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MICROPROCESSOR APPLICATION ENGINEERING PROGRAMME

DP/IND/84/030

INDIA

Technical report: Microprocessor application in industry*

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 D. Popovic,
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1. Summary

According to the expected duties of the Expert, as defined in his Job Description DP/IND/030/11-01/J13315, the Expert has:

- visited the Project Centres in Delhi, Pune, Lucknow, Jabalpur and Ranchi,
- informed himself about the running project activities within the individual Project Centres,
- reviewed the results achieved thus far and discussed the steps to be taken in the near future,
- talked to the leading persons of the institutions where the visited Project Centres are situated in order to encourage them in better support of project activities,
- planned in each Project Centre the future scheduling of terms for technical trainings and study tours,
- provided the project staff with the most recent publications in the relevant work areas,
- delivered a series of lectures in various areas of microcomputer applications in engineering during his stay at Delhi, Pune, Lucknow, Jabalpur and Ranchi,
- visited a series of Indian companies and institutions that are current partner or future co-operation candidate of Project Centre and discussed the possible common actions,
- participated at National Workshop on Microcomputer Application in the Steel Industry,
- prepared two contributions for the announced National Seminar on Computer Application in the Fertilizer Industry, that was postponed for December 1987.

2. Objectives of the Mission

The Job Description of UNIDO includes the following objectives of the mission:

- upraising of the Expert on the current status of Micro-processor application in the Indian industry,
- promotion of Microprocessor application in Indian industry by suggestion of measures to be taken,
- support of planning and development of hardware and software ,
- deliver the lectures on the state-of-the art of technology in this area,
- visit of relevant industries as appropriate project partner and suggestion of a plan of further actions,
- advising the Project Centres in development of Microprocessor application in industrial control,
- participation at National Symposiums on Microcomputer application in steel and fertilizer industry.

3. Activities of the Expert During his Mission

3.1 Activities at Project Centre in New Delhi

During his multiple stay in New Delhi the Expert has

- reviewed the Project work in discussion with Project staff and advised the staff in steps to be taken in the near future,
- also reviewed the state-of-the art of the MAEP Project and discussed with the National Project Co-ordinator the best strategies to be applied in individual Project Centres for work progress in view of the local difficulties of the Centres,
- discussed with the National Project Co-ordinator the Project resources and planned their future distribution,
- planned further National Symposia on Microprocessor application in various areas to be organized in the coming year,
- considered the possibility of continuation of Project work through organization of new activities which could develop to extensive national or international projects in the future

3.2 Activities at Project Centre in Pune

During the two week stay in Pune the main activities of the Expert have been:

- Acquaintance with the procured and already delivered project equipment as well as with the software that has been developed and/or to be developed.
- Review of Project activities in the area of Microcomputer application in Medicine and Equipment Test Technology, e.g. of the running and planned 'small projects'.
- Visiting of current and future co-operation partners of the Project Centre in order to discuss the future development of co-operation.
- Discussion with the engineers of the centre and advising them in solving their problems.
- Lecturing on Local Area Networks and their application in industrial control.
- Planning the study tour of the Project Co-ordinator and the training trips of the staff.

3.3 Activities at Project Centre in Lucknow

The one week stay with the Project Centre was devoted to the following activities of the Expert:

- Extensive discussion of two main project activities (s. later) of the Centre in the area of track measurement by the use of Microcomputer including the work on alternative technical solutions of the problem.
- Visiting of new work facilities of the Project Centre (Laboratories, Library, etc).
- Planning of future approach in order to practically implement the equipment and electronic circuits for solving the discussed problems, especially in view of the fact that some semiconductor elements needed are not available in India and perhaps even not deliverable to India.
- Planning of future sending of Project staff abroad for technical training.

