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UNMANNED IoT BASED AUTOMATED INSPECTION OF LARGE-SCALE MINING HAUL TRUCKS FOR ASSESSMENT OF VEHICLE OPERATION READINESS

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ABSTRACT

We have developed an automated system for inspection of operational readiness of large mining haul trucks. The developed system is designed to minimize or replace the presence of ground inspectors to mitigate safety hazards and improve operational efficiency.

Eight parameters were selected to assess the status of engine functionality of mining haul trucks. The parameters of interest are fluid levels of steering, hydraulic, brake, torque converter, coolant, differential oil, and engine oil. In addition, grease level in a grease injector, and the ambient temperature at sensor locations were also included in the data acquisition system. We used an internet of things (IoT) approach to collect and transmit these sensor readings to a central server, where they are stored and made available for visualisation through a web-based user interface (UI).

Sensors were placed on trucks using custom-built mounts for ex-situ deployment of the modules. Sensor modules were designed for data acquisition through indicator sight-glasses, or through independent voltage signals. This approach allows us to deploy the automation system on operational mining trucks without the need for time consuming major mechanical or electrical overhauling. The eight sensor modules on-board a vehicle form a network that is coordinated by a network coordinator circuit (NCC). The network coordinator is powered by the vehicle power system and responds to requests sent by the server. Upon receiving the request, individual sensor modules within a network (the specific truck) change their status from a default sleep-mode to an active mode for the acquisition and transmission of data to the server through radio transceivers. The central server then stores these sensor readings in a database and makes them available for visualisation through the web-based UI.

The operation readiness of each haul truck is further inspected through pan-tilt-zoom cameras placed at strategic angles to cover a 360-degree view of the vehicle under inspection. A wireless fidelity (Wi-Fi) network spread over the vehicle inspection region through access points (AP) was designed for wireless camera connectivity. The camera images, synchronized with the fluid level sensor data, provide comprehensive information on haul truck operational readiness during their inspection at designated site(s) within the mine field region. Our system of automated inspection provides an opportunity of eliminating human inspection related safety hazards for large mining haul trucks. The system is also designed for improvements in operational efficiency and reduction of vehicle downtime related to safety procedures and human related errors.