GRADUATE PROJECT

COMPUTERIZED PAYROLL SYSTEM

FOR THE

TEXAS INSTRUMENTS 990 MINI COMPUTER

Prepared For

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COMPUTERIZED PAYROLL SYSTEM

PROJECT DEFINITION

The goal of this project was to develop a payroll system which would satisfy the needs of a small Texas based company. Emphasis was placed on the concepts of structured design and programming, in an effort to produce a payroll system that could be enhanced or modified without having to redefine the entire system design.

This payroll system was designed to allow the system user to easily create a payroll data base and then use the payroll data base to execute the calculation of the employee's payroll.

Although limited in scope, this system will handle most of the employee related needs of a small company.
COMPUTERIZED PAYROLL SYSTEM

PROJECT METHODOLOGY

The computer language selected for the implementation of the payroll system was Cobol. Cobol was chosen because it is one of the most widely used computer languages for business applications. This allows the software application to be more easily implemented on computer systems other than the system for which it was originally designed.

Although it is understood that computer related problem solving is closely linked to the computer system being used, an effort has been made to avoid the use of "special" or non-standard cobol statements, which tend to limit the portability of the software.

The computer system chosen for the project implementation is the Texas Instruments 990 mini computer. This computer system supports sequential, relative, and key indexed file types in a multi-programming environment.

The job control language used by the Texas Instruments 990 is called "SCI" (System Command Interpreter). It is a relatively flexible and user friendly language.
COMPUTERIZED PAYROLL SYSTEM

PROJECT METHODOLOGY

The payroll system utilizes the Texas Instruments 990 sort/merge facility to order payroll transactions prior to calculating the payroll. This sort is external to the payroll calculation Cobol program.

On the Texas Instruments 990, Cobol source code is compiled to an intermediate object language, which is then interpreted upon execution.

The development and implementation of this payroll system included such tasks as:

1. Defining the purpose and function of the system.
2. Defining each separate task needed to satisfy the purpose of the system.
3. Defining the data to be stored and manipulated by the system.
4. Describing the file structures to hold the data.
5. Dividing the major system objectives into finite user executable steps (procedures).
6. Identifying common sub-functions which may be executed as Cobol subroutines.
7. Designing the programs necessary to execute each user executable procedure.
8. Writing the job control language for each user and system procedure.
9. Testing and verifying that the procedures and programs actually perform as expected.
COMPUTERIZED PAYROLL SYSTEM

PROJECT DESCRIPTION

The data base for the project consists of six permanent files and a few temporary sort and report files. The permanent files are the Payroll Master File, Security File, Transaction File, Calculation File, Earnings History File, and the Payroll Log File.

Company data, federal tax data, and employee related data is stored in the Payroll Master File, using three record types.

The Security File contains the authorized payroll system user's names, identifications, passwords, and priority levels. Each payroll system program and procedure interrogates the validity of the user.

Payroll transactions are entered into the Transaction File, which is used as input to the calculation routine. Payroll Transactions may be printed and modified before and after the execution of the payroll calculation procedure.

The result of the payroll calculation procedure is the Payroll Calculation File. This file was designed to be used as the input for a check writing procedure, which was not included in this project due to the vast number of different check sizes and formats.
COMPUTERIZED PAYROLL SYSTEM

PROJECT DESCRIPTION

The Earnings History File (PRTOTAL) maintains hours and earnings information for the current pay period, the quarter-to-date period, and the year-to-date period. The payroll posting procedure uses Payroll Calculation File as input to post current payroll figures to the Earnings History File.

Each procedure or program execution is recorded with an entry in the Payroll Log File. Both initiation and termination (successful or unsuccessful) steps are recorded.

The user may interface with the payroll system via payroll menus. These menus are in the form of a table of contents, describing the function and the name of the payroll procedures that the user may execute.

To execute a procedure, the user simply enters the name of the procedure in the bottom left hand corner of the screen (normal cursor position), and presses the "RETURN" key.
COMPUTERIZED PAYROLL SYSTEM

PROJECT DESCRIPTION

Procedures are included in the system to assist the user in the initial database creation, as well as employee payroll production procedures and data base maintenance procedures.

The maintenance procedures allow the user to modify company data, federal tax data and tables, employee personal data and calculation parameters, payroll system user data (Security File), and payroll transactions.

The payroll production procedures include payroll transaction entry, payroll transaction printing, employee payroll calculation, and payroll postings to the Earnings History File.

The Earnings History File may be printed by period (current, quarter-to-date, year-to-date) for a particular employee or for all employees.

Any period in the Earnings History File may set to zeros for a particular employee or for all employees. This procedure would most likely be used at the beginning of a new quarter, or at the end of the year.
DATA INTEGRITY IS A FACTOR WHICH IS VERY IMPORTANT IN A PAYROLL SYSTEM. THEREFORE, BOTH A PERMANENT FILE BACKUP PROCEDURE AND FILE RESTORE PROCEDURE HAVE BEEN INCLUDED. ALSO, CRITICAL INPUT FILES, SUCH AS THE CALCULATION FILE FOR THE POSTING PROCEDURE, HAVE BEEN RENAMED AFTER BEING USED TO AVOID ACCIDENTAL DUPLICATE PROCEDURE EXECUTION.

