

TECHNICAL PROGRESS REPORT

Quarterly Report

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ABSTRACT

A prototype tracking system was built and tested. Moving vehicles were detected by the tracking system when a vehicle was 20 to 30 feet away from a location sensor. The identity of the vehicle was transmitted to Transtek's in-mine communications system and relayed to a desktop computer.

TABLE OF CONTENTS

Executive Summary	5
Research, Development, and Experimental	6
Results and discussion	8
Conclusions	9

EXECUTIVE SUMMARY

We built and tested a vehicle (people) tracking system. The system detects and identifies moving objects when they approach within a distance of 20 to 30 feet from a beacon that designates the location. A test vehicle and its location identities were transmitted to Transtek's in-mine wireless communications system. This system, in turn, relayed the information to a desktop monitor.

While the system functioned as required, it is recommended that a variation of the system in which the beacon and sensor are replaced with an RFID pair be investigated. This would eliminate the need to power the transponder device on the vehicle, or person, as the device would receive the energy from the location identifier beacon positioned at a fixed location.

RESEARCH, DEVELOPMENT, AND EXPERIMENTAL

The tracking system was designed for compatibility on the premises that all the system components belong to the same family. To prevent interference with our mine-wide communications system, we chose for the tracking method frequency hopping at a frequency one order of magnitude higher than the frequencies used for the in-mine system. The tracking system consists of transponders mounted on the moving object (vehicle or person), beacons mounted at known locations, and repeaters to link the tracking system to the in-mine communications system.

We designed the hardware and programmed the software. We built and tested a prototype system. We adjusted the sensitivity of detection so that a transponder and beacon communicated with each other when the distance between them was 20 to 30 feet. Each transponder is programmed with its own ID. The sensing section of the beacon received the ID from the transponder, added its own ID to identify the location, and sent the information through a repeater to a wireless receiver connected to an RS232 terminal of an in-mine communication system control module. The in-mine system then relayed the information to a video display of a computer connected to a remote in-mine control module. The software was designed so that in addition to the identification information, the monitor also displayed a continuous count to indicate that the system is active and functioning. This prevents an erroneous conclusion that the system “froze” if a vehicle or person remains for a long time near a beacon causing a constant identification display.

It is advisable to try a minor modification of the system. Since the distance of communication between transponder and beacon needs to be only on the order of 30 feet, it is not necessary to use relatively high-powered transceivers for this portion of the system. The repeater that bridges the tracking system and the in-mine system must be of relatively high power since the distance will in general be several hundred feet. To be able to choose all the components from the same family, we used relatively high-powered components throughout and adjusted the sensitivity as needed. For low power components, so called RFID devices can be used.

RFID devices have been developed for applications such as checking inventory in a warehouse. Each stored object is furnished with a transponder. As a clerk passes a beacon along the shelves, each transponder registers with the beacon and is accounted for. Since the distance between the beacon and transponder is small, the transponders do not need to have their own power source. The energy needed to transmit the response is radiated from the beacon to the transponder.

Such devices seem to be attractive for the mining tracking application. In the mining tracking system discussed above, each transponder uses the vehicle or cap lamp battery for power and requires voltage regulators and the associated electronic circuitry. An RFID transponder would simplify the equipment considerably and lower the cost accordingly. However, the RFID equipment would have to be interfaced with the remainder of the tracking system since, for reasons given above, a relatively high-powered repeater is needed to reach the in-mine system.

RESULTS AND DISCUSSION

We designed and built a functioning tracking system that is integrated with our in-mine communications system and can track and identify moving objects along pathways that are equipped with beacons. While this is a functioning system, an alternative was suggested that would make the system smaller and less expensive. Additional work must be done to examine the properties of this alternate approach.

Another challenge would be to build a system that would be able to identify vehicles and their locations anywhere in a mine without requiring the machines to follow along prescribed paths. This would pave the way to the use of fully autonomous machines.

CONCLUSIONS

The plans that were laid out to design and build a mining tracking system were followed and the resulting equipment was tested. The test resulted in a well functioning system. The method is sound and development of a system for commercialization appears to be feasible. Ways were shown that can be followed to simplify the equipment that would result in lower cost.