ATM-BankIT™

Yuji Izawa Kazuhiro Kondou
Mamoru Kanbayashi

Since the implementation of automated teller machines (hereinafter referred to as "ATMs") by financial institutions, such as banks, their installation at various locations, including post offices, consumer credit and financing institutions, credit card companies, brokerage firms as well as convenience stores, has been steadily expanding. The range of services offered has also increased and today ATMs have secured a place in society overall, having become part of the essential social infrastructure of our daily lives.

Oki Electric developed a large scale ATM in 1977, the first of its kind in Japan. In 1982 the company developed a bank note recycling-type ATM, the first of its kind in the world. Henceforth the company has consistently fulfilled the role of a technologically leading manufacturer by actively substantiating the basic functions of ATMs, such as increasing its capacity to contain a larger number of bank notes and receipts, increasing the speed of transaction processes, as well as increasing the reliance of the system. New services, such as transactions involving IC cards, multiple payment transactions or lottery ticket sales, as well as a bank note recycling feature, self-confirmation feature for checking the remaining balance in cassettes, cash group management system and cassette interchange feature with cash processors, are examples realized through technological innovation and have been provided to the industry ahead of the competition.

The need for ATMs has been changing with the benefits of implementing these systems for users and financial institutions, market environments and time. Oki Electric developed the "ATM-BankIT™" (**Photo 1**), an ATM with a raised level of security for preventing crime, higher reliability for reducing operating costs, operability to ensure that elderly and handicapped persons are able to operate the system in comfort and with ease, as well as expandability to accommodate mobile phones and non-contact IC cards with a full understanding of the recently changing environment that surrounds ATMs. Because more than 160,000 ATM units are operating in Japan they impact the environment in a significant manner, therefore, this product was developed with a consideration for the protection of the global environment with efforts made to miniaturize components and reduce the number of parts used, as well as through the elimination of harmful substances from the parts and materials that comprise the system, raising the level of recycling and reuse, while reducing materials.

Photo 1 Overall view of ATM-BankIT

The development concepts of ATM-BankIT are described below.

Raised security levels

Incidents relating to ATMs, such as crime involving individuals impersonating authorized users by using counterfeit cards, stolen cards used to illegally withdraw cash funds or fund transfer fraud, have become social problems in recent years. Along with improvements to the conventional functions and performance of AMTs, significant enhancements to the security functions in particular have been implemented with ATM-BankIT.

TIPS The name of ATM-BankIT™

The following two meanings are incorporated in the name of ATM-BankIT:

① The "ATM-BankIT™" provides strong support for the banking business of the future through an advanced information technology ("IT") and mechatronics technologies.

② The system, a smart device ("Kit") to fill the role of a capable "Banker" who handles banking business, will become much more sophisticated and further diversified in the future.

(1) Support to prevent crime, such as counterfeit card use

① Support of IC cash cards

IC cash cards are far more tamper resistant than conventional magnetic strip-type cash cards, making it more difficult for counterfeit cards to be created through the skimming of data or the loading of unauthorized data. Support for IC cash cards is a standard feature with ATM-BankIT, thereby promoting the popularization of IC cash cards.

② Visible angle-limiting filter

A special visible angle-limiting filter is incorporated as a standard feature to limit the field of view of the customer operation screen to prevent someone peeking from behind or from either side to obtain the entry details (particularly personal identification numbers).

③ Rear view mirror

A wide angle mirror, which provides a 90-degree view, is incorporated into the front section of the ATM facing the user to eliminate any apprehension of the user by allowing them to verify if any suspicious individuals are standing behind to sneak a peek at their personal identification numbers. This feature is also expected to deter criminals.

④ Customer image capturing camera

A camera is mounted inside the front section of the ATM to capture the facial image of a customer while they are operating the ATM. The aim of this feature is to identify persons involved in transactions for which stolen or counterfeit cards are used or when fund transfer fraud has been verified from an image (primarily facial image) captured by the camera. Furthermore, the design of the camera is such that the customer is not aware of the fact that their image is being captured by the camera.

Security enhancements have also been implemented to the conventional security method of using a personal identification number, with software, such as “Personal Identification Number Scrambling”, “Personal Identification Number Change” and “Guidance to Invoke Caution on the Screen”, to prevent sneak peeks of personal identification numbers or fund transfer fraud.

