Food Traceability and Security in Supply Chain Using RFID Technology

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Abstract— In recent year due to high demand of food product especially agricultural food then supplied from various countries or regions and lands. Some cases facing out such as on delivery, food safety and consumer care. Thus, agricultural food product safety, traceability and monitoring system is required for food product. In this paper propose a system for food traceability and security in supply chain using RFID technology, where a tag attached to every bucket or packet of food product as identification for product source, batch and expire date. Every process in supply chain of food product identified by RFID reader and scanning the tags then all scanned data send to centralized database for product information. In retail store consumer be able to check food product detail especially expire date and in case of food issues happen supplier easly identified source of product. Beside identification and product safety, delivery can be monitoring by agent as every bucket tagged by an RFID tag. By using this system benefit for the consumer, supplier and authority for identification and monitoring system.

Keywords— Food, Traceability, Security, RFID, Supply Chain, Database

I. INTRODUCTION

Human population in the world is increasing by the year, statistic shown some countries very significant growing of human population. Thus need to supply high quantity food product as required by human, nowadays some of consumers smart to choose and select food product. A method to provide safe and good food product is by trace and monitor all the way started from preparation (manufacturing or farming) to reach user (consumer). Product traceability is the ability to track and monitor movement of a product started from delivery until reach to destination. Food product traceability and monitoring included all stages of process such as, preparation, production, processing and distribution. Food product processing involve in traceability and identify of the source all for input component for processing, such as raw materials, additives, ingredients, packaging. Implementation of food product traceability enables corrective action in case of something happen on the product either safety or defective. When a case of product potentially identified or happen then quick action can be done by food business or related government to isolate or quarantine to prevent contamination to other product before reaching consumers. The other way, if case happens while food product consumed by consumer also can be rectify immediately before scattering to other consumers.

Food Supply Chains can be integrated to the food traceability system in order to maximize technology used. For example modernization of food supplier and farmer for long distance food product delivery and trading. The use of technology in supply chain also can be impact to the marketing strategic of food product, efficiency in manufacturing and delivery and also good for consumer [1]. Another technology can be integrated to the supply chain for food product is Radio Frequency Identification (RFID) technology. RFID is used to describe various technologies that use radio waves to automatically identify human or objects. RFID technology concept is similar to the bar code identification systems concept as we seen in retail stores every day, however one big difference between RFID and bar code technology is that RFID does not required line of sight reading as bar code scanning requires line of sight reading [2]. The component of radio frequency identification system consists of tag, readers and backend system (computing system) for processing the information received by the readers. By added RFID technology into food supply chain traceability then a product early and fully monitored by supplier or consumer, in case something goes wrong easy to identify.

In previous year some of research related to food traceability has been done, one of topic was discussed on framework for the evaluation of a traceability system for the agro-food industry; the automation level in an RFID-based traceability system is analyzed and compared with respect to traditional ones. Internal and external trace abilities are both

considered and formalized, in order to classify different environments, according to their automation level [3]. In this research only focused only the framework and process flow of the traceability system. Another research in traceability system is developing in the wine production sector by joining this RFID technology with the use of wireless sensor networks for monitoring at the vineyards. A proposal of such a merged solution for a winery in Spain has been designed, deployed in an actual environment, and evaluated. It was shown that the system could provide a competitive advantage to the company by improving visibility of the processes performed and the associated control over product quality. Much emphasis has been placed on minimizing the impact of the new system in the current activities, system shows implementation sensor network in farming and production system but not much for consumer information [4].

This research proposes a new system for food product traceability complete started from farming (production/manufacturing) until user reach to destination or consumer. RFID technology was used as a tool in traceability (tracking and monitoring) of food product. Where, an RFID tag used as identification in every parcel (pallet) of product. Supply chain technology ability to propose proper and efficient process for the food product so minimize the risk of food contaminate or mix to others during delivery.

II. SUPPLY CHAIN SYSTEM IN PRODUCT DELIVERY

Supply chain management systems are allowing meeting customer demands more effectively and efficiently [5]. This system gives the ability to quickly and effectively process orders in delivery to ensure customer needs are addressed quickly. The concept of supply chain management is based on two core ideas, firstly is that practically every product that reaches at end user represents in effective time and secondly is that the product delivery to the user in safe and secure to consume. Supply chain management is the active management of supply chain activities to maximize customer value and achieve a sustainable competitive advantage. This represents a conscious effort by the supply chain firms to develop and run supply chains in the most effective & efficient ways possible. Proposed supply chain activities cover from product development, sourcing, production, and logistics, as well as the information systems needed to coordinate these activities. The organizations that make up the supply chain are "linked" together through physical flows and information flows. Physical flows involve the transformation, movement, and storage of goods and materials. Figure 1 shows how is a complete of supply chain management system work stated from processing, delivery system and reach to the customer.

In order to monitor quality and security of a food product, monitoring need to start from first process for example bananas fruit, starting from plantation (location), cutting and processing, packing and delivery then retailing and reach to user for consume. All the plantation location and product batch to be tagged and classified according to the delivery and the data stored in a big central data based to be shared to other parties.

Fig. 1. Food product supply chain management system.

III. PRODUCT TRACEABILIY USING RFID SYSTEM

Food product traceability can be defined as the information necessary to describe from production history of a food crop and processes of the crop might be subject to on its journey from the grower to the consumer. The ability to collect the information as much as possible and use it to ensure product quality in "real time" provides tangible benefits to the food industry. It provides a greater assurance of food product quality and enables faster identification of problems. It also provides the procedure for communicating to the consumer the diligence with which a business operates. Information technology has developed over the last decade to a point where it can quickly and efficiently move, store and analyze vast volumes of data. As the use of personal computers continues to rise, access to appropriate technology and software systems is increasing amongst all members of the food supply chain. To solve the problems of data collection, transmission and analysis within the industry, there must be a common and standard means of communication, available to all [6-7].

