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A FORM MANIPULATION SYSTEM FOR RELATIONAL DATABASES

by

Christina To

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SUMMARY

A lot of activities in an office involve the processing of forms. One way to automate an office is therefore to computerize its processes for form manipulation.

Our major work is the design and development of a computerized form manipulation system FMS-UO and its integration with a relational database management system. FMS-UO can be used in a small office or a home environment, where the computer resources are very limited. It runs under the Disk Operating System DOS 3.3 in an APPLE II computer having at least 64K RAM and two disk drives. Through a friendly user-interface, FMS-UO provides the user with the facilities of designing the formats for forms, inputting data into the forms, storing data for forms in diskettes and outputting them onto the screen or the printer. To enhance the capabilities of FMS-UO, we integrate it with an inexpensive commercial relational database management system, RQL. The codes of RQL are modified and a data file is set up for transferring data between RQL and FMS-UO.

In this thesis, we first describe the basics of electronic forms and their operations. We then review some relevant works in the literature (Chapters 1 and 2). Description of FMS-UO from the user's point of view and the implementational details of the system are included in Chapters 3 and 4. An example of creating a letter by means of the integrated systems is provided. The example shows how a letter can be generated for different clients (Chapter 5).

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CHAPTER 1

ELECTRONIC FORMS

1.1 INTRODUCTION

Most of the data processing activities in an office are related to the preparation, distribution, relocation, filing, retrieval and checking of documents, such as reports, letters, minutes, memos, etc <DESO81>. These documents are manipulated essentially in the format of forms <GEHA81>. A form can be considered as a structured set of slots containing textual or graphical data. These slots of data are functionally related and can each be treated as a unit for operations.

It is more efficient to handle computerized forms than paper forms. Forms, if computerized, reduce drastically their storage space requirement. They can be stored, retrieved, processed and transmitted at an electronic speed. For example, it will be much faster to test data conformance with constraints and do numerical calculation in a computerized system <BAIR78> <BURN77> <COCH80>.

In the past, many form manipulation systems with primitive capabilities have been built for facilitating individual office procedures. The current trend of system development gears towards integrating these tools into a single system. Office services, such as typing, copying and telephone communications which were provided by different means in the past, can now be supported by a stand-alone computerized office system. This integration reduces the complexity of human interfaces with different office machines. Integration can also greatly enhance

the capabilities of many single form manipulation systems. The facilities of an isolated form manipulation system are usually limited to a few functions, such as inputting of data from the console, printing of the forms, etc. If the system is integrated with other systems designed particularly for data manipulation, such as database or file management systems, additional services can be obtained. In particular, recent developments tend to integrate office automation systems with relational database management systems.

In this thesis, we first design and develop a form manipulation system (FMS-UO) and then integrate it with an existing relational database management system called RQL. Most of the existing systems which can process forms require quite sophisticated hardware or software facilities. FMS-UO, however, aims at users in a home environment with a limited amount of computing resources. To illustrate this point, Figure 1.1 compares the well-known database management system DB.III with our FMS-UO in terms of hardware and software requirements, target users and the ease of use.

	DB III	FMS-UO
a. HARDWARE		
Microprocessor	8088/8086	6502
Memory Size	256K	64K
Disk Drive	One 160K double sided floppy disk drive	Two 112K single sided floppy disk drives
b. OPERATING SYSTEM	IBM PC DOS 2.0 or higher versions, or MS-DOS	APPLE DOS 3.3
c. TARGET USERS	Medium-size offices. Users are required to have some knowledge of programming skills.	Small offices or homes. Users are not required to have any programming skills.
d. EASE OF USE	Quite complicated. Most report generation requires creation of programs	Very easy to use. Form generation is menu driven

Figure 1.1 Comparison of system requirements of DB III and FMS-UO

The rest of this chapter describes the elements of electronic forms and their operations. The second chapter reviews some relevant works in the literature. Some form manipulation systems are described. In the third chapter, the functions and operations of FMS-UO are presented. It also briefly describes the system RQL and its integration with FMS-UO. Chapter 4 presents the details of implementing FMS-UO, such as its system architecture, the data structures used for its text files, the processes for system integration and data retrieval, etc. Lastly, an example of creating business letters using the integrated system described in Chapter 5. This example also illustrates the integration of the two systems.

1.2 FUNDAMENTALS OF FORM MANIPULATION SYSTEMS

In Section 1.2.1 the different elements of forms, such as form fields, form instances, form templates, etc., will be

described from a user's point of view. Section 1.2.2 stipulates the different operations on forms, such as creation, insertion, deletion, modification, storing, copying and outputting. Forms may also be routed or traced in a network environment <MAZE83>.

1.2.1 ELEMENTS OF ELECTRONIC FORMS

Hereafter, "electronic forms" are simply called "forms". In the following, we explain the three basic elements of forms.

(A) Fields

A form is composed of various fields which a user fills with relevant information. For example, a letter, the most commonly used form in the office, may have five fields : letter heading, date, name of the receiver, contents of the letter and name of the sender.

A field is a unit of information for processing and with independent characteristics. Certain constraints that govern the characteristics, processing order and sources of data may be imposed upon the fields. Data entered into or removed from them must be checked for consistency and conformance with these constraints. Some examples follow :

a. Restrictions on insertion

For some fields, data can be entered only at the time when a form is created. Other fields allow delayed data entry but cannot be changed afterwards.

b. Automatic insertion

For certain fields, data are automatically entered as the consequence of a specific computation or operation.

c. Mandatory insertion

Entry of data into some fields may be mandatory when other related fields are filled. For instance, in a form containing employee information, once the value "married" is entered into the field MARITAL STATUS, the system will require the fields SPOUSE'S NAME and NUMBER OF CHILDREN to be filled with appropriate data as well.

d. Order of insertion

The order of entering data into a number of fields may be mandatory in certain applications. For instance, the field SIGNATURE, which indicates the approval or authentication of the form at different administrative levels, must be filled by the managers in the order of increasing responsibility.

e. Restricted access

A field can be made accessible or inaccessible to certain users. Some systems require a user to enter a password before accessing a read-only, or a write-only field.

(B) Form Instances

A collection of values for the fields at a certain moment constitutes an instance of the form. A form instance may be stored in various kinds of media.

(C) Templates

A template is a structural skeleton through which form instances are presented to the user. The same form instance may be presented via different templates to different output media (see Figure 1.2). For example, in a display system, a form instance is mapped onto a text template in order to create a textual output. Similarly, if a graphic template is used to

display a form instance, a picture is created. In more sophisticated systems, a voice message may be obtained via a speech template.

A special kind of text template, called FRAME, is developed in this thesis for displaying form instances. It will be described in Chapter 3.

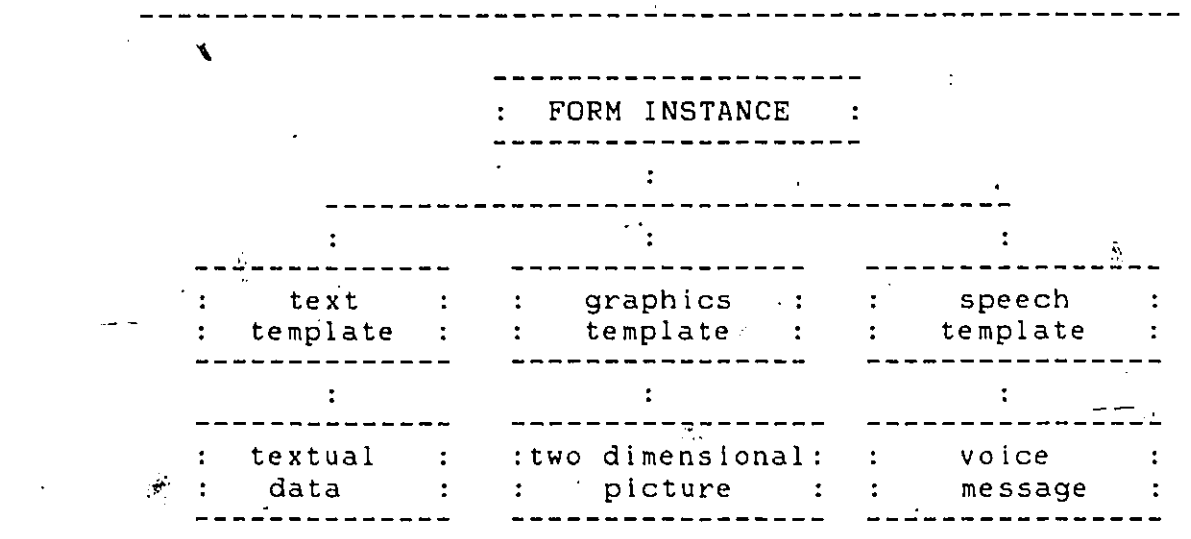


Figure 1.2 A form instance is presented to different output media through different templates

1.2.2 BASIC OPERATIONS ON FORMS

The following table lists some of the basic operations on form instances and form templates.

OPERATIONS ON FORM INSTANCES	OPERATIONS ON FORM TEMPLATES
CREATION	CREATION
MODIFICATION	MODIFICATION
DELETION	DELETION
STORING	STORING
COPYING	COPYING
OUTPUTTING	
ROUTING	
TRACING	

Figure 1.3 Basic operations on form instances and templates

(A) OPERATIONS ON FORM INSTANCES

a. Creation/Modification of form instances

Data can be entered into a form through the keyboard or from other file systems. The data must conform with the specified restrictions.

b. Storing/Deletion of form instances

Form instances can be stored for future applications. The method of storing is system and implementation dependent. In some systems, for example, form instances are stored as tuples of a relational database <FERR82>. Form instances can be removed from the text file only if they are not protected against deletion.

c. Copying form instances

Copying reproduces an exact copy of the original. One important aspect in the manipulation of forms, as often required in legal or business transactions, is to distinguish the duplicated copies from their original. To achieve this, copies are usually each given a copy number. In an office environment, keeping the consistency of data among the different copies and the original is an important management issue.

d. Outputting form instances <RABI81>

As described in Section 1.2.3, form instances can be outputted in various formats by using different templates. Hence, the same form instance may appear as a textual image, or as a two dimensional graphic image, or as a voice message.

e. Routing/Tracing form instances <LADD80>

In an environment where there are many workstations, form

instances may have to be routed from one workstation to another. A trace command provides the processing history of a form instance. For example, in a network environment where forms are processed through different workstations, the route along which the form flows through the workstations can be traced. In TLA <TSIC82>, a method is developed for determining whether the form is circulating infinitely in a loop within the network.

(B) OPERATIONS ON FORM TEMPLATES

a. Creation of form templates

Users can specify the characteristics of templates, such as their data domains, the positions and display formats of the data, etc.

b. Modification of form templates

The characteristics of existing templates can be changed by different operations.

c. Storing/Deletion of form templates

In general, templates to be used for a set of form instances can be stored for future applications, but they can also be deleted from a system unless they are protected by the user.

d. Copying form templates

Reproducing form templates with similar characteristics as an existing template can be performed easily by copying the existing templates.

CHAPTER 2

REVIEWS ON SOME FORM MANIPULATION SYSTEMS

As there exist numerous form manipulation systems, it is impossible to give an exhaustive review on all of them. Instead, we review only some of them with the objective of illustrating the useful features of an ideal system. These systems are:

. Business Definition Language (BDL)
. System for Business Automation (SBA)
. OfficeTalk-Zero & OfficeTalk-D
. Toronto Latest Acronym (TLA)
. DBASE III

Readers are referred to <FERR82>, <SHU81>, and <EMBL80> for more complete reviews.

Form has been used quite loosely in the literature as a generic name to mean form instance and template.

2.1 BUSINESS DEFINITION LANGUAGE (BDL) <KRUS74> <FURU82>

BDL is a form-based office automation language developed by IBM. Its special feature is the built-in structure that enables the user to build programs without performing any translation of his interpretation of the problem to the language available. This is achieved through the three components of the language : the Form Definition Component (FDC), the Document Flow Component (DFC), and the Document Transformation Component (DTC).

(A) Form Definition Component

In FDC, a user defines the forms using an interactive graphic system. The following characteristics of a form can be defined :

. name
. width
. height

. preprinted information
. properties of the forms, such as data type definitions, data formats, etc.

(B) Document Flow Component

This component is used to define the basic structure of an application by describing the office and its flow of documents. The BDL user uses an interactive language for drawing data flow graphs whose nodes correspond to objects, such as departments, sections, people, or functions within an office. Each arc between two nodes is labelled with the title of the document that flows between them. Actions will be carried out when their triggering conditions are satisfied <HOWE75>.

(C) Document Transformation Component

This component expresses the precise functional relationships among the documents of the system. It is here that the actual computations are specified. DTC also describes how output documents are constructed.

2.2 SYSTEM FOR BUSINESS AUTOMATION (SBA) <ZLOO77> <LUO81>

In this system, information is expressed in tables, business forms, reports, etc. The language supported by the system has three components :

. the language (QBE) Query-By-Example for database management
. a programming language for writing application programs
. a business system specification language

In Query-By-Example (QBE) <ZLOO75> <ZLOO77> <ZLOO81>, the basic data objects are tables (relations). In a uniform way, the user is provided with the skeleton of a table for querying, updating, defining or maintaining a database. The user formulates his query by filling in a table which is associated with examples

of possible answers in some of the fields. For example, if the user wants to find the red items from his stocks, he specifies the query as shown in Figure 2.1.

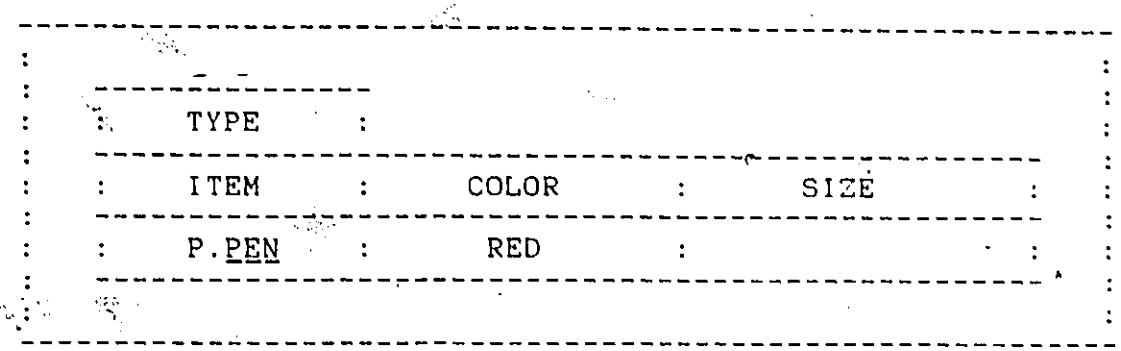


Figure 2.1 An example of data retrieval by QBE

When the user enters 'TYPE' as the name of the requested table, the system automatically generates the headings : ITEM, COLOR, and SIZE . In order to print all the items in the stock that have a red color, he enters RED below the heading COLOR and P.PEN below the heading ITEM as an example to the system. P.PEN here stands for "printing an item such as a PEN".

An SBA program is composed of a set of applications of Query-By-Example on those data represented in tables or more complex data types, such as forms, charts, reports, etc. Its significant departure from the language Query-By-Example is its inclusion of the INPUT and OUTPUT sections used for establishing a means of communications with other application programs. A typical SBA program is shown in Figure 2.2.

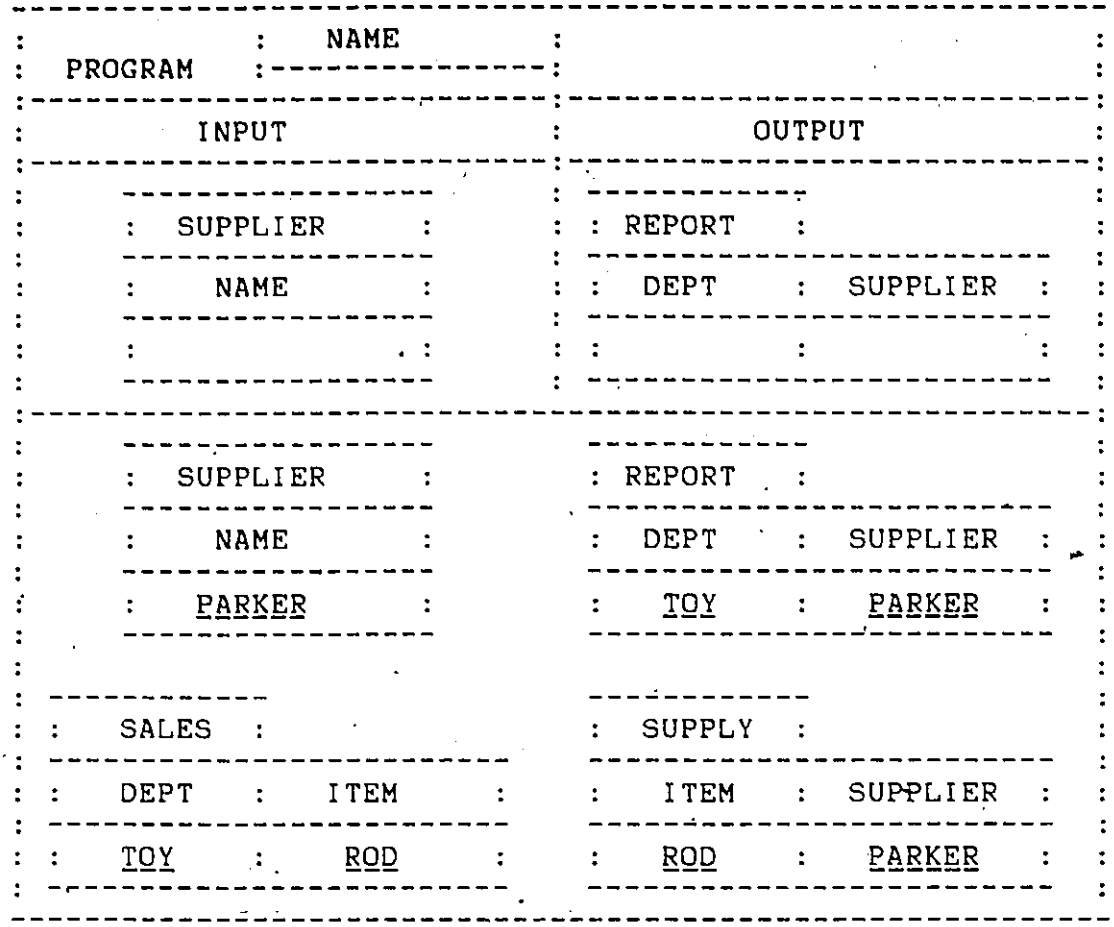


Figure 2.2 A typical SBA program

2.3 OFFICETALK-ZERO and OFFICETALK-D <ELLI80A> <ELLI80B>

OfficeTalk-Zero was developed at Xerox Palo Research Centre (PARC) in 1976. Its most attractive feature is the abundance of tools to be utilized by the users. OfficeTalk-Zero is integrated with many other Xerox systems, such as :

- text editors
- graphic packages
- communications facilities
- file management facilities
- forms data entry facilities

To implement a particular OfficeTalk application, a tailored set of blank forms must be designed and entered into the

database. OfficeTalk-Zero provides a form editor which allows one to specify the graphical design of a form and the style of each of the fields of the form. The editor restricts the data types to match the form's field definitions. The forms can be transmitted to another workstation and traced by the user. OfficeTalk-D <ELLI80> was another experimental office information system developed at PARC. As an extension to OfficeTalk-Zero, the D in OfficeTalk-D refers to the emphasis of this experiment on the system aspects of distributed control and cooperation among a group of users. The central element is an entity-relationship database. An information control net model <ELLI79> is used to provide a global graphical description of all the activities and tasks currently in progress.

