New MARS Terminal Set Utilizing Personal Computer

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To enhance the marketing capacity of MARS (Magnetic electric Automatic Reservation System), the train seat reservation system in JNR, we have developed a simple and economical seat reservation terminal set, for small stations or travel agencies, applying a personal computer technology which has made remarkable progress in recent years. It has a CRT guidance adopting general keyboard, a software logic adopting multi-task ability, a printing mechanism for accurately printing ticket characters and a security facility. Ticket printing tests have proved excellent in the workability, the issuing ability and the printing quality of the terminal set with good prospect of its practical application.

1. Introduction

MARS has a history of about twenty years, at booking counters so-called "Midori no Madoguti" (Green counter) i.e. ticket counter for seat reservation of stations or travel centers in JNR and travel agencies. About 1800 seat reservation terminal sets are installed and tied to MARS host computer. They handle as many as 0.7 million seats every day. They are required to possess excellent manipulation and fast response characteristics. They have paged matrix plates indicating names of trains, names of boarding and destination stations, function keys inputting classification of operation, category of ticket and other necessary items, digital keys inputting boarding date, train number, etc. and keys inputting dispatch or release.

Although these mechanisms have excellent workability, exclusiveness of hardware and software configuration has prevented economization of terminal set. To promote ticket sales in severe management environment, simple and economical terminal sets which can be installed at small stations and travel agencies have to be developed. Therefore we set eyes on personal computer and developed an economical terminal set.

In chapter 2, an outline of MARS is shown. In chapter 3, necessity for and policy of development of a new terminal set are discussed. In chapter 4, the author shows development items such as guide screen of excellent manipulation, selling software logic with fast response time, precise ticket paper control system, security system and configuration of new terminal set with application of these items. In chapter 5, he summarizes and assesses the original target and lastly in chapter 6, he draws concluding Remarks.

2. Outline of MARS System

2.1 Central system of MARS[1]

MARS was introduced in 1960 to replace the manual

reservation system, but it was a trial product for the purpose of ascertaining the possibility of automating all seat reservations. A full-fledged introduction of the system on a nationwide basis, was initiated with MARS-101 in 1964. Since then MARS-102, 103, 104 were successively introduced that can accommodate increased numbers of seats and system functions. All of them have been enlarged and converted one by one to MARS-105 in 1973. On the other hand, MARS-201 which allows booking, 5 months in advance, for group tours and sells passenger tickets and MARS-202 which has an expanded function have been introduced respectively in 1969 and 1975. Moreover MARS-150 which has a push-button telephone booking system was introduced in 1975. All of these new systems worked satisfactorily, but lack of universality of software and shortage in the capacity of the main memory storage posed a problem. Thus MARS-301 (Fig. 1) which unifies MARS-105 which is a comprehensive reservation system, MARS-150 which is a telephone system and MARS-202 which is a group reservation system has been developed in 1984. At present this system is working in good condition.

Fig. 1 Main processor of MARS-301

2.2 Terminal system of MARS

Various type terminal sets have been developed for reasons of business diversification and technological progress in MARS. In MARS-1, Z-type which inputs vending information by push-button, displays answer data by lamps and prints out a receipt by typewriter was developed. In MARS-101, Y-type which inputs names of trains and stations by printing club (one club corresponds to station and train) and other vending information by button or digital key was developed. Latter, it has been taken over by X-, W-, V-type added with functions for automatic change of train or discount, etc. In MARS-105, N-type which inputs names of trains or stations by paged-matrix plates was developed. Moreover, K-type and HN-type utilizing a

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digital switch and paged-matrix plates inputting names of trains and stations were developed.

On the other hand, in MARS-201, G-type which performs quick reservation and offers diverse services by utilizing paged-matrix plates was developed. In MARS-202, T-type which treats not only reserved seat tickets but also group tour cupons was developed to mitigate the burden on the operator which has been increased with diversification of services and to economize equipment use of with general keyboard supported by CRT guidance for universality and expandability.

In MARS-301, M-type which issues various kinds of tickets on one terminal set having paged matrix plates and is supported by CRT guidance was developed.

