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Research Article

A Study on Intelligent User-Centric Logistics Service Model Using Ontology

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Much research has been undergone in the smart logistics environment for the prompt delivery of the product in the right place at the right time. Most of the services were based on time management, routing technique, and location based services. The services in the recent logistics environment aim for situation based logistics service centered around the user by utilizing various information technologies such as mobile devices, computer systems, and GPS. This paper proposes a smart logistics service model for providing user-centric intelligent logistics service by utilizing smartphones in a smart environment. We also develop an OWL based ontology model for the smart logistics for the better understanding among the context information. In addition to basic delivery information, the proposed service model makes use of the location and situation information of the delivery vehicle and user, to draw the route information according to the user's requirement. With the increase of internet usage, the real-time situations are received which helps to create a more reliable relationship, owing to the Internet of Things. Through this service model, it is possible to engage in the development of various IT and logistics convergence services based on situation information between the deliverer and user which occurs in real time.

1. Introduction

Logistics services have improved immensely, after the emergence of ubiquitous computing [1]. In the early days, the logistics services experienced more time related constraints due to the traffic and frequent change of the customer environment. Many researches have been underway to reduce the time and effort which can help in providing a faster, safer, and more accurate delivery service. Such efforts have been put forth in the practical development by taking advantage of various advanced computing technologies and smart communication devices in the logistics service environment which is well explained by Klaus [2].

Most popular research includes the optimal routing technique [3] and the logistic tracking by using wireless telecommunication technology based on RFID or GPS [4] for more reliable service. Many of such services include the user interaction. The smart computing environment centered on individual smartphone users, which is recently growing rapidly [5], is demanding the evolution of human-centered computing services that can reflect the user's opinion and surrounding situation more directly in various service areas. In other words, the immediate action on the situational context in the logistics process according to the user's requirement and the frequent change in the environment can improve the service quality. All the logistic services are focused on the user which drives to build a fast reliable service [6]. For the situation based decision making, we need a shared understanding among the context information to gain complete awareness [7]. Using ontology in the service model enables the understanding of the relationship between the context and situation information.

This paper proposes a model based on the user-centric smart logistics/delivery services considering various situational information which arise in ubiquitous computing environment. In addition, the context based ontology model for the proposed model is developed to deal with the semantic situations. The proposed service model makes use of GPS-based tracking technology as well as various types of situation information based on sensing information technologies from various sensors in a smart space as limiting factors of the route and schedule planning of logistics/delivery services. Users are allowed to track, interact, and change the location through the GUI-based application developed for the smart phone. For this, the proposed service model includes GUI-based situation information processing technology using smartphones and context-aware GUI-based logistics service scenario and model technologies which use smartphones.

The rest of the paper is organized as follows. In the Section 2, the related studies for the designed model are designed. Next, Section 3 discusses the situation in logistics with the context information. Section 4 discusses the service model of the logistics process. Scenario based route decision and logical view of the logistics service is explained in Section 5 and the final section provides the conclusion and future work.

2. Related Studies

In recent times, there are active studies underway on logistics automation technologies and IT based logistics smart service technologies in the ubiquitous environment. In particular, practical technology researches [8] are underway on smartphones and RFID/USN technologies for providing context-aware services in various areas from shopping malls to logistics, home delivery, and ship and air freight. It proves that the environment is entering a new dimension with the Internet of Things [9]. Scholz-Reiter [10] explains the automation process in logistics with the RFID transponder that locates the objects on a real-time. Related studies on logistics environment, using location data and RFID have proposed the convergence of IT technologies and logistics regarding various application areas such as control of delivery vehicles using location data based on RFID, method for logistics information and event notification, and management of logistics warehouse [11–14].

Such research has great significance in the fact that it enhances the efficiency of logistics and delivery work by grafting computing models and networking technologies into traditional logistics related work processes. Another impact factor in the logistic management is the vehicle routing problem (VRP). Many technologies and algorithms were developed to acquire an optimal routing of the transportation. Peng et al. [15] attempt to resolve the VRP problem through the hybrid computational intelligence where some approaches include various algorithms to find the optimum route [16, 17]. In addition, such studies have developed into studies which attempt to consider the simple data values which are sensed from a sensor in a logistics system and process management and control, along with various types of situation information such as user and environmental information, as the flow elements of the logistics/delivery process. Through these efforts, several researchers have defined situation information for logistics/delivery environment and have proposed methods and models for recognizing and processing situation information for logistics/delivery services and systems [18–20].

Usage of the phone has improved the productivity in various consumer-producer [21] and receiver-deliverer relationships for safe transactions. A case study on logistics/delivery services using smartphones presented its usefulness by examining various events which occur when employees in a USA logistics/delivery company were actually prepared to use a logistics/delivery system using smartphones [22]. According to research findings, Internet based logistics/delivery control system using smartphones was introduced rather than the traditional PDA-based logistics/delivery computer system [23]. As many studies proved that the user-centric service has enhanced the productivity [24], it also had a positive effect on the user convenience of people in charge of logistics/delivery using the devices.

Presently, it is anticipated that the services using smartphones will have a very wide range and diversity of applicable service domains [5] and will also benefit many applications [25]. However, most studies [26–28] are being concentrated in the tracking of logistics/delivery based on simple position information using GPS and optimization of routes, and there is a lack of studies on the models that can apply various types of sensing information communicated from RFID/USN of the logistics/delivery environment. Thus, there is a need for the studies on smart logistics/delivery service model that can provide the optimum logistics/delivery service according to user-based situation information arising in real time in the actual logistics delivery environment.

