IoT Application In The Mining Industry

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Abstract- Human beings cannot be happy with any kind of tiredness based work, so they focused on machines to work on behalf of humans. The Internet-based latest technology provides the platforms for human beings to relax and unburden feeling. The Internet of Things (IoT) field efficiently helps human beings with smart decisions through Machine-to-Machine (M2M) communication all over the world. According to condition that safety situation of national coal mine production remains serious, and serious accidents have not been effectively curbed, current status of safety supervision information is analysed. Through introducing concept of Internet of Things (IOT), view of using IOT to help safety supervising authorities of coal mine strengthen supervision on enterprises implementing principal responsibility for safety along with specific application of IOT in safety supervision of coal or metal mine can be undertaken.Program of networked remote inspecting technology on basis of IOT provides a new way for innovating supervising way, thereby working effectiveness of supervision against coal mine can be enhanced, and serious situation of safe production in coal mines can be improved, finally safe and stable development of both the coal industry as well as the metal industry can be further promoted.
Keywords: IoT, Machine to Machine Communication, coal industry, metal industry, safety, supervision, stable development.

I. INTRODUCTION

The term “Internet of Things (IoT)” acts as an umbrella keyword that covers the various features such as the extension of the internet, the web as physical realm, deployment of extensive embedded distributed devices, sending and the actuation abilities. The term IoT is also called future internet.

The IoT four key technological enablers are: -

For tagging the things RFID technology is used

For sensing the things sensor technology is used

For thinking the things smart technology is used

For shrinking the things Nanotechnology is used

The IoT devices have border vision which covers several services, consisting of earthquake monitoring systems, building health system, landslides detection, energy management (smart parking and lighting), automation of public building and air quality of noise monitoring system. The IoT is a fusion of heterogeneous networks including chip technology that scopes gradually more and more, expanding due to the rapid growth of internet applications such as logistics, agriculture, smart community, intelligent transposition, control and tracking systems.

II. BACKGROUND

The mining industry has been facing significant headwinds lately. Low commodity prices, increased environmental requirements, and greater haulage distances are all pressuring profitability. Replacement rates of large and long-life deposits are declining and the lead times to develop greenfield sites are, at the same time, increasing. Add skilled labour shortages into the mix and it’s no wonder the industry is feeling squeezed.Several technologies are available, or under development, to help mining companies face these challenges. Some have been around for years but they are only just becoming economical enough to rollout. Increased mechanisation, optimised equipment and material flow, and real-time performance monitoring are only a few of the initiatives.While each application alone has potential, together they could be the shift the industry needs to get the wind back in its sails.

III. LITERATURE REVIEW

IoT can be applied to the mining industry in several ways due to its wide application and benefits. It can be applied in data integration from an increasing number of sources enables mining companies to plan mines and future operations with unparalleled accuracy. It can be applied for unmanned vehicles. Driverless mine vehicles operate autonomously. Some don’t include a cab, meaning it’s not even possible to ride on board. These GPS-powered vehicles can fully interact with each other to minimise delays and fuel costs. Today, one mining giant has these trucks hauling iron ore 24*7 at mines in Australia. It can be used for predictive maintenance as predictive maintenance technologies help determine precisely when equipment will need maintenance.By combining analytics with inventory management, companies could ensure inventory is stocked on a just-in-time basis, in just the right quantities thereby improving inventory management. Finally, technologies such as cloud-based logistics and load-

sharing platforms can enable mining companies to optimise their supply chains. Companies can use digital tools to execute and manage sales contracts, determine price in real-time, and manage inventories and product flows in ways that control for risks and optimise costs.

IV. THEORY

The system layout of a basic IoT network in a mine mainly consists of three layers namely the perception layer, the network layer and the application layer. In the perception layer the waste materials from the waste dumps and other sources are transported either to the treatment plant or to the disposal facilities. Dumpers are responsible for the transportation processes. In order to implement IoT in a mine all the devices and machines are connected together with the help of RF trans-receivers. The trans-receivers send and receive signals at regular interval form the central computer as well as from other set-ups present on different devices. Data integration

Data integration from an increasing number of sources enables mining companies to plan mines and future operations with unparalleled accuracy. Applying models and running simulations using information such as weather, ground conditions and machine availability provide invaluable insight enabling them to know exactly what is in the ground and precisely where to operate. This information can be used to optimise drill and blast patterns, which generates the greatest possible value at the lowest possible cost and environmental impact. This technology is expected to trickle down through the entire industry.