2.4 TORONTO LATEST ACRONYM (TLA) <TSIC79>

TLA is an extension of the electronic Office Form System (OFS) <TSIC80A> <TSIC80B>. Both TLA and OFS were developed at the University of Toronto for the PDP-11 series of mini-computers and the LSI-11 micro-computers <CHEU80>. TLA is intergrated with a relational database management system called MRS. The query-oriented language SLQ is used to specify form procedures in terms of form sketches. Form sketches are images of forms in which user can input his requests for the operations. It is through these form sketches that the form procedures are modified. Three different form sketches and their functions are briefly described below.

(A) Precondition Sketches

Using a precondition sketch, the user can find a form

instance whose values satisfy the specific constraints. Figure 2.3 shows an example of a precondition sketch. The underlined portion against the field NAME indicates that this field of the requested form instance must contain the characters "U OF O". The symbol "?" indicates a field name is being specified. The field DOWN must contain a value less than the value in the field TOTAL. The field ACCOUNT must match the field ACCOUNT of another form called LIMIT.

```
-------------------------------------------------------------
:   CREDIT REQUEST                              KEY..... :
:                                                        :
:   NAME  U OF O                                         :
:   ACCOUNT  ? LIMIT.ACCOUNT                             :
:                                                        :
:   TOTAL  < 10000                          OLD LIMIT .... :
:   DOWN   < ? TOTAL                        NEW LIMIT .... :
:   DUE ..........                                       :
:                                                        :
:   APPROVED ..                                          :
-------------------------------------------------------------
```

Figure 2.3 A precondition sketch with constraints in TLA

(B) Action Sketches

A user can specify how values can be assigned to the fields by specifying procedures in three ways :

a. A constant value is inserted into a field. For example, in Figure 2.4, the value "YES" is inserted into the field APPROVED when the procedure is executed.

```
-------------------------------------------------------------
:   CREDIT REQUEST                              KEY..... :
:                                                        :
:   NAME  .....                                          :
:   ACCOUNT  ..............                              :
:                                                        :
:   TOTAL  .....                    OLD LIMIT ?LIMIT.CREDIT:
:   DOWN   .....                    NEW LIMIT !LIMIT.CREDIT:
:   DUE  # EXPR ? TOTAL - ? DOWN                         :
:                                                        :
:   APPROVED YES                                         :
-------------------------------------------------------------
```

Figure 2.4 An action sketch in TLA

b. A value is copied from a field of another sketch. The requested sketch and field are entered into the field in the format "?SKETCH.FIELD". As illustrated in Figure 2.4, the value in the field CREDIT of another sketch LIMIT is copied into the field OLD LIMIT of this sketch.

c. A function assigns a value to a field. A function call is indicated by an inital "#" followed by the function's name and its arguments. This is demonstrated in the field DUE in Figure 2.4. The function is EXPR , with arguments TOTAL, - and DOWN.

(C) Pseudoform Sketches

A pseudoform sketch is used to specify the actions, or preconditions which cannot be expressed in the fields of the forms. For example, in the case where there is no field on the form for indicating its origin, a pseudoform sketch can be used by the procedure to specify that only those forms from certain workstations can be processed. The psuedoform sketch shown in Figure 2.5 indicates only those forms from the finance department are accepted for processing. Similarly, a pseudoform sketch can be used to define the dispersement information of the forms such as the destination, the copies shipped, etc..

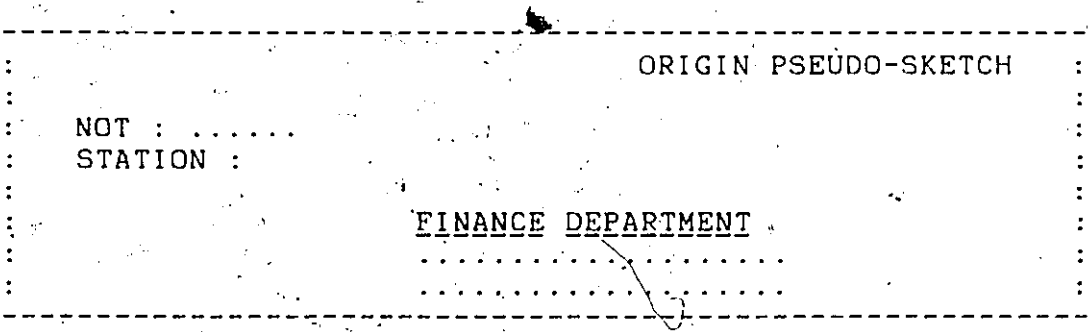


Figure 2.5 An origin pseudoform sketch in TLA

2.5 DBASE III

DBASE III is a relational database management system to be used in microcomputers. Four main functions are supported by the system :

. database manipulation
. querying
. report/form generation
. procedure creation

(A) Database manipulation

DBASE III can be used to create and modify databases. By using the CREATE instruction as shown in Figure 2.6, the database INVENTORY is set up and its field names, data types, field widths and data formats are defined.

New data records can either be appended at the end or inserted in the middle of the database file.

B:INVENTORY

	field name	type	width	dec
1	LIQUOR	Char/text	10	
2	BRAND	Char/text	20	
3	SIZE	Char/text	7	
4	QUANTITY	Numeric	3	
5	COST	Numeric	6	2
6	PRICE	Numeric	6	2

Figure 2.6 Creation of database INVENTORY by DBASE III

Changing databases in DBASE III can be categorized into 3 areas:

. changing the database structure, e.g., adding and deleting attributes, data type of attributes, etc.

. adding and deleting records

. changing the contents of records

(B) Querying

The user can issue requests for information to DBASE III through its query language called Application Development Language (ADL). ADL has procedural and non-procedural commands. With the procedural commands, the user instructs the system to produce the desired results step by step. With non-procedural commands, the user can state the macro-type commands. For example, the user may try to determine the total quantity of a liquor called BOURBON by issuing the following ADL command :

```
.SUM QUANTITY FOR LIQUOR = 'BOURBON'
```

Other non-procedural commands such as DISPLAY, LIST, COUNT, etc., are also available.

(C) Report/Form Generation

The REPORT command can be used to produce reports/forms. These forms are of rather rigid format and have a heading and several columns of data. When the REPORT command is initiated, the system will allow the page heading of the report to be inputted on a screen and the attribute name and heading of each column of the report on another screen.

(D) Procedure Creation

DBASE III uses procedures to extend its data processing capabilities. For example, the user can use a procedure to produce a function selection menu for applications, such as database update. It will display the different possible update choices to the user and prompt for a selection. Procedures can be used to produce special reports with formats specified by the user which cannot be obtained by using the REPORT command in the normal way.

2.6 COMPARISON OF FUNCTIONS AMONG THE FORM MANIPULATION SYTEMS

The following table summarizes the important functions that are supported by the different form manipulation systems.

FUNCTIONS	BDL	SBA	OFFICETALK-D	TLA	DB III
FORM INSTANCE					
CREATION	X	X	X	X	X
MODIFICATION	X	X	X	X	X
DELETION	X	X	X	X	X
STORING	X	X	X	X	X
COPYING	X	X	X	X	
OUTPUTTING	X	X	X	X	X
ROUTING	X	X	X	X	
TRACING	X		X	X	
FORM TEMPLATE					
CREATION	X		X	X	X
MODIFICATION	X		X	X	X
DELETION	X		X	X	X
STORING	X		X	X	X
COPYING	X		X	X	
OUTPUTTING	X		X	X	X
ROUTING	X		X		
TRACING	X		X		
DEFINE CHARACTER.					
OF FIELDS	X		X		
DISTRIBUTED DB				X	
QUERY FACILITY		X		X	X
FORM SPECIFICAT.					
LANGUAGE	X	X		X	X

Figure 2.7 Comparison of functions of different form manipulation systems

CHAPTER 3

A USER'S PERSPECTIVE OF THE FORM MANIPULATION SYSTEM FMS-UO

3.1 INTRODUCTION

In this chapter, the form manipulation system FMS-UO we designed and implemented at the University of Ottawa is described from the user's point of view. With the limitation of time and resources, this thesis emphasizes only on the design and the implementation of some basic functions of a form manipulation system and its interface with a relational database management system. FMS-UO aims at users in a home environment using very little computing resources. It runs under the Disk Operating System DOS 3.3 in an APPLE II computer having at least 64K RAM and two disk drives.

The operations of FMS-UO are enhanced because of its integration with the commercially available relational database management system RQL. Data retrieved from RQL can be inserted into the forms in FMS-UO. A subset of the basic operations on forms described in Section 1.2.2 is implemented. Operations of FMS-UO are described in details in Section 3.2. The system RQL is described in Section 3.3. Their integration is explained in Section 3.4. Error messages for the different operations of FMS-UO are included in Appendix A.

3.2 THE OPERATIONS OF FMS-UO

The main operations of FMS-UO are displayed as five options in the MAIN menu (see Figure 3.1) when the system is initiated or after any operation has been completed. These options will be

explained in the following sub-sections. When information is required from the user during the form operations, the system will prompt the user with a message starting with "FMS>".

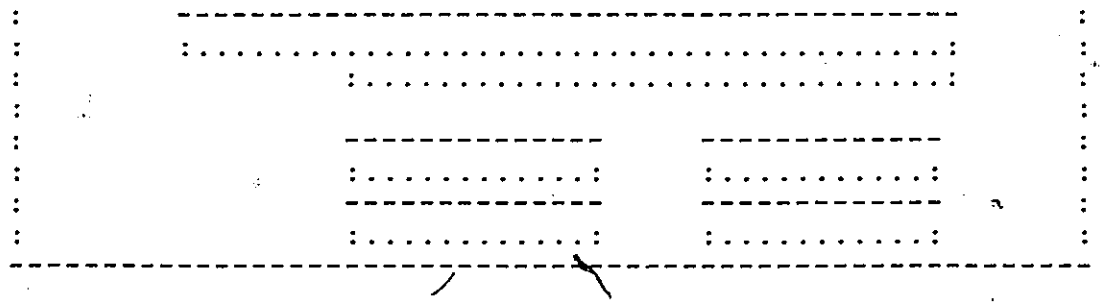
```
FMS> INDICATE YOUR CHOICE BY ENTERING
     THE NUMBER

  1. CREATE A FRAME
  2. MODIFY/DELETE BLOCK COORDINATES
  3. CREATE/MODIFY/DELETE DATA FROM
     A FORM
  4. DISPLAY/PRINT DATA USING A FRAME
  5. DISPLAY FRAME LAYOUT
  6. QUIT
```

Figure 3.1 The MAIN menu of FMS-UO

3.2.1 CREATE A FRAME

A special kind of text template, called FRAME, is used in FMS-UO for displaying or outputting form instances. A frame is composed of rectangular areas called BLOCKS. Figures 3.2 and 3.3 show how the same form instance appears differently through different frames.



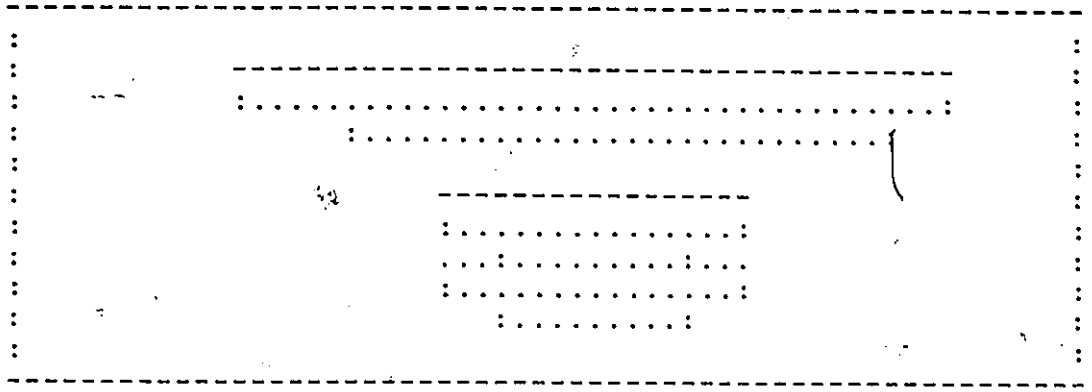
```
NOTICE : THE FOLLOWING EMPLOYEES ARE

         TO BE TRANSFERRED TO TORONTO

         JOHN SMITH          1234

         DAVID PATTER        3641
```

Figure 3.2 A form instance displayed through the frame above it



NOTICE : THE FOLLOWING EMPLOYEES ARE

TO BE TRANSFERRED TO TORONTO

JOHN SMITH
1234
DAVID PATTER
3641

Figure 3.3 The same form instance displayed through another frame

A frame is created by specifying the layout of its blocks. As shown in Figure 3.4, the user is first prompted to enter a name for the new frame. If the name is already used for another frame, the user will be prompted for another one. After a valid name has been entered, the user enters the coordinates of its blocks. At this point, he is given the opportunity to have a view of the frame. (See Figure 3.5.)

CREATE A FRAME
==========

FMS> PLEASE GIVE A NEW FRAME NAME :

Figure 3.4 FMS-UO prompts for a new frame name

```
BLOCK # 1

FMS> DO YOU WANT TO SEE THE FRAME
     FIRST ? (Y OR N) :
```

Figure 3.5 The user has the opportunity to view the frame

If requested, the frame is displayed with the X and Y scales along the top and the left side of the screen. (Details of this operation are explained in Section 3.2.5.)

Next, the system will prompt for the X and Y coordinates of the top left corner of the block. (See Figure 3.6.) The user is given the option to see the frame before defining the coordinates of the bottom right corner of the block. (See Figure 3.7.)

```
FMS> PLEASE SPECIFY THE X, Y COORDINATES
     OF THE TOP LEFT CORNER OF BLOCK # 1

X, (1-40) : 2
Y, (1-22) :
```

Figure 3.6 Coordinates of the top left corner of a block are defined

```
FMS> DO YOU WANT TO SEE THE FRAME
     FIRST ? (Y OR N) : N

FMS> PLEASE SPECIFY THE X, Y COORDINATES
     OF THE BOTTOM RIGHT CORNER OF BLOCK # 1

X, (1-40) : 19
Y, (1-22) :
```

Figure 3.7 Coordinates of the bottom right corner of a block are defined

The system checks the validity of the data. The user is required to re-enter the data if the X coordinate is not within

the range of 1 to 40 or the Y coordinate is not within the range of 1 to 22 or the blocks are overlapping. Before completion, the system prompts for any alterations, as shown in Figure 3.8. If the response is 'Y', the whole block has to be re-defined. Otherwise, the user proceeds to define another block.

```
:     FMS> DO YOU WANT TO MAKE ANY CHANGES          :
:          FOR THIS BLOCK ? (Y OR N) :              :
:                                                   :
```

Figure 3.8 The user may redefine the block

3.2.2 MODIFY/DELETE BLOCK COORDINATES

The coordinates of an existing block can be modified using Option 2 of the MAIN menu. First, the system will prompt for the frame name. If the input matches one of the existing frame names, the menu MODIFY BLOCK COORDINATES will be displayed, as shown in Figure 3.9. When Option 1 or 2 or 3 is selected, the existing block numbers are displayed and the user can choose to see the frame before modifying the block number. (See Figure 3.10.)

```
:    MODIFY/DELETE BLOCK COORDINATES                :
:    ==============================                 :
:                                                   :
:    FMS> PLEASE SPECIFY FRAME NAME :  STUDENT      :
:                                                   :
:    FMS> PLEASE INDICATE YOUR CHOICE BY            :
:         ENTERING THE NUMBER                       :
:                                                   :
:      1. MODIFY AN EXISTING BLOCK                  :
:      2. ADD A NEW BLOCK                           :
:      3. DELETE AN EXISTING BLOCK                  :
:      4. DELETE THE WHOLE FRAME                    :
:                                                   :
```

Figure 3.9 The menu - MODIFY BLOCK COORDINATES

```
FMS> BLOCKS DEFINED SO FAR ARE :
     1 2 3

FMS> DO YOU WANT TO SEE THE FRAME
     FIRST ? (Y OR N) : N

FMS> PLEASE SPECIFY THE BLOCK NUMBER
     TO BE MODIFIED :
```

Figure 3.10 The prompts displayed when option 1 or 2 or 3 is selected.

The following paragraphs explain the options in the menu - MODIFY BLOCK COORDINATES.

Option 1 - MODIFY AN EXISTING BLOCK

The block number specified by the user for modification is checked against those already defined. If the block exists, the coordinates of the block can be re-defined following the same procedure as described in the function - CREATE A FRAME. (See Section 3.2.1.)

Option 2 - ADD A NEW BLOCK

The user has to input a unique number for the new block. The block is defined by following the procedure as described in the function - CREATE A FRAME. (See Section 3.2.1.)

