Arduino vehicle anti-theft device Functional Specification

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1 Introduction

1.1 Overview

The AVAD is an arduino based device that aims to help a car owner prevent their car from being stolen or track it if it has been stolen. The AVAD will alert an owner of a car when their car is stolen so they can act instantly in recovering their car. The AVAD will then provide updates of the location, through SMS which would hopefully aid the owner in tracking their car down as quick as possible. The AVAD will use an arduino mega to control four different modules. They consist of a bluetooth module, a GPS module, a GSM module and an OBD II module.

The OBD II module will allow the arduino to connect to cars on-board computer. This will let the arduino check when the vehicle goes over fifteen kilometers per hour. When this happens the bluetooth module will check that the owner is in the car by connecting to their phone through bluetooth. If the owner is not in the car the arduino will send an SMS message using the GSM module to the owners phone. The message will contain a time and location of the car which will be acquired through the GPS module. The AVAD will continue to send periodic updates to the owners phone of the current location of the car.

1.2 Business Context

N/A

1.3 Glossary

Arduino - Computer
AVAD - Arduino vehicle anti-theft device
ECU - Engine control unit
GPS - Global positioning system
GSM - Global system for mobile communications
LED - Light emitting diode
OBD II - On-board diagnostics (Standardised computer port in a car)
SMS - Short message service

2 General Description

2.1 Product Functions

The main functions of the AVAD are as follows:

- Send SMS messages
- Read SMS messages
- Connect to a phone through bluetooth
- Determine how fast a car is moving
- Determine GPS coordinates

2.2 User Characteristics and Objectives

The AVAD will be aimed at anyone who owns a car and also uses a smartphone. While the device handles all of the functionality, the initial setup requires that the user follow multiple instructions. The lack of a screen may lead to a some confusion while setting up the device but the instructions will be easy to follow so repeating them will not be an issue if there is a failure in setting up the device.

Once the setup has been completed the device will operate by itself without any need for user input. The device will turn on once the car is started. When the car begins to move above fifteen kilometres per hour the device will then check if the users phone is in the car. If device establishes a connection to the user's phone, it will do nothing until the next time the car is started.

If the device does not establish a connection with the user's phone, the device will then use the GPS module to find its current coordinates and forward the coordinates through SMS to the users phone, alerting them that the car is driving while they are not present. The device will continue to send SMS messages to the user with up to date coordinates at set intervals until the car is turned off at which point the user will receive a final SMS message of its location. Alternatively, the user can stop the messages being sent by sending an SMS message to it.

2.3 Operational Scenarios

2.3.1 Setup

- Install sim card into device noting the sims number
- Plug device into OBDII port on vehicle
- A green LED turns on
- A text is then sent from the user to the device with a four digit pin created by the user
- A blue LED then turns on showing that the device is looking for devices
- The user connects their phone to the device through bluetooth and supplies the pin they created
- The device and phone are now linked

2.3.2 Adding additional bluetooth device

- A message containing the pin code followed by “setup” is sent to the device
- A blue LED turns on
- The user connects their phone to the device through bluetooth and supplies the pin they created
- The device and phone are now linked

2.3.3 Resetting Device

- A message containing the pin code followed by “reset” is sent to the device
- The device has then been reset

2.3.4 Car stolen

- The car starts travelling above ten kilometres per hour.
- The device checks if a user is in their car by trying to establish a connection to the user’s device.
- The device can’t establish a connection to the user’s device.
- The device sends a message to the users phone with the vehicles coordinates.
- This repeats at set intervals until the user silences the device or the device runs out of power.

2.3.5 Find Device

- A message containing the pin code followed by “find” is sent to the device
- The device sends a message to the users phone with the vehicles coordinates.

2.3.6 Silencing Device

- A message containing the pin code followed by “mute” is sent to the device
- The device stops sending alerts until the car is turned off and on again or the user sends a “find” message to the device

2.3.7 Loss of power to device/Device disconnected

- The device sends a message to the users phone with the vehicles coordinates.
- This repeats at set intervals until the user silences the device or the device runs out of power.

2.3.8 Loss of pin code

- A message containing the string “help” is sent from the user’s phone to the device.
- The device recognises this command and sends the pin code to the owner’s phone.