(2) Enhancement of personal identification feature

① Biometrics authentication

Instead of personal identification number entries the use of biometrics technologies, which have a higher level of security for identifying specific individuals, has been made available with ATM-BankIT.

These methods of biometrics authentication include “fingerprint authentication”, “palm vein authentication”, “finger vein authentication” and “iris authentication”. Authentication devices for these methods are selectable and mountable to accommodate a user's needs and to support user systems. These biometrics authentication methods have a high level of personal identification, with an erroneous recognition rate of 0.01% or less. A significantly higher level of security, in comparison with the conventional personal identification number method, which identifies individuals based on the entry of a four-digit number, can be secured to effectively prevent crime involving the use of stolen cards or counterfeit cards.

Operating costs reduced

The purpose for implementing ATMs is to reduce the labor of bank tellers. During initial implementation some people considered “ATMs are machines, therefore, suspension of their operation due to malfunction is unavoidable”. This perception has been changed to "the suspension of ATM operations presents problems" as the operating mode of these systems recently extended to be made available around the clock every day of the year. The suspension of ATM operations not only deteriorates the level of service offered to users but also significantly impacts operating costs. For this reason, in addition to a reduction in the frequency for work to replenish or replace consumables and media, such as receipts, improvement of the system's reliability has been achieved through the inhibition of equipment operation suspension and improvements to implementations following the suspension of operations, to realize a reduction in operating costs with ATM-BankIT.

(1) Frequency of media replenishment and replacement work reduced

Long periods of unmanned operations, approximately double that of conventional systems, have been made possible with ATM-BankIT, increasing the capacity by approximately 45% for bank notes and 50% for receipts, thereby reducing the frequency of suspending equipment operations due to a shortage of media. Furthermore, the life of consumables, such as printer ribbons for passbook entries, has been extended.

(2) Equipment reliability improved

① Bank note dispenser

Cash transactions (deposits, fund transfers and withdrawals) account for approximately 80% of the reasons for using an ATM. The impact of reliability for the bank note dispenser, therefore, has an impact on the reliability of the overall ATM, making this function extremely significant.

ATM bank note dispensers must be equipped with sophisticated bank note processing technologies as it is essential for them to process in a short time the maximum number of bank notes in a variety of conditions, from brand new bank notes to soiled or heavily creased bank notes that have been circulated over long periods of time.

During the development of the bank note dispenser for ATM-BankIT, the causes for suspended operations (hereinafter referred to as “errors”) and malfunctions occurring with existing equipment were analyzed and a technology was developed to improve and modify this.

a. Stabilizing bank note feeds

The majority of errors were either bank note jamming errors or feeding errors arising from skewed feeding, overlapped feeding and stringed feeding at “the bank note separator section”, which resulted from bank note separation failure (failing to roll out bank notes in the proper manner). The “bank note separator section”, a precision mechatronics mechanical section that is the key to various bank note processing operations, is comprised

of bank note cassettes for storing the bank notes deposited by customers and bank notes refilled by bank personnel, as well as denominational bank note stackers, etc.

Since it is necessary for the "bank note separator section" to have stable repeating operations to reduce bank note feeding errors, dramatic improvements were made to the "bank note separator section" mechanism, with the aim of making it possible to roll out bank notes straight and one at a time with fixed intervals.

Furthermore, bank note feeding errors were also reduced through the incorporation of a feature for safely feeding bank notes at low speeds and an automatic jam removal feature that allows transactions to continue even if bank notes jam in the bank note feeder routing, simply by automatically removing the jammed bank notes.

b. Return function of erroneously entered foreign objects enhanced

More than half of all malfunction incidents occur due to foreign objects, such as coins, which have become mixed in with bank notes and deposited into the "customer interface section", which is the section for receiving and dispensing bank notes to customers.

The vast majority of foreign objects erroneously deposited into the bank note depositing slot of the "customer interface section" include coins, along with center folded bank notes, four folded bank notes, damaged bank notes and media other than bank notes, such as receipts. After thoroughly researching and experimenting with means to eliminate such objects through mechanisms and controls, dramatic improvements were made to the mechanism of the "customer interface section" and as a result the foreign objects returning feature, which is able to return foreign objects (erroneously deposited foreign media) to customers without suspending equipment operations or resulting in an equipment malfunction, was enhanced.