Option 3 - DELETE AN EXISTING BLOCK

A block can be removed from a frame by this option. The block number X specified by the user is checked against those already defined. If it exists, the block will be deleted and the following message will be displayed :

```
FMS> BLOCK NUMBER X HAS BEEN DELETED
```

Figure 3.11 The message displayed after deletion of Block X

Option 4 - DELETE THE WHOLE FRAME

If this option is selected, the user is asked to confirm his intention by the following message.

```
:       FMS> YOU HAVE CHOSEN TO DELETE THE          :
:            WHOLE FRAME, DO YOU STILL              :
:            WANT TO GO AHEAD ? (Y OR N)            :
:                                                   :
```

Figure 3.12 The system prompts the user to confirm his intention of deleting the whole frame

3.2.3 CREATE/MODIFY/DELETE DATA FROM A FORM

When this option is selected from the MAIN menu, the user can create, modify or delete data in each of the fields in the form. After the system prompts for a form name, the menu CREATE/MODIFY/DELETE DATA IN A FORM is presented. (See Figure 3.13.)

```
:   CREATE/MODIFY/DELETE DATA FROM A FORM           :
:   ====================================           :
:                                                  :
:   FMS> PLEASE SPECIFY THE FORM NAME : CLASS       :
:                                                  :
:   FMS> PLEASE INDICATE YOUR CHOICE               :
:        BY ENTERING THE NUMBER                    :
:                                                  :
:    1. CREATE/MODIFY DATA IN A FIELD              :
:    2. DELETE DATA FROM ONE FIELD                 :
:    3. DELETE DATA FROM ALL FIELDS                :
:                                                  :
```

Figure 3.13 The menu - CREATE/MODIFY/DELETE DATA IN A FORM

Option 1 - CREATE/MODIFY DATA IN A FIELD

The user is prompted for the number of the field whose data he wants to create or modify. (See Figure 3.14.) If the specified field already contains data, the user is given the

```
:   FMS> PLEASE GIVE THE FIELD NUMBER :
:
```

Figure 3.14 The system prompts for the field number

choice of modifying it or leaving it as it is. Two ways are available for inserting data into a field, as shown in Figure 3.15. If "C" is entered, the system will prompt for the entry of data through the console. (See Figure 3.16.) Otherwise, data will come from RQL.

```
:     FMS>  DO YOU WANT TO INPUT DATA FROM
:           CONSOLE OR FROM RQL ? (C OR R)
:
```

Figure 3.15 Two methods for inputting data

```
:     FMS>  PLEASE INPUT DATA
:
```

Figure 3.16 The system prompts for data input through the console

Option 2 - DELETE DATA FROM ONE FIELD

In this option, as shown in Figure 3.14, the user is also prompted for the field number whose data is to be deleted. After the user enters the number, the data is removed from the field and the messages in Figure 3.17 are displayed.

```
:    FMS> DATA IN FIELD #X HAS BEEN DELETED
:
:    FMS> CREATE OR MODIFY OR DELETE DATA
:         IN ANOTHER FIELD ? (Y OR N) :
:
```

Figure 3.17 Messages displayed after data has been deleted from a field

3.2.4 DISPLAY/PRINT DATA USING A FRAME

The data of a form can be displayed or printed (See Figure 3.18) through frames with different layouts. The system then prompts for the names of the form and the frame. (See Figures 3.19 and 3.20.) The user may output part or the entire form by answering the question shown in Figure 3.21. If a

```
: DISPLAY/PRINT DATA USING A FRAME                    :
: ================================                    :
:                                                     :
: FMS> PLEASE INDICATE YOUR CHOICE BY                 :
:      ENTERING THE NUMBER                            :
:                                                     :
: 1. DISPLAY DATA ON THE SCREEN                       :
: 2. PRINT DATA ON THE PRINTER                        :
:                                                     :
```

Figure 3.18 The user is given a choice of methods for outputting data

```
: FMS> PLEASE SPECIFY THE FORM NAME :                 :
:                                                     :
```

Figure 3.19 The system prompts for the form name

```
: FMS> PLEASE SPECIFY THE FRAME NAME :                :
:                                                     :
```

Figure 3.20 The system prompts for the frame name

```
: FMS> HOW MANY FIELDS DO YOU WANT TO                 :
:      OUTPUT ? (0 MEANS ALL) :                       :
:                                                     :
```

Figure 3.21 The system prompts for the output options

non-zero number is input, the system will prompt for the numbers of the specified fields before outputting the data. (See Figure

3.22.)

```
:     FMS) PLEASE SPECIFY THE FIELD NUMBERS:          :
:                                                     :
```

Figure 3.22 The system prompts for the field numbers for output

3.2.5 DISPLAY FRAME LAYOUT

This function displays the layout of the blocks of a frame. It can be initiated under 3 of the 5 options of the MAIN menu. (See Figure 3.1.) :

- Option 1 CREATE A FRAME
- Option 2 MODIFY/DELETE BLOCK COORDINATES
- Option 5 DISPLAY FRAME LAYOUT

Scales are displayed along the top and left edges of the screen. A block with dotted perimeters is displayed as shown in Figure 3.23. The block number is displayed inside the top left

```
:12345678901234567890123456789012345678901234567890:
:2                                                   :
:3                          *                        :
:4    ...................                            :
:5    :1                  :                          :
:6    :                   :                          :
:7    ...................                            :
:8                                                   :
:.                                                   :
:..                                                  :
:1                                                   :
:2                                                   :
:  PRESS ANY KEY AFTER VIEWING                       :
```

Figure 3.23 A frame layout

corner of the block. In the course of defining a block (Option 1 or 2 of the MAIN menu), if only its top left corner has been defined, the coordinate is represented by an asterisk "*". Display of the frame can be terminated by pressing any key.

3.2.6 QUIT

This option allows the user to leave FMS-UO and return to DOS.

3.3 RQL

In order to fully utilize FMS-UO, a user should also be familiar with RQL. Following is a summary of its main operations. See <CHEN83> for more details. RQL is a relational database management system developed by HELLO Software Ltd. It operates under DOS 3.3 in APPLE II micro-computers with at least 48K RAM and two floppy disk drives. The user manipulates the databases interactively by using a query language. RQL offers some useful data processing capabilities such as searching, sorting and merging of data.

In the system, a relation is described in terms of a table. Each database in RQL is composed of at least one table (see Figure 3.24). There can be more than one database in RQL.

STUDENT NAME	NUMBER
STEVE MORGAN	102468
SUSAN GRAND	103357
BILL LAYTON	124420
STEVE ZOOM	124789

Figure 3.24 The student names and numbers are stored in the table "CLASSA" of the database "STUDENT".

Five operations are available for database manipulations :

a. Define a new database
b. Access an existing database
c. Display or print the names of all tables in a database
d. Destroy a database
e. Rename a database

Eleven operations are available for table manipulations :

a. Define a new table within an existing database
b. Manipulate (insert, delete, update) the rows of a table
c. Create a new table from an existing table
d. Create a new table by joining two existing tables
e. Display or print the format of a table
f. Display or print the content of a table
g. Destroy a table
h. Sort a table on a particular column
i. Compute aggregate functions : Average, Count, Sum, Minimum, Maximum
j. Rename a column of a table
k. Rename a table

Most commands, begin with a key word, such as "DEFINE" or "DISPLAY", followed by the key word "DATABASE" or "TABLE" and then the actual name of the database or the table. We shall give an example of storing the names and numbers of students in a new table "CLASSA" within a new database "STUDENT". The command "DEFINE DB STUDENT" is used to define the database. The name and description of the database have to be specified. After the database is defined, we can create a table within this database by using the command "DEFINE TABLE CLASSA". In this command, the name, width, data type and description of each attribute are defined. Data can then be inserted into the TABLE using the command "INSERT CLASSA".

To retrieve data, the user has to specify the name of the database and the table in which the data is stored. For example, to retrieve the names of the students whose number is greater than "12345", the following commands have to be used :

```
USE DB STUDENT
DISPLAY TABLE CLASSA ON NAME WHERE NUMBER > "12345"
```

The first command is for specifying the database "STUDENT". The second command is to display from the table "CLASSA" the names of

the students whose number is greater than "12345". The content of "CLASSA" is shown in Figure 3.24 and the names of those students who satisfy the specified condition are shown in Figure 3.25.

```
:                          NAME                          :
:                        ------                          :
:                                                        :
:                      BILL LAYTON                       :
:                      STEVE ZOOM                        :
```

Figure 3.25 Names of students whose number is greater than "12345"

3.4 INTERFACE BETWEEN FMS-UO AND RQL

The data management capability of a form manipulation system such as FMS-UO is quite limited. It can be greatly enhanced if integrated with a relational database management system such as RQL. The user can manipulate data stored in the databases before passing it on to the forms prepared in FMS-UO.

The user can switch between the two systems at three operational points :

. After booting the computer
. After completion of an RQL command
. When creating or modifying data in Option 3 of the MAIN menu of FMS-UO

(A) After booting the computer

The system prompts the user for a choice between FMS-UO and RQL. (See Figure 3.26.) If "F" is selected, the MAIN menu of FMS-UO is displayed. Otherwise, RQL is executed.

```
:        DO YOU WANT TO RUN FMS-UO OR RQL ?              :
:        (F OR R) :                                      :
```

Figure 3.26 The user may initiate FMS-UO or RQL

(B) After completion of an RQL command

The user can continue operating under RQL or switch to FMS-UO after having completed a RQL command by responding to the question in Figure 3.27.

```
:        DO YOU WANT TO STAY IN RQL OR SWITCH TO          :
:        FMS-UO ? (R OR F) :                              :
```

Figure 3.27 The user may switch systems after completing an RQL command

(C) When creating or modifying data in Option 3 of MAIN menu under FMS-UO

After the user has specified the form name and the field number, the question in Figure 3.28 is displayed. If "R" is

```
:        FMS> DO YOU WANT TO INPUT DATA FROM              :
:             CONSOLE OR FROM RQL ? (C OR R)              :
:                                                         :
```

Figure 3.28 Choice of the source of input data

selected, the RQL system is executed and a message is displayed (see Figure 3.29).

```
:                                                         :
:      ** NOTE : IF YOU HAVE A TABLE WHOSE DATA           :
:         YOU WANT TO MOVE TO FMS, USE THE                :
:         RQL COMMAND TO DISPLAY THAT TABLE,              :
:         OTHERWISE, DEFINE YOUR TABLE NOW.               :
:                                                         :
```

Figure 3.29 The message displayed after RQL is selected as the source of input data

Data transfer from RQL

The data has to be collected in a single table in order to be transferred to FMS-UO. The operations JOIN and DISPLAY are particularly useful for this purpose. When the operation DISPLAY

is used to display a table, the user is given the option of transferring the data in the table to FMS-UO. (See Figure 3.30.) If the answer is "Y", the data is moved to the field of the form in FMS-UO and FMS-UO will be invoked. If the answer is "N", the user continues with other RQL operations.

```
: DO YOU WANT TO MOVE THIS DATA TO :
: THE FORM ? (Y OR N) :            :
```

Figure 3.30 The user has the option of moving the data to a form

CHAPTER 4

DESIGN AND IMPLEMENTATIONAL DETAILS OF THE FORM MANIPULATION SYSTEM FMS-UO

4.1 INTRODUCTION

This chapter presents the details of designing and implementing FMS-UO. This includes its integration with RQL. An overview of the functional hierarchy of the system is first depicted in Figure 4.1, together with the hardware and software requirements. In Section 4.2, the functions of FMS-UO are described in details. The record layouts of the files are explained wherever they are used. In Section 4.3, the system integration of FMS-UO and RQL is described.

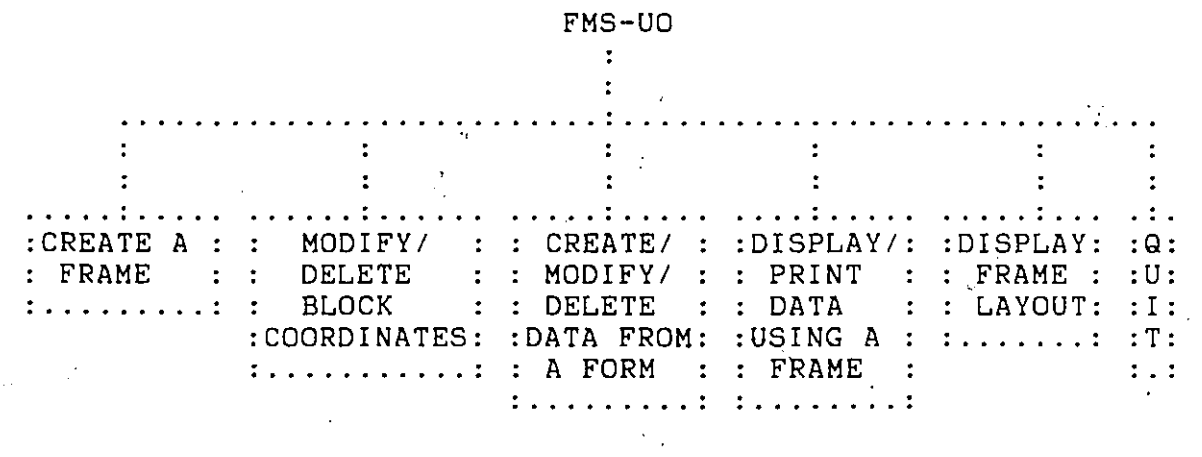


Figure 4.1 Functional hierarchy of FMS-UO

Hardware and software requirements of FMS-UO

(A) Hardware requirements

Computer	: APPLE II
RAM	: at least 64K
DISK DRIVE	: two

(B) Software requirements

The Disk Operating System DOS 3.3 and the following programs are needed in order to run FMS-UO.

a. HELLO - greeting program of FMS-UO
b. APPLESOFT - language program of APPLE II
c. FPBASIC - language program of APPLE II
d. RDB.OPT.HALF - RQL program
e. SORT - RQL program
f. SET.OPT - RQL program
g. TH2 - FMS-UO program

The programs of the systems RQL and FMS-UO are both written in the language APPLESOFT BASIC. The program TH2 is composed of a control block and many subroutines. The control block contains a section in which functions are selected. If a certain function is selected, the system branches to the subroutines for handling that function. After processing the function, control is returned to the control block.

Random access and sequential files are used to store information of the forms and frames. The file commands, OPEN, WRITE, READ and CLOSE, are used for both kinds of files. Other file commands, POSITION and APPEND, are used only for sequential files.

4.2 THE FUNCTIONS OF FMS-UO

The functions listed in Figure 4.1 are described in the following subsections according to the following aspects :

. the purpose of the function;
. how the function is initiated;
. the input files used in the function;
. the output files used in the function;
. coding reference (Refer to Appendix B for actual codes); and
. the procedures (steps) used for achieving its purpose.

4.2.1 CREATE A FRAME

Purpose : To define the coordinates of the blocks in a new frame.

Initiated by : Option 1 of the Main menu

Input file : TFRAME

Output files : TFRAME, framename.COR

Code reference : Lines 400 to 910 in TH2

Procedures :

a. If the frame name specified by the user is not found in the file TFRAME, a new frame name has to be re-entered.

b. Before defining the coordinates, user can choose to look at the frame. If some blocks have already been defined, the coordinates are read from the file framename.COR for displaying the frame.

c. After the coordinates of a block are defined, they are checked against the coordinates of the existing blocks in the file framename.COR. If any blocks overlap, go to step b.

d. If modification is not needed for the block which has just been defined, go to step f.

e. User can re-define the coordinates of the block by going to step b or return to the MAIN menu.

f. The coordinates are stored with a new record number in the file framename.COR. The total number of blocks defined and the block numbers are updated in the first record of the file

g. The new framename is stored in the file TFRAME and the total number of frame defined is incremented by one in the first record of the file.

Figures 4.2 and 4.3 show the file layouts of framename.COR and TFRAME.

Filename	framename.COR
Function	stores coordinates of blocks
File type	random access
Record type	50 bytes

RECORDS

#	Field # in record	Descriptions
0	1	total number of forms defined. Block #
1	1	X coor. of upper left corner of block 1
	2	Y coor. of upper left corner of block 1
	3	X coor. of bottom right corner of block1
	4	Y coor. of bottom right corner of block1
2	1	
	.	

Figure 4.2 Layout of file framename.COR

Filename	TFRAME
Function	stores names of frames
File type	random access
Record type	20 bytes

RECORDS

#	Field # in record	Descriptions
0	1	total number of frames created
1	1	frame name #1
2	1	frame name #2
3	1	frame name #3
.		

Figure 4.3 Layout of file TFRAME

4.2.2 MODIFY/DELETE BLOCK COORDINATES

This function consists of four sub-functions as depicted in Figure 4.4.

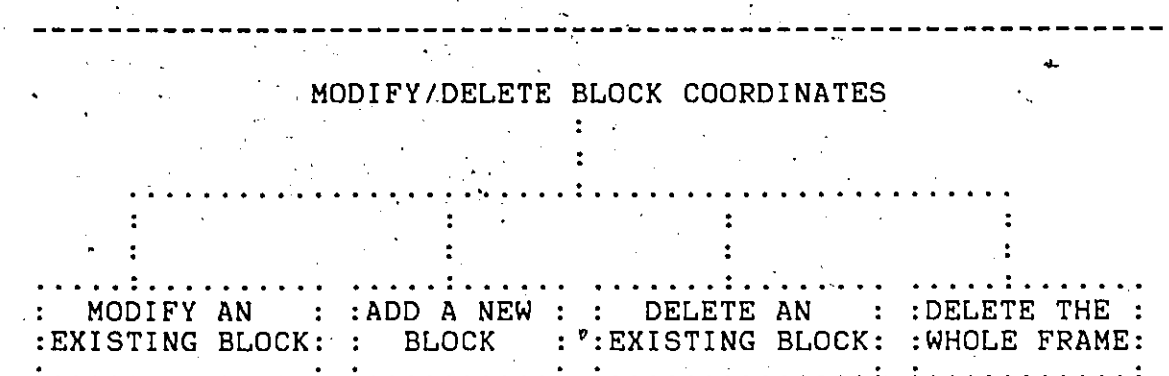


Figure 4.4 Sub-functions of MODIFY/DELETE BLOCK COORDINATES

(A) MODIFY AN EXISTING BLOCK

Purpose : To update the coordinates of an existing block.

Initiated by : Option 2 of the MAIN menu and Option 1 of the sub-menu MODIEY/DELETE BLOCK COORDINATES

Input files : TFRAME, framename.COR

Ouput files : TFRAME, framename.COR

Code reference : Lines 900-1950 in TH2

Procedures :

a. If the frame name specified by the user is found among the frame name in the file TFRAME, the block numbers in the first record of the file framename.COR are read. These block numbers are displayed with a message
"FMS> BLOCKS DEFINED SO FAR ARE : "

b. If the block number specified by the user matches one of the existing blocks, the coordinates of the block are read from the file framename.COR.

c. The coordinates of the block are re-defined by the same procedure as in the function - CREATE A FRAME.

(B) ADD A NEW BLOCK

Purpose : To add a block to a frame

Initiated by : Option 2 of the MAIN menu and Option 2 of the sub-menu MODIFY/DELETE BLOCK COORDINATES

Input files : TFRAME, framename.COR

Output files : TFRAME, framename.COR

Code reference : Lines 930 to 1950 in TH2

Procedures :

a. If the frame name specified by the user is found among the ones stored in the file TFRAME, the block numbers stored in the first record of the file framename.COR are read. These block numbers are displayed with a message :
"FMS > BLOCKS DEFINED SO FAR ARE :"

b. If the block number specified by the user does not match any of the existing ones, the coordinates of the block can be defined.

