

Design of Application To Tracking System and Temperature Monitoring During Delivery Based on IoT Device

Revina^{1*}, Dewi Oktaviani², Didiet Rachmat Hidayat³,
Doddy Himawan Triyasa⁴, Danang Darunanto⁵
^{1,2,3,4,5} Institut Transportasi dan Logistik Trisakti, Jakarta, Indonesia
*Corresponding author: revinav13@gmail.com

Abstract. In the industry 4.0 era – a variety of new technologies to added value. Industry 4.0 is the end – to – end digitalization of all physical assets and integration into the digital supply chain with value chain technologies. Digital supply chain brings down those walls and the chain becomes a completely connected that is transparent to all the actors involved from the shippers of goods, delivery service companies, and finally to the customers. Logistics as part of the supply chain has an important role in Indonesia. Specifically, in delivery services. Currently, the tracking of the delivery service company can only be executed from one drop point to another drop point. A trip between drop points cannot be traced so that the tracking becomes not transparent. Logistics roles in delivery service company should utilize the Internet of Things (IoT) in handling customer who needs real-time transparency routes and monitoring of temperature-sensitive pharmaceutical cargo and perishable cargo. If this is implemented, delivery service companies in Indonesia can be crowned as the most advanced delivery service company in the world. The research information system uses a quantitative method. The data collection technique used in this research was collected by filling out a questionnaire. The result shown indicates that delivery service companies in Indonesia may use Traceable e-Seal that are connected to the MyTraceable application as a solution to transparency route, real-time monitoring of temperature-sensitive goods. We prompt to use MyTraceable application and smart lock because it can increase customer satisfaction and delivery service company performance.

Keywords: IoT, digital supply chains, customer satisfaction, delivery service

1. Introduction

In the industrial era 3.0 and earlier, the tracking of the delivery service company still not transparent. Entering the industrial era 4.0, the tracking of the delivery service company is no longer effective. The tracking of the delivery service company can only be executed from one drop point to another drop point. The trip between drop points cannot be traced so that the tracking becomes not transparent. If the goods sent consist of perishable items, pharmaceutical cargo, fruit and vegetables that need to be monitored against the temperature and transported using a refrigerator container, the tracking of delivery service company has not been able to do so.

In the industrial era, 4.0 - various new technologies are added value. Industry 4.0 is the end-to-end digitalization of all physical assets and integration into digital supply chains with value chain technology. The digital supply chain undermines these walls and the chain becomes fully connected which is transparent to all actors involved from freight forwarders, delivery service companies, and finally to customers. With increasing global competition, delivery service companies are recommended to implement the Internet of Things (IoT) in dealing with customers who need route transparency, timely monitoring and monitoring of temperature changes that occur during delivery if the goods sent are perishable items, pharmaceutical cargo, fruits and vegetables what monitors need to do with temperature and transport it using a refrigerator container.

The use of tracking delivery service can be replaced by an IoT (Internet of Things) embedded Traceable e-Seal. The Internet of Things is a global network infrastructure, linking physical and virtual objects through data capture and communication capabilities [1]. IoT platform is the monitoring system currently on the delivery to provide real-time monitoring of temperature-sensitive pharmaceutical cargo. The concept of IoT accommodates these objects that can be connected and can be controlled by a connected remote control so that it is expected to increase the chances of better integration between the physical world and the computer world to produce a more efficient work or process in terms of energy, accuracy, and economy.

Traceable e-Seal is a tool for locking doors on fleets used in delivery service companies. There is a Traceable e-Seal device that is IoT which can be used to track routes in real-time and transparently and can also be used as monitoring temperature during delivery. Traceable e-Seal has many advantages such as high reliability, high durability, easy to use, high-level security, shake-proof, water resistance, providing lock and unlock notifications, and also receive alerts from the padlock.

Cloud Computing plays an important role to help success the IoT. Cloud Computing has many benefits to IoT, is based on the concept of allowing users to perform normal computing tasks using services delivered wholly over the internet. Cloud computing as a function for big data storage and analytics. The real innovation will come from combining IoT with cloud computing. The consolidate of cloud computing and IoT will bring through new monitoring services and powerful processing of sensory data streams. The cloud effectively improved decision-making and optimized internet-based interactions. Cloud computing proffers a practical utility-based model that will enable businesses and users to access applications on-demand anytime and from anywhere. In short, cloud computing is available for use anytime and anywhere so long as the device is connected to the internet based on the platform as a service (PaaS) service model.

