SEMINAR ON THESAURUS (1975). Paper BB

SEMI-AUTOMATIC CONSTRUCTION OF THESAURUS

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Describes computer program for generating a thesaurus from Feature Heading of a Bibliographical Record. Also gives a description of computer program for constructing synonym subject string. Programs are written in COBOL. Gives flow charts and a sample of thesaurus output.

1 INTRODUCTION

The emergence of on-line interactive information systems gave a renewed boost to the importance of heuristic search for information. This, in turn, emphasized the value of a controlled vocabulary. One of the devices used for this purpose is a 'Thesaurus'. A thesaurus is a device which displays the semantic relationship of a term with all the other terms associated with it. The design and construction of thesaurus of terms in subject-fields for use in information storage, retrieval, and dissemination have received a fillip in recent years. While manual method of constructing a thesaurus has been going on, attempts have also been made to use computers for doing repetitive process in the compilation of thesaurus. During the past year DRTC has been experimenting with the computer generation of thesaurus.

As has been pointed out by Neelameghan (2), the following two approaches have been pursued in the computer generation of thesaurus at DRTC;

Procedure 1 :

(a) Facet analysis of the subjects of discourses on the subject-field concerned according to the method of postulates, which in turn, is based on the General Theory of Subject Classification ;

(b) Use of the subject-structures (subject-representations) arrived at (a) as data base for designing a faceted scheme for classification according to the methodology formulated ; and

(c) Use of the faceted scheme for classification arrived at (b) as data base for computer generation of thesaurus.

Procedure 2:

(a) Same as (a.) of Procedure 1 ; and

(b) Use the subject-structures (subject-representations) arrived at (a) as data base for computer generation of thesaurus.

The programs developed for generation of thesaurus adopting Procedure 1 has already been reported (1). Data structure used in developing programs for computer generation of Thesaurus has been reported earlier (1, 4),

2 SCOPE OF THE PAPER

This paper presents the computer programs developed for semi-automatic method of construction of thesaurus from the Subject Heading of a bibliographical record. It emphasises the design, operation and implementation of the program from the point of view of designer, systems analyst and manager of information services. Also it provides a view of the characteristic capabilities and limitations of the programs.

3 PROGRAM DESCRIPTION

3A Program 1

3A1 Name of the Program: Semi-Automatic Construction of Thesaurus

3A2 Acronym: AUCT

3A3 Author: I K Ravichandra Rao

3A4 Date of Current Version: 1975-10-08

3A5 Purpose

The purpose of this program is to generate and output a thesaurus for a given subject Wing. Subject heading is analysed and structurd using the principles developed by S R Ranganathan.

3A6 Input

The input to the program consists of Machine Readable Bibliographical Data Base (MRBD) and a control card,

The access mode and file organisation of MRBD are sequential. It contains four bibliolical records per logical record or a block. logical record is 2048 characters in length. Data format procedure involved in creation of MRBD, operation and implementation of MRBD ! discussed elsewhere (3). A sample of input, that is, the bibliographical records in MRBD is given in Sec 911. Card design of the control card is given below :

Table 1 : Card Design of Control Card

SN	Number of Characters	Position of Characters	Description
1	2	11-12	Zeroes
2	1	14	Zero
	1	15	One
4	1	19	Zero
	7	23-29	Zeroes
6	1	30	Two
1	2	31-32	Zeroes
8	2	63-64	Zeroes
	12	69-80	Magnetic tape label

Mote : - 1 To punch control informa- *Wkm* select the indicator digit used in Feature Heading Section and add one to decimal value of the indicator digit. Punch either zero or one or two in corresponding column. For example, consider an indicator digit Comma. The decimal value of Comma is 30 in ICL 1901 computet, Punch zero in 31st column,

Greater than srgn (>) and Hyphen (—) are used to denote Hierarchical relation and speciatoi relation respectively. Therefore, in control card these two digits are given tags 1 and 2 in column 15 and 30 respectively,

3A7 Output

The output file from AUCT is a file on magnetic tape called TESTDATATAPE. The access mode and file organisation are sequential, It contains 16 records per logical record or block. Each logical record is 2048 characters in length. The output may be obtained on on-line printer whenever necessary, A specimen copy of the output is given in Sec 914,

The file called TESTDATATAPE is to be organised into an alphabetical sequence. The computer manufacture software called # XSDA, in case of ICL 1900 series, may be used to sort the file. Information to be required for sorting the file is given in Sec 4A. Magnetic tape label of the sorted file is THESAURUS.

