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Design of Distributed CMS Using Intelligent Computing Mechanisms

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Abstract:
Handling environmentally sensitive products (ESPs) as it progresses from one level to another in a supplychain management requires the use of special refrigeration systems. As supply chain strategies increase, safeguarding ESPs and controlling factors such as temperature, humidity and lighting level from deviated from designated storage conditions becomes a tremendous task. Hence an efficient Cargo Monitoring System becomes mandatory to preserve the functional quality of ESPs, without which the products become deteriorated or even obsolete. Moreover customers of ESPs go for companies who provide inventory visibility of the products throughout the operational environment. Considering the above factors, this article proposes a Cargo Monitoring System to monitor environmental changes of ESPs in order to ensure their functional quality throughout the operational environment. This work uses Block chain to provide the best inventory visibility throughout the supply chain. Operational efficiency, maintenance strategy, environmental change, and electricity consumption are considered in real-life cold chain operations. Bringing in distributed systems like Block chain additionally provides an extra level of security for the ESPs. Intelligent AI techniques such as fuzzy logic and case-based reasoning techniques are used to provide storage condition establishment and storage guidance respectively.

Keywords:*Cargo monitoring, cold chain environment, fuzzy logic, case-based reasoning, block chain, distributed systems.*

INTRODUCTION

As product awareness increases day by day, the need for proper protection and monitoring is much needed and state-of-art technology implementation becomes more and more essential. In the previous version they have given a deep insight about how the product quality levels can be monitored by end customers to know the levels of inventory obsolescence. This is an analysis of the different monitoring mechanism and a different method in renewing a previous problem in obtaining a feasible solution. The cold chain handling and cargo traceability includes many areas such as agriculture, pharmaceuticals and frozen products. Third-party logistics (3PL) companies are authorized to handle the ESPs and are responsible to bear certain risks if the products are damaged. Hence they are ready to deploy state-of-art technologies. The use of centralized databases such as dedicated cloud platforms creates a void with regard to the security perspective. Addition to that it acts as a single point of failure and control. As the products involved in the supply chain increases. The demand for intelligent computations is drastically increased. This paves a necessity to replace centralized systems with distributed systems. This article adopts the use of block-chain to ensure proper securitytechniques and enhance a better level of product traceability to customers. The blocks contain values such as temperature, humidity, pressure, lighting levels and electricity consumption. The data is highly unclear and requires the use of linguistic variables such as heat, cold, light, and power. Hence we require the

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use of Fuzzy Logic to convert the vague data to clear and quantifiable value. The computed data is stored in a case library for future use.

LITERATURE REVIEW

Supply Chain Management

Supply chain management the entire product chain starting from raw materials to customer. The supply chain strategies vary from product to product and depending upon the number of suppliers involved in the chain. Almost every supply chain includes purchasing, warehousing, shipping and transporting goods to distributors. The possibility of creating unhappy customers increases when the supply chain strategies are weak and absence of proper logistics for transportation. Since this network consists of several players, there is lack of transparency in them and hence discrepancy of records. This paves way for third party interceptions. Block chain is such a revolutionary technology developed to remove this drawback of supply chain management.

Block Chain Technology

A block chain is a tamper-proof, secure innovation that introduces the concept of decentralization. This uses distributed ledger system in shipping, logistics and customs. Use of block chain can provide greater supply chain visibility and combat the distribution of counterfeit products. In a general supply chain, the details of finished goods moving from one chain to the other is stored in a block and a hash table is decided based on the chronology. This is visible to all people linked in the chain. The material quality deciding parameters such as temperature, pressure, humidity, frequency of operation and frequency of machine maintenance are also added and converted into a block with hash value. This impacts largely on the customer traceability and also enhance security without internet coverage[2].

Fuzzy Logic

Traditional systems are designed to determine discrete results such as True or False, 0 or 1 etc. But in case where the involving parameters are non-numeric, the degree ofpositivity or negativity comes into picture for which traditional techniques do not suffice the problem. FL based systems are new-age intelligent systems that is used to provide clarity on concepts where vague algorithms have to be implemented to provide a definite solution. It provides improved knowledge representation methods and can also represent linguistic variables such as hot, near, high, etc….

FL systems involves 3 primary steps, namely

- Fuzzification of input parameters
- Execution of the parameters with respect to the rules and constraints in the rule base.
- De-fuzzification of the output parameters to know the degree of variation from observed to required value.

Case Based Reasoning

Case-Based Reasoning (CBR) is a problem solving paradigm. It is a .special AI approach that utilises specific knowledge of the previous successful solutions, known as cases. Widely regarded as a subfield of Machine Learning, CBR uses 4 steps, namely retrieve, revise, reuse and recycle. A new Solution is retrieved finding out the maximum similarity using nearest neighbour approach. Secondly, the revision to this particular problem is done, followed by using the solution. The final step is to update the current condition back to the case library for future use. The complexity of finding a problem decreases as more number of cases are added to the library i.e. as number of cases increase, the accuracy of CBR system grows. It also provides some additional advantages such as

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- Providing means of solutions when no algorithmic solutions are available
- Avoids knowledge elicitation without the requirement to ask from experts
- Complete understanding of the domain is not essential.

DESIGN OF DISTRIBUTED CMS

Data Acquisition and Distribution Module

In a supply chain, a product is transported by a 3PL company from warehouse to distribution centers, or from manufacturing factories to warehouse centers. In the former phase block chain becomes an integral part of the unit. Hence we make it viable for the customers to view instantaneous changes in their product. Any customer who is buying their ESP can monitor their products instantaneous changes through blocks. This decentralization helps in making the users not stuck in a single node and enhances the levels of security with the help of blocks.

Every data involved with the required measurement will be entered and converted as a block. The further process are converted to a block againchronologically some information areprovided.

Warehouse information Address, floor area, buildingheight, frequency of machine maintenance.

Product information Name, batch number, required storagetemperature, required storage humidity, storage type, product category.

Operation information Number and frequency of inboundand outbound operations, storage temperature and humidity.

Storage Condition Establishment Module

The storage condition is established using FL with the data obtained in the previous module in the cloud repository. The values are fuzzified into fuzzy sets and then an inference engine gives an algorithm to calculate the changes based on IF-THEN rules based on the algorithms present in rule-base and then the resulting values are de-fuzzified using centroid de-fuzzification to find the exact deviation from the requirement.

Guidance Establishment Module

Once the values are obtained the data's are stored in a case library and any similar situation will make use of this solution using the nearest neighbour approach. We use 8-point CBR nearest neighbour approach to retrieve the previous cases and find the similarity between the new case and an arbitrary existing case. By this method we can enhance the security threats involved and also decentralization of data to enable product visibility to all customers who want to monitor their ESP's and enable a possibility of viewing the same in case of any connectivity failures. The overall efficiency of ESP's are increased.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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