

# UTILISING EDGE COMPUTING IN A 3-TIER SYSTEM BETWEEN CLIENT DEVICES AND A DATA CENTRE.

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## Project Description

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With the growing rise in popularity of Client Devices and Cloud Computing, it follows that there would be an increase in the strain placed on central servers to process a multitude of requests. The purpose of this project is to see how the implementation of Edge Computing can reduce the stress placed on these Data Centres and improve the performance of Client Devices.

*Edge computing provides a means to collect and process data at local computing devices rather than in the cloud or a remote data center.* – [Business Insider](#)

To address this problem, I will setup a 3-tier network that consists of a "Client Device", "Edge Node" and a "Data Centre". The Client Device will send data to an Edge Node that will process it and then send the processed data on to the Data Centre.

It will also be possible to host multiple Edge Computing solutions in the one environment as to ease the stress on multiple Data Centres while utilising a single Edge Node. This could mean dynamically adding solutions to pre-existing Edge Clusters as necessary and controlling access to resources.

A few likely candidates of applications for this technology are;

### - Voice Recognition

- Receiving a voice request from a Client Device
- Performing some voice to text processing on an Edge Node
- Infer information from the processed request on an Edge Node
- Sending the text and the inference to the Data Centre for storage

### - Deep Learning

- Receiving information from a Client Device
- Processing requests based on learning models and data sets on the Edge Node
- Sending the processed request on to the Data Centre

### - Processing many requests from Internet of Things (IOT) devices

- Receive requests from Client Devices
- Process request data to infer information on the Edge Node
- It will then be sent for storage in a Data Centre
- It can be queried at a later stage.

### - A Caching Technique

- Receive requests from Client Devices for web pages
- Handle this request on the Edge Device and store it for later retrieval

- There could be multiple requests received for a web page meaning that the web page should be cached so the request can be processed faster and returned to the Client Device from the Edge Node.

I hope to utilise a few of these candidates in this project to find out if Edge Computing is viable and useful to ease stress on central Data Centres.

I will also work out how to efficiently utilise these resources for an application that requires more computational demand than Client Devices can or should offer. We can measure these metrics by recording latency of requests between these devices, the computational stress on each node and the total cost of these systems including their potential re-usability and energy consumption.

## Goals and Requirements

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### Goals

The goal of my project is to design an Edge Computing infrastructure capable of servicing multiple Edge Computing applications aimed at reducing strain of Data Centres and improving performance of Client Nodes.

### Requirements

The most critical aspect of my project is the applications that run on the infrastructure but it is necessary to have the infrastructure in place to service these applications.

Requirements are as follows;

1. A user interface for the Client Node to allow interaction with the infrastructure and to display data to the user
2. A low latency connection between the Client and Edge Node
3. The requests from the Client to be pre-processed quickly in the Edge Node before being passed on to the Data Centre or returned to the Client
4. The implementation of a Data Centre application
5. The computational strain placed on the Data Centre should be lessened by the introduction of Edge Computing
6. The development of applications capable of performing Edge Computing tasks
7. The ability to run multiple applications on the same Edge Node to allow for extensibility
8. Applications easily deployed, controlled and updated

There are several research questions that I want to have an answer for or a better understanding of;

- To what extent does Edge Computing improve CPU load, memory bandwidth and latency of the Client and the Data Centre
- How do we do load balancing between the applications running on the Edge Device if it is placed under strain and runs out of available resources

# Hardware and Software

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## Hardware

The hardware that I will need will be;

