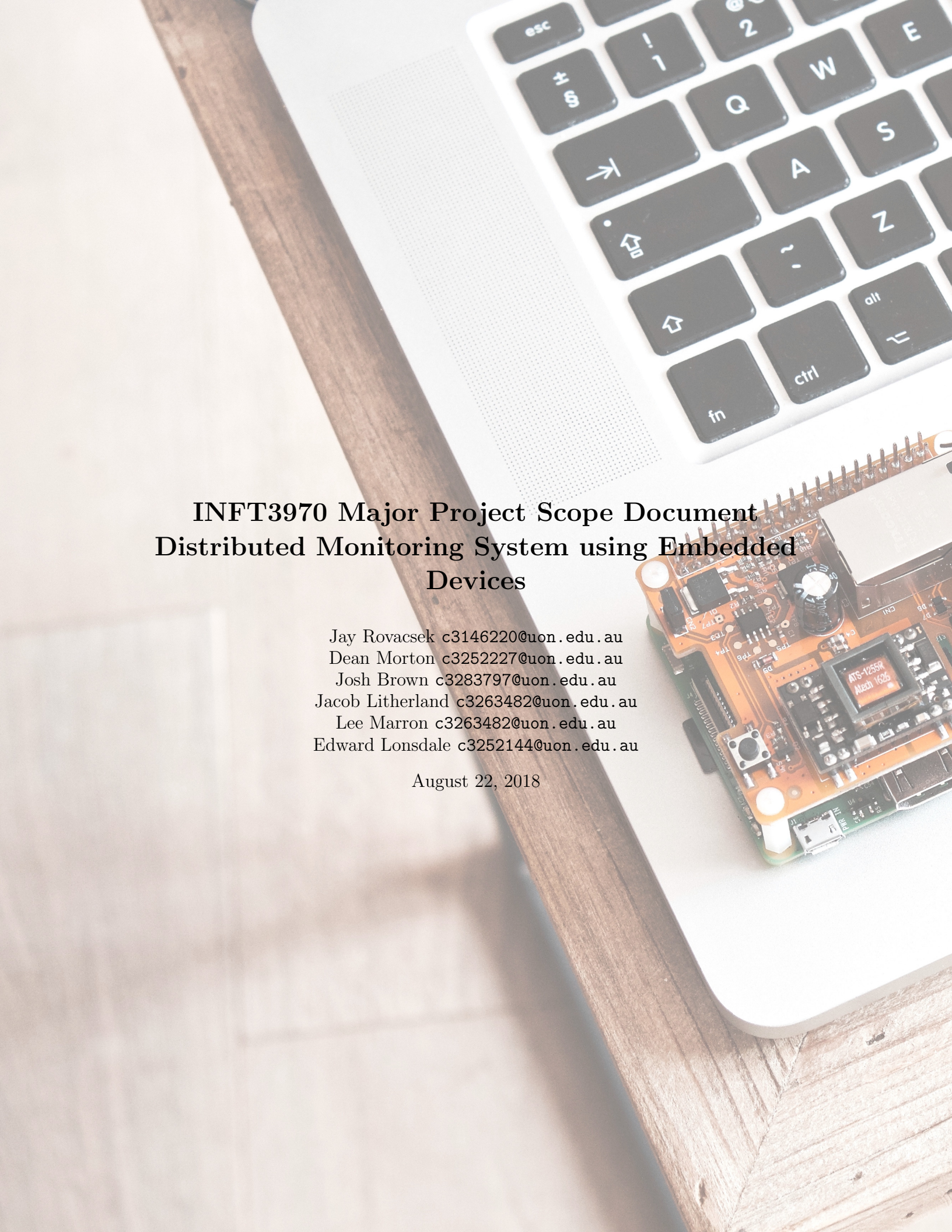

INFT3970 Major Project Scope Document
Distributed Monitoring System using Embedded Devices

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Contents

Executive Summary

0.1 Background

Riding the wave of "IoT Revolution" [1], this project will develop a low cost, easily deployable IoT product in any setting.
IoT or *The Internet of Things* has proven to be an explosive trend within the consumer electronics markets. Never before have such small versatile devices been available for general consumption, leading to an estimated combined business and consumer spending value in excess of $6 *trillion* dollars globally in 2018 [1].
For the vast majority of consumers, both corporate and end-customer [2], a large movement toward both minimisation of waste and optimisation of spending is occuring on a global scale in the developed world, with the developing world rapidly following this trend also [3].
Citing this movement, it would only be logical to create a simple to use set of devices that allow for the monitoring and therefore optimisation of such measurables.

