Monitoring and Tracking Model of Logistics Based on ICT network

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Abstracts

Transportation in the logistics, many business organizations are engaged in monitoring and tracking the vehicles in order to improve logistics services, reduce expenses and secure security in cargo transportation. It is saving time and money by tracking and monitoring vehicles which transport cargo in supply chain of logistics. Therefore the main issue of delivery flow is to improve services, and ensure the safety in transportation system. This article suggests the tracking and monitoring model to keep safety transports on ICT network. It focuses on precise delivery control by monitoring and tracking vehicles to save time and costs. The status of product movement is analyzed for proper decision making. The vehicle embedded with RFID is automatically tracked in the movement process by tracking and monitoring model. The main role keeps safety tracking to reduce costs and to deliver products at proper time and location.

Keyword

RFID, ICT, TM, TMS, DP,

Ⅰ. Introduction

In supply chain of logistics, transportation has an important role to control logistics flow. Most of logistic cost occurs in the process of transportation[1]. Then it is recommended to apply ICT network in that process to reduce its cost and enhance efficiency. Actually a several business organizations have adapted logistics process to run on ICT network. The important things are right location and just-in-time in the process of product delivery, which can be achieved via mobile communication based on ICT network[2], the majority of business organizations are interested in monitoring and tracking logistics process aiming at improving services, reducing costs and ensuring the safety in logistic supply chain. The monitoring and tracking of products is essential to improve logistics process that is cost reduction, speeding deliveries and even identifying bottlenecks and operational deficiencies [3]. Thus it is key role in the logistics to monitor and track continuously the status of product movement by transportation vehicle. This can be available in case that the vehicle embedded with sensor such as RFID[4]. Providing just-in-time and precise right location delivery is able to keep competitive logistics market with safety.

Ⅱ. General Function of Tracking and monitoring(TM) model

Tracking and Monitoring(TM) model aims at permitting business organization to manage transportation vehicle in a secure way using mobile device, RFID technology and Control Program. Figure 1 shows Conceptual TM model, which is composed of five main components, as follows. Those are Delivery Provider(DP), Web Server(WS), TM Server(Tracking and Monitoring Server), Transportation Vehicle(TV), and Arrival Place(AP). The Delivery Provider provides a package of web page for customer to give information about shipments, such as source and destination place. The input of data is done by service providing company, which is called delivery company. TM model performs administrative functionalities for tracking and monitoring of products movement and

supports Web Server which display view feature to show to monitor, at real time, the continuing movements and warning signals occurrence as detour route, low battery and delivery status.

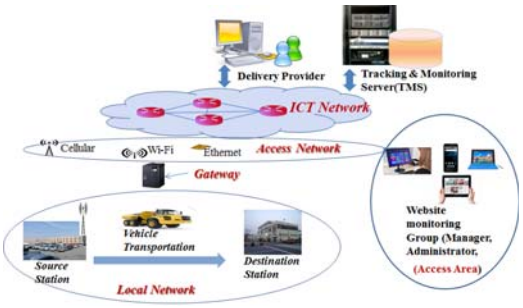

Figure 1. conceptual model for tracking and monitoring of logistic flow

The administrator has full access to the Web Server. The TM server monitors to check the continuing transportation, and check deliveries and movement information. The logistics administrator manages TM server with storing location data sent by mobile devices. The TMS controls and manages logistic routes and vehicles, to optimize the routes, and also to provides resources as services to other TM model's components. The Transportation represents vehicles that deal with products transportation and identifies events when a products enters or leaves the vehicles. This vehicle has responsible for obtaining the coordinates. Finally, the arrival station represents logistics place that is a warehouse or distribution points. TM control function monitors and tracks, when the products enters or leaves, transmits the information to TM model server, confirms the product's reception, and support web services of Web Server and protocol for communication.

Ⅲ. Implementation of Each Component[5]

3.1 TM Server

This server process TM functions and provides data to other functions for tracking and monitoring. The server architecture, shown in figure 2, is divided into three layers. The first one is the Services Layer, which provides functionalities and stored data. This layer is further divided in four modules, which represent distinct interface groups of functions for the Transportation Vehicle, Web Server, Delivery Provider, and Arrival Place.

The Transportation Vehicle[6] interface contains functions that the mobile devices use to send data about their current location, the vehicle's velocity and regarding the products.

The Web server provides tools for administration actions related to routes, drivers, transportation vehicles, and arrival places. It also provides information to the TM server be able to perform real-time tracking and monitoring of vehicles and products[7].

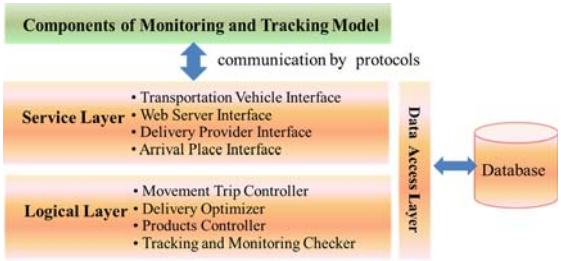

Figure 2. TM server architecture

The Delivery Provider interface supplies methods to the Delivery Provider. These methods let the provider to send a new data of information to be stored into database. It permits the Delivery Provider to read, edit, and erase batches from database. The Arrival Place Interface enables the Arrival Places to read data that are going to be sent, and also confirms the deliveries already done.

The TM model uses the controller of vehicle transportation of TM server to check the movement. The Movement Control module is in charge of initializing and finalizing a movement trips. It analyzes continuously if the vehicles are following the predefined route with product controller and delivery optimizer.

