

Bee Deli box: A Better Solution for Food and Beverage Delivery Box Based on Authorization

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Abstract

The increasing number of COVID-19 cases has proven to have a significant impact not only in health area but also on the global economy. Tenants/restaurants are not allowed to accept dine-in customers if there are many confirmed cases of COVID-19 in their area. Delivery solutions can solve the dine-in problem, but customers face other problems that can occur when food/beverage is being delivered: the delivery person opens the package and eats it without the customer's acknowledge and some even spit on the food/beverage. These overwhelming incidents have an impact on lowering the level of customer trust to buy food/beverage from tenants/restaurants because COVID-19 is an infectious disease that uses air as a medium that attacks the respiratory system and can also spread through droplets of saliva. We developed an innovative delivery box solution called BeeDelibox (BettEr DELIvery BOX) which can keep food/beverage hygienic while been delivered to customers. Internet of Things (IoT)-based delivery box is specially designed to be opened only when the customer gives the authorization to delivery person to open it. This novel solution can keep food/beverage hygienic when delivered to customers.

Keywords

Pervasive, Internet of Things, Delivery Box, Access Control System and Authorization

1. Introduction

World Health Organization (WHO) declares that the Corona Virus Disease 19 (COVID-19) outbreak is a global emergency. The increasing number of COVID-19 cases has proven to have a significant impact not only in health but also on the global economy (Rowe et al. 2021). Economic stability in Indonesia was affected and caused the economic and business activities to decline drastically (Susilawati et al 2020, Evans 2020). The Micro, Small and Medium Enterprises (MSMEs) sector such as food/beverage and other businesses that rely on crowds are the most vulnerable sectors to have an economic crisis because these businesses depend on the velocity of money from their sales (Fitriasari 2020, Kiram et al. 2021). Their revenue has decreased drastically, some of them even reach 80% (Wijaya 2020). The restrictions on business activities, opening hour restriction, and social distancing protocol make MSMEs cannot do their activities like usual/normal (Yanti et al. 2020, Harlianty et al. 2020).

If there are many confirmed cases of COVID-19 in the areas where MSMEs sell food/beverage, they are generally not allowed to accept dine-in customers (Widayat and Arifin 2020). This situation forces a shift in business or lifestyle from dine-in (on-site) which requires a face-to-face meeting to go online using a delivery. MSMEs that have businesses in food/beverage sector are trying to survive during these difficult times by doing online marketing so the customers can still order food/drink and deliver it to their place (Kiram et al. 2021, Prasetyo et al. 2021).

Delivery solutions can solve the dine-in problem, but customers face other problems that can occur when food/beverage is being delivered. DetikFood (2020), FR24 News (2020), and New York Daily News (2019) reported a case that occurred during food delivery, for example a delivery person opening the package and consuming the food/beverage without the customer's acknowledge and some even spitted on the food (Era Baru 2020). This incident is very overwhelming and can have an impact on lowering the level of customer trust to buy food/beverage from tenants/restaurants because COVID-19 is an infectious disease that uses air as a medium that attacks the respiratory system and can also spread through droplets of saliva (Rowe et al. 2021, Mogi and Spijker 2021). If a customer consumes food/beverage that has been spotted on or previously consumed by a person with COVID-19, this incident can potentially transmit the virus to the customer. If the delivery person opens the food/beverage package without the knowledge of the customer, this action can cause contamination of the food/beverage by the surrounding air. If food package is wrapped in a plastic bag and hung on a motorcycle without additional protection, there is a possibility that the package will become contaminated due to direct exposure to air/dust/smoke/water during delivery. Strong preventive measures, tight implementation of control strategy plans, people's awareness, and social behavior, as well as both indoor and outdoor environmental circumstances, are the key elements to control the spread of COVID-19 (Rowe et al. 2021, Habeebullah et al. 2021, Senatore et al. 2021).

Sealed package at least can reduce the possibility of food/beverage from being contaminated during the delivery process (Prasetyo 2021). To increase and restore customer trust from the cases occurred during the food/beverage delivery process, we proposed an innovative delivery box solution called BeeDelibox (BettEr DELIvery BOX) which contains pervasive technology to solve these problems. Especially during the COVID-19 pandemic, this novel solution can keep food/beverage hygienic while been delivered to customers. Internet of Things (IoT)-based delivery box can be connected to the user application and specially designed to be opened only when the customer or an authorized person allows the BeeDelibox to be opened by the delivery person to avoid the package being opened/consumed without the permit/acknowledge and remains hygienic during the delivery. The IoT system allows us to have control over the device and build a more safety procedure programmatically. We also implemented an application as a companion of the developed IoT system.

