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An Advance Techniques of Computer Based Equipment Monitoring Structure in Open Cast Mines

Rajesh Mishra[1]* Dr. Kavita[2]

[1] Research Scholar

[2] Associate Professor, Jayoti Vidyapeeth Women's University, Jaipur

Abstract – The state-of - the-art computing technology has development to the extent that there are many truck dispatching technologies that provide the ability to increase the efficiency of the truck and eventual savings. The installation of a dispatching device in a mine will yield operational advantages through minimizing processing times and achieving additional benefits by improved tracking, efficient routing and grade management. The performance of the utilized truck-shovel fleet based on the dispatch method in place, the nature of the truck-shovel network and a number of other factors. It is a typical circumstance in the mining industry that a substantial review of the possible strategies is carried out before shipping is carried out. In certain instances, machine imitation is the most appropriate & efficient way of evaluating different dispatch approaches. The machine tracks the position and condition (full or zero, heading and speed) of each vehicle in the fleet. The program analyzes output figures, such as hauling roads, historical data on drive time to a given shovel spot, and loop time as long as it needs to make a round trip from the shovel to the dumpsite and returning.

Key Words- Indian Surface Mining, Computer Equipment Performance Monitoring, Global Positioning Systems

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INTRODUCTION

Truck haulage is the most efficient way of transporting ore / waste in open pit mining activities, but it is also the most costly unit process in a truck shovel mining network. The state-- computing technology has progressed to the extent that there are many truck dispatching technologies that provide the ability to increase the efficiency of the truck and eventual savings. The installation of a dispatching device in a mine will yield operational advantages through minimizing processing times and achieving additional benefits by improved tracking, efficient routing and grade management. The performance of the utilized truck- fleet depends on the dispatch method in place, the nature of the truck- network and a number of other variables. It is a typical circumstance in the mining industry that a substantial review of the possible strategies is carried out before shipping is carried out. In certain instances, machine simulation is the most applicable and efficient way of evaluating different dispatch approaches.

While developing dispatching schemes, it is normal to strive to develop the best possible method in relation to such success parameters, although subject to mining and resource constraints. When the number of possible machine designs is not too high, traditional methods are used to solve optimization problems: rating and filtering, and frequent comparisons with the better models. Ranking and evaluation procedures give rise to one judgment, i.e. which system design has the highest expected performance, although several contrasts with the best results, i.e. the discrepancy between the average output of each system architecture as well as the best of all other model designs. However, this principle is not commonly found in reality. The data network of a mine holds large quantities of knowledge used by mining machines in the region. Building networks directly into mining machinery allows vast volumes of data to be gathered and analyzed in real time to monitor drills, shovels, dumpers and other machines in reaction to these data[1].

Minimizing shovel wait time (MSWT): The vacant truck in this category is allocated to a shovel that has been waiting for a vehicle for the longest period of time, which is scheduled to be idle next.

Minimizing Truck Cycle Time (MTCT): The purpose of this technique is to allocate the appropriate vacant truck to the shovel, that would have the

necessary value for the execution of the planned Truck Cycle Time to optimize either overall tons or ton-miles per unit of time.

Minimizing Truck Waiting Time (MTWT): The purpose of this requirement is to send a vacant truck to the shovel in which the vehicle loading process is performed first.

Minimizing shovel saturation (MSS): The purpose of this law is to allocate the trucks to the shovel at the same intervals in order to maintain the shovel going without awaiting for the trucks. The truck is mounted to a shovel with the lowest amount of existing coverage to the target area.

INDIAN SURFACE MINING STATUS:

The prevalence of surface mining in the Indian mining industry, with such a contribute to over 80 per cent and 54 per cent of overall production in Coal India Limited and SCCL, identify for a depth investigation of the means & methods used to upgrade the production & performance of surface mining structure in the 21st century. Even when there are surface mining systems of varying sizes & sophistication, there was no doubt that surface mining structures from small to medium scale and mega- mines would require significant new technology inputs to be cost-, environmentally responsible and to satisfy production criteria. Technology will be the biggest catalyst for progress in the development of higher levels of performance in the challenging environment of the 21st century, in which information technology (IT) can play a crucial role.

