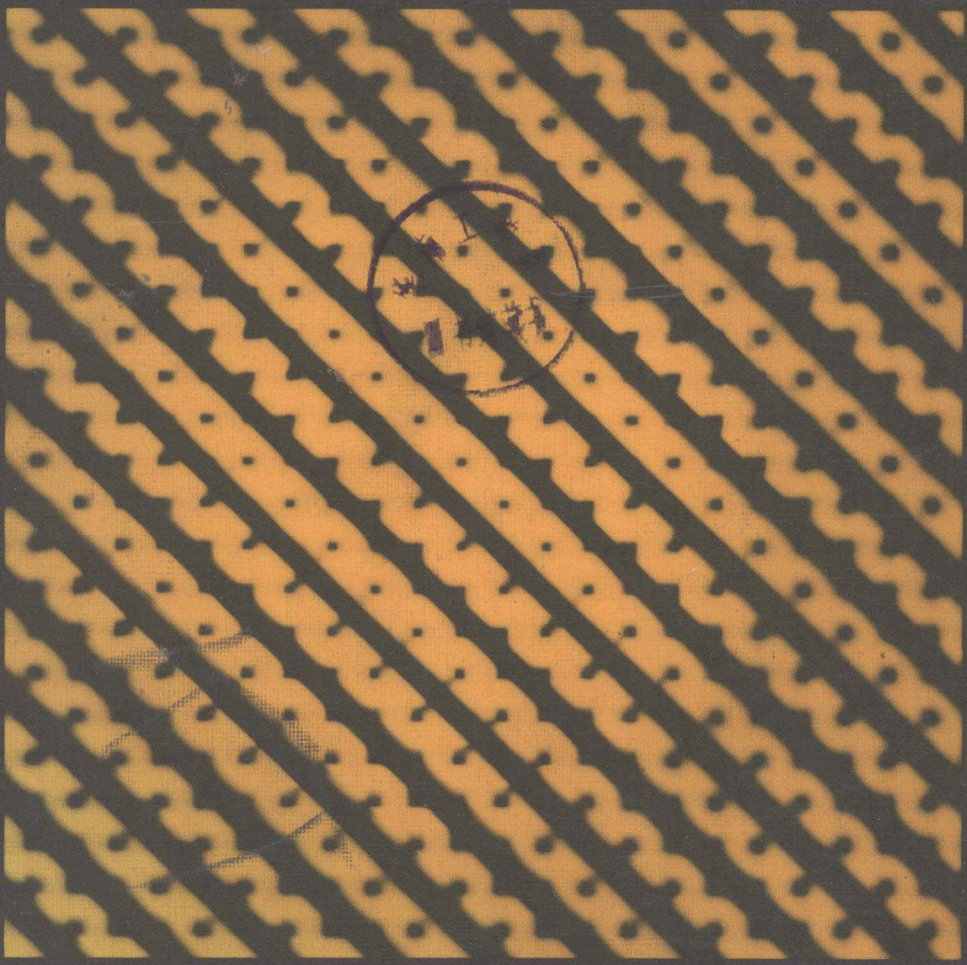
COMPUTER PERIPHERALS

Barry Wilkinson & David Horrocks



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Computer Peripherals

Preface

Anyone coming into contact with computers, even if only superficially, cannot fail to become aware of the importance of peripherals. Developments in peripheral devices have been many and varied in recent years and a wide range of devices with differing capabilities is now manufactured.

However, the current interest in this topic is not generally reflected in the many books on computers. Most of these books devote no more than a chapter to peripheral devices and are unable therefore to describe more than a few of them.

This book attempts to meet the need for a wide-ranging and straightforward account of how present-day peripheral devices work and what they are capable of doing. Emphasis is placed on the underlying principles of operation of the devices, rather than on providing a product description of manufacturers' wares. The aim is to include all the main types of peripheral device which may be encountered.

To maintain the relevance of the material, and keep the page count within reasonable limits, devices that are still at the development stage and not yet fully available are not included. One or two exceptions to this have been made where it can be foreseen, with some confidence, that a device is to be marketed in the near future.

No special academic or technical background is required of the reader, although some interest in, and knowledge of basic computer operation is assumed. Also, familiarity with simple concepts and ideas of electronics would be helpful in some parts of the book.

This text should be of value to HTC, HTD, and BSc students studying engineering and computer technology at polytechnics, technical colleges and universities, especially when used in conjunction with one of the many books on computers. This book will also be of interest to those dealing with computers, in and out of the computing industry, who would like an account of the subject which is informative but not over-technical.