2. Literature Review

Internet of Things (IoT) is a pervasive technology and technically an extension of the Internet worldwide (Singh and Kumar 2020). It has brought the significant changes in human life by making the transmission of information more harmonious. Pervasive can be implemented in embedded devices, for example Raspberry Pi (Ichsan et al. 2020). This embedded device has the advantage of being small enough to be placed almost anywhere.

Access Control System (ACS) is designed to provide safe and secure access in building facilities for authorized user such as homes, offices, factories, facility server rooms, airports, and banks (Yoon et al. 2020). This system does not allow unauthorized users to enter certain building facilities. To secure a building, it uses electronic ACS embedded in a door lock system that provides access depending on the credentials given to the user. The illustration of using a standard door access control system is illustrated in Figure 1.

2.1 Related works: The research begins with conducting a literature review to find the state of the art and the problems still occur that are not yet or difficult to solve. A literature review based on the news and the results of previous researchers is needed to get an overview of the problems that occur. Based on the literature found, this research area is very interesting and unique because at the time this research document was written, researchers had not succeeded in finding previous research on pervasive delivery box for storing food/beverage, so the ACS door was used as the initial benchmark for innovating delivery box by applying pervasive technology.

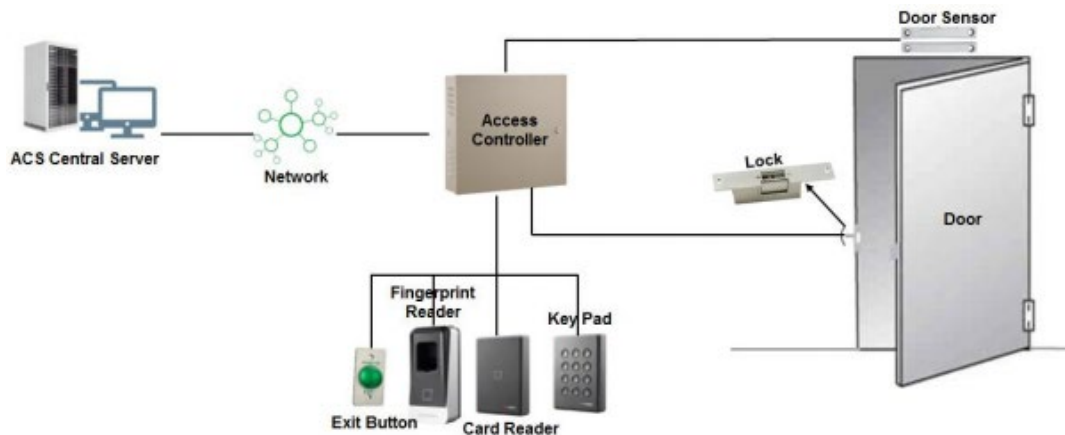


Figure 1. Door Access Control System (ACS) (Yoon et al. 2020)

3. Research Methodology

Research methodology is needed as a systematic method to ensure the research been done properly and can achieve the target (problem that need to be solved). The research conducted in five main steps: literature review, problem formulation, pervasive solution: design and planning, development, and conclusion. In this study, we implemented the IoT system as our proposed solution to address the problem with unhygienic food when ordered it online. Especially during the pandemic situation, where everyone has to maintain proper health protocol to avoid getting infected with the disease. In this section, we explain the research methodology in more detail.

3.1 Problem Formulation

Problem formulation is one of the important steps to find out the root of the problem that needs to be solved and what effects can this problem have. COVID-19 is a contagious disease that uses air as a medium. The problem that needs to be solved in our research, as mentioned in Section 1, is as follows: “How to protect the foods from being contaminated and to prevent the spread of COVID-19, if the delivery person eats/drinks the food/beverage ordered by the customer or the food/ beverage package is opened or if the food package is wrapped in plastic and is hung/put on a motorcycle without any additional protection?”

3.2 Pervasive Solution: Design and Planning

To ensure the implementation of the research runs smoothly, detailed, and proper planning needs to be prepared in advance. Pervasive technology is able to solve existing problems as well as an innovative solution to maintain the hygienic of food/beverage when delivered to customers. The design ideas of how Bee Deli box solution works (Figure 2) require three actors: customer, tenant/restaurant, and delivery person. Internet connection is also needed to let them, and the application communicate with each other.

