Digital Solutions 2019 v1.2

IA3: Sample assessment instrument 2

Project — folio (25%)

This sample has been compiled by the QCAA to assist and support teachers in planning and developing assessment instruments for individual school settings.

This assessment instrument has been designed to be completed over a duration of nine weeks.

Student name

Student number

Teacher

Issued

Due date

Marking summary

Criterion	Marks allocated	Provisional marks
Retrieving and comprehending	6	
Analysing	7	
Synthesising and evaluating	8	
Communicating	4	
Overall	**25**	

Conditions

Technique	Project — folio
Unit	Unit 4: Digital impacts
Topic/s	Topic 1: Digital methods for exchanging data Topic 2: Complex digital data exchange problems and solution requirements Topic 3: Prototype digital data exchanges
Duration	—
Mode/length	Source code with annotations: • Written: 2–4 A4 pages Documentation: • Multimodal: 8–10 A3 pages Demonstration of the functionality of the digital solution by video recording: • Multimodal: 1–2 minutes
Individual/group	Individual
Other	Title and contents pages, reference list and appendixes are not included in the page count. Students may use class time and their own time to develop a response.
Resources	• Computers • Internet • Technical proposal • Raspberry Pi (including additional components and sensors) • Access to a greenhouse

Context

Data is used by every company to store, process and query information. As people increasingly embrace technologies, companies want real-time data with immediate results. Using real-time data enables intelligent systems to act on data values through alerts or to automate changes to a specific environment.

The growth of the Raspberry Pi coupled with software and hardware add-ons has excited the young and old alike. From home automation to learning to code, the Raspberry Pi has many potential uses. One such use is to have the Raspberry Pi record data to an SQLite database and have the data transmitted to the internet using tools like the internet of things (IoT). IoT devices are items embedded with electronics, software, sensors, actuators and network connectivity that enable these objects to collect and exchange data. Using 'if this then that' (IFTTT) logic, triggers and actions are processed across a range of services.

As data can be sensitive and prone to attack, it is imperative that programmers understand and develop methods of securing data exchange between computer systems for data validation, data authentication and privacy.

Task

Your task is to access data from an intelligent system, transfer the data into a database, and then visually display the data to the user through a web application. An intelligent system will automatically record data using sensors, including soil moisture and temperature sensors in one or more walk-in semi-automated greenhouses. The plants grown in the greenhouse must be listed, the type of sensors used will be dependent on what plants are being grown in the greenhouse and what their requirements are. This data will be stored in a text file such as a .CSV.

Read the technical specifications (stimulus material) and then present a prototype for a new web application to display the collected data to the user. The problems that exist with the scenario are:

- the site is open to the elements (wind, rain) and animals
- there may be no electricity
- there may be no internet.

The project will have data uploaded to the internet so that the users of the greenhouse and web application users will be able to see the recorded data without having to visit and disturb the greenhouse daily. The aim is to have a point-of-time analysis of the correlation between the weather, date and time for improvement in production of the greenhouse. This information could be used to inform the gardeners when to add water or fertilise the plants.

The project is multimodal, using two or more communication modes within the same response, where all modes are used to provide evidence of the assessable objectives.

The multimodal presentation for this instrument includes:

- a document containing written text, annotations, algorithms, code, screenshots, pictures and/or sketches
- a digital video that may combine images, video, sound, text and a narrative voice.

To complete this task, you must include headings and split your presentation into three parts.

Part 1: Research and investigation

- **recognise** and **describe** key elements of
  - a data exchange application
  - components of data exchange systems
  - data security processes
- **symbolise** using mind maps and one or more of constructed sketches, annotated diagrams, images or screenshots, and **explain**
  - data interface, data structures and data specifications
  - digital methods of exchanging data
- **analyse** the data exchange problem to **identify**
  - the data structures, including data input and output requirements
  - data exchange methods
- **determine** data exchange system requirements
- **evaluate** the most suitable process for exporting and importing data between the two digital systems against prescribed and self-determined criteria

Part 2: Data exchange solution

- **symbolise** using mind maps and one or more of constructed sketches, annotated diagrams, images or screenshots, and **explain**
  - data flow relationships within and between systems
  - programming features and ideas using annotated code segments
  - algorithms communicated in pseudocode
- **determine** prescribed and self-determined criteria
- **synthesise** data, algorithm and coded component ideas to **generate** components of a data exchange solution that simulates the exchange of data between two digital systems; the solution will receive data in one format and programmatically transform it into another format for sharing/displaying
- **evaluate** the
  - accuracy of code after testing to identify errors and actions to make improvements
  - digital data exchange solution against prescribed and self-determined criteria
  - functionality, useability and efficiency of the components of the digital solution
- **make refinements** and **justified recommendations** for current and future improvements

Part 3: Impacts

- **recognise** and **describe** key elements of
  - risks associated with storing and accessing data
  - digital security strategies, including authentication and encryption strategies

- **analyse** a data security problem to **identify** risks to
  - the system
  - data security and privacy
- **determine** a security strategy for data
- **evaluate** the impact of data transmission on personal, social and economic needs against prescribed and self-determined criteria
- **recommend** an appropriate strategy to increase data security

Stimulus

See the technical proposal for additional technical specifications.