To facilitate tracking of routes in a timely and transparent manner and monitor temperature changes effectively, the MyTraceable application is designed as a transparency route solution, real-time monitoring of temperature-sensitive pharmaceutical cargo based on IoT (Internet of Things) devices. Using the MyTraceable application can improve customer satisfaction and the performance of a delivery service company. With this research, it is expected to improve the control and monitoring system of goods during delivery in order to reduce lead times and delivery costs.

2. Literature Review

Internet of Things (IoT) is a network of physical objects or "things" that are embedded with electronic systems, software, sensors, and connectivity and allows them to achieve greater value and services by exchanging data between producers, operators and/or other devices that are interconnected [2]. IoT not only connects things to things but also things to people and people to people. IoT is not only a network connection of physical objects, but also includes relationships between people, processes, and data [3]. IoT affects the overall flow of the supply chain so that supply chains become more optimal, effective, transparent, real-time and all aspects of the supply chain become more integrated [4].

IoT sensors can collect information about geographical position and temperature during delivery [5]. IoT in the world of logistics is needed because of the need for greater transparency and accuracy of products, time, place, quantity, conditions and costs throughout the supply chain. The final customer also requests delivery tracking in a transparent and real-time manner. Consumers also need temperature tracking for sensitive items during delivery [3].

Trip tracking from origin to destination will be better if based on IoT so that temperature control for cold cargo can be integrated and transparent especially for items that are easily spoiled, damaged and need special handlers [6]. IoT consists of several devices that can sensing, monitoring, detecting, and information. Cloud computing used to access requests for

information shared in computing resources that are availability has unlimited storage and easily obtained. Cloud works as a basis for getting networks that can be used to improve work result [7].

Traceable e-Seal helps people access the door using controls. This e-Seal prevents security breaches and helps keep items inside. e-Seal is made with lines of code that can be pressed on the front of the e-Seal [8]. This e-Seal is independent, flexible and easily installed by connecting to the application as long as the application is connected to the internet [9].

e-Seal is designed and implemented to reduce damage to digital door locks and improve security and monitoring functions using IoT technology because digital door locks have been widely used in households, offices, logistics activities. The proposed system features like to detect thieves or intruders who try to attack or try to open by damaging the physical key, for sending the data or image transferred. Usually, the thieves will force open by all means. So if the thieves entered the code incorrectly several times, the system gets a picture of the thieves and will transfer it to the application mobile device [10].

Orbcomm IoT technology company makes a device to track the movement and status of refrigerated containers and send that data to cloud computing as storage so that it can be accessed through cellular connections. This device can be installed in seconds. This device is very useful for companies that send goods in the form of perishable goods [11].

3. Research Methodology

The method used in this study is a quantitative method. This method of research data in the form of numbers and analyzed using statistics [12]. This study examines the effect of IoT devices on the Application of Tracking and Temperature Monitoring. This study uses a Likert scale with 5 alternative answers; agree (5) , ST: Agree (4), RG: Doubtful/Neutral (3), TS: disagree (2), STS: strongly disagree (1) which had been taken by random sampling of 21 respondents with the distributed questionnaires in google form filled by the respondents.

3.1. Data Collection

Data collection is done from employees who are working or have worked in a delivery service company. Data is taken from questionnaires and company data. Questionnaires are data collection techniques carried out by giving questions or statements that are given directly written or open through google forms to be answered by respondents [12].

3.2. Validity

Valid instruments can be used to measure what should be measured to obtain valid data [12]. The number of correlation obtained (r count) must be compared with the critical number of the product-moment correlation table (r table) at the level of 5%. An attribute is said to be valid if the value of r counts $>$ r table ($r_h > r_t$) and is positive. To find the r table using the formula $dk = N$, then $dk = 21$. And the table at position 21 with a significant level of 5% is 0.433.

Validity test is performed on variables X1, X2, and Y. below are the results of the validity test of each variable:

Based on the validity of all variable questionnaire statements X1 (Tracking Application), X2 (Temperature Monitoring), Y (IoT Device), it can be seen that there are no invalid statements because they have the value of Corrected Item-Total Correlations $>$ 0.433, thus, statements that deserve to be analyzed for variables X1, X2 and Y are 11 statements.