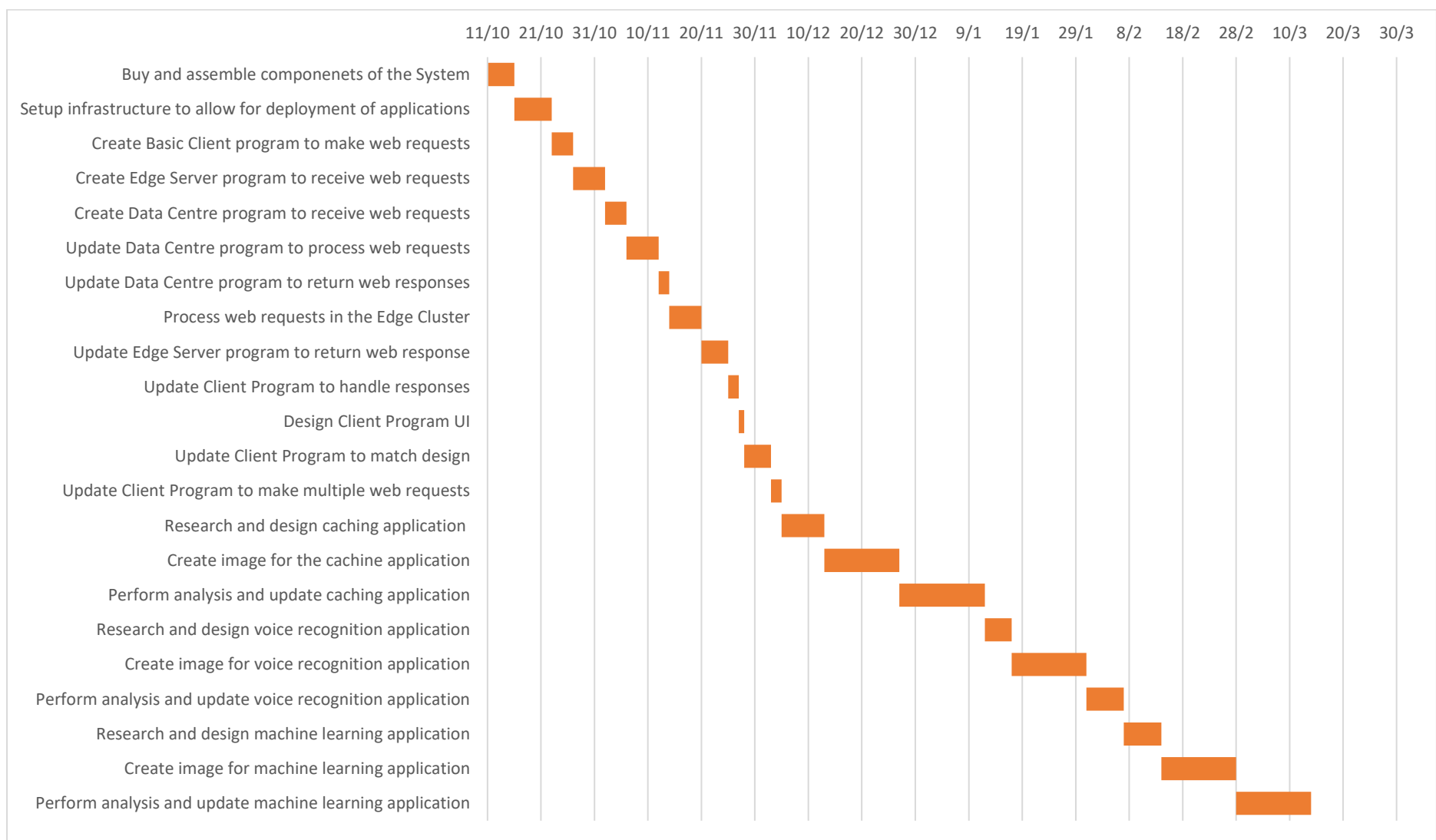
- The Client
  - o A low Powered Client in the form of a Raspberry Pi 3
- The Edge Node
  - o A cluster of small devices so they can be stored easily, I will use 3 Raspberry Pi 3's
- The Data Centre
  - o A laptop or desktop computer

## Software

The software I will need will be;

- An operating system for the Raspberry Pi's
  - o An option would be Raspbian as it is optimised for the Raspberry Pi hardware
- A framework to handle the Edge Computing applications
  - o An option would be Docker as it is developed to create an easy solution to software development and deployment
- Software/Framework to write code for the Client's user interface
  - o An option would be Electron as it allows the creation of native desktop applications using JavaScript and HTML while also having access to Node.js API's
  - o I can research and consider other solutions to creating a user interface
- An application that is best to receive requests on the Edge Node
  - o There is a multitude of server software available to use so I shall have to consider the best solution, some options are
    - Nginx
    - Apache
    - Lighttpd
- Software to write code for the Edge Node
  - o I will need to process requests for different applications so I can use Python or JavaScript/Web based languages/libraries and look to see if there are other solutions that I am unaware of
  - o I could also see if it is possible to create a solution using Java or a similar language
- I will need to implement a web server to act as the Data Centre
  - o I can consider the web server applications described above
  - o I can also consider .NET/C# solutions to see if these are better fitted while running on a windows environment

# Work Plan



## Major Milestones

- Getting Edge Computing infrastructure setup
- Getting Client user interface implemented
- Creating and deploying Edge Computing application
- Creating Data Centre application
- Calling Edge Service from Client
- Calling Data Centre from Edge Node
- Further developing Edge Computing Applications

## Deliverables

- Infrastructure to manage all the applications
- Client Application
- Edge Node Applications
- Data Centre Application

## References

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[Wired article about the move to Edge Computing](#)

[Business Insider Edge Computing in the IoT](#)

[Using docker with the Raspberry Pi](#)