(C) DELETE AN EXISTING BLOCK

Purpose : To remove a block from a frame

Initiated by : Option 2 of the MAIN menu and Option 3 of the menu MODIFY/DELETE BLOCK COORDINATES

Input files : TFRAME, framename.COR

Output files : TFRAME, framename.COR

Code reference : Lines 930 to 1950 in TH2

Procedures :

a. If the frame name specified by the user is among the ones stored in the file TFRAME, the system will prompt for a block number.

b. If the input block number is found in the file framename.COR, the block is deleted.

c. The total number of blocks defined is reduced by one and the block number is removed from the first record of the file framename.COR.

(D) DELETE THE WHOLE FRAME

Purpose : To remove a frame from the system

Initiated by : Option 1 of the MAIN menu and Option 4 of the sub-menu MODIFY/DELETE BLOCK COORDINATES

Input files : TFRAME, framename.COR

Output file : TFRAME

Code reference : Lines 930 to 1950 in TH2

Procedures :

a. If the frame name specified by the user is among the ones in the file TFRAME, the system confirms the deletion process by prompting the user.

b. The frame name is deleted from the first record of TFRAME and the total number of frames defined is reduced by one. The file framename.COR is deleted.

4.2.3 CREATE/MODIFY/DELETE DATA FROM A FORM

This function consists of three sub-functions depicted in Figure 4.5.

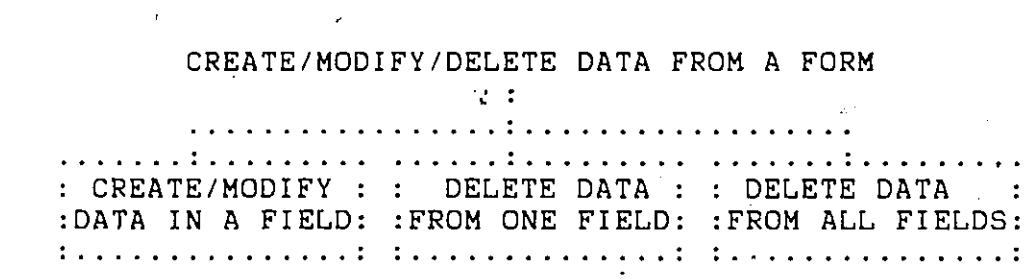


Figure 4.5 Sub-functions of CREATE/MODIFY/DELETE DATA FROM A FORM

(A) CREATE/MODIFY DATA IN A FIELD

Purpose : To add or modify data in a field

Initiated by : Option 3 of the MAIN menu and Option 1 of the sub-menu CREATE/MODIFY/DELETE DATA IN A FORM

Input files : TFORM, formname.DAT, PASS

Output files : TFORM, formname.DAT, PASS

Code reference : Lines 1960 to 3550 in TH2

Procedures :

a. If the form name specified by the user is among the ones stored in the file TFORM then go to step d.

b. Initialize a data file with a name formname.DAT.

c. The form name is stored into the file TFORM. The total

number of forms created is incremented by one.

d. The system prompts for the field number in which data is to be input.

e. The data flag in the file formname.DAT is read to determine whether the field contains any data.

f. If no data exists, go to step j, otherwise user has a choice to modify the data.

g. If the user chooses to modify the data then go to step j.

h. The system prompts the user whether to modify other fields.

i. If the answer is "Y", the system prompts for a field number. Otherwise, the system returns to the MAIN menu.

j. User has a choice of inputting data from the console or the RQL.

k. If console is chosen, user inputs data through the keyboard. Otherwise, the system RQL is invoked. (Refer to Section 4.3 for details.) The input data is stored in a file formname.DAT.

The file layouts of the TFORM, framename.DAT, PASS are shown in Figures 4.6, 4.7 and 4.8.

Filename	: TFORM	
Function	: stores names of forms	
File type	: random access	
Record type	: 20 bytes	
	RECORDS	
#	Field # in record	Descriptions
0	1	total number of forms created
1	1	form name #1
2	1	form name #2
3	1	form name #3
.		

Figure 4.6 Layout of file TFORM

Filename	: formname.DAT	
Function	: stores control information & data of form	
File type	: sequential	

Field #	Position: from	length	Descriptions
0	1	2	Number of non-empty fields
1	3	3	Initial location of new data in the file
2	6	1	A flag for field #1 (empty or non-empty)
3	7	1	A flag for field #2
4	8	1	.
5	9	1	.
.	.	.	.
12	15	1	A flag for field #10
13	16	1	Number of string variables for field #1
14	17	1	Number of string variables for field #2
.	.	.	.
22	25	1	Number of string variables for field #10
23	26	3	Initial location of field #1
24	29	3	Initial location of field #2
.	.	.	.
32	53	3	Initial location of field #10
33	56	length	Data of field #1
.	.		.

Figure 4.7 Layout of file formname.DAT

Filename	: PASS	
Function	: stores information for data transfer	
File type	: random access	
Record type	: 300 bytes	

RECORDS

#	Field # in record	Descriptions
1	1	A flag - data transfer request in FMS-UO
2	1	A form name in which data is stored
3	1	A field # in which data is stored
4	1	A flag - data from RQL is transferred
5	1	The # of string variables required
6	1	Data from RQL

Figure 4.8 Layout of file PASS

(B) DELETE DATA FROM ONE FIELD

Purpose : To remove data from one field

Initiated by : Option 3 of the MAIN menu and Option 2 of the sub-menu CREATE/MODIFY/DELETE DATA IN A FIELD.

Input files : TFORM, formname.DAT

Output files : TFORM, formname.DAT

Code reference : Lines 1960-3550 in TH2

Procedures :

a. If the form name specified by the user is found among the ones in the file TFORM, the system prompts for the field number in which data is to be deleted.

b. The flag which indicates the existence of data in the field is set to zero in the file formname.DAT.

(C) DELETE DATA FROM ALL FIELDS

Purpose : To remove data from all fields in a form

Initiated by : Option 3 of the MAIN menu and Option 3 of the sub-menu CREATE/MODIFY/DELETE DATA IN A FORM

Input files : TFORM, formname.DAT

Output files : TFORM

Code reference : Lines 1960 to 3550 in TH2

Procedures :

a. If the form name specified by the user is among the ones in the file TFORM, the system confirms the deletion action by prompting the user.

b. If deletion is not confirmed, the system returns to the MAIN menu. Otherwise, data is deleted by erasing the file formname.DAT. The formname is removed from the file TFORM.

4.2.4 DISPLAY/PRINT DATA USING A FRAME

This function allows user to output a form using a frame. Two types of output can be obtained on screen or on printer as

shown in Figure 4.9.

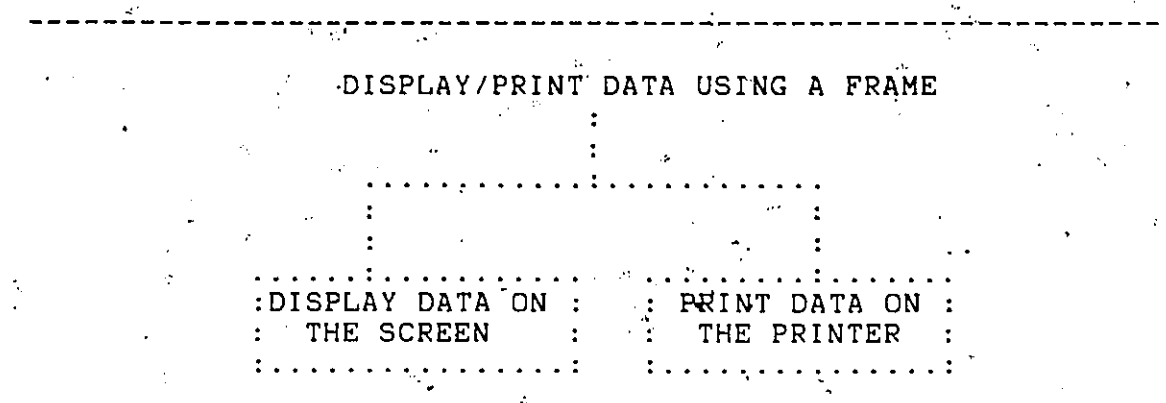


Figure 4.9 Sub-functions of DISPLAY/PRINT DATA USING A FRAME

Purpose : Output a form on the screen or on the printer

Initiated by : Option 4 of the MAIN menu and Option 1 of the sub-menu DISPLAY/PRINT DATA USING A FRAME

Input files : TFRAME, TFORM, framename.COR, formname.DAT

Code reference : Lines 3560 to 4640 in TH2

Procedures :

a. If the formname specified by the user is found among the ones in the file TFORM, user will be prompted for the frame name.

b. If the framename is found in the file TFRAME, user can specify whether to output the whole form or part of the form

c. If part of the form is specified, the system prompts for the field number.

d. If the field contains data and the corresponding block have been defined, the form is outputted by positioning the data at the coordinates.

4.2.5 DISPLAY FRAME LAYOUT

Purpose : To display the coordinates of the blocks in the frame

Initiated by : Option 5 of the MAIN menu or in the function CREATE A FRAME or MODIFY/DELETE BLOCK COORDINATES

Input file : framename.COR

Code reference : Lines 4650 to 5030 in TH2

Procedures :

a. If the frame name specified by the user is found in the file framename.COR, the coordinates of the blocks are read and are displayed with scales on the sides of the screen.

4.2.6 QUIT

The user can exit from the system and return to DOS on completing a function of FMS-UO.

4.3 SYSTEM INTEGRATION OF FMS-UO and RQL

One of the obstacles we encountered during integration was to find a suitable relational database management system which runs on micro-computers. Among the very few existing systems, RQL was the only one which we were able to obtain permission from its developer HELLO Software Ltd. for copying and modifying the codes so that integration is possible.

The limitation on the size of the memory prohibits loading both systems, FMS-UO and RQL, into memory. Instead, one system is loaded at a time. When the user initiates the transfer of data from one system to the other, the DOS command RUN is used to execute the other system. This command RUN clears the memory before the new system is loaded. Thus, a data file PASS is used to store data that is passed from one system to the other. Because of this obstacle, longer processing time for system integration is needed and the number of functions that can be implemented on form is limited.

A lot of effort is spent on designing the features of system

integration such as how system integration is initiated and the entrance and exit points of this function in both systems. Data transfer is initiated in the option CREATE/MODIFY/DELETE DATA FROM A FORM in FMS-UO. When the user specifies the transfer of data from RQL, the flag in record 1 of the file PASS is set to "1". The name of the form where data is to be input is stored in record 2, and the field number is stored in record 3 of PASS. The system control is passed to RQL. Data resulted from the RQL command DISPLAY is transferred to FMS-UO on the user's request. The system control is then returned to FMS-UO to continue with the process of creating or modifying data in a form. If the value of the record 4 of PASS is "1", data is retrieved from record 6 and is stored in the field of the form as specified in records 2 and 3 of PASS.

RQL consists of a Main program RDB.OPT.HALF and two subprograms SORT and SET.OPT. The program RDB.OPT.HALF consists of a section for identifying keywords in the command input by the user. The system then branches off to the subroutine of a specific function. The system control is passed to and from the Main program and two subprograms SORT and SET.OPT using the BASIC command RUN.

The original codes in the program RDB.OPT.HALF are modified in order to integrate RQL with FMS-UO. Codes are added at the beginning of the program for reading the flag in record 1 of the file PASS to determine whether data transfer is requested. When a command DISPLAY is input, the subroutine for the command is executed to search the tables for data that meet the specification in the command. If data transfer is requested, an

additional prompt is displayed to ask the user whether data resulted from the command DISPLAY be transferred to FMS-UO. If the answer to the prompt is "Y", the data selected to be transferred is stored in record 6 of the file PASS. The flag in record 4 of PASS is set to "1" to indicate the transfer of data from RQL. The system control is returned to FMS-UO using the BASIC command RUN. If the user responds "N" to the prompt for data transfer, the system control goes to a section in RQL which prompts for an command. Upon completion of an RQL command, a prompt is added to ask the user if he wants to continue with RQL or execute FMS-UO. Figure 4.10 describes the logic flow of RQL after the modification for system integration.

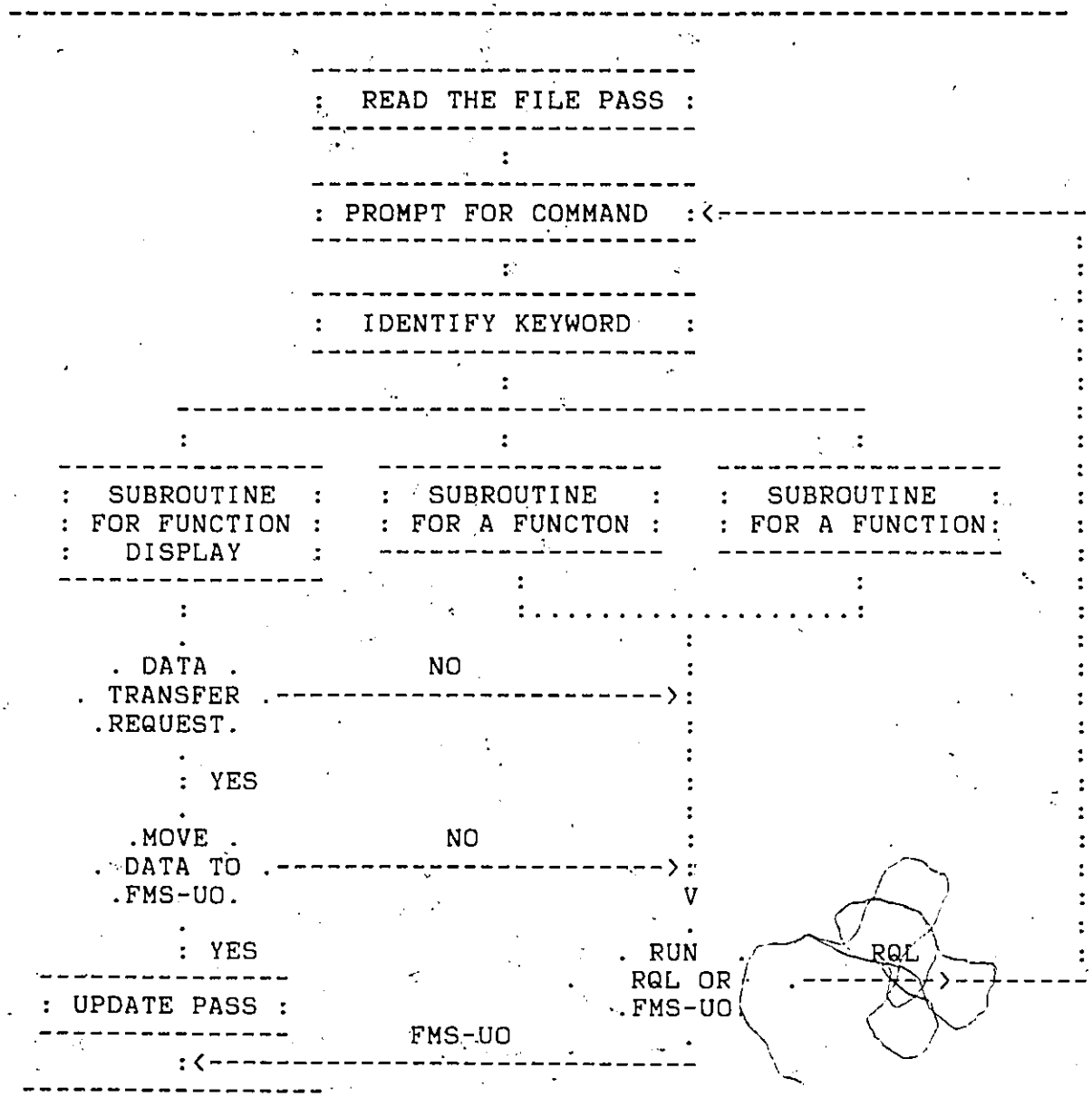


Figure 4.10 The logic flow of RQL after the modification for system integration

CHAPTER 5

AN EXAMPLE AND SOME CONCLUDING REMARKS

5.1 INTRODUCTION

In business, companies often send their clients and employees circulars or letters with identical contents but different names and addresses. It will be very tedious and time-consuming to have the same contents typed repeatedly. In this chapter, we illustrate how time and effort can be saved by generating the letters through the operations and interface of the two systems FMS-UO and RQL. Different formats for outputting the letters are also considered. The limitations of FMS-UO and areas for future research are discussed in Section 5.5.

5.2 THE PROCESS OF GENERATING SIMILAR LETTERS - AN EXAMPLE

The process consists of four steps :

(A) The names and addresses of the clients are stored in a relation in RQL.
(B) A frame for the output format of the letter is created by FMS-UO.
(C) Data of the letter are stored in a data file in FMS-UO.
(D) The letters are generated.

We shall explain these steps using the clients' names and addresses listed in Figure 5.1. A sample letter is shown in Figure 5.2.

LNAME	FNAME	STREET	CITY
BROWN	MARY	20 MAIN ST.	TORONTO
STEWART	JACK	111 LAURIER ST.	OTTAWA
SMITH	JOHN	10 DUNDAS ST.	HAMILTON

Figure 5.1 Names and addresses of clients

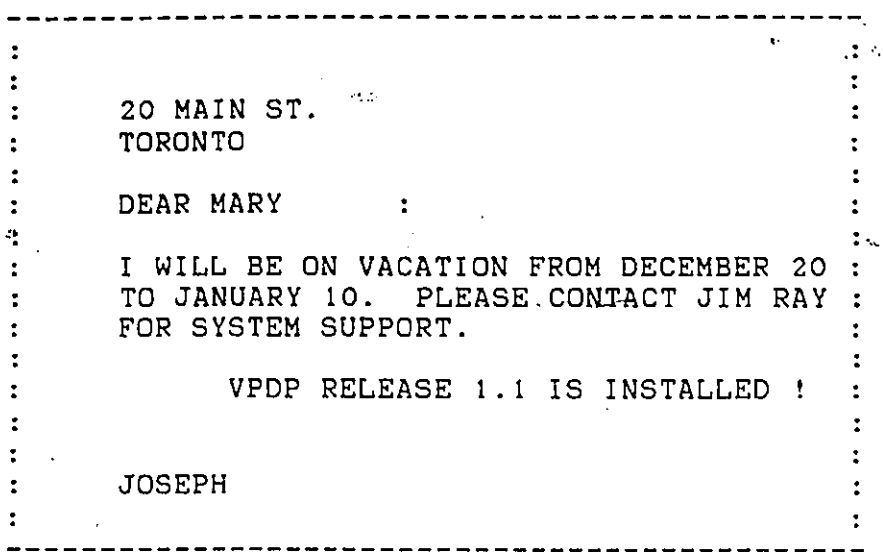


Figure 5.2 A sample letter

(A) The names and addresses of the clients are stored in a relation in RQL

The data in Figure 5.1 is stored in a table (relation) INFORM of a database CLIENT in RQL using the following commands :

. DEFINE DB CLIENT
(To create a database called CLIENT)

. USE DB CLIENT
(To specify the database)

. DEFINE TABLE INFORM
(To create a table called INFORM, the description, data type and width of each column are described)

. INSERT INFORM
(To input data into the table INFORM)

(B) A frame for the output format of the letter is created

The letter shown in Figure 5.2 is divided into different fields according to the functions and locations of the data. (See Figure 5.3.) Some guidelines for the division are :

a. A unit of data to be manipulated independently of the others is considered as a field, e.g., the name of a client.

b. Any part of the data requiring special layout can be assigned as a field. For example, the line which starts with "COFFEE TABLE ..." in Figure 5.2 is labeled as field #8. These words have special starting and ending positions which are different from those in the other lines.

