Hiroshima Journal of Medical Sciences
Vol.34, No.1, 1~5 , March , 1985
HIJM 34-1

Development of Information System for Bio-Chemical Study in Central Laboratory

Masayuki KAMBE, Tokuo TSUBOKURA, Yoshimi SUGIMOTO, Nobumasa YASUDA and Eiichi TAKEZAKI

Department of Clinical Pathology, Hiroshima University School of Medicine, 1-2-3, Kasumi, Minami-ku, Hiroshima 734, Japan

(Received October 12, 1984)

Key words: DBMS, MUMPS, Bio-chemical study, HDM, Statistical analysis

ABSTRACT

MUMPS (Massachusetts General Hospital Utility Multi-Programing System) is a good system for medical information processing by computer.

So, we have systemized the biochemical laboratory information system by using of DSM-11 (Digital Standard MUMPS) through PDP-11/34 mini-computer system in Hiroshima University Hospital.

This system has some functions of transfering data from PDP11/34 to M-180 large computer and can transfer data form from tree model DBMS of DSM-11 on PDP11/34 to relational model DBMS of M-180 large computer.

As HDM (relational model DBMS of M-180) has a function of using SPSS statistical programs package by DBMS, our designed system (DSM11/HDM system) can analyze a lot of laboratory data easily and statistically.

We got much effortness by medical applications of this system.

MUMPS (Massachusetts General Hospital Utility Multi-Programming System) is a good system for medical information processing by computer, being utilized in many facilities, because of its interpreter system of easy use and its structured tree model data base management system (DBMS) function available with a mini-computer level computer.

As there was no valid data base system before MUMPS has come on the medical field, we were interrupted a good many times to make full use of living body informations found in medical laboratory tests or for clinical purpose. Authors, therefore, also appreciate the advantages provided by DSM-11 (Digital Standard MUMPS) which is one of MUMPS and by use of which we have systemized biochemical studies in the Department of Clinical Pathology, Central Laboratory, Hospital of Hiroshima University, through PDP 11/34 mini-computer system as shown hereinafter[2,7].

This report has been prepared for information of some matters under examination to amplify the aforementioned biochemical study system further.

SUBJECTS

The number of clinical laboratory tests being studied by the Central Laboratory of Hiroshima University Hospital amounts to one million specimens approximately per annum, 60—70% of which are for biochemical study.

Under above circumstances, we designed 2 years ago a biochemical study data processing system by means of PDP 11/34 minicomputer, and then developing such system, we have made it of hard configuration as shown in Fig. 1.

The system is mainly composed of 2 automatic multiple chemical analysis devices which can simultaneously and automatically analyze 45 items for testing, and is connected to PDP 11/34 mini-computer through a microcomputer. Main memory of PDP 11/34 mini-computer has an enlarged memory capacity of 256 KB, but disc ac-

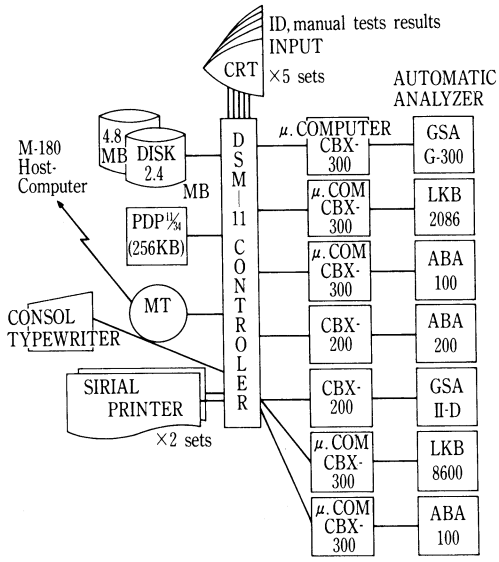

Fig. 1. Biochemical laboratory information system in Hiroshima University Hospital

cessory memory capacity is small, being 7.2 MB.