A study of a controlling system for the logistics vehicle using a smartphone proposed a design, which overcomes the limitations of a logistics vehicle control system using only the existing GPS-based location information and for a smooth logistics vehicle control system in a limited time and location using the 3G network of smartphones [29]. Along with the vehicle tracking and routing technique, the situation aware system is required for a user centered service in the logistic system. Howard and Cambria [30] explains the importance of the situation awareness in the human centric environment where the situation is subjected to change in unexpected variations. The perspective of the situation varies for each service in which Yau et al. [31] defines situations as well as contexts and classifies situations into atomic and composite ones.

The situation aware context information needs to be processed in the automated logistic service to generate an optimal route according to the customer's requirement. For this purpose, the OWL based ontology is used which is the ontology representation language. Many studies are underway in the ontology based logistics services to enhance the productivity and time efficiency in the delivery.

3. Situation in Logistics Process

In the dynamic computing environment, situation awareness is more important for decision making system. As our proposed system revolves around the user change, the situational change takes its turn. The set of context information obtained determines the situation of logistic and provides optimal route information according to the customer's needs.

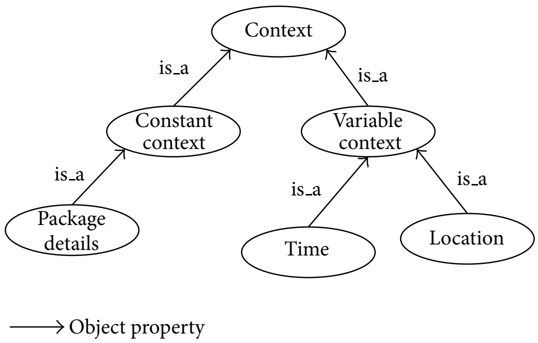

Figure 1: Ontology tree of context class.

To provide a user based service, the context information is required, which can be classified into constant context and variable context. The constant context consists of unchangeable information, whereas the variable context contains the changeable information that may create a situation in the logistic process. The package details of the customer are certain and fixed information that is linked with the corresponding customer. The variable contexts in the logistic are time and location that are related to both the deliverer and the receiver. Figure 1 presents the ontology tree of the context class.

The location of the vehicle and the customer are the basic changes in the situation logistics. The context information about the location is obtained through the communication network. The location concept in the ontology is shown in Figure 2. The vehicle's location is obtained with the GPS tracking system with the coordinates X and Y. Customer will be able to view the location of the vehicle from their smartphone to keep track of the product. Logistics App is installed on the customer's smartphone which not only helps in the tracking but also keeps discovering the location of the customer by activating the discover button. The customer's location is originally the address provided for the logistic, but the customer is permitted to modify the location when the vehicle crosses their nearby location. Also, by turning on the discovery tab, the location of the customer is made visible in the deliverer's smart device. According to the situation of the customer, the location and time can be changed and fulfill the customer needs.

4. Service Model for an Intelligent Logistic Environment

Generally speaking, the actual smart logistics/delivery environment exists in the ubiquitous or intelligent space where various sensors connected to USN carry out mutual computing through networking with wired/wireless communication network. The general structure chart of the service model proposed by this paper for providing a smartphone-based smart logistics/delivery services linked to various sensors in a ubiquitous computing environment is as depicted in Figure 3.

The proposed smart logistics/delivery service model consists of the server part of providing the smart logistics/delivery service information based on the actual sensed

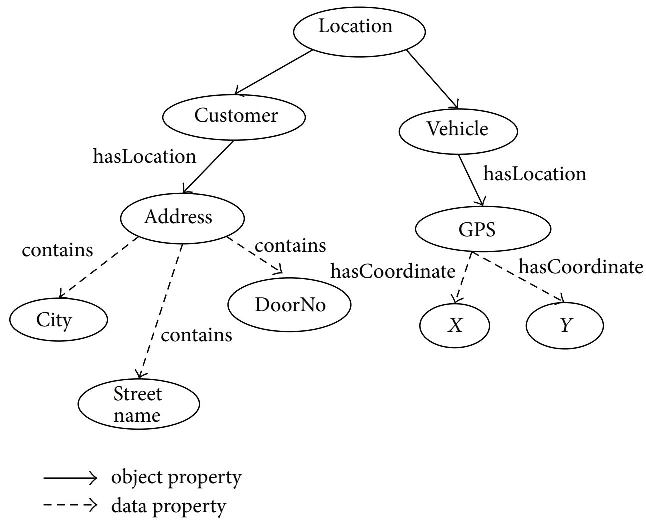

Figure 2: Location concept of the logistic ontology.

situation information to the person in charge of logistics/delivery and the user. The situation information from the user's smartphone is attained in the server of the smart logistics service to determine the route information about the logistics. The route of the delivery is determined by the user's location and availability. As noted by Gruber [32], ontology is a formal, explicit specification of a shared conceptualization. So, by taking advantage of the concept, understanding between the system and situation benefits the logistics service by providing a precise delivery.

4.1. High Context View of the Smart Logistics. The server receives the input of situation information, including the location of the sensed or entered logistics/delivery vehicle, location of the customer, status of the goods, time and method of how the customer received the delivered goods, and the real-time route change information of the person in charge of logistics/delivery.