2.4 Constraints

2.4.1 Time

If a car is stolen the most important factor is time. If a car owner is notified as quick as possible it allows the owner to begin working straight away to recover the car. Therefore time is a very important factor in this project and the time between a car being stolen and the device alerting the owner must be as small as possible.

2.4.2 Cost

Operating a sim card for the device can be costly. As a result it is imperative to keep the SMS messages sent to a minimum and pack all of the information into as few messages as possible.

2.4.3 Power

The device needs power to monitor the car and send SMS messages. While the device uses the OBDII port as a power source, there will be a backup power device in the event that the device is unplugged without prior knowledge of the owner. In this event the device will alert the owner to the device being unplugged.

2.4.4 Signal

The ability of the AVAD to send and receive SMS messages relies on the availability of a network signal. To ensure that the device receives the best possible signal an external aerial will be used that should be place in a position to receive a good signal. Similarly the users phone must have a network signal to send and receive SMS messages.

2.4.5 Inaccessibility

While the OBDII port isn't a commonly used port, it is necessary to ensure that it is difficult to stop the AVAD from performing its function. As a result the sim card will be secured beneath a screwed down surface that will allow the device time to send a message to the owner before the sim card can be removed.

3 Functional Requirements

3.1 Send/Receive messages

Description - The AVAD uses a mobile phone providers network to send and receive messages. Thus, a sim card is necessary to provide a connection to the network.

Criticality - It is the most critical part of the device. Without a connection to the mobile network the device cannot send or receive messages and therefore won't be able to alert an owner to a stolen vehicle.

Technical issues - Requires the arduino to interface correctly with the GSM module to send/receive messages while receiving signal through a GSM antenna.

Dependencies - The ability to send and receive messages relies on an active sim card with a constant connection to the network.

3.2 Bluetooth connectivity

Description - The AVAD determines whether a user is in a vehicle by connecting to the users phone.

Criticality - It is very critical as it is the bluetooth connection which will determine whether or not the car has been stolen or not.

Technical issues - Requires the arduino to interface correctly with the bluetooth module.

Dependencies - The ability of the bluetooth module to correctly determine whether a vehicle has been stolen relies on the user's bluetooth being turned on while they are in their car.

3.3 Acquiring GPS location

Description - In order to help an owner to find their car after it has been stolen it is necessary to have an accurate GPS location of the vehicle.
Criticality - The accuracy of the GPS location is very critical as it will determine whether a user will be able to relocate their vehicle after it has been stolen.

Technical issues - The arduino must interface correctly with the GPS module.

Dependencies - It requires that a GPS antenna be placed in clear view of the sky in order to have a good signal.

3.4 Reading car speed

Description - In order to determine when the vehicle starts to travel at a speed above ten kilometres per hour, the arduino connects to the vehicle's OBDII port to extract the information from the vehicles computer.

Criticality - Determining the speed of the vehicle is very critical as the ECU initiates the entire process to perform the check to see whether the owner is in the car.

Technical issues - The arduino must be able to interface correctly with the OBDII port in order to extract the information necessary to determine the vehicles speed.

Dependencies - The arduino requires a cable to connect the OBDII module to the vehicle’s OBDII port.

3.5 Interpret text commands

Description - The arduino must be able to recognise commands and pin codes from SMS messages.

Criticality - This process is very critical as it enables the user to setup the device, find the current location of the vehicle or silence the device.

Technical issues - The arduino must accept all command strings regardless of case and match as many variances as possible. This is necessary in order to allow for error. This in turn will enable users who do not have a great knowledge of technology to use the AVAD successfully.

Dependencies - The ability to retrieve the commands relies on pattern matching code to recognise any possible command. It also relies on the arduino being able to retrieve SMS messages.

3.6 Update the user instantly

Description - The arduino should be able to send SMS messages very quickly.

Criticality - This process is not very critical as it will still function but not at optimum levels. It is important though as it can be very useful in increasing the chances of recovering the vehicle.

Technical issues - The code must be as efficient as possible in order to reduce the time taken to send an SMS message.

Dependencies - This process depends on the GSM module having a mobile network signal and being able to utilise it efficiently.

