dependent on the performance of the technology adopted. Cost pressure and willingness to change is the engine of introducing modern techniques. They depend on the speed with which collect the information needed to make informed decisions to increase productivity and reduce costs.

A lot of elements, characterized by some attributes with relations between parts of them, forming an organized whole, which makes a practical activity to operate intended purpose, define the concept of operating system.

Mining mass transport results in the excavation process is the main task to transport coal from open pit mines energy movement sterile or tailings from lignite

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delivery to consumers on conveyor belts or rail through the point of loading in wagons.

An operating system is characterized by:

- Type of equipment components: extraction, transport and deposition;
- Type of operation: cyclic / discontinuously or noncyclic / continuous;
- The organization of work: technological flows, which represent different combinations of excavating machinery, with a means to transportation and storage;
- Practical work carried out to consists of open pit mining excavation, transport and storage of mining mass;
- The aim is extraction of useful minerals.

Equipment's components feature technology flows from open pit mining in relation to their operational continuity make up a system of exploitation: continuous, discontinuously or combined.

Continuous operating systems are most prevalent in lignite quarries, process steps being carried on in a normal sequence, machinery components being correlated in point of view of capacity excavation - transport - dump - storage. Within these operating systems continuous action can be found buckets wheel excavators, high capacity conveyor belts machines and equipment deposited in damp and deposit equipment's. Main equipment arrangement of within the process flow of careers is based on technical studies, which according to geological and mining parameters of each perimeter determines the type, place and the working mode. Process steps are carried out in a normal sequence, and the equipment is correlated in point of view of excavation capacity and appropriate to the ore deposit.

Conveyors belt are part of the chain that allows transport of excavated material to the coal depot or the place of the tailings deposit.

An essential problem which has been resolved is to optimize transport capacity by varying the speed of the conveyor belt.

Such a solution is placing the inspection camera above the belt determines in real time the section conveyed material, figure 1. This profile represents one of the input data of the mathematical model. With this mathematical model to determine the optimal speed of the conveyors belt.

Fig. 1. Determination of the real-time section of the conveyed material using inspection camera

Important is the implementation of the adjustment functions of centering the band and oversight flaws that may occur in the rubber carpet.

Each conveyor belt must have its own control system. Their individual control systems are connected to central dispatch.

The control system performs the following functions:

- Submit to central dispatch all

necessary data such as:

- Images from surveillance cameras;
- Current operating parameters;

- Parameters related to the transported material:

- Information for system diagnosis and monitoring.
- Control and monitoring functions that ensures automatic operation of the belt.

Belt conveyors, in addition to the transport function of the material, can also be used in the management of the quantities conveyed. Mounting on the scales allows real-time transmission of data on quantity transported, which can be integrated into a management system quantity of materials conveyed.

2. THE INSPECTION PROCESS

The inspection process is based on using a special sensor (usually a video camera) whose output signal is picked up by a digital processing system. What distinguishes fundamentally this system of a simple video surveillance camera is its ability to make decisions.

Basically, we can define the system as an automated system that is able to make decisions based on the analysis of various geometric and topographical characteristics of the "stage" analyzed. Overall "stage" system presented is a physical object that can be simple or complex, a banal object or a complex mechanical assembly, but can also relate to other situations in which the analyzed "stage" represent is another nature image. The set of software tools used to verify and measure differences in contrast and in what sense are evaluated. Digital cameras then collect this information and evaluate them based on programmed rules. Because measurements are directly dependent of contrast (the difference in intensity between pixels) is very important that the lighting is constant and uniform.

2.1. Description of functioning

Inspection Cameras acquires images then analyzed based on rules set by the programmer, if they satisfy the criteria. It further describes the functionality internal inspection cameras. In Figure 2 the decision-making levels determined by the internal components. On the upper level are system parameters. These parameters are common for each inspection that cameras are executed, parameters affect the overall behavior of the cameras, at least of some certain checks.

