OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

FAIR USE POLICY

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

RESTRICTED

16627

DP/ID/SER.A/945
6 January 1988
English

MICROPROCESSOR APPLICATION ENGINEERING PROGRAMME

DP/IND/84/030

INDIA

Technical report: Microprocessor applications in medicine*

Prepared for the Government of India
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

Based on the work of Prof. Dr. A. Satanek, expert on microprocessor applications in medicine

Backstopping officer: V. Smirnov, Engineering Industries Branch

United Nations Industrial Development Organization
Vienna

---

* This document has been reproduced without formal editing.

7'1

V.88 20089

REPORT CONTENTS

1. SUMMARY

With regard to the objectives of the Mission to India, the Expert has:

1. Visited and become acquainted with the Microprocessor Application Engineering Program Center in Pune.
2. Reviewed, studied, and analyzed technical and bio-medical projects carried out by MAEP.
3. Held discussions concerning problems from point of view of biomedical engineering, physiology, and pathological physiology.
4. Provided many inputs, suggestions, and materials including circuit designs for the purpose of solution of problems in current biomedical projects.
5. Delivered a presentation concerning biomedical electronic instrumentation logistics and technology.
6. Organized and managed two seminars aimed at Medical Computing with demonstrations of medical software including expert systems.
7. Worked out eight documents covering the topic of Microprocessor systems applications in medicine.
8. Discussed proposed new projects in Biomedical Instrumentation with special emphasis on Image Processing and pattern recognition and interpretation.

9. Provided extensive information on modern technology and desirable enhancements in medical and scientific information storage and retrieval systems.

10. Suggested implementation of modern microprocessor and television based educational technology with respect to the MAEP Center's activities.

11. Outlined new forms and methods of training activities.

12. Stressed the importance of and made suggestions with respect to national and international information interchange regarding ongoing projects.

2. INTRODUCTION

Project title:	Microprocessor applications in medicine
Job Description:	DP/IND/84/030/11-10/J13315
Purpose of Project:	To participate in hardware and software project discussions and to impart training to centers as well as industries on design methodology.
Duration of mission:	five weeks
Duty station:	Pune, India

Objectives of the Mission:

1. Appraisal of the current status of microprocesor applications in the Indian industry.

2. Appraisal of the objectives status and the results of various system engineering development projects going on in various centers.

3. Help the project personnel in hardware and software development for various projects.

4. Train project personnel as well as centers on methodologies for microprocessor - based system engineering system.

The Expert was expected to perform a thorough analysis with respect to the above listed objectives, evaluate the current status, perform activities as described in Project title, and to prepare a final report for the UNIDO with recommendations to the Indian Government.

3. ACTIVITIES OF THE EXPERT DURING THE MISSION

1. Review of MAEP Center activities (Discussion with the Project Consultant Prof. Dr. Rathod.
2. Discussion with the Principal System Engineer, Mr. S. Y. Watwe on Project status.
3. Analysis and evaluation of current status of Project development.
4. Discussions with individual Project Center Staff members on industrial and biomedical aspects of the projects.
5. Workshop on analysis and interpretation of ECG signals with emphasis on following details:

   Automatic formatting of ECG Charts

   QRS Complex analysis, Basic Rhythms, typification

   Identification of P and T waves

   P and T wave reading

   Fourrier transform and noise reduction procedures

   Screening

   ECG rhythms simulations

   Knowledge base system development
6. Workshop on Patient Data Monitoring with emphasis on:

   Temperature monitoring

   Callibration of sensors

   Sensor sterility assurance and surveillance

   Physiological measurement points

   Heart rate monitoring

   Acoustic and optical sensors

   Blood pressure monitoring (methods and techniques)

   Korotkoff sounds

   Systolic and diastolic blood pressure

Mean pressure calculation

Measurement accuracy and validity

Automatic cuff compression techniques

Active filter systems for frequency noise reduction

7. Discussion about proposed new projects in biomedical instrumentation.

8. Outlining of recommendations for future activities.

9. Presentation, seminars, demonstrations, preparation of specific materials, and visits as listed.

10 In the last phase of the expert's mission, discussions were held with Prof. Dhake, Project Co-ordinator to Pune Center about contemporary project status.

