A Study on the Expected Effect of Mobile Prepaid Payment for the Activation of Food Waste Volume-Rate System

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음식물 종량제 활성화를 위한 모바일 선불결제 적용에 따른 기대효과 연구

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Abstract This study proposes an NFC-based payment system that considers user convenience while expanding the existing payment method for RFID-based individual food and logistics waste equipment. In line with this trend, I proposed to apply NFC to the existing RFID-based food meter to release the food in the meantime and to address the problem of re-carrying due to card loss, card not possessed, and non-filling, and the question that could not be identified by various cumbersome procedures. NFC's function alone has been certified for its convenience, which led to its introduction and research in the period of time. Of course, we need to negotiate fees with the transportation card company, but if we see a market share related to transportation card soon, we think smooth negotiations will take place. NFC method will be expanded to all phones with iPhone NFC opening. Therefore, in the next study, we intend to apply the payment system in NFC by linking with local currency, mobile vouchers, and card companies, which are being paid as respective payment means according to the recent emergency support system for COVID-19.

Key Words : RFID, Food Waste, NFC, IoT, Meter-rate of Food waste, Things of Internet

요 약 본 연구에서는 RFID기반 음식물류폐기물 개별계량 기기의 기존 결제방식을 확장하면서 사용자의 편리성을 고려한 모바일의 NFC방식의 결제 시스템을 제안하고자 한다. 본 연구는 이러한 흐름에 맞춰 기존 RFID기반 음식물 종량기에 NFC를 적용하여 그간의 음식물을 배출하면서 카드분실, 카드 미소지, 미충전으로 인한 다시 들고 가야 하는 문제점과 그간의 내가 배출한 음식물 현황을 확인하기 위해서는 여러가지 번거로운 절차로 인해서 확인할 수 없던 궁금함을 해소하고자 제안을 하게 되었다. NFC의 기능 하나만으로도 그 편리성이 인증이 되었고 이를 계기로 종량기에 도입하고 연구를 하게 되었다. 물론, 교통카드사와 수수료 관련해서 협상이 필요하지만 곧 교통카드 관련 시장 점유율을 본다면 원만한 협상이 이루어질 것으로 본다. 아이폰 NFC 개방으로 NFC방식이 모든 폰에 확대될 것이다. 따라서, 다음 연구에는 최근 코로나19 확산으로 인한 긴급재난지원금 지원제도에 따라 각각의 지급수단으로 지급되고 있는 지역화폐나 모바일상품권, 카드사와 연계하여 결제시스템을 NFC방식으로 적용하고자 한다.

주제어 : RFID, 음식물쓰레기, NFC, IoT, 음식물쓰레기종량제, 사물인터넷

1. Introduction

Most RFID systems use active RFID tags that use consumable batteries[1]. Before using RFID-based food waste equipment, the existing food waste was discharged by purchasing a bag dedicated to food waste or paying a chip. However, many of the operational problems have begun to emerge. Especially, as I tried to put a lot of food waste into my bag, I had to fill it up to the right line. However, when we put the tape on the envelope, we put it on the envelope, so the people who live alone or cause bad smell because the food soup is overflowing in the elevator or hallway of the apartment. Thus the people who do not have a lot of food waste, so the smell and the flies started to grow in the house.

Also, it was necessary to take action against the complete ban on maritime dumping of food waste, which took effect on January 1, 2013. Accordingly, the introduction of the food quantity system, which is a method of levying as a means of reducing food waste, was made mainly by the Korea Environment Corporation, and by 2014, RFID-based food waste mass machines were installed in the Seoul metropolitan area, which reduced about 30 percent of the existing food waste emissions, resulting in more than 160 billion won in cost savings, and continued to spread throughout the region in recognition of their effects. NFC authentication technology, an NFC technology, has become more popular with the introduction of the technology in the payment system of the smartphone, including Apple Pay and Samsung Pay. In particular, NFC is installed on Android smartphones in Korea, attracting more attention as they are convenient and highly utilized among young office workers[2].

The core contents of this study is to analyze the expected effects of NFC-linked mobile prepaid payment methods by developing service technologies for mobile payment of food waste costs, data provision for real-time food waste emission, and customer-centered service programs for effectively expanding eco-friendly consciousness.

