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| Solent University |
| Project Initiation Document |
| Transmitter Power Measurement |
| **Joshua Alsop-Barrell**  **Matthew Brook**  **Klea Cengu**  **Matthew Dear**  **Kieron Gillingham**  **Mark Hartop** |
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| **Tutor: Craig Gallen**  **Project Sponsor: Arqiva** |

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# Introduction

## Background

Arqiva operate the terrestrial broadcast TV and radio network of transmitters in the UK. These transmitters are controlled and monitored from a central location in Yorkshire. High power VHF transmitters are tested by connecting them to a 'test load' instead of an aerial. The transmitter functions at full power, but the radio frequency energy is sunk in a test load instead of being transmitted. Operating at full power can cause the test load to become extremely hot. Currently the temperature of the test load is calculated using a thermostat locally.

* Need to monitor power output of transmitters
* Power is measured by a applying it to a test load (of water)
  + To adhere to regulations
* Power is then calculated by reading the difference in temperature before and after the test load
* Currently using glass thermometers

## Proposed Solution

The vision for the project is to create a mechanism to allow the temperature to be measured using a thermocouple and reported remotely.

* Project aims to replace analog thermometers with digital sensors
* Allow digital sensors to be read/monitored remotely



# Objectives and Benefits

The project will need to achieve the following to meet its goals:

* Develop a process to change the glass thermometers for ‘calorimetry’ power measurement at high power VHF sites on the Test Loads, using two-input digital thermometers, thermo-pockets and suitable temperature probes.
* Chosen temperature probes should have a temperature range – 0 – 100C not -300C to +3000C and a differential, not absolute, accuracy of 0.05C would be acceptable.
* The digital thermometer will be required to do the temperature difference calculation T1 – T2.
* Testing will be required to prove it is immune from VHF interference and checked against known good glass thermometers.

*It has been advised to use commercially available parts, with industry standard probes. If plugs/sockets are used, they must be reliable so that means good quality and probably capped/sealed (either with two handheld meters, one per ‘side’, or the meters could be permanent).*

# Requirements

## Requirements

* Describe requirements in text before listing them
* Budget

The functional requirements within the scope are as following:

1. Gather thermocouple readings from sensors
2. Gather flow-rate reading from the flow-rate sensors
3. Power should be calculated from the sensor data
4. On-site hardware should be able to be individually calibrated
5. On-site hardware should be secure
6. On-site hardware should transmit sensor readings/calculations securely
7. Sensor readings should be stored securely
8. A remote user should be able to view stored sensor readings for each transmitter
9. The visualisation software should be secured against unauthorised access
10. Thermocouples should be able to withstand temperatures of up to 100˚C.
11. Thermocouples should have a differential accuracy of 0.05˚C.
12. Hardware should cost no-more than £200 per test load.

Whereas the non-functional requirements of the project are as following:

1. Visualise the sensor readings for each transmitter
2. Display historical sensor data for each transmitter
3. Thermocouples should be able to be simulated for testing purposes.
4. There should be a test harness
5. The system should detect and raise alerts for anomalies in power/temperature readings, including response timeouts.

## Scope

The features of the project are determined and defined below to show what will be included in the scope of the project and which features will be considered out of scope.

* In scope:
  + Software for on-site hardware
    - Sensor Readings
    - Transmission of messages
  + Communications
    - Recieving of messages
    - Datastorage
  + Front-End
    - User Interface
* Out of scope:
  + Installing hardware

|  |  |  |  |
| --- | --- | --- | --- |
| IN SCOPE | | OUT OF SCOPE | |
| 1 |  | 1 |  |
| 2 |  | 2 |  |
| 3 |  | 3 |  |
| 4 |  | 4 |  |
| 5 |  | 5 |  |

# Key Stakeholders

## Team

* Responsibilities
* Discuss Original roles ?
  + Why we changed

|  |  |
| --- | --- |
| Name | Role |
| Mark Hartop | Project Owner |
| Matthew Dear | Scrum Master |
| Matt Brook | Front End Lead |
| Kieron Gillingham | Communication Lead |
| Klea Cengu | Documentation Lead |
| Joahua Alsop-Barrell | Back End Lead |