4 System Architecture

The numbers in the following diagrams are labels with definitions set out below:
1 - Arduino Mega
2 - GPS module
3 - GSM module
4 - Bluetooth module
5 - OBDII module

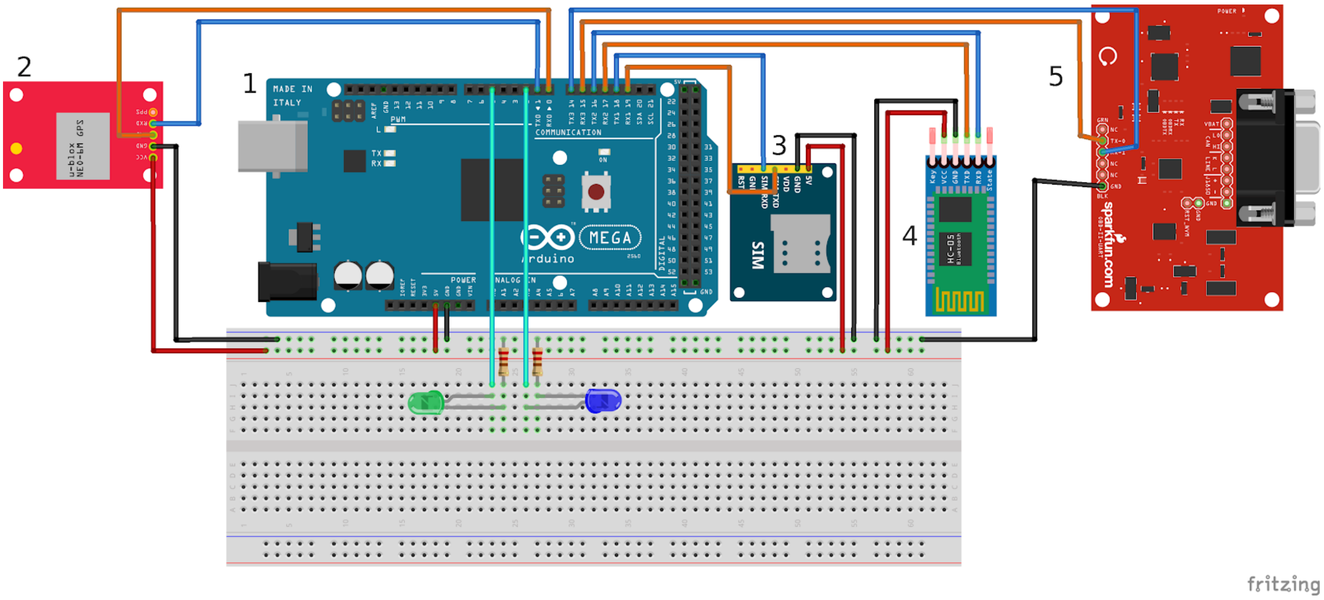

Fig 4.1 - Fritzing arduino diagram showing how all of the modules attach to the arduino mega board.