Checkpoints

☐ Week 4: CHECKPOINT project progress submission (Part 1 completed).

☐ Week 7: DRAFT submission (Part 1 and Part 2 completed. Part 3 in progress).

☐ Week 9: FINAL submission.

Authentication strategies

- You will be provided class time for task completion.
- Your teacher will observe you completing work in class.
- Your teacher will collect copies of your response and monitor at key junctures.
- Your teacher will collect and annotate a draft.
- You must acknowledge all sources.

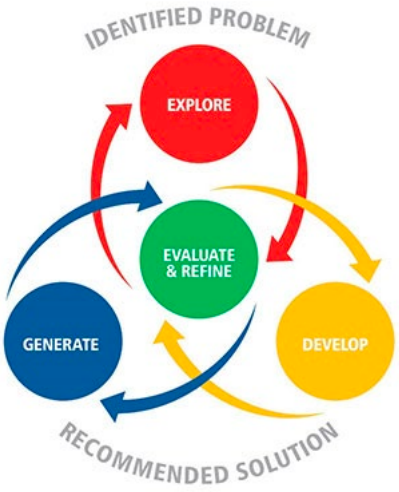
Scaffolding

Your response must include:

- headings that organise and communicate the iterative phases of the Digital Solutions problem-solving process
- source referencing, using APA in-text referencing style
- documentation that will be split into three parts
  - Part 1: Research and investigation
    - four A3 pages presenting research and investigations
    - one A4 page including sample code
  - Part 2: Data exchange solutions
    - three A3 pages presenting the digital solution
    - one A4 page including sample code
  - Part 3: Impacts
    - one A3 page on impacts

You may include additional pages of documentation to make up the total 8–10 A3 pages and 2–4 A4 pages of code with annotations in any part.

You must use the Digital Solutions problem-solving process in your assessment. This means you must identify a problem and state how you are going to solve the problem. Explain and justify how your solution helps to solve the identified problem.



Instrument-specific marking guide (IA3): Project — folio (25%)

Criterion: Retrieving and comprehending

Assessment objectives

1. recognise and describe key elements of an application, components of data exchange systems, and data security processes
2. symbolise and explain data interface, structures and specifications; data flow relationships within and between systems; and digital methods of exchanging data

The student work has the following characteristics:	Marks
• accurate and discriminating recognition and discerning description of key elements of an application, components of data exchange systems, and data security processes • adept symbolisation and discerning explanation of data interface, structures and specifications; data flow relationships within and between systems; and digital methods of exchanging data.	5–6
• appropriate recognition and description of key elements of an application, components of data exchange systems, and data security processes • competent symbolisation and appropriate explanation of data interface, structures and specifications; data flow relationships within and between systems; and digital methods of exchanging data.	3–4
• variable recognition and superficial description of elements of an application, components of data exchange systems, or data security processes • variable symbolisation and superficial explanation of aspects of data interface, data flow relationships or digital methods of exchanging data.	1–2
• does not satisfy any of the descriptors above.	0

Criterion: Analysing

Assessment objectives

3. analyse a data exchange problem and information related to data security
4. determine data exchange system requirements, a security strategy for data, and prescribed and self-determined criteria

The student work has the following characteristics:	Marks
• insightful analysis of the data exchange problem and relevant information related to data security to identify the data structures, data exchange methods, risks to data and code components • astute determination of data exchange requirements, security strategy for data, code for the data conversion program and essential prescribed and self-determined criteria.	6–7
• considered analysis of the data exchange problem and relevant information related to data security to identify the data structures, data exchange methods, risks to data and code components • logical determination of data exchange requirements, security strategy for data, code for the data conversion program and effective prescribed and self-determined criteria.	4–5
• appropriate analysis of the data exchange problem and information related to data security to identify the data structures, data exchange methods, risks to data and code components • reasonable determination of data exchange requirements, security strategy for data or code for the data conversion program and some criteria.	2–3
• makes statements about aspects of the data exchange problem, data structures, data exchange methods, risks to data or code components • vague determination of some data exchange requirements, security strategy for data and some criteria.	1
• does not satisfy any of the descriptors above.	0

Criterion: Synthesising and evaluating

Assessment objectives

5. synthesise information and ideas to determine selected data, algorithms and coded components of data exchange solutions
6. generate components of the data exchange solution
7. evaluate impacts, coded components and a data exchange solution against prescribed and self-determined criteria to make refinements and justified recommendations