In this case, the context model based on the rule of Figure 3 objectifies the low level terminal status information from the client through the RDF-based context model in the form of the status information class form of API level. Objectified low level terminal status information can be processed into high level status information with a richer meaning through the repetitive rule coupling with other objectified low level terminal status information. Figure 4 shows the conceptual diagram of the logistic process of the proposed service model for generating high level status information through coupling which has applied rules through the coupling applied with rules. The low level data delivered from various sensors is constituted into types and values according to the ontology knowledge dictionary related to the stored logistics/delivery domain in the ontology storage. A low level data represented by types and values is objectified into higher level status information through the repetitive coupling process with other low level data. For example, the coordinate information $\langle X : Y \rangle$ representing the user location transmitted from a position sensor and GPS in

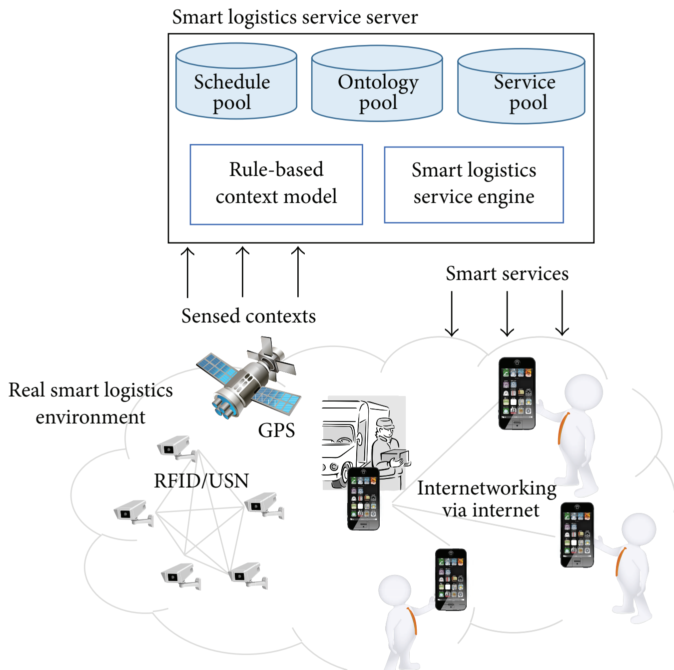

FIGURE 3: Service model of logistics service.

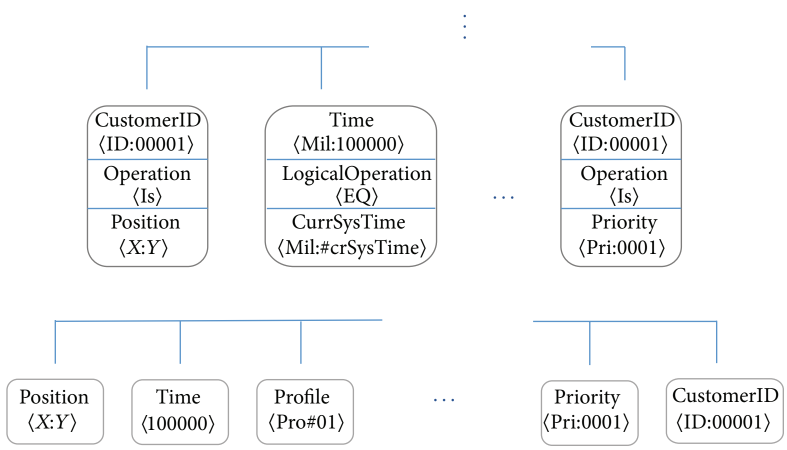

FIGURE 4: High level context information.

Figure 4 is expressed as a pair of position type for showing the actual integer and the semantic information of that value. The generated {Position, $\langle X : Y\rangle$} information couples with {CustomerID, ⟨ID : 00001⟩} information for recognizing a specific user, and the user position with ID:00001 can be abstracted into a higher level information called $\langle X : Y\rangle$.

The smart logistics/delivery service provides various logistics/delivery related services ranging from the service for providing logistics/delivery route optimization information to the logistics/delivery automatic control service in the form of web service from the service storage using objectified high level status information. Then, the service engine uses the logistics/delivery plan information and the high level status information stored in the schedule storage as a limiting factor for executing a specific service. The client sends the sensing information occurring in real-time from various sensors and the RFID and GPS devices installed on the logistics/delivery vehicles to the server. Then, the sensed information can be networked with the user's smart device, and the user and the person in charge of logistics/delivery can be communicated through their smart devices. Through this kind of networking, the immediate user requirements can be considered in real time for the new services.

5. Logistics Ontology

User-Centric Intelligent Logistics Service uses OWL based ontology approach for fulfilling the customer satisfaction.

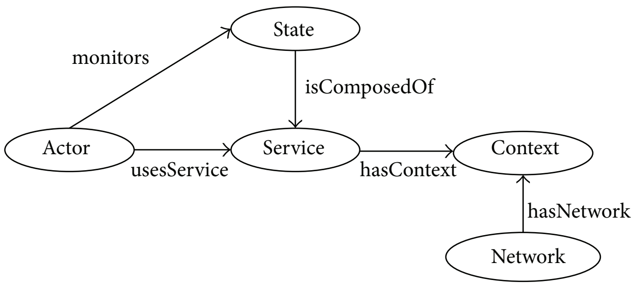

Figure 5: Top level ontology model of logistics service.

Usually the ontology contains the concepts, relations, axioms, and individuals. As a first step in the ontology development, the basic concepts of the logistics centered around the user are identified. The concepts are classified as network, state, service, context, and actor concepts. Figure 5 shows the Upper Ontology of the Logistics. The Concepts are briefly explained in the following subsections.