Data format of the output file is given below :

Table 2: Data Format of Output File

SN	Number of Characters	Position of Characters	Description	Remarks
1	4	1- 4	Record length	Characters are in binary form
2	59	5- 63	Leading Term	Characters are in alph; numeric form
3	2	64-•65	Relationship	•
4	59	66-•124	Context term	•
5	4	25 128	Space	"

3A8 Procedure

1' The Procedure used is simple and uses many times the Principle of Push-down Stack and Table Look-up procedure. To begin with, Control Card is read,

2 After reading a bibliographical record from MRBD, each descriptor is picked up from Feature Heading Section and stored in a Table form or Array form -- single dimensional. It is stored in array called DESCRIPTORS. Maximum number of characters in a descriptor is restricted to 59. Number of

descriptors in Feature Heading Section should not exceed 100.

3 In the above said array, every descriptor is preceded and succeeded by indicator digit as it occurs in Feature Heading Section of bibliographical record. For example, the descriptor DISEASE may be preceded and succeeded by a semi-colon and a hyphen. Therefore, in an array of descriptors, the term DISEASE is stored as follows :

DISEASE -

But for the purpose of convenient processing, tags are stored instead of indicator digits as follows:

0 DISEASE 2

In the above string 0 and 2 are tags for semi-colon and hyphen as discussed in Sec 3A6. Succeeding character of Last Descriptor in an array is Blank character. A specimen copy of array is given in Sec 912.

4 Next, the above said array is processed as follows :

Consider the first descriptor as Lead , Term and all other terms as Context Term. If the Lead Term is succeeded by a zero or one, and the Context Term is preceded by a zero or one, then construct subject string with RT relation, Similarly, if the Lead Term is succeeded by one and the immediate next Context Term is preceded by one, then, construct subject string with NT/BT relation; and so on. This process is repeated for all descriptors considered as Lead Terms. A specimen copy of subject string for a given array of descriptors which is generated from a Feature Heading of a bibliographical record is given in Sec 91 3.

5 As and when a subject string is generated it is written on output file called TEST-DATATAPE.

6 At the end of the process, the output file is to be arranged in alphabetical sequence as said in Sec 3A7. Magnetic tape label of sorted output file is THESAURUS. In Sec 91 5 Flow Chart illustrates the systems procedure.

3A91 Decision Logic Table

The following decision logic table illustrates the procedure, or a set of rules and action to be taken for generating subject string with all possible relationships such as BT, NT and RT.

_ Table 3: Decision Logic Table

Table 3 : Decision Logic Table

SN	Condition	Tags	Rules
	Condition Description		1 2 3 4 5 6 7 8 9 10 11 12 13
1	Facet to Facet	(0, 0)	
2	Facet to NT of a Facet [ON-1 is zero)	(0, 1)	
3	Facet to NT of a Speciator (ON-1 is one)	(0, 1)	
4	Facet to Speciator of other Facet	(0, *Z)*	
5	BT/NT to Facets	(1, 0)	
6	Hierarchical relation (QN-2 is zero)	(1, 1)	
7	Hierarchical relation (ON-2 is one)	(1, 1)	
8	BT/NT to Speciator	(1, *2)*	
9	Facet with spectator to Facet	(2, 0)	
10	Facet with speciator to NT of a Speciator (ON-3 is aero)	(2, 1)	
11	Facet with speciator to NT of other Facets (ON-3 in one)	(2, 1)	
12	Facet with speciator to Speciator (ON-3 is zero)	(2, 2)	
13	Speciator to Speciator (ON-3 in one)	(2, 2)	
SN			
1	Generate Subject String with RT		
2	Generate Subject String with NT/BT		
3	ON-1 <— 1		
4	ON-2 <— 2		
5	ON-3 <— 3		
6	No Action		x x
7	Write Tape		

Note - 1 BT = Broader Term
NT = Narrower Term
RT = Related Term

2 ON-1, ON-2, ON-3 are data names defined in working storage section.

3 Immediately after generating subject string with RT relation, Lead Term and Context Term are to be interchanged for which a subject string is to be generated with RT relation. Similarly for a subject string with NT relation, Lead Term and Context Term are to be interchanged for which a subject string is to be generated with BT relation.

3B Program 2

3B1 Name of the Program: Synonym Subject String Generation

3B2 Acronym: SYNG

3B3 Author : I K Ravichandra Rao

3B4 Date of present version: 1975-10-08

3B5 Purpose

The purpose of this program is to generate synonym subject string for the records in thesaurus wherever necessary. The program is incorporated into the programs developed for computer generation of thesaurus from a schedule of classification (1).

3B6 Input

The input consists of thesaurus on tape. That is, the output of program CARI developed earlier (2). A subject string consists of Term Used For and Term Used, in Lead Term or Context Term in case of synonyms. It is separated by a virgule and contains an asterisk in 68th character position of Lead Term or Context Term. Magnetic tape label of the input file is THES-DATA. Implementation of the program and creation of THES-DATA is discussed elsewhere (2).