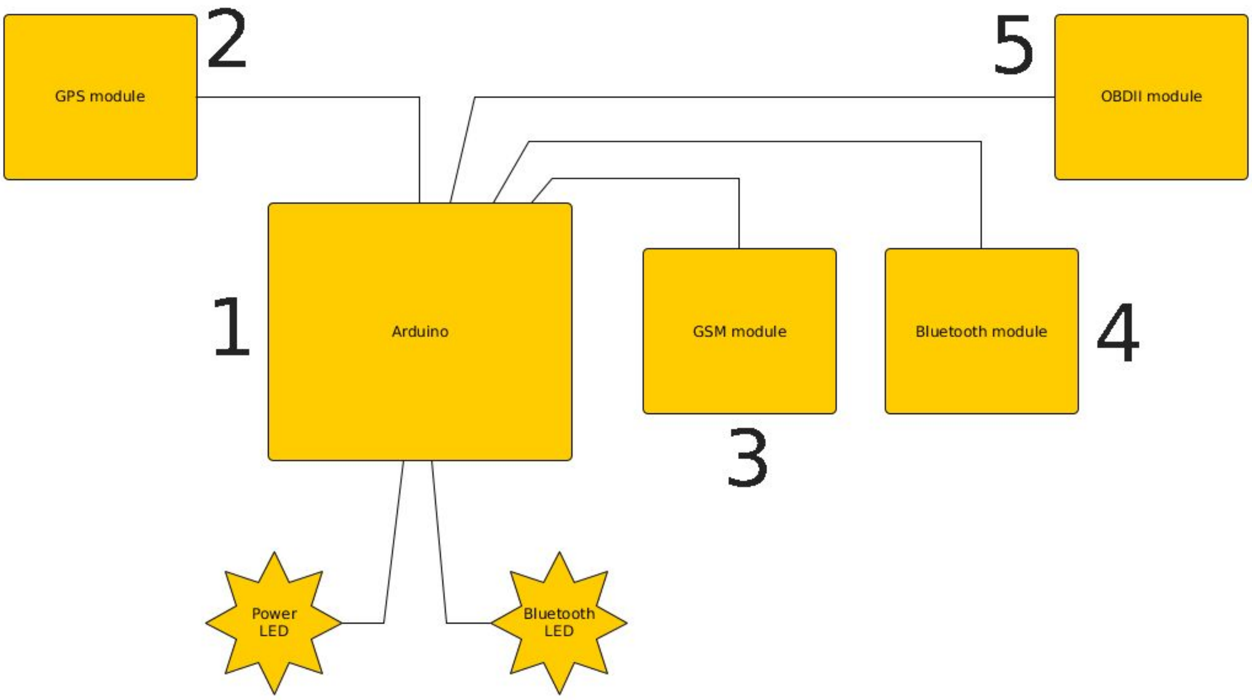

Fig 4.2 - A basic diagram showing the arduino and the modules and LEDs that connect to it.