The first chapter discusses the role of peripherals and is followed by a chapter which presents the ways that peripherals connect to a computer and how information and data are passed between them.

Chapters 3–10 deal with the various peripheral devices, mechanisms and techniques under major headings and form the main part of the book. These chapters need not be read in order, and the reader can safely turn first to those chapters of greatest interest.

The final chapter, on data communications, which can be considered as an extension of Chapter 2, gives a short account of the communication equipment and techniques used when peripherals, perhaps large in number, are remote from the processor.

The writing of this book has been an enlightening experience, and a co-operative venture for its authors, neither of whom would claim to have made the larger contribution.

In preparing the manuscript we have had the benefit of information supplied

by many companies, and of discussions with many people. In particular we mention our valued colleague, Martin Healey. We are indebted to Llewela Gibbons and Margaret Wilkinson who between them typed so well the manuscript, and to Brian Steven and Alan Whittle at Hodder & Stoughton for their editorial help. David Horrocks is grateful to his wife Chris for all the help and support and to his four-year-old son Jim for his good behaviour over this period. Barry Wilkinson particularly wishes to thank his wife, Margaret, for helping him prepare his part of the manuscript. Without her continued help and encouragement it would never have been achieved.

To all concerned we say thank you.

DHH and ABW

Contents

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The role of computer peripherals

1.1 Preamble

A digital computer system comprises a central processor unit (with memory) which performs arithmetic operations and controls the operation of the computer system, and peripheral devices connected to the central processor. These devices input information, output information and store information for future use. For a medium-sized computer system, say, costing £50 000, about 15% of this cost will typically be due to the central processor and 85% due to the peripheral devices connected to the central processor. This book is concerned with that 85% – the construction, operation and control of the peripherals.

Before entering into the subject in the following chapters let us look, by way of introduction to the peripherals of a computer system, at some of the present-day applications (and the roles the peripherals play). These applications have expanded and diversifed in the last 30 years to cover all aspects of life from business and commerce to social activities and leisure. As a name of a peripheral or keyword is introduced in this text, it will be italicized.

1.2 Payroll and accounts

Whenever one receives an invoice for payment of a gas or electricity or rates bill, or for other services or goods, there is every likelihood that the amount on the invoice will have been calculated using a computer, and the invoice printed under control of the computer by a computer peripheral, in this case a *printer*.

Similarly employees of all but the smallest concerns are likely to receive their wage slips printed and calculated by computer. Computer systems that handle such items as wages and accounts come within the sphere of 'data processing', where often large amounts of data are processed. These data can be entered into the computer using a variety of input devices.

Punched cards have in the past been widely associated with data-processing applications where maybe the same calculation is performed on different data. Each punched card measures about 18.7 cm by 8.2 cm and has holes punched in rows through the card in selected positions to represent alpha-numeric characters. This is done by skilled operators using a keyboard punch. The information on the cards can be entered into the computer using a *card reader*, a stack of cards at a time. In a wages calculation, for example, each card might hold the information concerning one employee, with the computer

instructed to read the cards in the stack sequentially and calculate the wages, PAYE, etc. of each employee.

Nowadays the most common means of input to a computer is via a 'typewriter' type of keyboard. The information is entered and results can be viewed on a 'television' type display, with the keyboard and display built as a composite unit, the *visual display unit* or VDU as it is called.

The data, whilst being immediately processed, are kept with the computer proper, but otherwise are often relegated to a *'backing store'*. In a data-processing system, the amount of data to be stored may be vast, and this can be stored on *magnetic tape* wound on 'open reels' measuring $10\frac{1}{2}$ in (26.7 cm) in diameter (for example).

Payroll and accounts may be separate functions or there may be some form of cross coupling. In a manufacturing company, for example, the cost of the product is directly related to the cost of the labour. This costing operation can utilize the payroll information in a composite system.

The size of the computer system depends upon the complexity of the problem and size of the organization, and can range from a large mainframe computer having a multitude of peripherals (card readers, VDUs, magnetic-tape units, printers, etc.) through the smaller mini-computers, down to the recent micro-computer systems. This last variety has been given the name 'small-business system' when applied to business applications and is suited to the small concern.

Figure 1.1 shows a small computer system suitable for payroll and other commercial applications.

