

# Delivery agent service system using Drone based on IoT technology

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## Abstract

As we enter the O2O era, we can see a variety of services using IoT technology. IoT technology has made it possible to share information between objects and people, things and things, and it has made it very easy to expand their business and services. The drones are unmanned airplanes that are not maneuvered by people, and their use is expanding by blending them with other technologies such as advanced control technology, GPS, and camera. In this paper, we designed a delivery agent service using a drone that combines IoT technology using beacon and Arduino. This system combines the position of the user using the smartphone short range communication technology provided by Beacon and the program to control the lock using Arduino to quickly use the drone, and we designed a delivery surrogate system with the low labor cost and expenses. The system provides the smartphone alarms to the sender and the recipient according to the drone's access and delivery status change to the delivery application, and the security of the delivered items is secured with the lock. We also designed the lock to be unlocked only when the password and the locker password that are given through the smartphone alarm match.

**Keywords:** O2O, IoT, Bluetooth 4.0, Beacon, Arduino, Drone

## INTRODUCTION

The world's largest international electronics exhibition CES2015 selected IoT (Internet of Things), drones, wearable and smart cars as the hottest product line. Today, with the advent of the O2O era, technologies that are integrated with IT are still being released. Among them, IoT (internet of things) technology is the most recent issue. IoT refers to sharing information by connecting objects in various fields such as home appliances, electronic devices, healthcare, remote meter reading, smart home, and smart car. In addition, wireless communication network technology for connecting networks to things like Bluetooth, WiFi, and Zigbee is rapidly developing. The drones selected at CES2015 are global companies paying close attention and expanding into real business fields to invest heavily. Drones have been studied mainly for fixed-wing drones for military purposes, such as reconnaissance and marking. However, the possibility of industrial / commercial drones based on rotating-wing drones

such as quad rotors is growing recently [1]. In particular, in order to improve freight transportation efficiency, promptness and customer satisfaction, there is a need to actively consider the introduction of new logistics services using drone [2]. Specifically, Google, DHL, Amazon and Domino pizza are trying to commercialize drones for delivery within the next few years. The use and size of drones has been growing with interest from a variety of companies from Korea Institute of Industrial Technology, ETRI, Samsung Electronics to small and medium sized toy companies [3].

There was interest in small flying machines as a means of delivering payloads well before this announcement. For example, in early 2009 my research group started receiving a large number of e-mails from would-be entrepreneurs, asking us if we could help them develop a pizza delivery system using drones [4].

Drones are increasingly being used in fusion with other technologies such as advanced control technology, GPS, and camera. Recent interest in quad rotor drones in the IT field is due to the fact that vertical take off and landing and hovering are possible, relatively professional aerodynamic knowledge is not required, it is also easy to obtain low cost sensors, SW, HW, etc [5].

With the advent of the O2O era, various services utilizing IoT technology are emerging. IoT technology has been applied to various places in life, and it has become possible to share mutual communication information between things, people, things and things, and it has become very easy to expand the business and services. In addition, recently, global companies have come to the fore to develop and maintain technology, and the drone is attracting attention as a future new business. Internationally, we are trying to establish and improve laws and regulations through coordination with relevant ministries in relation to drone flight.

In this paper, I have planned a delivery service using a drone that combines IoT technology using beacon and arduino. When the drones approach a certain distance via Bluetooth 4.0 technology using beacons, smartphone alarms are provided to senders and recipients, and the user can operate the locks of the item box with smartphone applications by the arduino. Upon receipt of the delivery, the sender will be provided with the smartphone alarm and the password for the start of the drone and the item box at the same time as the drone starts. Likewise, when the drones that load the goods then depart from the sender to the recipient, a smartphone alarm is

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provided to the recipient as well. This process is designed to provide delivery service using drone.