11. On the occasion of the visit of Dr. Krishna Kant, Chief Project Co-ordinator to Pune Center, discussions concerning the major Center's activities were held.

4. FINDINGS AND EVALUATION OF CURRENT STATUS OF MICROPROCESSOR APPLICATION ENGINEERING PROGRAM

UNDP Project of Govt. of India

CENTRE PUNE

The MAEP Western Regional Center has been established by the Department of Eclectronics of Govt. of India at the College of Engineering, Pune, under the United Nations Development Program to promote microprocessor technology in the industry. The Center is one of the six regional centers established by Government of India, to serve as focal points of relevant aspects for various engineering and scientific disciplines in India. These centers are carrying out application engineering and training activities to cater to manpower needs generated by these sophisticated technology.

Objectives:

The Center has following objectives to promote the application of microprocessors in industries by:

1. Training of engineers and scientists
2. Guiding industries in development of application hardware and software

The main specialty areas of the Center are Tests and measuring instrumentation, ATE, biomedical applications.

College of Engineering has been conducting a variety of courses predominantly in the field of electronics and telecommunications with specialization in microwave and electronic instrumentation and control, computer technology, biomedical instrumentation and electronics, etc.

The College has a minicomputer facility with ten terminals installed in the Electronics & Telecommunication

Department, a number of personal computers (IBM PC compatibles and others), a wide range of indigenous and imported digital and communication test instruments, and various types of trainer kits.

Location:

The Center is at present housed in the Electronics & Telecommunication Department of the College of Engineering, Pune. A separate building for the MAEP Centre is proposed to be constructed.

Staff:

Project Co-ordinator: Prof. A. M. Dhake, Head of Electronics & Telecommunications Department of the College of Engineering, Pune.

Staff: The Center has a technical staff of eleven engineers. The Senior staff includes full time Project Consultant, Prof. Rathod, Principal System Engineer, S.Y. Watwe, and two Senior Project Engineers. The secretarial staff of seven members is available.

One Senior Project Engineer is responsible for biomedical systems. One Junior Engineer is responsible for the Project of Patient Data Monitoring Unit development, and another Junior Engineer for the project Expert System for ECG Analysis.

Other Senior Project Engineer has the responsibility for industrial systems. A Junior Engineer is in charge of the Project Design of Relay Parameter Testing Instrument, and two Junior Engineers are responsible for the Project Exhaust Pollution Monitoring.

The organizational structure of the manpower is revealed in Fig. 1.

M.A.E.P. , PUNE

- Project Co-ordinator
  Prof. A.M. Dhake
  (Head of E&T/C dept.)
  - Prof. Rathod
    (Project Consultant)
    - Mr. S.Y. Watve
      (Principal Systems Engineer)
      - **Biomedical Systems**
        - Mr. H.M. Pathak
          (Sr. Project Engg.)
          - Patient Monitor
            - Ms. Chitra Deshpande
              (Jr. Engg.)
          - ECG
            - Mr. Prem Daryanant
              (Jr. Engg.)
      - **Industrial Systems**
        - Exhaust Pollution
          - Mr. S.P. Dixit
            (Sr. Proj. Engg.)
            - Relay Testing
              - Mr. Bhingarkar
            - Gas Turbine
              - Mr. Niranjan Mayya
                (Jr.
              - Mr. Shirish
                (Jr.

- Artwork/Layout
- Mechanical

- Accountant
- Librarian
- Store Keeper
- Typist

Equipment:

The Center has procured the following equipment for its training and development activities: 4 System Development Stations, 1 Apple II microcomputer with printer, 2 IBM PC/XT compatibles, 2 IBM PC/AT compatible computers, 1 Tektronix 300 MHz CRO, 1 digital multimeter, 3 Intel PDs, 1 Intel MDS, 1 logic analyzer.