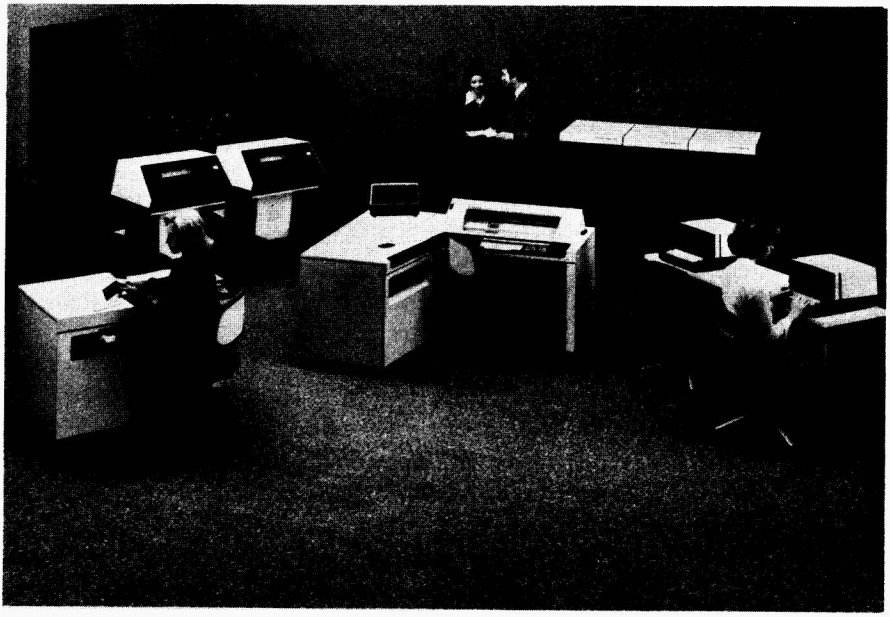

Figure 1.1 Small computer system suitable for commercial applications (Burroughs B80 system: Courtesy of Burroughs Machines Ltd).

1.3 Retail stock control and distribution

This is one area where the average housewife is likely to notice a change to 'computerization' in the coming years. The retail trade encompasses all the high-street shops and the larger cash-and-carry warehouses and hypermarkets located away from the high streets. Most of the larger high-street organizations have or are in the process of installing a computer system for store inventory and collection of data at the check-outs. All have computer systems for general stock-control functions (in addition to payroll).

However, it is in the large volume sales of supermarkets, hypermarkets and cash-and-carry warehouses that the more radical changes can be made. At the check-out (point of sale), the function of the cashier can be automated as follows (Fig. 1.2). As the customer's goods are handled (say physically moved from one trolley to another), sensors detect special labels on the goods which provide information such as the price (excluding value-added tax), value-added tax rate, quantity, and an identifying product code. This information is entered into the system together with information entered manually – for example, a customer code (the customer might have an account with the concern). The

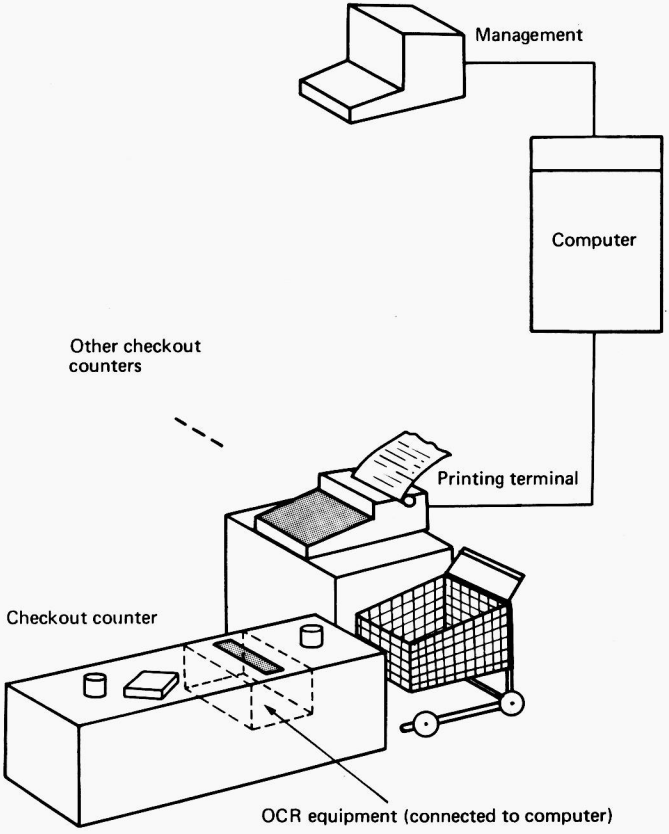

Figure 1.2 Supermarket check-out system.

appropriate printout is produced, giving details of all the goods bought and the grand total. Such systems may be based upon small or medium-sized computers.

