**NZQA**

**Approved**

Achievement standard: 91375 Version 3

Standard title: Implement advanced interfacing procedures in a specified electronic environment

Level: 2

Credits: 3

Resource title: If it’s too hot in the kitchen …

Resource reference: Digital Technologies VP-2.48 v2

Vocational pathway: Services Industries

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| Quality assurance status | These materials have been quality assured by NZQA.  NZQA Approved number A-A-02-2015-91375-02-8282 |
| Authenticity of evidence | Assessors/educators must manage authenticity for any assessment from a public source, because learners may have access to the assessment schedule or exemplar material.  Using this assessment resource without modification may mean that learners’ work is not authentic. Assessors/ educators may need to change figures, measurements or data sources or set a different context or topic to be investigated or a different text to read or perform. |

Vocational Pathway Assessment Resource

Achievement standard: 91375

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Learner instructions

# Introduction

This assessment activity requires you to implement advanced interfacing procedures to construct a climate control system for a kitchen that meets specifications.

You are going to be assessed on how efficiently you implement advanced interfacing procedures to construct a climate control system for a kitchen that meets specifications.

The following instructions provide you with a way to structure your work to demonstrate what you have learnt to allow you to achieve success in this standard.

Assessor/educator note: It is expected that the assessor/educator will read the learner instructions and modify them if necessary to suit their learners.

# Task

A climate control system measures the amount of humidity in the air, light levels and air temperature in a kitchen. It displays this information on a screen and logs the information in a database.

You will develop functional models for four main interfaces:

1. to manage the fan/s
2. to manage sensors that detect the analogue input signals (temperature, humidity and light), which the climate control system will read
3. to manage communications between the climate control system and its LCD screen
4. to manage communications for data logging.

See Resource A for the system and interface specifications.

Each interface requires development work in both hardware and software to make them function more efficiently. Keep records (for example photos and notes) as you work. These records will be used to write a report, to be submitted for assessment with the climate control system.

Resource B describes the techniques likely to be required in producing evidence and Resource C discusses health and safety considerations in using machines and processes, while Resource D lists some useful websites.

You should provide evidence of modification, testing and debugging of the functional model’s sensor and actuator subsystems that substantially improve the quality and way the climate control system works and gathers data.

Show evidence in your report that you have:

* used the electronic components provided to produce a sensor that can interact with the environment (i.e. the sensor can accurately detect humidity and temperature levels)
* used the electric motors or relays provided so that the software on the climate control system can reliably control the fans
* used the LCD display provided to enable the climate control system to provide useful information to the programmer, which will allow the performance of the climate control system to be improved
* written, tested and debugged well-structured, clearly annotated, readily understandable software to manage the interface between the humidity meter’s processor and the sensors and actuators it controls.

Your evidence should show a selection of the following actions:

* selecting the best type and value of component
* selecting the best arrangement of components
* modifying hardware input and/or output parameters
* modifying software parameters.

You can meet these requirements by including in your written evidence:

* schematic circuit diagrams for any electronic circuits you develop as part of an interface
* printed circuit board images for any printed circuit boards you make as part of your interface
* photos of any interfaces you construct
* a brief description explaining the role of each interface
* brief descriptions of any testing and debugging procedures you undertook to substantially improve the operation of the interfaces
* photos and explanations of any modifications you made to interfaces to substantially improve their performance
* printouts of any software that interfaces with either the actuators or the sensors on your humidity meter, showing that your software is well structured, clearly annotated and readily understandable.

# Resource A

## Specifications

### Climate control system

* Must be capable of measuring and determining the humidity percentage in the air and be accurate to within 5% of a known accurate measurement device.
* Must be capable of measuring and determining the air temperature and be accurate to within 5% of a known accurate measurement device.
* Must be water resistant (as it is to operate in damp conditions).
* May use commercial products such as Arduino shields for main components such as the microprocessor and screen and the communication with other devices (but could be other proprietary products).
* Sensors for basic humidity, temperature and light are to be constructed from the supplied components and following the drawings provided.
* Must be able to detect the temperature so that it starts the fan when it is too hot (over 25 degrees).
* Must be able to ensure the cooling fans do not run when the kitchen is in darkness.