The student work has the following characteristics:	Marks
• coherent and logical synthesis of relevant information and ideas to determine selected data, algorithms and coded components of data exchange solutions • purposeful generation of efficient components of the data exchange solution • critical evaluation of impacts, coded components and a data exchange solution against essential prescribed and self-determined criteria to make discerning refinements of code and astute recommendations justified by data.	7–8
• logical synthesis of relevant information and ideas to determine data, algorithms and coded components of data exchange solutions • effective generation of components of a data exchange solution • reasoned evaluation of impacts, coded components and the digital data exchange solution against effective criteria to make effective refinements of code and considered recommendations justified by data.	5–6
• simple synthesis of information or ideas to determine data, algorithms and coded components of data exchange solutions • adequate generation of components of the data exchange solution • feasible evaluation of impacts, coded components and a digital data exchange solution against some criteria to make adequate refinements of code and fundamental recommendations justified by data.	3–4
• unclear combinations of information or ideas to determine data, algorithms or coded components of data exchange solutions • superficial evaluation of impacts, or the digital data exchange solution, against criteria.	1–2
• does not satisfy any of the descriptors above.	0

Criterion: Communicating

Assessment objectives

8. make decisions about and use mode-appropriate features, written language and conventions for a technical audience

The student work has the following characteristics:	Marks
• discerning decision-making about, and fluent use of – written and visual features to communicate about a solution – language for a technical audience – grammatically accurate language structures – referencing and investigation conventions.	2–3
• variable decision-making about, and inconsistent use of – written and visual features – suitable language – grammar and language structures – referencing or investigation conventions.	1
• does not satisfy any of the descriptors above.	0

Stimulus

Technical proposal for new digital solution

Identification

It has been shown that the consumption of fruit, vegetables and herbs is a way to feel healthier, improve one's health and decrease the risk of several chronic diseases. Many crops, even in Australia are harvested prematurely and stored for year-long sales, which can lead to poor taste and a decrease in nutrition. This has created an increased interest in organic and locally produced food, including shopping at farmer's markets, joining street community gardens, green corners and growing one's own food at home. Locally grown foods are picked at their peak of ripeness and are therefore full of flavour and nutrition. However, it takes a lot of time and effort to grow your own, and time is a commodity that most of us do not have much of (Attalla & Wu, 2015).