Benchmarking of surface mining operations around the world has shown a massive gap between the production of the better of the mines & worst of the mines, so there's an immediate want to near the distance. Since the scale of open-cast coal mining operations in India has increased by leaps & bounds, new techniques of mining surveying have been established, preparation and activity will have to be revised to fulfill the criteria. A whole range of state-of - the-art infrastructure technologies and frameworks for successful surface mining operations have developed during the last decade.

MINES WHERE COMPUTER EQUIPMENT PERFORMANCE MONITRING IS USED OUTSIDE INDIA

Even one of the main mines in which the device is being utilized:-

1. The Century Zinc Mine, run by Zinifex in northern Queensland, has already been utilizing high-precision APS GPS on two excavators for three years. The mine field is housed in a grey shale. Identifying material and waste is challenging. Era also runs GPS devices on the Bucyrus 495B shovels used during overload stripping.

2. Collinsville Coal Mine, managed by Xstrata Coal and run by Thies Contractors, is a mixed coking & thermal surface coal mine in northern Queensland. Overload stripping is operated by dragline, dedicated stripping dozers & excavator & truck fleets. The mine has two Liebherr 994 excavators and two Liebherr 995s built to high-precision GPS guidance.

3. The Asarco mine in Arizona needs a high-speed data network to track each truck and shovel to decide whether the shovel will allow a truck to load or which truck will be nearest. It's moving into the idle time with both shovel & the tractor. The dispatch program often tracks the vital signs of the cars, such as oil pressure and temperature, to help deter breakdowns.

4. U.S.— Borax Mine in California's Mojave is the producer of about half the world's supply of processed borates. Developed a heavy-precision global positioning (GPS) device for computer guidance. It allows shovel users to work securely in potentially hazardous environments. In addition to shielding people and equipment, the GPS system has also increased the efficiency of the mine.

5. In the scenario of the Chuquicamata mine in Russia, approximately 130 haul trucks are used in tandem with the GPS truck dispatch program to improve productivity[2].

MINES WHERE COMPUTER EQUIPMENT PERFORMANCE MONITRING IS BEING UTILIZED INSIDE INDIA

1. Northern Coalfields Ltd (NCL), Jayant open-cast mine management, has reported an overall improvement of 7% in the profitability of capital-intensive mining equipment such as excavators and dynamite-driven vehicles.

2. Tata Steels extension of the Truck Dispatch Program to the Opencast Coal Mines situated in West Bokaro (Hazaribagh District of Jhakhand State of India) 3. Truck dispatching services at Nalco, Damonjodi, use the GPS services of the Australian firm.

GLOBAL POSTIONING SYTEMS

The Global Positioning System (GPS) has been in operation for more than 25 years. Applications and implementations have evolved quickly and the infrastructure is well developed and effective. Nearly all mines are now using GPS for surveying. Within a few hours, a single surveyor will accomplish what a

team of people previously took days of tiresome field research and office work. GPS was also specifically used for mine equipment. GPS guidance systems enable the user to complete complicated earth-moving projects without the need for field-moving. More sophisticated technologies allow reliable real-time efficiency tracking and automated production of 'as-builts' in the form of Digital Terrain Maps (DTMs). Once we get to the key problem, let's try to get back to where and when GPS began. The first one named NAVSTAR GPS (Navigation Satellite Timing and Ranging Global Location System) was (and still is) a satellite radio direction and survey device delivering precise three-dimensional location, direction and time knowledge to suitably fitted users worldwide on a continuous basis[3].

Opencast coal-mining works with regular blasting and then excavations accompanied by the deposition of Over Burden (OB) and the extraction of fuel. Two major sub-processes are involved in the coal mining process. The extraction of OB and the recovery of coal was prevalent. Yet much of the attempt is made to eliminate OB, so this has a powerful impact on efficiency. In the phase of replacement of OB, two of the appliances vis. Rear Dumper and Excavator have a leading position to perform. Once the blasting plan has been configured for a particular region of the mine, the Excavator loads the OBinto RD and each RD basically goes through four separate system states, i.e. Waiting (near the Loaded Zone), Loaded, Complete and Clear (in the Dumping Zone). This series of RD system states is a single journey. Now it can be recognized that in order to track efficiency automatically, it is important to control the movement of RDs across the corresponding Excavator, i.e. Loading field to the Dumping zone and then to the Shipping region.

