The librarian's guide to Microcomputers for information management

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Preface

When we prepared *Introducing Microcomputers: a guide for librarians* we were conscious that the speed with which microcomputer technology was changing meant that a new edition would be needed within a few years (on the assumption that the book was successful in the first place!). It was well received, but such has been the pace of development in this area that a new edition proved necessary after two years, if the book was to continue to be of value to practising librarians and students. We have, therefore, made many changes, although the overall pattern of the previous edition has been maintained.

The chapters on hardware have been revised to reflect the many changes in that area, and some emphasis has been given to the optical disk, since it is the authors' view that this technology represents a major step forward in microcomputer-based information storage and retrieval. Subsequent chapters on applications have also been extensively revised to include new software and applications, including the 'new generation' of integrated microcomputer software for library applications. Similarly, the appendices on software and the bibliography have been completely updated. We have also tried to take into account the constructive comments made in some of the reviews of the book.

It is our hope, therefore, that this book will continue to be of value to the librarian and the student, and also perhaps to the computer specialist interested in library and information applications. It has remained our intention, as was suggested in the earlier book, 'to provide a single source of information on the process of automating with a microcomputer'.

ACKNOWLEDGEMENTS

We are again grateful to all those who have contributed in one way or another to the making of this book, by asking questions, describing

applications or commenting in general on the use of microcomputers in library and information work. Any errors and omissions, however, remain our responsibility.

Once again, our thanks go to Lindesay and Mandy for their patience during the writing of this edition. JHP would also like to thank Wendy Shoulder, who typed his chapters.

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Preface to the first edition

It hardly needs to be said that the microcomputer is now a fact of life, but its impact upon the world of information retrieval and libraries generally has been less marked than in many other areas. One reason for this is an apparent uncertainty among librarians about just what the microcomputer is capable of in a library context. In the early days of microcomputing (i.e. towards the end of the 1970s!) there was some reason to be doubtful about the potential for library applications: storage was limited and suitable software was in even shorter supply.

These problems have now been overcome, but the interested librarian (and there are many) is faced with a plethora of articles and conference papers which are scattered throughout the professional journals. There is a need for a book which brings together this wealth of information, in order to provide a single source of information on the process of automating with a microcomputer.

The authors hope that this book will satisfy that need, for it considers the requirements of information retrieval and other library routines, and suggests how these can be operated on a microcomputer. Particular emphasis has been placed on software, because without software a computer is simply a collection of electronic circuits: without the right kind of software, attempts at automation are doomed from the start. In addition to the discussions of suitable programs for each application, there is an appendix listing details of library-specific software.

The book is intended for the practising librarian and the student, and it is hoped that it will serve as both textbook and reference work. Each chapter is, as far as possible, self-contained, and so it is possible to study either a single application or the entire subject. The core of the book (Chapters 4 to 6) provides guidelines for specific applications, while Chapters 8 and 9 look at the equally vital topics of software and hardware selection, with a discussion of the necessary management principles following in Chapter 10.

The authors feel that, while it is perfectly feasible to use a microcomputer without any idea of what makes it 'tick', a knowledge of the basic technology will help to get the best from both software and hardware. To draw an analogy, it is perfectly possible to drive from A to B without knowing how the internal combustion engine works. However, unless the driver is prepared to call in a mechanic, it is useful to know how to top up the oil or the radiator (and why), and some knowledge will also make it easier to detect faults and to discuss them sensibly when a mechanic does have to be called in. By the same token, knowing the basics of microcomputers technology will help the librarian to appreciate why the computer does what it does with bibliographic records, for example, and so an introduction to the technology is provided in Chapters 1 to 3.

With such a work as this, in order to ensure clarity without excessive detail, it is inevitable that certain complex concepts have to be simplified. There are numerous works on software and hardware which treat the subject in more depth. Similarly, the reader can be referred to a number of dictionaries of the new technology for any unfamiliar terms.

Illustrative examples are provided, whenever possible, of actual practice in libraries, since one of the most useful ways of successfully implementing a microcomputer is to consider the experiences of others. Those who have had the courage to describe their problems and successes are listed in the Bibliography.

1
Electronics for microcomputers

1.1 MILLIONS OF MICROCOMPUTERS

There are millions of microcomputers in homes in North America, Western Europe and elsewhere. The cheapest of these machines costs under $100 and they can be bought in stores, supermarkets and by mail-order. The number and sizes of microcomputer magazines have rocketed: *Byte* which is perhaps the leader, regularly tops 500 pages per issue.