2. Materials and Methods

2.1. RFID

Beginning with the preparation of comprehensive measures to reduce food waste in 1996, the basic plan for the resource nation of food waste was established by the Ministry of Environment and six government policies were implemented over 15 years, including the establishment of a basic plan for the resource development of food waste jointly among related ministries. As shown in Figure 1 below, Food waste currently accounts for about 26% of the total amount of household waste, and economic waste, environmental burden and disposal costs are gradually increasing[3,4].
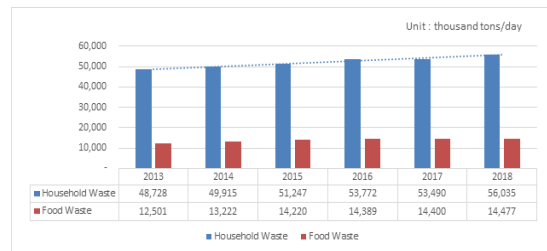

Fig. 1. Food waste generation compared to household waste('13~'18)

Radio Frequency Identification (RFID) is a technology that can identify targets (e.g., objects, people, etc.) using radiofrequency. Early RFID technology was developed for military purposes, including identification of allies and enemy aircraft and tracking of ballistic missiles, but has been applied in various areas since the 1970s, including industrial automation of

electronic goods management and location tracking[5]. RFID systems have the advantage of being able to recognize multiple tags simultaneously without contact, while still recognizable on-the-go, barrier penetration, semi-permanent use, repeatability of extensive data and rapid recognition speed, while radio technology interference or spectrum allocation issues[5].

2.2. RFID-based Volume-Rate Waste Disposal System

The system, which was implemented from 1995 to the present, has been successful, including the promotion of separate collection of recyclable waste and the reduction of stagnant household waste. However, a separate measure was needed for food scraps that were worth recycling to be buried in a volume-based bag[6]. The RFID-based food meter already has 15,000 equipment installed in 62 areas of the metropolitan area. Unlike the current RFID-based food waste treatment system, the RFID-based food processor can collect food waste by tagging the terminal with a transportation card and using a dedicated card, and the collected food waste can be immediately disposed of by measuring the weight by a certain amount of food waste.

Table 1. Methods of the Scheme

Divsion	Picture
Dedicated bag	
Payment chip	
RFID Tag	

Table 1 shows the method of applying the volume system[7].

First, Dedicated bag is the waste purchase a food waste metering bag and disposes of it by himself/herself or into a hub container. Upfront payment settled by purchasing the dedicated bag. Second, Payment chip is the waster attaches a chip or sticker on a separate container and disposes of the waste into the container. Fee incurred proportionally to the number of disposal(using a dedicated container, etc.). Upfront payment settled by purchasing the chip or sticker. Finally, RFID Tag is the waster renders an RFID tag recognized and disposes of the waste → the information on the waster and his/her waste weight is automatically transferred to the center control system.

As a result, the total cost of each household's food waste was reduced by about 50 percent from 1,500 won per month to 700 to 800 won per month after implementation, as the existing method of jointly charging apartment owners once a month, including apartments, excluding general housing, was used to pay for food waste. Also, it is estimated to reach 800 billion won annually, and the resulting economic loss is estimated at 20 trillion won per year.

The Ministry of Environment predicts that the implementation of the system will save 20 percent of food waste and 160 billion won in processing costs annually. The precise reduction effect and economic analysis related to the food waste volume system require continuous data acquisition in the future. To secure and supplement the accuracy of the information, a separate management system at the level of the central and metropolitan governments is required to manage the data that is sent directly to the central server[8].

2.3. NFC

Near Field Communication (NFC) technology was jointly developed by Sony of Japan and NXP Semiconductor of the Netherlands in 2002. NFC technology has been used since NFC Forum was established in 2004. NFC technology has become increasingly popular as mobile phone manufacturers such as Nokia and Samsung Electronics have announced NFC-equipped smartphones and announced NFC-related business strategies of IT industries such as Apple and Google along with the launch and distribution of NFC-equipped smartphones[9].