5.1. Context Based Concept. The context information is obtained from the smart space through the proper means of smart devices. The concept context in the smart logistics consists of time, location, and the information on the product delivered. As mentioned in the previous section, the context can be briefly classified into constant and variable context considering both the deliverer and customer.

5.2. Network Based Concept. The location information of the deliverer and the customer are considered of equal importance in the delivery of the product. Therefore, network is kept in check for the constant update of information. Location of the deliverer is obtained using GPS connection. The delivery time is calculated and sent to the customer with the location of the vehicle.

5.3. State Based Concept. According to the event and the action performed, the state of the delivery process is updated. Each stage of the process is updated on the server and presented to the customer. When the state of the process is in "On Delivery" state, the customer will be able to track down the delivery vehicle and also update personal change in the schedule. But once the delivery is done and state is converted to "Delivered" state, the customer will end all their connections from the logistics.

5.4. Service Based Concept. User-centric service is the main focus of the paper. The service revolves around the routing of the delivery with the situation based context information.

5.5. Actor Based Concept. In our model, the role of the actor is determined to be a customer or a driver. The basic information of the receiver and the sender is stored in the actor concept. In addition to this, the logistics company can also be added as one of the actors in broader vision.

The ontology is modelled using the protégé with OWL plugin. The class, object property, data property, and individual assertions are all created for a prototype modelling. Figure 6 shows the logistics ontology which explains the class relationship among the derived concepts.

6. User-Centric Scenario for Smart Logistics

Let us discuss a prototype scenario of the smart logistics with the situation and events that surround the customer and the deliverer.

(i) Customers A, B, and C are planning to receive their delivered goods at each of their specific locations.

(ii) The person in charge of the field Y of smart logistics/delivery company X initially receives the delivery route in the order of A, B, and C.

(iii) Customer A recognizes that they currently have a personal matter to attend to and communicates this to the delivery company using their smart device.

(iv) Customer B was to personally receive the delivered goods at their home, but B decided to briefly go out nearby.

(v) Customer C was to personally receive the delivered goods at his home, but did not arrive at his house yet.

Now, we have some possible situations arising in the above mentioned scenario. With the received context information, a new route adjustment is derived and sent to the deliverer by exercising the proposed service model.

6.1. Route Management Based on User Situation. For each possible situation change, the route information is altered and sent to the deliverer. Considering the above mentioned scenario, the possible route changes are discussed as follows.

(1) The time information from the private schedule entered by Customer A is objectified into new status information, and the existing logistics/delivery route is changed using the limitation information for setting a new route. Then, the newly determined route changes recommendation information as indicated on the smart device of the person in charge, and the person in charge continues the logistics/delivery service through the newly changed route (B $\rightarrow$ C $\rightarrow$ A).

(2) While Customer B is briefly moving near their home where they were initially supposed to receive the goods, they directly send their own location information to the server using their smart device. Or the location of Customer B is automatically sent to the server through the sensor linked via network to a smart space and the networking with Customer B's smart device.

(3) New status information is objectified from Customer B's location information and used as the limiting information for setting a new route. Then, if Customer