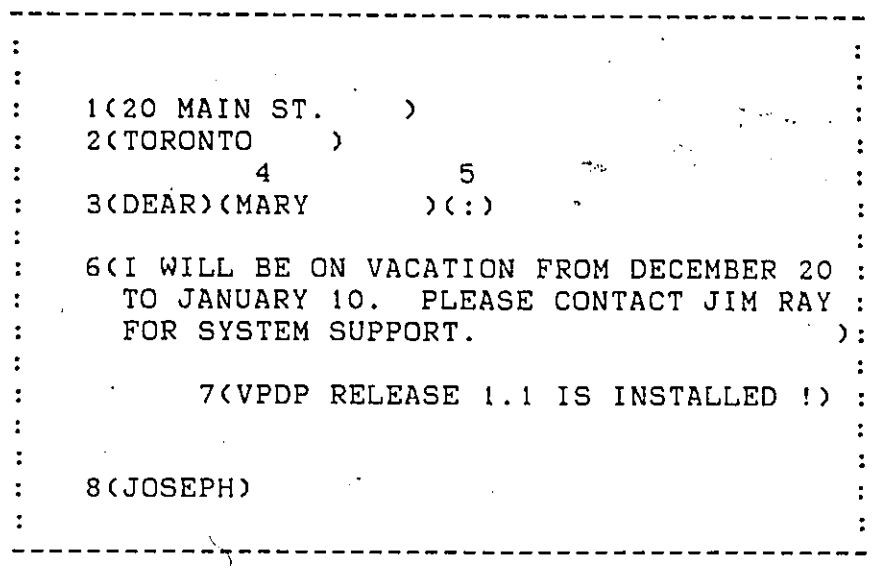


Figure 5.3 The different fields of the letter

The frame "ALETTER" is defined under Option 1 of the MAIN menu. The coordinates of its 9 blocks are listed in the following table.

BLOCK NUMBER	UPPER LEFT X	UPPER LEFT Y	BOTTOM RIGHT X	BOTTOM RIGHT Y
1	3	5	18	5
2	3	6	14	6
3	3	8	6	8
4	8	8	19	8
5	10	8	10	8
6	3	10	40	12
7	8	14	40	14
8	3	17	8	17

The frame ALETTER as shown in Figure 5.4 is displayed using Option 5 DISPLAY FRAME LAYOUT of the MAIN menu.

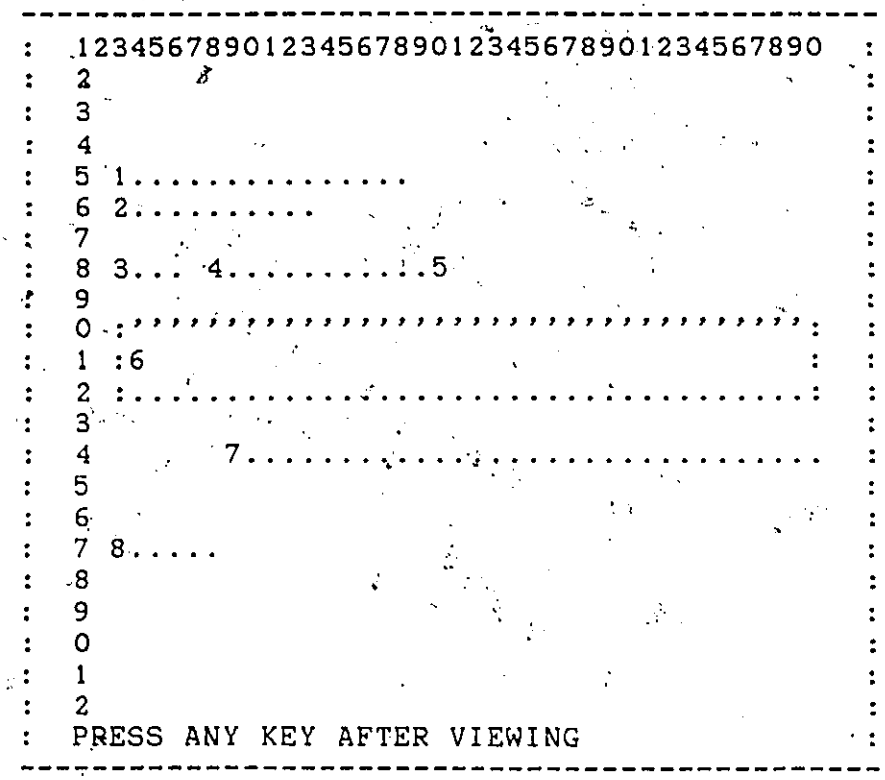


Figure 5.4 The frame ALETTER as displayed on the screen

(C) Data for the letter are stored in a data file in FMS-UO

For each letter, data is input into its fields #1, #2 and #4 from RQL and into the remaining fields from the console. The form name "SALE" is input under Option 3 CREATE/MODIFY/DELETE DATA IN A FORM of the MAIN menu. Option 1 CREATE/MODIFY DATA IN A FIELD is chosen from the sub-menu.

a. Data input from RQL

To input the street address of the client, Mary Brown for example, from RQL, field #1 is specified when the system prompts for the field number of the input data and answer with an "R" to the question in Figure 5.5. The message in Figure 5.6 will appear on the screen.

```
FMS> DO YOU WANT TO INPUT DATA FROM
     CONSOLE OR RQL ? (C OR R)
```

Figure 5.5 User can input data from console or RQL

```
** IF YOU HAVE A TABLE WHOSE DATA
   YOU WANT TO MOVE TO FMS-UO, USE
   THE RQL COMMAND TO DISPLAY THAT
   TABLE.  OTHERWISE, DEFINE YOUR TABLE NOW
```

Figure 5.6 The displayed message after user inputs data from RQL

In response to the prompt RQL>, the following commands should be typed in order to retrieve the street address of the client, Mary Brown.

```
RQL> USE DB CLIENT
RQL> DISPLAY TABLE INFORM ON STREET WHERE LNAME = "BROWN"
```

Figure 5.7 shows the street address retrieved from the database. The system then prompts if the data displayed is to be moved to the field in FMS-UO. (See Figure 5.8.) If the anwser

```
STREET
------
20 MAIN ST.
```

Figure 5.7 The address of Mary Brown retrieved from database

```
DO YOU WANT TO MOVE THIS DATA TO
THE FORM ? (Y OR N) :
```

Figure 5.8 The system prompts if the data is to be moved to the form

is "Y", the street address "20 MAIN ST." will be inserted into field #1 of the letter.

b. Data input from the console

The literal "DEAR" is input into field #3 of the letter through the console by specifying a "C" to the question as shown in Figure 5.5.

(D) The letters are generated

After having created the contents and frame of the letter, we choose Option 4 DISPLAY/PRINT DATA USING A FRAME of the MAIN menu to output the letter. Suppose we want to display the whole letter, we will select the Option DISPLAY DATA ON THE SCREEN and answer with "0" to the following question :

```
:          FMS> HOW MANY FIELDS DO YOU WANT TO          :
:               OUTPUT? (0 MEANS ALL) :                 :
```

Figure 5.9 The system prompts for the fields to be output

If we want to output only the street, city and name of the client, we answer with a "3" to the above question. As shown in Figure 5.10, we specify Fields #1, #2 and #4 to be output. The result is shown in Figure 5.11.

```
:          FMS> PLEASE SPECIFY THE FIELD NUMBERS :      :
:               1 2 4                                   :
```

Figure 5.10 The field numbers specified for output

```
:          20 MAIN ST.                                  :
:          TORONTO                                      :
:                                                       :
:               MARY                                    :
:                                                       :
:                                                       :
```

Figure 5.11 The address and name of the client are output

5.3 Generating letters with same contents but different clients

To generate similar letters for the other clients, Jack Stewart and John Smith, their names, street addresses and cities have to be retrieved from the database in RQL. The letter to Jack Stewart, as shown in Figure 5.12, is generated by selecting Option 4 DISPLAY/PRINT DATA USING A FRAME of the MAIN menu and specifying the frame "ALETTER" and the form "SALE".

```
111 LAURIER ST.
OTTAWA

DEAR JACK :

I WILL BE ON VACATION FROM DECEMBER 20
TO JANUARY 10.  PLEASE CONTACT JIM RAY
FOR SYSTEM SUPPORT.

      VPDP RELEASE 1.1 IS INSTALLED !


JOSEPH
```

Figure 5.12 The letter addressed to Jack Stewart

5.4 Outputting the letter by a different format

The format of the letter with the same contents can be changed if a different frame is used. If the frame "BLETTER" shown in Figure 5.13 is created under Option 1 of the MAIN menu, the generated letter is shown in Figure 5.14.

```
----------------------------------------------
:  1234567890123456789012345678901234567890  :
:  2                                          :
:  3       7...............................   :
:  4                                          :
:  5 1...............                         :
:  6 2..........                              :
:  7                                          :
:  8 3... 4...........5                       :
:  9                                          :
:  0 :....................................:   :
:  1 :6                                   :   :
:  2 :....................................:   :
:  3                                          :
:  4                                          :
:  5                              8.....      :
:  6                                          :
:  7                                          :
:  8                                          :
:  9                                          :
:  0                                          :
:  1                                          :
:  2                                          :
:  PRESS ANY KEY AFTER VIEWING                :
----------------------------------------------
```

Figure 5.13 The frame BLETTER

```
----------------------------------------------
:                                            :
:                                            :
:       VPDP RELEASE 1.1 IS INSTALLED !      :
:                                            :
:   111 LAURIER ST.                          :
:   OTTAWA                                   :
:                                            :
:   DEAR JACK        :                       :
:                                            :
:   I WILL BE ON VACATION FROM DECEMBER 20   :
:   TO JANUARY 10.  PLEASE CONTACT JIM RAY   :
:   FOR SYSTEM SUPPORT.                      :
:                                            :
:                                            :
:                              JOSEPH        :
:                                            :
----------------------------------------------
```

Figure 5.14 The letter addressed to Jack Stewart

5.5 SOME CONCLUDING REMARKS

In this thesis, a computerized form manipulation system FMS-UO and its integration with a commercial relational database management system are designed and developed. FMS-UO is implemented in a very restrictive computing environment - micro-computer APPLE II using the Disk Operating System DOS 3.3. Many form manipulation features, such as routing and tracing of forms cannot be implemented because of the limitation of computing resources. Its random access memory is only 64K which is very small for implementing system integration. For example, data shared between the two systems cannot be stored in the memory, instead, a data file is used. The speed of executing the functions is slow because of the micro-processor used. The screen is limited to 20 lines by 40 characters which is quite unlikely to represent a normal work paper. More sophisticated hardware and software facilities will enable the development of a more marketable system. The data processing capability of FMS-UO can be extended in the area where data retrieved from RQL for more than one form instance can be updated to the form instances in FMS-UO respectively.

As the cost of hardware is dropping considerably, automated systems for the home environment can become more sophisticated. It not only supports the inputting and outputting of voice, image, text, data and graphics, but can also be connected through the local area network to the banking system, grocery system and other commercial systems.

APPENDIX A

ERROR MESSAGES FOR FMS-UO

The system can detect certain errors during input or output operations. Following is a list of the error messages and their explanations.

CREATING A FRAME, MODIFY/DELETE BLOCK COORDINATES

*** ERROR! DUPLICATE FRAME - TRY AGAIN ***

If the input name for the new frame already exists, this error message will be displayed.

*** ERROR! X MUST BE BETWEEN 1 AND 40,
REDEFINE THE X COORDINATE ***

The X coordinate is outside the range allowed by the system.

*** ERROR! Y MUST BE BETWEEN 1 AND 22,
REDEFINE THE Y COORDINATE ***

The Y coordinate is outside the range allowed by the system.

*** ERROR! COORDINATES OF THE BOTTOM POINT
MUST BE GREATER THAN THE TOP COORDINATES,
REDEFINE THE BLOCK ***

The bottom right corner must by on the right and below of the top left corner.

*** ERROR! OVERLAPPING BLOCKS. REDEFINE THE BLOCK ***

The block overlaps with other blocks of the frame.

*** ERROR! FRAME HAS NOT BEEN DEFINED ***

*** ERROR! BLOCK HAS BEEN DEFINED, CANNOT BE ADDED ***

*** ERROR! BLOCK DOES NOT EXIST BEFORE, CANNOT BE DELETED ***

CREATE/MODIFY/DELETE DATA IN A FORM

*** ERROR! FIELD NUMBER CANNOT BE <= 0 ***

*** ERROR! FIELD NUMBER CANNOT BE > 10 ***

Field number must be between 1 and 10, inclusive.

*** ERROR! FORM HAS NOT BEEN DEFINED ***

The Form specified by the user has not been created.

DISPLAY/PRINT DATA USING A FRAME

*** ERROR! FRAME HAS NOT BEEN DEFINED ***

The frame requested for outputting does not exist.

*** ERROR! FORM HAS NOT BEEN DEFINED ***

The form specified for output does not exist.

*** ERROR! BLOCK #X HAS NOT BEEN DEFINED ***

The block #X in the specified frame for outputting the form has not been defined yet.

*** FMS> PLEASE INSERT THE DISKETTE WHICH
CONTAINS THE FILE FORM.DAT INTO
DISK DRIVE 2 THEN PRESS ANY KEY

The data file is not in disk drive 2.

*** FMS> PLEASE CONNECT THE PRINTER THEN
PRESS ANY KEY

The printer is not hooked up to the computer.

DISPLAY FRAME LAYOUT

*** ERROR! FRAME NAME DOES NOT EXIST ***

APPENDIX B

THE PROGRAM OF FMS-UO (TH2)

CODES	COMMENTS
100 REM THIS FORM MANIPULATION SYSTEM (FMS) CONSISTS OF TWO PARTS :	
110 REM PART I. FACILITIES FOR CREATING, MODIFYING, DELETING, DISPLAYING AND PRINTING FORMS.	
120 REM PART II. FACILITIES FOR INTERFACING WITH AN EXISTING RELATIONAL DATABASE SYSTEM (RQL).	
125 D$ = CHR$ (4): PRINT D$;"MAX FILES 4"	
130 DIM X1%(10),X2%(10),Y1%(10),Y2%(10),X%(10),A$(100),P$(10,100),PS$(100),N%(10),C$(100),E$(22,10,10)	Declaration of arrays
140 Z% = 0:W% = 1:G% = Z%:G$ = CHR$(7):D$ = CHR$ (4)	
150 REM CHECK IF THERE IS ANY DATA PASSED FROM RQL TO FMS	Check if any data is passed from RQL in the file PASS
160 PRINT D$: PRINT D$;"OPEN PASS,L300,D1,S6": PRINT D$;"READ PASS,R1": INPUT FB%: PRINT D$;"CLOSE PASS": IF FB% = 0 THEN GOTO 180	
170 PRINT D$;"OPEN PASS,L300,D1": PRINT D$;"READ PASS,R4": INPUT LD%: PRINT D$: PRINT D$;"WRITE PASS,R1": PRINT 0: PRINT D$: PRINT D$;"CLOSE PASS"	
180 ONERR GOTO 200	
190 PRINT D$;"UNLOCK TFRAME,D1": POKE 216,0: GOTO 220	Check if the file TFRAME exists.
200 POKE 216,0	
210 PRINT D$;"OPEN TFRAME,L20,D1": PRINT D$;"WRITE TFRAME,R0": PRINT Z%: PRINT D$;"CLOSE": PRINT D$: PRINT D$;"OPEN TFORM,L20,D1": PRINT D$;"WRITE TFORM,R0": PRINT Z%: PRINT D$: PRINT D$;"CLOSE"	
220 IF FB% = Z% THEN GOTO 250	
230 IF LD% = W% THEN GOTO 3030	Data is passed from RQL
250 CALL - 936: REM MAIN MENU	
260 PRINT "FMS> INDICATE YOUR CHOICE BY ENTERING THE NUMBER"	Display the Main Menu

CODES

COMMENTS

```
270  PRINT : PRINT "1. CREATE A F
     RAME": PRINT : PRINT "2. MOD
     IFY/DELETE BLOCK COORDINATES
     "
280  PRINT : PRINT "3. CREATE/MOD
     IFY/DELETE DATA IN": PRINT "
        A FORM": PRINT
290  PRINT "4. DISPLAY/PRINT DATA
      USING A FRAME ": PRINT
300  PRINT "5. DISPLAY FRAME LAYO
     UT": PRINT
310  PRINT "6. QUIT": PRINT : INPUT
     AN$
320  IF AN$ = "1" THEN  GOTO 430
330  IF AN$ = "2" THEN  GOTO 930
340  IF AN$ = "3" THEN  GOTO 1970

350  IF AN$ = "4" THEN  GOTO 3590

360  IF AN$ = "5" THEN  GOTO 4680

370  IF AN$ = "6" THEN  GOTO 5030

380  GOTO 250
400  REM
410  REM     CREATE A FRAME
420  REM
430  CALL  - 936:RO% = W%:RE% = Z
     %
440  PRINT "CREATE A FRAME": PRINT
     "==============": PRINT : INPUT
     "FMS> PLEASE GIVE A NEW FRAM
     E NAME :";FF$
450  GOSUB 1900: REM   CHECK FOR
     DUPLICATE FRAME NAME
460  IF Y% = Z% THEN  PRINT G$;"*
     ** ERROR! DUPLICATE FRAME -
     TRY": PRINT "      AGAIN ***"
     : FOR PAUSE = 1 TO 1500: NEXT
     PAUSE: GOTO 430
470 I = W%:NE% = W%:TP% = Z%:BI =
     I: REM  NO DATA IN THE COORD
     INATE FILE YET
480  GOSUB 1380: REM   THE USER W
     ANTS TO SEE THE FRAME DISPLA
     Y
485 I = BI
490  PRINT : PRINT "BLOCK# ";I:BI
      = I
500  PRINT : PRINT "FMS> PLEASE S
     PECIFY THE X,Y COORDINATES":
      PRINT "     OF THE TOP LEFT
      CORNER OF BLOCK# ";I
```