NFC is an electronic RFID tag using near-field high-frequency radio communication in the 13.56MHz band, providing two-way data communication that enables read/write between devices, primarily through convergence with smartphones. It is also analyzed that the new application business model will be available due to the advantages of providing interoperability with existing contactless smart card technology and wireless recognition technology and providing stability between data communications through the application of cryptographic standards[10]. NFC is a type of electronic RFID tag that refers to a technology that sends and receives data between SMS terminals or tags that are close to an NFC module when contacted. Typically used for public transportation, such as buses and subways, and is in our lives such as permission to enter or advertise[11]. These NFC technologies are gaining popularity as smartphones. Media and media outlets have been predicting that NFC will bring a new paradigm to the payment market since a few years ago, but it has yet to become widely available in real life due to problems in commission fees, revenue allocation and mobile card issuance by mobile carriers.

NFC chips, antennas, and SE (Secure Element) are the components of the device required for NFC payment. NFC chips are built into the phone, and antennas are attached to battery covers, so it is common to connect with NFC chips. SE is a kind of security area where important data such as financial information, services and security applications can be safely stored. Depending on which medium SE is implemented, there are microSD method, USIM method, internal chip method, and sticker method[12].

mobile phones are equipped with another MICRO SD memory, which is designed to be implemented so that NFC roles can be played by utilizing that memory to provide customer convenience and service. If App is downloaded easily, it not only allows users to pay but also see real-time food waste emissions and compared data from the previous month.

When it comes to the architecture of the volume-rate waste disposal system with payment system using NFC, it would be like the Fig. 2 shown below.
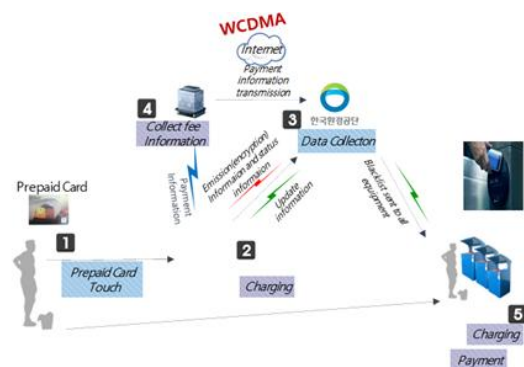

Fig. 2. Service Architecture of volume rate disposal system

For this kind of services to be possible, we need the smart disposal system with NFC communication capability. The smart disposal system that would be able to scale the weight of

the waste with NFC tagging should be possibly to communicate through the Internet for some reason in the future. With the consideration on this, we are designing the smart disposal system with NFC shown in Fig. 3.

Fig. 3. Volume rate disposal system and the paying procedure

3. Results and Discussion

It is convenient for users at present, with smartphone users approaching 40 million, rather than bus cards or self-cards, which are necessary to dispose of food waste by linking new concept mobile micro SD card and Near Field Communication (NFC) App to RFID-based food meter. It is a technology to connect NFC Application Program Interface (NFC API) technology by using micro SD chip in consumer's mobile so that it can be useful and develop necessary App to provide optimized service to users.

The new concept of mobile micro SD card and NFC API interworking technology will eventually lead to technology tie-ups and purchases from the perspective of competitors by securing their own technology capabilities, having already abundant experience in implementing this technology business, having networking infrastructure in the technology field, and making it easier and useful for consumers to use the NFC can be used in a variety of areas such as access control, home appliances, check-in systems, healthcare, information collection, coupons, payments and transportation[13], i.e., exchange of equipment data, connection of services using smart posters

with RFID tags, electronic payments, and ticketing.

NFC technology, powered from the Android 2.3 GingerBread platform, is a key technology that has led Google to create new business models. Google has implemented its services by establishing existing physical IC cards called Google Payments. These mobile payment systems were previously present in the form of RFID technology, but their utilization was very low. The combination of NFC and smartphone extends security and service utilization in a more advanced form of intermixing existing RFID and communication technologies[14].