3. Necessity for and Policy of Development

3.1 Necessity for development

K-, N-, HN-types which sell fare or reserved seat tickets mainly, and T-type which sells not only reserved seat tickets but also group tickets. M-type which sells all sorts of tickets including season ticket, etc. are installed at booking counters of about 800 stations or travel centers or travel agencies. To increase passenger revenue and competitiveness of JNR against air lines, installation of an economical terminal set which sells readily and in large volume MARS fare tickets or reserved seat tickets is now demanded from small stations or travel agencies which have no "green counter". At present the terminal sets at booking counters are K-, N-, HN-, T-, M-types. All of them, except T-type, adopt exclusive keyboard for MARS, since operational function has to be simplified. Existing terminal sets have the following features and their introduction at small stations or travel agencies is difficult.

(1) K-, N-, T-types are difficult to economize, since they are exclusive terminal sets for MARS.

(2) K-, N-, T-types are superannuated, because ten years have passed after development.

(3) K-, N-types are wired logic, therefore they lack in expandability and flexibility.

(4) T-type can not adopt Chinese characters and it lacks in intelligency such as pre-set or one-touch function for CRT of old generation.

As a way of solution, we intend to adopt personal computer, but the terminal set at booking counter for seat reservation requires special elements, such as exellent manipulation fast response characteristics, reliable issuing ability and reasonable security system, and a technological solution which is able to realize them has been in demand.

3.2 Basic policy of development

(1) In this development work, we newly develop a printer issuing various tickets, but we use commercial product for front keyboard to input vending information.

(2) Terminal sets connect to TCP (Terminal Control Processor) and link to MARS-301 via DACS (Data Switching Network in JNR) subnetwork. Transmission control procedure adopts simple terminal protocol (this protocol is based on OSI of ISO for data terminal in JNR).

(3) Commodities offered include fare ticket and reserved seat ticket, etc. and operational functions are selling,

inquiring, summing-up, cancelling, etc. For both purposes a new terminal set similar to the N-type is to be employed.

4. Development Items and Configuration of New Terminal Set

4.1 Development items

4.1.1 Guide screen

(1) Basic arrangement of guide screen is in the order of boarding date, name of train, boarding station, destination, number of tickets, category of ticket, position of seat and additional information. A blank on guide screen is one-touch function area and we display name of trains and stations as numerals.

(2) In guide screen which is likely to handle large numbers of fare tickets, reserved seat tickets, selling or inquiring is done by a function key. Other guide screens for summing-up or cancelling, etc. are assigned guide screen number.

(3) Boarding date, boarding station, number of adult or child passengers, etc. can be preset in the input area and names of trains and stations registered in the blank area of guide screen can be set by separate utility program.

(4) Indispensable input items and operational input items are distinguished by adopting a variety of glitters. Additional information is prepared for every kind of guide screen. Fare and reserved seat ticket can be simultaneously handled. Changing station and changing train can be handled on the same guide screen.

4.1.2 Selling software logic

(1) We have developed a selling software logic of fare ticket, etc. for specified MARS with use of general OS on line real-time multi-task.

(2) Task composition comprise line-, printer-, KB/CRT controls which are physical control logics; communication-, KB/CRT-, and buffer managements which are logic controls of general task; initial-, CRT-, transmission and receiving-, editing-, system processes and utility program package which are user tasks. Initial process initiates every task, CRT process inputs data from keyboard and outputs data to CRT. Transmitting and receiving process composes requested information or decomposes answer information. Editing process outputs ticket information to journal or ticket printer. System process displays issuing system conditional information. Utility program presets data and makes entry or change of train and station data.

(3) Simultaneous parallel process is done using buffer control. To describe conceptually, CRT process task receives system buffer including answer data and receives requested data after displaying "yes" or "no" on CRT. In case of ticket issuing, after transmission control task receives transmission character, it gives system buffer to editing task and continues to receive next answer data.

4.1.3 Ticket issuing and printing mechanism

(1) We have developed a ticket issuing mechanism with bottom feed of paper, and a changeable pin platten mechanism to change the paper width utilizing a commercially available printing head of dots.

(2) Character fonts include 128 characters in N-type terminal set. Numerals, Katakana letters, and symbols were composed of 12 lateral dots and 24 vertical dots. Chinese characters were composed of 24 lateral and 24 vertical dots.

Numerals, etc. were gothic type and Chinese characters were "Mincho" type (Table 1).

4.1.4 Security system

(1) We have locked power supply and covered platten knob or ticket storage of the ticket printer. Under power supply-off, the mechanism developed does not permit the ticket to be easily taken out.