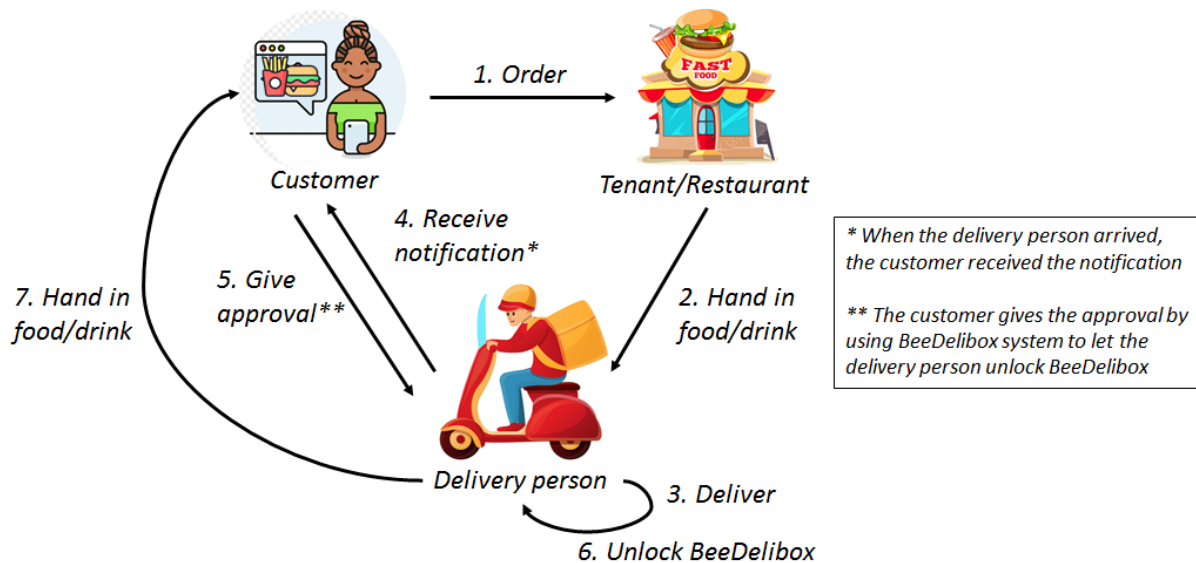


Figure 2. How Bee Deli box solution works

First, the customer places an order using a smartphone through a system that is integrated with the Bee Deli box system. Tenant/restaurant will receive notification and prepare customer orders. When the order is ready, then the tenant/restaurant hand in food/beverage to the delivery person. The food/ beverage is then put into the Bee Deli box, then the box door is closed and locked by pressing the lock button on the Bee Deli box system. After the delivery person arrives at the customer's destination, the customer will receive a notification on the smartphone and need to give approval to the delivery person to open Bee Deli box. After the approval is given, the Bee Deli box lock will open automatically, and the delivery person can open Bee Deli box and hand in food/beverage to the customer.

3.4 Hardware and Software Design

Bee Deli box development focuses on hardware and software solutions. The development process is carried out continuously until the hardware and software work properly and produce the results as expected.

The IoT framework been use separated into four levels: application (can be accessed by smartphone), storage, middleware, and sensing. Figure 3 is the design architecture of Bee Deli box. The approval authorization from the customer by using Bee Deli box – software was sent through the server by using the internet. Bee Deli box - hardware uses mobile hotspot to let it connect to the internet. Bee Deli box - hardware, represented as a box in Figure 4, connected to the internet to get order information and the approval status. After it was unlocked and opened, Bee Deli box – hardware sends the unlock status back to the server by using the internet.

The Bee Deli box - hardware solution attached in insulated food delivery bag (Figure 4). Researchers modified the bag so that there is an acrylic door (including doorknob and hinges), a solenoid door lock, Raspberry Pi, and a power inside it. Solenoid door lock functions as a lock so that the acrylic door cannot be opened if it is locked. The solenoid door lock is connected to the Raspberry Pi using a cable and there is an intermediate system for controlling the solenoid door lock (to lock or unlock) installed in the Raspberry Pi. This system is also connected to the internet and checks whether there is approval from the customer that allows the solenoid door lock to be unlock. Power (by using a power bank) connected to the cable provides electrical power to the Raspberry Pi. The use of a power bank with a 10000 mAh specification is sufficient to provide power to Raspberry Pi for 8-9 hours (assumption: 8-9 working hours per day).

