

**Internal Assessment Resource**

**Digital Technologies & Hangarau Matihiko Level 3**

This resource supports assessment against achievement standards 91901 and 919041

**Standard title:**  91901 Apply user experience methodologies to develop a design for a digital technologies outcome (3 credits)

91904 Use complex techniques to develop an electronics outcome (6 credits)

**Credits:** 9

**Resource title:** Battery poweredwater irrigation system

**Resource reference:** Digital Technologies & Hangarau Matihiko 3.2B\_3.5B

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| This resource:   * Clarifies the requirements of the achievement standard * Supports good assessment practice * Should be subjected to the school’s usual assessment quality assurance process * Should be modified to make the context relevant to students in their school/kura environment and ensure that submitted evidence is authentic |

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| Date version published by Ministry of Education | December 2018 Version 1  To support internal assessment from 2019 |
| Authenticity of evidence | Teachers/kaiako must manage authenticity for any assessment from a public source, because students may have access to the assessment schedule or student exemplar material.  Using this assessment resource without modification may mean that students’ work is not authentic. The teacher 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. |

**Internal Assessment Resource**

**Achievement Standards:** 91901 and 91904

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**Teacher/Kaiako guidelines**

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

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

**Context/Te Horopaki**

This is an integrated assessment activity supporting a project approach that assesses against two achievement standards.

This activity requires students to:

* Use complex techniques to develop a refined electronics outcome that enables irrigation control in remote locations. Specifically interfaces for environmental sensing, automated timers and manual interrupts.
* Generate and model design ideas using user experience methodologies to address component selection, user interfaces and interfacing of input/output and power supply.

The use of the word “battery powered” is intentional to make students look at power supply considerations within components.

**Conditions/Ngā Tikanga**

It is recommended that students should have multiple checkpoints with their teacher as they work through this assessment activity to ensure they have an opportunity to ask questions and gather feedback.

Conditions of Assessment related to this achievement standard can be found at <http://ncea.tki.org.nz/Resources-for-Internally-Assessed-Achievement-Standards>

**Resource requirements/Ngā Rauemi**

The list of resources for these standards will depend on the teaching and learning programme. As an overview, students will need access to appropriate electronics components and equipment that could include:

* Microprocessor such as Atmel/Picaxe/Arduino or Wi-Fi capable ESP8266 along with programming cables
* Battery Power Supplies, Photovoltaic Cells
* Electronic components and a range of input components, sensors and output devices
* Multimeters, Breadboard components, Vero board or Kiwi Patch boards or Printed Circuit Board equipment.

Students will need access to a computer with appropriate IDE’s for writing and downloading code into a Microprocessor.

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**Student/Akonga instructions**

**Introduction/Kupu Arataki**

This assessment activity requires you to:

* Develop a refined electronics outcome that enables irrigation control in remote locations, specifically interfaces for environmental sensing, automated timers and manual interrupts.
* Generate and model design ideas using user experience methodologies to address component selection, user interfaces and interfacing of input/output and power supply.

You are going to be assessed on how effectively you apply user experience methodologies to develop a refined design for your electronics outcome and on the skills and knowledge shown in the development of an electronics outcome.

You may work with others to help generate ideas and develop those ideas. However, you will be expected to show your own thinking and evidence of how you discussed and combined ideas together to write and submit your own evidence.

Teacher note: Insert due dates and timeframes

**Task/Hei Mahi**

Follow the steps below:

**Apply user experience methodologies**

* Select an appropriate situation/location for your battery powered irrigation system, for example: family vegetable garden, school plants, indoor pot-plants, local community garden, farm paddock.
* Explain the purpose of the outcome and the requirements of the end users.
* Investigate relevant user experience methodologies: this could include usability evaluation techniques, user-interface design guidelines. Summarise your findings.
* Generate at least two design ideas using user experience methodologies.
* Select an appropriate design and explain the appropriateness of the design chosen.
* Model and test the chosen design. This means test/check whether your ideas are feasible, check that end users understand how your system will function.
* Effectively use data gained from modelling to improve the design.   
  *Present your design ideas with annotations that show feedback on your designs and improvements.*
* How does your chosen design address each of the following?
  + justify the user experience methodologies used to develop the chosen design
  + justify how the design is suitable for the purpose and end users
  + evaluating how the chosen design makes use of user experience methodologies (e.g. evaluating the ease of use of the interface for the end user)
  + explain relevant implications and evaluate how the chosen design addresses them
  + justify how the chosen design might be further developed.