(2) To prevent change of terminal number or password, we have developed a program system which is centrally managed. To encode the data linking the main body to the ticket, we have developed an algorism and loaded it to the ticket printer.

4.2 Configuration of new terminal set and its basic roles

4.2.1 Configuration of terminal set

(1) The terminal set consists of several devices such as the main body, character display (CRT), general keyboard (KB), ticket printer (TPR), journal printer (JP) and modem (MOD). The main body consists of CPU, main memory, communication controller and other peripheral controller. CPU employs a micro processor of 16 bits and clock frequency of 8 MHz and a main memory of 712 k byte. Communication controller adopts modem interface (the transmission rate is 1,200 bit/s). Printer controller adopts Centronics interface.

(2) Key arrangement of general keyboard conforms to JIS (Japanese Industrial Standard) and it has data keys, digital keys, function keys and other OA function keys.

(3) CRT is a 14 inch colour display. Characters to be displayed on the CRT are mainly Chinese characters and Katakana letters of legible gothic type.

(4) Ticket printer is a dot impact printer. N-type character font is memorized into ROM in the ticket printer. Number of letters or characters printable in a line is 37. Printing method (half-size) is two-directional printing of 60 characters per second.

(5) Journal printer is a dot impact printer of highly legible

Chinese characters, etc. Number of letters or characters printable in a line is 40 for full-size character and printing method is similar to TPR.

4.2.2 Basic roles of device

(1) The main body serves to input requested information, to send vending information, to receive answer information, to output ticket issuing information and performs all other functions.

(2) KB is employed for inputting vending information. In case of vending fare ticket, when the operator pushes Function Key 2, fare ticket guide screen is displayed, then the operater inputs requested information and lastly he pushes Function key 10 and Function key 11 respectively for "selling" and "dispatch".

(3) CRT display is divided into the following parts, such as "data input", "response contents indication", "one-touch area of trains and stations".

(4) Ticket printer issues N-type tickets. In case of fare ticket printing, it receives character data which are compiled by main body and printed on the surface of ticket.

(5) The journal printer is used for recording the response concerning vending such as records of summarizing and issuing.

5. Development Results and Their Evaluation

5.1 Development results

5.1.1 Input method

(1) We developed 14 guide screens. Minimization of the items of guide screen has improved legibility of Chinese characters or Katakana letters.

(2) Vending information input is done following the guidance. For the purpose of making the operations easy and reliable, names of trains and stations of high frequency of occurrence are registered pereliminarily in the blank area of guide screen, thereby enabling one-touch input operation.

(3) Boarding date or train number is input including digits,

Table 1 Specification of TPR

Specification \ Item	Contents		Features
Printing method	Dot matrix impact method		
Printing control	Two-direction		
Printing speed	Full-size	40 characters/second	Option
	Half-size	60 characters/second	
Kinds of characters Numerals Alphabet Katakana letters Symbols Chinese characters	Full-size Half-size	JIS 1 standard + non Chinese JIS 2 standard Chinese Numeral: 10, Alphabet: 9, Katakana: 45 Symbol: 18, Chinese: 37, Space	} Option
Configuration of characters Numerals Alphabet Katakana letters Symbols Chinese characters	Full-size Half-size	Lateral 24 dots, Vertical 24 dots Numeral, Alphabet, Katakana, Symbol: Lateral 12 dots, Vertical 24 dots Chinese: Lateral 16 dots, Vertical 24 dots	Option Gothic Mincho
Character, Column pitch	1/10 inch, 1/3 inch		
Paper feed	Bottom feed		
Width adjustment	Pin platten		

but one space should be taken before or after the digit entry.

(4) Boarding date or a desired number of seats which exceeds the permissible number in MARS is checked numerically, erroneous input is checked about name of trains or stations, double input of identical item is checked about additional information. In case of misinput, we display "input mis" in the input area of guide screen and indicate erroneous point by means of "cursor" and we indicate inputting of non-numerical data in the numerical field by issuing a "peep" alarm (Fig. 2).
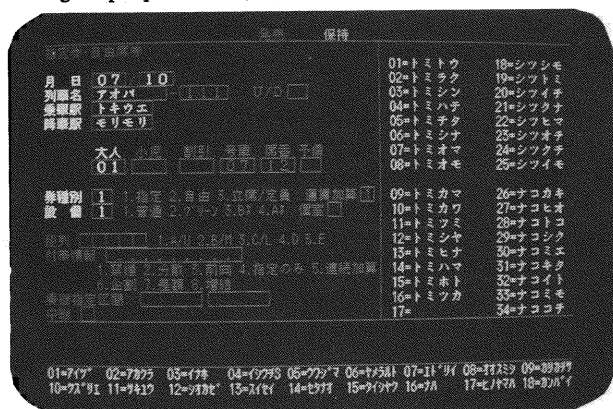