## RELATED WORK

### O2O (Online to Offline)

O2O (online to offline) sales model is also called offline business model. It means on-line business will promote off-line shopping. To increase offline customers, stores push up-to-date information to Internet users by means of discount, information providing and service reservation. This business model is suitable for some special products or services which need physical stores [6]. Stores who are running O2O business model often provide more discount for on-line payment than off-line payment. Special discount would attract customers shopping and payment on-line. For stores, advertisements on-line could turn into real purchasing behavior and every transaction will generate a "trace code" automatically. The "trace code" or "transaction log" is useful for stores who want to introduce customer relation management (CRM). The importance of O2O business model is as follows [7].

- (1) Based on off-line service experience, customers trust off-line stores more than on-line stores.
- (2) For some localized service or product, customers could get better service.
- (3) On-line information provides more information for customers.
- (4) Localized stores provide better or more special service than chain store. By means of on line business model, localized stores could broaden their customers.
- (5) By means of user feedback from Internet, stores could provide customized service to enhance high stickiness.

### IoT (Internet of Things)

While the term Internet of Things is now more and more broadly used, there is no common definition or understanding today of what the IoT actually encompasses [8]. The origins of the term date back more than 15 years and have been attributed to the work of the Auto-ID Labs at the Massachusetts Institute of Technology (MIT) on networked radio-frequency identification (RFID) infrastructures[8][9]. Since then, visions for the Internet of Things have been further developed and extended beyond the scope of RFID technologies. At the same time, a multitude of alternative definitions has been proposed. Some of these definitions exhibit an emphasis on the things which become connected in the IoT. Other definitions focus on Internet-related aspects of the IoT, such as Internet protocols and network technology. And a third type centers on semantic challenges in the IoT

relating to, e.g., the storage, search and organization of large volumes of information [8].

The fields of application for IoT technologies are as numerous as they are diverse, as IoT solutions are increasingly extending to virtually all areas of everyday. The most prominent areas of application include, e.g., the smart industry, where the development of intelligent production systems and connected production sites is often discussed under the heading of Industry 4.0. In the smart home or building area, intelligent thermostats and security systems are receiving a lot of attention, while smart energy applications focus on smart electricity, gas and water meters.

Smart transport solutions include, e.g., vehicle fleet tracking and mobile ticketing, while in the smart health area, topics such as patients' surveillance and chronic disease management are being addressed[10].

### Bluetooth 4.0

Bluetooth low energy (Bluetooth LE, BLE, marketed as Bluetooth Smart) is a wireless personal area network technology designed and marketed by the Bluetooth Special Interest Group aimed at novel applications in the healthcare, fitness, beacons, security, and home entertainment industries. Compared to Classic Bluetooth, Bluetooth Smart is intended to provide considerably reduced power consumption and cost while maintaining a similar communication range.

Bluetooth Smart was originally introduced under the name Wibree by Nokia in 2006 [4]. It was merged into the main Bluetooth standard in 2010 with the adoption of the Bluetooth Core Specification Version 4.0.

Mobile operating systems including iOS, Android, Windows Phone and BlackBerry, as well as mac OS, Linux, Windows 8 and Windows 10, natively support Bluetooth Smart. The Bluetooth SIG predicts that by 2018 more than 90 percent of Bluetooth-enabled smartphones will support Bluetooth Smart [11].

Bluetooth Low Energy, which is Bluetooth 4.0, is relatively slower than other wireless transmission standards because peripherals that can last for years are the main targets for batteries. The chips that support only BLE are called Single Mode, and only the one-way transmission is supported. The chip-equipped product is called Bluetooth SMART. The chip that comes with the Classic Bluetooth is called Dual Mode with the dual-way transmission. The mounted product is called Bluetooth SMART READY. Compared to the existing Bluetooth standard, it has a relatively small duty cycle (active state retention time), can be produced at a low cost, and minimizes power consumption through a low data rate. Thus, a coin cell battery It is possible to operate for more than 1 year when using it, and simplified device connection procedure without pairing.