3.4 Activities at Project Centre in Jabalpur

This was the first longer visit of the Expert to the Project Centre so that much discussion has been spent to the past and current problems of the Centre that are essential for a proper technical work there (staff recruitment, necessary rooms for staff and procured equipment, availability of special sensors needed etc). In addition to this the, following activities of the Expert have been his main concern during his stay with the Centre

- Detailed consideration of the main project activities of the Centre in the area of measurement of plant parameters by the use of microelectronic-based special sensors, including the work on possible practical implementation of corresponding field equipment.
- Visiting of Vice-Chancellor of the University, Dr.D.K. Sharma, and the repeating talks with him concerning the accelerated improvement of project work by solving the main start problems of the Centre.
- Visiting of existing and future facilities of the Centre (new Project Centre rooms, Library of the University, available equipment for research in the area of agricultural instrumentation etc).
- Planning of future training of Project staff abroad.
- Planning of an International Seminar on Application of Electronics in Agriculture to be held March, 1988 in Jabalpur.

4. Finding of the Expert

4.1 Finding Concerning the Project Centre in Delhi

The Project Centre staff is working on a series of 'small projects', already described in the last Technical Report of the Expert, 1987. The work is in an advanced stage, partially also at the final implementation stage, that will be subject of this Report.

- A microprocessor-based system for road user cost study was developed in co-operation with the Central Road Research Institute in Delhi. System hardware and software are ready and a quantity of system data has been collected and evaluated. The main problem, e.g. the automated measurement of the side acceleration of the vehicle in the road curve (in order to avoid the existing instrumentation with the reading by eyes). The measurement is important for calculation of running costs or of losses of the vehicle and will be solved by the use of a suspended mass accelerometer, produced in India. The final target of the work is December 1987.
- In co-operation with the Water Supply and Sewage Disposal Undertaking in Delhi the work is going on development of a microcomputer-based system for automation of a water supply system of a colony. At the moment, the main problem represents the efficient, accurate measurement of the water level in the main supply tank of 17 feet height.
- In the mean time, great progress has also made the Project staff working on water flow measurement of a supply plant. Here, integrated water flow should be measured in a 2.8m tube, probably by the use of ultra sonic sensors for determination of water depth, wherefrom the water quantity will be calculated. For this purpose a plant operator panel was developed as a convenient monitoring and command facility. Moreover, the software for control of the keyboard-display, of Analog-to-digital Converter and of the printer was developed. As the next task the formula, representing the integrated flow, based on a corresponding mathematical model of the flow system, should be derived and programmed as a calculating algorithm which initial data are based on measurement of local sensors (two of them). As a target, December 1987 has been determined, providing the required sensor will be available, that probably costs Rs 70 - 75 000 each.

- The development of the microcomputer-based system for monitoring of the flash butt welding has been finished: the relevant equations and programs have been implemented and will be tested in the field, starting with October 1987. As measuring parameters, needed for determination of welding process phases (burn off, reheating, flashing and butting), the welding current, trolley moment and but pressure are to be measured.
- Also in the final stage is the development of a microcomputer-based system for measurement of railway track survey trolley, whereby the software needed for data collection in the field is ready as well as the corresponding hardware. The data should be stored for statistical calculation on a 128 KByte bubble memory, which is still not available. (At the moment this takes place in a large-scale computer for which also the software was developed.

December 1987 was determined as a probable target.

- Finally, the 'small project' of real-time simulation of forces on railway wagons is also in the final stage and will probably be closed end of this year. The required hardware and software have been developed, but some mechanical and power supply back-up problems have still to be solved, before a 6 months test period in the field starts.
- Further work running here concern the development of software tools for microprocessors, like diverse cross-assemblers and code simulators of microcomputers Intel 8085, 8086 and 8051, which should be able to run on large-scale NEC-computer in the time-sharing mode. The software is useful for education and training of engineers from the industry, in which case many microcomputer hardware system will be saved by the use of developed software.

Here also, some of the Project will be completed by the end of 1987.

