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Management information system for draglines and dumpers used in mines

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ABSTRACT

Mother Nature has bestowed our country with quality mineral deposits and today we are mining 87 minerals to support the Indian economy which is expected to grow at plus 7 % rate. This growth rate requires 10 to 12 % growth in mining sector every year. (1). Achieving such voluminous growth is only possible by employing huge Heavy Earth Moving Machineries (HEMM). Big size machines are extremely costly, one 24 cum dragline cost @250 crores and one 240 ton dumper Rs 24 crores (2). The idle time cost of such costly machines is very high. Hence it calls for an efficient management information system (MIS) for better availability and utilization of machines. (3) GPS based MIS are available but their capital and operational cost is high as it requires specialized manpower. This calls for indigenous development of economical sensor based MIS packages which could produce temper proof online data along with facilities of analysis.

Keywords— *HEMM, Costly, Indigenous, MIS*

1. INTRODUCTION

Mother Nature has bestowed our country with quality mineral deposits and today we are mining 87 minerals to support the Indian economy which is expected to grow at plus 7 % rate. This growth rate requires 10 to 12 % growth in mining sector every year. (1). Achieving such voluminous growth is only possible by employing huge Heavy Earth Moving Machineries (HEMM). Big size machines are extremely costly, one 24 cum dragline cost @250 crores and one 240 ton dumper Rs 24 crores (2). Idle time cost of such costly machines is very high. Hence it calls for efficient Management Information System (MIS) for better availability and utilization of machines. (3) GPS based MIS are available but there capital and operational cost is high as it requires specialized manpower. This calls for indigenous development of economical sensor based MIS packages which could produce temper proof on line data along with facilities of analysis.

2. PARAMETERS WHICH ARE REQUIRED TO BE MONITORED

The main dragline parameters which needs monitoring are production (in terms of number of buckets), cycle time of each bucket, swing angle of each bucket, drag and hoist rope travel, bucket loading time, total working time, total walk time, total idle time, idle time analysis etc. Shift wise comparison of average cycle time of bucket can indicate operator's efficiency. Average swing angle for a given cut of dragline can project efficiency of planning. Hoist and drag rope travel data can be clubbed with production and the rope replacement can be calculated in terms of production. Bucket loading time can be a good indicator for assessing quality of dragline blast. Total working time /total idle time for a shift can indicate performance of maintenance crew of the shifts. Idle time analysis can be done effectively by sub dividing it into different reasons like electrical/ mechanical failures, power failure, unavailability of face, unavailability of dozer, idle time due to blasting etc. Micro level analysis of spares and manpower management can be worked out for preparing maintenance schedules. Walking time recorded can be scrutinized by calculating its ratio with total available time for a given cut or in terms of percentage of total production of a cut. Comparison between any two time frames for a given parameters is possible because of availability of data. Utilization of dragline in terms of material handled can be an indicator of management efficiency. (5)

Operational parameters like availability time of dumper, dumper loading time, loaded cycle time, unloaded cycle time, numbers of trips made, haul road condition etc. can present some useful decision making data. Loading time of a dumper can tell us about blast quality and shovel operator efficiency. From loaded/unloaded cycle time data parameters like optimum loading distance, dumper operator efficiency, fuel consumption, maintenance quality, haul road condition etc. can be evaluated or correlated. Monthly data can be used to generate reports like shift wise comparison, operator wise comparison, quality of haul road, maintenance cost verses haul road condition etc.

3. SENSORS WHICH CAN GENERATE THE DATA

Opencast mines has difficult conditions of dust, vibrations, high temperatures and muddy conditions during rainy season. The sensor has to pass all these conditions. Proximity sensors were found to give best results. The YES or NO condition provided by proximity sensor was used to develop logic for generating data for above parameters. Current sensor was used to determine loaded condition of the bucket by converting hoist current to frequency in case of dragline. Micro controller 89V51RD 2 was used to store and process the data. (4)

3.1 Conditions considered for developing logic for dragline MIS

(a) Two proximity sensors were installed at hoist and drag drums to give direction of rotation and to indicate start of loading operation.
(b) Two proximity sensors were installed at swing motor so as to get direction of swing as well as angle of swing.
(c) The current output of hoist motor was converted to frequency to recognize the load or no-load component of bucket.
(d) The auxiliary contacts of marching motor were directly tapped to record marching of the dragline.
(e) Minimum time to fully load the bucket under different strata conditions was also recorded. Legal load was considered only when swing angle was more than 25 degrees.
(f) The system is provided with six idle time buttons. During idle time the operator has to press the requisite reason button to classify the idle time. With this idle time can be stored with a reason and then can be analyzed for six different reasons.

3.2 Conditions considered for developing logic for dumper MIS

(a) One proximity sensor was installed between the operator's cabin and body of the dumper to recognize the load condition.
(b) Second proximity sensor was installed near the chassis to record unloading condition.
(c) Load condition was accepted only when suspension of dumper were compressed due to loading after a time interval of 45 seconds.
(d) Any other recording of sensor number one was considered for haul road condition assessment only.

4. CONCLUSION

The system was tested in the mines of Western Coalfields Limited and was found to fulfill all the conditions considered to generate temper proof on line data. Such sensor based systems are not only economic but mine officials can install and calibrate them easily after maintenance.