Then the inspection programs can make changes to the parameters that relate to a single inspection program (such as lighting), essentially parameters are at the program works only on a particular program, the rest remain uninfluenced.

Finally, the parameters of the instruments can only change those parameters inspection tools.

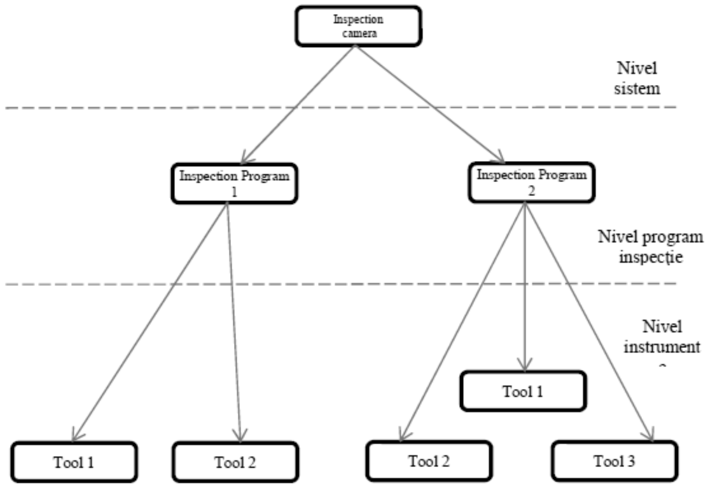

Fig. 2 Hierarchical organization of inspection cameras

Achieving and innovative design an inspection system using digital cameras is easy due to the properties hardware, software and variety of communication protocols. Logic diagram inspection system is relatively simple and is shown in Figure 3.

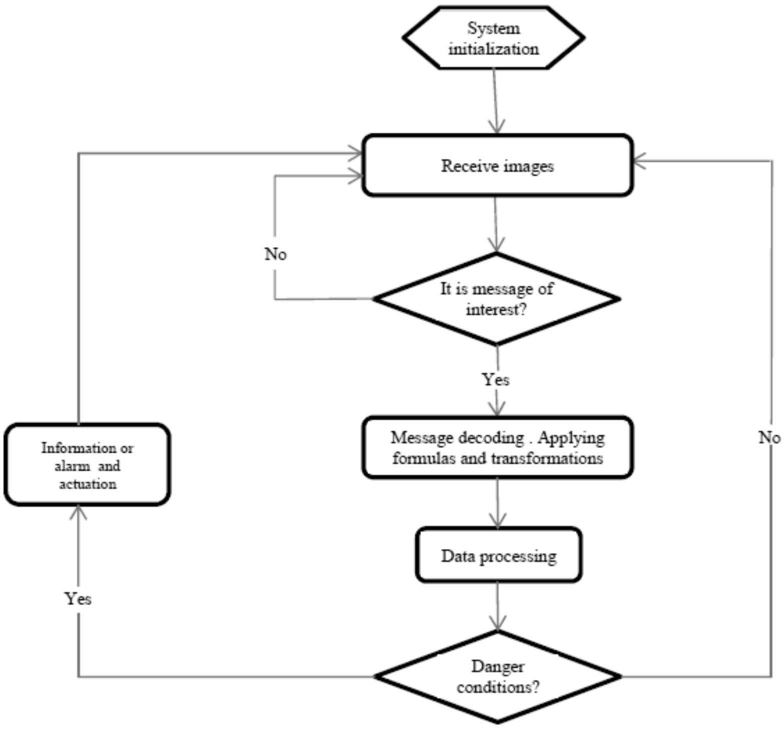

Fig. 3 Logic diagram of inspection system

2.2 Parameters basic characteristics of belt conveyors

Productivity is an important technical feature of the conveyor, which is expressed in t/h and is calculated using the relation:

$$Q_m = 3600 \cdot A_0 \cdot v \cdot \rho \ ; \text{[t/h]} \quad (1)$$

Where:
A_0 – real cross-sectional area by material [m^2];
v – the transport speed [m/s];
ρ – density of the material [t/m^3];
Due to shocks and vibrations during belt movement, sectional area of the material layer changes. To determine the real section will take account of the degree of filling of the conveyor expressed by the filling factor ψ. If trough conveyor belt filling factor depends on the type of material and the working conditions, ψ =0,4 ÷ 0,6.
For the conveyor belt in Figure 4, the size of the section after which are placed the material is determined by the width of the belt *B*.