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4.1 Unmanned Vehicles

Driverless mine vehicles operate autonomously. Some don't include a cab, meaning it's not even possible to ride on board. These GPS-powered vehicles can fully interact with each other to minimise delays and fuel costs. Today, one mining giant has these trucks hauling iron ore 24/7 at mines in Australia. At one site, the trucks work alongside an automated blast hole drill system, enabling multiple drill rigs from different manufacturers to be operated remotely. The company is also upgrading the trains that haul the ore, allowing the locomotives to drive themselves and be loaded and unloaded automatically, greatly improving safety.

4.2 Predictive Maintenance

Predictive maintenance technologies help determine precisely when equipment will need maintenance. Vehicles equipped with sensors transmit their operational status and performance statistics to a central automation system. The system then analyses the data, in conjunction with equipment suppliers, to predict required maintenance and prevent unplanned equipment failures. Using this information promises to reduce maintenance spending and prevent costly, unexpected interruptions.

4.3 Inventory Management Of Spare Parts

Mining companies often keep spare parts on-hand to be available for repair and maintenance. However, many of these parts become obsolete before they are even used and are then discarded. By combining analytics with inventory management, companies could ensure inventory is stocked on a just-in-time basis, in just the right quantities. Stock would be ordered at the appropriate time and any unused inventory would be sold off before it becomes obsolete, thus reducing risk and inventory costs. To cap it off, digital control systems would automatically settle the transactions and produce management information reports, saving valuable time.

4.4 Cloud-Based Logistics

Finally, technologies such as cloud-based logistics and load-sharing platforms can enable mining companies to optimise their supply chains. Companies can use digital tools to execute and manage sales contracts, determine price in real-time, and manage inventories and product flows in ways that control for risks and optimise costs.

A driverless truck pulls up to an excavator operated from a computer mile away, is loaded and departs with the exact weight to optimise fuel consumption. The truck receives instructions from the mine's central automation system to haul the ore to the unattended loader, where it is placed on rail cars before being transported – again unmanned – hundreds of miles to the port.

As we go further in our discussion, we will get to know how to implement these factors in the present mining conditions using IoT and how to achieve optimum working condition for economic running of the mines.

