SMR/90 - 13

COLLEGE ON MICROPROCESSORS:

TECHNOLOGY AND APPLICATIONS IN PHYSICS

7 September - 2 October 1981

GENERAL INTRODUCTION TO THE COLLEGE

C. VERKERK

DD Division
CERN
1211 Geneva 23
Switzerland

COLLEGE ON MICROPROCESSORS

TECHNOLOGY AND APPLICATIONS IN PHYSICS

MICROPROCESSOR REVOLUTION STARTED LESS THAN 10 YEARS AGO (NOV. 15, 1971):

INTEL 4004.

DESIGNED FOR A HIGH-PERFORMANCE, PROGRAMMABLE POCKET CALCULATOR FOR BUSICOM, JAPAN.

VERY RAPID DEVELOPMENT:

1972 :	8008
1974 :	8080 AND 6800
	ALSO: PACE
1976 :	8048, MICROCOMPUTER
1978/79 :	8086, 9900, Z8000
1979 :	8088, 6809, 68000
1981 :	iAPX 432

IN 1979 75 M MICROPROCESSORS WERE SOLD.
AT END '79 TOTAL NUMBER SOLD: M 11 M

WHERE DID THEY END UP?

- A FEW : REPLACEMENT OF MINICOMPUTER
- MANY : REPLACEMENT OF RANDOM LOGIC
- THE LOT : NEW APPLICATIONS

IN MANY APPLICATIONS THE MICRO IS TRANSPARENT TO THE USER ("EMBEDDED"):

- HOME APPLIANCES (WASHING MACHINES)
- AUTOMOBILES (CARBURATOR, IGNITION CONTROL; TEST STANDS)
- TV GAMES.
- CERTAIN INDUSTRIAL CONTROLS

MORE "INTELLIGENT" APPLICATIONS:

- INDUSTRIAL CONTROL ⟶ ROBOTS
- HOBBY AND PERSONAL COMPUTERS
- COMPUTER PERIPHERALS (TERMINALS)
- WORD PROCESSING, OFFICE AUTOMATION.
- SCIENTIFIC INSTRUMENTS AND EXPERIMENTS

USES IN EXPERIMENTS:

- MONITORING
- CONTROL
- DATA ACQUISITION AND RECORDING
- DATA ANALYSIS (REAL-TIME OR OTHER)

IN 1980 ICTP DECIDED TO ORGANIZE A COURSE ON MICROPROCESSORS.

RESULT:

A COURSE FOR PHYSICISTS BY PHYSICISTS

OBJECTIVE OF THE COURSE:

PROVIDE SUFFICIENT KNOWLEDGE OF MICROPROCESSOR HARDWARE AND SOFTWARE TO ENABLE THE PARTICIPANTS TO WORK EFFECTIVELY WITH MICROS IN THEIR LABORATORY.

i.e. - PLAN
- DESIGN
- BUILD
- INTEGRATE

A MICROPROCESSOR SYSTEM

THE COURSE THEREFORE SHOULD HAVE:

- INTEGRATED HARDWARE/SOFTWARE APPROACH.
- PRACTICAL HANDS-ON EXPERIENCE IN ADDITION TO THEORY.
- EXAMPLES OF APPLICATIONS IN DIFFERENT FIELDS OF PHYSICS

AT END OF THE COURSE PARTICIPANTS SHOULD HAVE ACQUIRED KNOWLEDGE OF MICROPROCESSOR

- HARDWARE
- INTERFACING
- PROGRAMMING
- PROGRAM DEVELOPMENT
- INTEGRATION
- SYSTEM DESIGN

OUR APPROACH WILL BE ALONG THE LINES OF STRUCTURED, TOP-DOWN DESIGN

PARTICIPANTS SHOULD THEN HAVE NO DIFFICULTY IN READING THE LITERATURE OR IN ADAPTING TO ANOTHER TYPE OF MICRO.

WE CHOSE TO BASE THE COURSE ON THE POPULAR MOTOROLA 6800. THIS DOES NOT IMPLY THAT THE 6800 IS "SUPERIOR" TO OTHER MICROS.

PRACTICAL REASON:

- IT ALLOWED TO SET UP THE PRACTICAL EXERCISES
  - TO SATISFY THE PRINCIPLES
  - AT REASONABLE COST
  - FOR A LARGE NUMBER OF STUDENTS.

PARTICIPANTS WILL TAKE HOME THEIR MICROPROCESSOR KIT.
THE KIT HAS RESTRICTED POSSIBILITIES, BUT
- IT GIVES YOU A BASE TO BUILD ON IN YOUR LABORATORY
- IT MAY SERVE AS A MEANS FOR YOUR TEACHING TO SPREAD THE KNOWLEDGE

ORGANIZATION OF THE COURSE

- FORMAL LECTURES IN THE MORNING.
  - FIRST TWO WEEKS: BASIC SUBJECTS. ESSENTIAL FOR THE EXERCISES. DON'T MISS THEM!
  - LAST TWO WEEKS: MORE APPLICATION ORIENTED + SUBJECTS OF GENERAL INTEREST.

SCHEDULE: 9.15 - 10.10
10.30 - 11.15
11.35 - 13.30

- PRACTICAL EXERCISES IN THE AFTERNOON, PRECEDED REGULARLY BY AN INTRODUCTION. 3 GROUPS.