The Transportation Vehicle has to do pickups and deliveries. The initialization and finalizing of logistics flow is done in case that the Transportation Vehicle enters in an area of a pickup or a delivery of sets and detects the arrival of a vehicle. Product controller detects the occurrence of any troubles during logistics flow; those are product's delivery in a Arrival Place where is not corresponding location, product's removal in a place where is not a Arrival Place, product's pickup in an unauthorized Arrival, and missing products in a package's delivery[8].

The delivery optimizer function has responsible for doing optimization in the package's delivery. The best solution calculates the optimization when a new package arrives, through the Delivery Provider, and creates a new route to the closest Transportation Vehicle from the package's source point. But it is not apply in fact, because the current route's alternative is not viable, since it is

not always possible to reestablish a new route during a movement trip. This is due to structural problems, such as one way streets, impossibility of U turns, difficulties in moving a truck, etc. To avoid this kind of problems, it applied two ways in the optimization. One of it is a creating optimal routes for package's delivery and verifying if exists a new package to be delivered on the predefined route, whenever it enters in a Arrival Place. When a Transportation Vehicle enters in a Arrival Place to pick up products, the Arrival Place always makes a call to the TM Server that transfer to the delivery optimizer the checking task if the database has a new package that can be delivered by a vehicle on its predetermined route, also considering its limitations of weight and quantity[9]. If exists, the TM Server returns to Arrival Place the package's code.

3.2 Transportation Vehicle(TV)

The Transportation Vehicle function means vehicles that have responsible for product's transportation. The TV was designed to permit many Transportation Vehicles, each is constituted by **a** collection of RFID tags and an application that run in a mobile device, The Transportation has RFID that identify the vehicle and the carried products. RFID tags is fixed on the vehicle, that provides its identification when it enters an Arrival Place. A RFID tag application aims to identify if a certain read tag is an entering or leaving event of load in a Transportation Vehicle. It communicates with the Transportation Vehicle mobile device via access network(wifi, bluetooth, cellurar, etc), to notify the event occurrences. The entering and leaving events of products can be managed by using RFID antenna fixed on the exit door of the Transportation Vehicle. The RFID tag application requests to the reader the tags that are inside the range, receiving the package of data in a format defined by the manufacturer. This format can be a vector, a list, or a binary tree. In every new requisition, this application stores the package of current tags A and the package of previous tags B, Thus, it uses a package of operations to find the products that entered and left the Transportation Vehicle. Through the operations V A-B is possible to identify all the tags that are now inside the vehicle and then notify the TV Mobile. The operation detects the tags that left the Transportation Vehicle since last requisition, notifying this event to the TV Mobile.

TV mobile is an application that runs as background service in a mobile device, and sends the Transportation Vehicle and products information to the TM Server.

3.3 Web server

The feature to manage products provides monitoring functions, managing products, and warning signals. User can register and edit devices, drivers, and movement trips via this server. The logistics administrator has access to manage movement and routes, and can establish the place of start and destination of the vehicle movement.

The web server permits the monitors to track at real-time entities such as vehicles, deliveries and loads. It enables them to visualize the covered history by entities. Monitoring function can access warning signals due to trouble during the logistics flow. These features speed up decision-making, thus reducing losses and damages in the logistics flow.

3.4 Arrival Places[10]

The Arrival Places represent the locals where the loads are picked up or delivered. Every Arrival Places has to be properly registered in the monitoring and tracking functions. Its key functions is to confirm the products' receiving. A Arrival Place is made of a Local Server and contain several RFID readers along its entering and internal divisions. The sensors are embedded with each division of Arrival Place. The Local Server has an application that communicates with the reader by using the access network(such as wireless network). The data accessed via API provided by the RFID reader's manufacturer. Every entering and or leaving event of a Transportation Vehicle in the Arrival Place is detected by readers and sent to the Local Server. This server collects the data, and after processing it, send it to the TM Server, which automatically does the confirmation of receiving the products. When the Local Server located in Arrival Place detects a vehicle's entering in the Arrival Place, it requests to the TM server if there are new package that can be delivered by the Transportation Vehicle, considering the determined route and the limits of weight and quantity of the vehicle. If in fact this situation exists, the TM server returns the package' code to the Arrival Place, so the administrator is able to confirm automatically, through the application is the Local server.

3.5 Delivery Provider

Delivery Provider consists in a package of web pages in way that business partners may inform data concerning the package of products. The information provided are points, where the products

must be picked up and delivered, time stamps, quantities, among other information regarding the supplier and the customer. The package registration done by the business partners, that are nominated in the Delivery Provider. The registered packages in the Delivery Provider are sent to TM server and stored into the database. The information is used subsequently in order to determine the movement routes. The predetermination is done through the monitoring and tracking function by the logistics manager.

Ⅳ. Conclusion

The Monitoring and Tracking model can manage the vehicle movement and products based on ICT network in the logistics flow. The TM model supports business organization to monitor product movement at real time. The interaction between the mobile device mounted on vehicle and sensor(such as RFID)tags makes to identify deliveries and pickups of products. It also can monitor and track product flow or potential product theft. First of all, using TM model, it is possible to manage product movement and its deliveries in an automatic way. This is important to shorten the user's interaction, optimizing time and reducing problem caused by human errors.

This suggests TM model is the real time monitoring and tracking of delivery in the logistics process. It is possible to manage automatic delivery without user's interaction, and optimize deliveries and to reduce logistics costs. In the future, the further study will required to keep sustainability of supply chain management and to explore the integration of cloud computing.

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