3B7 Output

The magnetic tape label of the output file is THES-SORT. It contains synonym subject string as explained in Sec 3B8, in addition to subject strings. The Data Format of the output file is similar to output of CAR1 (t), A specimen copy of the output is given in Sec 916.

3B8 Procedure

1 To begin with a record from THES-DATA is read.

2 System checks for an asterisk in 68th position of Lead Term field and Context Term field of a record. If it encounters an asterisk in either of the field, it generates synonym subject string for corresponding term. It is likely that

1 Both Lead Term and Context Term may have asterisk; or
2 Either Lead Term or Context Term may have asterisk; or
3 Both Lead Term and Context Term may not have asterisk.

The following four subject strings illustrates the above case:

1 Safety clutch /Slipping clutch*
RT Safety clutch / Overload clutch*

2 Jaw Safety clutch / Toothed safety clutch*
RT Friction Safety clutch

3 Overload prevention
NT Safety clutch / Slipping clutch *

4 Interlocking mode
RT Overload prevention-

For the above subject strings, the following subject strings and synonym subject strings are generated.

1 Safety Clutch
UF Slipping clutch
2 Slipping clutch
U Safety clutch
3 Safety clutch
UF Overload clutch
4 Overload clutch
U Safety clutch
5 Safety clutch
RT Safety clutch
6 Jaw Safety clutch
UF Toothed Safety clutch
7 Toothed Safety clutch
U Jaw Safety clutch
8 Jaw Safety clutch
RT Friction Safety clutch
9 Safety Slipping clutch
UF Slipping clutch
10 Slipping clutch
U Safety clutch

11 Overload prevention
NT Safety clutch
12 Interlocking mode
RT Overload prevention

In the above strings, item nos 1, 2, 3, 4, 6, 7, 9, and 10 are synonym subject strings. Provision is made in program to delete subject strings for which the Lead Term and Context Term are equal such as item no. 5. Item nos 8 and 12 are subject strings with RT relation.

3 After completing above process, the intermediate output file called THES-SORT is to be sorted. It is not recommended to use the program CAR 2 developed in 1974, since it is most economic. Therefore, it is preferable to use manufacturer's software XSDA to sort the file. Magnetic tape label of the sorted output file is THES-DATA.

4 Next step in the programming is to delete the unnecessary records as explained in Step 2. This can be done by executing the program again with the status of the sense switch 23 as ON. At the end, output is available on magnetic tape called THES-SORT. Modified version of CAR2 (1974), i.e. CAR2 (1975) can be used to obtain printout on on-line printer. In Sec 917, Flow Chart illustrates the procedure involved in the programming.

OPERATING PROCEDURE

41 Compilation

Both AUCT and SYNG must be compiled, loaded and executed. After the compilation the object program may be dumped on punch cards, but preferably on magnetic tape. This avoids the compilation of the program whenever program is run.

4A AUCT

1 -The program is to be loaded on to computer memory. To begin with the following message appears on the console typewriter.

DISPLAY - ON 23 IF THESAURUS ON PRINTER
HALTED - 00

2 If the program is used to create a file of subject string/Thesaurus, then press the ACCEPT key on console typewriter. Then the following message appears on Console Typewriter.

DISPLAY - LOAD INPUT FILENAME & DIGITS
DISPLAY - ON 15 IF PRINT OUT REQUIRED
HALTED - 73

3 Load the Control Card as discussed in Sec 3B6.

4 Type ON 15 and press ACCEPT key if the printout of array of descriptors and Subject String on on-line printer is necessary.

5 Load input, and a scratch tape.

6 At the end of the successful process, the following message may appear on Console Typewriter.

HALTED END OF RUN

7 Sort the intermediate output file called TESTDATATAPE using the software =#= XSDA. The information required for sorting the file is given below:

Label of the input file	TESTDATATAPE
Label of the output file	THESAURUS
Number of keys to be sorted	**2**
Address of the first key	**5**
Length of the first key	**20**
Address of the second key	**64**
Length of the second key	**20**

8 Load #= AUCT. The message given in 1 will appear on Console Typewriter. Type ON 23 and press the ACCEPT key. Type GO and press the ACCEPT key. The following message will appear on Console Typewriter.

DISPLAY - LOAD INPUT FILE NAME
HALTED - 03

9 Load input file called THESAURUS.

10 Load control card as discussed in Sec 3B6. Magnetic tape label in control card should be THESAURUS. Type GO and press ACCEPT key. Output is now available on on-line printer. Thesaurus on tape called THESAURUS may be preserved.