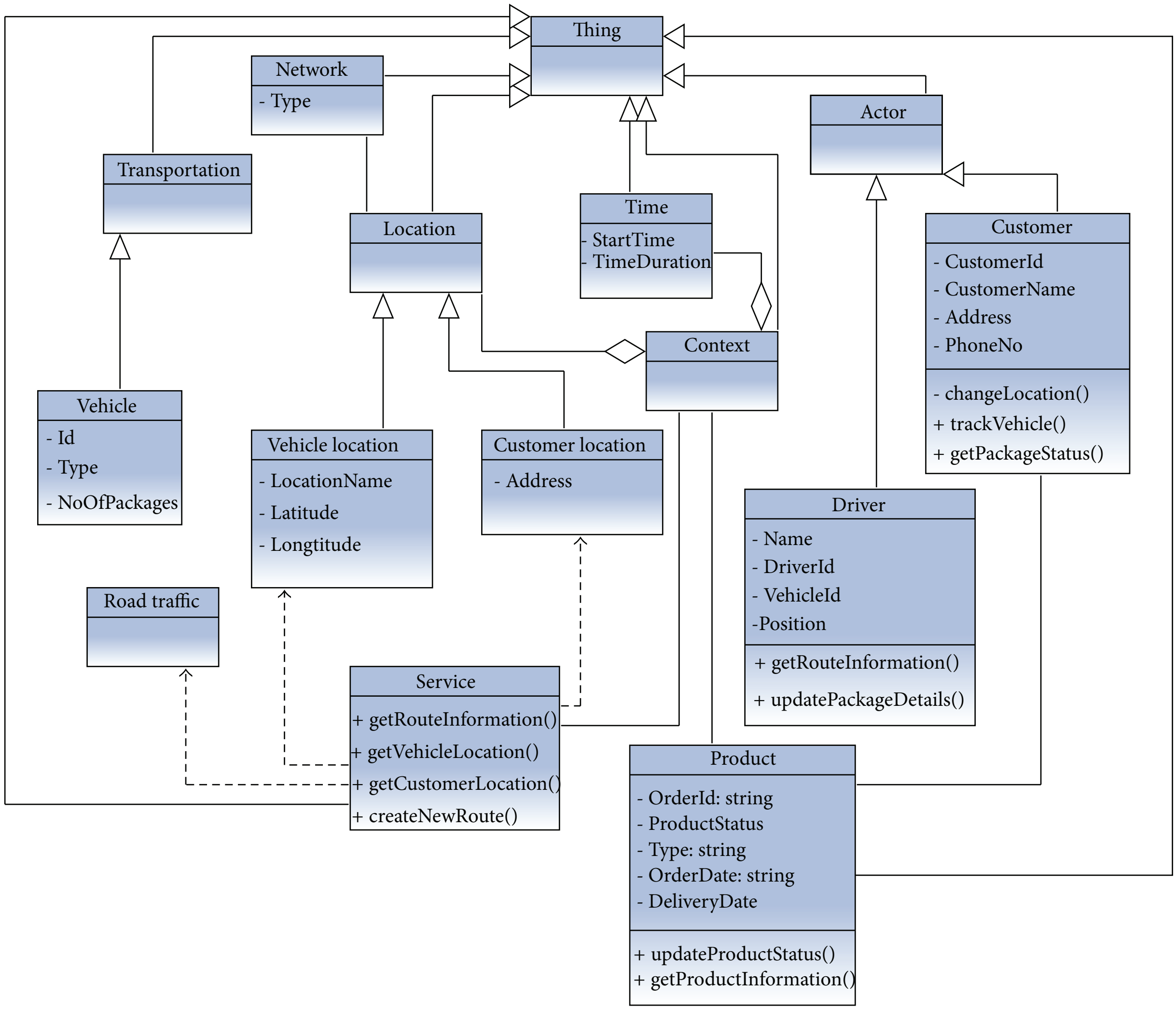

Figure 6: Class diagram of logistics ontology.

B's location should come later than the flow of time context and location context of Customer A or C in the new route which takes into account the time information of Customer A in 1, the new route is decided as C $\rightarrow$ B $\rightarrow$ A or C $\rightarrow$ A $\rightarrow$ B, and the newly decided route change recommendation information is indicated in real time on the smart device of the person in charge.

(4) The service engine of the server tracks and monitors in real time the logistics/delivery service process currently in progress.

(5) If the current location information of Customer B is close to the moving route of the person in charge, the service engine of the server sends a message to Customer B's smart device and provides automatic SMS service so that whether or not the goods were received can be checked midway. At this time, if Customer B reads the SMS text sent to his smart device and changes the reservation to receive the goods midway, the new details are immediately delivered to the person in charge.

(6) Customer C is currently moving to his home and Customer C's location information is sent to the server in the method explained in 2. At this time, if Customer C's location is before the current location of B or is closer to the route of the person in charge, the new route is decided as C $\rightarrow$ B $\rightarrow$ A or C $\rightarrow$ A $\rightarrow$ B, and the newly decided route change recommendation information is indicated in real time to the smart device of the person in charge.

(7) The final available route may be B $\rightarrow$ C $\rightarrow$ A (if Customer C approaches a person in charge Y before they reach Customer B) or C $\rightarrow$ B $\rightarrow$ A (if Customer C can approach the person in charge Y after they reach Customer B).

6.2. Logical View of the Intelligent Logistics. In the basic scenario, the information of the delivery item, the time and

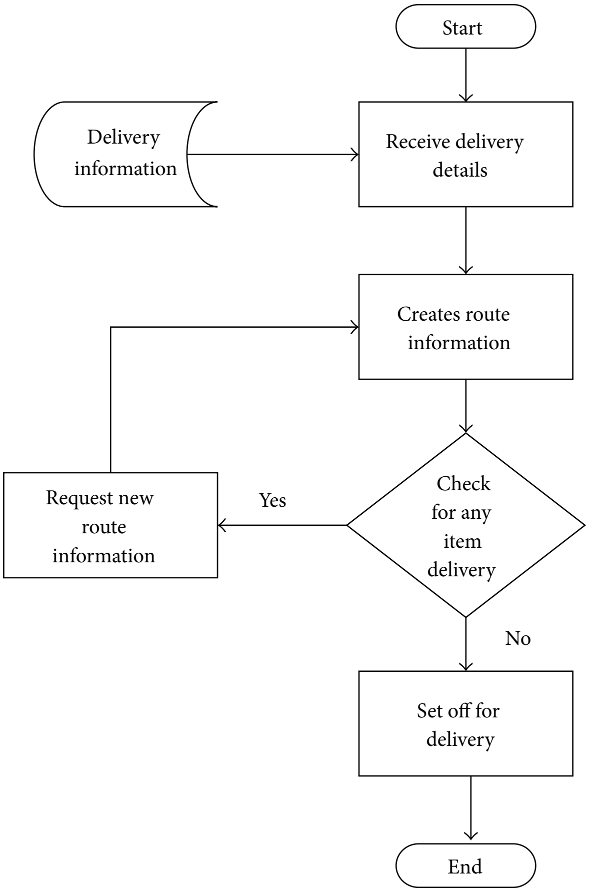

Figure 7: Basic scenario logic for delivery route information.