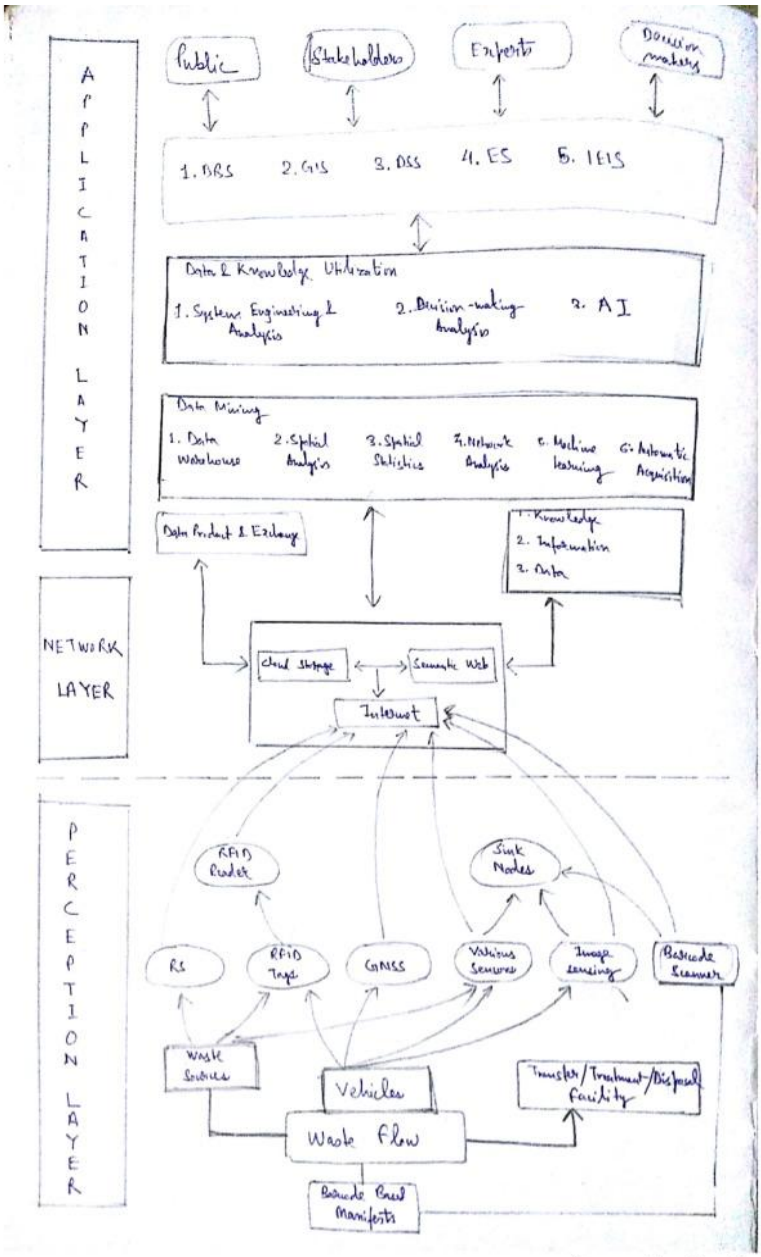

Figure 1: System Layout Of Basic Iot Network In A Mine

In the network layer, the data received from the perception layer is now stored in the Internet belonging to the Network layer. From here the data can either be transferred to the cloud storage from where it can be accessed by different gadgets or to the semantic web network. From the Network layer the data is transferred into the Application layer where it is processed as per the user need. The data from the network layer either enters for the Data Product and Handling or it is sent for the Data Mining. The Data Mining comprises of an array of applications and processes which are discussed in the later part. From Data Mining the information is sent for Data and Knowledge Utilisation. It comprises mainly of three parts, i.e. System Engineering and Analysis, Decision-making Analysis and Artificial Intelligence.