The list of available software and the bibliography at the end of this book show that information retrieval and library applications are not being left behind. However, it is likely that a machine will have a cost of at least ten times that of a $100 personal computer if it is to be of real use to a library or information service.

It is difficult to define, therefore, how a microcomputer differs from its larger relations, the minicomputer and the even larger mainframe machine. They are certainly at the cheap end of the market and their availability has been brought about by the development of integrated circuits. These have been used to produce a range of electronic devices or 'chips' at low cost which can be put together to make computers at the extremely low prices we see today.

The development of integrated circuits has led to the birth of large numbers of new companies and the success of the microcomputer led even the giant IBM to begin to produce its own machines, a move which did much to make the microcomputer industry come of age.

Microcomputers are not the answer to all our computer problems, although they are taking on many more tasks today than would have been thought possible even five years ago. For very small organizations, they may serve most of the immediate needs, but for larger ones they may not be the answer, or may only be of use in quite limited circumstances. Larger computers have also benefited from developments in microelectronics and there is often a range of hardware and software solutions to a particular need.

The storage and retrieval of information are of interest to us all and are not the sole domains of librarians or information specialists. The microcomputer has given us the chance to improve the control of information in libraries, information services and a wide range of occupations. For instance, real estate agents can retrieve more extract details of property for sale and networks of car dealers can locate vehicles more in line with a customer's requirements using information retrieval techniques.

The content of this book will, it is hoped, provide insight into how microcomputers work (Chapter 1–3), their application to information retrieval and other library automation problems (Chapters 4–7), acquisition of hardware and software (Chapters 8 and 9) and, once obtained, how to make them work successfully (Chapter 10). First of all, we shall look at the electronics that is the basis of all computers.

1.2 FROM VALVES TO SEMICONDUCTORS

Early computers were built with valves or tubes, just as old-fashioned radios were. They were extremely large, consumed large amounts of electricity and were unreliable. The invention of the transistor changed both computers and other electronic machines, since here was a device that was smaller, more reliable and consumed less electricity than the valve.

Valves work by passing electric currents through a vacuum between electrodes: transistors are built from materials called semiconductors, which have properties which make them neither good conductors nor good insulators. Silicon and germanium crystals are most frequently used to make transistor devices.

The trick comes in altering the properties of the semiconductor by introducing a very small amount of an impurity. The process is called *doping* and it interferes with the conducting properties of the semiconductor. There are two basic ways of doing this. One is called n-type which is formed by adding an impurity which produces an excess of electrons (these are the basis of the conduction of electricity). The other (p-type) produces a deficiency of electrons. By putting the two together, a p–n junction is formed which can form the basis of a device called a *diode* which will conduct a greater current in one direction than in the other (see Fig. 1.1).

By putting three pieces of doped semiconductor together, transistors are formed which can be made to have various electrical properties. For instance, the n–p–n transistor, formed by sandwiching a piece of p–type semiconductor between two pieces of n–type, can be made to amplify a current (see Fig. 1.2). This particular property is used, for instance, in audio amplifiers, and the transistor effect is also used in computers.

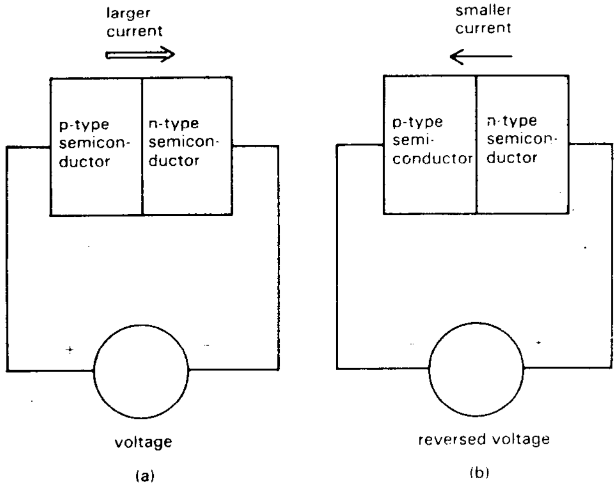

Figure 1.1 A diode formed from a p–n junction conducts a greater current in one direction (a) than in the other (b).

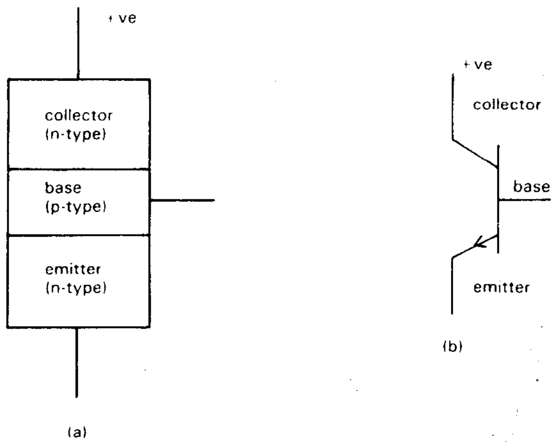

Figure 1.2 Arrangement of semiconductor materials in an n–p–n transistor (a) and its symbol used in diagrams (b).

