Unit 113: Principles and Applications of Microcontrollers

Unit code: Y/602/2230
QCF Level: 4
Credit value: 15

Aim
This unit will provide learners with an understanding of the applications of microcontroller-based systems and will develop the skills required to design, write and test software and interface such systems.

Unit abstract
In this unit learners will investigate the different types of microcontroller device and the wide range of applications of embedded control systems. Learners will design software and will use computer packages to write programs for a microcontroller-based system in order to implement a given specification. They will also use simulation tools to test and debug the software and will program and interface a microcontroller in order to implement a design.

Learning outcomes
On successful completion of this unit a learner will:
1. Understand microcontroller-based systems
2. Be able to produce software for a microcontroller-based system
3. Be able to interface microcontroller-based systems
Unit content

1 Understand microcontroller-based systems

*Types of microcontroller device:* comparison based on the features of the family of PIC devices (clock speeds, internal architecture, on board memory, I/O ports, instruction size and type, interrupt facilities, additional features (eg A/D converters, oscillators and timers), package types)

*Applications:* use of embedded control systems in computer systems (mouse, keyboard, modem, fax card, sound card), domestic systems (door locks, air conditioning, TV remote controls, appliances), telecommunications (cellular phones, pagers, answering machines), automotive (keyless entry, anti-lock braking, engine management, air bags) office automation (copiers, printers, fax), industrial control (machinery)

2 Be able to produce software for a microcontroller-based system

*Design software:* algorithms in the form of a structure chart showing actions and conditions or in pseudo code (structured English) in sufficient detail to allow coding to proceed

*Specification:* use of specifications that require modularisation and the passing of data between modules

*Write programs:* programs written in a form that follows directly from the design; programs written in an assembly language (eg MPLAB) and then assembled using an appropriate procedure

*Test software:* suitable test data (eg inputs and expected outputs) prepared prior to running programs and test results documented; use of software tools (such as debugger, single-step and breakpoints) to identify errors; changes to program code or structure carried out where necessary

3 Be able to interface microcontroller-based systems

*Input/output connection:* set up of the port control registers for input or output connection; understanding of the ‘TRIS’ command; software design of input/output; use of programs to interface typical I/O peripherals to a microcontroller (eg as could be found on a standard project application board), including switches, LEDs, 7-segment displays, stepper motor, buzzers, traffic lights

*Practical project:* design and build software to realise an assigned project to operate the external peripherals using both input and output devices on the applications board to a given specification; software design fully documented and the appropriately programmed microcontroller demonstrated with the available peripheral devices operating to specification
## Learning outcomes and assessment criteria

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<thead>
<tr>
<th>Learning outcomes</th>
<th>Assessment criteria for pass</th>
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<tbody>
<tr>
<td>On successful completion of this unit a learner will:</td>
<td>The learner can:</td>
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<tr>
<td>LO1 Understand microcontroller-based systems</td>
<td>1.1 compare types of microcontroller devices</td>
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<td>1.2 investigate three typical applications of microcontroller-based systems</td>
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<td>LO2 Be able to produce software for a microcontroller-based system</td>
<td>2.1 design software to a given specification using a structured design technique</td>
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<td>2.2 write programs to implement the specification using an appropriate computer package</td>
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<td>2.3 test and de-bug software, using appropriate simulation tools, to ensure it meets the given specification</td>
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<td>LO3 Be able to interface microcontroller-based systems</td>
<td>3.1 implement the design by programming a suitable microcontroller</td>
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<td>3.2 test and de-bug using the microcontroller’s programmable ports connected to an appropriate project applications board</td>
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Guidance

Links
There are no links for this unit.

Essential requirements
Learners will need access to a suitable software development system (ie personal computers/terminals capable of running program development software for microcontrollers such as MPLAB, providing assembly, editing and debugging facilities).
The software development system will need to be able to program the microcontroller to operate the target application.
Microcontroller applications board with peripheral devices such as switches, LEDs, stepper motor, simulated traffic lights, buzzers etc are also required.

Employer engagement and vocational contexts
Delivery of this unit will benefit from centres establishing strong links with employers willing to contribute to the delivery of teaching, work-based placements and/or detailed case study materials.