0.2 Overview and Purpose

The concept of this project is to create a distributed system in which small devices are used to monitor, log and analyse a number of select metrics from a multitude of potential data points.
The purpose of the project is to deliver a viable product that could be replicated for a reasonable price for both end-user and business alike. We believe the market to be on a precipice of further explosive growth, with the consumer market partially realised, but far from tapped by curent offerings.
In this document we intend

0.2.1 Metrics

The metrics measured included will be:

- Temperature
- Humidity
- Motion

We anticipate further development on the project to be viable post submission date, however realise the limitations of the current timeframe.

Metrics measured would be viewable on a users dashboard, with data being able to be scoped to multiple filter requirements such as time, select edge cases or specific locations.
The end-goal being an ability for users to better determine inefficient or bad decisions they may make unwittingly in regards to home or business heating, coupled with the impact of room utilisation.

1 Project Objectives

Within the timeframe still available to this project, we aim to develop and deploy a number of IoT devices [4] to a home enviroment or two and to track heat, humidity and motion of the dwelling to better understand the potential correlations of room use, heating and potential inefficiencies created in areas such as 'High Traffic' spots (Loungerooms and Hallways)
Optimally we ain to couple this with a mapping of the dwelling, allowing a more intuitive expression of the data collected.

We intend on using student subscriptions to leverage Azure for both website hosting and databasing coupled with a small budget of roughly $100-$200 to purchase all required equipment which currently is expected to be:

- Arduino UNO3 Microcontroller
- ESP8266 boards
- DHT11 Temperature and Humidity sensors [6]
- XC-4444 PIR Motion sensors [5]
- Various required breadboards / generic electronics items

The overall goals of the project is to enhance our knowledge of of IOT sensor technology in the scope of exploratoring what this technology can achieve and expanding the paradigm of this technologies implementations.

Secondarily the group seeks to develop our ability to interface with middleware using a number of appropriate languages to create a frontend user interface for users to monitor/operate and perform data analytics on the system and a backend for data management system that interfaces with an SQL server implementation.

We intend in this project to showcase out abilities while expanding our capabilities and have an aim to deliver a prototype by week 9.

1.1 Deliverables

Included deliverables for the project will include a large span of items crossing a number of percieved IT-sub-disciplines:

- Raw data be stored in an online database including:
  - Temperature
  - Humidity
  - Motion
  - Sensor IDs
  - Associated timestamps for datapoints
  - User information including:
    - Name
    - Address
    - Postcode
    - Sensor Ownership

The user interface will be developed to allow the users to access their stored infomation and optionally remove sections of data. Each user will be able to customise their own homepage in order to display to their needs. The user interface will deliever:

- Login page
- Registration
- Home Page (Where all data is displayed)
- Graphs based on the user's data
- Analytic results
- Suggestions
- Logout

1.2 Milestones

Major milestones for the project include are split into a number of concurrently developed sub-sections:

1. Sensors:
    1.1. Sensor proof of concept implementation (serial to USB)
    1.2. Testing of POC
    1.3. Sensor and Wifi Implementation
    1.4. Testing of Sensor and Wifi implementation
    1.5. Sensor to API communication including:
        1.5.1. Implementation and testing of Temperature logging
        1.5.2. Implementation and testing of Humidity logging
        1.5.3. Implementation and testing of Motion logging
        1.5.4. Testing of Sensor to API communication
2. Database:
    2.1. Database Pilot (Including creation and design)
    2.2. Review and Testing of Database
    2.3. Optimisation of datatypes used in each table
    2.4. Implementation of indexing and other optimisations to avoid big O issues.
    2.5. Final database implementation.
3. Backend:
    3.1. Decision of framework to be used
    3.2. Initial POC on framework
    3.3. Feature implementations:
        3.3.1. Implementation of PING GET endpoint to avoid sending of data unnecessarily
        3.3.2. Implementation and testing of POST endpoints:
            3.3.2.1. Temperature
            3.3.2.2. Humidity
            3.3.2.3. Motion
        3.3.3. Implementation and testing of application helpers to aid front-end data sourcing
    3.4. Refactor existing code
        3.4.1. Peer review of code, implementation of required changes
4. Front End:
    4.1. Initial implementation of POC dashboard
    4.2. Initial POC of authentication using a login page
    4.3. Review of code by peers
    4.4. Migrate dashboard behind successful login page
    4.5. Improvements and refactoring of dashboarding code
    4.6. Review and refactor to suit all devices commonly used to browse websites.
    4.7. Implement required bootstrap/css framework to handle display of data.
    4.8. Final peer review and refactor