1.3 INTEGRATED CIRCUITS

The first transistors were individual devices with wires joining them to other electronic components such as resistors, capacitors and other transistors. It became clear that the production of electronic circuits could be made more efficient if transistors, other devices and the circuits connecting them could be built up together (integration). At first, electronic devices with only a few circuits could be fabricated this way but the numbers increased as techniques became more advanced. Today it is possible to build a whole computer on a single chip of silicon crystal. A photolithographic process selectively dopes minute areas of the silicon and so builds up circuits. The chips are very small and the whole process must be very accurately controlled.

1.4 MANUFACTURE OF INTEGRATED CIRCUITS

Most of the integrated circuits in use today employ silicon as the basic semiconducting material. Sand is the raw material used in the production of modern integrated circuits and the process begins by heating the purified material until it becomes molten. A small single crystal of silicon is then dipped into the molten silicon and, as the crystal is withdrawn, it begins to grow as molten silicon attaches itself to the crystal. This process, which is known as *seeding*, creates a large crystal with the same atomic arrangement as the original, small seed crystal. The enlarged crystal is then sliced into individual discs or wafers which, after polishing, are about a quarter of a millimetre thick. Each wafer is large enough to produce around a hundred integrated circuits.

The aim of the manufacturing process is to build up a series of selectively doped areas of silicon which are connected together by metal wiring. The surface of the wafer is first oxidized to form silicon dioxide and is then coated with a layer of a light-sensitive material called a *photoresist*. The treated wafer is then exposed to ultraviolet light which is shone onto its surface through a mask, thus exposing only part of the photoresist (see Fig. 1.3). The process can be likened to the way in which photographic negatives are turned into prints in a darkroom. Fig. 1.4 shows how the mask is used to create an identical pattern in the photoresist. The ultraviolet light hardens the photoresist and the unexposed material is chemically washed away (see Fig. 1.5). The wafer is then etched with acid which removes the silicon dioxide but leaves the pure silicon untouched (Fig. 1.6) and then the remaining photoresist is removed (Fig. 1.7). The dopant is then introduced into the pure silicon. Fig. 1.8 shows the dopant diffusing into the silicon where the surface is exposed, thus reflecting the design of the mask. It is not possible to lay down all the circuits at once and hence the process is repeated a number of times. The silicon dioxide layer is refreshed as shown in Fig. 1.9 before re-starting the operation.

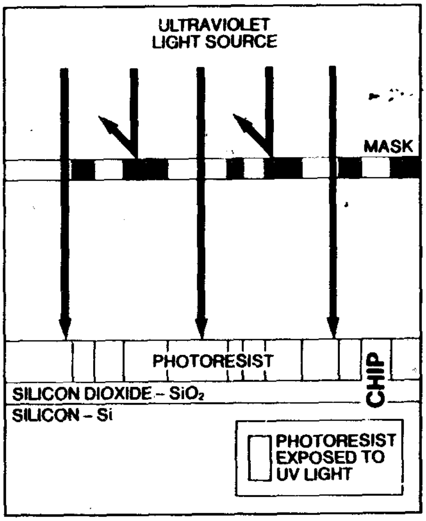

Figure 1.3 Chip surface covered with photoresist and exposed to ultraviolet light. (Reproduced courtesy of IBM.)

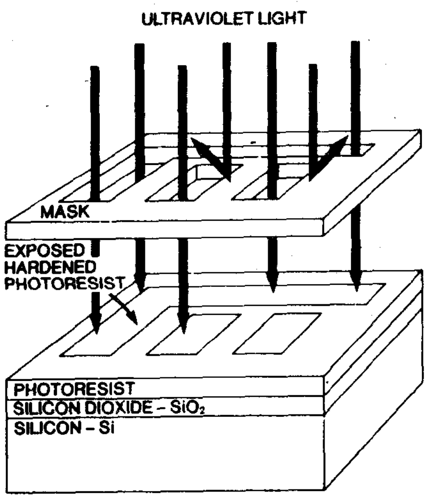

Figure 1.4 Photoresist exposure pattern governed by pattern of mask. (Reproduced courtesy of IBM.)