Port-to-Port Expedition Security Monitoring System Based on a Geographic Information System

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ABSTRACT

Transportation companies operating both domestically and internationally are starting to worry about the safety of cargo freight. Utilizing a GIS-based port-to-port expedition safety monitoring system based on global information system is the appropriate way to handle the security and safety concerns in cargo assets because cargo crime is the largest difficulty facing supply chain companies. Reports will be sent in real time by the system to the central office via the data communication network. The application of tracking and traceability systems (tracking), dispatch (cargo loading and unloading), and access authority for cargo operations are the main topics of this study. Waterfall systems and system design using UML diagrams are the methods utilized in system development. This system employs GPS tracking technology with a digital lock for expedition operations where the position of the cargo dispatch, the location of the pick-up, and the open and closed status of each door container padlock during the field logistics' loading and unloading operations are all tracked in real time.

KEYWORDS

Cargo, Digital Lock, Expedition Security Monitoring System

INTRODUCTION

From the original warehouse to the port, goods transported in a pallet or container will travel via land, air, or sea. After the cargo arrives at the target port, it will be sent to the destination warehouse and eventually be delivered to the client. A cargo company is responsible for the delivery of goods from the initial warehouse to the port. Goods transported on pallets or containers will travel by land,

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air, or sea. After the cargo arrives at the target port, it will be sent to the destination warehouse and finally delivered to the client (Stergiou et al., 2021; Wang et al., 2019). However, we need to realize that shipping cargo and assets requires a high level of security and safety because guaranteeing the assets in the shipping package is the responsibility of the logistics service provide(Akyuz, 2017; Progoulakis et al., 2021). Therefore, strategic decisions need to be taken to maintain the security and safety of assets during the journey from the origin location to the destination location by land, air, and sea (Ashraf et al., 2022). The issue of the security and safety of freight cargo has become a concern for transportation businesses both nationally and internationally. An international organization whose membership consists of three regions, namely America, Asia/Pacific, and Europe, has formed an association called TAPA (Transported Asset Protection Association) (Castro et al., 2020; Christensen et al., 2022). The aim is to combat cargo crime and create global standards that can be used in business and security agreements between buyers (shippers) and logistic service providers (LSPs). Cargo crime is the biggest challenge in the supply chain business. This challenge threatens valuable manufactured products, high-risk products, and logistics service providers (Casola et al., 2019). This motivates the author to conduct research that focuses on implementing monitoring and tracking systems, delivery (loading and unloading of cargo), and access authority into cargo operations.

Thus, this research has the following contributions:

- This research focuses on handling the security and safety issues of cargo assets by creating a system that uses a digital key system based on a geographic information system (GIS).
- The system will send reports via the data communication network to the head office in real time. This is conducted through the implementation of monitoring and tracking systems, dispatch (cargo loading and unloading), and access authority into cargo operations.
- The system uses a real-time GIS-based Digital Lock system by sending reports via a data communication network to the head office to address security and safety issues with cargo assets. An electronic padlock is installed on the container. This padlock will send location data that has been regulated by the system, where determining this location is a work order for picking up and dropping off cargo. Every logistics truck vehicle operator carrying the container must be equipped with an electronic padlock, and the operator must have an RFID card. This RFID is used to open and lock electronic padlocks by placing the RFID card on the surface of the padlock. Operators are only permitted to open containers in locations determined by the system as work orders. If RFID activity occurs to open electronic locks outside the work area, the system will send an alarm or warning that there has been a violation of loading and unloading activities in the field. Likewise, if, without RFID access, this electronic lock is opened either by force or automatically, the system will send an alarm as a sign that a violation with a high level of danger has occurred.

This paper is organized as follows. Part 1 discusses the facts of many cases of cargo theft crimes during the journey from the location of origin to the destination location, motivation, and the contribution of this research. Section 2 describes the related work used in this research. Section 3 explains how to develop a system to monitor cargo from the origin location, throughout the journey to the delivery destination. Section 4 explains the flow of application development results and testing, followed by discussion. Finally, the research conclusions are presented in section 5.

RELATED WORK

The introduction of new threats affecting all architectural layers has resulted from the heterogeneity of involved technologies, including the integration of various resource-constrained devices and networks. This has urged the design and enforcement of appropriate security countermeasures, including effective monitoring capabilities. According to Ashraf (Ashraf et al., 2022) the study aims

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