The language used is above-mentioned DSM-11 and constructs a biochemical study data base of structured three-model. However, because of small disc accessory memory capacity, a satisfactory large data base has not yet been connected.

We therefore have inquired into the method to transfer PDP 11/34 data base to larger data base of the general large sized DBMS (named HDM) which General Information processing Center of Hiroshima University has developed for very large computer (named M-180 made in Hitachi Co.).

METHOD

The General Information Processing Center of Hiroshima University has recently developed a data base management system (hereinafter abbreviated DBMS) which is called the relationship model HDM. Hiroshima University has utilyze this DBMS for developing and practical use of library information system and office information system, and we, authors, are also utilyzing HDM system to design a medical information system (called HUMOR). Biochemical study system is a part of such information system.

We have studied the methods to convert biochemical study data base of structured tree-model DBMS which is designed by DSM-11 for PDP 11/34 mini-computer into that of large size relationship model DBMS for M-180 computer., as shown below.

(1) *Data Transfer from PDP 11/34 mini-computer to M-180 Computer*

For data transfer, we have reviewed the method by time sharing system (TSS) through MODEM and another one by which the data are transferred through MT reading device after conversion into magnetic tape, and have selected the latter which is generally used so far.

First of all, necessary items such as receipt data of tests, number of case history sheet, patient's name, sex, test item code, test data result have been detected from the structured tree-model biochemical study data base of PDP 11/34 mini-computer, and program to make the magnetic tape memorize has been made out by DSM-11. We have called the program "MTH".

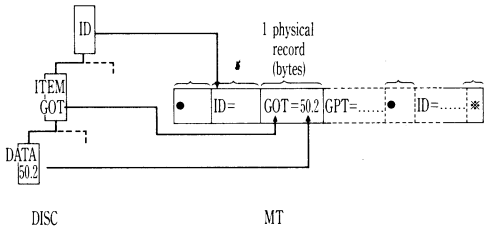

Fig. 2. Transfering data format from tree model to relational model

Magnetic tape format is processed by "MTH" to that convertible into relationship model DBMS for M-180 computer as shown in Fig. 2 and is recorded with a form like this (field name = data) in the variable length record. Data for a patient are divided from those for another patient by a period (.) and an asterisk (*) is used for indicating the finish of the data recorded.

Fig. 3 shows the procedures for conversion into magnetic tapes actually applied. It is designed so that addition or correction of tests items may be made easily by only changing the table defined in the file.

In this data transfer, a conversion ASCII code to EBCDIK code was to be made since the data in PDP 11/34 computer were of ASCII code while those of M-180 computer were of EBCDIK code. We have made this conversion using the function of DSM-11 concerning magnetic tape recording.

(2) *Data Conversion into HDM data base system*

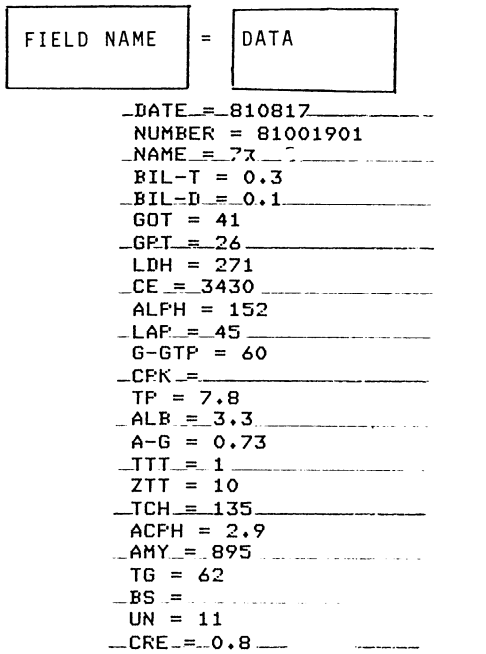

Fig. 3. Transfered data on MT DSM-11 to HDM (relational model)

