

Active Work Zone Safety Using Intrusion Alert Technologies

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Highway construction work zones are risky environments characterized by a dynamic and limited workspace. The increasing number of roadway widening, rehabilitation, and reconstruction projects has made work zone safety a critical concern due to the increase in construction workers' exposure to hazardous conditions. A need exists for a management approach that considers not only the implementation of active intrusion sensing technologies but also their effectiveness in alerting both the pedestrian workers and vehicle drivers in work zones. This study advocates new cutting-edge technologies for improving work zone safety in infrastructure construction or maintenance. The main objective of this research was to conduct both conceptual analysis and experimental evaluation of intrusion sensing technologies for work zone safety. The study provides an evaluation of the applicable intrusion technologies for work zone safety and implements commercially available intrusion sensing technologies in a simulated highway work zone testbed through field experimentation.

To achieve the objectives of this research, an exploratory review of the applicable technologies was conducted to identify the intrusion technologies that can be implemented for work zone safety. An objective assessment of each technology was provided based on selected evaluation metrics to elicit their capabilities. Commercially available technologies were selected based on the outcomes of the exploratory review and evaluated using field experiments in simulated work zones. An implementation guide was created for integrating innovative sensing technologies for work zone safety in the construction and maintenance of transportation facilities projects. The implementation guide was formulated as a conceptual framework from the critical review of Department of Transportation (DOT) needs, the findings of the current study as well as best practices adopted to enhance the transfer of emerging technologies in construction. From the review of intrusion technologies that can be deployed in work zones, five categories of intrusion technology systems were identified: a) kinematic intrusion technology systems, b) infrared-based intrusion technology systems, c) pneumatic and microwave intrusion technology systems, d) radar-based intrusion technology systems, and e) radio-based intrusion technology systems.

The findings of the preliminary testing, field experimental trials, and overall evaluation of the intrusion alert technologies indicate that the technologies have the potential to enhance the safety of work zone workers by providing warning alerts when hazardous situations exist. The results of the experimental investigation imply that warning alerts can be provided to the workers and vehicle drivers around work zones when a hazardous situation occurs. The implementation guide developed in this research provides best practices associated with implementing and maintaining a highway work zone intrusion alert system. These technology systems, as well as others, can provide an additional layer of safety protection for DOT personnel in hazardous work environments. This research contributes to the body of knowledge by providing strategies for selecting and implementing intrusion sensing technologies for active work zone safety.

Keyword: Construction safety, intrusion alert, sensing technology, work zone safety