11 At the end, message given in Step 6 will appear on Console Typewriter.

4B SYNC

1 Load #= SYNG. To begin with, following message will appear on Console Typewriter.

DISPLAY - ON 23 IF TAPE-TO-TAPE FOR DELETION
HALTED - 01

2 Press the ACCEPT key. Load the input file called THES-DATA and a scratch tape.

3 At the end of successful process, following message will appear on Console Typewriter.

HALTED END OF RUN

4 Intermediate output file is now available on magnetic tape called THES-SORT. This file is to be sorted using # XSDA software. The information required for sorting the file is given below:

Name of the input	THES-SORT
Name of the Output	THES-DATA
Number of keys to be sorted	2
Address of the first key	5
Length of the first key	20
Address of the second key	79
Length of the second key	20

5 Load # SYNG. A message will appear on Console Typewriter as given in Step 1. Type ON 23 and press the ACCEPT key. Type GO and press the ACCEPT key. Program now requires input, i.e., sorted file called THES-DATA and a scratch tape.

6 At the end, a message appears on Console Typewriter as given in Step 3. Output file is available on tape called THES-SORT. Load # CAR 2(1975), i.e., modified version of CAR2 developed in 1974. # CAR2 (1975) is to obtain a printout on on-line printer from THES-SORT. THES-SORT may be preserved.

5 IMPLEMENTATION

The programs are written in COBOL language and were implemented on ICL-1901A computer, with memory size 16K words. Four bytes constitute a word in which 6 bits constitute a byte. The following peripherals were used in compilation and testing programs.

ICL 2105	Card Reader
ICL 1920	Card Punch
ICL 2405/2	Line Printer
ICL 1971	Magnetic tape units. At least 2 tape units are required, provided a disc unit - ICL 2821 is available. Otherwise 4 tape units are required.
ICL 2821	Magnetic Disc (Twin Exchangeable disc store)

6 CONCLUSION

The programs for generation of a thesaurus as presented in this paper, largely uses batch processing method. The system analysis and procedure adopted in the paper may have to be perfected by applying it to a large sample of subject- structures covering a narrow subject field. Experiments are being made on a large assorted sample of subject-structures in the field "Lathe Production Engineering".

The input for the process of computer generation of thesaurus is a large assorted sample; of completely facet analysed subject-structures each of which display the syntactic relations between the concepts incident in a subject. It may be noted that in subject structures coextensively representing the subject of document there may be terms which are common - that is, general terms whose meaning may not change according.to context such as the terms 'increase', 'study', 'evaluation'. Such terms may not be treated as associative term to a special term in the subject field-such as the term 'Bacteria', 'Microbiology'. In other-words, entries such as following:

Microbiology
RT Increase
Bacteria
RT Study

need not be generated.

It may be observed that in AUCT, the terms having coordinate relation is not taken care of, because individual subject-string does not reflect such a relation; whereas computer generation of thesaurus according to Procedure 1 would generate coordinate relationships only. Therefore, it may be productive and helpful to blend suitably the approaches to derive a consolidated thesaurus for a particular subject field.

It is observed that in the output of thesaurus it may be helpful to provide indicator digits against each preferred term so that it may be used in computer-reader dialogue advantageously. Computer generation of thesaurus using AUCT depends upon the Data Base. And therefore, a properly designed data base with pre-coordinate indexing system preferably coordinated according to a freely faceted sche-

me, may be used to develop a good thesaurus, It maybe helpful to adopt AUCT for computer generation of a thesaurus for data bases such as CAS, INSPEC, etc.

Computerisation of thesaurus construction should not take precedence over human judgement in the evaluation of vocabulary, but these studies and others provide the basis for some useful decision. In otherwords, the identification of terms and relationships in a semi-automatic method should be considered as a kind of pre-processing of subject analysis before transforming terms into thesaurus form. The results of this processing are then used in the further steps of thesaurus building. Fully automatic building up of thesaurus may be attractive as an academic proposition. But it is not feasible in the present stage of development of information systems especially in India.

7 BIBLIOGRAPHICAL REFERENCES

1 Sec 1 Sec 3B5 Sec 3B7 SHEPHERD (Michael) and WATTERS (Carolyn). Computer-generation of thesaurus. (Lib. Sc. 12 ; 1975; Paper E).