**Develop an Electronics Outcome**

* Use appropriate resources and techniques to develop a functional outcome and that addresses relevant implications.   
  *Take photos of development and clearly annotate/label each interface.*
* Construct, test and analyse functional circuits, all input interfaces, output interfaces, modify any template code, and debug any issues to ensure that the electronics outcome:
  + has input sensors that respond correctly to environmental conditions or user input
  + has well-structured code
  + functions as intended
  + is reliable

*You should list the tests you performed, analysis of interfaces, and any modifications to components or software code because of tests.*

* Explain, either through photos and annotations or through written description, the relevant communication protocols and the behaviour of at least two of the following (choose two which directly apply to your own electronics outcome):
  + 1-Wire Protocol for the DS18B20: how it functions and how to use 1-Wire protocols to interface with it
  + RS232 Serial data communication: what RS232 is and how it works
  + I2C communication: how the I2C protocol works and its advantages
  + Real Time Clock RTC: how it functions and how to use I2C protocols to interface with it
  + Aspects of wireless transfer of information such as checksums
  + Power stabilisation using decoupling capacitors
  + Effects of internal battery resistances with high current loads
  + Software flags, interrupts and how a microprocessor handles interrupts.
* Iteratively improve your outcome throughout your design, development and testing process.
* Justify the choice of communication protocols used.
* Justify the choice of components and subsystems used.
* Describe how you addressed relevant implications.

**Assessment schedule/Mahere Aromatawai: Digital Technologies & Hangarau Matihiko 91904 - Battery powered water irrigation system**

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| **Evidence/Judgements for Achievement/Paetae** | **Evidence/Judgements for Achievement with Merit/Kaiaka** | **Evidence/Judgements for Achievement with Excellence/Kairangi** |
| Use complex techniques to develop an electronics outcome.  The student has:   * used appropriate resources and techniques to develop a functional outcome   The student has developed a functional electronics outcome that meets specifications. Each interface works, and the student is able to demonstrate a working Battery Powered Irrigation System.   * constructed, tested, and analysed functional circuits to ensure the electronics outcome performs to specifications   The student may show evidence of:   * analysing analogue data gained from moisture sensor in relation to soil moisture content * testing the input interface on expected sensor inputs, on expected automated timing events, on expected manual interrupts * testing the output interfaces to show display on LCD and/or valve open close * modifying code beyond any template or teacher supplied code samples * analysing power output of solenoid (current draw) and its effect on power supply stability. * tested, modified, debugged the outcome   The student shows they have tested sensor-controlled events, timer-controlled events and manual interrupt events that allow water irrigation system to work to specifications.   * explained the behaviour and function of the electronics outcome and relevant communication protocols   The student has explained the behaviour and function of selected interfaces or components within their electronics outcome   * Real Time Clock RTC, how it functions and how the student has used I2C protocols to interface with it * software flags and interrupts and how a microprocessor handles interrupts * explained relevant communication protocols * addressed relevant implications   The student is able to address implications. For example (partial evidence):   * has well-structured code The student's software code is well structured, including variable and constant declaration. Code comments etc. * functions as intended.  The student resolves any issues that affect the functioning of the system. * is reliable.  The student addresses concerns over reliability that may include soldering components onto a board, enclosures with mounted components, secure wiring. * meets all copyright or intellectual property concerns   *The examples above are indicative samples only* | Use complex techniques to develop an informed electronics outcome.  The student has:   * used information from testing and analysis to ensure the circuit(s) functions reliably   The student is able to test and show reliability in their electronics outcome. This may include a selection from:   * Improved analysis and performance of an analogue moisture sensor. * Well organised breadboard layout with no loose components. Evidence that the system can function in a consistent manner in its intended location. * Soldered components on a Vero board or Kiwi Patch board or Printed Circuit boards will provide evidence of improved reliability and robustness as long as the system is proven to work in a consistent manner in its intended location.   *The examples above are indicative samples only* | Use complex techniques to develop a refined electronics outcome.  The student has:   * undertaken iterative improvement throughout the design, development and testing process   The student shows evidence of iterative design, development and testing within the process of constructing the electronics outcome. The student should be able to show   * multiple instances of development, testing and consequent iterative improvements that lead to a functional outcome * trialling in the outcomes intended location to determine the outcome is fit for purpose   The student was able to produce evidence of the project developing in expected stages, and that after a series of investigation, research and trialling it was further developed, tested and refined. This process was evident throughout the project.   * justified the choice of components and subsystems   The student is able to justify the choice of components**.** They are able to compare competing components, interfaces for the same purpose and justify their decisions in using one over the other.  **For example (partial evidence)**  “*I decided to use a RTC to automate the timing of the water irrigation system over moisture sensing as I found that the pot plant was in a more stable environment” ….” After analysis of max water capacity of the pot plant I was able to modify the timing of the valve to avoid over watering …”*   * justified the choice of communication protocols   **For example (partial evidence)**  *“I used RS232 Serial data communication because it is good to see what information is being captured, RS232 allow me to connect my laptop up to the water irrigation equipment and get live data from the sensors whereas TTL suffers from noise, interference, and degradation.”*  *The examples above are indicative samples only* |