5 High-Level Design

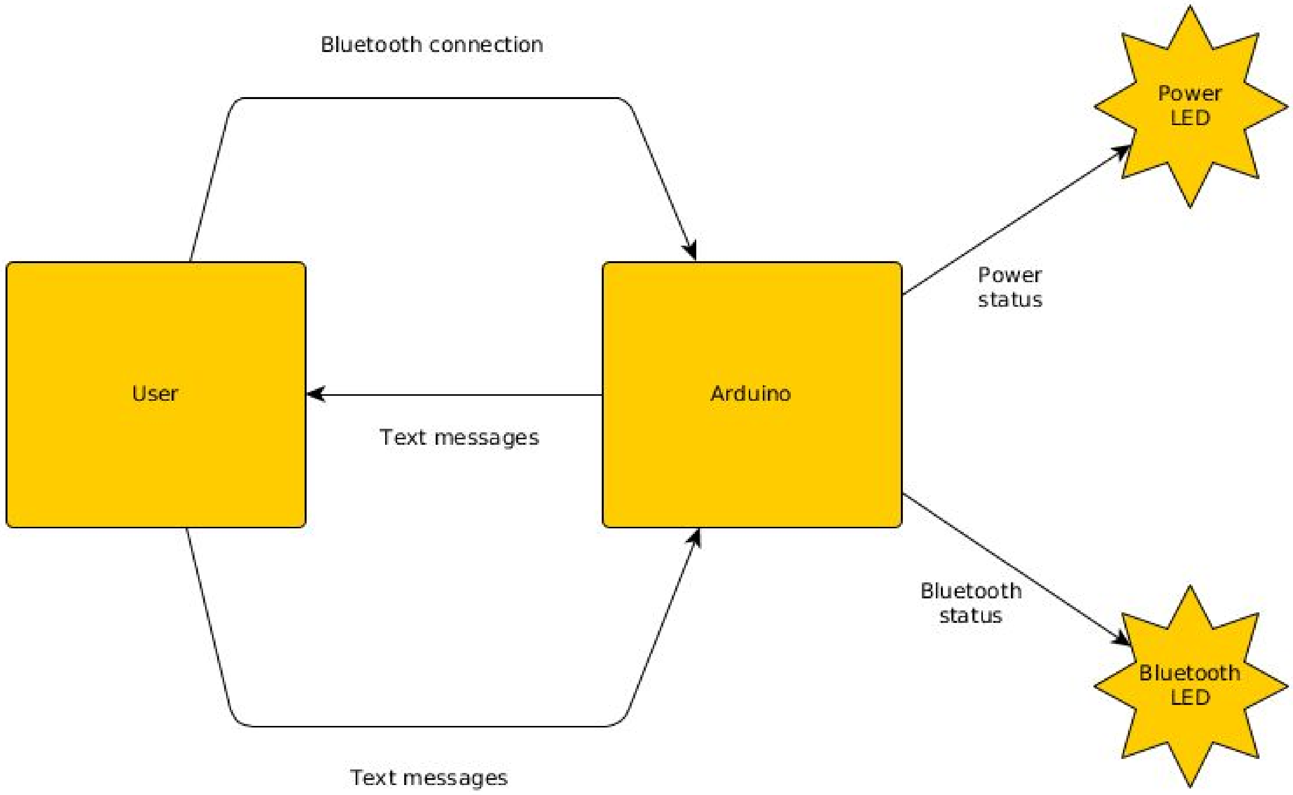

Fig 5.1 - High level context diagram showing the relationship between the user and the various components of the system. The various inputs and outputs between the system and the entities are shown here.

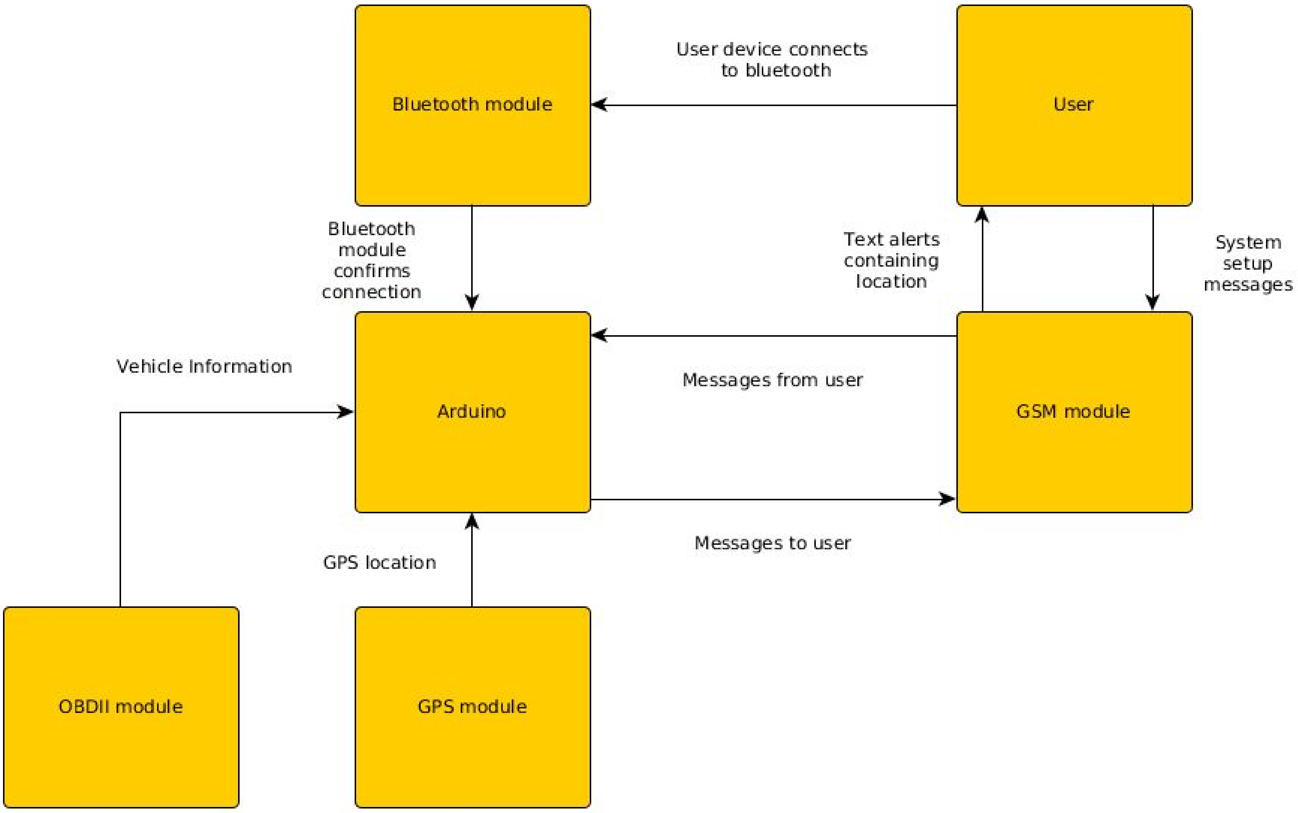

Fig 5.2 - High level data flow diagram showing the flow of data between the system and the user.

