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## The Evolution of Minicomputer and Scope of its use in India

The advent of modern semi-conductor technology in recent years has made the minicomputer smaller and less costly on one hand, and more capable with higher capacity on the other. This has in fact rendered the definition of minicomputer difficult. These minicomputers have made economical and feasible most of the applications where large computers could not be justified. This market is the most rapidly growing segment of the computer industry.

In the early sixties, computers fabricated with discrete components, and consequently costly, bulky and slow, were prevalent. This was the time when there was no clear segregation of mini from midi computers since mini truly was not evolved. In the latter half of the sixties minis, in the real sense of the term, were taking shape with the commercial availability of inexpensive integrated circuits. In the rudimentary stages, the hardware and the support-software were designed with a view to supply minis to Original Equipment Manufacturer (OEM) users for dedicated or special applications, anywhere from computerized theatre-lighting to lunar landing guided by the on-board mini.

Such minis lacked general organization of hardware and had only basic software to programme the machine, namely the assembly language. This language provides direct correlation of mnemonics and machine vocabulary (numbers representing computer instructions). Until recently any one who attempted to utilize minicomputers outside the area of dedicated applications felt the acute shortage of software. The modern mini overcomes the shortcomings by its versatile hardware organization supported by rich software. To enhance through-put, floating point hardware, decimal arithmetic and double precision hardware are now available with many mini computers. Further, the generalised central

processor can support almost all types of peripheral devices that are hooked to the large computers enabling the users to configure a near-maxi system around a mini computer.

Higher level languages\*\* like FORTRAN and COBOL, available with minicomputers make, possible scientific batch processing and Business data processing without incurring colossal overheads on large computers doing the same job.

A scientific minicomputer configuration typically can be used in research and educational institutions for scientific problem-solving, statistical and mathematical analysis, development work, admissions, exam-results and training. A business minicomputer rich in peripherals is lucratively used for speeding up processing work where data is too large for manual processing and to reduce time lag in receipt and processing of data.

In India, during the last decade most of the computers installed were built using second generation technology. These were used primarily for job-automation while a few were engaged for problem-solving in universities. The scope of utilisation could have been better but for the inadequate information and awareness among the users of computers which were alien to majority of them at that time.

Computerization of commercial jobs like payroll billing of materials, inventory reports, production statistics, financial accounting could be afforded only by the government, banks, insurance and large industrial houses. Even these were not computerised to desired level due to large financial overhead and scarcity of foreign exchange. The contemporary mini offers a very attractive alternative, with its low cost, whereby larger segments of the industry can afford computerization. Time-sharing and multiprogramming offered now by minicomputers further widen their use and economic viability. It can be stated without exaggeration that Indian Railways, one of the larger net works in the world, Life Insurance Corporation, a mammoth organization, and the defence services for which sizable

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\*\*Higher level languages in contrast with lower level languages have compact statements resembling a mathematical notation, an English sentence or mixture of both. Each high level language statement causes a computer to perform several machine language instructions. Assembly language and machine language are lower level languages.



amount of budget has been set aside, can harness networks of minicomputers for their administration, thereby improving efficiency, bettering services and providing for inhouse development.

The applications of real-time\* computers which are generally custom made are numerous : Communication control, network control, traffic control, continuous process control, production line control, machine control and instrumentation control are examples of applications in research, industries or public utility systems. Pulse-height analysis of a nuclear reaction and air line reservation system are examples of applications in research and commercial utility. In one of our hill-stations a real time computer is used for detection and analysis of radio waves from sources like pulsars and quasars. This is achieved by collecting data at a fast rate through steerable battery of parabolic antennas and analysing the information using the computer.

With know-how completely developed in India and expertise cultivated locally, ECIL's 12 bit and 16 bit (TDC-312 & TDC-316) minicomputers use integrated circuits. The central processor organizations of these computers have versatile characteristics to support wide range of software enabling most of the applications possible, some of which could be implemented only on large computers in the past. Higher level languages, FORTRAN, BASIC\*\* for scientific and ECOBAL\*\*\* COBOL, for business data processing made available with TDC series enable easy programming. For scientific and business environments, application programs of jobs that are frequently computerised (as mentioned earlier) for problem-solving and commercial job automation are available with the above computers. Further, decision making and monitoring activities indispensable for management are aided by mathematical tools such as PERT/CPM techniques, forecasting, budgeting and linear programming are being made available with the above systems.