Use the GPS Receivers app, it is possible to calculate the absolute location of every cell unit. In fact, the device contains load indicators, cap switches, RF telemetry, etc. The network comprises of 24 satellites, plus three active spacers, positioned in near-circular orbits on six orbital planes of 55o inclination at a height of approximately 20,200 km. There are always more than 24 working spacecraft because new ones are introduced to replace aging ones. The orbit altitude is such that the satellites replicate the same trajectory and structure at some stage nearly every 24 hours. Satellites have 12-hour cycles such that at least 4 satellites are usable for Land, Sea and Air measurements at any point in the year everywhere in the world. GPS offers specifically coded satellite signals that can be interpreted in a GPS receiver, allowing the receiver to measure location, velocity and time. Signals from four satellites are needed to measure four dimensions of X, Y, Z (position) and Time at every point on Earth[5].

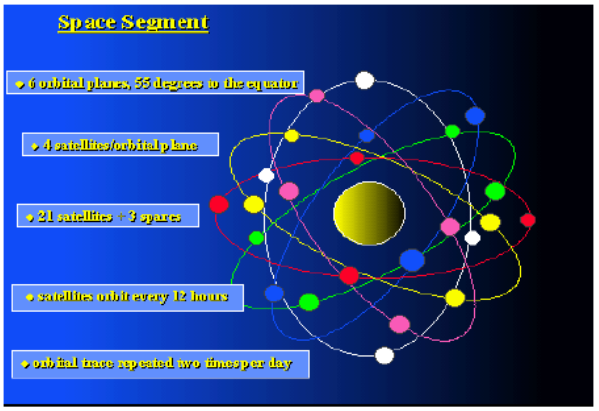

FIG: 1: GPS 24 SATELLITES CIRCLING THE EARTH

The GPS device will say the position somewhere that is above the Earth within around 300 feet. Far greater precision, typically less than three feet apart, may be accomplished with corrections measured by the GPS receiver at a specified fixed position. The idea behind the GPS is to measure the distance (or "range") between the antenna & satellite. Satellites also informed us exactly wherever they are in their orbits above the earth. Operates like this: since we know our precise location from a satellite in space, we conclude that we are situated on the surface of an imaginary object with a radius equal to that of a satellite center. When we learn our precise range from two satellites, we understand that we are right on the side where the two spheres intersect. And, if we find a third estimate, there are just two possible locations where we might be identified. Any of these is normally difficult, so the GPS receivers provide statistical means of removing the position of an unlikely position. To order for the network to work, the receiver must know precisely where the satellites are, as well as the satellites must be able to retain accurate time.

INITIALIZATION

High precision GPS allows GPS receivers to calculate the phase variations between the two code signals (L1 and L2) of each satellite and the carrier wave itself. Since the duration of the surface wave signal is shorter than the code step resolution, the GPS device must overcome the confusion across both wavelengths. It needs at least five satellites and can take some time to do so. For the consumer, this implies that there may be a pause after the system is turned on until the software can establish a specific location (reaches "lock"). If the delay is lengthy this can be a source of irritation. Some manufacturers' algorithms are more efficient than others and hence require less time to achieve "lock". The more satellites that are available, the shorter the time necessary to achieve "lock".

COMPUTERS

Computers used on board mining equipment must contend with difficult environmental conditions. When the machines are unattended in the field the temperatures can range from the very cold to the very hot. When the machine is in operation, it is subjected to vibration and sometimes to relatively high dust levels. To be useful to the operator it must be easy to use and be visible under varying ambient light conditions. Rotating hard disks have a short life in this application and must be replaced by solid state memory. At least 2 GB of non volatile memory is necessary to hold the operating system, system software and complex designs. The machine will have a touchscreen for ease of service. It should be quick enough to determine the location of the bucket and to change the history of the panel in a development situation[5].

REQUIREMENT OF COMPTER BASED EQUIPMENT PERFORMANCE MONITORING SYSTEM:-

1. The CBEPMS was established specifically for the performance control of dumpers & shovels. Many devices may be used, like draglines, drills, dozers aren't included owing to time restrictions.