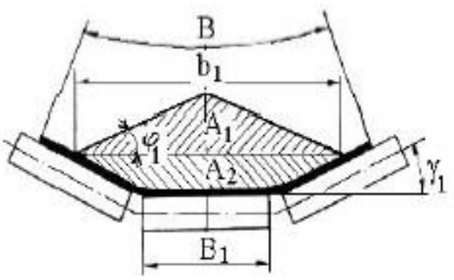

Fig. 4 The size of the section after which are placed the material

$$b = 0{,}9 \cdot B - 0{,}05; \text{ [m]} \quad (2)$$

$$h = \frac{1}{12} \cdot b \quad (3)$$

Such the material section area will be:

$$A = \frac{2}{3} \cdot h \cong \frac{1}{18} \cdot (0{,}9 \cdot B - 0{,}05)^2 \quad (4)$$

Taking into account the unevenness coefficient ψ, relations for calculating the real cross-sectional area becomes:

$$A_0 = \frac{1}{18} \cdot (0{,}9 \cdot B - 0{,}5)^2 \cdot \psi \quad (5)$$

$$A_0 = 0{,}075 \cdot B \cdot \psi \qquad (6)$$

Substituting the expression of the relation (2), A_0 result:

$$Q_m = 270 \cdot B^2 \cdot v \cdot \rho \ ; \ [\text{t/h}] \qquad (7)$$

Or:

$$Q_m = 3{,}6 \cdot \frac{G}{d} \cdot v \ ; \ [\text{t/h}] \qquad (8)$$

Where:
G – Load weight transported [kg];
d – Distance between two consecutive tasks [m].

Transport speed is another characteristic parameter. Belt speed is chosen depending on the type of product transported and depending the productivity.

To study the possibility of using images to calculate the flow rate of the unit we chose a mining conveyor EM Lonea, conveyor that makes the C.F.R wagons loading. The total flow is 120 tons and made at certain times time, from 10 to 10 tones.

The data used for comparison were obtained by weighing and provided courtesy of the staff that served this work point.

Such is synthetically in tabular Table 1 and graphic Figure 5, Figure 6, the results obtained using and processing the recorded images and comparing the data obtained with the data provided.

Table 1. **The data used for comparison**

Nr.crt	Time	Data provided using weighing	Data obtained using images
1	0	0	0
2	t1	10	9.9523
3	t2	20	20.1592
4	t3	30	29.8712
5	t4	40	40.0298
6	t5	50	49.9531
7	t6	60	58.9821
8	t7	70	71.0098
9	t8	80	80.4678
10	t9	90	90.2512
11	t10	100	99.3542
12	t11	110	108.8798
13	t12	120	120.2687

