Mobile Phone and Data Capture (AIDC) Technology

1. Historical Background

Introduction of Automatic Identification and Data Capture (AIDC) technology may not be feasible unless ICT evolves to become a standard technology widely used in each country. The AIDC is a technology equipped with a specific ability for connecting information on a data carrier included in the target object that is to be scanned and the information accumulated in a database. More precisely, digitalization of information and development of a database required to centrally collect the information will be fairly difficult without an advanced digital (computer) technology. In that regard, the AIDC technology serves as a link between the database and the information obtained in real space.

Looking back the history of data carriers (linear symbols, two-dimensional symbols, RFID, biometrics and ID cards), they met their first turning point around 1985. To start with, Intel Corporation developed an early type of CPU, which is a backbone of computer system, the CPU “4040” in 1971, and then “8080” (8 bits) in 1978, “80286” (16 bits) in 1982 and “80386” (32 bits) in 1985, respectively. In the history of computer world, a major breakthrough came in 1981 when IBM released its personal computer called “IBM PC”. It is widely recognized that this IBM PC used Microsoft’s MS-DOS for its operating system. Thereafter, a drastic increase in the capacity of information in the database triggered a rapid expansion of AIDC applications.

The second turning point of data carrier was the mid 1990s. In 1992, URL (Uniform Resource Locator), HTML (HyperText Markup Language) and HTTP (HyperText Transfer Protocol) were developed and collectively termed as “WWW (World Wide Web). Following that, in 1995, Microsoft developed the “Internet Explore” web browser and opened it together with Windows95 to the public free of charge. This was a beginning of another era, marking a new way of data carrier applications attributed to a wide spread use of Internet communications networks.

Then, the third turning point came in the mid 2000s when new applications ideally suitable for mobile phones were developed. Integration of QR Code and its reader/writer in a mobile phone began in 2003, which was followed by the implementation of IC card in 2005 and then a TV feature (multi-media), or so-called One-Segment broadcasting in Japan, in 2006. By using a mobile phone as a personal tool, a new kind of business strategy from “Business to Customer” that was impossible before is now achieved that may have largely contributed to a cultivation of new AIDC markets.

It can be said, as described above, that the use of AIDC technology depends basically on to what extent information and computer technologies are acknowledged or accepted in the society. Now that the AIDC has become a commonly used technology worldwide, it is seen anywhere in the world especially in the advanced countries like Japan, U.S.A. and EC countries. Further expansion of AIDC to developing nations is also quite predictable, particularly in China and India where informatization has been advancing at a high speed. It is quite likely that the size of China and India markets will exceed that of U.S.A. and Europe in the near future.

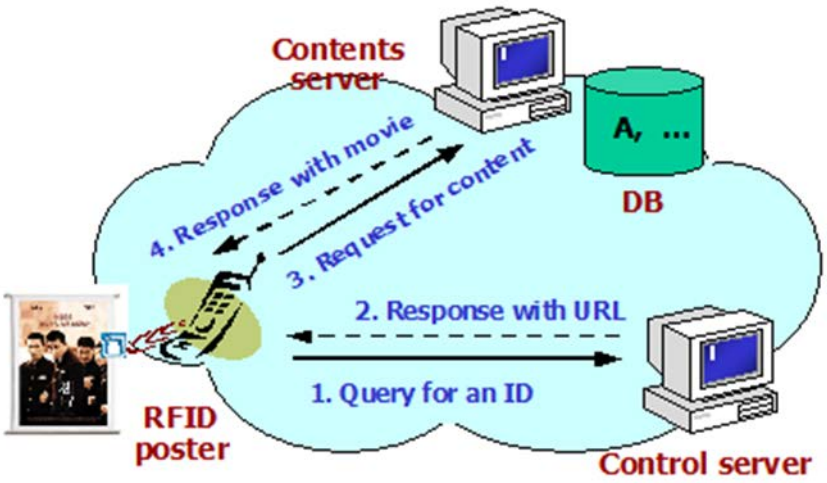
2. Mobile Phone and AIDC Technology

In recent years, you may come across the term “Ubiquitous Network Society” on many occasions, for example, in newspapers and magazines. The most important component of this ubiquitous network society is probably a state-of-the-art technology for network, information security and multimedia. One of the physical devices in which all these three technologies are integrated in a single unit, is a mobile phone, and two types of AIDC technologies, i.e., a data carrier and a reader/writer that supports a data carrier, can be established in a mobile phone. Those classified into data carriers include linear symbols, two-dimensional symbols, RFID and contactless IC cards. Among them, implementation of linear and two-dimensional symbols and contactless IC cards is already materialized in some mobile devices. Considering the fact that a mobile phone provided with onboard readers/writers for linear and two-dimensional symbols is already released to the market, I believe integration of RFID will be a matter of time. With the continuing improvement of mobile technologies, as with the case of personal computers, a biometric feature will soon become an essential tool for mobile devices to reject improper access and protect against unauthorized use.