Further talks of the Expert with the National Project Co-ordinator have shown, that within the Centre in Delhi a variety of new Projects of different volume have been planned, like

- Computer-based water treatment plant
- Automation of an irrigation plant for water saving
- Optimal distribution of electric power, e.g. automation of electricity supply
- Driver training system by simulation

Each of the Project, since being complex, will need the input of US\$ Mio 1.5 so that the total input could be US\$ Mio 6. The Indian Government is ready to contribute the corresponding input in Rs. In addition to this, there is direct interest of the relevant industry to co-operate with the Project Centre on new projects.

At the moment, the completed Project Document has been prepared for the Water Treatment Plant Automation Project and will be forwarded to the Indian Government for further processing. In view of the fact, that MAEP Project develops in a very satisfactory way and that there are significant successes to be demonstrated thus far, the Expert recommends future increase of UNIDO input to the Project and extension of its duration.

Besides the above activities, the Project Centre carries out the training and other promotional activities for the people from the industry and research institutes. Its 1987 schedule is as follows:

- January 1987: training course in microprocessor application for engineers of CRRI (1 week, 14 participants)
- Mai 1987: training course for railwais engineers (2 weeks, 20 participants)
- April 1987: a two days meeting was organized with lecturing in microcomputer application for 50 people from the industry
- October 1987: a 3 days Workshop has been palanned to which about 30 to 40 engineers of Water Treatment and Sewage Disposal are expected
- December 1987: a two days Workshop has been planned to which 15 to 20 engineers of the Central Road Research Institute are expected
- December 1987: a microprocessor application will be organized to which about 20 to 30 railways engineers are expected

The Expert recommends to extend the training facilities in Delhi, and this in the sense of facilities needed for basic training in microprocessors as well as those needed for training in microcomputer application in relevant technical fields mentioned above.

4.2 Findings Concerning the Project Centre in Pune

The main operational field of the Centre is the Microcomputer application in medical and test equipment. At the begin of the work there have been some essential staff and procedural difficulties, most of them being solved since the last visit of the Expert there in 1985. However, the problems of suitable Project Centre rooms are still not in their final phase of the solution. They will still need another year.

The Project Centre staff has worked on following specific projects:

- Microcomputer-based unit for automatic relay test by measuring of relay parameters. The full breadboard testing is complete as well as the corresponding mechanical design and packaging. The project is in its final phase.
- Microcomputer-based patient data monitoring system. The system should be a portable one and should be able to monitor patients temperature, blood pressure and heart rate, and to print monitoring results on a printer. Presently the temperature and heart rate part of the system is complete in breadboard testing. However, due to the serious difficulty to find and to order the transducer capable to locate the systolic and diastolic points of the blood pressure, the finalization of the project will be delayed.
- Automatic monitoring of exhaust pollution, e.g. monitoring of CO content in vehicle exhaust. The hardware of the project is ready. The main difficulty is at the moment the procurement of the suitable CO sensor, available in India, but this is on the way to be solved.
- IBM PC-based Expert System for ECG Analysis. The project is in good progress: the necessary algorithms and the knowledge-based software are under development. As a result, a system should be implemented, capable to diagnostic electrocardiographic signals for speedy results.
The work on the project is to be recommended because of the know-how that will be gained in the area of concepting, generation of knowledge-based software, that is going to be the automation software of the future.
- Turbine slip monitoring and annunciator system is a software developing and hardware testing system to be developed in co-operation with MELTRON. The project is in the final stage and after its field test the system will be produced.
With METRON also a further project has been planned in the area of automatic test equipment, based on an Expert System.

- Ultrasound Image Processing is a further microcomputer application field where a project will be defined, based on some previous case study work. A corresponding device should be developed for Malaria detection. This will be possible additional Project staff has been recruited.
- There is also the possibility to re-open an earlier project in the area of microprocessor-based X-Ray Machine control. Here, however, further clarification of objectives is needed as well as a better specification of control requirements. Once the project work starts, the main problem is going to be the X-ray intensity sensor necessary for feedback control of optimal exposure time.

