Faculty of Computing, Engineering and Science

Assessment Brief

**Module Title:** Advanced Integrated Computing Devices

**Module Code:** IS3S687

**Module Leader/Tutor:** Dr Nathan Thomas

**Assessment Type:** Practical Coursework 2

**Assessment Title:** Internet of Things (IoT) Case Study using OpenHab

**Weighting:** 50%

**Word count/duration/equivalent:** N/A

**Submission Date:** Friday 13th December 2024 by 23:59 UK/GMT time zone

Return Date: typically 21 working days after submission

## Assessment Description

**Assessment Task:**

You are required to explore the implementation of an Internet of Things (IoT) solution using OpenHab. The assignment requires you to create two deliverables:

1. A prototype system implemented using the OpenHab Home Automation open-source platform.
2. You must submit a mandatory video demonstration of your working prototype with a narrative overview to verbally describe the various features and functionality contained within it.

**Scenario**

You are an IoT developer of a fast-growing tech company which focuses on various IT solutions and have been approached by a local council to propose a prototype IoT solution for the elderly. The pilot scheme will be conducted within a new and ultra-modern residential care home to eventually ascertain as part of a bigger long-term project how useful an IoT solution could be used for typical applications such as healthcare monitoring, security, safety and general convenience and well-being. For now, the prototype IoT solution within the care home will be restricted for testing purposes to a single residential apartment and the warden’s office.

An initial feasibility study has identified that the council has a limited amount of money to spend on the prototype system so an expensive commercial solution is out of the question and a cheaper solution must be found. The tech experts within your IT company have therefore proposed a cheaper low-cost alternative prototype making use of inexpensive ESP8266 devices, Raspberry Pi’s with various sensors such as a DHT11 for monitoring temperature and humidity combined with using open-source IoT automation software. The residential care home already has excellent Wi-Fi infrastructure throughout the building so this is not a concern. Your IT project manager has drawn up a list of **essential functional requirements** as a minimum acceptable solution however there is scope for significant additional features by also exploring some or all the desirable functional requirements below.

**Essential functional requirements must include:**

* The test residential apartment must monitor indoor temperature and humidity readings via a suitable DHT11 sensor so that:
  + If the temperature of the apartment becomes too warm (more than 24⁰C) or too cold (less than 14⁰C), a suitable alert or notification alerts the occupier of the apartment to manually increase or decrease the thermostat to a safer level.
  + When excessive temperatures (over 70⁰C) are detected (this may indicate a possible fire) the resident and warden are alerted to evacuate the building.
  + Humidity readings would also need to be monitored (to prevent dampness and mould in winter months) and when an excessive amount is detected (over 75%) the resident is alerted to check to see if they have left a kettle boiling or the shower is still running.
* The care home is located close to a major steelworks. On certain days the steelworks can emit harmful levels of pollution (measured as an Air Quality (AQI) index). On a regular basis and sometimes twice daily, the warden must manually check the AQI which is published on a local website. This however is a time-consuming process especially when the AQI is not of a concern. Since it will be out of budget and scope to invest in dedicated hardware to externally monitor air quality and pollution at the residential care home, an alternative solution must be found to monitor Air Quality Index (AQI) via a third-party service which can be automatically integrated into the IoT prototype.
* To detect movement of a resident in their apartment making use of the PIR sensor.
* The council have asked to display various sensor data and readings based on the above essential requirements via a simple User Interface so that the warden can help to monitor the test residential apartment. It is envisioned that this simple UI could be displayed on a monitor or tablet located within the warden’s office.

***Desirable functional requirements to include some or all the following:***

(This will help you to gain significant additional marks)

* In the summer, residents often like to sit outside and enjoy the hot sunny weather. Elderly people tend to lose track of time and they are at an increased risk of skin burn (due to their delicate skin and high UV) and dehydration (due to high temperatures). Since it will be out of budget to invest in dedicated hardware to monitor UV index levels, current sun elevation, ozone density etc at the care home, an alternative solution must be found which can be integrated into the IoT prototype and the warden is alerted if the UV levels or outside temperatures exceed a harmful level.
* A common condition for elderly people is that they are unable to feel a change in temperature or they do not realise how hot or cold their surroundings are. Whilst a previous essential functional requirement has mostly addressed this problem, the council has asked to see if an additional measure can be put in place to alert a resident to a sudden change in temperature in the form of a visual cue (i.e. change of a light bar strip or LED colour to blue or red indicating too cold or too hot).
* To send a warning message to the warden if no movement has been detected in a resident apartment by 11am.
* The care home employs four wardens throughout a typical working week on a 24-hour rotation. Some residents become confused as to which warden is on duty at a particular time or day. The council have asked if there is a way to automatically ascertain which warden is on duty by detecting their presence when they enter or leave the building.
* The council has asked for the User Interface to include additional data and information from the above desirable functional requirements into a more detailed visual experience (note this can be explored using Pages).

Your implementation does not need to be a fully-fledged system that can be used in a full-scale context, but should be more of a proof-of-concept and prototype version that demonstrates how the system could potentially operate. The minimum solution would be one in which explores only the essential functional requirements to ensure a pass grade. Significant additional marks can be further gained by exploring some or all of the desirable functional requirements above.