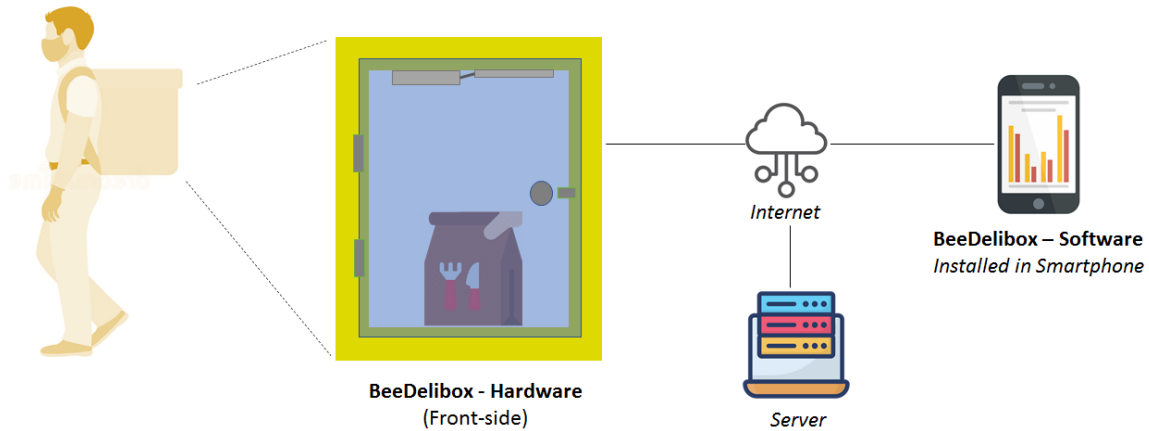


Figure 3. Bee Deli box – architecture design

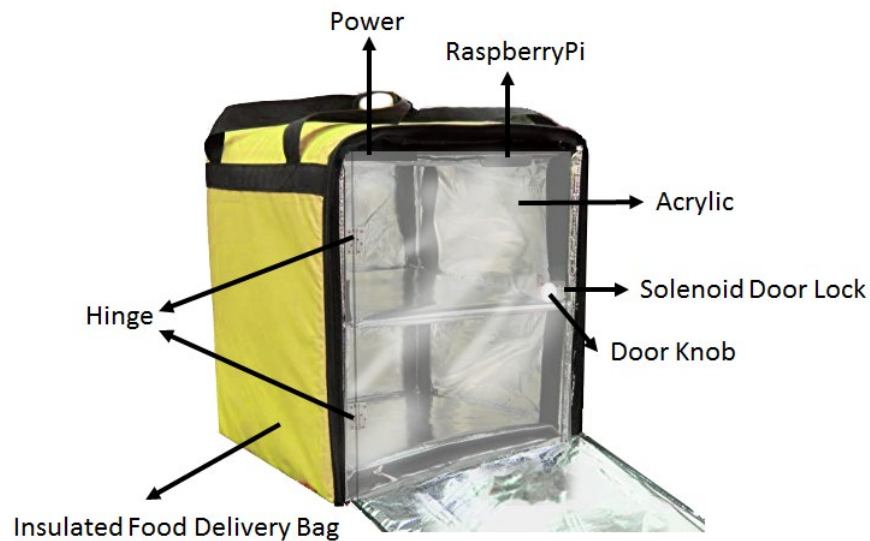


Figure 4. Bee Deli box hardware implementation in insulated delivery bag

Bee Deli box software solution developed for three user accesses: customer, tenant/restaurant, and delivery person. This software (system) needs to be browsed in smartphone to be use. Customer' user access has the feature of being able to order, check the status of the order, and give the approval to open the box (Figure 5). The system on the tenant/restaurant side can receive orders, update order status, view the overall order status, and give authorization as a plan B in case the customer has difficulties giving the approval. The system for delivery persons has a feature to update the status of delivery orders and view the overall order status.

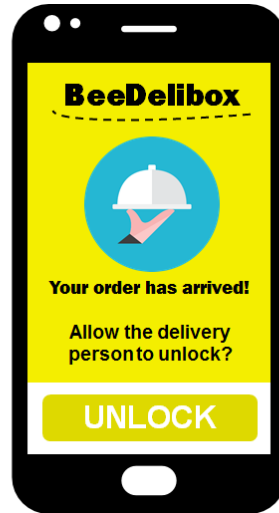


Figure 5. Customer - approval page

4. Results, and Discussion

4.1 Testing and Implementation Result

In the testing stage of Bee Deli box, we invited 5 participants to be involved in evaluating our system. The participants were invited based on several criteria: (1) they need to have a current online business (food, cake, or beverage), (2) they are able to accept cash payment, (3) the food they sell is properly wrapped for longer distance. The test case (Table 1) and the result is provided as below:

