XXIII Conference of PhD Students and Young Scientists

Interdisciplinary topics in Mining, Geology and Geomatics

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Use of AI to predict the damage to the rubber belt used at coal mine

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Purpose

The conveyor belt systems are used to transport the heavy and bulk material at mining sites due to their features like continuous operation and proven reliability compared to other means of transport. The rubber belt segments and loops are the core of such systems and various factors contribute in the continuous damage done to it during the material carrying-loading-unloading process. The incessant damage can lead to unplanned repairs and emergency breakdowns. The downtimes are costly at such production sites where mining is carried out.

Timely maintenance and repairs can reduce the emergency breakdowns and extend the service life. The study of governing factors for the wear of the rubber belt can help in better control and implementation of the operating conditions.

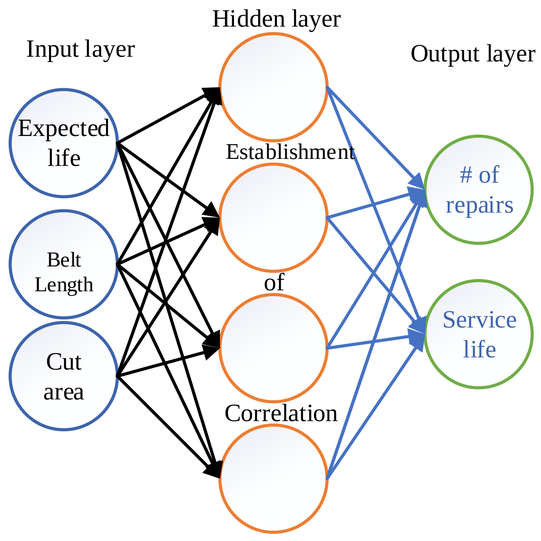

Figure 1. Example of training and prediction with ANN

Ishikawa Diagram

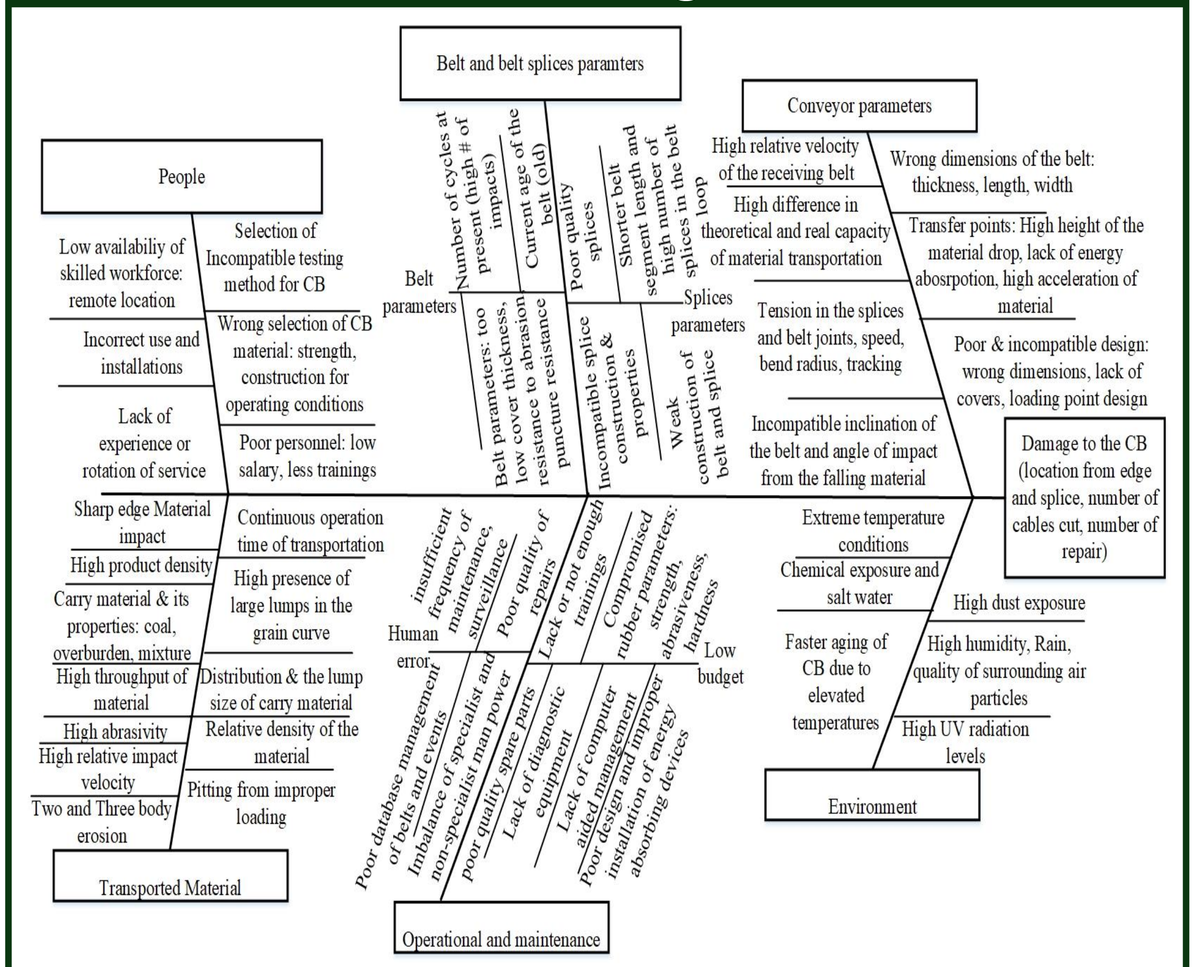

Figure 2. Ishikawa Diagram depicting potential causes of damage done to the conveyor belt at coal mining site

Ishikawa diagram can be used to identify the parameters which contributes in the damage to the belt during production at mining site. Subsequently, enlisted cause and effect parameters in the Ishikawa diagram can be divided into quantifiable and non-quantifiable categories which can be used into the dataset records which are recorded at mining site. The stored database can be used in the statistical analysis and then in developing the machine learning model which can learn the correlation between the cause and effect variables within Example of training and prediction with ANN
the dataset and then predict the damage to the rubber belt.

Hypothesis, Tools and Techniques

Hypothesis- Use of AI driven modelling techniques for predicting the damage and its progression in due time of operation at mining site

- The prediction of development damaged area, total cumulative cuts and repairs, density of cuts per meter length of belt segment etc.
- It has been published [1, 2, 3] that the statistical analysis approach can be used to identify the correlation between the input and output variables of the system.
- Potential usage of AI driven approach [3] is also mentioned by the several research groups from the Poland and the rest of the world as well.

Tools and Technique

Tools: Keras, numpy, pandas, matplotlib, sklearn, LSTM (RNN), Google Colab

Technique: Usage of dataset received from the lignite mine which already has Diagbelt+ system for scanning → several iteration of the belt scanning is performed → belt replacement timing is estimated based on scanning →
to train the LSTM neural network → store the trained model → use the trained model to predict the future behavior of the system under specific operating conditions

Importance of predicting maintenance time of conveyor belt and its influential factors

- Reliability of the conveyors can be increased by fulfilling repairs and maintenance at regular intervals
- 50 % of unexpected mining production halt occurs due to CBS failure
- 1,000 to 3,500 tons per hour of coal production capacity can have 600 to 1800 $ financial loss per minute
- Preventive and pro-active measures by identifying small targeted areas in CBS before they result in chain reaction and finally suspension of production

References

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