5. Documentation
    5.1. Generate POC documentation from project
    5.2. Generate scope document
    5.3. Comment code extensively for readability
    5.4. Document APIs
    5.5. Document database design, with considerations of optimisation and required modifications
    5.6. Generate user guide for final product
    5.7. Generate final report

2 Technical Requirements

2.1 Generalised Requirements

The team collaboratively have agreed on a few generalised requirements of the project including:

- Ease of use: The devices must be able to used by a nontechnical user, they must be supplied in such a way that an ability to place the device in place, and connect power are the largest difficulties that the end user encounters.
- Abstraction of underlying technologies: as a byproduct of the requirement of ease-of-use the devices and web application should not require the end user to have any knowledge of the underlying technolgies used.
-

2.2 Data Requirements

Requirements for raw data be stored in an online database are only access for the development resources to be able to access any suitable cloud account, self-host on a local machine or debug required functions in the application with localised data generation via ajax queries of similar methods.

2.2.1 Azure

Azure is a likely candidate for the Database and website hosting, The database will be used to store all the data that is sent from the sensors. The uptime of the database the web application is vital to the user experience and the success of the project. Azure provides this security with 99.95% uptime [9].

2.3 Hosting Enviroment

Pages for the site itself will require a suitable host either cloud or local which supports .NETcore 2.0 [7] and suitable network access to reach a required TSQL [8] database hosted by the team.

2.4 Network Connectivity

Functioning network connectivity will be heavily depended on by the project, all of the sensors will be connected to a local network wirelessly which will enable the boards to post data at the API endpoint at either `https://www.inft3970.com` (Parked domain) or `https://inft3970.azurewebsites.net` (Currently functioning endpoint)

Requirements for the user to maintain a 2.4gHz enviroment will exist, as without this an expansion board or alternate boards will be required isntead of the proposed ESP8266 [4] and UNO3 [10].

2.5 User Requirements

The users of the system will need to be confident in browsing webpages and accessing them. Generally we recognise any device with browser functionality will suit the purpose, and development will use a mixture of Firefox [11] or Chromium [12] based browsers to find all possible bugs within the project span.
The lack of an adblocker or similar addons for the chosen browsing enviroment would be suggested also, third party javascript libraries are likely to be used and cannot be assured to function under such enviroments including modification or blocking of traffic/assets.

2.6 Development Requirements

A number of softwares will be required by the development team in order to complete the project, these softwares may include:

- SQL management studio to manage the database. Azure is using TSQL which can be managed by SQL management studio on the developers local machine.
- Visual studio to develop the front and back-ends of the web application.
- Visual Studio Code to develop elements of the front-end
- Arduino IDE software for editing/flashing the boards in C/C++.
-

3 Limitations

It is important to acknowledge the limitations of this project, given that this project is taking place in a compressed format it will primarily be an exploratory exercise in IOT sensor technology and its ability to interface with middleware frontend/backend and an SQL server implementation.

In order to managing expectations we are primary focused on heat,humidity and motion, this proof of concept implementation reduces the risk of under delivering on expectations.

The ESP8266 is limited to the 2.4gHz wireless spectrum, and therefore a number of modern wireless networks may prove incompatible with the device. This is only a small hinderence to the device as most modern networks will use both 2.4 and 5.1gHz spectrums. Furthermore the 2.4gHz spectrum is better suited to longer distance connections than the 5.1gHz range, and even in the most heavily congested of wireless areas it would be reasonable to expect the payload from the ESP would have no issues at a measly 200bytes on average.

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