Educational activities:

Training courses: The MAEP Centre has been conducting courses in digital and microprocessor systems design aimed at training of scientists and engineers in industry and research and development organizations. The Center has organized following courses in the past two years:

1. Microprocessor hardware & software
2. Digital systems design
3. Microprocessor systems design
4. Digital and microprocessor system design
5. Microprocessor system design
6. Digital system design
7. Intel 8085 microprocessor and assembly language programming
8. Course on 8 bit microprocessor interface design
9. C - language programming, Prolog & Expert systems
10. 8086 Microprocessor system family

Development projects:

The Center is carrying out six development projects either independently or in collaboration with industries. The current projects are:

1. Design of Relay Parameter Testing Instrument
2. Patient Data Monitoring Unit

3. Exhaust Pollution Monitoring Unit
4. Expert System for ECG Analysis
5. Expert System for PCB Diagnostics
6. Turbine Slip Monitoring and Annunciator System

For the future there are following development projects in biomedical instrumentation proposed:

1. Infusion Pumps and Syringe Pumps
2. Plaque Counter for Virus
3. Genetical fingerprints of viral RNA using image processing techniques
4. Ophtalmoscope
5. Baby Incubator
6. Central Patient Monitoring System
7. Auto Analyser for Pathological Laboratories

Definition of major problems:

The major problem of MAEP is high fluctuation of staff members. Every year one or two staff members leave the Center, this year the number of members that left the center has risen to seven including the Principal System Engineer what imposed a serious problem particularly with regard to the ongoing projects.

The problems with manpower development are emphasized by inappropriate specialization of staff members, the staff is lacking mainly technicians responsible for physical realization of the projects.

In addition to this, MAEP has to cope with problems arising from insufficient workspace for experimental laboratories, and lack of instruments and equipment, primarily of electronic tools, measurement instruments, materials and devices (such as transducers and sensors).

5. FINDINGS AND EVALUATION OF CURRENT STATUS OF PROJECTS DEVELOPMENT

The following projects were reviewed:

1. Design of Relay Parameter Testing Instrument

This up-based unit aimes at automatic measurement of various relay parameters as per ISI specifications, for low voltage electro magnetic and read relays. It aimes at measurement of pull in voltage, dropout voltage, operate lag, coil resistence, contact resistence, bounce time, chattering frequency, life test, etc.

Current state: This microprocessor based unit at automatic measurement of various relay parameters was satisfactorily completed.

2. Exhaust Pollution Monitoring Unit

This project aimes at monitoring the contents of carbon monoxide gas in vehicle exhaust. It must be kept below specified percentage. An 8085 based board with A/D converter has been designed and tested.

Current state: The completion of the project is delayed due to unavailability of imported carbon monoxide sensing device.

3. Patient Data Monitoring Unit

A portable hand held LCD battery operated unit for monitoring of patient's temperature, blood pressure, and heart rate is proposed to be developed. The proposed unit should have an interface for a small printer and a real time clock as optional additional equipment.

Current state: The project has not yet reached the stage of a draft design, nor has been specified in detail.

Comment of the Expert:

The primary purpose of medical instrumentation is to extend the human senses in order to obtain measures which provide the data needed for more accurate diagnosis and treatment of the sick or injured. Also monitoring of the patient is the major objective of the intensive care facility.

The vital parameters like temperature, heart rate, blood pressures, ECG, and respiration rate are monitored electronically to indicate the corrective actions required. Also another reason for monitoring is to provide retrospective data that can be studied to evaluate the effectiveness of treatment and medication given to the patient.

Automatic microprocessor controlled equipment is now used in some clinics and also in practice in hypertension prevention and sport area.

Temperature Monitoring

For electronic monitoring of the patient's temperature a callibrated sensor for the range of 35 to 45 Centigrades is used, with an amplifier and a display. Temperature sensor must be covered by material which can be sterilized. There are several locations on the human body on which temperature readings provide valid results.

Heart Rate Monitoring

For monitoring of the heart rate an optical sensor is used (with amplifier and display). There are several problems associated with the measurement chamber that contains the optical sensor. This heart rate monitor is at present very popular also for use in sport area and fitness control.

Blood Pressure Monitoring

Arterial pressure is a driving force that causes blood to perfuse through the tissue of the entire body. Maintaining of adequate pressure is essential for the correct function of vital organs and prevention of vascular collapse. Because of the importance of blood pressure to the well being of the critically ill patients especiallv those in shock or with cardiovascular problems, blood pressure is routinely monitored in critical care areas.

