# ID620 Embedded Systems

## Final Project

## Learning Outcomes Covered

1. Make decisions about appropriate architectures, components, performance metrics, and program design when faced with a specific application development task
2. Analyse the problem parameters of an embedded computing situation
3. Select the appropriate hardware for an embedded computing situation
4. Implement a simple representative embedded system.

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| --- | --- |
| Marks: | 40 marks (50% of your final mark for the paper) |
| Issued: | Week 13 |
| Due: | Week 16 |

This is your final project. We have three weeks of class time allocated to this, plus whatever time outside of class you wish to spend. **As this is our last project, there can be no extensions or late submissions.**

## Your Project

You can choose the topic of your final project. This can be something new, something from the internet (see the proviso at the bottom), or you could extend something you have already done (Another project or even a kit task from the Sparkfun workbook)

Scope needs to be “significant”. This is tricky to define exactly – this project needs to feel bigger than your last one - at least at the level of the final task in the Sparkfun labbook (The robot.) Some suggestions:

* Building on your previous sensor project
* Increasing the level of technical complexity
* Increasing the physical size of the project
* Increasing the size of the problem you are trying to resolve
* Learning and implementation in a new technical area

**Internet Projects – for this assignment, ideas found on the internet can be used as an inspiration. HOWEVER your project should not be you just following someone else’s instructions and only that. Your own version of such projects should show significant extension or customisation. You need to own this.**

**You MUST talk to me about your project idea and get my sign-off on the scope and content BEFORE you start.**

## Specialist Hardware

You should aim to be able to build your project from the parts in your kit, anything you have purchased for yourself, plus whatever extras I have at hand. Because of time and budget constraints, I’ll only consider ordering parts in stock from physical stores in New Zealand.

## Timeline for Project

|  |  |
| --- | --- |
| Week 13 | Assignment issued. Project Ideas to be approved by Vaughn. Hardware purchase requirements sent to Vaughn by FRIDAY. |
| Week 14 | Project Work |
| Week 15 | Project Work |
| Week 16 | Presentation and grading in class |

## Project Requirements

Your project must meet the following requirements:

**Good Code Practice**: Make sure your code is **formatted neatly**, and makes use of **tabs** and **whitespace**. Ensure **comments are used where appropriate**, but you don’t need to go crazy where it’s obvious what your code is doing. As much as possible, **implement your code using Methods**. This avoids overloading Loop() with a lot of spaghetti that can be hard to follow. Loop() should only contain enough logic for program flow.

Your project **must implement at least two** of the following:

* External Interrupts
* Custom library
* Watchdog Timer
* Coded as a State Machine
* Custom software that monitors output from your Arduino via the USB/virtual COM port (Serial monitor) or sends commands to the Arduino via the USB.
* Soldering and creating a circuit on a circuit board.
* ~~Your own 3D design and printing~~

Your final deliverables will consist of:

1. Hardware prototype (Video evidence or a practical demonstration)
2. Software.
3. A breadboard layout with optional circuit diagram.
4. Narrative

## Project Breakdown and Deliverables

* **Make sure you project ideas has been approved by Vaughn.**
* **Make sure you have sent request for hardware purchases to Vaughn by the end of Week 13 (The week the assessment is issued) Include URL and details of New Zealand Supplier.**
* **Your project should consist of the following components:**

1. **Hardware prototype** 
   1. You must have created a working project on a breadboard and/or soldered circuit
      1. Video or physical evidence of functioning hardware is presented.
2. **Arduino Sketch**
   1. Arduino sketch.
      1. Code is formatted neatly, tabs and whitespace
      2. Comments are used where appropriate
      3. Methods are correctly implemented (No overloading of Loop() with spaghetti).
3. **Diagrams** (Breadboard or Circuit diagram)
   1. Choose to show **one** of the following:
      1. Diagram of your breadboard layout
         1. Colour is used to differentiate wire by function (power, ground, data, etc)
      2. Circuit diagram
         1. Components are laid out and should be logically associated with each other.
4. **Narrative** – your narrative can be done as a fully narrated video, or demonstration of your working project. You will need **supporting written material** (PDF or powerpoint, etc) for either format. Make sure you explain the following:
   1. Explain **how you came to design** your project in the way it has turned out
   2. Tell me about your **analysis of potential problems, scope, other issues** and how this informed the build of your project
   3. **Justify** how your **hardware choices** fulfil the **requirements of the analysis**
   4. Any **insight of discoveries you made**, compromises, etc, that appeared as a result of building your project