② Card reader and receipt printer

The aligning mechanism of the receipt printer was reviewed for the purpose of preventing receipt jams arising from the curling inclination of rolled paper used to print summary sheets and detailed audit sheets, which are stored in the collection section during the course of ATM operations.

Features to prevent the overlapping of two inserted bank cards and to prompt cleaning, by monitoring the trends of card feeding abnormalities due to soiling through the accumulation analysis of the card feeding status, were incorporated in the card reader. Cleaning was made possible for sensors and rollers using a cleaning card, resulting in an improvement that simplifies procedures needing attention by attending personnel.

③ Passbook printer

The thickness of booklet-shaped passbooks depends on where they are opened. This varying thickness must be dealt with by the equipment, which demands a particularly stable feeding of the passbook, because the equipment must read data stored within the magnetic strip in the passbook. Stabilization of passbook feeding was sought through mechanical improvements to the passbook feeding segments of the ATM-BankIT. Furthermore, the equipment is designed to support highly magnetic resistant passbooks, created to inhibit ordinary magnetic forces in order to prevent the corruption of data stored in the magnetic strip on the passbook, which may be caused through close contact with buckles on handbags or the speaker section (magnet) within mobile phones.

④ Coin dispenser

A large number of operation suspensions also arise from the deposit of foreign objects in coin dispensers, such as paper clips mixed in withcoins. The foreign object removal mechanism and control was improved as a countermeasure. In order to ensure that feeding errors do not occur, even when objects with a small diameter, such as foreign coins, are mistakenly deposited, unevenness of the feeding route surfaces was reduced. Coin dispensers that use a sequential depositing method to inhibit the deposit of foreign objects, which help to make customers aware of the need to deposit only coins, are also available.

⑤ Hard disks

The malfunction of a hard disk requires a long recovery process since the re-installation of programs and reconfigurations become necessary. In order to resolve the suspension of operations over a long period of time, hard disk redundancy (system redundancy) was introduced in ATM-BankIT.

With this system operations can continue even if the hard disk malfunctions, since switchover to the second hard disk, containing a completely identical set of systems or various data, takes place automatically. It is possible to accommodate the ATM operating status at an installed branch office (waiting for quiet hours, for example) when replacing malfunctioned hard disks. The system recovery takes place automatically simply by replacing the hard disk.

This feature makes it possible to perform replacement and recovery procedures with a minimal impact on the operations of the ATM, even if a hard disk malfunction occurs.

⑥ Recovery procedure features improved

The improvements described below were implemented with ATM-BankIT to minimize operation suspension times even when errors occur.

First of all, the attendant operating section was improved by equipping it with a15-inch color display so that the equipment status can be visually verified on a large screen. Furthermore, "operation navigation" that uses static and dynamic images on the screen, assures the proper processing of media removal or recovery procedures without any confusion, even if an attendant is not familiar with the system (**Fig. 1**).

The structure of the operation section was designed in such a way so that it opens wide in consideration for media removal work, to make the carrying out of such procedures easy. Furthermore, since individual mechanical components are modularized, their replacement is simple in the event of failure, thereby helping to shorten the time for recovery performed by maintenance personnel.