Blood pressure, as it is conventionally measured, is essentially the lateral pressure, or force exerted by the blood on one unit area of wall in a blood vessel. This lateral force is assumed to be equal to the force per unit area in the longitudinal direction as a result of Pascal's law describing the transmission of forces of fluids. This law states that a force is tr[illegible]smitted equally in all directions in a contained fluid. The arterial blood pressure is constantly changing during the course of the cardiac cycle. The highest pressure of maximum amplitude of arterial pressure is called the systole. It is the result of the ejection of blood in to the aorta by the left cardiac ventricle. The lowest pressure, or minimum pressure is called the diastole. It occurs during the resting or diastolic phase of the cardiac cycle. Mean blood pressure represents the average pressure attained in the cardiac cycle. It is not the arithmetic average of the systolic and diastolic pressure because the arterial pressure is changing with time. The mean pressure is computed by integrating the pressure over one cardiac cycle and dividing by the time for one cycle. Mean blood pressure is often considered the most important of the blood pressure values as it is considered to be the parameter that indicates if vital organs are adequately perfused. Mean arterial pressure should be above 40 mm Hg to avoid vascular collapse. The mean pressure is not affected by arrhythmias causing a variation in the amplitude of the arterial waveform. Some typical ranges for normal arterial pressure are: systolic: 100 - 140 mm Hg, diastolic: 60 - 90 mm Hg, mean: 80 - 100 mm Hg.

A number of factors, acting in concert and dynamic equilibrium, are integrated via the central nervous system, in the determination of the arterial blood pressure. Some of these are:

1. Cardiac output
2. Peripheral vascular resistence
3. Volume of blood in the arterial system
4. Blood viscosity
5. Compliance of the arterial walls

The exact combination of each of these factors is not known, but peripheral resistence and cardiac output seem to have the greatest influence on blood pressure.

There exist direct and indirect methods of measuring blood pressure, the method used in routine examinations is to occlude the arteries in the upper arm with an expandable wraparound pressure cuff. The cuff is wrapped around the upper arm of the patient and the pressure increased to above systolic pressure. The pressure in the cuff is then slowly released. The theory goes that when the pressure in the cuff has fallen to a level equal to the peak, or systolic pressure, a stethoscope can pick up the sounds of the blood squirting through the once compressed artery. The sounds of the turbulent blood flow through the distorted lumen of the artery are called Korotkoff's sounds after the Russian physician who described them originally in a paper in 1906. These sounds may be divided into five phases:

Phase one is the sudden appearance of a clear but faint tapping sound growing louder during the succeeding 10 mm Hg fall in pressure.

In phase two the sound takes on murmurous quality during the next 15 mm Hg fall.

During phase three the sound changes little in quality but becomes clear and louder during the next 15 mm Hg fall.

During phase four the sounds take on a muffled quality which last through the next five to six mm Hg fall.

Phase five is simply the onset of silence, when all sounds disappear.

The beginning of phase one sounds usually occurs around 120 mm Hg in normals and is representative of systolic pressure. The pressure at which phase five occurs is an indirect approximation to diastolic pressure. In normals this occurs at about 80 mm Hg. This method of indirect blood pressure measurement is referred to as sphygmomanometry.

There are other ways of determining the systolic pressure including watching the mercury column for the first signs of a visible pulse and simply feeling for a pulse at the brachial artery.

Automatic microprocessor controlled equipment is now used in some instances to inflate a cuff at regular intervals while a microphone picks up the 400 to 500 Hz

Korotkoff sounds. The pressure at the beginning and at the end of the sounds is recorded and mean pressure is calculated to provide a long term record of a patient's blood pressure. These devices are becoming more popular for use as automated blood pressure monitors.

Many of the microprocessor controlled blood pressure devices have small dot matrix printers attached to them for logging the patient blood pressure data over periods of time. This type of indirect blood pressure monitor is beginning to be used more frequently because of the trauma and risk imposed by direct measurement of blood pressure and the lack of better indirect methods for monitoring the haemodynamic state of the patient.

Conclusion

Many discussions were held from engineering and biomedical viewpoint for better understanding the underlying physiological principles in order to reach a conclusion acceptable from both medical and technical aspects.

It is highly recommendable that the system should be designed in a modular way not only for the purposes of better maintainance but also, with respect to importance of its application to human life, also to automatic self testing capability.

In addition to this, much attention must be paid to periodic calibration of the temperature sensors and pressure transducers, which converts mechanical pressure into electrical signals with periodic accuracy check-ups.