Option 1. CREATE A FRAME

The system prompts for a new frame name

User can select to see the frame

Define coordinates of the top left corner of a block

CODES

COMMENTS

```
520 WX% = Z%:C1% = W%
530 I = BI
540 PRINT
550  INPUT "X, (1-40) : ";X1%(I):
     X% = X1%(I):FR% = 1: GOTO 16
     10
560  INPUT "Y, (1-22) : ";Y1%(I):
     Y% = Y1%(I):FR% = 1: GOTO 16
     28
595  GOSUB 1380:X1%(BI) = X%:Y1%(
     BI) = Y%: REM    IF USER WAN
     T S TO SEE THE FRAME DISPLAY

600 I = BI: PRINT : PRINT "FMS> P
     LEASE SPECIFY THE X,Y COORDI
     NATES": PRINT "      OF THE B
     OTTOM RIGHT CORNER OF": PRINT
     "      BLOCK# ";I
620 WX% = Z%:C1% = Z%:I = BI:WB% =
     W%
630  PRINT
640  INPUT "X, (1-40) : ";X2%(I):
     X% = X2%(I):FR% = 2: GOTO 16
     10
650  INPUT "Y, (1-22) : ";Y2%(I):
     Y% = Y2%(I):FR% = 2: GOTO 16
     28
690  IF X2%(I) < X1%(I) OR Y2%(I)
      < Y1%(I) THEN  PRINT G$: PRINT
     "*** ERROR! COORDINATES OF T
     HE": PRINT "    BOTTOM POINT
      MUST BE GREATER": PRINT "
       THAN THE TOP COORDINATES."
     : PRINT "    REDEFINE THE BL
     OCK ***": GOTO 490
700  IF I = W% AND RE% = W% THEN
      GOTO 720
710  IF I = W% THEN X%(1) = 1: GOTO
     750
720  IF RO% = W% THEN X%(I) = I:K
      = I
730  GOSUB 1430: REM   CHECK IF T
     HE BLOCKS OVERLAP
740  IF ER% = W% THEN  PRINT : PRINT
     G$;"*** ERROR! OVERLAPPING B
     LOCKS.": PRINT "    REDEFINE
      THE BLOCK ***":ER% = Z%: GOTO
     490
750  PRINT : PRINT "FMS> DO YOU W
     ANT TO MAKE ANY CHANGES": INPUT
     "      FOR THIS BLOCK ? (Y OR
      N) : ";AN$
```

User can select to see the frame

Define coordinates of the bottom right corner of a block

Check the coordinates of a block

Blocks overlaps, redefine the coordinates of the block

The system prompts if the coordinates are to be modified

CODES

COMMENTS

```
760  IF AN$ = "Y" THEN  GOTO 764
762  IF AN$ = "N" THEN  GOTO 780
763  IF AN$ < > "Y" AND AN$ < >
     "N" THEN  GOTO 750
764  PRINT : PRINT "FMS> DO YOU W
     ANT TO LEAVE THIS OPTION ?":
      INPUT "      (Y OR N) : ";CE
     $
767  IF CE$ = "Y" THEN  PRINT D$:
      PRINT D$;"CLOSE": GOTO 250
768  IF CE$ = "N" THEN  GOTO 490
769  IF CE$ < > "Y" AND CE$ < >
     "N" THEN  GOTO 764
780  GOSUB 1700: REM   STORE THE
     COORDINATES INTO THE FILE
790  IF RE% = 1 THEN  GOTO 850
800  GOSUB 1830: REM    RECORD TH
     E BLOCK# BEING DEFINED
810  IF RO% < > W% THEN  GOTO 85
     0
820  PRINT : INPUT "FMS> DO YOU W
     ANT TO DEFINE ANOTHER BLOCK
         ? (Y OR N) : ";AN$
830  IF AN$ = "Y" THEN I = I + 1:
      GOTO 490
840  IF AN$ < > "Y" AND AN$ < >
     "N" THEN  GOTO 820
850  IF RO% = Z% THEN  RETURN
860  REM   PUT DATA INTO TFRAME T
     O RECORD THE FRAME NAME
870  PRINT D$;"OPEN TFRAME,L20,D1
     ": PRINT D$;"READ TFRAME,RO"
     : INPUT K%
880  PRINT D$;"WRITE TFRAME;RO": PRINT
     K% + 1
890  PRINT D$;"WRITE TFRAME,R";K%
      + 1: PRINT FF$
900  PRINT D$;"CLOSE TFRAME"
910  GOTO 250
920  REM
930  CALL  - 936:RO% = Z%
940  PRINT "MODIFY/DELETE BLOCK C
     OORDINATES": PRINT "========
     ======================": PRINT

942 RE% = Z%: REM     BLOCK EXIST
      BEFORE?
944  PRINT : INPUT "FMS> PLEASE S
     PECIFY FRAME NAME : ";FF$
946  PRINT D$;"OPEN TFRAME,L20,D1
     ":TEMP = Z%
```

Store the frame name into the file TFRAME

Option 2. MODIFY/DELETE BLOCK COORDINATES

The system prompts for the frame name

CODES

COMMENTS

```
948  PRINT D$;"READ TFRAME,RO": INPUT
     K%: PRINT D$: IF K% = Z% THEN
      PRINT : PRINT G$;"*** ERROR
     ! FRAME HAS NOT BEEN DEFINED
      **": PRINT D$: PRINT D$"CLO
     SE": FOR PAUSE = 1 TO 1500: NEXT
     : GOTO 250
950  FOR I = 1 TO K%: PRINT D$;"R
     EAD TFRAME,R";I: INPUT FY$: IF
     FF$ = FY$ THEN TEMP = I
952  NEXT : PRINT D$
954  IF TEMP = Z% THEN  PRINT G$;
     "*** ERROR! FRAME HAS NOT BE
     EN DEFINED ***": PRINT D$: PRINT
     D$;"CLOSE": FOR PAUSE = 1 TO
     1500: NEXT PAUSE: GOTO 250
960  PRINT : PRINT : PRINT "FMS>
     PLEASE INDICATE YOUR CHOICE
     BY": PRINT "     ENTERING TH
     E NUMBER"
965  PRINT : PRINT "1. MODIFY AN
     EXISTING BLOCK": PRINT : PRINT
     "2. ADD A NEW BLOCK ": PRINT
     : PRINT "3. DELETE AN EXISTI
     NG BLOCK"
970  PRINT : PRINT "4. DELETE THE
      WHOLE FRAME": PRINT : INPUT
     CE$
975  CALL  - 936
980  IF CE$ <  > "1" AND CE$ <  >
     "2" AND CE$ <  > "3" AND CE$
      <  > "4" THEN  GOTO 950
1060  IF CE$ <  > "4" THEN  GOTO
     1120
1070  PRINT : PRINT "FMS> YOU HAV
     E CHOSEN TO DELETE THE": PRINT
     "     WHOLE FRAME, DO YOU ST
     ILL": INPUT "     WANT TO GO
      AHEAD ? (Y OR N) : ";AN$
1080  IF AN$ <  > "Y" AND AN$ <  >
     "N" THEN  GOTO 1070
1090  IF AN$ = "Y" THEN  GOTO 111
     0: REM   DELETE ALL BLOCKS
1100  IF AN$ = "N" THEN  GOTO 250

1103  GOTO 1070
1110  PRINT D$;"WRITE TFRAME,R";T
     EMP: PRINT "": PRINT D$: PRINT
     D$;"CLOSE TFRAME": PRINT D$;
     "DELETE";FY$;".COR,D1": GOTO
     250
1120  PRINT D$;"OPEN";FF$;".COR,L"
     50"
```

Check if the frame name has been defined

Display options in submenu

The system prompts for confirmation of deleting the whole frame

Delete the frame name from the file TFRAME

CODES

```
1130  PRINT D$;"READ";FF$;".COR,R
      O": INPUT K: FOR J = 1 TO K:
       INPUT X%(J): NEXT
1140  PRINT D$;"CLOSE";FF$;".COR"

1142  IF CE$ = "1" THEN  PRINT "M
      ODIFY AN EXISTING BLOCK'S CO
      ORDINATES": PRINT "=========
      ============================
      ="
1144  IF CE$ = "2" THEN  PRINT "A
      DD A NEW BLOCK": PRINT "====
      ==========="
1146  IF CE$ = "3" THEN  PRINT "D
      ELETE AN EXISTING BLOCK'S CO
      ORDINATES": PRINT "=========
      ============================
      ="
1150  PRINT : PRINT "FMS> BLOCKS
      DEFINED SO FAR ARE : "
1160  FOR J = 1 TO K: PRINT X%(J)
      ; SPC( 1): NEXT
1170  PRINT : GOSUB 1380: PRINT :
       REM  SEE DISPLAY
1180  PRINT "FMS> PLEASE SPECIFY
      THE BLOCK NUMBER": INPUT "
         TO BE MODIFIED : ";I
1185 RE% = 0
1190  FOR J = 1 TO K
1200  IF I = X%(J) THEN RE% = 1:G
      E% = X%(J): REM  THIS BLOCK
      EXIST
1210  NEXT
1215  IF CE$ = "2" AND RE% = 1 THEN
       PRINT G$;"*** ERROR! BLOCK
      HAS BEEN DEFINED, ": PRINT "
           CANNOT BE ADDED **": FOR
      PAUSE = 1 TO 1500: NEXT PAUS
      E: GOTO 250
1220  IF CE$ = "1" OR CE$ = "2" THEN
       GOTO 1320: REM   ATTACH AND
       MODIFY BLOCKS' COORDINATES
1230  IF CE$ = "3" THEN  CALL  -
      936: PRINT "DELETE BLOCK": PRINT
      "============": PRINT
1240  IF RE% <  > W% THEN  PRINT
      G$;"***ERROR! BLOCK DOES NOT
       EXIST BEFORE,": PRINT "   C
      ANNOT BE DELETED ***": FOR P
      AUSE = 1 TO 1700: NEXT PAUSE
      : GOTO 250
```

COMMENTS

The system prompts for the block number to be modified

The block number exists, cannot be added

CODES

```
1250  PRINT D$;"OPEN";FF$;".COR,L
      50"
1260  PRINT D$;"WRITE";FF$;".COR,
      R0": PRINT (K - 1)
1270  FOR J = 1 TO K: IF X%(J) < .
      > GE% THEN  PRINT X%(J)
1280  NEXT
1290  PRINT D$;"CLOSE";FF$;".COR"

1300  PRINT "FMS> BLOCK NUMBER ";
      : PRINT GE%;: PRINT " HAS BE
      EN DELETED": FOR PAUSE = 1 TO
      1500: NEXT PAUSE
1310  GOTO 250
1320 ER% = Z%: PRINT D$;"OPEN";FF
      $;".COR,L50,D1": FOR J = 1 TO
      K: PRINT D$;"READ";FF$;".COR
      ,R";J: INPUT X1%(J): INPUT X
      2%(J): INPUT Y1%(J): INPUT Y
      2%(J): NEXT : PRINT D$
1330  GOSUB 490: PRINT D$
1340  PRINT D$: PRINT : PRINT "FM
      S> DO YOU WANT TO MODIFY OTH
      ER BLOCKS": INPUT "     OF T
      HIS FRAME ? (Y OR N) : ";AN$

1350  IF AN$ = "Y" THEN  CALL  -
      936: GOTO 960
1360  IF AN$ <  > "Y" AND AN$ <  >
      "N" THEN  GOTO 1340
1370  PRINT D$: PRINT D$;"CLOSE":
       GOTO 250
1375  REM  SUBROUTINE TO ASK THE
      USER IF HE WOULD LIKE TO SEE
       THE FRAME
1380  PRINT D$: PRINT : PRINT "FM
      S> DO YOU WANT TO SEE THE FR
      AME": INPUT "     FIRST ? (Y
       OR N) : ";AN$
1390  IF AN$ = "Y" THEN SU% = W%:
       GOSUB 4750: REM   SEE THE F
      RAME DISPLAY
1400  IF AN$ <  > "Y" AND AN$ <  >
      "N" THEN  GOTO 1380
1410  IF AN$ = "Y" THEN  CALL  -
      936
1420  RETURN
1430  REM   SUBROUTINE TO CHECK
      OVERLAPPING
1440 L = W%
```

COMMENTS

Decrement the number of blocks defined

The system prompts if other blocks is to be modified

The system prompts if the user would like to see the frame display

CODES

COMMENTS

```
1450 J = X%(L)
1460  IF RE% = W% THEN  GOTO 1550

1470  IF Y1%(I) < Y1%(J) AND Y2%(
     I) < Y1%(J) THEN  GOTO 1520
1480  IF X1%(I) < X1%(J) AND X2%(
     I) < X1%(J) THEN  GOTO 1520
1490  IF Y1%(I) > Y2%(J) AND Y2%(
     I) > Y2%(J) THEN  GOTO 1520
1500  IF X1%(I) > X2%(J) AND X2%(
     I) > X2%(J) THEN  GOTO 1520
1510 ER% = W%: RETURN
1520  IF RE% = W% THEN  GOTO 1560

1530 L = L + 1: IF L < K THEN  GOTO
     1450
1540  RETURN
1550  IF I <  > J THEN  GOSUB 147
     0
1560  IF ER% = W% THEN  RETURN
1570 L = L + 1: IF L <  = K THEN
     J = X%(L): IF I <  > J THEN
      GOTO 1470
1580  IF I = J AND L <  = K THEN
      GOTO 1570
1590  RETURN
1600  REM   CHECK COORDINATES LIM
     IT
1610 WX% = Z%
1620  IF X% < 1 OR X% > 40 THEN  PRINT
     G$;"***ERROR! X MUST BE BETW
     EEN 1 AND 40.": PRINT "   RE
     DEFINE THE X COORDINATE ***"
     :WX% = W%
1623  IF WX% = W% AND FR% = 1 THEN
      GOTO 550
1625  IF WX% = W% AND FR% = 2 THEN
      GOTO 640
1626  IF WX% <  > W% AND FR% = 1 THEN
      GOTO 560
1627  IF WX% <  > W% AND FR% = 2 THEN
      GOTO 650
1628 WX% = Z%
1630  IF Y% < 1 OR Y% > 22 THEN  PRINT
     G$;"***ERROR! Y MUST BE BETW
     EEN 1 AND 22.": PRINT "   RE
     DEFINE THE Y COORDINATE ***"
     :WX% = W%
1632  IF WX% = W% AND FR% = 1 THEN
      GOTO 560
1633  IF WX% = W% AND FR% = 2 THEN
      GOTO 650
```

Check if blocks overlap

Check if the coordinates are within the limits

CODES

```
1634  IF WX% <  > W% AND FR% = 1 THEN
      GOTO 595
1635  IF WX% <  > W% AND FR% = 2 THEN
      GOTO 690
1700  REM  STORE DATA INTO FRAMEN
      AME .COR
1710  PRINT D$;"OPEN";FF$;".COR,L
      50"
1720  IF RE% = 1 THEN  GOTO 1780
1730  IF NE% = W% THEN  PRINT D$;
      "WRITE";FF$;".COR,RO": PRINT
      1: PRINT D$: GOTO 1780
1740  PRINT D$;"READ";FF$;".COR,R
      O": INPUT NB%
1750  PRINT D$
1760  PRINT D$;"WRITE ";FF$;".COR
      ,RO": PRINT NB% + 1
1770  PRINT D$
1780  PRINT D$;"WRITE";FF$;".COR,
      R";I
1790  PRINT X1%(I): PRINT X2%(I):
      PRINT Y1%(I): PRINT Y2%(I)
1800  PRINT D$;"CLOSE";FF$;".COR"

1810 NE% = Z%
1820  RETURN
1830  REM  PUT BLOCK# INTO RO OF
      FF$.COR
1840  PRINT D$;"OPEN";FF$;".COR,L
      50"
1850  PRINT D$;"READ";FF$;".COR,R
      O": INPUT NB%
1860  PRINT D$;"WRITE";FF$;".COR,
      RO"
1870  PRINT D$;"POSITION";FF$;".C
      OR,R";NB%
1880  PRINT D$;"WRITE";FF$;".COR"
      : PRINT I
1890  PRINT D$;"CLOSE";FF$;".COR"
      : RETURN
1900  ONERR  GOTO 1920: REM  CHEC
      K FOR DUPLICATE FRAME NAME
1910 Y% = Z%: PRINT D$;"UNLOCK";F
      F$;".COR ,D1": POKE 216,0: RETURN

1920 Y% = W%: POKE 216,0: GOTO 46
      0: REM     NOT EXIST BEFORE

1930  ONERR  GOTO 1950: REM  CHEC
      K  IF FRAME NAME EXIST
1940 Y% = Z%: PRINT D$;"UNLOCK";F
      F$;".COR,D1": POKE 216,0: RETURN
```

COMMENTS

Store the coordinates into the file TFRAME

CODES

```
1950 Y% = W%: POKE 216,0: GOTO 21
     00: REM  NOT EXIST BEFORE
1960  REM
1970  REM   ENTER, MODIFY OR DELE
     TE DATA IN FRAME
1980  REM
1990  CALL  - 936
2000  PRINT "CREATE/MODIFY/DELETE
      DATA IN A FORM": PRINT "===
     ========================
     ====": PRINT
2002  PRINT : INPUT "FMS> PLEASE
     SPECIFY THE FORM NAME : ";FF
     $
2004  PRINT D$: PRINT D$;"OPEN TF
     ORM,L20,D1":TEMP = Z%
2005  PRINT D$;"READ TFORM,R0": INPUT
     K%: PRINT D$
2006  IF K% = 0 THEN  GOTO 2008
2007  FOR I = 1 TO K%: PRINT D$;"
     READ TFORM,R";I: INPUT FY$: IF
     FY$ = FF$ THEN TEMP = I: REM
      DATA FILE EXIST
2008  NEXT : PRINT D$: PRINT D$;"
     CLOSE TFORM"
2010  PRINT : PRINT : PRINT "FMS>
      PLEASE INDICATE YOUR CHOICE
      BY": PRINT "     ENTERING T
     HE NUMBER : ": PRINT : PRINT
     "  1. CREATE/MODIFY DATA IN
     A FIELD"
2020  PRINT "  2. DELETE DATA FRO
     M ONE FIELD": PRINT "  3. DE
     LETE DATA FROM ALL FIELDS"
2030  INPUT A$
2040  IF A$ <  > "1" AND A$ <  >
     "2" AND A$ <  > "3" THEN  GOTO
     2010
2050  IF TEMP <  > Z% THEN  GOTO
     2220
2120  IF A$ = "3" OR A$ = "2" THEN
      PRINT G$;"***ERROR! FORM HA
     S NOT BEEN DEFINED ***": FOR
     PAUSE = 1 TO 1500: NEXT PAUS
     E: GOTO 250
2140  ONERR  GOTO 2160
2150  PRINT D$: PRINT D$;"OPEN";F
     F$;".DAT,D2": POKE 216,0: GOTO
     2180: REM  INITIALIZE FILE
```

COMMENTS

Option 3. CREATE/MODIFY/ DELETE DATA IN A FORM

The system prompts for the form name.