Here, the Expert would like to express its concern regarding the life danger of the Project staff that should work in the vicinity of the X-Ray Machine. Thus, this project should be rejected or should have the lowest priority.

As regard the training programme of the Centre, six training courses of the level 0, 1 and 2 have been organized in the last 12 months with about 20 participants per course. In addition, 3 further courses have been planned for 1987/1988, one at each level, along with the course each in C Language, PROLOG, Intel 8086, and in IBM PC.

4.3 Findings Concerning the Project Centre in Lucknow

The Project Centre is situated at Research, Design and Standards Organization which is under Indian Railways Authorities. The Centre was established in November 1985 with the objectives to start the project activities in order to solve various problems of interest in railway working and to train the RDSO and Railway engineers in microprocessor based automation systems.

The following two main projects have been identified as work items:

- Development of Weld Monitor, a project which objective is to record the geometry of rail joint in vertical and lateral plane, before and after welding. The project is of great importance due to the fact that the joint is the weakest link and presents a lot of difficulties to the permanent way maintenance. Thus, both rails have to be inspected before welding for straightness in vertical and lateral plane as well as each completed joint. Presently this is usually done manually, which is a slow process which does not guarantee the quality specified in the Code of Practice in Indian Railways for Welding.
- Measuring Wheel Analyser is the second project which objective is to process the signal generated by the sensors that measure the local load of the wheel during the movements of the vehicle along the track. The measured load is variable due to the irregularities of the track, which are random in nature. For this purpose six vertical and six lateral strain-gauged bridges should be used for each wheel as signal generators.

Beside this, the Centre has conducted in the past three training courses in Microprocessor Basics and Applications, and has organized the First National Seminar on Microprocessors on Indian Railways in Delhi January 28-29, 1987.

The Center has, however, until now sent no engineer abroad for training and the Project Co-ordinator has still not made his study tour, although the originally planned Project end is next year. This should be immediately corrected.

4.4 Findings Concerning the Project Centre in Jabalpur

The Project Centre is with the Instrumentation Department of Jawaharlal Nehru Agriculture University of Jabalpur. Its main area of work is Microcomputer application in Agriculture.

The two main difficulties of the centre are room and the recruitment problems. In addition, the communication problem to the National Project Co-ordination Centre as well as to other Project Centres is also the essential one.

The present Project rooms are unacceptable for keeping the expensive and high sensitive research instruments. On the other side, no adequate possibilities are given to train the people from the Agriculture in Microcomputer application. This, however, seems to be changed very soon. The new Project Centre Rooms which are going to be adequate for establishment of Microcomputer Laboratories and the Training Centre are under construction within the University Building. This is due to the excellent support that the Centre gets from the Vice-Chancellor of the University Dr. D.K. Sharma. Due to the support of Dr. Sharma the Centre has also the best chances to soon solve its staff recruitment problem.

The communication problem of the Centre still remains to be solved. Here both the telephone connection of the Centre as well as its transport facilities needed for field work of engineers are very poor. The Centre as good as not reachable per telephone and there is no vehicle available, suitable for transport of sensitive instrumentation to the field. This is that should be corrected by installing a STD line to the Centre and by purchasing a suitable, dust isolated and air conditioned vehicle for the above purposes as soon as possible. Both costs are incomparably low as regard the total Project investments of the Centre.