Finally, it is necessary to solve one of the major general problems, i.e. assurance of sterility of the equipment, particularly of the sensors and especially in cases when sensors are inserted into the mouth or anus as it is usually done in infants.

4. Expert System for ECG Analysis

This project aimes at the signal conditioning, recognition, measurement, record, printout, and preprocessing for subsequent automated diagnostics. The system is supposed to be implemented on an IBM personal computer using PC compatible A/D card.

Current status: This project proposed to be realized in four phases. In the initial stage, an ECG waveform is input from an existing ECG recorder into the system and measurements using DSP techniques are performed on the data. During the subsequent phase the measurements carried out are passed through a diagnostic criteria module to analyze simple types of abnormalities and to make gross classification of heart disorders. The third phase consists of detailed breakup of each gross category and exact diagnostic criteria can also be fed to the system. In the final phase it is supposed this system to be implemented on a portable personal computer with an LCD display and ROM contained software.

At present, the project is in a stage of a simple computer generated ECG curve simulation with arithmetic curve segmentation.

Comment of the Expert:

The analysis and interpretation of the ECG seen as a multidimensional signal, can be considered as a series of pattern recognition tasks. The acquisition of knowledge in an expert system corresponds with the selection of features (the choice of attributes) and the design of a classifier (development of rules and selection or development of an inference mechanism). This process is most manifest in the modules for rhythm and contour classification. Based on a number of parameters mainly consisting of amplitude and time measurements in the ECG, a number of criteria should be determined. The evaluation of rules in which this criteria are used yields a diagnosis. During the QRS complex typification, for instance, a pairwise comparison of QRS complexes takes place in order to detect similar patterns. It is hard to derive rules which describe the feature selection process of humans. It mainly is an art which is based on a common sense, prior knowledge of the origin of biological signals, and diseases, and insight. Nevertheless, the choice of the features is of utmost importance. When features are used with no discriminating power, no classifier will yield reasonable results. On the other hand, once features with a high discriminating power should be selected, many different classifiers will give good results. The classifier is designed using a set a learning cases. The composition of such a set as well as its size constitute intricate problems. Furthermore, often is used an enriched set of ECGs, i.e., a set which contained a large number of pathological cases compared to a set of routinely recorded ECGs. The number of cases to be included in the learning set is often heuristically determined. A commonly accepted rule states that the number of cases should be at least 15 to 20 times the number of features.

Severe problems may be posed by the validation of the cases which are used in the learning phase. The problem of knowledge evaluation is very difficult.

The evaluation commonly is performed by processing a number of test cases. The problems with respect to composition and size of the learning set also apply to the test set. Of course, independent learning and test sets should be used. Both learning and test sets should be validated in order to be useful in the knowledge acquisition and evaluation phase.

It should be stressed, however, that validation is very difficult or may not be possible at all.

Conclusion

A number of issues were discussed from a knowledge engineering and biomedical point of view with following items emphasized:

- Modularity in the design of a system should be pursued from the beginning.
- The selection of the proper features upon which the diagnostic classifiers are based is of utmost importance.
- The evaluation of knowledge is an essential step toward user acceptance, and in the past has not been awarded appropriate attention.
- Validation of data is the heart of the knowledge acquisition and evaluation process.

5. Expert System for PCB Diagnosis

This project is an entirely new project and involves development of hardware and software on IBM personal computer for automatic diagnosis of various IBM PC cards in mass manufacturing QC level and fault diagnosis.

Current state: Project design and schedule is not prepared at present.

6. Turbine Slip Monitoring and Annunciator System

The project rests upon development of software for hardware already designed by the industry, i.e. an 8085 - based microprocessor system using PL/M-80 operating system.

Current state: The software was developed and tested.

6. RECOMMENDATIONS

1. Prior to project annoucement a pilot study should be performed with the task to acquire all relevant information on same or similar activities that are being or have been carried out within the country and abroad, possibly stating results already achieved.

2. All the projects developed now and especially in the future should be prepared well in advance according to a standardized plan containing list of necessary data, detailed definition of objectives, project descriptions from viewpoint of philosophy, technology, but also with respect to estimated user's requirements. The project development plan should clearly identify individual phases, targets, tasks, and milestones stating dates and activities involved. Specific attention should be paid to estimated critical points, such as procurement of specific or specialized devices or materials.