**Deliverables:**

**The IoT Prototype using OpenHab**

* Your prototype IoT system must be implemented entirely using the OpenHab Home Automation open-source platform making use of MQTT where appropriate.
* Your OpenHab software installation can be done via a Raspberry Pi, Windows PC, Linux, Virtual OS etc.
* You are free to use the supplied equipment such as a Raspberry Pi, ESP8266 NodeMCU board; DHT11 sensor etc OR you are welcome to purchase some of this cheap equipment yourself using the links supplied on BB. Note: Bindings such as Astro, Air Quality, Networking etc are web services so no physical hardware is required as you can easily integrate these into your prototype IoT system. You are free to improvise where necessary. i.e. for audio output you can use your own headphones which can be plugged into the 3.5mm audio output of a Raspberry Pi or the speaker output port of your laptop or PC (if you have implemented this on an alternative device). Hint: For additional desirable requirements you can make use of existing devices such as your iPhone or Android smartphone to help with Presence Detection making use of the Network Binding in OpenHab.

**A demonstration video with a narrative overview (mandatory requirement)**

You must provide a short video demonstration showcasing your OpenHab implementation. The video (with an audio narrative) can be recorded using your smartphone and should last no more than 10 minutes or so in duration. When demonstrating your working OpenHab system it is recommended to do this within the last scheduled timetable session prior to the submission deadline. When recording your video demonstration ensure you clearly show all the features and functionality within OpenHab to include the front-end (UI), and also the back-end administration section such as Things, Items, Rules etc. Ensure you also clearly show in the video other aspects such as the IoT hardware such as the 3D printed sensor box and the changing of the RGB lights when certain Rules are triggered. Make sure you demonstrate all features within your video as no marks can be awarded past the deadline if you neglect to demo specific features. You can upload a copy of the video to Blackboard or alternatively you can provide a link to YouTube or equivalent and provide the URL in the upload submission comments box. ***Important note: If you fail to supply a video demonstration by the deadline no marks can be awarded as the video acts as evidence of you having completed this assessment.***

## Guidance on Format of Assessment

Note: Students are reminded **not** to include this assignment brief with the assignment submission.

Referencing must be completed in line with the USW Harvard style, as outlined here: <https://library.southwales.ac.uk/collections-subject-guides/referencing/>

## Learning Outcomes Assessed

LO1: To demonstrate a critical understanding of integrated computing device functionalities and the technologies associated with the Internet of Things (IoT).

LO2: To analyse the requirements and design an appropriate implementation of an IoT system using integrated computer technologies.

## Marking Criteria/Rubric

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Criteria** | **Fail (< 40)** | **Lower Pass (40 – 49)** | **Upper Pass (50 – 59)** | **Merit (60 – 69)** | **Distinction (70 +)** |
| OpenHab Prototype  (100%) | Key components such as ‘Bindings’, ‘Things’, Item’s are missing or not properly integrated  No use of MQTT protocol or binding.  The semantic model/UI has not been integrated  The essential functional requirements have not been addressed | Limited number of ‘Things’ / ‘Bindings’ have been integrated  The ‘Semantic Model’ has been explored to a basic requirement.  Only a single ‘Rule’ has been integrated  Only the essential functional requirements have been addressed. | Some relevant ‘Things’, ‘Bindings’ have been integrated  The ‘Semantic Model’ is present but is limited in scope with limited information being displayed via UI  Some basic ‘Rules’ have been integrated with issues  All essential functional requirements have been addressed along with one additional desirable feature. | A good number of relevant ‘Things’, ‘Bindings’ have been explored and integrated  Very good use of the ‘Semantic Model’ and a very good working UI  A few ‘Rules’ have been integrated with no issues  All essential functional requirements have been addressed along with two additional desirable features. | Several or more relevant ‘Things’, ‘Things’ have been explored and successfully configured  The ‘Semantic Model’ along with a detailed interactive UI / pages have been explored  Several more complex ‘Rules’ have been successfully integrated with no issues  A fully configured working prototype system which successfully explores and exceeds all requirements around IoT automation to a very high standard. |
| Total: |  | | | | |

## Submission Details

You must submit to Blackboard by the deadline:

* A short, pre-recorded video with audio narrative (no longer than 10 minutes in length) using your smartphone or other recording equipment to provide a demonstration of your working IoT system

**Note: \*No marks will be awarded if you do not submit a video demonstration which must include a narrative (audio) voice-over.**

* An electronic copy of your Word document that contains your written report. Hard copies are not required.
* Upload both the Word document and video to Blackboard by the submission deadline.

## What happens next?

Your marked assessment should be available 20 working days after submission (excluding the Easter break period). However, please be advised that this may be subject to change in the event of Bank Holidays, University Closure or staff sickness. If there is something about the feedback you have been given that you are unclear about, please see your module tutor.

## Feedback Method

Feedback will be made available via Blackboard.

## Late Submission

The assessment submission slot on Blackboard will remain open after the deadline has passed. If it necessary for you to submit your work late then you should submit your work through the same method and inform your lecturer when you have done so. Your work may then be assessed, if appropriate.

## Retrieval in the Event of Failure

Resit assessments opportunities will be available in the summer if appropriate. This assessment is not eligible for In Year Retrieval.

## Extenuating Circumstances

[https://advice.southwales.ac.uk/a2z/extenuating-circumstances](https://advice.southwales.ac.uk/a2z/extenuating-circumstances/)

## Referencing, Plagiarism and Good Academic Practice

[https://advice.southwales.ac.uk/a2z/referencing-plagiarism-and-good-academic-practice](https://advice.southwales.ac.uk/a2z/referencing-plagiarism-and-good-academic-practice/)

## Learning Support Resources

[https://studyskills.southwales.ac.uk](https://studyskills.southwales.ac.uk/)

## Your Assessment Queries

Assessment related queries should be raised in class.

## Student Checklist

Ensure you complete all of the following elements:

|  |
| --- |
| Part 1- IoT implementation in OpenHab |
| Part 2 – Written Report |
| Perform a video demo (with narrative audio) of your prototype |