2 Sec 1 NEELAMEGHAN (A). Non-hierarchical associative relationships : Their types and computer-generation of RT links. (Seminar on Thesaurus (1975). Paper AC)

3 Sec 3A6 RAVICHANDRA RAO (IK). Generalised approach to computer-based information storage, retrieval and dissemination. (Project submitted in part fulfilment of the requirements for the Associateship in Documentation of Indian Statistical Institute (1975))

4 Sec 1 USE OF computers in information storage, retrieval and dissemination. 1975. (Course material of a special course organised jointly by DRTC and INSDOC, Bangalore March-May 1975. Sponsored Department of Science and Technology, Government of India.

Sample Input : AUCT

SN. **DOCUMENTATION LIST** **PAGE NO**

6V.21
MICROBIOLOGY, BACTERIA; PRODUCTION-ANTIBIOTIC- INCRF ASE-STlMuLATION-TRRADlATION>ELECTROMAGNETIC RADIATl ON>ULTRAVI0LETRAYS

GV.21
MICROBIOIOGY, BACTERIA; CELL, WALL: DECOMPOSITION-CH **EMICAL>DRUG>ANTlBIOTIC**

0 **GY,2l**
MICROBIOIOGY, BACTERIA, CELL, WALL; STRUCTURE; STUDY -MICROSCOPF>ELECTRON MICROSCOPE

L,32
MFDlClNF, HUMAN BODY>CIPCULATORY SYSTEM>HEART: STlMU LATlON-CHEMICAL>DRUG>ANTlBIOTIC

L.A5
MEDICINE, HUMAN BODY> RFSPIRATORY SYSTEM> LUNG; DISF ASE-BACTERIA>M1C0BACTERIUM TUBERCULOSIS ; TREATMENT- CHEMICAI>DRUG>ANTIB10TIC

LX3.631
PHARMACOlOGY, CHEMICAL>DRUG>ANTIBIOTIC; STIMULATION-C IRCULATORY SYSTFM>HEART: STUDY-ANIMAL>RABBIT

TECHNOLOGY. CHEMICAL>DRUG>ANTIBIOTIC: PRODUCTION,PER MENTATION:CONTAMINATlON. PREVENTION

82 Array of Descriptors : A Sample

SEMI-AUTOMATED THESAURUS

0 MICROBIOLOGY
0 BACTERIA
0 PRODUCTION
2 ANTIBIOTIC
0 INCREASE
2 STIMULATION
2 IRRADIATION
1 ELECTROMAGNETIC RADIATION
1 ULTRA VIOLET RAYS

83 Subject String : A Sample

MICROBIOLOGY	RTBACTERIA
BACTERIA	RTMICROBIOLOGY
MICROBIOLOG Y	RTPRODUCTION
PRODUCTION	RTMICROBILOGY
MICROBIOLOGY	RTINCREASE
INCREASE	RTMICROBIOLOGY
BACTER1A	RTPRODUCTION
PRODUCTION	RTBACTERIA
BACTERIA	RTINCREASE
INCREASE	RTBACTERIA
PRODUCTION	RTANTIBIOTIC
ANTIRIOTIC	RTPRODUCTION
PRODUCTION	RTINCREASE
INCREASE	RTPPROUCTlON
ANTIRIOTIC	RTlNCREASE
INCREASE	RTANTIBIOTIC
IRRADIATION	RTELECTROMAGNETIC RADIATION
ELECTROMAGNETIC RADIATION	RTIRRADIATION
ELECTROMAGNETIC RADIATION	NTULTRAVIOLET RAYS
ULTRAVIOLET RAYS	RTELECTROMAGNETIC RADIATION

84 Sample Output : AUCT

SEMI-AUTOMATED THESAURUS

ANTIBIOTIC
BT DRUG
RT CONTAMINATION
RT DECOMPOSITION
RT FERMENTATION
RT INCREASE
RT PHARMACOLOGY
RT PREVENTION
RT PRODUCTION
RT STIMULATION
RT STUDY
RT TECHNOLOGY

BACTERIA
RT CELL
RT DECOMPOSITION
RT DISEASE
RT INCREASE
RT MICROBIOLOGY
RT PRODUCTION
RT STRUCTURE
RT STUDY
RT TREATMENT
RT WALL

CELL
RT BACTERIA
RT DECOMPOSITION
RT MICROBIOLOGY
RT STRUCTURE
RT STUDY
RT WALL

CHEMICAL
NT DRUG
RT CONTAMINATION
RT DECOMPOSITION
RT FERMENTATION
RT PHARMACOLOGY
RT PREVENTION
RT PRODUCTION
RT STIMULATION
RT STUDY
RT TECHNOLOGY