3.3. Reliability

To measure a research questionnaire which is an indicator of a variable that is by using a reliability test. Instruments are considered reliable if they can be used repeatedly to measure the same object with the same results [12]. Reliability test is done by using the retest test technique

(retesting), with reference to Cronbach's alpha, namely the level of reliability or the price of r (alpha) reaching 0.70. If $\alpha > 0.90$ then reliability is perfect. If α is between 0.70-0.90 then reliability is high. If α is 0.50-0.70 then the reliability is moderate. If $\alpha < 0.50$ then reliability is low. If α is low, it is possible that one or more items are not reliable. From the output table data the reliability test results above show the Cronbach Alpha value for the Tracking Application variable (X1), Temperature Monitoring (X2), which is used in this study greater than 0.70, so it can be concluded that the information technology variable (X1) is high reliability.

3.4. Central Tendency and Variability

3.4.1. Tracking Application (X1)

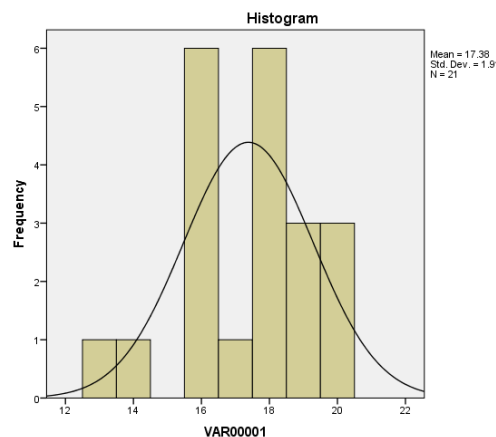


Figure 1. Histogram Tracking Application
Source: Processed Data SPSS 24.0

The picture above shows the histogram for the Tracking Application variable (X1). Calculation of skewness and kurtosis from the data gives the following results:

The skewness number gives the meaning that the distribution curve has a negative slope so that the tail protrudes or enlarges to the right. Kurtosis of 0.039 means that it tends to approach 1. This gives the meaning that the curve is a Pleticurtic distribution.

3.4.2 Temperature Monitoring (X2)

Based on the research data obtained from collecting data about the Temperature Monitoring variable (X2) as follows:

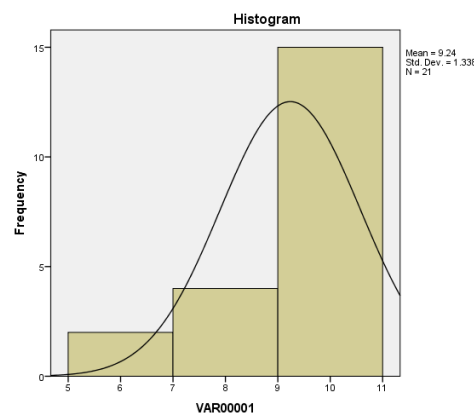


Figure 2. Histogram Temperature Monitoring
Source: Processed Data SPSS 24.0

The figure above shows a histogram for temperature monitoring variables (X2). Calculation of skewness and kurtosis from the data gives the following results: The skewness number gives the meaning that the distribution curve has a negative slope so that its tail sticks out or enlarges to the left. Kurtosis of 1,428 means it tends to be greater than 1. This gives the meaning that the curve is a moderate or Leptokurtic distribution.

3.4.3 IoT Device

Based on the research data obtained from the data collector about IoT Device (Y) variables as follows:

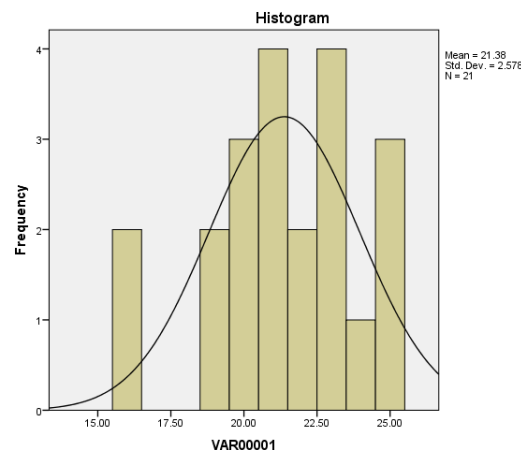


Figure 3. Histogram IoT Device
Source: Processed Data SPSS 24.0

The picture above shows the histogram for the innovation variable (X2). Calculation of skewness and kurtosis from the data gives the following results: The skewness number gives the meaning that the distribution curve has a negative slope so that its tail sticks out or enlarges to the left. Kurtosis of 0.070 means it tends to be close to 1. This gives the meaning that the curve is a Pleticurtic distribution.