Table 1. Test case

Test Case ID	Purpose	Test Scenario	Test Steps
#TC-01	To test the ideal condition.	Both delivery person and customer smartphone are connected to internet and the door lock in Bee Deli box is fully charged.	<ol style="list-style-type: none"> 1. Delivery person arrived at customer's place 2. Customer sees "Your order has arrived!" information on the smartphone 3. Customer press the unlock button 4. Delivery person able to open the Bee Deli box door
#TC-02	To test the special condition if delivery person internet connection is failed	Delivery person connection is failed, and the customer smartphone is connected to the internet.	<ol style="list-style-type: none"> 1. Delivery person arrived at customer's place 2. Customer cannot see "Your order has arrived!" information on the smartphone 3. Customer needs to press a "help" button and choose "I want to unlock" 4. Customer press the unlock button

			5. Delivery person able to open the Bee Deli box door
#TC-03	To test the special condition if customer internet connection is failed	Delivery person is connected to the internet and the customer smartphone connection is failed.	<ol style="list-style-type: none"> 1. Delivery person arrived at customer's place 2. Customer cannot see "Your order has arrived!" information on the smartphone 3. Customer informs the delivery person (no internet connection) and provide the "secret unlock key" pin number to delivery person 4. Delivery person enters the "secret unlock key" pin number 5. Delivery person able to open the Bee Deli box door

During the evaluation period, all the testing case has been done satisfactorily. Although several feedbacks from the testers were received. The feedback is mentioned as below:

1. Integrated payment system is necessary to make the transaction process easier for the tenants.
2. Bee Deli box can deliver several orders to different customers.

5. Conclusion and Recommendation

Sealed package at least can reduce the possibility of food/beverages from being eaten/spitted by the delivery person and being contaminated during the delivery process. An innovative delivery box solution called Bee Deli box (Better Delivery BOX) which contains pervasive technology can solve these problems. This innovative solution can keep food/beverage hygienic when it delivered to customer, especially during the COVID-19 pandemic. The IoT-based delivery box is uniquely built to be opened only when the customer gives the authorization to delivery person. This solution prevents the package from being opened/consumed without customer's permission/acknowledgement and stay hygienic during delivery.

For future work, a password-based door lock using a keypad door lock can be added to Bee Deli box. After the delivery person arrives at the destination but there is no internet connection on Bee Delibox, he/she can ask the customer for a passcode to be entered into the keypad door lock.

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Biographies

Maria Seraphina Astriani graduated from Doctor of Computer Science, Bina Nusantara University. She is a lecturer at Bina Nusantara University, Indonesia. Her teaching expertise included Algorithm Design and Analysis, Enterprise

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Andreas Kurniawan got his bachelor's degree with magna cum laude distinction in Information Technology at Bina Nusantara University in 2008. He continued to receive his master's degree in cum laude distinction as Master of Information Technology at Bina Nusantara University in 2010. He likes to participate in competition and won as Gold Medalist at 6th Asean Skills Competition, Bandar Sri Begawan, Brunei Darussalam in 2006.

Nunung Nurul Qomariyah, Ph.D completed the Bachelor program in Computer Science, Gadjah Mada University, Indonesia in 2006. In 2011, she completed her master's in information technology at the University of Indonesia, and in 2018, she completed her doctoral degree at Computer Science, the University of York, UK. She is currently an Assistant Professor at BINUS University International, Jakarta, Indonesia. She is a former member of the Artificial Intelligence Research Group, University of York, UK. Her PhD topic is in the area of recommender systems, particularly in e-commerce user preference learning from pairwise comparisons.

Arif Priyono Susilo Ahmad, S.Sn., M.Sn. is a lecturer, designer + visual artist who focuses on exploring character design, typography, naive illustration and is enthusiastic about developing creativity, visual arts, exploring the field of visual communication design, especially implementation in the environment and small and medium enterprises. He graduated from the Master of Arts program from the Indonesian Art Institute (ISI), Yogyakarta. Currently, in addition to actively teaching at the School of Design, Visual Communication Design department at Binus University, he is also active in exhibiting both design and visual arts. In addition, he also holds 6 IPR certificates for works created by MONSSA, JAG, BESTARI ORNAMENTS, IGOLOGI, MUKAKU, TOMORO. His achievements as a designer are Designer Selected New Design Indonesia 2013, Kemenparekraf RI (2013) and 1st Place in TPA Logo Design Competition (Taman Pendidikan Al-qur'an) IISB – Brisbane Australia (2014).