## CONFIGURATION OF DELIVERY AGENT SERVICE SYSTEM

### Beacone

Beacons help guide navigators to their destinations. Types of navigational beacons include radar reflectors, radio beacons, sonic and visual signals. Visual beacons range from small, single-pile structures to large lighthouses or light stations and can be located on land or on water. Lighted beacons are called lights; unlighted beacons are called daybeacons [12].

The beacon is a Bluetooth 4.0 (BLE) protocol based short range wireless communication device capable of communicating with devices within a maximum distance of 70m. It is well suited for the Internet implementation of things that all devices are always connected because of high accuracy and low power consumption so that the distinction of 5 ~ 10cm can be done. This strength has played a major role in bringing back the Bluetooth technology that had fallen due to the IoT era. Initially, the technology that will lead the IoT era has been spotlighted by NFC (tagged wireless communication), which is applied to distances of less than 10 cm, but users have been interested in beacons again. The beacon has a longer usable distance than NFC, providing a space-based user experience and providing indoor location information that was impossible with GPS technology. Moreover, the price is low and the size is small, so it is appropriate as the basic unit of building IoT infrastructure. In addition to short-distance marketing, the beacons are used forever.

### Arduino

Arduino is an open source microcontroller board that uses Atmel's AVR. Because it is an educational platform developed for those who have no experience in embedded development, it is easy to handle and simplify the process of writing programs and loading programs on the board. Depending on the version, it differs slightly, but the Arduino board and development environment usually looks like this: For reference, the photo board is the Uno R3 version, the reference board as of 2013 and the most commonly used board. The microcontroller used is ATMEGA328, which operates at 16MHz and is integrated processor with 32Kb of EEPROM (memory).

### Drone

The drone is a plane or a helicopter-like plane flying by the induction of a radio wave without a person burning. At first, it was used as a target instead of the enemy for airborne, anti-aircraft, and missile fire. However, with the development of wireless technology, drones of various sizes and performance have been developed depending on the purpose of the drone, micro drones have also been actively developed

and studied. There are also many things that have been developed and commercialized as personal hobbies. The drones are put into operation in areas that are not accessible to humans, such as jungles, remote areas, volcanic areas, natural disasters, and nuclear power plant accident areas. Recently, the use of drones has been increasingly used for transport purposes.



Figure 1. Heli-cam shooting by Drone

### Arduino Development Tool

Arduino's integrated development environment (IDE) uses C++ to code the desired behavior, and uploads it to the board. Arduino upload is stored in the flash memory. If you want to receive and process data from Arduino on your PC or Android, you need to write a program using the development tools for your operating system. IDE has Visual Studio on PC or SDK on Android. If you feel that these development tools are more difficult, you can easily code them using the processing. The processing can be performed on a PC separately from the arduino development environment, communicating from the arduino to the COM port, and displaying the data on a screen or the like. It also provides functions for graphics processing. If you change from processing to android mode, you can process it on android.

It is designed so that users who are unfamiliar with software development can easily program. The program or code created with this arduino IDE is called "Sketch".

### GCM

Google Cloud Messaging for Android (GCM) is a service that sends data from the server to the app on the Android device. That is, Push Service. Previously there was a Push Service called C2DM. But at the 2012 Google I / O, the GCM service was released with Jelly Bean. Using GCM technology, the system handles the launch of the drones via the button on the web and receives a smartphone push alarm from the user.

## IMPLEMENTATION OF DELIVERY AGENT SERVICE SYSTEM

### Push Alarm of Drone Start

As shown in [Figure 2], when the administrator confirms the application for delivery and clicks the button to inform the start of the drone, it provides a push alarm that the drone is leaving the user's smartphone. At this time, a randomly generated password of the lock device is provided together.