Check if the form exists

Display the options in the submenu

CODES	COMMENTS
2160 Y = PEEK (222): IF Y = 9 THEN PRINT "FMS> DISK FULL! PLEASE INSERT AN": PRINT " INITIALIZED DISKETTE INTO DISK": PRINT " DRIVE 2 THEN PRESS ANY KEY": GET A$: GOTO 2140	
2170 IF Y = 8 THEN PRINT G$"FMS> PLEASE INSERT A DISKETTE": PRINT " INTO DISK DRIVE 2 THEN": PRINT " PRESS ANY KEY": GET A$: GOTO 2140	
2180 PRINT D$;"WRITE";FF$;".DAT": REM INITIALIZE THE DATA FILE	Initialize the data file
2190 PRINT "00": PRINT "000": FOR I = 1 TO 20: PRINT "0": NEXT	
2200 FOR I = 1 TO 10: PRINT "000": NEXT	
2210 PRINT D$;"OPEN";FF$;".DAT": PRINT D$;"POSITION";FF$;".DAT": PRINT D$;"WRITE";FF$;".DAT": PRINT "033": PRINT D$;"CLOSE"	
2215 PRINT D$;"OPEN TFORM,L20,D1": PRINT D$;"READ TFORM,R0": INPUT K%: PRINT D$: PRINT D$;"WRITE TFORM,R0": PRINT K% + 1: PRINT D$: PRINT D$;"WRITE TFORM,R";K% + 1: PRINT FF$: PRINT D$: PRINT D$;"CLOSE TFORM"	
2220 ONERR GOTO 2240: REM DATA FILE EXISTS	
2230 PRINT D$: PRINT D$;"VERIFY";FF$;".DAT,D2": POKE 216,0: GOTO 2250	
2240 PRINT : PRINT "FMS> PLEASE INSERT THE DISKETTE WHICH": PRINT " CONTAINS THE FILE ";FF$;".DAT INTO": PRINT " DISK DRIVE 2 THEN PRESS ANY KEY": GET AN$: POKE 216,0: GOTO 2220	
2250 IF AS$ = "3" THEN GOTO 3270	
2270 PRINT : INPUT "FMS> PLEASE GIVE THE FIELD NUMBER : ";BB%: IF BB% > 10 THEN PRINT G$"***ERROR! FIELD NUMBER CANNOT BE > 10 ***": GOTO 2270	The system prompts for the field number

CODES	COMMENTS
2280 IF BB% < = 0 THEN PRINT G $;"***ERROR! FIELD NUMBER CA NNOT BE <=0 ***": GOTO 2270	
2360 IF AS$ = "2" THEN GOTO 350 0	Delete data in one field
2370 PRINT D$;"OPEN";FF$;".DAT,D 2"	
2380 PRINT D$;"POSITION";FF$;".D AT,R";BB% + 1: PRINT D$;"REA D";FF$;".DAT": INPUT AN$: PRINT D$: IF VAL (AN$) = 0 THEN M O% = Z%: PRINT D$;"CLOSE";FF $;".DAT": GOTO 2460: REM ENTER DATA FROM THE CONSOLE OR FROM RQL	Check whether the field contains data
2390 PRINT : PRINT "FMS> THE BLO CK CONTAINS DATA, DO YOU": INPUT " WANT TO MODIFY THE DAT A ? (Y OR N) : ";AN$	The system prompts if the data in the field is to be modified
2400 IF AN$ < > "Y" AND AN$ < > "N" THEN GOTO 2390	
2410 IF AN$ = "Y" THEN MO% = W%: GOTO 2460: REM C OR R	
2415 IF AN$ < > "Y" AND AN$ < > "N" THEN GOTO 2390	
2420 PRINT : INPUT "FMS> CREATE OR MODIFY OR DELETE ANOTHER FIELD ? (Y OR N) : " ;AN$	The system prompts if data in another field is to be modified
2430 IF AN$ < > "Y" AND AN$ < > "N" THEN GOTO 2420	
2440 IF AN$ = "Y" THEN GOTO 200 4	
2450 GOTO 250: REM IF AN$="N"	Return to Main Menu
2460 PRINT : PRINT "FMS> DO YOU WANT TO INPUT DATA FROM": INPUT " CONSOLE OR FROM RQL ? (C OR R) : ";AN$	The system prompts whether data is input from RQL or console
2470 IF AN$ < > "C" AND AN$ < > "R" THEN GOTO 2460	
2480 IF AN$ = "R" THEN GOTO 298 0: REM DATA FROM RQL	
2490 PRINT : PRINT "FMS> PLEASE INPUT DATA ";CO% = Z%:SC% = W%:FB% = Z%: REM SC%= NO. OF STRING	The system prompts for data from the console
2500 B$ = ""	
2510 GET AA$: IF AA$ = CHR$ (8) THEN GOTO 2540: REM BACK SPACE	

CODES

COMMENTS

```
2520  PRINT AA$;: IF AA$ =  CHR$
     (13) THEN  GOTO 2650: REM
     CARRIAGE RETURN
2530  GOTO 2580
2540  IF  LEN (B$) = 0 GOTO 2510
2550  IF  ASC ( RIGHT$ (B$,1)) >
     31 THEN  PRINT AA$" "AA$;
2560  IF  LEN (B$) = 1 THEN B$ =
     "": GOTO 2510
2570 B$ =  LEFT$ (B$, LEN (B$) -
     1): GOTO 2510
2580  IF AA$ =  CHR$ (21) THEN 25
     10: REM   FORWARD
2590  IF AA$ = "," THEN B$ = B$ +
     "-+1": GOTO 2510: REM   HAVE
      TO CONVERT THE CHARACTERS I
     F IT IS
2600  IF AA$ =  CHR$ (34) THEN B$
      = B$ + "-+2": GOTO 2510: REM
       "," OR " OR ":" , BECAUSE

2610  IF AA$ = ":" THEN B$ = B$ +
     "-+3": GOTO 2510: REM   THEY
      ARE NOT VALID CHARACTERS IN
      THE DATA FILE
2620 B$ = B$ + AA$
2630  IF  LEN (B$) = 240 THEN A$(
     SC%) = B$:B$ = "":SC% = SC% +
     1: GOTO 2510
2640  GOTO 2510
2650 A$(SC%) = B$
2660  REM   SEE IF ANY COMMA, COL
     ON OR BACK SPACE IN THE INPU
     T
2670  FOR U = 1 TO SC%:ZA$ = A$(U
     ): FOR J = 1 TO 100:C$(J) =
     "": NEXT J
2680 M% = W%
2690  FOR J = 1 TO  LEN (ZA$)
2700 C1$ =  MID$ (ZA$,J,1)
2710  IF C1$ <  > " " THEN C$(M%)
      = C$(M%) + C1$:W1% = Z%: GOSUB
     2750: GOTO 2730
2720 M% = M% + 1
2730  NEXT J: GOSUB 2800
2740  NEXT U: GOTO 3060
2750 S =  LEN (C$(M%)): IF S > 3 THEN
      GOSUB 2800
2760  IF  RIGHT$ (C$(M%),3) = "-+
     1" THEN C$(M%) = ",": RETURN
```

Convert comma, quotation mark and colon before storing them into the file

CODES

COMMENTS

```
2770  IF  RIGHT$ (C$(M%),3) = "-+
     2" THEN C$(M%) =  CHR$ (34):
      RETURN
2780  IF  RIGHT$ (C$(M%),3) = "-+
     3" THEN C$(M%) = ":": RETURN

2790  GOTO 2830
2800  IF  RIGHT$ (C$(M%),3) = "-+
     1" THEN S = S - 3:S$ =  LEFT$
     (C$(M%),S):C$(M%) = S$ + ","
     : RETURN
2810  IF  RIGHT$ (C$(M%),3) = "-+
     2" THEN S = S - 3:S$ =  LEFT$
     (C$(M%),S):C$(M%) = S$ + CHR$
     (34): RETURN
2820  IF  RIGHT$ (C$(M%),3) = "-+
     3" THEN S = S - 3:S$ =  LEFT$
     (C$(M%),S):C$(M%) = S$ + ":"
     : RETURN
2830  RETURN
2970  REM   ENTER DATA FROM RQL
2980 FB% = W%: CALL  - 936:
2990  PRINT : PRINT "** NOTE: IF
     YOU HAVE A TABLE WHOSE DATA"
     : PRINT "     YOU WANT TO MO
     VE TO FMS, USE THE": PRINT "
          RQL COMMAND TO DISPLAY
     THAT TABLE": PRINT "     OTH
     ERWISE, DEFINE YOUR TABLE NO
     W":X =  FRE (0)
3000  PRINT D$;"OPEN PASS,L300,D1
     ": PRINT D$;"WRITE PASS,R1":
      PRINT FB%: PRINT D$: PRINT
     D$;"WRITE PASS,R2": PRINT FF
     $: PRINT D$: PRINT D$;"WRITE
      PASS,R3": PRINT BB%
3010  PRINT D$: PRINT D$;"WRITE P
     ASS,R4": PRINT 0: PRINT D$: PRINT
     D$;"CLOSE PASS"
3020  PRINT D$;"RUN RDB.OPT.HALF,
     S6,D1": REM     INPUT COMMAN
     D OF  RQL BUT  FOR FORM DISP
     LAY
3030  PRINT D$;"OPEN PASS,L300,D1
     ": PRINT D$;"READ PASS,R2": INPUT
     FF$
```

Store the from name and block number into the file PASS before running RQL

Run the RQL program RDB.OPT.HALF

CODES

COMMENTS

```
3040  PRINT D$;"READ PASS,R3": INPUT
      BB%: PRINT D$: PRINT D$;"REA
      D PASS,R5": INPUT SC%: PRINT
      D$: PRINT D$;"READ PASS,R6":
       FOR I = 1 TO SC%: INPUT A$(
      I): NEXT : PRINT D$;"CLOSE P
      ASS": GOTO 2670
3050  REM   CHECK IF THE RIGHT DI
      SKETTE IS IN THE DISK DRIVE
3060  ONERR  GOTO 3080
3070  PRINT D$: PRINT D$;"VERIFY"
      ;FF$;".DAT,D2": POKE 216,0: GOTO
      3090
3080  POKE 216,0: PRINT "FMS> PLE
      ASE INSERT THE DISKETTE WHIC
      H": PRINT "     CONTAINS THE
       FILE ";FF$;".DAT INTO": PRINT
      "     DISK DRIVE 2.  THEN PR
      ESS ANY KEY": GET AN$: POKE
      216,0: GOTO 3060
3090  IF MO% = W% GOTO 3350: REM
       MODIFY THE DATA
3100  PRINT D$;"OPEN";FF$;".DAT,D
      2": PRINT D$;"READ";FF$;".DA
      T"
3110  INPUT NB$:NB% =  VAL (NB$) +
      1: PRINT D$;"OPEN";FF$;".DAT
      "
3120  PRINT D$;"WRITE";FF$;".DAT"
      : IF NB% < 10 THEN NB$ = "0"
       +  STR$ (NB%)
3130  PRINT NB$: PRINT D$: PRINT
      D$;"READ";FF$;".DAT": INPUT
      LF$:TE$ = LF$
3140  PRINT D$;"OPEN ";FF$;".DAT"
      : PRINT D$;"POSITION";FF$;".
      DAT ,R1"
3150  PRINT D$;"WRITE";FF$;".DAT"

3160 LF% =  VAL (LF$) + SC%: IF L
      F% < 10 THEN LF$ = "00" +  STR$
      (LF%): REM   C OR R
3170  IF LF% < 100 THEN LF$ = "0"
       +  STR$ (LF%)
3180  PRINT LF$
3190  PRINT D$;"POSITION";FF$;".D
      AT,R";BB% - 1: PRINT D$;"WRI
      TE";FF$;".DAT": PRINT 1
3200  PRINT D$;"POSITION";FF$;".D
      AT,R9": PRINT D$;"WRITE";FF$
      ;".DAT": PRINT SC%
```

Calculate the start address of the new data in the data file

Change the flag for no data in the field to 1

CODES

```
3210  PRINT D$;"POSITION";FF$;".D
     AT,R9": PRINT D$;"WRITE";FF$
     ;".DAT":TE% =  VAL (TE$): IF
     TE% < 10 THEN TE$ = "00" +  STR$
     (TE%)
3220  IF TE% < 100 THEN TE$ = "0"
      +  STR$ (TE%)
3230  PRINT TE$: PRINT D$
3240  PRINT D$;"OPEN";FF$;".DAT":
      PRINT D$;"POSITION";FF$;".D
     AT,R"; VAL (TE$) - 1: PRINT
     D$;"WRITE";FF$;".DAT": FOR I
      = 1 TO SC%: PRINT A$(I): NEXT
     : PRINT D$
3250  FOR I = 1 TO SC%:A$(I) = ""
     : NEXT : GOTO 3520
3260  REM   DELETE ALL BLOCKS' DA
     TA
3270  PRINT : PRINT "FMS> YOU HAV
     E CHOSEN TO DELETE DATA FROM
     ": PRINT "     ALL THE FIELD
     S. DO YOU STILL WANT": INPUT
     "     TO GO AHEAD ? (Y OR N)
      : ";AN$
3280  IF AN$ <  > "Y" AND AN$ <  >
     "N" THEN  GOTO 3270
3290  IF AN$ = "Y" THEN  GOTO 331
     0
3300  GOTO 250
3310  PRINT D$;"DELETE";FF$;".DAT
     ,D2"
3320  PRINT D$;"OPEN TFORM,L20,D1
     "
3330  PRINT D$;"WRITE TFORM,R";TE
     MP: PRINT ""
3340  PRINT D$: PRINT D$;"CLOSE T
     FORM": PRINT : PRINT "FMS> D
     ATA IN ALL THE FIELDS HAVE":
      PRINT "     BEEN DELETED": FOR
     PAUSE = 1 TO 1500: NEXT PAUS
     E: GOTO 250
3350  REM   MODIFY THE DATA
3360  PRINT D$;"OPEN";FF$;".DAT,D
     2": PRINT D$;"POSITION";FF$;
     ".DAT,R1"
3370  PRINT D$;"READ";FF$;".DAT":
      INPUT LF$:TE$ = LF$
3380  PRINT D$;"OPEN";FF$;".DAT":
      PRINT D$;"POSITION";FF$;".D
     AT,R";BB% + 21: PRINT D$;"WR
     ITE";FF$;".DAT": PRINT LF$
```

COMMENTS

Store the number of strings used in the field

Store the data retrieved from RQL into the file

The system prompts for confirmation for deleting data from all the fields

The data file is deleted

Delete the form name from the file TFORM

Modify data in the field

Store the start address of the field

CODES	COMMENTS
3390 PRINT D$;"OPEN";FF$;".DAT": PRINT D$;"POSITION";FF$;".DAT,R1"	
3400 PRINT D$;"WRITE";FF$;".DAT":LF% = VAL (LF$) + SC%	
3410 IF LF% < 10 THEN LF$ = "00" + STR$ (LF%)	
3420 IF LF% < 100 THEN LF$ = "0" + STR$ (LF%)	
3430 PRINT LF$: PRINT D$: PRINT D$;"OPEN";FF$;".DAT": PRINT D$;"POSITION";FF$;".DAT,R"; VAL (TE$) - 1: PRINT D$;"WRITE";FF$;".DAT": REM CHANGE LENGTH AND ENTER DATA	
3440 FOR I = 1 TO SC%: PRINT A$(I): NEXT : PRINT D$	Store the modified data into the file
3450 PRINT D$;"OPEN";FF$;".DAT": PRINT D$;"POSITION";FF$;".DAT,R";BB% + 11	
3460 PRINT D$;"WRITE";FF$;".DAT": PRINT SC%: GOTO 3520: REM CHANGE # OF STRING	
3470 REM DELETE DATA IN A FIELD	
3480 INPUT "FMS> PLEASE GIVE THE FIELD NUMBER TO BE DELETED : ";BB%	The system prompts for the field number in which the data is to be deleted
3490 IF BB% > 10 OR BB% < 1 THEN PRINT G$;"***ERROR! FIELD NUMBER HAVE TO BE": PRINT " BETWEEN 1 AND 10 ***": GOTO 3480	
3500 PRINT D$;"OPEN";FF$;".DAT,D2": PRINT D$;"POSITION";FF$;".DAT,R";BB% + 1: PRINT D$;"WRITE";FF$;".DAT": PRINT 0: PRINT D$: PRINT D$;"CLOSE"	Set the flag to 0 for the field when deleting the data
3510 PRINT D$: PRINT : PRINT "FMS> DATA IN FIELD# ";BB%;" HAS BEEN DELETED"	
3520 PRINT D$: PRINT : PRINT "FMS> CREATE OR MODIFY OR DELETE DATA ": INPUT " IN ANOTHER FIELD ? (Y OR N):";AN$	
3530 IF AN$ < > "Y" AND AN$ < > "N" THEN GOTO 3520	
3540 IF AN$ = "Y" THEN GOTO 2004	