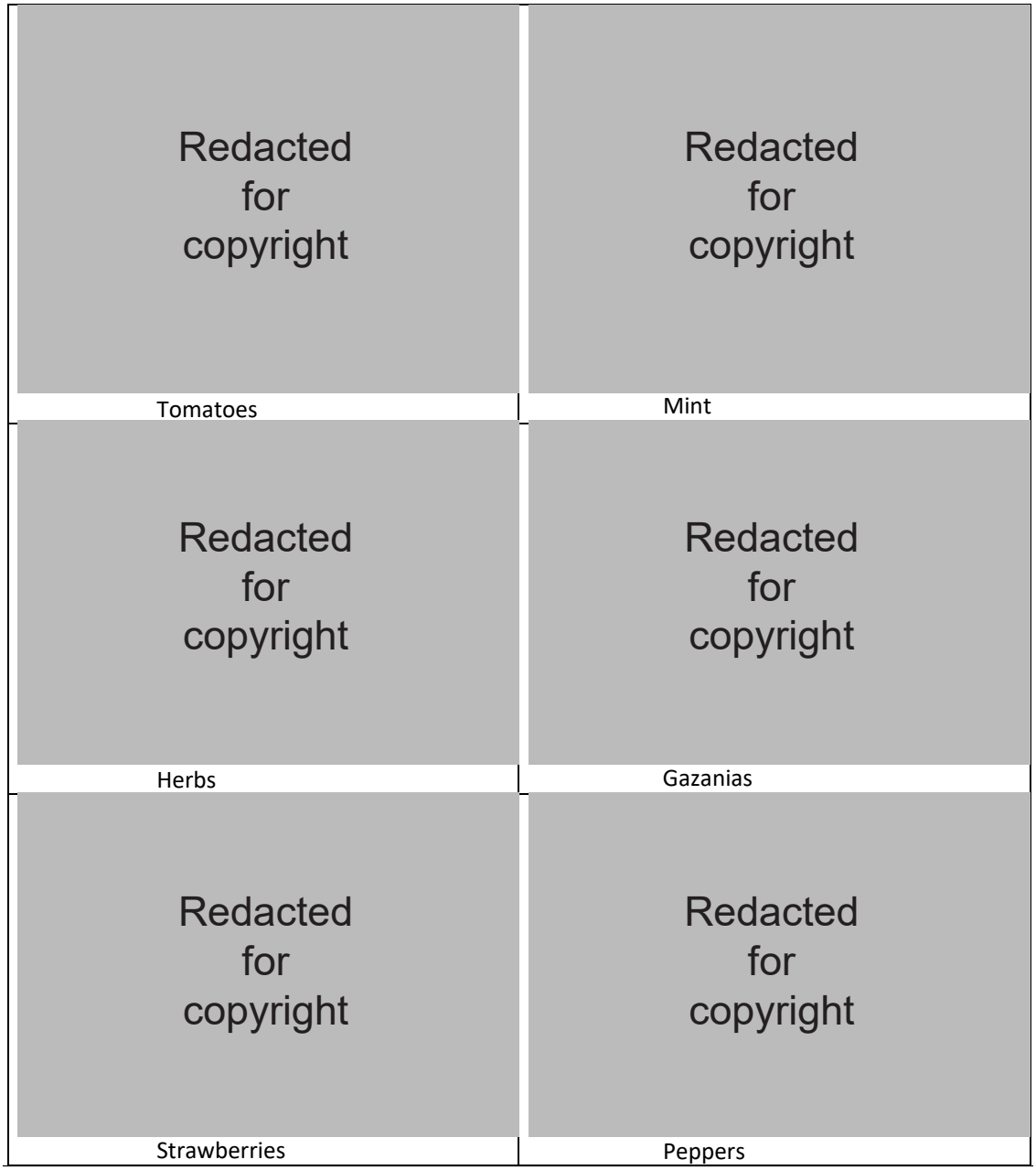
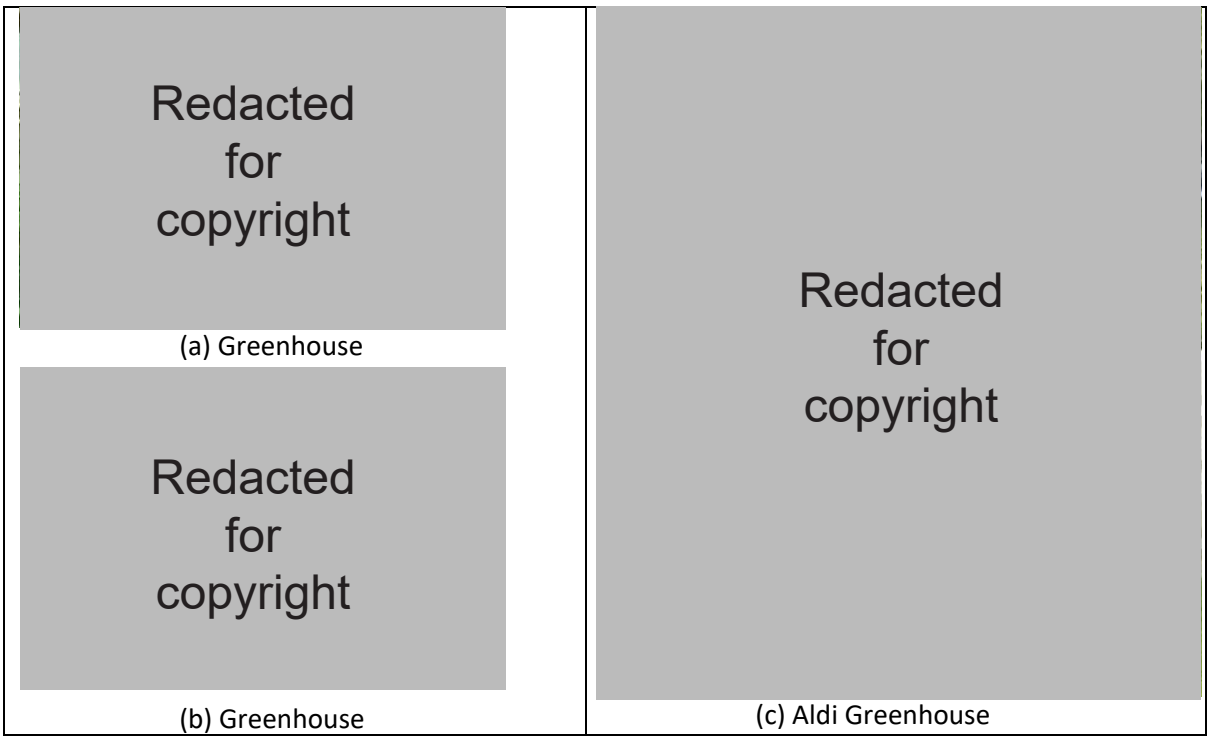


Figure 1: Best Greenhouse Plants: Good Plants to Grow in A Greenhouse (Gardening Know How. 2019)

The best greenhouse plants thrive in containers, at least temporarily, and fit in well with the type of microclimate you are able to produce inside your greenhouse. Common greenhouse plants include vegetables (beans, beets, broccoli, cabbage, carrots, cauliflower, cucumbers, eggplant), ornamentals (geraniums, impatiens, petunias, caladiums, ferns, poinsettias, chrysanthemums, pansies, coleus, gazanias), tropicals (caladiums, calla lilies, cannas, ginger, orchids, venus fly traps), and herbs (basil, chives, coriander, dill, parsley, chamomile).