### The four interfaces

* Interface 1 allows a microcontroller to independently and reliably manage a cooling fan system. Any EMI generated by the fan should not be allowed to interfere with the reliable functioning of the humidity meter.
* Interface 2 allows a microcontroller to reliably measure the humidity and temperature levels.
* Interface 3 allows a microprocessor to send messages to an LCD display mounted on the humidity meter.
* Interface 4 allows the data being logged to be uploaded or sent to a database.

# Resource B

## Techniques likely to be required in producing evidence

* Design of circuit schematics on printed circuit software such as EAGLE.
* Design of printed circuit boards in software such as EAGLE.
* Chemical etching or other methods of producing printed circuit boards.
* Soldering components to printed circuit boards.
* Selection and assembly of electrical connectors.
* Techniques to reduce unwanted effects of electromagnetic interference.
* Data logging techniques, possibly including averaging or other methods to improve reliability.
* Construction techniques to fabricate mechanical components of interfaces.

# Resource C

## Health and safety

Learners must be able to use all machines and processes safely and in accordance with the technology department’s policies for health and safety, such as:

* Ensure sleeves are rolled up when using any machines.
* Wear safety glasses when machining.
* Ensure all machine guards are fitted and working before starting machines.
* Ensure machines are turned off before using any measuring instruments.
* Ensure you are wearing safety glasses if using ferric chloride to etch printed circuit boards.
* Ensure soldering iron tips are clean before use and that the irons are turned off when you have finished with them.
* Do not use any machine to fabricate parts for your climate control system unless you have been specifically trained to perform that sort of operation on that machine.

# Resource D

## Useful websites

Picaxe [www.picaxe.com](http://www.picaxe.com) and [http://www.rev-ed.co.uk](file:///C:\Users\Neilson\Documents\NZQA%20VP%20project\Original%20files\91375\www.rev-ed.co.uk)

Raspberry Pi [www.raspberrypi.org/](http://www.raspberrypi.org/)

Arduino [www.mindkits.co.nz](http://www.mindkits.co.nz) and [www.arduino.cc](file:///C:\Users\Neilson\Documents\NZQA%20VP%20project\Original%20files\91375\www.arduino.cc)

LEGO Mindstorms [www.legoengineering.com](file:///C:\Users\Neilson\Documents\NZQA%20VP%20project\Original%20files\91375\www.legoengineering.com)

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Assessor/Educator guidelines

# Introduction

The following guidelines are supplied to enable assessors/educators to carry out valid and consistent assessment using this internal assessment resource.

As with all assessment resources, education providers will need to follow their own quality control processes. Assessors/educators must manage authenticity for any assessment from a public source, because learners may have access to the assessment schedule or exemplar material. Using this assessment resource without modification may mean that learners' work is not authentic. The assessor/educator may need to change figures, measurements or data sources or set a different context or topic. Assessors/educators need to consider the local context in which learning is taking place and its relevance for learners.

Assessors/educators need to be very familiar with the outcome being assessed by the achievement standard. The achievement criteria and the explanatory notes contain information, definitions, and requirements that are crucial when interpreting the standard and assessing learners against it.

# Context/setting

This activity requires learners to efficiently implement advanced interfacing procedures to construct a climate control system for a kitchen.

# Conditions

This is an individual task.

Learners should complete all their practical work in the presence of their assessor/educator so that you can assess how the techniques are implemented as well as the quality of the outcome.

# Resource requirements

Learners may require access to:

* a fully equipped workshop, if possible with engineering lathes, milling machines and, optionally, a rapid prototyping machine
* the necessary equipment for designing and constructing an autonomous climate control system controlled by an internal microprocessor
* software for designing and manufacturing printed circuit boards
* 3D CAD, to design mechanical systems for the humidity meter if required
* a camera to take and annotate photographs to use as evidence.