## Other Stakeholders

|  |  |
| --- | --- |
| Name | Role |
| Peter Katic | Sponsor |
| Craig Gallen | Mentor |
| Temperature Monitoring Attendant | The end user who will monitor the incoming messages through the provided visualisation software. |
| On-Site Engineer | An engineer who may be required to recalibrate the hardware on-site. |
| System Administrator | An administrator who will need unrestricted access to any component of the system including data storage. |
| Governing Body | An organisation that requires the system to adhere to safety guidelines and policies. |

# Plan

## Approach

The proposed intention is to create custom software for Arqiva to ensure that they will be able to report remotely.

* Agile
  + Scrum
  + Set requirements
* Sprints
* How will quality be managed?
* Assessing quality of

## Assumptions

Some assumptions for the project include:

* The team will be available for the required period 01/02/2021 - 21/05/2021
* Key stakeholders will be available for the required oversight/governance
* Team have the necessary technical skills

## Constraints

Some limitations are as following:

* Completion of the project
* Working remotely, we can’t physically attend site
* No access to arqiva server/hardware/database

## Schedule

The project milestones and tasks are displayed in the table below:

* Sprints

Table

Description automatically generated

## Management

* Communication
  + GitHub
  + Discord
    - Breakout Rooms
    - Screen Sharing
    - Roles
* Meetings
  + Team
  + Tutor
  + Sponsor

# Governance and Controls

The link provided below will provide you access to the documentation of our Wiki page on GitHub:

Wiki: <https://github.com/mattdear/temperature_transmitter/wiki>

Our project register of issues can be accessible with the link provided below:

<https://github.com/mattdear/temperature_transmitter/issues?q=is%3Aopen+is%3Aissue>

The governance of the team can be depicted in the team structure diagram. It was initially agreed that there would be 2 team meetings a week that are scheduled on Tuesdays and Thursdays.

Diagram

Description automatically generated

# Initial Risks

Below we have provided an initial view of project risks. It is likely that not many risks will be known at this stage, but we have described the risks we are fundamentally aware of.

* Owner?

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| # | Description | Impact | Probability | Total Risk | Actions | |
| 1 | Loss of work if power went down | 2 | 1 | 3 | | As we are working remotely, other team members to cover the loss of work and backing up work regularly |
| 2 | Team members sick | 2 | 3 | 5 | | Ensuring there are multiple people on the team to cover whenever necessary |
| 3 | Issues implementing technologies | 4 | 5 | 9 | | Have plans in place which may involve using alternative technologies |
| 4 | Unclear commit messages | 1 | 1 | 2 | | The team to continue using the conventional commit standard |
| 5 | Loss of internet access | 1 | 2 | 3 | | As the team is not working from a central location, other members will have internet access and be able to cover the work |
| 6 | Team turnover | 1 | 1 | 2 | | If a team member leaves the project before the complete dare, other members are qualified to complete it |
| 7 | Requirements change | 2 | 2 | 4 | | New requirements would be evaluated and adapted into the project and milestones |
| 8 | Scheduling problems | 1 | 1 | 2 | | Unanimously adjust the schedule to fit the availability of the team |
| 9 | Inaccurate information/data | 2 | 1 | 3 | | The data ranges are set, if they change it can be adjusted in the program |
| 10 | Compromising/ignoring features of the scope | 3 | 2 | 5 | | Reinitiating the requirements of the scope of the project |

# Deliverables

* Software
  + Docker
  + Live Deployment?
* User Guide
* Development Guide
* Discuss aspects that could be replaced or integrated with existing architecture
* How to assess quality of product

# Implementation

## Design

The architecture diagram also includes the software we are intending to use.

Diagram

Description automatically generated

## Development of the System

## Further Work

* Security
  + HTTPS considered
  + Apache Reverse Proxy
  + TLS
  + Security of the MVP was not done because it was decided that any security protocols would need to be changed for the actual deployment.

# Conclusion

## Recommendations

# References

* NodeRED
* Raspberry Pi
* ActiveMQ

# Appendices