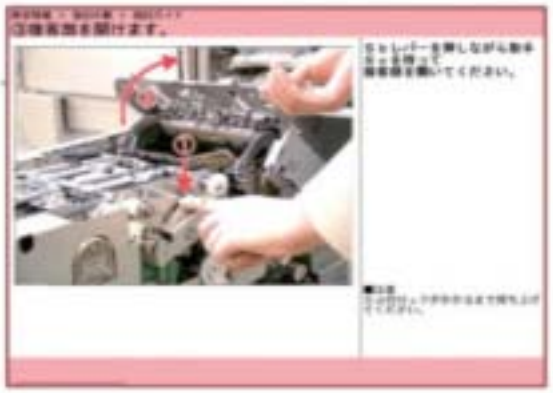

Fig. 1 Example of operation navigation

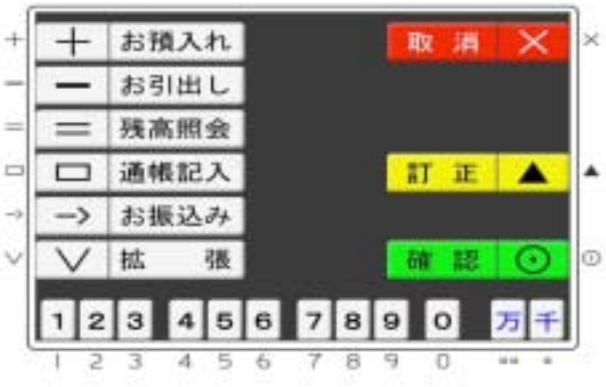

Fig. 3 Example of tactile symbols screen

Furthermore, the equipment is loaded with a mechanism to rapidly recover the equipment and this is made possible by a substantial linking with remote maintenance that allows for the proper allocation of recovery support to the attending personnel, as well asseparation for failure, while making available the necessary parts in an accurate manner.

⑦ Self-diagnosis function enhanced

The self-diagnosis function that utilizes life and consumption data, control statistics data, as well as control log data, was enhanced in ATM-BankIT by detecting tendencies that lead to the suspension of operations in advance and implementing preventative action before incidents occur, preventing errors that cause the suspension of operations.

Many such steps to improve reliability have been implemented with the ATM-BankIT and we are proud to say that this is an ATM users and customers can use with peace of mind.

Comfortable operability

Optical operation guidance and media guidance were realized with the ATM-BankIT (**Fig. 2**).

Dispensing slots and guidance instructions for passbooks, bank cards, bank notes and coins, which need to be handled during ATM transactions, are lit at the respective times for each of these individual items to provide operation guidance. Lighting at media slots turn on and off slowly and gradually to provide gentle optical guidance.

Such features offer a secure feeling that prevents confusion when customers operate the equipment, helping to prevent erroneous operations by customers. ATMs are often labeled as “equipment that elderly people find difficult to deal with” and as systems evolve to provide multiple functions, operations also become more complex. As a result a considerable number of elderly people shy away from ATMs, preferring to use tellers instead.

In order to make ATM-BankIT a user friendly ATM for all who use it, such as elderly and handicapped customers, as well as attending personnel and maintenance personnel, research findings from various undertakings were reflected in the product, aside from the implementation of tactile symbols for visually impaired persons (**Fig. 3**) and voice guidance provided through the use of a handset, to create a universal design based on a diverse range of usability tests. The usability tests revealed that raising the recognition levels on the display screen was not necessarily enough for elderly persons. A “simplified operation mode”, developed based on the following general rules, was incorporated into the equipment (**Fig. 4**):

- One operation per screen display.
- Clear statements with fewer words.
- Operation support with voice guidance.
- Slow switching of screens.

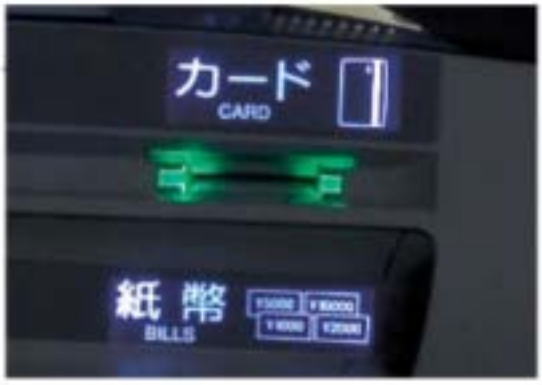

Fig. 2 Example of optical guidance

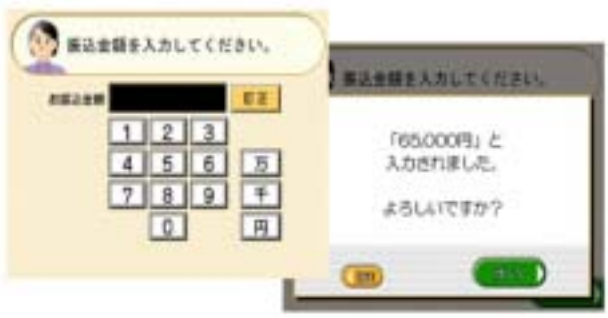

Fig. 4 Example of simplified operation mode screen display

Furthermore, the following features were adopted to cater to persons in wheelchairs:

- Curving body contour for an easier approach.
- Inclined angle for easier viewing.
- Media slots with a simpler form located in low positions.
- Dispensing slots with a mirror for verifying the existence of any bank notes or coins.