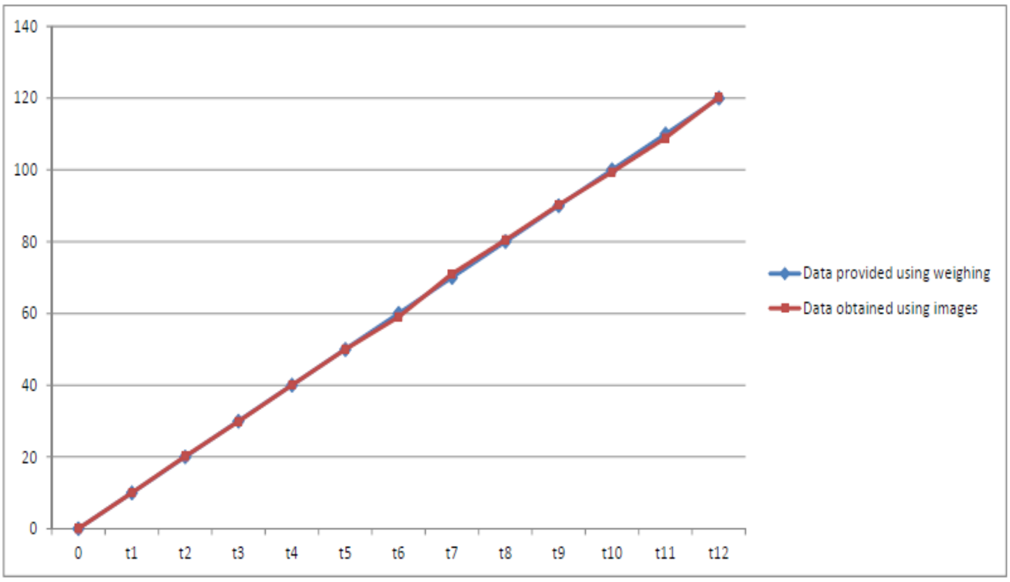

Fig. 5. The data used for comparison

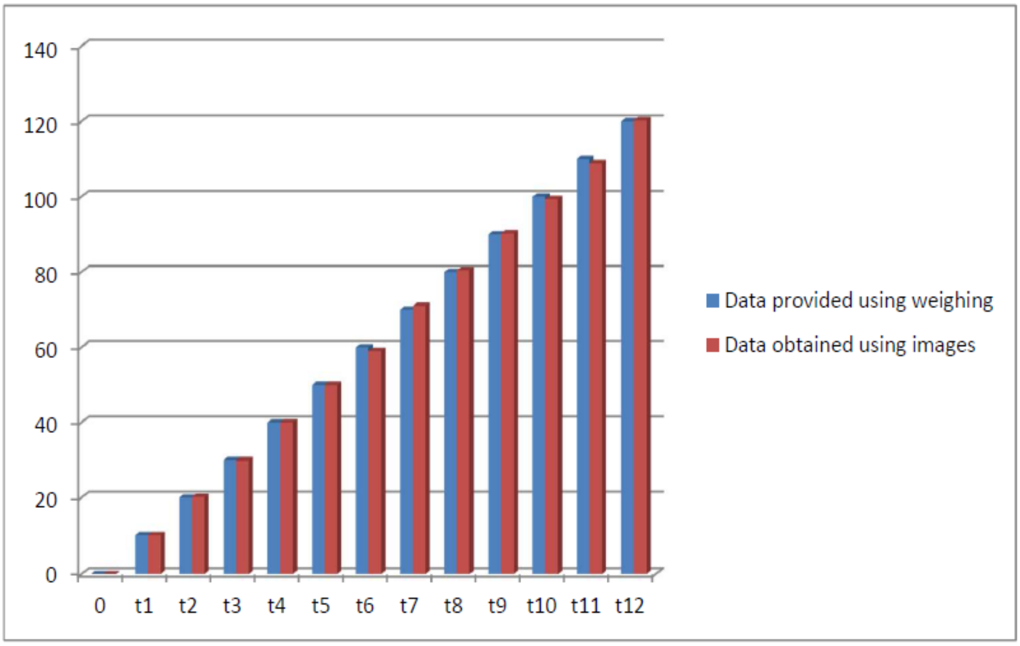

Fig. 6. The data used for comparison

3. CONCLUSIONS

Using networked equipment enables remote diagnostics of machines. This can shorten the minimum response time in case of a fault. Furthermore, it can also provide a system for monitoring and programming equipment conducting routine maintenance work so that unplanned downtime is minimized.

Integration of all equipment, command and control from the central dispatcher can secure controlled coal qualities through effective use of data from geological model of the reservoir. All this to fulfill current major desideratum: obtaining a controlled coal quality with maximum productivity under conditions of minimal costs.

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