The input peripheral in these systems comes under the heading of 'special purpose' direct entry. The labels may be sensed optically (using *optical character recognition*) or by other means. Another perhaps more familiar application of automatic data entry is the handling of bank cheques. These cheques have magnetic markings which enable direct reading of the cheque number, branch and bank.

1.4 Transaction processing

The principal peripheral in a computer transaction-processing system is the visual display unit. An example of transaction processing is a business order system (Fig. 1.3). Orders are received by telephone or letter and entered into the system and stored on *magnetic discs*. Invoices, despatch notes and other documents are produced on a printer. For telephone orders, the customer can be informed immediately whether the goods required are in stock.

Systems in which data are entered via a keyboard with the data then placed onto discs are known as 'key-to-disc' systems.

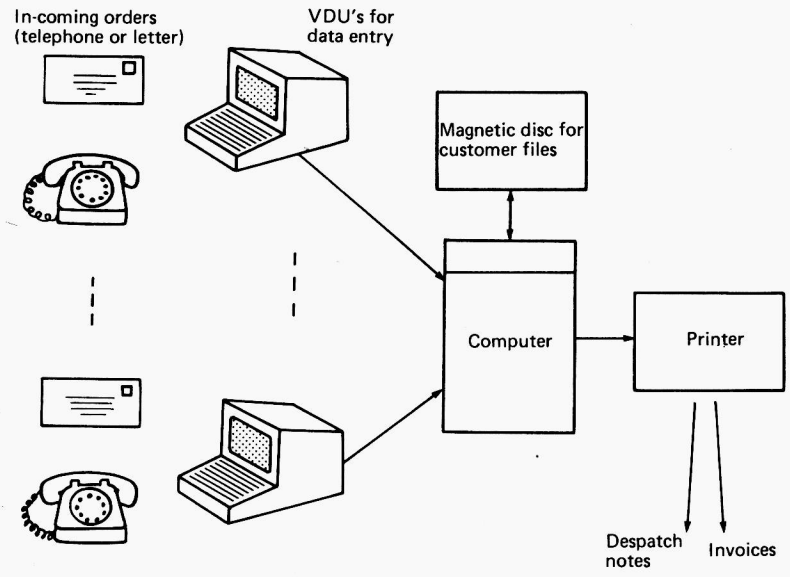

Figure 1.3 Order system (transaction processing).

1.5 General information systems

An information system is one in which data are collected and stored and retrieved as required (an information-'retrieval' system). There are many existing examples of this, e.g. library information systems, museum catalogue systems, hospital information systems, police information systems, health and social security systems. In some cases special input peripherals are used; in others VDU's are adequate. The main reason for developing these systems is to reduce paper work and files and aid cross-referencing. Generally, there is a large amount of data to be stored and this can be held on *magnetic tapes* or *magnetic discs*.

A hospital information system, for example, collects information regarding patients to assist the overall running of the hospital. Records are kept of the patients, their treatment and progress, perhaps on a day-to-day basis. A modern hospital computer system has VDU terminals in each ward, in clerical offices and research laboratories, maybe connected to a central computer or via several local computers. There may be over 50 terminals to handle admissions/discharges, and clerical laboratory procedures.

Records can be kept on the availability of beds, operating theatres, X-ray rooms, and nursing 'manpower'. Waiting lists can be stored and managed. Statistical information can be produced.

The police information system installed at Scotland Yard holds records of two million fingerprints in addition to information on stolen vehicles, wanted and missing persons, disqualified drivers, people convicted or on suspended sentences, and some types of stolen property. This is held on disc stores with a capacity of 4600 million characters of information, and is available for retrieval from 800 terminals throughout England, Scotland and Wales.

A library information system is in some ways similar to the point-of-sale system described previously with a special optical character recognizer (say) for reading details of books lent as they are taken out. Here the customer's library membership card may provide the 'customer code'.

1.6 Patient monitoring

In the previous section a computer system in a hospital was outlined for collecting information. A computer can be used in a more active role for monitoring individual patients' medical parameters such as ECG (electrocardiograph) readings, blood pressure, body temperature, and activating alarms if certain conditions occur. Such a system is shown in Fig. 1.4. The peripheral input device for such systems (usually based on mini-computers) is the *analogue-to-digital converter* (*ADC*), which converts analogue signals such as voltages and currents from sensors placed on the patient to digital form for subsequent processing. One computer may service several patients. There may be a link to a larger computer-system that holds the patients' records.