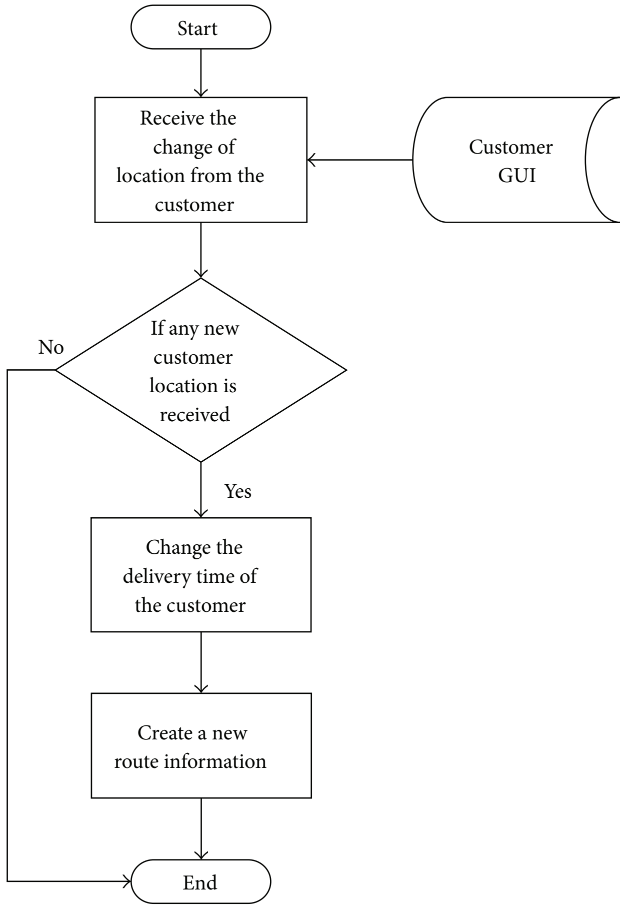

Figure 8: Time change request scenario logic from customer.

the location of the customer, and the optimal route for the delivery are obtained as shown in the Figure 7.

As soon as the Customer A communicates the change in time, the information is objectified as new status information. A new schedule or route is created considering the customer's needs. The updated delivery information is sent to the deliverer which is automatically displayed on the smart device of the person in charge. The approximate time change is also notified to the customers simultaneously.

The flow of the service is explained in Figure 8. The scenario mentioned in the above section was drawn with respect to the customer's change of location in which they send their own location themselves. On the other hand, the location can also be updated automatically to the server which can also be adopted by the customer.

The location information of each customer can be sent to the server through direct input, and, because the proposed smart logistics/delivery service client is already installed and running on Customers A, B, and C's smart devices, the customers' location information can be sent to the server in real time through various sensors in the smart space and the networking between GPS and customer's smart device. The details examined through the exercise scenario are a consideration of only one instance regarding changes in a very vast and complicated real time change in status information that may arise in an actual logistics/delivery environment.

We also encountered a point in the earlier scenario, where the customer wishes to receive the delivery midway knowing the vehicle's location. When the GPS tracking is enabled on both the receiver and deliverer's smart phones, when the two devices come near to each other, the information is popped up on the customer's smartphone. If they choose to receive the package, the time change and the route information are updated and sent to the deliverer. Figure 9 shows the process flow of customer location change.

To be exact, when the distance between the customer and the vehicles is less than or equal to a kilometer, then an SMS is sent to the customer regarding the vehicle's location. A fragment of the algorithm for the above mentioned flowchart is discussed as follows:

Input Order $O = \{O_1, \ldots, O_N\}$

Matching each order with location respectively, the Order result $\mathrm{OR} = \{(O_1, L_{\mathrm{cus}1}), \ldots, (O_N, L_{\mathrm{cus}N})\}$

If $D(L_{\mathrm{cus}8}, L_{\mathrm{veh}}) \leq 1\,\mathrm{km}$

Then Send SMS to customer.

$\ldots$

If cus8 change the location $L_{\mathrm{cus}8}$,

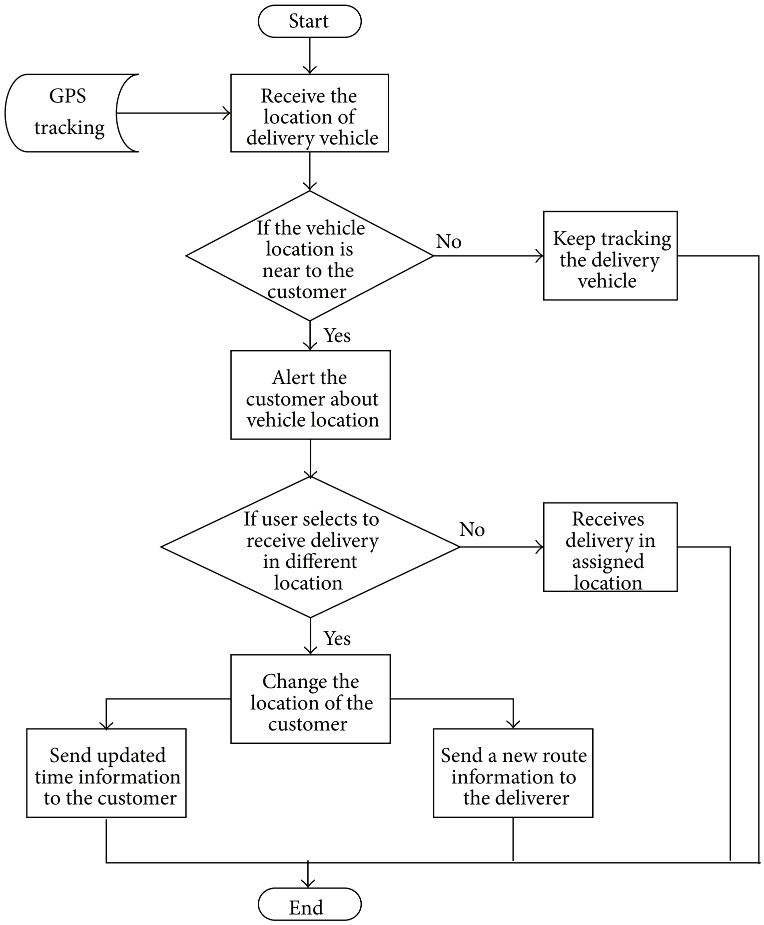

FIGURE 9: Location change request scenario from customer.