Fig. 2 An example of guide screen

5.1.2 Sales operational system

(1) Kinds of operations are selling, inquring, cancelling, etc. and kinds of tickets are fare and reserved seat ticket, lodging ticket, etc.

(2) Selling logic is multi-task method. We reduce time to input next vending information or time to issue the ticket by adopting a simultaneous parallel process which can accept next request for seat after receiving "yes" or "no" answer about seat availability and can issue tickets while receiving the ticket data.

5.1.3 Issuing system

(1) Ticket issuing logic is adopted to print out an N-type ticket of letter pitch 1/10 inch, column pitch 1/3 inch. But a printing mechanism which is fit for issuing T-type ticket (larger in size) is introduced in preparation for future. Ticket paper stock can be cut at a position 11/12 inch higher than the next printing position.

(2) Lettering on the ticket surface includes English alphabets, Katakana letters, symbols or Chinese characters. A new font has been developed and the printing quality has been improved with more dots employed than in the present terminal set.

5.1.4 Reasonable security system

(1) For the purpose of crime prevention special keys are adopted for platten knob, ticket storage and power supply of the ticket printer.

(2) Against illegal use by password, the terminal set is basically guarded by key control system. Meanwhile protection from the theft of software is provided by encoding the data linking the main body to the ticket printer (Fig. 3).

5.2 Total evaluation

(1) We can realize not only low cost of the main body by employing marketed products but also low cost including
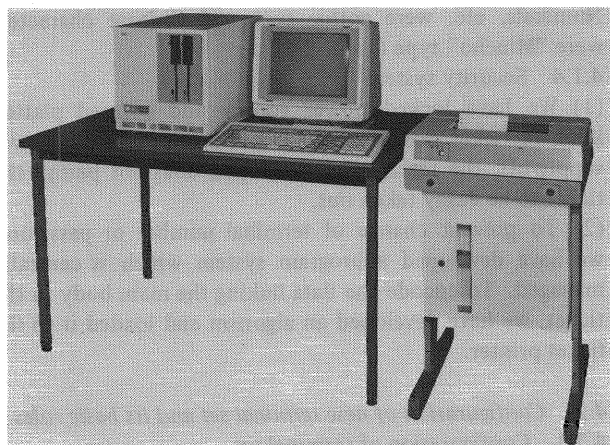

Fig. 3 New MARS terminal set

the communications line in total by utilizing DACS.

(2) Hardware cost depends on the marketing prices, therefore further cost down can be expected in future.

(3) Input operation is very much simplified by introduction of pre-set function for data or boarding station data, one-touch function for names of trains and stations, manual select function for categories of tickets, seat class, etc. Moreover, selection of non-smoker, front facing seat and other additional information can be handled as prospective passenger wishes.

(4) We realize a precise ticket issuing control system and legible printing characters. When format of ticket is enlarged, we have only to recontrust software with no reconstruction hardware.

(5) Ticket handling management, use management or software theft management could be provided without any system cost up. Special cipher algorism is made very compact. Function tests confirm high security ability. But password management and innovation of software management are not perfect. Central management of password and partial ROM memorization terminal number will remain a future problem.

(6) The other OA package includes such functions as tabulation, graphical drawing, Japanese word processing or personal computer function. This package will be applicable to handling of non-scheduled business likely to develop at stations or to station revenue management now being considered. Thus the terminal set is expected to have its cost/performance ratio still more improved.

6. Concluding Remarks

In May of this year, the terminal set called L-type reached about 200 units in number at booking counters of stations and its vending calls total about 18000 per day. In the near future, the installation of this terminal set not only at stations but also at travel agencies is scheduled.

I hope this report will prove of any use to readers.

Reference
1) Mochizuki, T.: "Concept of MARS-301 and its New Terminal Equipment", JRE (in Japan), Vol. 23, No. 4 (1984).

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