(a) Greenhouse

(b) Greenhouse

(c) Aldi Greenhouse

Figure 2: (a) Best greenhouse plants: Good plants to grow in a greenhouse (Gardening Know How, 2019), (b) Why do plants grow better in a greenhouse? (Hartley Botanic, 2019), (c) Aldi Reviewer, (Reddit. 2019)

Creating a device using a Raspberry Pi will make it easier to grow food at home with the use of a walk-in semi-automated greenhouse. The greenhouse sensors enable people to grow their own food or plants at home knowing it is truly organic without having to constantly look after them. This may include maintaining the greenhouse soil moisture and temperature in a desired range for optimal plant growth to attain an ideal humidity level and adding liquid fertiliser at ideal times that suit the plants chosen to grow. This data is recorded and transmitted to provide research data, which can be used to improve productivity and the continual health of the plants.

We will build an intelligent system device using the Raspberry Pi 4 that will record soil moisture or humidity levels for the specific plants in the greenhouse. The identified problems that exist with the scenario are:

- the site is open to the elements (wind, rain) and animals
- there may be no electricity
- there may be no internet.

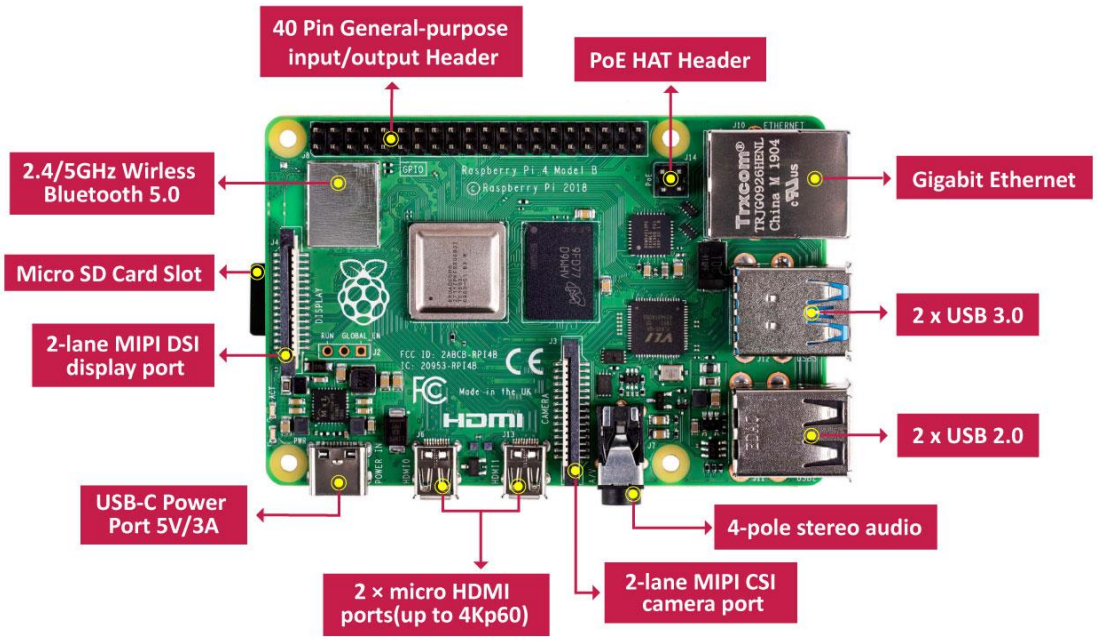


Figure 3: Raspberry Pi 4 Model B 2019 Quad Core 64 Bit WiFi Bluetooth (4GB)