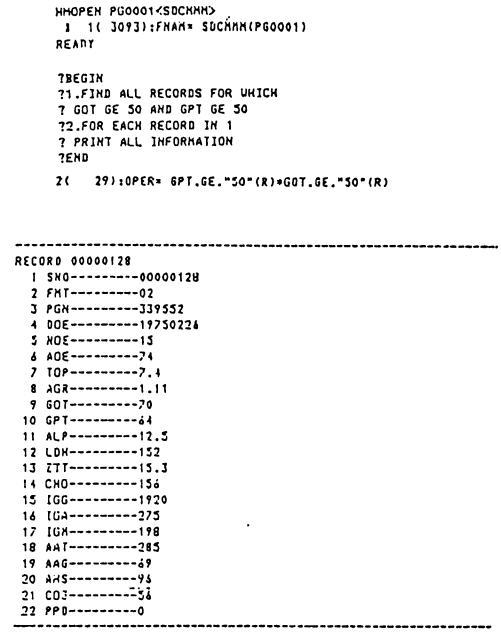

Fig. 4. Selection of liver functions disturbance cases from biochemical data base by use of HDM functions

Details in magnetic tapes are memorized in the disc by use of operation system of M-180 computer. The data have been already converted into EBCDIK code. As necessary items which should be housed in the data base of M-180 computer have been already edited by "MTH" program, we have converted them into HDM relationship model data base making use of HDM data definition and some commands regarding data input.

RESULT

There is no doubt that biochemical study data can be detected by DSM-11 biochemical study data base system of PDP 11/34 computer, but HDM is more useful as it can process many data statistically and at once because SPSS statistical package[4,5] can be automatically utilized by HDM.

Fig. 4 shows a case in which patients with hepatic function disorder have been detected from biochemical study data base having 3093 testing samples by setting tentative diagnosis criteria which should satisfy GOT $>$ 50 unit and GPT $>$ 50 unit. This is an example of HDM function.

Fig. 5 (a) and (b) shows the operation procedures and the result of factor analysis for drawing out the properties of hepatic function in the above-mentioned data base. This is an example of HDM/SPSS functions. It shows that 3 main factors indicate 76% of properties of hepatic function of GOT $>$ 50 unit and GPT $>$ 50 unit samples. The first main factor is a group to which total cholesterol (CHO), GOT (GOT) and alkaline phosphate (ALP) relate, and obstructive hepatic disorder is presumed. The third main factor is a group to which Zinc Sulfate Turbidity Test (ZTT) results relate.

Most of these samples concern those taken from the persons who have normal daily life in the opportunity of periodical medical inspection, and therefore, it is assumed that even when a person passed normal daily life, he suffers from a slight hepatic function disorder and that the main disorder concern the fatty liver or obstructive hepatic disorder which is similar to the former.

```
HMSPSS 2
*PARAM--TOP.N,AGR.N,GOT.N,GPT.N,LDH.N,ALP.N,ZTT.N,CHO.N
PROCEDURE--------FACTOR
PARAMETER--------VARIABLES=TOP,AGR,GOT,GPT,LDH,ALP,ZTT,,-
                 CHO/TYPE=PA1/ROTATE=NOROTATE
OPTIONS----------
STATISTICS-------ALL
CONTINUE(Y/N)--N
LIST(TM/LP)--TM
```

Fig. 5 a) Operation example of SPSS/HDM

VARIABLE	EST COMMUNALITY	FACTOR	EIGENVALUE	PCT OF VAR	CUM PCT
TOP	1.00000	1	3.48992	43.6	43.6
AGR	1.00000	2	1.62189	20.3	63.9
GOT	1.00000	3	1.01238	12.7	76.6
GPT	1.00000	4	0.68433	8.6	85.1
LDH	1.00000	5	0.48000	6.0	91.1
ALP	1.00000	6	0.33390	4.2	95.3
ZTT	.00000	7	0.23933	3.0	98.3
CHO	1.00000	8	0.13823	1.7	100.0

SPSS BATCH SYSTEM 07/07/81

FILE NONAME (CREATION DATE = 07/07/81)