2. The success of the system is totally dependent on the availability and incorporation of data into the system. If the data will not be available then the system cannot provide good results.

3. The data which has been incorporated into the system also should be correct otherwise it would provide wrong information to the management.

LITERATURE REVIEW

M. Jamshidi (2018) et al. In multi-component stores, various squares are mixed together to make an item with a predetermined quality. By and large, mixing expects to get an uncommon quality and quantity dependent on deciding the handling plant or client needs. Nonetheless, mixing causes various items dependent on the store properties. Along these lines, a square is mixed with others to make one of numerous potential items. The present examination means to build up a mixed integer programming model for the production booking of iron metal mines. The model can think about various goals for mine squares. Every goal has its own particulars for the principle component (Fe) and other existing components, for example, sulfur and phosphorous. For this reason, ten distinct situations were assessed to research the impact of numerous items on production planning and Net Present Value (NPV) of the related undertaking. Among the four chose situations, the mine was booked dependent on single item while different items were considered in planning in different situations. In light of the outcomes, the most extreme NPV in situations with different items is roughly 15% higher than that of the single item situations [6]

C. H. Ta (2006) et al In the mining business, truck task is an important and complex procedure and an optimal truck allotment can bring about significant reserve funds. Right now, truck assignment model is figured utilizing an opportunity constrained, stochastic optimization approach that can suit dubious parameters, for example, truckload and process duration. An ongoing pulling structure, which comprises of the opportunity constrained optimization model and a model updater, is created to make up for changes in the dubious key working parameters. The utilization of the model updater helps the truck portion framework to adjust to arbitrary operational changes. The adequacy of the possibility constrained methodology in managing dubious procedure parameters, when combined with model refreshing, is demonstrated to be a suitable execution structure in the dispatching activity [7].

M. J. F. Souza (2010) et. al. This paper manages the Open-Pit-Mining Operational Planning issue with dynamic truck portion. The goal is to enhance mineral extraction in the mines by limiting the quantity of mining trucks used to meet production objectives and quality prerequisites. As indicated by the writing, this issue is NP-hard, so a heuristic system is legitimized. We present a half and half calculation that consolidates qualities of two metaheuristics: Greedy Randomized Adaptive Search Procedures and General Variable Neighborhood Search. The proposed calculation was tried utilizing a lot of genuine information issues and the outcomes were approved by running the CPLEX analyzer with similar information. This solver utilized a mixed integer programming model additionally created right now. The computational examinations show that the proposed calculation is exceptionally serious, finding close to optimal arrangements (with a hole of under 1%) in many cases, requesting short registering occasions. [8]

Eduardo Moreno (2010) et. al. We study an augmentation of the priority constrained rucksack issue where the backpack can be filled in different periods. This issue is referred to in the mining business as the open-pit mine production planning issue. We present another calculation for explaining the LP unwinding of this issue and a LP-based heuristic to get plausible arrangements. Computational analyses show that we can comprehend genuine mining examples with a great many things in minutes, acquiring arrangements inside 6% of optimality[9].

Masoud (2015) et. al. The issue of long haul production arranging of open pit mines is an enormous combinatorial issue. Utilization of scientific

programming approaches experience the ill effects of decreased computational efficiency because of the enormous measure of choice factors. This paper presents another metaheuristic estimate approach dependent on the Ant Colony Optimization (ACO) for the arrangement of the issue of open-pit mine production arranging. It is a three-dimensional optimization methodology which has the capacity of thinking about a goal work, non-straight requirements and genuine specialized limitations. The proposed procedure is modified and tried through its application on a genuine scale Copper–Gold store. The investigation uncovered that the ACO approach is competent to improve the value of the underlying mining plan in regards to the present business apparatuses thinking about punishments and without, in a sensible computational time. A few variants of ACO were examined to locate the most good variants and the best parameter ranges. Results demonstrated that the Max–Min Ant System (MMAS) and the Ant Colony System (ACS) are the most ideal variants dependent on the necessary less measure of memory. It is likewise demonstrated that the MMAS is the most explorative variant, while the ACS is the quickest technique. [10]