One of the major benefits for integrating AIDC technology into a mobile phone resides in its real-time based communication ability, in other words, you will be provided with a function to communicate with others anywhere, anytime. This sort of timeliness is indispensable for the construction of true ubiquitous society. Among other AIDC technologies, RFID has been especially attracting considerable attention because of its real-time capability. When combined with RFID and sensors, a mobile phone will work as a system in support of real space network.

To implement AIDC functions in a mobile phone, some forms of well-defined applications shall be presented. Figure 1 shows a mobile RFID service model proposed by Korea to ISO/IEC JTC1 SC31 that is responsible for the international standardization of AIDC technologies.

Figure 1: Mobile RFID Service Model

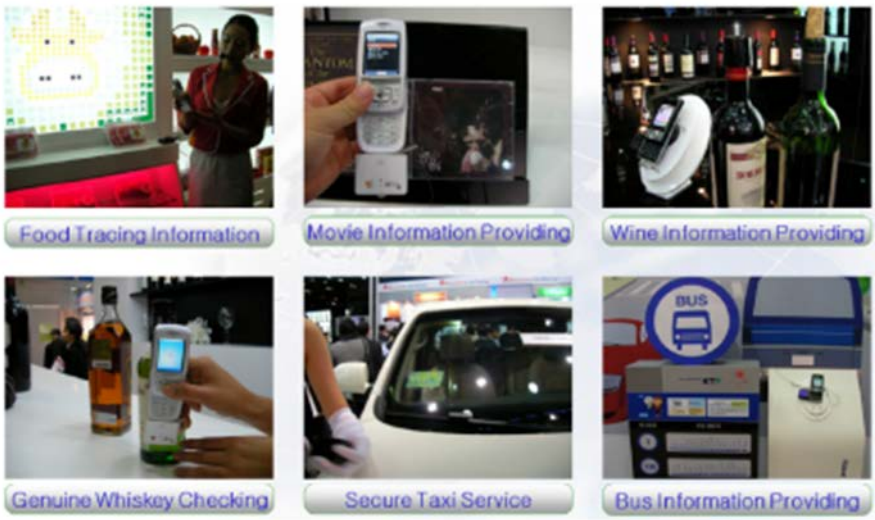


The same model is also applicable to auto ID center and ubiquitous ID center. In most of today’s mobile service applications, data is normally transmitted directly to the contents server by bypassing the control server. In this structure, for example, a company first encodes its URL in a QR Code and then applies it on its products to provide users with a useful means so that they can easily access company’s

website by just reading the QR-coded URL with their mobile phone. Users may view detailed information on the company's products and important precautions on safety and security via company's website. As the next stage, a kind of structure as shown in Figure 1 may be required for sensitive information that needs high level of security in the future.

Figure 2 illustrates the actual examples of RFID-based applications. Applications using QR Code have also been introduced in many industries in Japan. As mentioned before, an URL serves as a path to access information including important notices and precautions on the safety and security of foods. In other scenarios, URLs are used as a linkage to information stored in the data carriers uploaded to a poster or bulletin board you may encounter in many public facilities like train stations. By reading such data carriers or data required to access the related database with a mobile phone, users are able to get information on the facility or a guide map nearby whenever demanded. In another use case, a data carrier applied on a wine or whiskey product allows the user to know the information on the product including its identification, i.e., it is fake or genuine. If you are a taxi driver, a data carrier such as an IC card and RFID uploaded to a mobile phone provides you with required information on the fare and destination. Reading it with a taxi-onboard terminal allows you to know the way to the target destination in combination with a car navigation system. Other potential use includes a control of traffic information on public transportation modes, which tells an expected arrival time of a traveling bus or train.