3. High attention it is necessary to pay to stabilization of personnel and manpower development. For in fact, the solution of this question is a conditio sine qua non for successful operation and further development of the MAEP Centre, Pune, and should be assigned the top priority.

4. The MAEP Centre should establish within a short period of time close relations to the industry in order to increase the benefits for both sides. The industry is providing impulses for research work, and in addition

to this may well provide necessary inputs, whereas it will benefit from application of research results. The profits of both sides are closely tied with the intensity of mutual contacts and information interchange. The industry becomes thus interested in implementation and possibly mass scale use of the results of research provided by the MAEP. The same applies to relations with medical institutions implying the same benefits.

5. MAEP should further increase its educational activities directed toward both pregraduate students, as well as to junior engineers. These should primarily gain their first expertise and experiences in work in the local industry and whithin junior expert exchange among similar centers at national level. This may be the most direct way to gain "hands on" experience, to learn by doing, and to acquire the desired skills and attitudes.

6. In order the Center to consolidate its activities and maximize its output, it is urgently necessary to resolve problems arising from insufficient workspace. However, the Expert has been informed that a new building is under construction and should be completed within two years. But even under current conditions it is possible and necessary to provide a small space for experimental electronic laboratory activities.

7. A matter of evenly high importance is the question of appropriate technical and analytical background in terms of necessary tools and equipment, as well as

knowledge and skill for its operation. All the equipment, especially if available in quantities less than optimal requires maximum utilization.

8. In educational activities a general concept of training should be adopted and guidelines set. In relation to this, modern educational technology is necessary to be acquired and mastered, predominantly in the area of microprocessor based systems. Also video equipment, which is available at the Center, should and could be used for educational purposes too. Adoption of these concepts would allow for preparation of curricula, and at the same time, the same equipment can be effectively deployed for measuring and control of training efficiency.

9. Activities of the library should be extended by computerized information acquisition, storage, and retrieval, as it corresponds with the current trends parallel in the world.

7. PUBLICATIONS AND SEMINARS

During the Mission the Expert has prepared following materials for the MAEP Centre, Pune:

1.	General attitude to application of microcomputer systems	4 pages
2.	Applications of computers in medicine	13 pages
3.	Guidelines to hardware selection	5 pages
4.	Guidelines to software selection	8 pages
5.	System development project	19 pages
6.	Computer stored medical record	11 pages
7.	Laboratory information system design	13 pages
8.	General outline of training in medical informatics	4 pages
9.	Biomedical instrumentation	15 pages
10.	Bibliography references on biomedical communications	11 pages

With respect to the general aim of the MAEP Centre, Pune, the program of microprocessor application in medicine and some of the projects currently going on in this center, the exp :t has conducted seminars oriented to train the project personnel in acquisition of skills and attitudes required for successfull application of microprocessor technology in medical applications, and presented examples of computer solutions to classic medical problems:

1. Evaluation of oral glucose tolerance test
2. Blood sugar index evaluation

3. Renal function control
4. Sample expert system knowledge base for diagnostics and classification of diabetes mellitus
5. Labtest - computerized evaluation and interpretation of bacteriological laboratory findings
6. Computerized EEG evaluation and interpretation

8. VISITS AND MEETINGS

NICNET

The National Informatics Centre is establishing a satellite based data communication network NICNET for activities in the field of informatics. This network extensively uses the latest state of the art computers for information processing and information interchange among individual Informatics Centres located at various parts of the country. This network has been designed in order to facilitate monitoring of various socioeconomic activities and / or projects.

The information is interchanged within the framework of this system between the administrative units of the centers, the state, and other administrative and monitoring departments dispersed throughout the country.

The primary tasks of this system is to facilitate:

- Exchange of messages and information between the central Government, State Governments, and district administrative units
- Monitoring of vital socio - economic projects
- Online information retrieval and updation facilities
- Optimal utilization of costly computer resources
- Emergency communication system
- Sharing of software
- Dissemination of important information

NIV

The National Institute of Virology (formerly the Virus Research Centre) has now emerged as a major center for virological research. During the past twenty five years, the Institute had devoted its attention to the problems of Arboviruses. Its contributions in this field have earned national and international reputation. A competent interdisciplinary team with a sound experience in various aspects of virological research has recently been generated. The Institute is now supposed to play an even greater role in the field of virology. It has to address itself to health problems arising from a wide range of pathogenesis viruses and it will also have to undertake a high level training in virology. It will have to play its legitimate role in advising policy makers in the formulation and implementation of appropriate measures for the prevention and control of viral diseases.