CIRCULATORY SYSTEM
BT HUMAN BODY
RT MEDICINE
RT STIMULATION
RT STUDY

CONTAMINATION
RT ANTIBIOTIC
RT CHEMICAL
RT DRUG
RT FFRMENTATtON
RT PREVENTION
RT PRODUCTION
RT TECHNOLOGY

DECOMPOSITION
RT ANTIBIOTIC
RT BACTERIA
RT CELL
RT CHEMICAL
RT DRUG
RT MICROBIOLOGY
RT WALL

DISEASE
RT BACTERIA
RT HUMAN BODY
RT LUNG
RT MEDICINE
RT MICOBACTERIUM TUBERCULOSIS
RT RESPIRATORY SYSTEM
RT TREATMENT

DRUG
BT CHEMICAL
NT ANTIBIOTIC
RT CONTAMINATION
RT DECOMPOSITION
RT FERMENTATION
RT PHARMACOLOGY
RT PREVENTION
RT PRODUCTION
RT STIMULATION
RT STUDY
RT TECHNOLOGY

ELECTROMAGNETIC RADIATION
BT IRRADIATION
NT ULTRAVIOLET RAYS

ELFCTRON MlCROSCOPE
BT MICROSCOPE
RT STUDY

FERMENTATION
RT ANTIBIOTIC
RT CHEMICAL
RT CONTAMINATION
RT DRUG
RT PREVENTION
RT PRODUCTION
RT TECHNOLOGY

HEART
RT MEDICINE
RT STIMUL**ATION**

SEMI-AUTOMATED THESAURUS

RT STUDY

HUMAN BODY
NT CIRCULATORY SYSTEM
NT RESPIRATORY SYSTEM
RT DISEASE
RT MEDlClNE
RT STIMULATION
RT TREATMENT

INCREASE
RT ANTIBIOTIC
RT BACTERIA
RT MICROBIOLOGY
RT PRODUCTION

IRRADIATION
NT ELECTROMAGNETIC RADIATION

LUNG
RT DISEASE
RT MEDICINE
RT TREATMENT

MEDICINE
RT CIRCULATORY SYSTEM
RT DISEASE
RT HEART
RT HUMAN BODY
RT LUNG
RT RESPIRATORY SYSTEM
RT STIMULATION
RT TREATMENT

MICOBACTERlUM TUBERCULOSIS
RT DISEASE
RT TREATMENT

MICROBIOLOGY
RT BACTERIA
RT CELL
RT DECOMPOSITION
RT INCREASE
RT PRODUCTION
RT STRUCTURE
RT STUDY
RT WALL

MICROSCOPE
NT ELECTRON **MICROSCOPE**
RT STUDY

PHARMACOLOGY
RT ANTIBIOTIC
RT CHEMICAL
RT DRUG
RT STIMULATION
RT STUDY

PREVENTION
RT ANTIBIOTIC
RT CHFMICAL
RT CONTAMINATION
RT DRUG
RT FERMENTATION
RT PRODUCTION
RT TECHNOLOGY

PRODUCTION
RT ANTIBIOTIC
RT BACTERIA
RT CHEM1CAL
RT CONTAMINATION
RT DRUG
RT FERMENTATION
RT INCREASE
RT MICROBIOLOGY
RT PREVENTION
RT TECHNOLOGY

RESPIRATORY SYSTEM
RT HUMAN BODY
RT DISEASE
RT MEDICINE
RT TREATMENT

STIMULATION
RT **ANTIBIOTIC**
RT **CHEMICAL**
RT **CIRCULATORY SYSTEM**
RT **DRUG**
RT HEART
RT **HUMAN BODY**
RT **MEDICINE**
RT **PHARMACOLOGY**
RT **STUDY**

STRUCTURE
RT BACTERIA
RT CEIL
RT MICROBIOLOGY
RT STUDY
RT WALL

STUDY

SEMI-AUTOMATED THESAURUS

RT **ANTIBIOTIC**
RT BACTERIA
RT CEIL
RT CHEMICAL
RT CIRCULATORY SYSTEM
RT **DRUG**
RT ELECTRON MICROSCOPE
RT **HEART**
RT **MICROBIOLOGY**
RT **MICROSCOPE**
RT **PHARMACOLOGY**
RT **STIMULATION**
RT **STRUCTURE**
RT **WALL**