DEDUCTION, SICK LEAVE, AND VACATION LEAVE DATA IS MAINTAINED IN THE PAYROLL MASTER FILE EMPLOYEE RECORDS. DEDUCTIONS ARE DEFINED IN THE PAYROLL MASTER FILE COMPANY RECORD (NAMED THE SYSTEM RECORD). THERE ARE THREE CATEGORIES OF DEDUCTIONS: FIXED AMOUNT DEDUCTIONS, PERCENTAGE OF GROSS INCOME DEDUCTIONS, AND FIXED AMOUNT UP TO A DEFINED LIMIT DEDUCTIONS. THE AMOUNT OF EACH DEDUCTION AND WHETHER AN EMPLOYEE TAKES A PARTICULAR DEDUCTION IS DEFINED IN THE EMPLOYEE RECORDS. THE TOTAL NUMBER OF DEDUCTIONS PER EMPLOYEE IS SIX.
COMPUTERIZED PAYROLL SYSTEM

PROGRAMMING METHODOLOGY

The Cobol programs used in this payroll system were designed and written to perform a business data processing function. In addition to being functional, the maintainability of the programs was a major consideration. Additions and changes to computer systems can be as costly as rewriting a system if the original design was not conceived in an orderly and structured manner.

Some of the methods used to maintain program continuity in the payroll system are:

1. Permanent files are defined in COPY statements, so all programs use the same data names for the same fields.

2. Fields of the same type in different files have similar names, so they may be easily identifiable.

3. All fields from a particular file all have the same prefix, so their source may be easily known when they are encountered in the Procedure Division.

4. Procedure Division paragraphs names are numbered in ascending sequence, so they may be easily located.

5. Major program functions usually begin with a paragraph name of 100, 200, 300, etc.
COMPUTERIZED PAYROLL SYSTEM

PROGRAMMING METHODOLOGY

6. File read paragraphs are found near the end of the programs in the "900" paragraphs.
7. Declaratives have been used to handle I-O errors so a program abend results with an entry in the Payroll Log File.

The concepts of structured programming were observed during program development. There was, however, one specific case where the "GO TO" verb was utilized. The particular structure involved was only used in the interactive verification of input data and never caused a branch of control out of the paragraph in which it occurred. By using the "GO TO" verb in this manner, the necessity of internal switches was greatly reduced, thereby reducing the complexity and increasing the maintainability of the program. An example of this usage follows:

500-INPUT-DATA.
   ACCEPT DATA-NAME LINE 5 POSITION 20.
   IF VALID-DATA-INPUT
      NEXT SENTENCE
   ELSE
      DISPLAY "INVALID DATA MESSAGE" LINE 24 HIGH
      GO TO 500-INPUT-DATA.
COMPUTERIZED PAYROLL SYSTEM

PROGRAMMING METHODOLOGY

The beginning paragraph in each program (usually named 100-DRIVER), is the major control paragraph for the program. In almost all cases, the program execution begins and ends in the first paragraph of the main section of the program. One exception to this convention occurs in the interactive programs when the user has completed the entry of data to a screen mask. The program will prompt the user with the following message: "ALL OK (Y/N/T/A)?". A response of "Y" will allow the program to continue. "N" will either allow the user to modify data on the screen or will return the user to the program's main option screen. "T" will always return the user to the program's main option screen. "A" is the exception to the controlling paragraph convention. The response "A" will abort the program immediately. This occurs in the "ALL-OK" standard paragraph found in the 200's paragraphs. Prior to stopping the program, a message is written to the Payroll Log File.

The value of the separate "A" abort function to allow the user to immediately terminate the program, has not proven itself to be necessary, and would probably be removed from future versions of this payroll system.
COMPUTERIZED PAYROLL SYSTEM

PROGRAMMING METHODOLOGY

Consistency of programming style in a system increases the ease with which programs can be read and understood. One programming method used in this system to accept and modify data in an interactive mode is shown below. This programming approach can be found in most of the payroll system programs. For the sake of the example, let us assume that 2 items (name and age) are to be entered by the user. The program will edit each field as it is entered. The user will then be allowed to modify the fields until satisfied they are correct.
COMPUTERIZED PAYROLL SYSTEM

PROGRAMMING METHODOLOGY

300-CONTROLLING-PARAGRAPH.
   PERFORM 310-DISPLAY-SCREEN.
   MOVE 1 TO LOW-FIELD.
   MOVE 2 TO HIGH-FIELD.
   PERFORM 330-GET-FIELDS
       VARYING FIELD-NUMBER FROM LOW-FIELD BY 1
       UNTIL FIELD-NUMBER > HIGH-FIELD.
   PERFORM 975-ALL-OK.
   PERFORM 320-MODIFY-FIELDS
       UNTIL ALL-OK = "Y" OR ALL-OK = "T".
   IF ALL-OK = "Y"
      CONTINUE PROGRAM ACTION.