Then rearrange the sequence of order delivery.

If any of the distance from $D(L_{\text{cus}1}, L_{\text{veh}}), \ldots, D(L_{\text{cus}N}, L_{\text{veh}}) < 1\,\text{km}$,

Then insert the Order $(O_8, L_{\text{cus}8})$ Next to it.

Calculate the time and update the database.

L_{cus} = Location of the Customer

L_{veh} = Location of the vehicle

$D(L_{\text{cus}}, L_{\text{veh}})$ = Distance between the Customer Location and Vehicle Location.

Similarly the event and action based flow also helps in the situational decision making in the logistic process. With the help of intelligent logistic services through the smart phone, the customer based services are accomplished.

Context awareness plays an important role in defining the relationship, which eventually helps in the automation process. The logistic ontology was implemented in OWL with protégé 4.2. The pellet reasoner is used to verify the relationship and rules of the individual created in the logistic ontology. An instantiation of the logistic ontology is shown in the Figure 10.

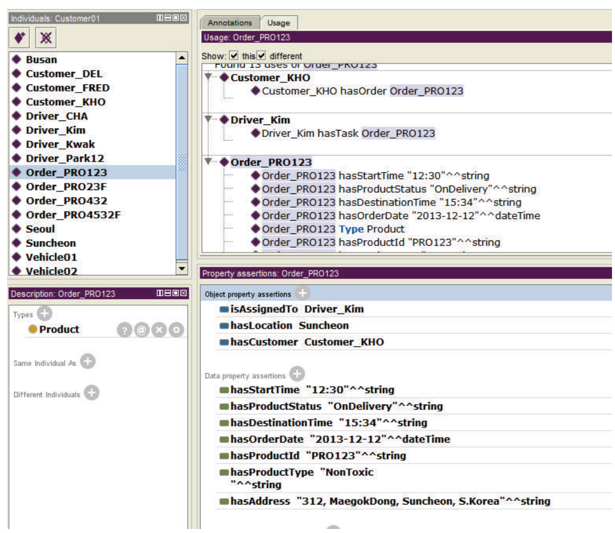

FIGURE 10: Instantiation of logistics ontology.

7. Conclusion and Future Work

In this paper, a user-centric smart logistics model using smart devices was proposed. The proposed service model can generate high level status information through a rule-based context model from low level terminal sensing information arising from various sensors existing in smart space and RFID/USN and GPS and provide status information based intelligent logistics/delivery service using this. Therefore, the service model proposed in this paper is anticipated to have high availability as a diverse, mutually interactive logistics/delivery service model based on smartphones and expected to be of great help in developing related application services and systems in a ubiquitous and an intelligent computing environment which is to come in the future.

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

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References

[1] R. Jedermann and W. Lang, "The benefits of embedded intelligence—tasks and applications for ubiquitous computing in logistics," in *The Internet of Things*, vol. 4952 of *Lecture Notes in Computer Science*, pp. 105–122, Springer, Berlin, Germany, 2008.

[2] P. Klaus, "Logistics research: a 50 years' march of ideas," *Logistics Research*, vol. 1, no. 1, pp. 53–65, 2009.

[3] G. M. Giaglis, I. Minis, A. Tatarakis, and V. Zeimpekis, "Minimizing logistics risk through real-time vehicle routing and mobile technologies: Research to date and future trends," *International Journal of Physical Distribution & Logistics Management*, vol. 34, no. 9, pp. 749–764, 2004.

[4] K. R. Prasanna and M. Hemalatha, "RFID GPS and GSM based logistics vehicle load balancing and tracking mechanism," *Procedia Engineering*, vol. 30, pp. 726–729, 2012.

[5] E. Ferrer, A. Camacho-Martinez, L. Cardona-Hernandez, A. Machin-Cruz, L. Santos-Velez, and V. Torres-Ortiz, "The impact of mobile technology on organizational communication: rethinking the social presence theory," *Continental Journal of Information Technology*, vol. 6, no. 2, 2013.

[6] R. Leuschner, F. Charvet, and D. S. Rogers, "A meta-analysis of logistics customer service," *Journal of Supply Chain Management*, vol. 49, no. 1, pp. 47–63, 2013.

[7] N. Baumgartner, W. Gottesheim, S. Mitsch, W. Retschitzegger, and W. Schwinger, "BeAware!—Situation awareness, the ontology-driven way," *Data and Knowledge Engineering*, vol. 69, no. 11, pp. 1181–1193, 2010.

[8] J. C. Augusto, V. Callaghan, A. Kameas, and I. Satoh, "Intelligent environments: a manifesto," *Human-Centric Computing and Information Sciences*, vol. 3, article 12, 2013.

[9] L. Atzori, A. Iera, and G. Morabito, "The internet of things: a survey," *Computer Networks*, vol. 54, no. 15, pp. 2787–2805, 2010.

