University of York

Second Year Project

Embedded Systems Project Written Report

Author:
Douglas Parsons

Supervisor:
Dr. M.J. Freeman

March 30, 2015

Contents

Chapter 1

Introduction

1.1 Summary of project work

The Second Year Embedded Systems Project was a ten week project, undertaken for the duration of Spring Term 2014-2015. The project was a primarily a group task, completed in groups consisting of four members. However, there was also the capability for individual extensions to the main body of the project, allowing each member to showcase competency and creativity.

The group project involved programming an ARM LPC1768 'MBED' microcontroller, situated on top of a board of peripheral accessories, in order to generate and play music on a user selectable channel corresponding to data being sent down a Controlled Area Network bus (CAN bus). The individual component was not specified, and was instead left up to each individual to decide on an extension project, research, and implement it.

The groups solution was very complete, not only matching the full spec, but also extending the implementation to a high degree, producing a user friendly, good sounding end product. My individual extension provided a more user friendly interface than the rudimentary keypad attached to the MBED board through the implementation of a shell type interface, allowing the user to input commands, and adjust settings though the use of the computer keyboard and monitor.

1.2 Experiences as a team

The capability to work successfully as a group was imperative to the triumph of the project. Throughout the ten week period, we held regular group meetings, allowing us to keep track of each person's development, and had strong levels of feedback on each individuals contributions to the group solution through regular code reviewing sessions, this enabled us to remain productive continually, and allowed continual flexibility to match each individuals talents . Each member of the group had a strong drive to provide a high quality finished product, and eagerness to develop their personal skills. This resulted in a large amount of time being spent in the labs outside of the scheduled practicals, enabling us as a group to progress much further than we otherwise might have done. Overall I feel we worked very well together, and the exercise served as a valuable insight into a fluent working environment as a team.

1.3 Expectations and actual outcomes

At the beginning of the ten week period it was very difficult to predict what would be possible to achieve. This difficulty arises from inexperience with programming embedded systems, and an uncertainty regarding the limitations of the LPC1768 board the project used. However, it was expected that during the course of the ten weeks my group would be capable of meeting the specifications of the project, as well as implementing our individual solutions. Certain aspects of the project took longer than initial expectations would have suggested, for example, it took a significant portion of time to implement the various different user control methods present in our final solution. Overall, our time management skills worked out very well though, and our completed solution lives up to the expectations of the group.

1.4 What is in the report

This report sets out to provide a description of our team solution to the set assignment, as well as highlighting areas of individual contribution throughout. The report will begin with a technical description of the set problem, including a discussion of requirements and technical challenges that may be faced in the meeting of these requirements. Following a description of the problem, the group solution will be discussed. The discussion will highlight how each section of the requirements has been met by the implemented solution, as well as detailing how the problem has been broken down for each individual member, presenting each members implementation and technical innovation. After a discussion of the group's solution, the appropriate testing strategies and methods that were used throughout the project will be examined in detail, providing feedback on how they have proved useful, and incorporating a discussion on a professional/social/ethical/environmental aspect of the solution. The report will then focus critically on my individual implementation, detailing the technical innovation, implementation, and testing undergone for my contribution. Finally the report will conclude with a reflective summary of work undertaken, considering which aspects of the project went smoothly, which areas did not go as smoothly, how this might be improved in future, and what lessons can be taken away from the completion of the project.

Chapter 2

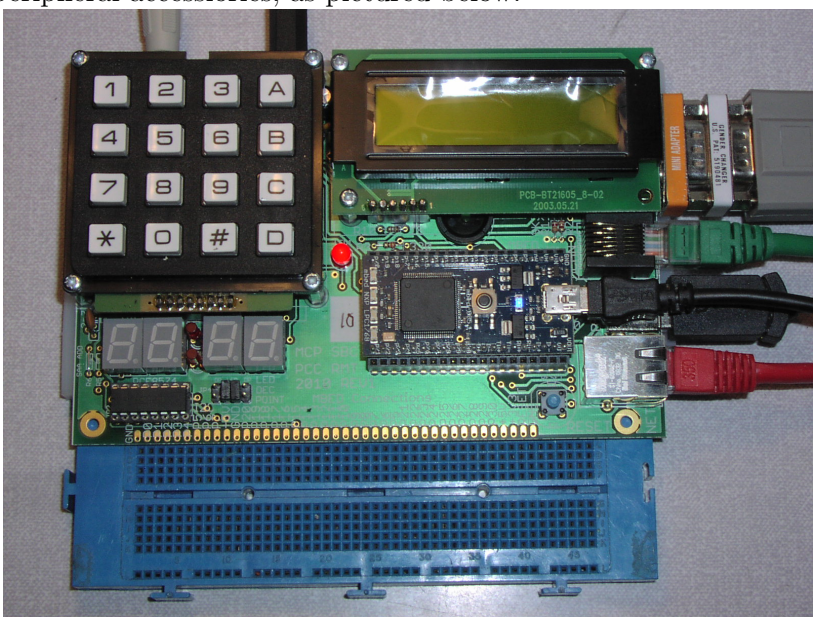
Technical Description of Problem

2.1 Description of Problem and Requirements

The Embedded Systems Project consisted of two main sections: a group solution to a predetermined problem, and an individual extension to the group's work, left up to each person to determine. Both sections of the project involved embedded systems software development in the C programming language.

The target platform of the development is an ARM-based microcontroller, situated on a board of peripheral accessories. The microcontroller consists of an interface board coupled with the ARM cortex-M3 based LPC1768, providing easy interaction via USB cable to transfer binaries, and simplifying the process of serial communication [how-mbed-works].

- Description of Peripheral Accessories. The mbed board is sat on a board of peripheral accessiories, as pictured below.



- Description of Group Task.
- Requirements for the group task.

2.2 Discussion of Technical Aspects and Challenges

- Technical aspect 1 - CAN Bus
    - Technical aspect 2 - Syth code
    - Technical aspect 3 - User interfacing
    - Technical aspect 4 - ??

Chapter 3

Description and Discussion of Team-based Solution

3.1 Description of the Team Solution

3.2 How the problem was broken down for individual members

3.3 Technical innovation and implementation of each member

Chapter 4

Evaluation and Testing of Team-based Solution

4.1 Description of the Team's Testing Strategy

4.2 Results of Testing Strategy and How Well This Met the Requirements

4.3 Section relating to a professional/social/ethical/environmental aspect of our solution

Chapter 5

Description, Discussion, Testing and Evaluation of Individual Component

5.1 Description of Individual Component Solution

5.2 Discussion of Technical Innovation and Implementation

5.3 Testing Strategy, and the Results

Chapter 6

Summary and Conclusions

6.1 Reflective Summary of Team Work

6.2 Reflective Summary of Individual Work

6.3 What went well

6.4 What went poorly

6.5 What could have been improved

6.6 Lessons Learned

Appendix A

Specified Documents

A.1 Meeting minutes

A.2 Evidence of Preparation