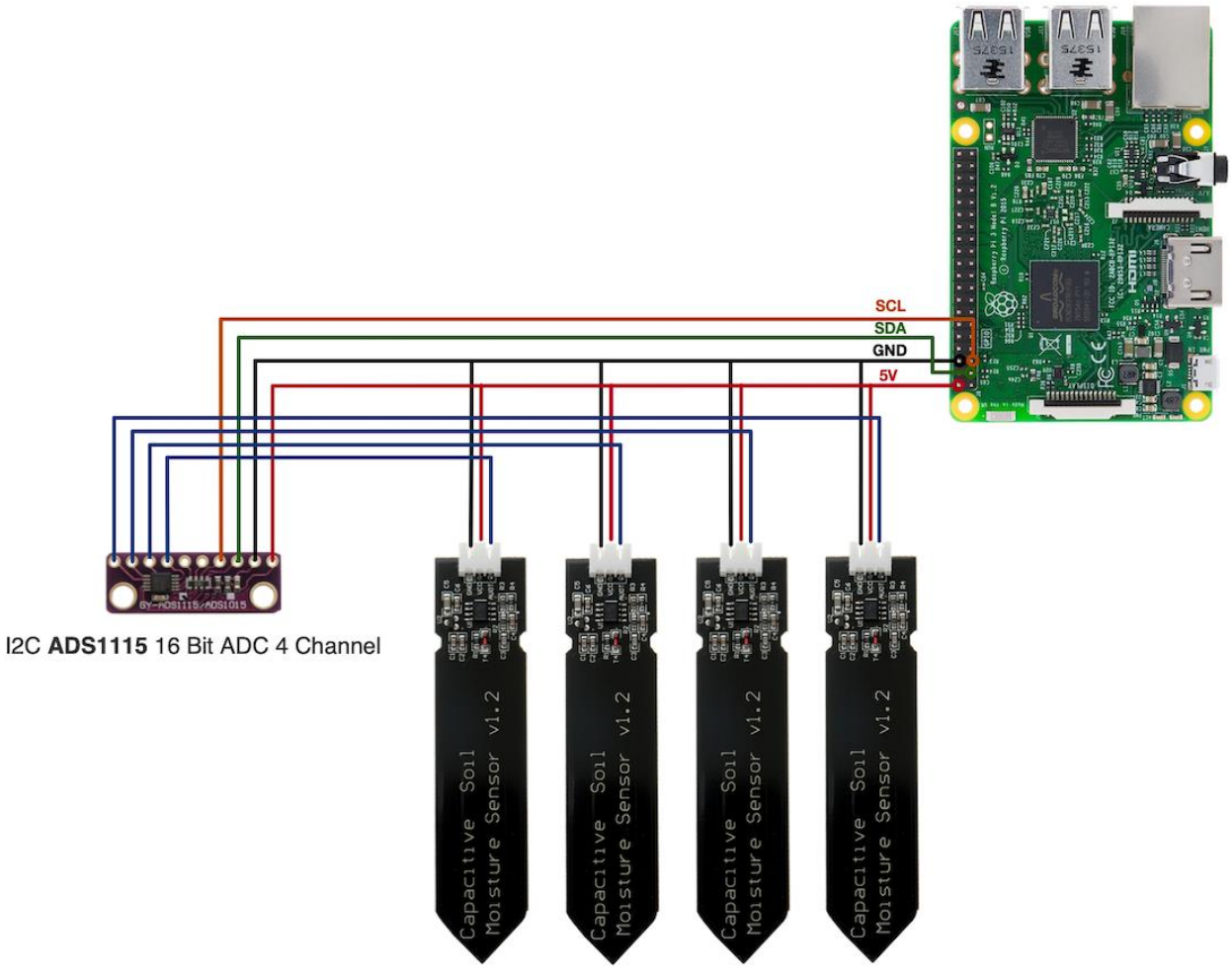


Figure 4: Gardening: Capacitive soil moisture sensor (Homecontrol, 2019)

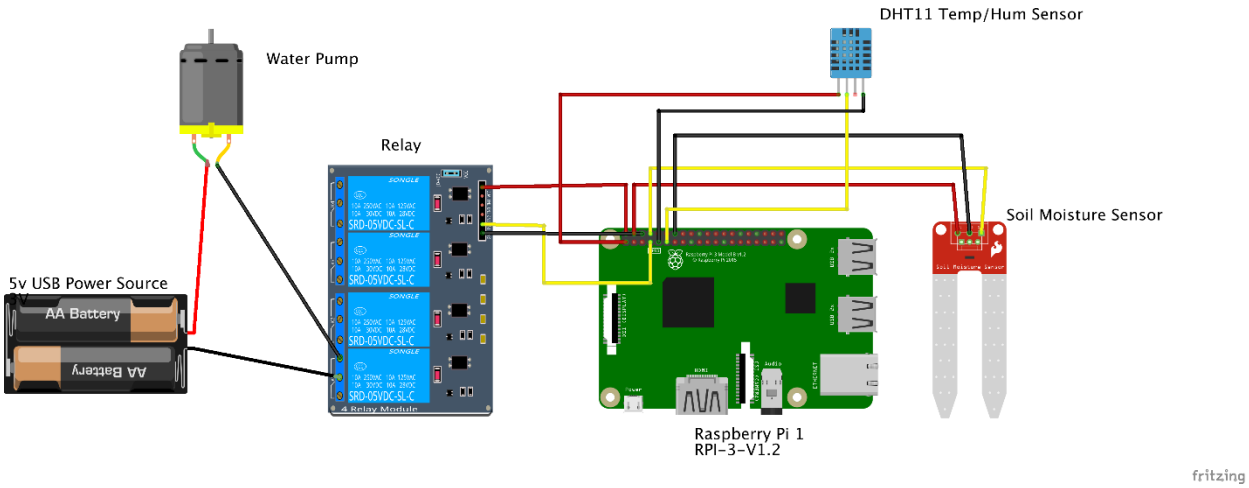


Figure 5: Build a smart, automated IoT plant irrigation system wtih Raspberry Pi and PubNub (PubNub, 2018)

The aim is to collect data using sensors connected to a Raspberry Pi 4 for at least soil moisture and temperature. The data will be recorded into a text file. This recorded data will be exchanged between the Raspberry Pi 4 digital intelligent system and a created database on a different device. A web application interface will be created to display the soil moisture and temperature data stored in the database to the user. Additional identified data may also be recorded and displayed.