Real-time configurations, that are marketed, are supported by suitable custom made real-time software in addition to standard software for background† programs.

\* Real-time is a term used to refer to any system in which the processing of data input to the system to obtain results occurs virtually simultaneously with the event generating the data. The processed output is used as feedback information.

\*\* BASIC is the expansion for Beginner's All Purpose Scientific Instruction Code. An easy-to-learn language, developed at Dartmouth College.

\*\*\*ECOBAL—Electronic Corporation's own Business Assembly Language.

† For efficient utilization of resource, the computer system will be operating on background, executing jobs using conventional software which has lower priority than the real-time software. Sporadic requirements are made by real-time software to be executed at which time the background job is suspended by computer to take up real-time execution.

For better appreciation some applications implemented in India are briefly explained in the following paragraphs.

At Gauribidanur, in Karnataka State, a TDC-12 real-time system has been successfully deployed to collect and monitor data from an 'L' shaped array of seismic sensors embedded in the earth. This set up facilitates detection and analysis of seismic events caused either by earthquakes or by underground nuclear explosions. Detection capability of the array is limited if events are manually monitored. TDC-12 plays a salient role in detection of weak events, while the noise analysis programs run at regular intervals, help considerably in reducing false-alarms.

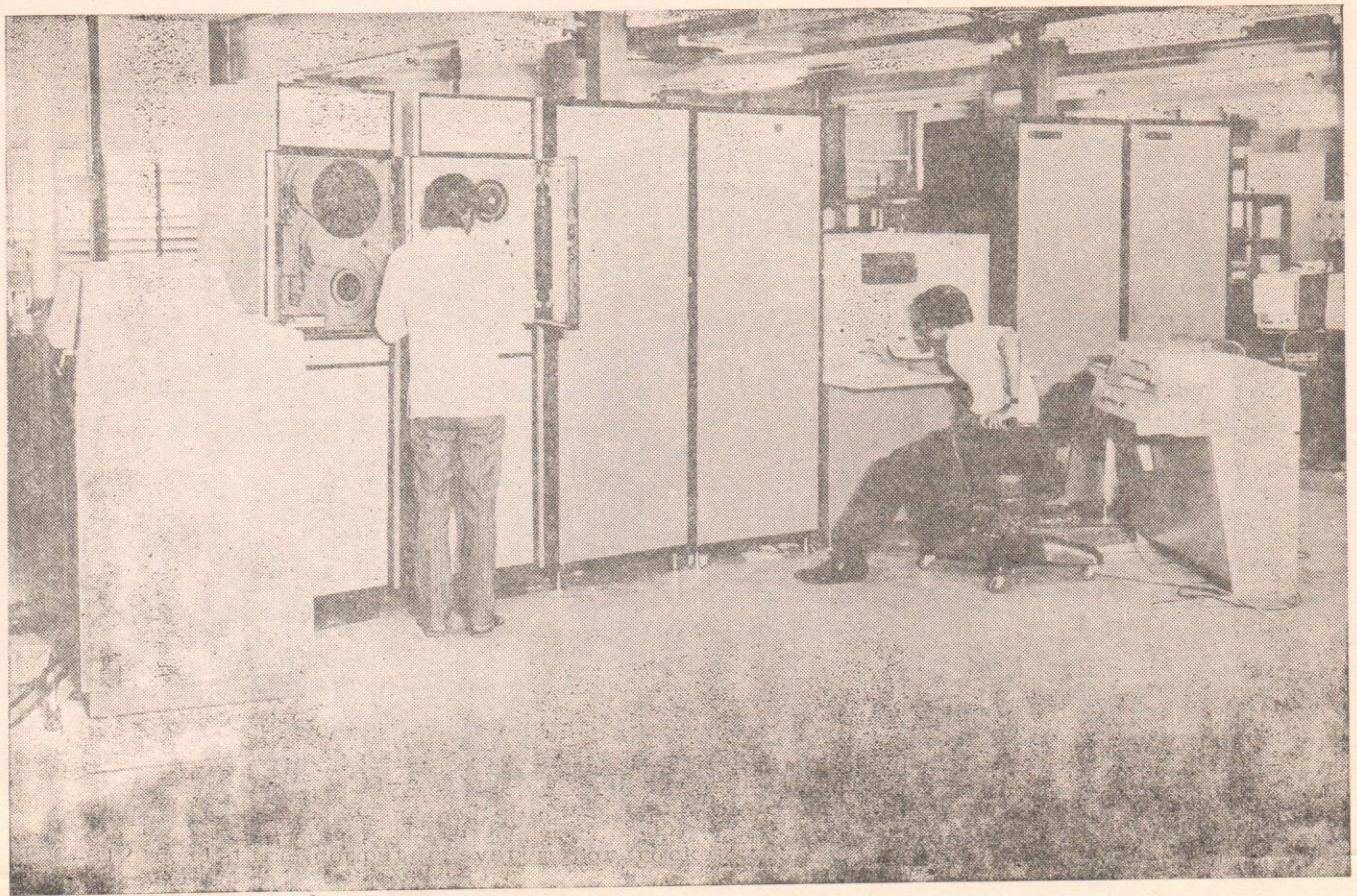
A sophisticated TDC-312 real-time computer system is being implemented at Gujarat State Fertilizer Plant for on-line process control of Ammonia-Urea group of plants. In a conventional set up hundreds of parameter values of the process, detected by instruments are displayed in a central control room which are systematically logged by operating personnel. Despite this, when any parameter goes off the set value, the process responds faster than the time taken by the personnel to notice the change and correct it. Even in case he is ready to take remedial action, there will not be enough time for fully analysing the cause and the effect relationships, to decide on the action.