Figure 2: Mobile RFID Applications

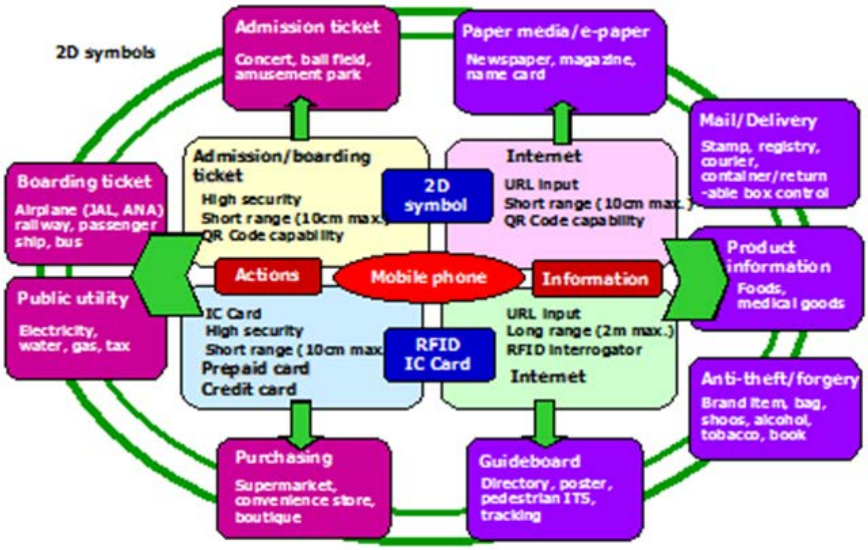


Though you may access a large quantity of information via your PC, a critical element in establishing a real ubiquitous society should be to make information available anywhere and anytime, and a mobile phone is considered to be an ideal solution.

Typical applications of mobile phone are summarized in Figure 3. In this figure, the upper half shows linear and two-dimensional symbols, while the lower half is RFID and IC cards. The right side of the figure is a mobile phone featuring a reader/writer and the left half is the one intended for data carriers. Most of the applications presented here are already available on the market. Whilst the development of an efficient technology to prevent forgery and theft is a future challenge of reader/writer units, some creative mechanism is also demanded for data carriers. Using a mobile phone for the payment of

public utility charges (use of linear symbols has already begun) and tax charges is quite feasible as a new application, as well as for a collection of annual pension that has become a big issue in Japan. Due to its characteristics, the system should ideally have a third party facility such as a convenience store and bank via which payment is done, between a charger and a payer. With this structure, creation of an advanced system free from tampering and unauthorized access becomes much easier. Meanwhile, in passenger transport business segments, introduction of boarding tickets is making a rapid progress by major players including JAL, ANA and JR. The same technology may also be practical in other industries as well.

Figure 3: Mobile Phone Applications



As the number of applications for mobile phone goes up, further consideration is obviously needed to ensure privacy and security. In case you lost your mobile phone, for instance, providing a sufficient recovery system service (to stop operation, etc.) to cover and compensate the loss should be provided in advance. In addition, to prevent unauthorized use, more accurate and precise identification method higher than the one employed in current PCs is critical for the approval of the right owner. All these factors indicate an integration of biometrics authentication with a mobile phone will soon come to realization before long.

With this background, RFID is expected as a real space network technology for the creation of safety ubiquitous society. In such real space network, “humans”, “animals and plants” and “physical objects” will be relatively connected each other. Aside from a technology of RFID network itself, the most important component of this network is how to configure or arrange the code symbols that are to be identified. Considering the fact that quite a number of different symbologies are already used in various industries, developing a new symbol not compatible with the existing symbols is probably out of question. Moreover, having a symbol standard applicable only to Japan is not sensible or almost useless in today’s globalized world. For example, applying a code that is valid only within Japan on a food product has no point unless it has high consistency with the country from which the food is imported, especially for a

county like Japan that relies on more than 60 percent of foods from abroad.

A biggest issue for us to overcome to make a ubiquitous society to reality will be how to integrate a real space network that uses RFID and a virtual space featuring a mobile phone, and a symbolog is likely to play a key role.

Further expansion of AIDC industry is expected with the advent of ICT technology if the challenged problems that must be solved are effectively settled. These challenges include privacy, security and symbology. As is the case of mobile phone market, further development of a new technology to combine a linear symbol, two-dimensional symbol, RFID, IC card and biometrics may largely help in creating a new big market.