In the past, the Centre has worked on following projects, which will continue in 1988:

- Automatic determination of amount of nutrients and certain micronutrients in soil. The project work is progressing very well. A computer-based laboratory version of Soil Analyzer has already been developed. However, in order to develop a field version of the instrument, in which modern light diode technique is used, new semiconductors will be needed. Here, a co-operation with a Laboratory abroad for a longer time is necessary. Under the supposition that the required sensor is very soon available, the project can be finished by September 1988.
- Irrigation prognostic system for prediction or indication of optimal instant of field irrigation, based on determination

of crop water stress. In this way also the approximate irrigation quantity can be calculated. It has been planned, that up to the End of 1987 a Technical Report will be prepared, containing the general approach to be applied, and the required sensors should be ordered. By September 1988 a laboratory version of the instrumentation system should be developed, so that a one year field test can start. In this case, however, for the work on project the recruited engineer should be soon available in order to keep the planned terms in time.

In further discussion, the possibility was identified for the Centre to work on problem of prediction of optimal harvest time. Due to the staff shortage, however, this work should be postponed for 1988. As soon as new Centre rooms are ready (about 500 m²), two training courses will be organized for engineers and agricultural scientists. For March 1988 also an International Symposium on Electronic Measurement Techniques and Microprocessors in Agriculture has been organized. The University, as Dr. Sharma has assured to the Expert, is glad to host the Symposium.

5. Summary of Findings

- The Project has, in the mean time, made a considerable progress, especially in the last twelf months.
- In each Project Centre the work items have been identified, clearly defined, and the work on them well progressed.
- The past activities on individual "small projects" have been successfull. They also promise future success.
- At the end of originally planned Project duration, in September next year, an exposition of successful equipments and systems should be organized during the planned National Symposium on Microcomputer application in Engineering in Delhi.
- Furthermore, a series of new project has been identified in the area of Microcomputer application in utilities, that are going to develop to future National Projects supported by UNIDO. Some of them, like Water Treatment Plant have already been technically prepared and forwarded for further processing by Governmental Institutions.
- All Centres have solved their recruitment problems to a required degree, or will solve them very soon.
- However, not all Project Centres have solved their room and communication problems: telephon, telex and transport facilities.
- The Centres have also not made the use of the possibility to send the planned number of engineers abroad for training. This especially concerns the Project Centre in Delhi, Lucknow and Jabalpur.
- The Project Centre Co-ordinators in Bangalore and Lucknow, have also not made the planned study tour.
- It proves repeatedly, that the lack or non availability of special sensors on the market slows down and even prevents a successful work on projects.
- In the mean time also the main administrative difficulties of Project Centres have been solved and the appropriate co-operation partners identified.
- Although the Project equipment, procured for training of engineers from the industry have been installed - with the exception of Project Centre in Delhi - relatively late, all Project Centres have still been able to organize a remarkable number of training courses in the past and have planned in regular distances the future courses.

5. Summary of Recommendation

- Extend the originally planned total duration of the MAEP Project for another year in order to finish the project work that has started with a delay, this due to the initial difficulties of Project Centres (administrative burdens, room and staff recruitment problems etc.).
- Supply the Project during the extension time with the necessary Governmental and UNIDO input.
- Support the organization and establishment of new Microprocessor Application Projects, planned by National Project Co-ordinator, as mentioned in 4.1 here.
- Send the National Project Co-ordinator for this purpose to a new study tour.
- Use, as soon as possible, the non-used grants for Project staff to be trained abroad.
- Solve all administrative difficulties and solve the room problems at Centres in Pune and Jabalpur as soon as possible.
- Introduce the STD telephone facilities in Jabalpur and Pune in order to efficiently communicate with the Centres.
- Provide the Centre in Jabalpur with transport facility for project work in the field, which should be an air conditioned, dust free vehicle.
- Help the Centres in Delhi, Lucknow, Pune and Jabalpur in selection and procuring the sensors necessary for further project work.
- Use the planned National Symposium on Microcomputer Application in Engineering, next September in Delhi, as a possibility to review the results of the past Project work through the adequate Reports (Seminar Papers) and by exposition of completed systems and equipment.
- Organize special National Symposia on Microprocessor Application in Medicine and Testfield in Pune, and in Communications in Bangalore.
- Give any support needed to the organization of International Seminar in Jabalpur, March next year.