TECHNOlOGY
RT ANTIBIOTIC
RT CHEMICAL
RT CONTAMINATION
RT DRUG
RT FERMENTATION
RT PREVENTION
RT PRODUCTION

TREATMENT
RT BACTERIA
RT DISEASE
RT HUMAN BODY
RT LUNG
RT MEDICINE
RT MICOBACTERIUM TUBERCULOSIS
RT RESPIRATORY SYSTEM

ULTRAVIOLET RAYS
BT ELECTROMAGNETIC RADIATION

WALL
RT BACTERIA
RT CELL
RT DECOMPOSITION
RT MICROBIOLOGY
RT STRUCTURE
RT STUDY

85 Flow Chart : AUCT

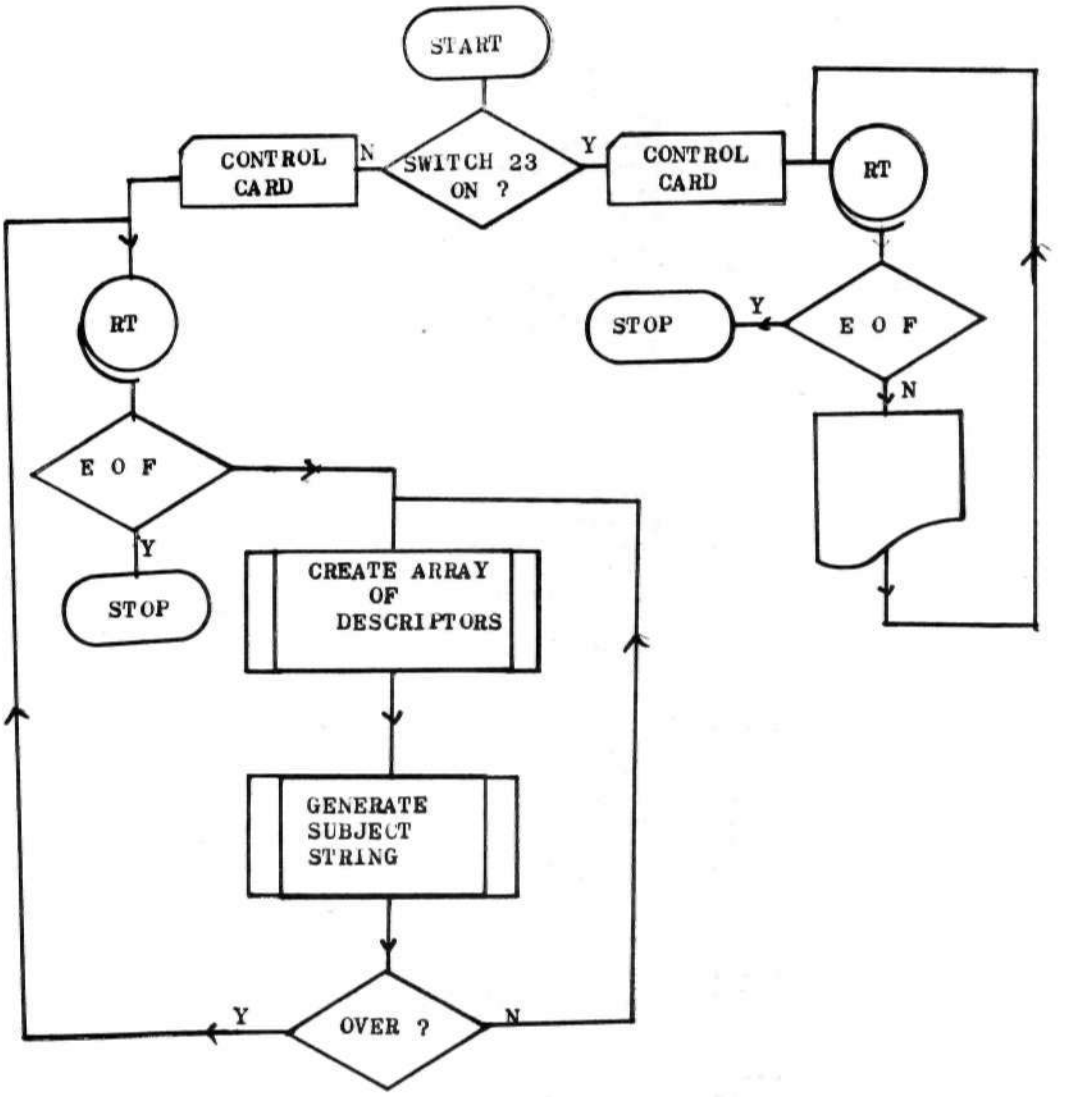

Fig **1** : Systems Flow Chart of AUCT

86 Sample Output : SYNG

SAFETY CLUTCH	**A1113**
UF OVERIOAD TRIPPING CLUTCH	**A111**
SAFETY CLUTCH	**A11**
UF SLIPPING CLUTCH	**A111**
SHEAR KEY	A113
BT OVERLOAD PREVENTION	**A11**