* **All deliverables uploaded to Moodle or linked to your Git repo.**

## Marking Rubric

*As per Academic Policy AP0903.06*

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| --- | --- | --- | --- | --- | --- | --- |
|  | *Pass* | | | *Fail* | |  |
| ***Marks allocated 🡪*** | ***10, 9*** | ***8, 7*** | ***6, 5*** | ***4, 3*** | ***2, 1*** |  |
|  | ***Worthy of top marks.*** | ***An honest attempt to be better than average*** | ***Enough for a pass*** | ***Struggling.*** | ***Insufficient to award a result*** | ***weighting*** |
| ***Hardware Prototype*** | *Hardware layout is superb*  *Physical design (if relevant) supports all functionality*  *Excellent cable management.*  *Soldering and circuit design (if present) is to a high standard* | *Hardware layout tidy*  *Physical design (if relevant) supports most functionality*  *Good cable management.*  *Soldering and circuit design (if present) is to a good standard* | *Hardware layout basically tidy*  *Physical design (if relevant) basically supports functionality*  *No cable management, but tidyish*  *Soldering and circuit design (if present) is basically presentable* | *Hardware layout messy*  *Physical design (if relevant) barely supports functionality*  *No cable management, messy!*  *Soldering and circuit design (if present) is poor* | *No hardware prototype* | ***25%*** |
| ***Arduino Sketch*** | *Code is formatted perfectly, tabs and whitespace*  *Comments are used where appropriate,*  *descriptive and useful.*  *Methods are correctly implemented (No overloading of Loop() with spaghetti).*  *Code is excellent, implements all features, allows for extensibility, etc.* | *Code is formatted neatly, tabs and whitespace*  *Comments are used where appropriate*  *Methods are mostly implemented (some code left in loop()).*  *Code is good, implements all features* | *Code is formatted, but inconsistently Code commenting, or comments are too brief or cryptic*  *Methods partially used – still code left in loop()*  *Code is ok, and implements most features* | *Code is poorly formatted. Few comments. No methods, spaghetti in loop()  Code is buggy and does implements minimal features* | *No code, or so poorly written as to implement very little functionality* | ***25%*** |
| ***Requirements met*** | *At least two requirements from list are implemented superbly* | *At least two requirements from list are implemented well* | *At least two requirements from list are minimally implemented* | *One or less requirements from list are implemented* | *No requirements from list are implemented* | ***25%*** |
| ***Narrative*** | *Problem is analysed  (narrative describes and supports* ***full depth of analysis****)  Project design is discussed  (Project design is clearly linked to analysis of problem and* ***represents a best solution****. Pros and cons are discussed)  Hardware choices are implemented  (hardware choices support the design. The hardware solution* ***implements the best solutions*** *and meets* ***all requirements*** *of the problem  Insights  (As part of the problem solving/building process insights should have been encountered. These are* ***fully discussed and justified*** *in terms of inclusion into (or rejection from) the final project)*  *Diagram of circuit – perfect in all details.* | *Problem is analysed  (narrative describes and supports* ***reasonable depth of analysis)*** *Project design is discussed  (Project design is clearly linked to analysis of problem and* ***represents a reasonable solution****. Pros and cons are discussed)  Hardware choices are implemented  (hardware choices support the design. The hardware solution* ***implements most of the solutions*** *and meets* ***most of the requirements*** *of the problem  Insights  (As part of the problem solving/building process insights should have been encountered.* ***These are reasonably discussed***  *Diagram of circuit – logical, but slightly untidy* | *Problem is analysed  (narrative describes and supports* ***modest analysis****)  Project design is discussed  (Project design is linked to analysis of problem and represents a* ***possible solution but maybe not the best****. Pros and cons are* ***mentioned in passing****!  Hardware choices are implemented  (hardware choices* ***mostly support the design.*** *The hardware solution* ***implements some of the solutions*** *and* ***meets some of the requirements*** *of the problem  Insights  (As part of the problem solving/building process insights should have been encountered.* ***These are discussed briefly****)*  *Diagram of circuit – logical but messy* | *Problem is analysed  (narrative* ***poorly describes*** *and has* ***little depth*** *of analysis)  Project design is discussed  (Project design is* ***NOT clearly linked*** *to analysis of problem.* ***Solution is random*** *or just copied with no explanation)  Hardware choices are implemented  (hardware choices does not support the design. The hardware solution poorly implement the solutions and does not meets the requirements of the problem  Insights  (****No insights****, or only facile coverage) No Diagram of circuit, or diagram is nonsensical* | *none or insufficient to honestly award a mark* | ***25%*** |