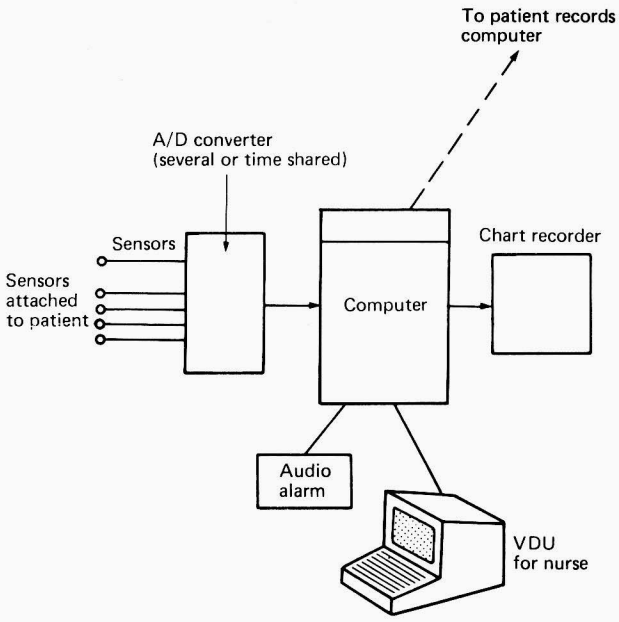

Figure 1.4 Patient monitoring.

1.7 Process control

The process-control industry particularly lends itself to control by computers. This industry is involved in the production of steel, paper, oil, cement, chemicals, and the direct control by computer means that pneumatic valves and switches are controlled by the computer. Certain inputs are read, for example temperature and pressure (Fig. 1.5). Between the process and the computer there need to be peripheral devices to convert voltages and currents (analogue quantities) to digital values and vice versa, i.e. *analogue-to-digital and digital-to-analogue converters* (*DACs*).

The type of control possible can be very advanced; the control of the final product may depend upon temperature and pressure and on the amount and condition of catalysts which may be altered during the process. There may be alternative products that can be produced; for example in the production of a mixture of ethylene and propylene there is a choice of different blends according to market demands.

1.8 Computer-aided design (CAD)

Computer-aided design is the use of a computer in the design of engineering products, e.g. cars, bridges and integrated circuits.

The peripheral device associated with this application is the *graphic display* which enables drawings to be displayed and altered using a *light pen*. A light pen is a device which is held near the surface of the display to point to

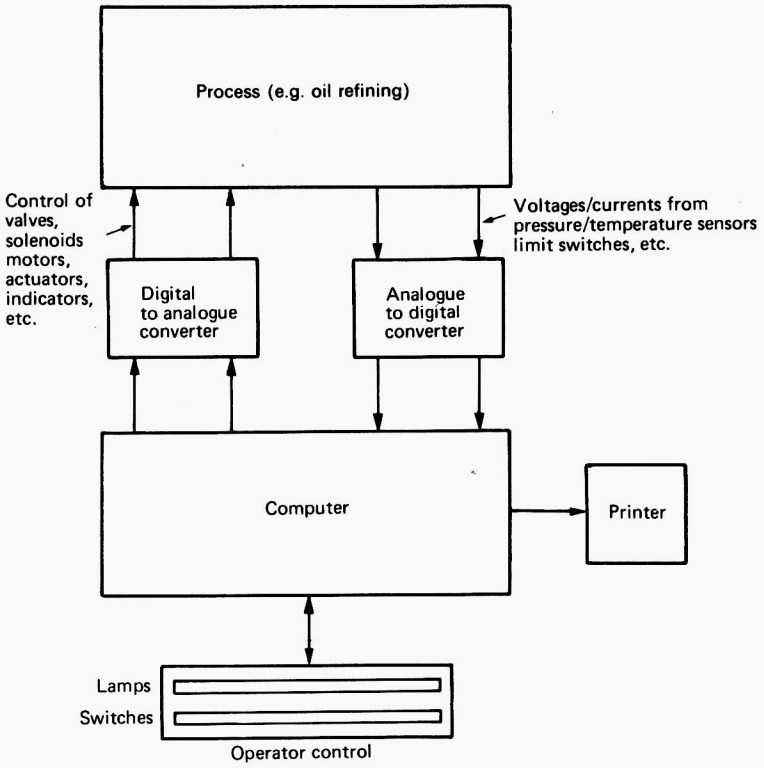

Figure 1.5 Process control.

specific parts of a picture on the display, or causes the picture to be altered in some way. Figure 1.6 shows a computer system with a graphic display and light pen. Diagrams can be produced on paper using a *graph plotter*.