SHEAR KEY	Al1
UF BREAKING KEY	A113
SHEAR PIN	A112
BT OVERLOAD PREVENTION	A11
RT SHEAR KEY	A113
SHEAR PIN	All
UF BREAKING PIN	A112
SLIPPING CLUTCH	**A11**
U SAFETY CLUTCH	**A111**
SPRING AND BALL SAFETY CLUTCH	A1112
ST SAFETY CLUTCH	A111
RT FRICTION SAFFTY CLUTCH	A1113
RT JAU SAFETY CLUTCH	A1111
UF BALL SAFFTY CLUTCH	A1111
TOOTHER SAFETY CLUTCH	A1111
U JAW SAFETY CLUTCH	A111
TRAVEL LIMITING DEVICES	Al3
BT LATHE SAFETY DEVICES	**A1**
NT EXTREME POSITION LIMITING DEVICES	**A131**
RT INTERLOCKING MODE	**A12**
RT OVERIOAD PREVENTION	**A11**

ALL DONE

87 Flow Chart : SYNG.

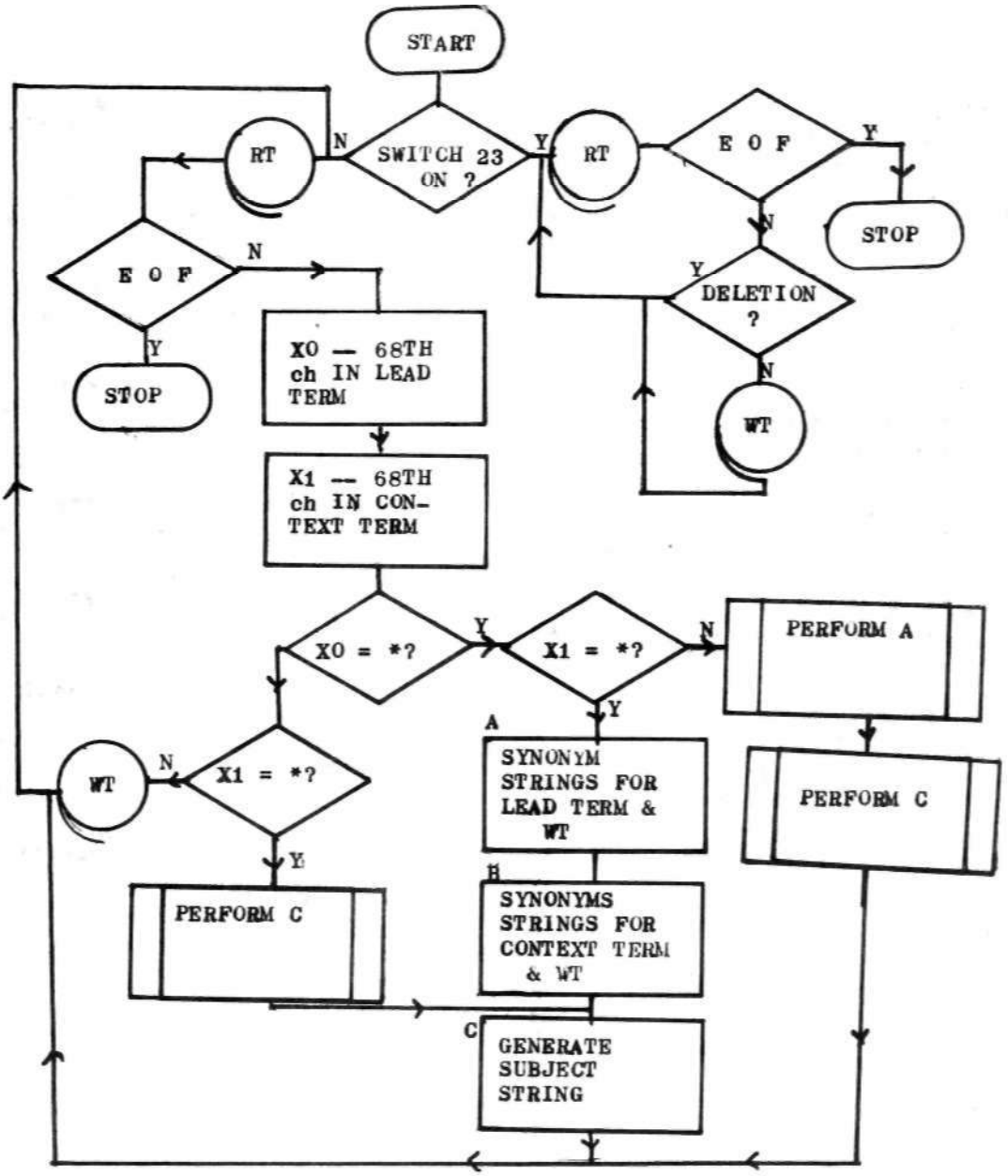

Fig 2 : Systems Flow Chart of SYNG