CHAPTER - I

INTRODUCTION

Emergence of Microprocessor as a out product of LSI technology in 1970[1] (Intel 4004) became land mark of an era, where dimensions of programmability, sophistication, context independent designability etc. could be added to the concept of dedicated control panels of the instruments. The endowed candidate, the Microprocessor, was professed characterising the technological developments in near future and over-whelming implementation of the device, in its multitudes, by the technocrats today doubtlessly accepts the claim.

Advancement of technology from LSI to VLSI, and utilization of the architectural know-how of the large computers 2nd and 3rd generation, not only fast breeded the candidate but also deviced the interface family members enriching the environments. Devicing electronics of equipments controlling complicated sequences of '**sophisticated instrumentation**' became feasible, but the prefix has lost its sophistication.

The present state of art of implementation of Microprocessor based control systems in scientific laboratories is application specific and the trend is either towards using programmable control systems, added on to the personal computers (PC ADD-ON) or towards devicing a system - prototype around a single board computer. Various features of these are elaborated with a few illustrations below.

Regarding custom design of PC ADD-ON within the Apple environment, demands of software overhead for data acquisition and file management[2] are meager. The version Apple II^{+} being supported by Apple-Soft DOS 3.3[2] , the first operating system made available on magnetic disks, offers a straight forward system access and simplifies complex file-management processes. The environment[3] supports upto 64 K RAM and 8 I/O slots, directly accessible through IN # n and PR # n commands. Exploiting these attractive features, H.S.Woon et_al[4] have developed a system around Apple II^{+} computer for measurement of deep level transient capacitance of semiconducting samples. Though the real time speed of the inherently noisy measurement was limited by the capacitance meter, faster sampling rates(45 microseconds/sample) and the averaging led to the improved performance over previous setups[4,5,6].

It is apparent from the above example that performance, accuracy of the measurement setup is not unidimensionally limited to the processor's (1 MHz in above example)[2] or facility of wider data basis. Therefore, selection of the environment, paying an attention to the hardware as well as the software implementation, and design of the interface devices should be carried out for achieving optimum performances.

As a few generalised features of PC ADD-ON, faster the processor better the sampling rates achieved and larger the available auxiliary storage averages would be more reliable. Not only because of meeting the above mentioned requirement, IBM PC/XT, offering I/O access time ∽ 1 microsecond[7] and supporting 20 MB of auxiliary storage, appears to be a suitable choice. But the operating system PC (MS) DOS[8], version 3.0 onwards, additionally offers an access to the so called higher level interface, the IBM BIO.COM. This facility allows user to pass required parameters to the BIO.COM. Making use of these parameters and calling an appropriate functions, e.g. 21H, the Function Request[9], the task of the system management become simpler. Neverthless, a expertise in the system design is inevitable. Though similar facilities are offered by CP/M plus compatibles through PIP command and relevant system management routines[10], these machines are not as popular as IBM PC/XT.

Recently the efforts are diverted towards development of hardware as well as software supports for a specific area of application and the commercial versions of PC ADD-ONs available in the market[11,12]. The range covered at present is mainly oriented towards multi-channel data acquisition systems (DAC). A.M.Elabdalla et_al[13] have reported a versatile hardware design while M.A.Havell et_al[14] have attempted development of a modular software structure for multi-channel data acquisition. Further, while devicing a system capable of controlling all the sequences of instrumentation, systems developed mainly for data acquisition are not sufficient and it is inevitable to restrict attention to a specific range of applications only.

Firstly, we attempt to analyse needs of 'software support, remaining restricted to the measurement of transport properties[15].

Now, movement the field of application gets restricted, the appropriate software modules for data acquisition, arithmatic operations, line fitting, single or multi variabled process control etc. could very-well be deviced. Further as the interpretable languages result efficient were mainly calls to assembly language routines are selectively embeded[16], integrating the above mentioned software modules through an interpretable language appears to be a convenient choice. Amongst the interpretable languages Basic structure stands to be the most popular, user-friendly and main part of the present thesis is devoted to the development of Basic like language structure, specifically applicable in the cryo-physics laboratories. Here not strictly for the sake of validating the dire need specialized language structure, it is temptious to refer the development of a software structure CALIBRATE by C.RINGEARD[17] for multimeter oriented measurements in other fields of application also.

Before attempting to out sort the needs of hardware requirement of control panels in the cryo-physics laboratories, it would be worth while comparing trade-offs of PC ADD-ONs and single board microcomputers. Having instrumentation controlled through ADD-ONs, offers implicitly an access to the standard I/O devices through the BIOS of the operating system. Therefore, if the standard peripherals are necessary and sufficient for the instrumentation requirement, then only the PC ADD-ON would be cost-effective alternative. On the other hand if the peripheral requirement of the instrumentation is exclusively non-standard and need of vast auxiliary storage lies at a subordinate level then designing a single board microcomputer prototype, with key parsed(18) function control, remains a convenient choice.

Development of Soft-ware, Hard-ware and Integration, .while implementing a single board protype continues interactively with a MDS and specially designed in-circuit emulators(19). The commercially available systems within this range are the OEM systems(20) by Intel Corporation, where the concept of distributed control (multi-master capabilities) for inter coupling the products, designed to suit a specific area of application, is incorporated. The memory modules of the system are dual-port units and allows transfer of O.S. from a master board or from a MDS (e.g. iPDS)(19). Interpretive languages e.g. Basic 80 for iSBC[R] 80/10B(19,20) operating on OEM systems are also available with Intel Corporation. These modules happens to be to general and include file-management facility, floating point arithmatic, editing facilities, etc. to the complete extent, though these are best suited in the environment of the IBM PC (with Math coprocessor). Thus the interpreter was bound to extend upto 24 KB or more and may hamper space and time economy trade-off badly. But the most desirous feature of linking object code routines to the main module is lacking in the language structure offered. The present attempt is intended towards development of a language structure accommodating commands of specific interest only and allowing arithmatic of minimum accuracy required. At present no detail performance evaluation is attempted.

In conclusion, it appears that approaches of PC ADD-ON or single board prototypes offer advantages of their-own and if a hardware structure is deviced offering advantages of both, the PC ADD-ONs and the multi-master kits[20] would be most benificial a attempt. The software development presented in this dissertation defines a hardware (H.W.) structure of the type mentioned above. The H.W. is basically a kit based on 8086 (8088 optional) and facilities of adding a kit on the IBM PC/XT or having a multibus (IEEE 796) termination on kit prototype, with custom H.W. design to incorporate a multibus with PC/XT are the options offered. The methods of inter-communication between a PC/XT and the kit are proposed, but development of the batch software for the purpose is beyond the scope of the dissertation.

The layout of the dissertation is as below :

The Chapter II elaborates requirements of cryophysics instrumentation. Additionally back-ground discussion of the devices used for H.W. design and software testing is included in this Chapter.

The Chapter III defines H.W. of the kit with detailed description of Memory and I/O decoding. The H.W. option of the PC/XT interfacing and required software is also cited in this Chapter.

The Chapters IV and V describe the language structure, coding, code execution etc. The last Chapter, i.e. Chapter VI covers testing procedures adopted and elaborates the proposed scheme of further developments and implementation of the system.