PRACTICAL EXERCISES LED BY
ROBERT MCLAREN (CERN)
WOLFGANG VON RUEDEN (CERN)

INSTRUCTORS:

MICHAEL BARTON	(2nd HALF)	UMIST
DARIO CROSETTO		TORINO
MARTYN EDWARDS	(1st HALF)	UMIST
ALESSANDRO MARCHIORO		CERN
BRIAN MARTIN	(1st HALF)	CERN
ULRICH RAICH		CERN
JEAN-PIERRE VANUXEM	(2nd HALF)	CERN

EXPERIENCED PEOPLE
WORKED A LOT, WILL HAVE A HARD JOB.

OUTLINE OF LECTURE COURSE.

LEVEL: SOME OF YOU MAY BE BORED, OTHERS MAY HAVE DIFFICULTIES.

LET US KNOW!

1ST TWO WEEKS:

1. PROGRAMMING PRINCIPLES.
   PROFESSOR ANDY VAN DAM
   LEVELS OF LANGUAGES
   ASSEMBLER, ARCHITECTURE
   STRUCTURED APPROACH
   DESIGN + LAYOUT OF A PROGRAM

2. LOGIC AND ARITHMÊTIC
   PROFESSOR ALBERT WERBROUCK
   HARDWARE BUILDING BLOCKS,
   FROM GATES TO ALUs
   ARITHMETIC
   NUMBER SYSTEMS

3. MICROPROCESSOR ARCHITECTURE
   DR MARTYN EDWARDS
   PROFESSOR DAVID ASPINALL
   INTERNAL STRUCTURE OF PROCESSOR
   CONNECTIONS TO MEMORY, I/O
   INSTRUCTION SET ADDRESSING MODE.

4. MICROPROCESSOR INTERFACING
   PROFESSOR JEAN-DANIEL NICOUD
   DECODING AND SYNCHRONIZATION
   PARALLEL I/O
   SERIAL I/O
   INTERRUPTS, POLLING

5. OVERVIEW OF TYPES OF MICROPROCESSORS
   PROFESSOR DAVID ASPINALL
   4, 8, 16-BIT PROCESSORS
   32-BIT
   MICROCONTROLLERS

6. SEMICONDUCTOR TECHNOLOGY
   ING. G. ZOCCHI
   MANUFACTURING PROCESS

7. I/O AND STORAGE DEVICES
   PROFESSOR ALBERT WERBROUCK
   I/O DEVICES, CHARACTERISTICS
   STORAGE HIERARCHY
   DISCS
   CCD, BUBBLES.

8. Programming Techniques and Tools.
Professor Costa Halatsis

- Assemblers ⟶ Compilers
- Editors
- File Access and Handling
- Linking and Loading
- Structured Programming

9. Desk Top computers
Rinus Verkerk

- Floating Point Attachments
- Languages, operating systems
- Possible use in data acquisition and control
- Large Personal Computers

10. Development Systems
Professor Costa Halatsis

- Kits with Hex Keyboard
- Stand-alone systems
- Multi-user systems
- Tools: Logic State Analyzer

11. System Design Methodology.
Rinus Verkerk

- Top-Down Approach
- Trade-offs (Hard/Soft)

12. Distributed Processing Systems.
Dr. Bob Dobinson

- Motivation
- Interconnections
- Local Area Networks
- Protocols

13. Microprocessors in Terminals
Dr. Carlo Vandoni

- Impact of Micros
- Intelligent Terminals
- Graphic Terminals
- Large Nets of Terminals + Processors

14. Bus systems
Dr. Paul Kunz

- Principles
- Standards
- Examples: S100, Camac, Unibus
- Arbitration
- Multi-master

15. Bit Slices and Microprogramming
Dr. Paul Kunz

- ALU slices
- File and sequencer slices
- Microprogramming
- Tools for Microprogram development

16. APPLICATIONS OF MICROPROCESSORS.

IN:

- SOLID STATE PHYSICS
  PROFESSOR S. FORNILI
- CLIMATOLOGY AND SOLAR ENERGY
  ING. A. MAZZA
- PLASMA PHYSICS
  PROFESSOR F. ZARAGA
- GENERAL PURPOSE DAC AND CONTROL (CAVIAR)
  DR. SERGIO CITTOLIN
- NUMBER CRUNCHING (168/E)
  DR. PAUL KUNZ

17. SPECIAL LECTURE

PROFESSOR ABDUS SALAM

ACKNOWLEDGEMENTS.

IN ITALY:
- CENTRO DI CALCOLO
- CONTROL DATA
- SIP
- OLIVETTI
- INFN TRIESTE
- ISTITUTO DI FISICA PADOVA, TRIESTE
- PIETRO MORAS

SWITZERLAND:
- NICOUD AND EPFL
- HOPITAL CANTONAL (SCHERRER)
- MOTOROLA
- CAPTRONIX

AT CERN:
- TECHNICAL TRAINING
- APPRENTICES
- DD WORKSHOP
- TRANSPORT AND CUSTOMS SERVICES
- TERMINAL PEOPLE: B. RODMANN, CANNON, BOURG
- JULIAN BLAKE, HORST VON EICKEO
- DG AND SEVERAL SUPERVISORS
- INSTRUCTORS