In 1967, the VRC was designated as one of the Collaboration laboratories of the World Health Organization, and in 1969 it started functioning as the Regional Centre of the WHO for South East Asia for Arbovirus studies. Since 1974, it has been functioning as a WHO Collaborating Centre for Arbovirus Reference and Research. The Centre received financial support both from the Indian Council of Medical Research and the Rockefeller Foundation.

LAVAL AUTOMATION

The Expert was invited to visit a company which is designing and manufacturing a wide range of electronic processing instruments and systems such as temperature controllers, proportional integral derivative controllers, data acquisition systems and smart sensor interface modules for implementation to and networking with microprocessor systems.

This company employes approximately eighty people and it is a typical representative of local industry.

9. CONCLUSIONS AND FURTHER CONSIDERATIONS

The scope of activities of the Microprocessor Application Engineering Programme Center in Pune is divided into two main areas.

The first major field covers educational activities in microprocessor systems and their applications for various medical and industrial applications.

In the past years many courses have been conducted by the centre concerning these topics. Although these courses are up to date from the contextual point of view, it is very desirable that the center works out appropriate curricula for study of these matters, set detailed objectives corresponding to individual phases of the study, and clearly defines final and partial learning goals.

The preparation of curricula should be done with respect to and in coordination with the needs of the final user, i.e. medical or industrial facilities.

The contemporary educational system, i.e. conventional courses, should be enhanced by implementation of new modern forms and methods of educational activities, primarily programmed individual and team problem solving approach, problem oriented methods, programmed instruction with use of audiovisual methods,etc. Also television programs with problem oriented contents may greatly contribute to increase the efficiency of education particularly in this field.

For these purposes, a task group within the center should be established.

The second major activity area of the MAEP Centre is project development in two basic directions: microprocessor based industrial systems and biomedical instrumentation.

The recommendation by the Expert to perform the search for user needs in educational activities applies with even greater emphasis to both industrial system development activities and biomedical instrumentation.

The Expert emphasizes this point especially because he is firmly of the opinion that in many places of the country there are many strong research projects which have been solved with excellent results. The Expert has performed his own survey and realized that many similar if not the same research projects are going on in various organizations, and that they are in different phases, even when in one place a research project has been satisfactorily completed, almost the same project has in another center just started. As an example can serve the Central Scientific Instruments Organization, Chandigarh, as well as others.

For this reason, the Expert would like to stress the urgency to establish some kind of national project development monitoring information system which would avoid duplication or multiplication in research efforts.

The Expert concludes that the MAEP Centre should undergo slight rearrangements in its structure and activities according to the items listed in recommendations section of this report.

10. ANNEXES

10.1 SCHEDULE OF ASSIGNMENT

MON November 2,1987	departure from Prague, arrival in Vienna briefing at UNIDO Headquarters
TUE November 3,1987	departure from Vienna, flight via Frankfurt to New Delhi, India
WED November 4,1987	arrival in New Delhi, briefing at UNDP Representative in India - Mr. Matiul Islam Industrial Development, Field Adviser
THU November 5,1987	(National Holiday)
FRI November 6,1987	Appointment with Ms. V. Sukuntha, UNDP Adviser Appointment with Dr. Krishna Kant, Chief Project Co-ordinator, MAEP
SAT November 7,1987	Arrival in Pune
MON November 9,1987	Introduction to MAEP Activities, Prof. Rathod, Project Consultant
TUE November 10,1987	Appointment with Mr. S.Y. Watwe, Principal System Engineer, introduction to project development
WED November 11,1987	Appointment with Mr. Pathak, Senior Project Engineer, introduction to biomedical projects
THU November 12,1987	Appointment with Mr. Prem Daryanani, Junior Engineer, discussion on biomedical project (ECG analysis)
FRI November 13,1987	Seminar and demonstration of medical software for staff members
SAT November 14,1987	Preparation of materials concerning