FACTOR MATRIX USING PRINCIPAL FACTOR, NO ITERATIONS

	FACTOR 1	FACTOR 2	FACTOR 3
TOP	-0.61233	0.10788	0.17112
AGR	-0.85986	0.12887	0.10532
GOT	0.88843	-0.00535	-0.02273
GPT	-0.04250	0.89418	-0.02411
LDH	0.78379	0.44175	-0.04473
ALP	-0.31720	0.68152	-0.45264
ZTT	0.14482	0.36453	0.87378
CHO	0.92103	0.03983	-0.02212

VARIABLE	COMMUNALITY
TOP	0.41586
AGR	0.76710
GOT	0.78986
GPT	0.80195
LDH	0.81178
ALP	0.76997
ZTT	0.91734
CHO	0.85036

Fig. 5 b) Factor analysis of liver function disturbance cases (29 cases/3093 cases)

DISCUSSION

To convert DSM-11 structured tree-model data base into HDM relational model data base, data transfer CPU to CPU and conversion of data format were required technically. Furthermore, in our case, as we have used magnetic tapes as a medium for conversion, we have had to make a program for conversion of codes ASCII → EBCDIK. This, however, has been achieved by us with ease making use of a function of DSM-11 by which an automatical conversion of codes ASCII→EBCDIK is made and the data are memorized with EBCDIK code upon data storage in magnetic tapes[1]. We, authors, have regarded that the data transfer CPU to CPU would be the most assured way, but it is observed that the method to make use of modem, the method to control the data making use of micro-computers must be carefully considered.

HDM is the package of data base management system which can be planned for use with a type of computer that have a common operation system with IBM computer. HDM can make the application program using such languages as FORTRAN, COBOL and PL/1[6]. The language for the end user as shown in the example may be a natural language that uses commands similar to MUMPS commands. Therefore, it is thought that MUMPS users can utilyze the system with little trouble. If data bases structured according to a different language system are developed so that they can be transformed for use in the MUMPS system, This can be thought to be a significant development.

The authors' present study is still at an experimental stage and the present time it has not developed to the stage of a general transfer system.

If we evaluate the PDP-11/34 system based on MUMPS from the standpoint of conducting clinical tests, since using the TSS method it is possible to easily accumulate the results of automatic chemical analyses in the data base, it has proven to be quite convenient. Although there are various problems relating to the necessity of simplifying the data input methods for identifying specimens, PDP-11/34 system is useful. Because this system already has numerous necessary functions of DBMS.

However, based on the transfer of biochemical test data to a larger data base system such as HDM, by using a broad data base, it can be used with the objective of providing in formation on clinical studies, and it is possible to contribute to the technological development of laboratory diagnosis. Reports have appeared describing a medical consultation system which uses a mechanical mental systems[3]. The authors have applied the above described system technology and they are now considering the development of Decision Supported System/Data Base System.

REFERENCES

1. **DEC Japan Ltd.** 1977. DSM-11 System, 8-14 8-31, Tokyo.
2. **Kambe, M., Tsubokura, T. and Shimuzue, A.** 1979. Studies on Computarization of biochemical examination. Jap. J. Clin. Path. **27** (General Meeting 3): 377.
3. **Kaihara, S.** 1980. Medical Consultation System. Instrument thinking together with human -. JJMI. **50**: 568-571.
4. **Miyake, I.** 1978. SPSS Analytical Package. I. Foundamental Volume. p.1-263. Tokyo Keizai Shinposha. Tokyo.
5. **Miyake, I.** 1978. SPSS Analytical Package. II. Analytical Volume. p.1-263. Tokyo Keizai Shinposha. Tokyo.
6. **Mitsui Knowledge Industry.** 1980. Users' language manual. p.1-170. Model 204, Data Base Management System.
7. **Tsubokura, T., Kambe, M. and Yasuda, N.** 1980. Development of clinical examination system using DSM-11. Jap. J. Med. Elec. Biol. Eng. **18** (special Issue 3): 708.