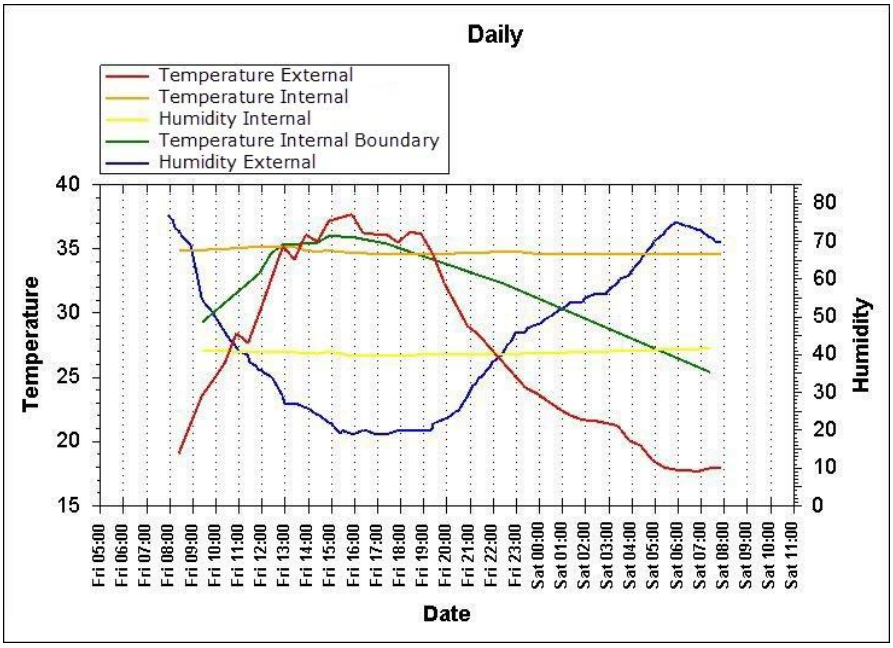


Figure 6: Sample data from a temperature and humidity sensor monitoring system

The web application to be developed must:

- be clear, consistent and comply with the Web Content Accessibility Guidelines (WCAG) 2.0 www.w3.org/TR/WCAG20/.
- include appropriate attribution to data and images used and must comply with copyright law.

A web template may be used for the user interface. The template must include HTML and CSS styles that can be adapted for the new web application. You will need to modify the chosen template to satisfy useability principles and implement the specified functionality. The proof of concept involves:

- developing a low-fidelity prototype of the web application for users
- generating the data exchange component that simulates exchange of data between two digital systems (Raspberry Pi intelligent system and web application). The solution will receive data in one format and programmatically transform it into another format for sharing and displaying
- evaluating impacts and making recommendations for improving data security during the data transfer
- developing a video to demonstrate data transfer functionality.

Interactions

Many people will use the system. Proto-personas have been developed for potential users of the website (see Figure 7). Each proto-persona has specific needs and requirements as to why they would find such a system helpful.