Learners should have access to websites that provide information relating to the microprocessor system they are using. Useful resources include:

* EAGLE printed circuit board design software from [www.cadsoftusa.com](http://www.cadsoftusa.com)
* humidity and temperature sensors, and various shields if using Arduino microcontrollers, from [www.mindkits.co.nz](http://www.mindkits.co.nz).

# Additional information

The specifications should be modified to precisely describe the specifications your learners must meet. Specifications describe the function and/or aesthetics of the finished product. They should not include reference to accuracy, independence or efficiency. The product is expected to meet specifications at all levels of achievement.

Two approaches are possible when using this standard for assessment:

* The learner is given a set of components, sensors and actuators and specifications, which they use to design and build an autonomous climate control system capable of:
* measuring humidity, light levels and air temperature in a kitchen
* displaying the data on a screen and logging it to a database
* controlling cooling fans.

The learner can use the equipment provided or negotiate with the assessor/educator to make their own modifications to it. The assessor/educator may providedrawings showing basic construction details for systems on the humidity meter.

* The learner has been engaged in technological practice and is now at the point where they have fully established the specifications for their outcome and are ready to make it.

You need to make judgements about the ways in which the techniques were implemented as well as about the quality of the outcome.

# Assessment schedule: Digital Technologies 91375 – If it’s too hot in the kitchen …

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| Evidence/Judgements for Achievement | Evidence/Judgements for Achievement with Merit | Evidence/Judgements for Achievement with Excellence |
| The learner implements advanced interfacing procedures to construct a climate control system by:   * using provided functional sensor subsystems to interact with the environment (e.g. light sensors that allow a climate control system to measure light levels)   For example:  The climate control system has been tested and meets the specifications.   * using provided functional actuator subsystems to interact with the environment (e.g. shutters that control light levels)   For example:  The learner has used the supplied actuators and sensors to create a functional system.   * writing software that interfaces with the data provided by the sensors and with the actuators it controls (e.g. analogue to digital conversion (ADC), data processing subroutines)   For example:  The software allows the system to function as per the specifications but is basic and not annotated.   * testing and debugging a functional model of the interface   For example:  There is evidence of testing and fixing problems with the interface(s) to ensure the interface works.  *The above expected learner responses are indicative only and relate to just part of what is required.* | The learner skilfully implements advanced interfacing procedures to construct a climate control system by:   * modifying sensor subsystems to improve the quality of the data delivered by the interface   For example:  The sensor subsystems have been modified to be more sensitive or better components have been used.   * modifying actuator subsystems to improve the way they work   For example:  There is evidence of modification of the actuator subsystems to use components that are more reliable or more suitable.   * writing annotated, readily understandable software that interfaces with the data provided by the sensors and with the actuators it controls   For example:  The software allows the system to function as per the specifications and is logical and understandable, and has some annotation.   * testing and debugging a functional model of the interface to achieve and demonstrate improved operation   For example:  There is evidence of testing and fixing problems with the interface(s) to ensure the interface works, and functions and operates in a manner that shows improved function.  *The above expected learner responses are indicative only and relate to just part of what is required.* | The learner efficiently implements advanced interfacing procedures to construct a climate control system by:   * modifying sensor subsystems to substantially improve the quality of the data delivered by the interface   For example:  There is evidence of modification of the sensor subsystems to develop a sensor that uses the most suitable components for the task and sensitivity required.   * modifying actuator subsystems to substantially improve the way they work   For example:  There is evidence of modification of the actuator subsystems to be the most reliable and efficient for the desired function of the system.   * writing well-structured, clearly annotated, readily understandable software that interfaces effectively with the data provided by the sensors and with the actuators it controls   For example:  The software allows the system to function as per the specifications and is well structured, logical and understandable, with extensive annotation.   * testing and debugging a functional model of the interface to achieve and demonstrate substantially improved operation   For example:  There is evidence of testing and fixing problems with the interface(s) to ensure that it works and functions efficiently.  *The above expected learner responses are indicative only and relate to just part of what is required.* |

Final grades will be decided using professional judgement based on an examination of the evidence provided against the criteria in the Achievement Standard. Judgements should be holistic, rather than based on a checklist approach.