RFID is a technology can be use as alternative solution for product identification and traceability. Figure 2 shows a traceability of food started from factory or manufacturer, where every product labeled and tagged with an RFID tag that programmed with original information then bring to freight forwarder for delivery. Once item tagged with information tag, every step of delivery process can be trace by system and all the information will send to data centre then user or customer able to see the location and status of goods. Normally, every retailer or supermarket has own warehouse for stocking the good and before entering warehouse every product scanned by RFID system at the entrance to make sure correct product and in good condition. Retailer shows or display product to sell at dedicated location then customer be able to check the goods especially food product before buying, with this system customer by using smart phone or tablet able to scan selected product to check all the information and status.
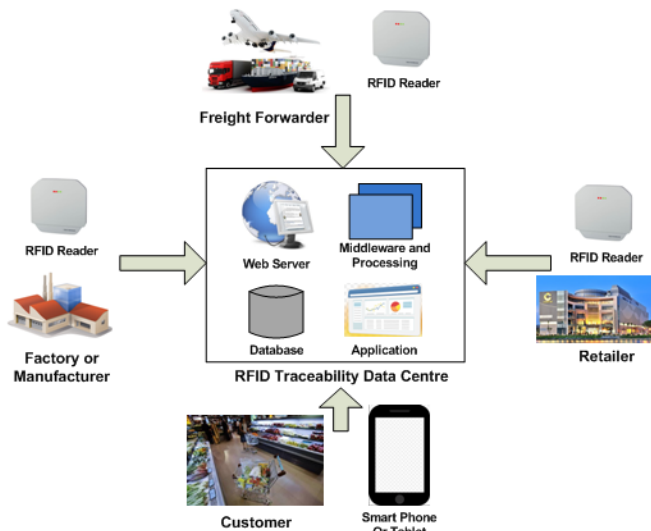
Fig. 2. RFID traceability data centre in supply chain system.

A. Product Tagging

In order to identify and track a product, tagging or labeling with identification is required to make a product detected by system. This system used RFID technology as a tool for identification, tracking and traceability thus an RFID tag is needed to stick on product either goods or carton box. In this case a passive RFID tag with inexpensive cost used as a label with some information stored inside the tag, the information represent some important data of the product such as date of expire for food product, farming location (area), manufacturer, supplier and importer. Besides that, with RFID tag product delivery can be track and trace if case happen on the goods for early precaution before reach to the consumer. Figure 3 shows a sample of food product (banana) that tagged on fruit and on carton box, the label on carton box represent number of goods inside then with this system applicable to use in inventory or stockiest for a retailer or supplier.

Fig. 3. RFID tagged on a carton box of a product.

B. Product Scanning and Identification

Every food products either bucket or carton box were tagged by an RFID tag, thus identification and scanning can be done at any place with available facility of fix RFID reader or mobile handheld RFID reader. Normally before product going out to deliver or shipping, a set of RFID system installed at the gate for automatic identification then system will scan and captured the entire food product out. All data captured will send to central database throughout network system, the data collected useable for local system such for record and inventory beside for customer and other parties need the information about food product. Figure 4 shows a system of RFID with fixed reader and mobile handheld reader to identify food products, where every products before loading to the truck should pass by outgoing portal system with installed RFID system with high power of transmission then all the product will detected in longer range (long distance). In some cases because of casing or enclose of product maybe fix reader can not or difficult to pass by portal system then the mobile handheld reader use for the scanning and identification. Data collected by handheld reader will send to central database as well by wirelessly throughout wireless access point.
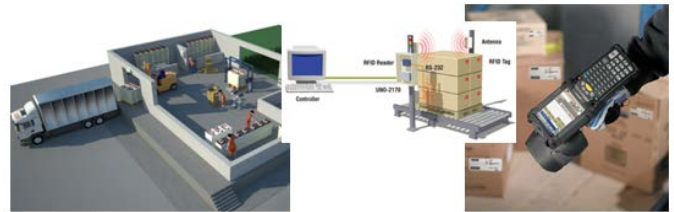

Fig. 4. Fix RFID reader and mobile handheld reader.

IV. PRODUCT VERIFICATION BY CONSUMER

Customer as user of food product expected every of product safe to consume, thus information is need to identify whether food product still good (not expire) and supplied from which country or land. Information technology with smart phone or table be able to detect food product with application software installed, mobile equipment very practical to use because of capability to bring any ware. Beside that nowadays most of mobile devices available with RFID scanner or reader which is Near Field Communication (NFC). User by using application software easily scan selected product to check the information and others related detail of product. Figure 5 shows an example of user scanning of a food product at retail store, product information will query to central database that has been uploading by supplier, manufacturer and freight forwarder and also retailer system. With this system user or customer be able to see all products information including delivery time, supplier, expire date, etc.

Fig. 5. An example of user scans a selected food product.

V. CONCLUSION

A system of food product traceability and security using RFID technology as elaborated has capability to gives user satisfaction to consume the product. Integrated of a few parts of system such as RFID technology, big database centre, supply chain and application software contribute for improvement in many kind of system. RFID system available at smart phone or tablet can be use for scanning of product information at retailer before consumer to proceed buying or consume. Big capacity of central database should apply in order o huge of data comes from many parties started from manufacturer or industries then freight forwarder and warehouse at retailer shop. This case of sample product of traceability is not limited to food product but any kind of product that required traceability and monitoring system for customer satisfaction.

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