**NZQA**

**Approved**

Achievement standard: 91375 Version 3

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

Level: 2

Credits: 3

Resource title: Keeping the plants alive

Resource reference: Digital Technologies VP-2.48 v2

Vocational pathway: Manufacturing and Technology

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| Quality assurance status | These materials have been quality assured by NZQA.  NZQA Approved number A-A-02-2015-91375-02-8243 |
| 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

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Learner instructions

# Introduction

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

You are going to be assessed on how efficiently you implement advanced interfacing procedures to construct a sprinkler control system 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

Construct a sprinkler control system that measures the solar energy (total watts/m2), displays it on a screen and logs it to a database. The device needs to be able to turn on sprinklers for an adjustable amount of time once 900,000 joules/m2 or 90 joules/cm2 of solar energy have been accumulated.

You will develop functional models for four main interfaces:

1. to manage the sprinkler/s
2. to manage the sensors that detect the analogue input signals (solar energy) which the sprinkler control system will be reading
3. to manage communications between the sprinkler control system and its LCD screen
4. to manage communications for data logging.

Each of these interfaces will require development work in both hardware and software to make them function more efficiently. As you develop the interfaces, keep records (for example photos and notes) of your work. These records will be used to write a report, to be submitted with the sprinkler control system.

See Resource A for the system and interface specifications. Resource B describes the techniques likely to be required in producing evidence and Resource C lists some useful websites.

## Evidence

Show evidence in your report that you have:

* used the electronic components provided to produce a sensor that can interact with the environment. This means the sensor can accurately detect the humidity level and temperature
* used the electric motors or relays provided so that the software can reliably control the sprinklers
* used the LCD display provided to enable the sprinkler control system to provide useful information to the programmer, allowing the system’s performance to be improved
* written, tested and debugged well-structured, clearly annotated, readily understandable software to manage the interface between the sprinkler control system’s processor and the sensors and actuators it controls
* tested and debugged the functional model and modified the functional model’s sensor subsystems and actuator subsystems to substantially improve the quality and the way the sprinkler control system works and gathers data.

Your evidence should show that you have:

* selected the best type and value of component
* selected the best arrangement of components
* modified hardware input and/or output parameters
* modified 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 that 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 operations of the interfaces
* photos and explanations of any modifications you make to any of the interfaces to substantially improve their performance
* printouts of any software that interfaces with either the actuators or the sensors on your sprinkler control system. These printouts should show that your software is well structured, clearly annotated and readily understandable.

# Resource A

## Specifications

### Sprinkler control system

* Must be capable of measuring and determining the amount of solar energy accumulated and displaying this to the screen.
* Must be able to easily vary the duration of time the sprinklers will operate.
* Must be water resistant, to operate in damp conditions.
* May use commercial products such as Arduino shields or other proprietary products for the main components such as the microprocessor and screen, and for the communication with other devices.
* Must use the supplied components and follow the drawings provided for the basic light sensors.

### The four interfaces

* Interface 1 allows a microcontroller to independently and reliably manage a sprinkler control system (any EMI generated by the sprinkler should not be allowed to interfere with the reliable functioning of the sensors).
* Interface 2 allows a microcontroller to reliably measure the humidity level and temperature.
* Interface 3 allows a microprocessor to send messages to an LCD display mounted on the sprinkler control system.
* Interface 4 allows the logged data 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

## 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](http://www.legoengineering.com)

Vocational Pathway Assessment Resource

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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 the learner to efficiently implement advanced interfacing procedures to construct a sprinkler control system that meets specifications.

# Conditions

This is an individual task.

The 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

The learner 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 sprinkler control system controlled by an internal microprocessor
* software for designing and manufacturing printed circuit boards
* 3D CAD, to design mechanical systems for the sprinkler control system if required
* a camera to take and annotate photographs to use as evidence.

The learner 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 the learner 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 sprinkler control system capable of:
* measuring the humidity, light levels and air temperature in an environment
* displaying the information on a screen and logging it to a database
* controlling the sprinkler system.

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 the functional sensor/actuator sub-systems used to construct the sprinkler control system.

* 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 – Keeping the plants alive

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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 sprinkler control system by:   * using provided functional sensor subsystems to interact with the environment (e.g. light sensors that allow a sprinkler control system to measure light levels)   For example:  The sprinkler has been tested and meets the specifications.   * using provided functional actuator subsystems to interact with the environment (e.g. shutters that control greenhouse 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:  The learner shows evidence of testing and debugging to ensure the system functions as intended and to the given specifications.  *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 sprinkler 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:  The learner shows evidence of testing and debugging to ensure the system functions as intended and to the given specifications, and has documented that the performance has improved.  *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 sprinkler control system by:   * modifying sensor subsystems to substantially improve the quality of the data delivered by the interface   For example:  The learner has developed a sensor that uses the components that are the most suitable for the task and sensitivity required.   * modifying actuator subsystems to substantially improve the way they work   For example:  The learner has modified 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:  The learner shows evidence of testing and debugging to ensure the system functions as intended and to the given specifications, and has documented that the performance has substantially improved.  *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.