3.1. The Effects of Commercialization on the Korean Economy

3.1.1. The impact on the market

First, it has the strength that it is possible to apply technology to existing markets by installing full-scale facilities in places that have not yet been established, as it is a modular upgrade technology, not a new product. Second, it is possible to explore the untapped market through proprietary technology. That is, as of 2014, 16,369 facilities were installed in 62 RFID-type facilities areas. To date, the development of this technology in the apartment pilot site allows the market to be expanded to the existing RFID-based facilities market as well as those that have not yet been installed.

3.1.2. Ripple effect

App technology development and operation management. Second, other markets. The potential for expansion and ripple effect on the product is the possibility of using the module in purchasing items in the home and making small payments. Third, social and environmental impacts. This will contribute to the eco-friendly

industry by drastically reducing the amount of existing food waste through NFC mobile payment facilities. In other words, it can encourage eco-friendly awareness through communities for actual facility utilization customers and prospective customers and encourage them to actively participate in the business.

3.2. Core Technology Required

3.2.1. Financial microSD standards

Financial microSD standards were established as collective standards (2012, 10, 5) by the Financial Informatization Promotion Council operated by the Bank of Korea. First of all, financial microSD refers to a portable memory card that can support financial services by embedding SE that can store financial information in a general microSD with only memory, and the financial microSD standard consists of five parts: basic requirements, SDSE(Finace MicroSD Secure Element) control interface, SDSE control command, financial microSD identification numbering system, and financial microSD issuer identification number management system [15-16].

In the case of financial microSD, the main purpose is to pay for credit cards or transportation cards, so it is mounted on mobile phones that everyone has, thus eliminating any inconvenience of possession. However, it is a problem because some phones are not supported yet. It is said that they will apply in the second half of this year, so if they are supported, the effect will be even greater.

3.2.2. Technology Development Status

The manufacturing and installation of food storage equipment and collaboration work with the installation operation company and NFC technology certification company prepared a stable business operation framework by reducing research costs based on reliability and stability of technology development, expanding synergies of businesses through business partnership, and sharing tasks. To compensate for these limitations, the collaboration work partnership with professional certification companies that are already using advanced technologies has enabled them to reduce R&D costs to prove their reliability and reliability parts. Currently, a company that can reliably implement NFC form in conjunction with Micro SD card memory through App has a research and development experience that can prove related technology and operating ability to realize through realization through the continuous relationship with businesses in the payment process.

Currently, RFID and NFC are widely used in electronics, telecommunications, and industrial sites because of their many conveniences. These RFIDs or NFC's are widely used because of their location-agnostic convenience. However, there are vulnerabilities in RFID or NFC due to ease of use[17-18]. As NFC services have become more common, security vulnerabilities have been continuously raised, but serious security problems have been neglected in Korea, such as illegal use of NFC services, financial information leakage and name theft, and user information fishing during payments. The biggest security problem of all was the threat of personal information leakage in NFC wireless environments[19].

Therefore, future studies will need to identify existing NFC security vulnerabilities and prepare countermeasures.

4. Conclusion

NFC services via Mobile are gaining popularity as they are quickly distributed to

E-wallet, access control, Absenteeism and Absenteeism, location tracking, and public transportation based on Android. The domestic market is being activated with a focus on transportation cards and card payments, with Samsung Pay at the center NFC opened in March when iOS 13 was upgraded on Sept. 20, 2019, as Apple also announced that it would release Apple Card in September along with NFC-enabled Apple Pay.

The proposals for this study, if adequately opened, will increase their effectiveness. In line with this trend, I proposed to apply NFC to the existing RFID-based food meter to release the food in the meantime and to address the problem of re-carrying due to card loss, card smile, and non-filling, and the question that could not be identified by various cumbersome procedures in order to check the status of the food that I have produced in the, Of course, there is a precedent that Apple opened NFC but was unable to use iPhone 6 since its function was not released before, and if international and Korean standards are different, there will be parts that will require replacement of all existing phones. If such a problem occurs, we believe that an alternative is necessary.

Based on this, future research has established a system for payment in NFC by linking with local currency, local love gift certificate, mobile gift certificate, and credit card companies, which are means of payment for emergency disaster support funds temporarily supported by the government to overcome the recent COVID-19.

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