[10] B. Scholz-Reiter, W. Echelmeyer, H. Halfar, and A. Schweizer, "Automation of logistic processes by means of locating and analysing RFID-transponder data," in *Dynamics in Logistics*, pp. 323–327, Springer, Berlin, Germany, 2011.

[11] I. Park, Y. G. Kim, S. H. Kim, C. B. Sim, and C. S. Shin, "Design and implementation of driver service system for logistics supporting vehicles," *Korean Society for Internet InFormation*, vol. 9, no. 2, pp. 197–200, 2008.

[12] Y. M. Lee, K. W. Nam, and K. Tyu, "Design and implementation of event notification system for location-and RFID-based logistics environment," *Journal of Korea Information Processing Society D*, vol. 15, no. 5, pp. 599–608, 2008.

[13] S. H. Lee, C. Y. Lee, D. S. Kim et al., "Sensor network deployment for warehouse management system based on RFID," *Korea Information Science Society Journal C*, vol. 14, no. 1, pp. 22–30, 2008.

[14] D. H. Seo and I. Y. Lee, "A study on RFID system with secure service availability for ubiquitous computing," *Journal of Information Processing Systems*, vol. 1, no. 1, pp. 96–101, 2005.

[15] G. Peng, K. Zeng, and X. Yang, "A hybrid computational intelligence approach for the VRP problem," *Journal of Convergence*, vol. 4, no. 2, 2013.

[16] L. Yan, O. Hoeber, and Y. Z. Chen, "Enhancing Wi-Fi fingerprinting for indoor positioning using human-centric collaborative feedback," *Human-Centric Computing and Information Sciences*, vol. 3, no. 1, pp. 1–23, 2013.

[17] A. Subramanian, L. M. A. Drummond, C. Bentes, L. S. Ochi, and R. Farias, "A parallel heuristic for the vehicle routing problem with simultaneous pickup and delivery," *Computers and Operations Research*, vol. 37, no. 11, pp. 1899–1911, 2010.

[18] A. W. Ter Mors, J. Zutt, and C. Witteveen, "Context-aware logistic routing and scheduling," in *Proceedings of the 17th International Conference on Automated Planning and Scheduling (ICAPS '07)*, pp. 328–335, September 2007.

[19] V. Q. Son, B. L. Wenning, A. Timm-Giel, and C. Görg, "A model of wireless sensor networks using context-awareness in logistic applications," in *Proceedings of the 9th International Conference on Intelligent Transport Systems Telecommunications (ITST '09)*, pp. 2–7, October 2009.

[20] S. Haseloff, *Context awareness in information logistics [Ph.D. thesis]*, TU, Berlin, Germany, 2005.

[21] D. Werth, A. Emrich, and A. Chapko, "An ecosystem for user-generated mobile services," *Journal of Convergence*, vol. 3, no. 4, pp. 35–40, 2012.

[22] J. V. Chen, D. C. Yen, and K. Chen, "The acceptance and diffusion of the innovative smart phone use: a case study of a delivery service company in logistics," *Information and Management*, vol. 46, no. 4, pp. 241–248, 2009.

[23] M. Linke, "Impact of global hyperconnectivity and increased smartphone usage on the delivery and structure of IT organization in transport logistics," *International Journal of Applied Logistics*, vol. 4, no. 2, pp. 18–33, 2013.

[24] R. Y. Shtykh and Q. Jin, "A human-centric integrated approach to web information search and sharing," *Human-Centric Computing and Information Sciences*, vol. 1, pp. 1–37, 2011.

[25] J. K. Yin, "Ubiquitous healthcare: healthcare systems and applications enabled by mobile and wireless technologies," *Journal of Convergence*, vol. 3, no. 2, pp. 15–20, 2012.

[26] N. Watthanawisuth, N. Tongrod, T. Kerdcharoen, and A. Tuantranont, "Real-time monitoring of GPS-tracking tractor based on ZigBee multi-hop mesh network," in *Proceedings of the 7th Annual International Conference on Electrical Engineering/Electronics, Computer, Telecommunications and Information Technology (ECTI-CON '10)*, pp. 580–583, May 2010.

[27] X. Lin and X. Zheng, "A cloud-enhanced system architecture for logistics tracking services," in *Proceedings of the International Conference on Computer, Networks and Communication Engineering (ICCNCE '13)*, 2013.

[28] A. H. Ho, Y. H. Ho, K. A. Hua, R. Villafane, and H. C. Chao, "An efficient broadcast technique for vehicular networks," *Journal of Information Processing Systems*, vol. 7, no. 2, pp. 221–240, 2010.

[29] M. S. Kim, J. W. Oh, Y. J. Lee, and J. S. Chae, "A design of transportation management system using smartphones," *Korea Computer Congress of Korean Institute of Information Scientists and Engineers*, vol. 37, no. 1, pp. 212–216, 2010.

[30] A. Howard and E. Cambria, "Intention awareness: improving upon situation awareness in human-centric environments," *Human-Centric Computing and Information Sciences*, vol. 3, no. 9, 2013.

[31] S. S. Yau, D. Huang, H. Gong, and H. Davulcu, "Situation-awareness for adaptive coordination in service-based systems," in *Proceedings of the 29th Annual International Computer Software and Applications Conference (COMPSAC '05)*, pp. 107–112, July 2005.

[32] T. R. Gruber, "A translation approach to portable ontology specifications," *Knowledge Acquisition*, vol. 5, no. 2, pp. 199–220, 1993.