4. Discussion

Entering the industrial era 4.0, the tracking of the delivery service company is no longer effective. The tracking of the delivery service company can only be executed from one drop point to another drop point. The trip between drop points cannot be traced so that the tracking becomes not transparent.

The solution is to use a Traceable e-Seal in which IoT devices are embedded. Traceable e-Seal is a smart e-Seal that is not only used to lock the door of a container but can also be used as a tool to track containers during delivery in a transparent and real-time manner and has added value of being able to monitor the temperature during delivery and will provide a notification when there are an increase and decrease in temperature during delivery.

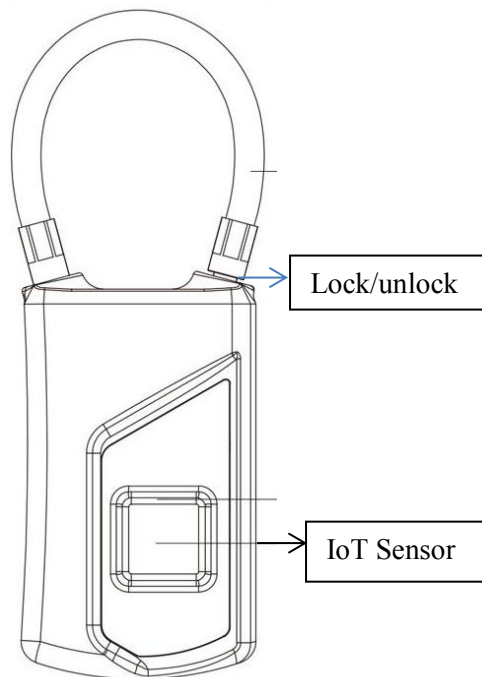


Figure 4. Inside the e-Seal



Figure 5. Outer appearance the e-Seal

IoT sensors can reduce various problems that may occur during delivery such as loss, damage, and error in delivery routes because this is an anti proofing tool Traceable e-Seal is connected with the MyTraceable application, all forms of temperature tracking and monitoring can be done via the application. Traceable e-Seal has a battery with high durability and strength. The battery can last for approximately 30 days of use. The way it works is IoT will send data to cloud computing as big data storage and then transfer it to the application so that it can be viewed directly and in real-time.

The use of IoT devices is better used in the digitalization era. This IoT device can carry out transparent tracking, on time and its added value can also be done monitoring the temperature of goods in the form of pharmaceutical cargo and easily damaged cargo and sending information to cloud computing shown in Figure 3. Cloud computing proffers a practical utility-based model that will enable businesses and users to access applications on-demand anytime and from anywhere. The concept of the model of sending information from IoT to cloud computing can then be accessed through MyTraceable application by means of IoT sensors collecting all the information then shortening and compressing that information and storing it to a large enough cloud computing storage. Cloud computing is a place to store information permanently on an internet server and as a liaison between IoT devices and applications so that data stored on IoT can be accessed on a mobile application.



Figure 6. The flow of Data Transfer

To be able to be seen through Traceable e-Seal user applications, you have to download the MyTraceable application so tracking container location and temperature monitoring can be done anywhere as long as it is connected to the internet. For each delivery, a delivery service company that uses a Traceable e-Seal device will provide a QR Code to the driver.

Drivers who will travel for delivery are required to scan QR Codes in the MyTraceable application that has been downloaded on the driver's smartphone first. After scanning the QR Code, the trip made by the driver will always be monitored by the delivery service company.



Figure 7. Traceable e-Seal

The recipient of the item will also be given a receipt number which is useful for tracking items to be received through the application. Tracking of goods in the application is done transparently and real-time because Traceable e-Seal in Figure 7 is used in the door of the container inside which IoT sensors are embedded which can track from one drop point to another drop point in real-time, transparent and give visibility. e-Seal is installed on the outside of the container door so that the signal is strong for tracking in real-time. There are 2 IoT sensors that will be installed in the container, first embedded in the e-Seal and the second installed in the door of the inner container. IoT sensors installed inside are used to monitor the temperature during delivery. IoT The internal sensor is placed on the door so that the IoT sensor is accurate in monitoring the temperature of the container room. When placed near the referee machine the temperature drops and monitoring becomes inaccurate. IoT sensors inside and outside container doors are connected to each other and can only be used once during delivery. If the lock is opened not in accordance with the parameters that have been determined, the lock will fail to open and a warning notification will be given via MyTraceable Application.

