Beginner's Guide to Interfacing the BBC Microcomputer

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to
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the
BBC Microcomputer**

Martin Phillips

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Preface

One of the most exciting features of the BBC microcomputer is the range of input and output facilities that it provides. This makes the BBC microcomputer an ideal machine for control use. This book deals with just two of the ports on the BBC, the User Port and the Analogue Port. It examines the way that they can be used, shows how devices can be connected to them, and explains how these devices can be used in practical applications. It is a beginner's book. It assumes some knowledge of programming but little knowledge of electronics. It steers clear of detailed theory, and concentrates on the practical use of the two ports.

I am aware that many think that the use of a soldering iron is beyond them. Soldering is an art, but a relatively simple art that comes with practice. Every effort has been made to keep the constructional projects simple, so that soldering is kept to a minimum. Another worry is the probability of doing permanent damage to the computer. The computer is quite robust, and care has been taken in this book to ensure that there is as little chance of causing damage to the computer as possible. Projects that require the use of the mains or high voltages have been avoided for this reason, and for reasons of safety. To assist the beginner, some of the projects are provided with computer programs that show the sequence of assembly step-by-step.

I would like to thank Acorn Computers for permission to reproduce the User Port circuit diagram. I would also like to thank my son Stuart for the loan of his Lego. Lastly I would like to thank my wife for her patience and understanding while this book was being written.

Martin Phillips

Introduction

Many owners of a BBC microcomputer wish to know how the computer can be used to control external devices. The BBC model B has several ports that can be used to input or output information, and it is an ideal computer for control work. The difficult part is knowing how or where to start. This book assumes that the reader has little knowledge of electronics but some knowledge of BASIC programming, and assumes that the reader will also wish to pick up general programming skills and not just those relating specifically to control applications. Indeed it is difficult to identify a clear border between general programming skills and those programming skills required for control. It is also necessary to have the courage to be adventurous and to experiment, because it is only by building some of the devices that one can appreciate that control can be quite easy.

There are two approaches to the investigation of control applications. One can be presented with a board which simply plugs into one or more of the ports on the BBC micro and provides a medium for inputting from, and outputting to, a variety of devices present on the board. Often the board comes with a set of programs, so that each device can be shown in operation. One needs little skill or understanding to see how such a board works, but extending the principles to practical systems is a difficult gulf to bridge. In this book I have adopted a different approach. Rather than having one board with all the devices displayed and ready to work, this book will examine a series of devices in turn and show how each can be connected to the computer and programmed. It is therefore necessary to have some knowledge of electronic components and electronic assembly techniques. In my experience it is this step that many find difficult. However, that difficulty is more a fear of the unknown, coupled with worry about the serious damage that could be caused by inexperienced hands. After building some of the projects, the reader will become aware that modern electronic components are remarkably robust. Electronic

assembly techniques are far from difficult, but as in many other fields their simplicity is often not appreciated until the correct procedures have been learnt and practised. Once all the individual techniques have been developed, and a series of devices examined, then the user has all the skills at his or her fingertips to explore the fascinating world of control, without being constrained by the practical difficulties of building devices. The integration of Lego building techniques in the latter part of the book allows the reader to construct a wide variety of control application models simply and effectively.

This approach has several distinct advantages. It takes much of the mystique out of electronics, and it offers the reader the confidence to explore the world of control beyond the boundaries of purpose-built demonstration boards. It can also help to improve programming skills, and is a much cheaper and infinitely more flexible approach than using commercial boards. Above all, it is open-ended. Having read and digested the contents of the book, the reader has not come to the end of the exploration, but has really just arrived at the starting point - the point where his or her own ideas can be put into practice.

Several projects will be developed within the book to show specific applications of control. The criterion for including such projects is that they should first and foremost be useful, and not result in something that once the novelty has worn off will get consigned to the bottom of the junk box. Such projects must also be inexpensive. Computing is already an expensive hobby without having to incur additional large costs in order to study control applications. Software is important and these projects will require good software to enhance their usefulness and their accuracy. Computer control is an integration of hardware devices and computer software. Some of these projects will be of the 'stand alone' variety, but others can be used with other projects in the book and eventually can be used to make a variety of models that rely on computer control. Above all it is hoped to show the simple concepts that underlie computer control, and to show practical electronic constructional techniques.

Hints on Entering Programs

A great deal can be learned about programming just by typing in listings. In this book there are many short listings and several longer ones too, all of which will be found useful for a better understanding of BBC BASIC. There is nothing worse than typing a program

into the computer only to find that it will not work, so at this stage some tips on typing in the programs are appropriate.

1. In many programs there are line numbers typed in with just a colon (:) to follow them. These have been put into the program to break the program down into more recognisable sections. For instance a line with just a colon has always been inserted before a procedure is defined. This makes identifying the procedures that much easier. Such lines can be missed out but to the detriment of readability.
2. Some of the programs have an "ON ERROR GOTO..." line. It is better not to put this line in while typing in the program; wait until the program works correctly. If a typing mistake is made and this line is present, the program will not work correctly when run, but will usually go back to the start of the program again without listing the fault. It then often appears that the program has crashed completely. You might find that the ESCAPE key does not function as it should, however, until this line is inserted.
3. Many of the DATA lines in programs have been split up into short sets of data. This has been done to avoid confusion when data is being entered.
4. Instead of having large gaps between quotes on print statements for spaces, the command SPC() has been used. In many of the programs screen layout is critical, and mistakes here cause endless problems.
5. It is useful to program the BREAK key when typing in listings so that the program cannot be destroyed that way. The following line will program the BREAK key to return to mode 7 and list the program with page mode on

```
*KEY10 OLD'M 'N LIST'M
```

It can be added as line 1 of the program or typed in as a direct command.

6. Many of the programs mix upper and lower case lettering. To avoid taking the CAPS LOCK off each time, on machines fitted with 1.2 OS, if the CAPS LOCK is put on while the SHIFT key is pressed, then the action of the shift key is reversed and lower case lettering can be obtained when SHIFT is pressed.
7. Do take care to insert all the punctuation marks correctly. Some very odd results can happen in the VDU statements if commas, for instance, are typed

instead of semi-colons. Error messages are not generated here and the faults are obscure and hard to find. Forewarned is forearmed!

8. Following the IF statements, the word THEN has been included for greater clarity. The use of the word THEN is optional on the BBC machine and it can be omitted provided that a space is inserted in its place.
9. Again for greater clarity, spaces have been inserted in some program lines. Unless you are confident about where spaces can be inserted and left out, it is advisable to include them or not as in the listings.
10. Do check a listing carefully when it has been typed in. It is better to check the program in small sections, especially if it is one of the longer programs. It is easy to confuse the capital 'O' with the number '0', and this is one thing to pay particular attention to.
11. All the programs in this book have been designed to work with either disc or cassette. It is advisable to save a copy of the program before you run it, or even part way through a long program. In that way, if anything disastrous does happen you always have a copy. You can save incomplete programs or part programs, as well as untested programs, on tape or disc. Time spent in making a copy is often time well spent.