310-DISPLAY-SCREEN.
   DISPLAY "1. NAME:" LINE 10.
   DISPLAY "2. AGE:" LINE 11.

320-MODIFY-FIELDS.
   PERFORM 330-GET-FIELDS.
   PERFORM 975-ALL-OK.

330-GET-FIELDS.
   IF FIELD-NUMBER = 1
      PERFORM 340-GET-NAME.
   IF FIELD-NUMBER = 2
      PERFORM 350-GET-AGE.

340-GET-NAME.
   ACCEPT NAME-FIELD LINE 10 POSITION 10.
   DISPLAY SPACES LINE 24 SIZE 80. *clear message line*
   IF 'VALID NAME' *edits performed on NAME-FIELD*
      NEXT SENTENCE
   ELSE
      DISPLAY "invalid name message" LINE 24 HIGH
   GO TO 340-GET-NAME.
COMPUTERIZED PAYROLL SYSTEM

PROGRAMMING METHODOLOGY

350-GET-AGE.
ACCEPT AGE-FIELD LINE 11 POSITION 10.
DISPLAY SPACES LINE 24 SIZE 80. *clear message line*
IF VALID-AGE *edits performed on AGE-FIELD*
    NEXT SENTENCE
ELSE
    DISPLAY "invalid age message" LINE 24 HIGH
    GO TO 350-GET-AGE.

975-ALL-OK.
DISPLAY "ALL OK (Y/N/T/A)" LINE 24.
PERFORM 980-GET-ALL-OK. *accept and validate*
IF ALL-OK = "A"
    "abort the program"
ELSE
    IF ALL-OK = "N"
    DISPLAY "FIELD TO CHANGE:" LINE 24 POSITION 25
    PERFORM 980-GET-FIELD-NUMBER. *accept/validate*

The paragraph 975-ALL-OK displays "ALL OK (Y/N/T/A)". If the user enters "N", then the user is prompted for the "FIELD NUMBER" of the field which is not OK. The field number is validated using LOW-FIELD and HIGH-FIELD as range limits. Then control passes to the MODIFY paragraph, which is executed until ALL-OK is "Y" or "T". Varying the values of LOW-FIELD and HIGH-FIELD allows this format to be used for various amounts of data.
COMPUTERIZED PAYROLL SYSTEM

PROGRAMMING METHODOLOGY

A security checking standard is maintained in nearly all of the programs in the payroll system. A call is made to the subroutine "FASWRD" which prompts the user to enter his payroll user identification and a password. The user identification is used to access the Security File, where the user's password is verified and the user's priority level is matched against the program's priority level. If any errors are found the program terminates with a message to the user on the screen and an entry in the Payroll Log File.

Another standard used in the system is the Log File subroutine call. At the beginning of every program an entry is written to the Log File, with a specific status denoting the program has started. When the program has completed or terminated another entry is logged, indicating the completion status.

Log File entries include the station number, user id, program name, procedure name, program status, date, time, and appropriate messages.
COMPUTERIZED PAYROLL SYSTEM

SYSTEM MENU DESCRIPTION

The Texas Instruments 990 operating system incorporates a menu system which executes much like command procedures. Menus reside in the procedure library (Directory in T.I. terminology). One menu is defined as a system default (Main Menu). This default menu will be displayed on the screen when there is no other foreground activity at the terminal. Other menus can be accessed from the Main Menu by entering "/name of menu". From a secondary menu any other menu can be accessed in this same method, or the Main Menu can be accessed by simply pressing the "RETURN" key.

A menu is simply a sequential file, containing 23 lines of 80 bytes each. Any character which can be displayed on the terminal screen can be used in a menu.

The payroll system menus are displayed on the following pages.
COMPUTERIZED PAYROLL SYSTEM

SYSTEIM MENU DESCRIPTION

PAYROLL SYSTEM MAIN MENU

/PR00 - CURRENT PAYROLL PERIOD PROCEDURES
/PR10 - PAYROLL REPORT PROCEDURES
/PR20 - PAYROLL MAINTENANCE PROCEDURES
COMPUTERIZED PAYROLL SYSTEM

SYSTEM MENU DESCRIPTION

PAYROLL SYSTEM

CURRENT PAYROLL PERIOD PROCEDURES

PR01 - BACKUP PAYROLL FILES
PR02 - ENTER PAYROLL TRANSACTIONS
PR03 - PRINT PAYROLL TRANSACTIONS
PR04 - MODIFY PAYROLL TRANSACTIONS
PR05 - CALCULATE CURRENT PERIOD PAYROLL
PR06 - POST CURRENT PAYROLL