6 Preliminary Schedule

For this project I will have to acquire multiple pieces of hardware. All of the hardware required is shown in fig.4.1. Once the hardware has been acquired I will begin writing the code for this project. I will be using C++ in the Eclipse environment to write the code for the AVAD. The code will then be pushed from a computer to the arduino which will then run the code.

Fig 6.1 - A gaant chart showing the schedule for this project. The chart is located on the next page.

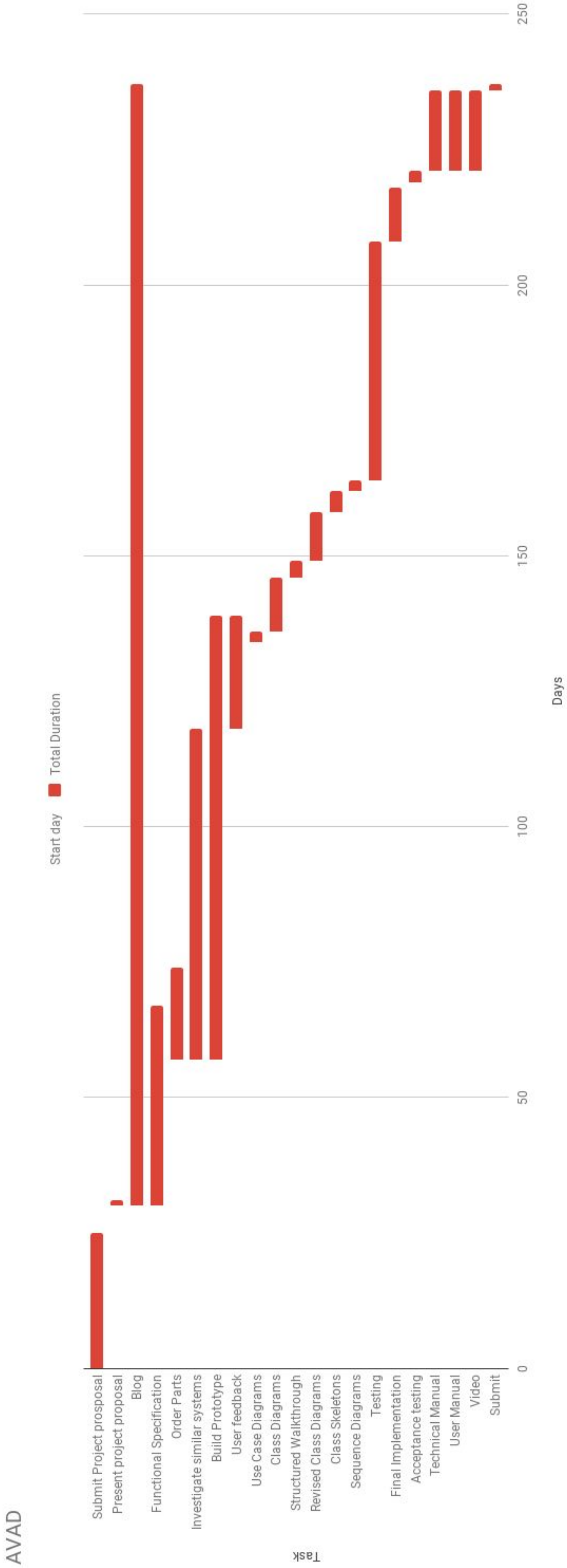
AVAD
Start day
Total Duration
Task
Submit Project prosposal
Present project proposal
Blog
Functional Specification
Order Parts
Investigate similar systems
Build Prototype
User feedback
Use Case Diagrams
Class Diagrams
Structured Walkthrough
Revised Class Diagrams
Class Skeletons
Sequence Diagrams
Testing
Final Implementation
Acceptance testing
Technical Manual
User Manual
Video
Submit
0
50
100
150
200
250
Days

fig 6.1

7 Appendices

- http://www.obdii.com/background.html - Information relating to the OBDII port and how it works.
- https://www.arduino.cc/en/Guide/Introduction - Information regarding arduinos.