1.9 Scientific calculations

Often in scientific work large and complex calculations are required; computers came into being to meet the requirements of complex calculations. This led to the development of large computers capable of operation at very high speed, and naturally at extremely high cost. These large 'number crunchers' were characterized by the mode of operation of accepting programs from a number of users in 'batches', running the jobs, and producing the results at some time later for the users to pick up. The computer would run continuously (hopefully) through the night, working on the jobs submitted. The method of submission for batch operation was by punched cards, loaded on a card reader by the operators. Results were printed on a single *high-speed line printer*.

Today there are generally two modes of operation for these machines, the original batch mode and the on-line or interactive mode. In the latter mode programs are entered by the user on terminals. Results appear on the terminal within a short period of time. The two modes operate concurrently

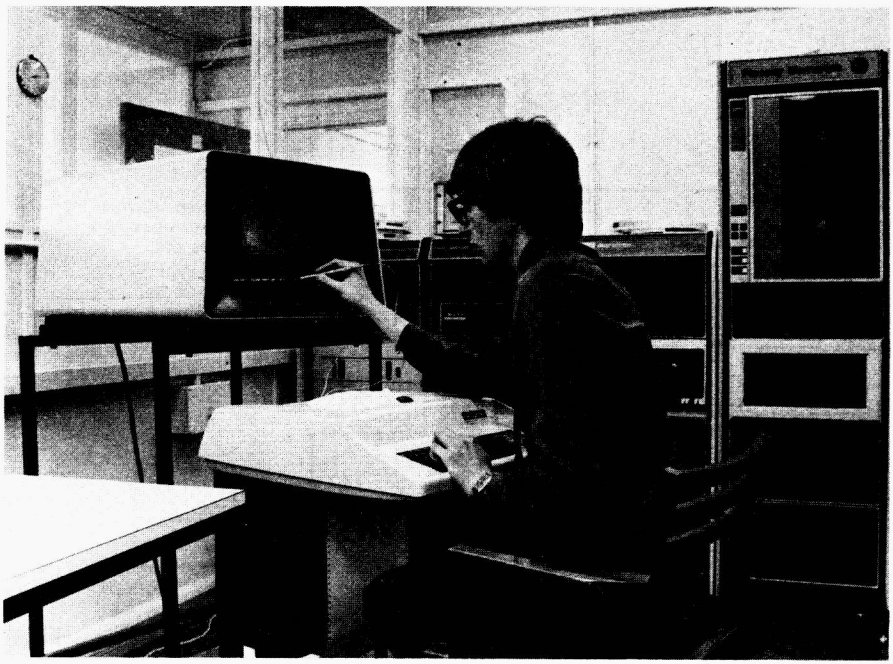

Figure 1.6 PDP-11 with graphic display.

(background/foreground operation).

A large computer system (Fig. 1.7) has perhaps the largest and widest selection of peripherals to cater for the user's needs. Apart from peripherals connected locally around the central processor, there may be a second processor unit known as a front end processor to control large numbers of other peripherals (Fig. 1.8) and *communications units* to transfer information from other computer sites.

1.10 The microprocessor

We leave this chapter with a mention of the most important device produced in the last few years; the *microprocessor*. This is a central processor in one integrated circuit (Fig. 1.9). With the additions of integrated circuits for storage and control of the peripherals, and the peripherals themselves, a small but very powerful *micro-computer* can be formed (Fig. 1.10). One particular peripheral has been associated with the micro-computer; the *floppy disc* unit, a magnetic-disc backing store where the disc is flexible and small (8 in (20 cm) or less).

An application of the micro-computer (the microprocessor with additional components to make a computer) is office word processing. Word processing is the name given to computer office equipment designed to assist the office typist in typing documents. The basic operations are typing of the original document, storage and editing of text and subsequent printing of the document.

Figure 1.7 Large computer installation (ICL 2980 system: Courtesy of International Computers Ltd).

Early equipment to store and retrieve text from typewriters used punched paper tape and later magnetic tape and magnetic card. Due to technological advance of the microprocessor, it is now possible to produce highly sophisticated, though inexpensive, computer systems for individuals or groups of typists, providing editing and many other facilities. Text is initially entered on a visual display unit. Storage is by means of floppy discs and printing by a high-quality character printer. The whole system is controlled by the micro-computer.