During transition periods like start-up, shut-down or emergencies, deviation from set value in one vital parameter triggers a chain of deviation in related parameters with high probabilities of undesirable effects. It is not always possible for the human operator to record all the relevant transient data during such periods. He, then will not be able to forestall undesirable occurrences, if any, in future, since he will be ignorant of plant behaviour during transitions.

The tremendous speed of TDC-312 circumvents such problems, not solvable at human speed. The Computer will scan all the relevant plant data, virtually continuously and log them at regular intervals or during transitions. Besides acquisition of data the behaviour of plant equipments will be analysed. During phase one of implementation Computer is used for data acquisition, logging, plant efficiency, mass/energy balance and optimum loading etc. In phase two, the computer will set the analog controllers in many important analog control loops.

It will not be possible to exhaustively list in this article the real-time functions a computer is capable of performing; a brief mention is, therefore, made on a few other real-time applications in India :





TDC-312 real-time Computer System for rocket testing.

In Kolar Gold Fields a TDC-12 is continually monitoring cosmic showers from outerspace and when it detects bursts of radiation, pulse height analysis is done to trace the nature of source. Data reduction and analysis is done in the background mode.

In a research establishment in Bangalore a TDC-12 is used to continuously log changing values of important parameters of a gas turbine under test. Elsewhere similar test system is being implemented for monitoring rocket engine performance and control of propellents.

A real-time configuration built around two TDC-16 computers is being developed for on-line control of nuclear and conventional power plant at the Fast Breeder Test Reactor in Madras. The complete system is expected to process 600 analog and 300 digital inputs in the real-time mode. Scientific processing will be simultaneously carried out in the background.

Recent statistics reveal that out of over 100 minicomputer models made by 50 manufacturers in the world, very few support scientific, business, real-time,

time-sharing software on a single minicomputer. Minis described above, however, fall in this small minority supporting all the above software. Many computer users accustomed to large scale computers fail to consider minicomputers as an alternative. The import of money-eating large computers in India have to be de-emphasised since the need projected by the user is often over-specified and the hard currency drain is by-no-means small. Another fact that minis have a place in the 'revolution of computerization of any organization is condoned. Not too infrequently the organizations which procure large computers but lacking infrastructure for large computerization find themselves under-utilizing their costly resource.

A requirement of about 900 minicomputers during next five years has been predicted. Indigenous computer manufacturing programmes have an advantage of harnessing development, implementation and marketing efforts towards satisfying present computer needs of India while, for itself, acquiring a first hand research and design experience.