Shi QiangLiu (2016) et al. In the mining optimization writing, most specialists concentrated on two vital level and strategic level open-pit mine optimization issues, which are individually named ultimate pit limit (UPIT) or constrained pit limit (CPIT). Notwithstanding, numerous scientists demonstrate that the substantial quantities of factors and requirements in genuine occurrences (e.g., with 50–1000 thousand squares) make the CPIT's mixed integer programming (MIP) model recalcitrant for use. In this manner, it turns into an impressive test to settle the huge scope CPIT cases without depending on careful MIP optimiser just as the convoluted MIP unwinding/decay strategies. To take this test, two new diagram put together calculations based with respect to network stream chart and conjunctive diagram hypothesis are created by exploiting issue properties. The exhibition of our proposed calculations is approved by testing late enormous scope benchmark UPIT and CPIT cases' datasets of MineLib in 2013. In contrast with most popular outcomes from MineLib, it is demonstrated that the proposed calculations beat other CPIT arrangement approaches existing in the writing. The proposed diagram based calculations lead to an increasingly skilled mine planning optimization master framework on the grounds that the outsider MIP optimiser is never again essential and arbitrary neighborhood search isn't vital. [11]

Eduardo Moreno (2010) et. al. We study an expansion of the priority constrained backpack issue where the rucksack can be filled in different periods. This issue is referred to in the mining business as the open-pit mine production planning issue. We present another calculation for explaining the LP unwinding of this issue and a LP-based heuristic to get achievable arrangements. Computational trials show that we can understand genuine mining occasions with a great many things in minutes, getting arrangements inside 6% of optimality. [12]

Chung H. Ta (2013) et. al. We're showing versions of vehicles and shovels in oil and natural gas surface mines. Models are designed to restrict the number of trucks for the particular arrangement of shovels, due to the constraints of productivity and mineral evaluation. We calculate and authorize the non-linear relation between the inert likelihood of the shovel (which dictates the productivity of the shovel) and the quantity of trucks on the shovel, based on a simple approximation, provided the hypothesis of restricted source lines. To merge this articulation into simple integer codes, we use linearization. We agree in our integer systems that each shovel is doled out of the lone size of the truck, but we're diagraming how one might represent various sizes of the truck per shovel in a deduced manner. Linearization of the idle probability of the shovel helps one to describe highly reliable truck distribution models that are easily resolvable for fair projected problems. [13]

Shi-Qiang (2012) et. al. Right now, intelligent arranging and booking system are proposed for improving tasks from pits to smashers in mineral mining industry. Arrangement of hypothetical and viable activities look into procedures are examined to improve the general efficiency of mining frameworks because of the realities that mining administrators need to handle optimization issues inside various skylines and with various degrees of detail. Under this structure, mine plan arranging, mine production sequencing and mine transportation planning models are coordinated and cooperated inside an entire optimization framework. The proposed incorporated system could be utilized by digging industry for decreasing equipment costs, improving the production efficiency and expanding the net present value. [14]

Yuri Voronov (2017) et. al. Hypothetical and methodological essentials of mining pull trucks optimal structure are enunciated. Techniques dependent on the frameworks way to deal with incorporated appraisal of truck specialized level and strategies for optimization of truck parameters relying upon execution norms are given. The consequences of utilizing these techniques are given. The created technique permits surveying the truck specialized levels as well as picking the most encouraging models and giving quantitative assessments of the choices to be made at the plan arrange. These zones are firmly associated with the issue of progress in the modern yield quality, which, being a piece of the broadly spread in Western world "total quality control" belief system, is one of the significant issues for the Russian economy [15]

CONCLUSION

The state-of - the-art computing technology has progressed to the stage that there are many truck dispatching technologies that provide the ability to increase the efficiency of the vehicle and eventual savings. The installation of a dispatching device in a mine will yield operational advantages through minimizing processing times and achieving additional benefits by improved tracking, efficient routing and grade management. The Computer-Based Equipment Performance Monitoring System (CBEPMS) is a valuable method for tracking the output of open-cast coal off-line testing devices. This is an automated network for all open coal mining facilities for output control. This method begins by recording the output trips of dumpers to the spare parts consumption / maintenance efficiency.

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Corresponding Author

Rajesh Mishra*

Research Scholar

mishra200@gmail.com