	microcomputers in medicine
SUN November 15,1987	Preparation of materials concerning hardware and software selection
MON November 16,1987	Visit to NICNET
TUE November 17,1987	(Regional Holiday) Preparation of materials concerning laboratory information system design
WED November 18,1987	Discussion on patient data monitoring system with Ms. Chitra Deshpande Visit to Virus Centre
THU November 19,1987	Further discussion on patient data monitoring system with Chitra Deshpade
FRI November 20,1987	Discussion on industrial projects with Mr. S.P. Dixit, Sr. Project Engineer Visit Laval Automation Co.
SAT November 21,1987	Preparation of materials concerning system development project
SUN November 22,1987	Preparation of materials concerning computer stored medical record
MON November 23,1987	Discussion about Project Exhaust Pollution Monitoring Unit with Mr. Niranjan Mayya
TUE November 24,1987	Meeting with Prof. Dhake, Project Co-ordinator, and Dr. Krishna Kant, Chief Project Co-ordinator, New Delhi Meeting with Principal of Engineering College
WED November 25,1987	Discussion about industrial projects with Mr. Bhingarkar
THU November 26,1987	Preparation of presentation on biomedical instrumentation and seminar

FRI November 27,1987	Preparation of presentation on biomedical instrumentation and seminar
SAT November 28,1987	Presentation on biomedical instrumentation Seminar with demonstration
MON November 30,1987	Visit to College of Medicine
TUE December 1,1987	Discussion with Prof. Rathod about contemporary problems of MAEP
WED December 2,1987	Discussion with Prof. Dhake about future projects
THU December 3,1987	Departure for New Delhi
FRI December 4,1987	Debriefing at UNDP - Mr. Matiul Islam, Ms. V. Sukuntha
SAT December 5,1987	Departure for Vienna
MON December 7,1987	Debriefing at UNIDO Headquarter, Vienna
TUE December 8,1987	Departure for Prague

10.2 LIST OF PERSONS WITH WHOM DISCUSSIONS HELD

UNDP - NEW DELHI

1. Mr. Matiul Islam	UNDP Field Adviser
2. Ms. V. Sukuntha	UNDP Adviser

DEPT. OF ELECTRONICS, GOVT. OF INDIA - NEW DELHI

3. Dr. Krishna Kant	Chief MAEP Co-ordinator

MAEP CENTRE PUNE

4. Prof. A.M. Dhake	Project Co-ordinator
5. Prof. K.K. Rathod	Project Consultant
6. Mr. S.Y. Watwe	Principal System Engineer
7. Mr. S.P. Dixit	Senior Project Engineer
8. Mr. H.M. Pathak	Senior Project Engineer
9. Mr. S.P. Kshirsagar	Junior Project Engineer
10. Mr. Prem Darianani	Junior Project Engineer
11. Mr. A.P. Bhingarkar	Engineering Assistant
12. Mr. Niranjan Mayya	Engineering Assistant
13 Ms. C.S. Deshpane	Engineering Assistant

COLLEGE OF ENGINEERING

14. Prof. V.T. Idate	Principal of College

LAVAL AUTOMATION LTD.

15. Mr. G.V. Mehenate	Manager
16. Mr. V.L. Mendes	Engineer
17. Mr. V.B. Virkar	Engineer

NATIONAL INFORMATICS CENTRE

18. Mr. P.D. Ubale	Principal System Analyst
19. Mr. U.P. Chonankar	Engineer
20. Mr. S.K. Navathe	Engineer

NATIONAL INSTITUTE OF VIROLOGY

21. Dr. F.M. Rodriguez	Director Grade Scientist
22. Dr. V.V. Wagh	Assistant Director
23. Dr. C.N. Dandawate	Senior Research Officer
24. Dr. H.N. Kaul	Senior Research Officer
25. Dr. S.R. Prasat	Research Officer
26. Dr. C.V. Mohan Rao	Research Officer
27. Dr. V.D. Kadam	Research Officer

J.P. MEDICAL COLLEGE

28. Dr. P.R. Sutaria	Head, Dept. of Gynaecology
29. Dr. M.K. Yevale	Dept. of Gynaecology
30. Dr. S. Gupte	Dept. of Gynaecology
31. Dr. M. Phadake	Head, Dept. of Paediatrics
32. Dr. Pramad Tog	Dept. of Paediatrics