Final grades will be decided using professional judgement based on a holistic examination of the evidence provided against the criteria in the achievement standard

**Assessment schedule/Mahere Aromatawai: Digital Technologies & Hangarau Matihiko 91901 – Battery powered water irrigation system**

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| **Evidence/Judgements for Achievement/Paetae** | **Evidence/Judgements for Achievement with Merit/Kaiaka** | **Evidence/Judgements for Achievement with Excellence/Kairangi** |
| Apply user experience methodologies to develop a design for a digital technologies outcome.  The student has:   * explained the purpose of the digital technologies outcome and the requirements of the end users   The student has chosen a specific context for the battery powered irrigation system such as an indoor pot plant, local community garden etc**.** The student then clearly explains the purpose and end users.   * investigated relevant user experience methodologies   The student researches methods or examples of generating design ideas using a range of user experience methodologies that could include: usability evaluation techniques, user interface design guidelines.   * applied user experience methodologies to generate a range of design ideas   The student selects and uses appropriate design conventions to generate 2 or more design ideas for the water irrigation system interfaces (automated timer controls, LCD feedback, switch placement and labelling, valve opening mechanism).   * explained the appropriateness of the chosen design * modelled and tested the design idea   The student shows evidence of trialling and testing design ideas. This may look like   * discussing with teacher interfaces, enclosures * trialling ideas with end users such as going through procedures needed to set a 1hr repeating timer for watering * checking that users understand the feedback from the LCD screen. * explained relevant implications   The student explains why the design will require a waterproof housing (functionality), use components that minimise power consumption (sustainability), and provide easy to understand feedback (usability).  *The examples above are indicative samples only* | Apply user experience methodologies to develop an informed design for a digital technologies outcome.  The student has:   * effectively used data gained from modelling and user testing to improve the design   The student shows where feedback/data has been used to improve their design or the design of an interface. This may include   * teacher feedback on feasibility and component selection * further internet research on a specific interface that lead to improved design * end user feedback on the suitability of access controls and user feedback. * evaluated how the appropriate use of user experience methodologies have informed the chosen design   The student has shown an evaluation of the user experience methodologies used in design and what information these methods were able to highlight and resolve prior to development of the electronics outcome.   * evaluated how the chosen design addresses relevant implications   The student has evaluated (given reasons) why the chosen design (or selected interfaces) will enable a fit for purpose electronics outcome. Students will have:   * explained how their design addresses implications such as ease of use and technical feasibility, accurate sensing, reliability * explained how their design addresses end user considerations.   *The examples above are indicative samples only* | Apply user experience methodologies to develop a refined design for a digital technologies outcome.  The student has:   * justified the choice of user experience methodologies to develop the chosen design   The student shows a clear link between the user experience methodologies used and the design and modelling they conducted. The student is able to justify the user experience methodology chosen with clear links to their design.   * justified that the chosen design is suitable for the purpose and end users   The student is able to justify design decisions around component selection for:   * sensor interfaces * user control of automated times, manual interrupts * LCD display and feedback * valve open/closing   The student is able to justify how each interface will function in a way that enables the system to work as expected and reliably for the end user.   * justified how the chosen design might be further developed in the future   The student looks beyond the initial design idea to a next phase of development justifying interface changes that refine the design to enable improved functionality.  *The examples above are indicative samples only* |

Final grades will be decided using professional judgement based on a holistic examination of the evidence provided against the criteria in the achievement standard