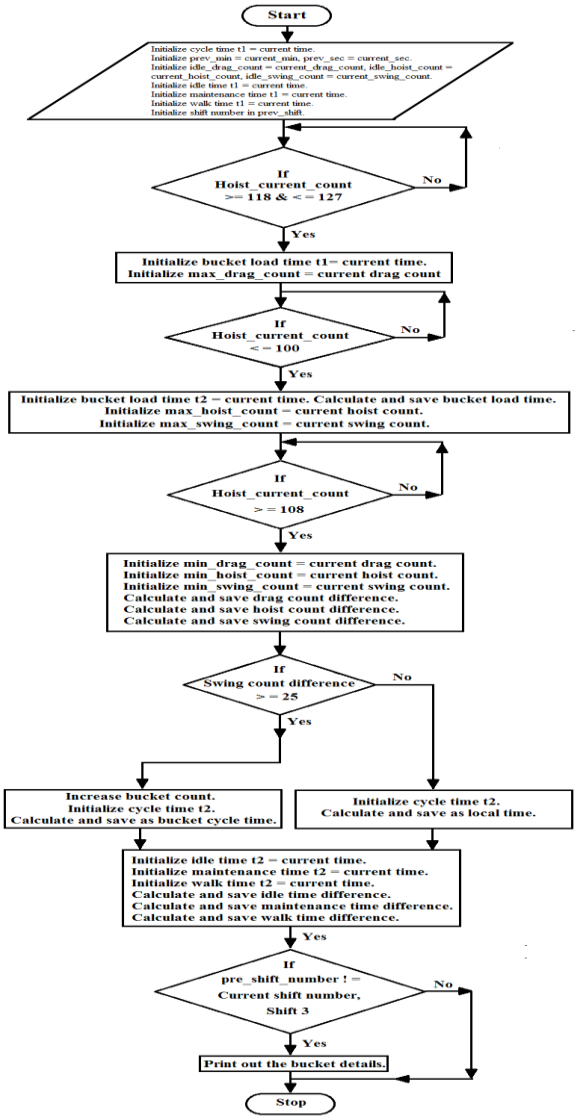

Fig. 1: Flow diagram for dragline

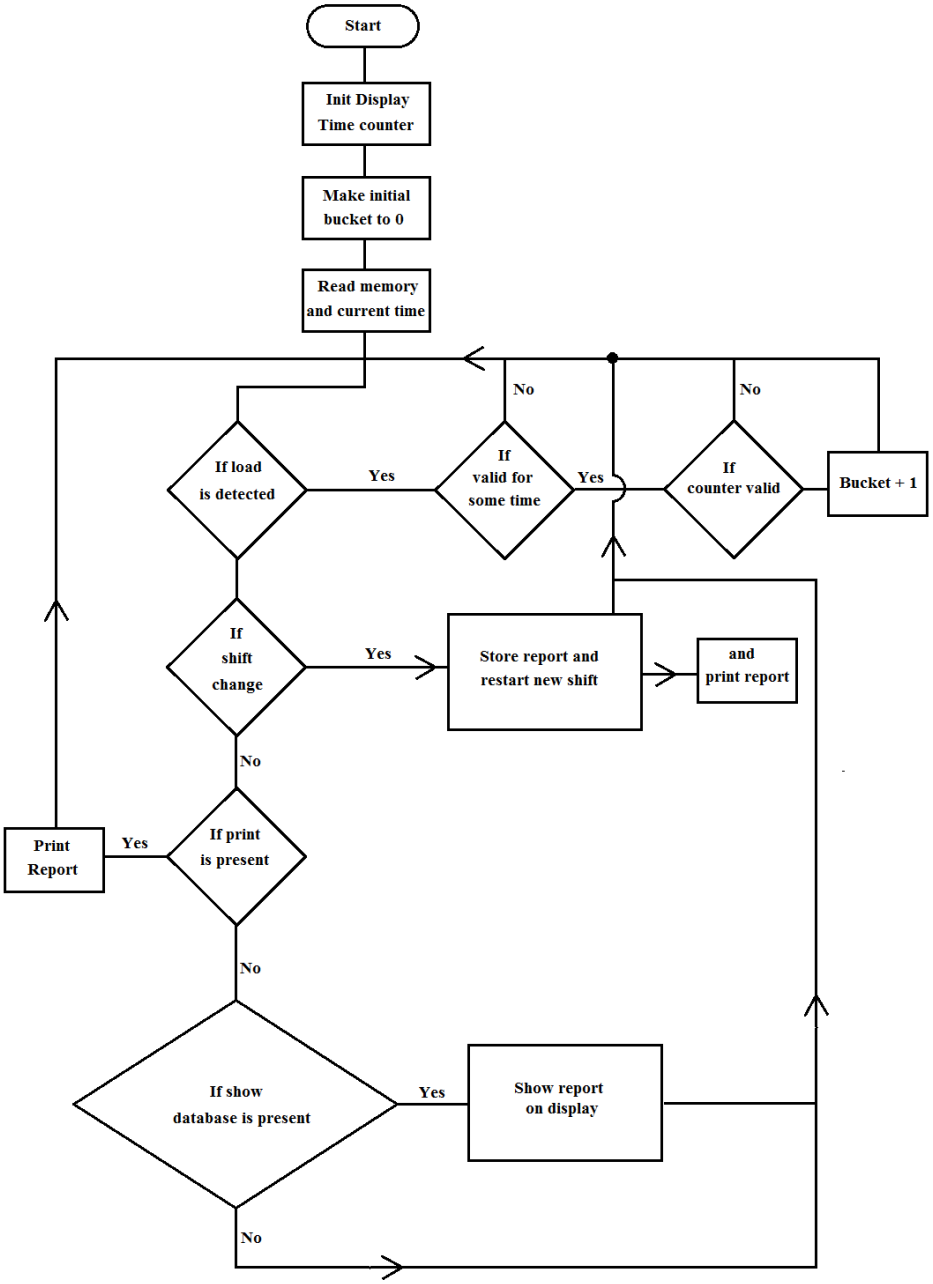

Fig. 2: Flow diagram for dumpers

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