Figure 2: GIS System

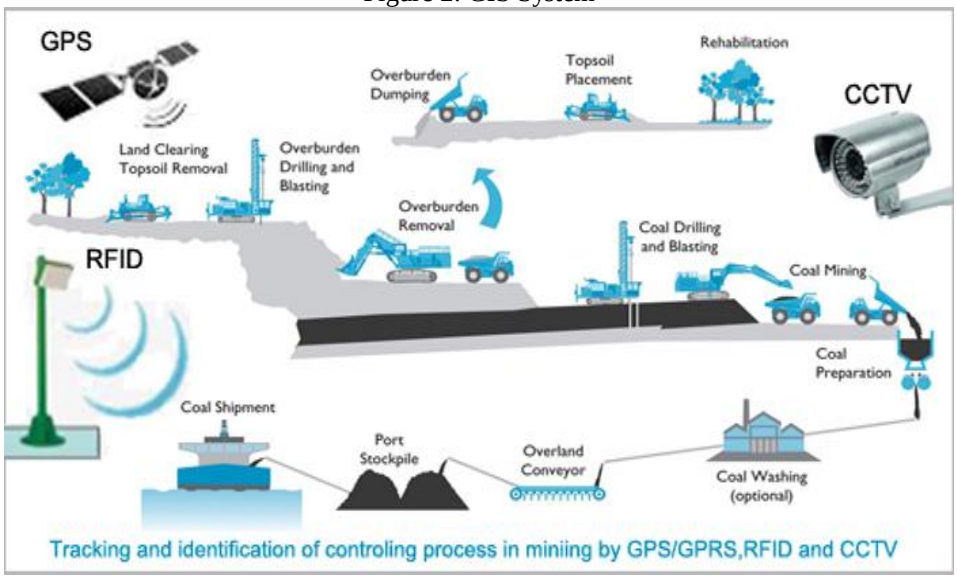

Figure 3: RFID System in Mines

IoT can be implemented in the mining industry in the following mentioned ways:
Use Sensors to Move Toward Proactive Maintenance.
Carry IoT capabilities into other areas by enabling remote control of certain heavy equipment by combining the operational technology that physically controls machines with IoT systems. Secondarily, the IoT can help companies identify the root cause of a performance issue, even if it originates in another asset or department. If a conveyor belt slows down, technicians are likely to only make adjustments at the belt.
Enable Real-Time Analysis: By switching to real-time analytics, organizations can achieve operational awareness as the data is being collected.
Consider Increased Autonomy and Smart Machines: Remote control of machinery or vehicles has delivered safety and production boosts in mining. Another use of IoT-related technology and real-time data analysis is autonomous smart machines.
Plan for a Machine-Only Future: Finally, nearly every industry foresees more people-less operations. Mining companies still require many employees on-site for now, but they're heading toward a machine-only future.
Further applications include:
Tracking supervision of underground personnel
Monitoring and warning of environment
Monitoring and warning of device
Supervision of management

V. CONCLUSION

I conclude from my project that the implementation of IoT in mining activities can be of greater advantage as all the systems will be connected with one another and this will help us to monitor the various activities from a single central computer location. I have also proposed the design of a website which will be having the template that will connect different aspects that are necessary for the running of the mines in a more economically profitable way. The website will be including Employee Data Base, Waste Dump site, Plan Data, Mine Data, Transportation units, Stockpile Area and Maintenance Bay. The website will accumulate all the data from different activities and sources which will then be processed by the central computer and then can be displayed on the operator's screen from where it can be monitored. Use of IoT in mining industry will drastically reduce the number of accidents as well as the cases of machine failures thus protecting both human lives and economic resources. The Fleet Management System can easily reduce the ideal time thus increasing the annual ROI of the mines. Adopting IOT technology for remote dynamic supervision, coal mine supervising pattern can be innovated, tracking inspection on illegal action can be achieved, capabilities of emergency response and accident investigation can be increased, situation of safe production can be further improved, and safe and stable development of coal industry can be promoted.

As we can see from the above picture the final view of our webpage would appear as above. We can see the various parts of the webpage that we can access to view our information for different sites, the whole mine and for local operations. The different sections have their following purposes:

EDB: The Employee Data Base can be accessed to view information regarding the employees, their names, area allocated to work, duties, salaries, attendance, work efficiency and so on by connecting the on site data reader like fingerprint scanner and ID reader through the internet to this central computer where the information will be connected and displayed once clicked on the menu.

Waste Dump: Here all the information regarding waste dump site like waste deposited per hour, over load or under load condition, disposal rate and much more can be obtained by interconnecting the devices present there for local collection of information through the internet to the central computer.

Plant Data: Plant data bar will help us access the necessary details regarding various plants like the crushing plant, Ore processing plant, waste treatment plant and more, and will also help us determine the working conditions of the various equipment being used in the mines and notify against any failure.

Mine Data: Here we can access the details related to amount of excavation being carried out per day, blasting information, any geological disturbance creating work hindrance, mine progress as a whole, ore deposits and much more.

Transportation: This will help us implement dynamic allocation and real time data analysis of the various machines being used and help us achieve optimal match number to eliminate mismatch using GPS and LPS system in the machines and mines. This will also incorporate the GOIC system in trucks.

Stockpile Area: This will help us access information related to the stockpile area, like the ore deposited, transported, quality, condition of bunker equipment like stacker, and so on.

Maintenance Bay: This will help us access information regarding the maintenance of vehicles, their availability, condition, requirements to be fulfilled for full repair and so on in the maintenance workshop.

VI. ACKNOWLEDGEMENT

It is my honour to work under the guidance of Professor Prabir Kumar Paul (Mining Engineering Department, Indian Institute of Engineering Science and Technology, Shibpur). I strongly acknowledge his efforts and am grateful for his mentorship. I also thank the Head of the Department, Mining Engineering, Indian Institute of Engineering Science and Technology, Shibpur, Professor Sudipta Mukhopadhyay for his constant encouragement.

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