The demand for mobile-based applications is very high from end-users to large companies, the solution is to access IoT-based applications called MyTraceable to make it easier for senders and recipients to track items sent during delivery. MyTraceable application connected delivery service company, transporter, and customer. The MyTraceable application can be downloaded for free and accessed via tablets, mobile devices, and laptops when connected to the internet. In this application, we provided features like live route transparency, real-time tracking, and real-time monitoring of temperature-sensitive pharmaceutical cargo and perishable goods. For the live route, transparency will be updated every 5 minutes. Monitoring of temperature-sensitive pharmaceutical cargo and perishable goods is supported by providing notifications when there are an increase and decrease in temperature during delivery. We also track the goods in the form of perishable goods and fresh food. The traceable application provides a Delivery Order Arrangement that can be accessed by the transporter [13]. The payment bill can be seen in this application and we facilitate payment features to the customers. The MyTraceable application offers some advantages of easier and real-time access to

information and it can also increase customer satisfaction and delivery service company performance.

5. Conclusion

The tracking of the delivery service company can only be executed from one drop point to another drop point. A trip between drop points cannot be traced so that the tracking becomes not transparent. IoT is a global structured network that connects things to things, things to people and people to people with technology that can track, monitor and sense. The use of IoT is embedded in Traceable e-Seal and can be accessed via MyTraceable Application. The advantage of using Traceable e-Seal and MyTraceable is to track items during shipping in a transparent and real-time manner. And it has the advantage of monitoring the temperature during shipping which can be used as a solution to the problem of shipping sensitive items. The use of tools and applications can increase customer satisfaction and company service delivery service.

References

- [1] X. Jia, Q. Feng, T. Fan, and Q. Lei, "RFID technology and its applications in Internet of Things (IoT)," *2012 2nd Int. Conf. Consum. Electron. Commun. Networks, CECNet 2012 - Proc.*, no. July, pp. 1282–1285, 2012.
- [2] M. I. Mahali, "Smart Door Locks Based On Internet Of Things Concept with Mobile Backend as a Service," *J. Electron. Informatics, Vocat. Educ.*, vol. 1, no. Jurusan Pendidikan Teknik Elektronika dan Informatika FT UNY November, pp. 171–181, 2016.
- [3] G. Chung, "Internet of Things in Logistics," *DHL Trend Res.*, vol. 1, p. 1, 2015.
- [4] L. Domingo, "The Challenges of Logistics 4.0 for the Supply Chain Management and the Information Technology," *Nor. Univ. Sci. Technol.*, no. May, pp. 1–84, 2016.
- [5] Y. Wang, H. Zhu, Z. Wang, H. Li, and G. Li, "A Uniform Parcel Delivery System Based on IoT," *Adv. Internet Things*, vol. 08, no. 04, pp. 39–63, 2018.
- [6] T. Senjoyo, R. N. Fazri, R. Didiet, R. Hidayat, and D. Himawan, "Maintaining Halal Cold Chain Warehouse Temperature Stability Using Iot To Increase Halal Food Brand Equity," *Glob. Res. Sustain. Transp. Logist.*, vol. 1, no. no 1, pp. 1–11, 2018.
- [7] P. R. B. B, P. Saluja, N. Sharma, A. Mittal, and S. V. Sharma, "Cloud Computing for Internet of Things & Sensing Based Applications," pp. 374–380, 2012.
- [8] K. S. Viraja, "IOT Based Smart Door System," *Int. J. Res. Appl. Sci. Eng. Technol.*, vol. 6, no. 4, pp. 438–443, 2018.
- [9] R. K. Gupta, S. Balamurugan, K. Aroul, and R. Marimuthu, "IoT based door entry system," *Indian J. Sci. Technol.*, vol. 9, no. 37, pp. 1–5, 2016.
- [10] I. Ha and S. Korea, "Security and Usability Improvement on a Digital Door Lock System based on Internet of Things Security and Usability Improvement on a Digital Door Lock System based on Internet of Things," no. August 2015, 2016.
- [11] B. C. Swedberg, S. Chain, and I. Internet, "Companies Testing New IoT Devices for Refrigerated Container Monitoring Companies Testing New IoT Devices for Refrigerated Container Monitoring," pp. 1–2, 2018.

- [12] Sugiyono, *Metode Penelitian Kuantitatif, Kualitatif, dan Kombinasi (Mixed Methods)*. Bandung: Alfabeta, 2017.
- [13] G. P. Optimization, Z. Azhar, H. Mardiana, R. Didiet, R. Hidayat, and D. Himawan, "The Implementation of Smart Port in Tanjung Priok Port for," pp. 132–138, 2008.