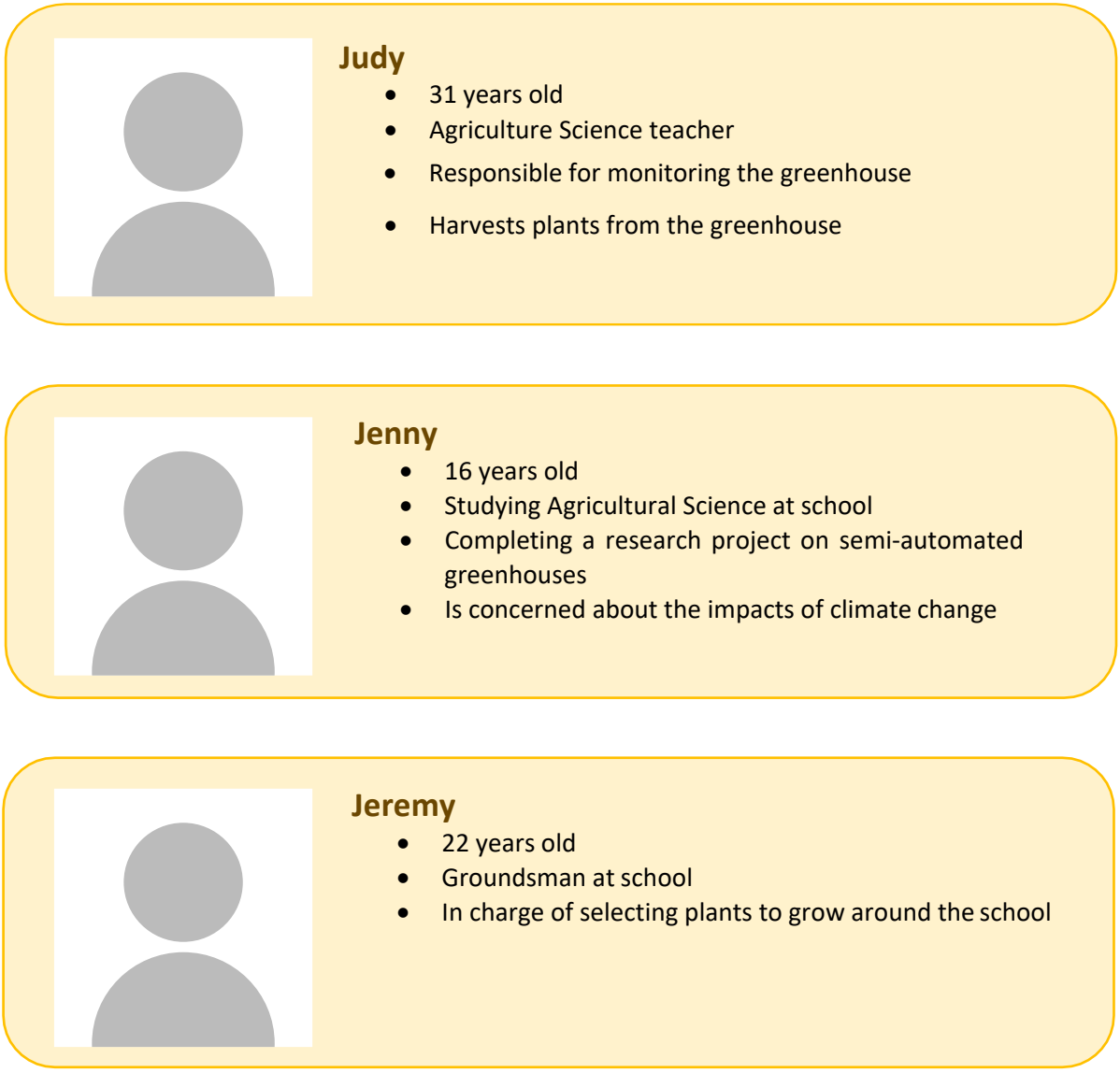


Figure 7: User profiles for the new web application

Component specifications

The solution must consider and integrate data values, good user experience and algorithms.

Data

The greenhouse soil moisture and temperature data will be measured using sensors in the Raspberry Pi system. The date and time the measurements are recorded will also be stored. These data values will be recorded to a text file (such as a .csv file).

The database structure must be developed and created to include the following data values.

- Soil moisture
- Temperature inside the greenhouse
- Date and time

Additional data to store would include details of significant events conducted by humans such as harvesting of plants from the greenhouse. While the data would automatically reflect these changes, it is useful to also record this information for the web application users.

Data in the text file from the Raspberry Pi system must be read and inserted into the database using coding. Iteration will be used to loop through the rows of data. Validation of the data must be considered to match database constraints when inserting the data.

Data from the database will then be displayed in a web application.

Security of the data and the data exchange must be analysed and determined. Consider the privacy and security issues that may arise from collecting and transferring such data.

User experience

The web application will be developed with the user in mind and incorporate useability principles.
The web application must:

- initially display the most recent data from the data exchange to the user
- give users the option to filter data for a specific date range
- be accessible on personal computers and mobile devices
- include at least one image on each webpage
- feature a responsive web interface.

Code

As the website is dynamic and links to a database, algorithms will need to be developed and modified to insert data, and to select and display the correct information to the user. You will need an algorithm to:

- access and read data from the text file
- exchange data from the text file to the database
- display the data from the database to the webpage
- prevent duplication of data in the database
- validate data

Table 1: Accessibility guidelines adapted from the Australian accessibility standards

Accessibility guidelines
Page titles: • must appear in the browser tab for all pages • must be appropriate for the page • must be different for each page.
Alt text: • must be used for all content images (except decorative images) • attribute is set to null for decorative images • appropriately describes the content of the image to which it relates.
Headings: • are on every page (at least one) • levels on each page have a meaningful hierarchy.
Zooming of pages: • results in correct display of the page with no horizontal scrolling • allows all buttons to remain visible.
Non-mouse navigation (keystrokes or tabs): • of page is in a logical order • allows access to all page elements.
Fields: • in forms and other form controls have a visible label to allow interaction with voice input and increase the clickable area • that are mandatory are clearly indicated and do not rely on colour alone • with required formats, such as dates (year, month, day), are clearly indicated.
Error messages (or validation messages): • are clear and specific • do not cause the form to be completely reset.
Accessibility options include: • general instructions for user input at the top of the form or section to which they relate • text transcripts provided for audio and video elements • appropriate contrast ratio between text and background (colour contrast) • a five-second time limit for all moving or flashing content, and the content can be disabled or controlled by the user.

References

Attalla, Daniela and Wu, Jennifer Tannfelt, Automated greenhouse: Temperature and soil moisture control, Degree project in mechatronics, KTH Royal Institute of Technology, Stockholm, Sweden 2015.

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Homecontrol 2019. Gardening: Capacitive Soil Moisture Sensor. Retrieved August 8, 2020 from http://homecontrols.ch/gardening.php#

PubNub 2018, Build a smart automated IoT plant irrigation systemwith Raspberry Pi and PubNub. Retrieved August 8, 2020, from www.pubnub.com/blog/smart-automated-iot-plant-irrigation-system-raspberry-pi-pubnub/

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