Since the improvement of operability is a universally fundamental need for ATMs, for the purpose of providing services without confusion to many customers, including elderly and handicapped persons, we shall consider this issue as a continuing theme and engage in relevant research in the future.

Expandability of services

ATMs are equipment in operation over a long period of time in a rapidly changing market environment, therefore, it is essential for ATMs to provide the latest services and business operations even three or five years after implementation, without becoming obsolete.

We looked to the future trends of technologies and services to enable the ATM-BankIT mechanisms to easily accommodate anticipated functional expansion of hardware and software in the future.

Areas for mounting functional expansion units are available in advance around the customer operation section, making it possible to add the following types of modules with very minor hardware modifications, in order to easily implement hardware expansion.

- Biometrics authentication sensors.
- Non-contact IC reader (**Fig. 5**).
- Secured PIN pad.
- Handset for voice guidance.

Fig. 5 Fund transfer transaction using non-contact IC reader

An architecture, “TxFlowTM”, firmly proposed by Oki Electric for a retail financial system, has been adopted to provide a software structure that easily realizes financial solutions, which are linked with peripheral systems. For this reason new services are achieved, such as fee businesses involving the running of advertisements or the display of sales messages suitable for particular customers (**Fig. 6**) by linking up with peripheral systems, such as customer relationship management (CRM) servers or sales office systems.

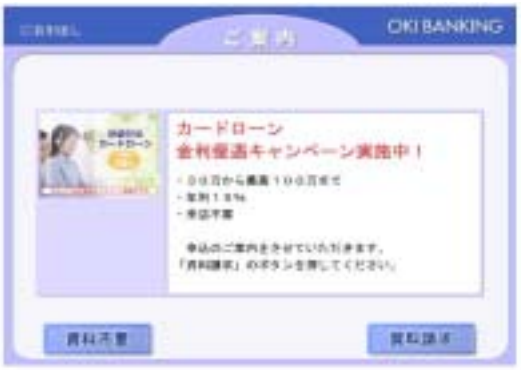

Fig. 6 Example of CRM-linked screen display

TIPS Basic Terminology Descriptions

Multiple payment transaction

A mechanism to make payments for various charges through ATMs and the Internet by linking up financial institutions with receivable businesses, such as local governments and utilities, in a network. Services such as these are already available under the name of “Pay-easy”.

Skimming

Criminal activities involving the unauthorized scanning of magnetically recorded information on credit cards and cash cards belonging to other parties, creating copies and the use such copies.

Tamper resistant

The degree of difficulty involved in analyzing the internal structure of software and hardware as well as stored data. The reading of data from external locations is made difficult through the adoption of encryption with IC cards, which are also incorporated with a mechanism for destroying data in the event unauthorized physical access is attempted.

CRM (Customer Relationship Management) server

A server for the consistent management of detailed customer information for the purpose of increasing convenience for customers and the degree of their satisfaction by offering meticulous responses to their needs.

Environmental considerations

Six harmful substances (lead, mercury, cadmium, hexavalent chromium, PBB and PBDE) were eliminated from the parts and materials that comprise the ATM-BankIT equipment. Furthermore, we succeeded in increasing the recycling, reuse and reduction rates, making ATM-BankIT an environmentally friendly piece of equipment, which are issues on a global scale.

As mentioned above, ATM-BankIT is the first of its kind to capture the needs of the market and it is a product born out of our challenging efforts for new technologies, based on numerous technological assets accumulated through many years of ATM development. We intend to continue with our efforts in technological innovation, aiming to evolve ATMs even further so that ATMs become closer to becoming the “face of banks” or the “bank itself”.

Authors

Yuji Izawa: System Hardware Company, System Hardware Div., System Design Dept.-2.

Kazuhiro Kondou: System Hardware Company, System Hardware Div., Product SE Dept.

Mamoru Kanbayashi: System Hardware Company, System Hardware Div., Mechanics Platform Development Dept.