CODES

COMMENTS

```
3550  PRINT D$;"CLOSE";FF$;".DAT"
    : GOTO 250
3560  REM
3570  REM    DISPLAY DATA IN FRAME

3580  REM
3590  CALL  - 936: PRINT "DISPLAY
    /PRINT DATA USING A FRAME": PRINT
    "==========================
    ====="
3600 A% = Z%
3610  PRINT : PRINT "FMS> PLEASE
    INDICATE YOUR CHOICE BY": PRINT
    "     ENTERING THE NUMBER": PRINT
    : PRINT "1. DISPLAY DATA ON
    THE SCREEN": PRINT "2. PRINT
     DATA ON THE PRINTER": INPUT
    AN$
3620  IF AN$ <  > "1" AND AN$ <  >
    "2" THEN  GOTO 3610
3630  IF AN$ = "2" THEN PR% = W%:
     REM   PRINT THE FORM ON THE
     PRINTER
3632  PRINT : INPUT "FMS> PLEASE
    SPECIFY THE FORM NAME : ";FF
    $:FO$ = FF$
3633  PRINT D$;"OPEN TFORM,L20,D1
    ":TEMP = Z%
3634  PRINT D$;"READ TFORM,RO": INPUT
    K%: PRINT D$: IF K% = Z% THEN
     PRINT : PRINT G$;"*** ERROR
    ! FORM HAS NOT BEEN": PRINT
    "     DEFINED YET ***": PRINT
    D$: PRINT D$"CLOSE": FOR PAU
    SE = 1 TO 1500: NEXT PAUSE: GOTO
    250
3635  FOR I = 1 TO K%: PRINT D$;"
    READ TFORM,R";I: INPUT FY$: IF
    FY$ = FF$ THEN TEMP = I
3636  NEXT : PRINT D$
3637  IF TEMP = Z% THEN  PRINT : PRINT
    G$;"*** ERROR! FORM HAS NOT
     BEEN": PRINT "     DEFINED
    YET ***": PRINT D$: PRINT D$
    ;"CLOSE": FOR PAUSE = 1 TO 1
    500: NEXT : GOTO 3632
3640  PRINT : INPUT "FMS> PLEASE
    SPECIFY THE FRAME NAME : ";F
    F$
3650  PRINT D$;"OPEN TFRAME,L20,D
    1":TEMP = Z%
```

Return to the Main Menu

Option 4. DISPLAY/PRINT DATA USING A FRAME

The system displays the options and prompts for the choice of the option

The system prompts for a form name

Check if the form name exists

The system prompts for a frame name

CODES

COMMENTS

```
3660  PRINT D$;"READ TFRAME,RO": INPUT
      K%: PRINT D$: IF K% = Z% THEN
       PRINT : PRINT G$;"*** ERROR.
      ! FRAME HAS NOT BEEN DEFINED
      **": PRINT D$: PRINT D$;"CLO
      SE": FOR PAUSE = 1 TO 1500: NEXT
      PAUSE: GOTO 250
3670  FOR I = 1 TO K%: PRINT D$;"
      READ TFRAME,R";I: INPUT FY$:
       IF FY$ = FF$ THEN TEMP = I
3680  NEXT : PRINT D$
3690  IF TEMP = Z% THEN  PRINT : PRINT
      G$;"*** ERROR! FRAME HAS NOT
       BEEN DEFINED **": PRINT D$;
      "CLOSE": FOR PAUSE = 1 TO 15
      00: NEXT : GOTO 3640
3710  ONERR  GOTO 3730: REM   CHE
      CK IF THE RIGHT DISKETTE IS
      IN THE DISK DRIVE
3720  PRINT D$;"UNLOCK";FO$;".DAT
      ,D2": POKE 216,0: GOTO 3740
3730  PRINT : PRINT "FMS> PLEASE
      INSERT THE DISKETTE WHICH
        CONTAINS THE FILE ";FO$;".
      DAT INTO": PRINT "     DISK
      DRIVE 2 THEN PRESS ANY KEY":
       GET AN$: POKE 216,0: PRINT
      D$: GOTO 3710
3740  PRINT D$;"OPEN";FF$;".COR,L
      50,D1": PRINT D$;"READ";FF$;
      ".COR,RO": INPUT NB$:NB% =  VAL
      (NB$): FOR J = 1 TO NB%: INPUT
      N$(J):N%(J) =  VAL (N$(J)): NEXT

3750  FOR J = 1 TO 10: FOR M = 1 TO
      100:P$(J,M) = "": NEXT M: NEXT
      J
3760  PRINT D$: PRINT : INPUT "FM
      S> HOW MANY FIELDS DO YOU WA
      NT TO          OUTPUT? (0 ME
      ANS ALL) : ";J%
3770  IF J% = 0 THEN  GOTO 3900: REM
       ALL BLOCKS
3780  PRINT : PRINT "FMS> PLEASE
      SPECIFY THE FIELD NUMBERS"
3790  FOR I = 1 TO J%: INPUT X%(I
      ): NEXT
3800 L = 1
3810 A% = Z%
3820  FOR I = 1 TO NB%
```

Check if the frame name exists

The system prompts for the number of the fields to be output

CODES

```
3830  IF X%(L) = N%(I) THEN A% =
     W%
3840  NEXT I
3850  IF A% = Z% THEN  PRINT G$;"
     ***ERROR! BLOCK ";BC%(L);" H
     AS NOT BEEN DEFINED ***": GOTO
     3760
3860 L = L + 1: IF L <  = J% THEN
      GOTO 3810
3870 NB% = J%
3880  FOR I = 1 TO NB%:N%(I) = X%
     (I): NEXT
3890  REM   READ COORDINATES
3900  FOR I = 1 TO NB%
3910  PRINT D$;"READ";FF$;".COR,
     R";N%(I):K% = N%(I)
3920  INPUT X1%(K%): INPUT X2%(K%
     ): INPUT Y1%(K%): INPUT Y2%(
     K%): NEXT : PRINT D$:
3930  ONERR  GOTO 3950: REM  READ
      DATA
3940  PRINT D$;"VERIFY";FO$;".DAT
     ,D2": POKE 216,0: GOTO 3960
3950  PRINT "FMS> PLEASE INSERT T
     HE DISKETTE WHICH        CON
     TAINS THE FILE ";FF$;".DATA
     INTO": PRINT "     DISK DRIV
     E 2 THEN PRESS ANY KEY": GET
     AN$: POKE 216,0: GOTO 3930
3960 I = 1
3970  IF I > NB% THEN  GOTO 4120
3980 K = N%(I)
3990  PRINT D$: PRINT D$;"OPEN";F
     O$;".DAT,D2": PRINT D$;"POSI
     TION";FO$;".DAT,R";N%(I) + 1

4000  PRINT D$;"READ";FO$;".DAT":
      INPUT AN$: IF AN$ = "0" GOTO
     4110: REM     NO DATA IN THA
     T FIELD
4010  PRINT D$;"POSITION";FO$;".D
     AT,R9": PRINT D$;"READ";FO$;
     ".DAT": INPUT CC$: PRINT D$;
     "POSITION";FO$;".DAT,R9": PRINT
     D$;"READ";FO$;".DAT": INPUT
     OS$: PRINT D$:
4020 M% = 1:W1% = W%:CC% =  VAL (
     CC$): REM   W1%=W WHEN SPACE

4030 OS% =  VAL (OS$) - 1
```

COMMENTS

Check if the coordinates of the block is defined

Read the coordinates of the blocks

Check if there is any data in the field

Read the # of strings and the start address of the data in the field

CODES

```
4040  PRINT D$;"OPEN";FO$;".DAT":
      PRINT D$;"POSITION";FO$;".D
     AT,R";OS%: PRINT D$;" READ "
     ;FO$;".DAT"
4050  FOR L = 1 TO CC%: INPUT A$(
     L):ZA$ = A$(L)
4060  FOR J = 1 TO  LEN (ZA$):C1$
      =  MID$ (ZA$,J,1)
4070  IF C1$ <  > " " THEN P$(K,M
     %) = P$(K,M%) + C1$:W1% = Z%
     : GOSUB 4130: GOTO 4090
4080 M% = M% + 1
4090  NEXT J: GOSUB 4190
4100  NEXT L:PS%(K) = M%
4110 I = I + 1: GOTO 3970
4120  PRINT D$;"CLOSE";FO$;".DAT"
     : GOTO 4230
4130 S =  LEN (P$(K,M%)): IF S >
     3 THEN  GOTO 4190
4140  IF  RIGHT$ (P$(K,M%),3) = "
     -+1" THEN P$(K,M%) = ",": GOTO
     4220
4150  IF  RIGHT$ (P$(K,M%),3) = "
     -+2" THEN P$(K,M%) =  CHR$ (
     34): GOTO 4220: REM    CHR$(
     34) IS A QUOTATION MARK
4160  IF  RIGHT$ (P$(K,M%),3) = "
     -+3" THEN P$(K,M%) = ":"
4170  GOTO 4220
4180  REM    CONVERT THE SYMBOLS
     INTO ACTUAL CHARACTERS
4190  IF  RIGHT$ (P$(K,M%),3) = "
     -+1" THEN S = S - 3:S$ =  LEFT$
     (P$(K,M%),S):P$(K,M%) = S$ +
     ",": GOTO 4220
4200  IF  RIGHT$ (P$(K,M%),3) = "
     -+2" THEN S = S - 3:S$ =  LEFT$
     (P$(K,M%),S):P$(K,M%) = S$ +
      CHR$ (34): GOTO 4220
4210  IF  RIGHT$ (P$(K,M%),3) = "
     -+3" THEN S = S - 3:S$ =  LEFT$
     (P$(K,M%),S):P$(K,M%) = S$ +
     ":"
4220  RETURN
4230  IF PR% = Z% THEN  GOTO 4560
     : REM   DISPLAY THE FORM ON
     THE SCREEN
4240  REM   CONVERT THE DATA LINE
     WISE FOR THE LINE PRINTER
```

COMMENTS

Read the data in the field

Convert the symbols into comma, quotation mark and colon

CODES

```
4250 YY% = Z%: FOR P = 1 TO 22: FOR
     Q = 1 TO NB%:K = N%(Q): FOR
     S = 1 TO 10:E$(P,K,S) = "": NEXT
     S: NEXT Q: NEXT P
4260  FOR L = 1 TO NB%:K = N%(L)
4270 WW% = X2%(K) - X1%(K) + 1:YY
     % = Z%:D = Y1%(K):S = Z%
4280  FOR M = 1 TO PS%(K)
4290 YY% = YY% +  LEN (P$(K,M))
4300  IF YY% < WW% THEN YY% = YY%
      + 1:S = S + W%:E$(D,K,S) =
     P$(K,M) + " ": GOTO 4340
4310  IF YY% = WW% THEN S = S + W
     %:E$(D,K,S) = P$(K,M): GOTO
     4340
4320 D = D + 1:S = W%:E$(D,K,S) =
     P$(K,M) + " "
4330 YY% =  LEN (P$(K,M)) + 1
4340  NEXT M
4350 YY% = Z%: NEXT L: CALL  - 93
     6
4360  IF PR% = W% THEN  PRINT "FM
     S> PLEASE CONNECT THE PRINTE
     R THEN": PRINT "     PRESS A
     NY KEY": GET A$: PRINT D$: PRINT
     D$;"PR#1"
4370  REM  SORT THE BLOCK IN INC
     REASING TOP LEFT X COORDINAT
     E FOR THE LINE
4380  FOR D = 1 TO 22:H = Z%
4390  FOR L = 1 TO NB%:K = N%(L)
4400  IF E$(D,K,1) = "" THEN  GOTO
     4420
4410 H = H + 1:F%(H) = K
4420  NEXT L: IF H = Z% THEN  GOTO
     4520
4430  IF H = 1 THEN  GOTO 4500
4440 G = H - 1:H1 = H - 1: FOR I =
     1 TO G
4450  FOR J = 1 TO H1: REM   PRIN
     T THE DATA
4460  IF X1%(F%(J)) > X1%(F%(J +
     1)) THEN TEMP = F%(J):F%(J) =
     F%(J + 1):F%(J + 1) = TEMP
4470  NEXT J
4480 H1 = H1 - 1
4490  NEXT I
4500  FOR N = 1 TO H
```

COMMENTS

Convert the data for printing

CODES

COMMENTS

```
4510  HTAB X1%(F%(N)): VTAB D:K =
      F%(N): FOR S = 1 TO 10: PRINT
      E$(D,K,S);: NEXT S: NEXT N
4520  PRINT "": NEXT D
4530  IF PR% <  > W% THEN  FLASH
      : HTAB 1: VTAB 23: PRINT "PR
      ESS ANY KEY AFTER VIEWING": GET
      AN$: NORMAL
4540  FOR I = 1 TO CC%:A$(I) = ""
      : NEXT I
4550  PRINT D$: PRINT D$;"PR#0":P
      R% = Z%: GOTO 250
4560 YY% = Z%: CALL  - 936
4570  FOR L = 1 TO NB%:K = N%(L):
       REM   KEEP THE WHOLE WORD T
      OGETHER
4580  HTAB X1%(K): VTAB Y1%(K):WW
      % = X2%(K) - X1%(K) + 1:YY% =
      Z%
4590  FOR M = 1 TO PS%(K):YY% = Y
      Y% +  LEN (P$(K,M))
4600  IF YY% < WW% THEN  PRINT P$
      (K,M); SPC( 1):YY% = YY% + 1
      : GOTO 4640
4610  IF YY% = WW% THEN  PRINT P$
      (K,M): GOTO 4640
4620 Y1%(K) = Y1%(K) + W%: HTAB X
      1%(K): VTAB Y1%(K)
4630 YY% =  LEN (P$(K,M)) + 1: PRINT
      P$(K,M); SPC( 1)
4640  NEXT M:YY% = Z%: NEXT L: GOTO
      4530
4650  REM
4660  REM   DISPLAY FRAME FORMAT
4670  REM
4680 SU% = Z%: REM   FROM SUBROUT
      INE SU%=W%
4690  CALL  - 936: PRINT "DISPLAY
       FRAME LAYOUT": PRINT "=====
      ==========="
4700  PRINT : INPUT "FMS> PLEASE
      SPECIFY FRAME NAME : ";FF$:F
      A$ = FF$
4710  ONERR  GOTO 4730
4720 Y% = Z%: PRINT D$;"UNLOCK";F
      F$;".COR,D1": POKE 216,0: GOTO
      4740
4730 Y% = W%: POKE 216,0: GOTO 47
      40: REM  NOT EXIST
```

Keep the whole word together

Option 5. DISPLAY FRAME LAYOUT

The system prompts for the frame name

Check if the frame exists

CODES

COMMENTS

```
4740  IF Y% = W% THEN  PRINT : PRINT
      G$;"***ERROR! FRAME NAME DOE
      S NOT EXIST ***": FOR PAUSE =
      1 TO 1500: NEXT PAUSE: GOTO
      250
4750  CALL - 936: FOR I = 1 TO 4
      0: HTAB I: VTAB 1: IF I < 10
       THEN  PRINT I
4760  IF I >  = 10 THEN I$ =  STR$
      (I):I$ =  RIGHT$ (I$,1): PRINT
      I$
4770  NEXT I
4780  FOR J = 1 TO 22: VTAB J: HTAB
      1: IF J < 10 THEN  PRINT J
4790  IF J >  = 10 THEN J$ =  STR$
      (J):J$ =  RIGHT$ (J$,1): PRINT
      J$
4800  NEXT
4810  IF NE% = 1 AND C1% = 1 THEN
       HTAB X1%(1): VTAB Y1%(1): PRINT
      "*"
4820  IF NE% = 1 THEN  HTAB 1: VTAB
      23: FLASH : PRINT "PRESS ANY
       KEY AFTER VIEWING": GET A$:
       NORMAL : RETURN
4830  PRINT D$;"OPEN";FF$;".COR,L
      50,D1"
4840  PRINT D$;"READ";FF$;".COR,R
      0": INPUT NB%: FOR I = 1 TO
      NB%: INPUT N%(I): NEXT
4850  FOR I = 1 TO NB%
4860  PRINT D$;"READ";FF$;".COR,R
      ";N%(I):L = N%(I): INPUT X1%
      (L): INPUT X2%(L): INPUT Y1%
      (L): INPUT Y2%(L)
4865  IF X1%(L) = X2%(L) AND Y1%(
      L) = Y2%(L) THEN  HTAB X1%(L
      ): VTAB Y1%(L): PRINT L: GOTO
      4990
4870  IF Y1%(L) = Y2%(L) THEN  HTAB
      X1%(L): VTAB Y1%(L): PRINT L
      : FOR J = X1%(L) + 1 TO X2%(
      L): VTAB Y1%(L): HTAB J: PRINT
      ".": NEXT : GOTO 4990
4880  IF X1%(L) = X2%(L) THEN  HTAB
      X1%(L): VTAB Y1%(L): PRINT L
      : FOR J = Y1%(L) + 1 TO Y2%(
      L): HTAB X1%(L): VTAB J: PRINT
      ":": NEXT : GOTO 4990
4890  IF X1%(L) = 1 AND Y1%(L) =
      1 THEN C0% = W%: GOTO 4930
```

Display the scale on the top of the screen

Display the scale on the left of the screen

Display a "*" if only the coordinates of the top-left corner of the block is defined

Read the block numbers that have been defined

Read the coordinates of the block numbers that have been defined

Display the boundary of the blocks

CODES

COMMENTS

```
4900  IF X1%(L) = 1 THEN CO% = 2:
      GOTO 4920
4910  IF Y1%(L) = 1 THEN CO% = 3:
      GOTO 4930
4920  VTAB Y1%(L): FOR J = X1%(L)
      + 1 TO X2%(L): HTAB J: PRINT
      "'": VTAB Y1%(L): NEXT
4930  VTAB Y2%(L): FOR J = X1%(L)
      + 1 TO X2%(L): HTAB J: PRINT
      ".": VTAB Y2%(L): NEXT : IF
      CO% = W% THEN  GOTO 4970
4940  IF CO% = Z% THEN  HTAB X1%(
      L): FOR J = Y1%(L) TO Y2%(L)
      : VTAB J: PRINT ":": HTAB X1
      %(L): NEXT
4950  IF CO% = 3 THEN  HTAB X1%(L
      ): FOR J = Y1%(L) + 1 TO Y2%
      (L): VTAB J: PRINT ":": HTAB
      X1%(L): NEXT
4960  IF CO% = Z% OR CO% = 2 THEN
      HTAB X2%(L): FOR J = Y1%(L)
      TO Y2%(L): VTAB J: PRINT ":
      ": HTAB X2%(L): NEXT
4970  IF CO% = W% OR CO% = 3 THEN
      HTAB X2%(L): FOR J = Y1%(L)
      + 1 TO Y2%(L): VTAB J: PRINT
      ":": HTAB X2%(L): NEXT
4980  HTAB (X1%(L) + 1): VTAB (Y1
      %(L) + 1): PRINT L
4990  HTAB 1: VTAB 23:CO% = Z%: NEXT
      I: IF C1% = W% THEN  HTAB X%
      : VTAB Y%: PRINT "*"
4995  PRINT D$;"CLOSE"
5000  PRINT D$: VTAB 23: HTAB 1: FLASH
      : PRINT "PRESS ANY KEY AFTER
      VIEWING": IF SU% = Z% THEN
      GET AN$: NORMAL : GOTO 250
5010  PRINT D$;"CLOSE"
5020  GET A$: NORMAL : RETURN
5030  END
```

Display the block number inside the boundary of the block

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