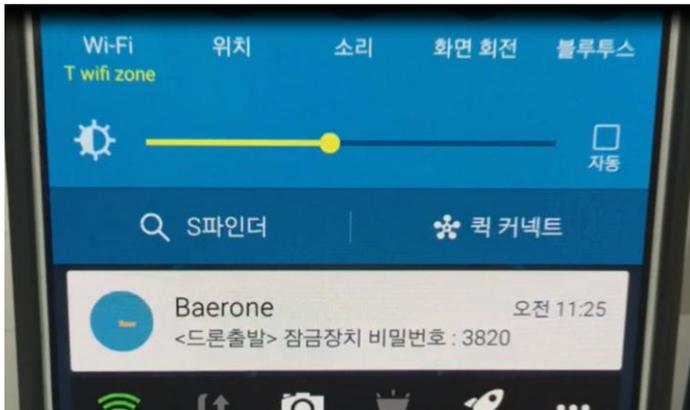


Figure 2. Push Alarm of Start

### Performing of Lock function

As shown in [Figure 3], enter the password provided by the administrator through the smartphone application in the box before the drones depart for the recipient and press the lock button to perform the lock. At this time, arduino is installed in the box, which controls the user's smartphone and Bluetooth function.



Figure 3. Lock function by app

### Shipment to recipient

As shown in [Figure 4], the drone moves the goods to the address of the recipient entered at the time of application for delivery. There remains a technical challenge of building a GPS-based moving system.



Figure 4. Deliver the item to recipient's address

### Push Alarm of Drone Arrival

As shown in [Figure 5], if the drones are approaching the sender and the recipient within a certain distance, a push alarm will be displayed to inform the user of the approach and a push alarm will be displayed to inform arrival.

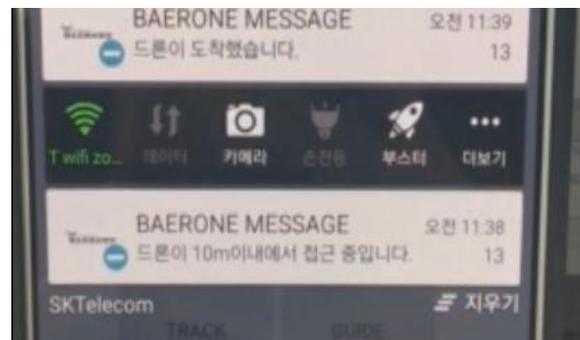


Figure 5. Push Alarm of Arrival

### Receipt of goods

As shown in [Figure 6], when the delivered drones arrive at the recipient, the recipient's smartphone application enters the password of the item box and unlocks the item.



Figure 6. Receipt of goods

## CONCLUSION

With the advent of the O2O era, various services based on IoT technology using beacon and Arduino have been introduced, and the emergence of a new business area called Drone has provided infinite possibilities of expanding the service.

In particular, the global enterprise 's drastic investment in drone courier and expansion of business suggest that the retail industry revolution will begin soon. The US, China, and Japan, which have already grasped the huge marketability of the drone, have been making aggressive efforts to drastically reduce regulations on drone flights and to establish laws and systems. Although there is a feeling that it is late, we should try to develop the technology and activate the market with a more positive attitude toward the drones market, considering that our country is not far behind in technology.

In this paper, we designed a delivery agent service using a drone that combines IoT technology using beacon and arduino. Using beacons to provide smartphone alarms to senders and recipients when the drones approach a certain distance via Bluetooth 4.0 technology. Your app also allows you to manipulate the locks on the item box through Arduino. At the same time as the start of the delivery, the sender provides the smartphone alarm to the recipient.

The discussions for constructing a more stable and usable system should be continued by combining the beacon and IoT technology using Arduino discussed above, and alternatives for applying service according to the situation in Korea where consist of many high-rise buildings and apartments. The first is to arrange for the customer to receive the items arriving at the nearest point of the drone courier service and the second to make a place where the drone can sit in the apartment veranda similar to the air conditioner outdoor unit.

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