FACULTY OF INFORMATION TECHNOLOGY CTU IN PRAGUE

Supervisor's statement of a final thesis

Supervisor:	Ing. Jiří Hušák
Student:	Bc. Jitka Seménková
Thesis title:	Robust flash memory bootloader for a microcontroller over near field communication
Branch / specialization:	Design and Programming of Embedded Systems
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Evaluation criteria

1. Fulfillment of the assignment

▶ [1] **assignment fulfilled**
[2] assignment fulfilled with minor objections
[3] assignment fulfilled with major objections
[4] assignment not fulfilled

The thesis assignment has been fulfilled. Jitka has done all the job required defined before the thesis work started. The work has been defined with a high focus on possible industrialization in real industry driven project. Some theoretical research of NFC basics and bootloader principles fundamentals has been done. On top Jitka created an example of Android application to be able to test the solution.
Regarding the testing, this part has been accomplished as much as possible – the testing was done in automated way with focus on robustness. Some aspects were not achieved mainly due to missing HW provided (no MCU to measure real power consumption) by the company or buggy implementation of the FPGA MCU bitstream.
Even though any market research was not part of written instruction of the Thesis, in future we may search for most suitable HW for a specific final application. This mainly covers NFC IC where we could probably find NFC tag with higher transfer speed.

2. Main written part   90 / 100 (A)

The written part gives a good insight into used technologies (NFC, bootloader, flash memory drivers). It shows well correct level of details of the implemented parts. The block and time diagrams show well the main implementation issues and the principal solution.
What I appreciated mostly is the design part, where the SW architecture is presented. The design was created with focus on reusability even over different protocol than NFC. Even though this constraint was presented during the implementation it has been accepted by Jitka and considered in the design.

3. Non-written part, attachments   95 /100 (A)

There is the watch code and android app code as attachment. The watch code was written in C and was created keeping in mind the future integration within real consumer electronics product, a watch. The code was written properly keeping in mind very limited HW resources of used MCU. What is not visible from the Thesis and the code itself is the necessity to be integrated into real MCU framework already developed inside the company. This brought a lot of work to Jitka where she had to deal with industrial SW development workflow which is far more complex than standard thesis code development.
The Android app attached was written only as a helper code, which will not be used in real life application. Therefore, the code quality has not been checked that carefully.

4. Evaluation of results, publication outputs and awards   90 /100 (A)

All the results of this thesis will be used in real industry application. During the lifetime of the project the business owner in the company decided to change the architecture of the end application, in particular the NFC interface was changed to SPI one. Thanks to modular layer design big part of the work can be easily reused. Nevertheless the NFC product can be achieved in the future as well.
The Android app was developed only as example and helper for future use, but gives an estimation of future efforts to develop the real phone application. The watch C code developed can be reused as is.
The thesis gave already good insight about the robustness of the used NFC IC in real communication environment, need of using error checking mechanism. What is missing for full qualification however is test with wider range of phones and final antenna RF specification.
Security of the communication was not really considered in this thesis, but even in final application, we don't expect much work here as NFC is really near field so any kind of MITM attacks are highly improbable.

5. Activity of the student

▶ [1] **excellent activity**
  [2] very good activity
  [3] average activity
  [4] weaker, but still sufficient activity
  [5] insufficient activity

Jitka showed a great ability to work independently, especially during the Covid times, when any personal contact and guidance was difficult. She was able work on two different platforms (embedded C in resource limited environment and Android app development). As the code was developed for future industry usage in real consumer electronics, Jitka had to learn and use the internal company coding standards and code integration process. In general she was able to implement and test all the thesis assignment, she created herself testing methodology and followed it.
The cooperation with Jitka was always smooth and she reacted promptly on any specific request.

6. Self-reliance of the student

▸ [1] **excellent self-reliance**
  [2] very good self-reliance
  [3] average self-reliance
  [4] weaker, but still sufficient self-reliance
  [5] insufficient self-reliance

I would especially like to highlight all the hours spent by debugging with immature development environment, which was provided. The MCU and its FW and tooling support was not in production quality at the time of development. The MCU was available only as a form of FPGA emulator with unstable bitstream.

The overall evaluation   90 /100 (A)

The overall thesis work and practical implementation fulfilled the given assignment. Jitka has made a good theoretical introduction; she studied the existing HW / SW given as a base by the company and then she developed a watch and phone application code which was thoroughly tested.

Instructions

Fulfillment of the assignment

Assess whether the submitted FT defines the objectives sufficiently and in line with the assignment; whether the objectives are formulated correctly and fulfilled sufficiently. In the comment, specify the points of the assignment that have not been met, assess the severity, impact, and, if appropriate, also the cause of the deficiencies. If the assignment differs substantially from the standards for the FT or if the student has developed the FT beyond the assignment, describe the way it got reflected on the quality of the assignment's fulfilment and the way it affected your final evaluation.

Main written part

Evaluate whether the extent of the FT is adequate to its content and scope: are all the parts of the FT contentful and necessary? Next, consider whether the submitted FT is actually correct – are there factual errors or inaccuracies?

Evaluate the logical structure of the FT, the thematic flow between chapters and whether the text is comprehensible to the reader. Assess whether the formal notations in the FT are used correctly. Assess the typographic and language aspects of the FT, follow the Dean's Directive No. 52/2021, Art. 3.

Evaluate whether the relevant sources are properly used, quoted and cited. Verify that all quotes are properly distinguished from the results achieved in the FT, thus, that the citation ethics has not been violated and that the citations are complete and in accordance with citation practices and standards. Finally, evaluate whether the software and other copyrighted works have been used in accordance with their license terms.

Non-written part, attachments

Depending on the nature of the FT, comment on the non-written part of the thesis. For example: SW work – the overall quality of the program. Is the technology used (from the development to deployment) suitable and adequate? HW – functional sample. Evaluate the technology and tools used. Research and experimental work – repeatability of the experiment.

Evaluation of results, publication outputs and awards

Depending on the nature of the thesis, estimate whether the thesis results could be deployed in practice; alternatively, evaluate whether the results of the FT extend the already published/known results or whether they bring in completely new findings.

Activity of the student

From your experience with the course of the work on the thesis and its outcome, review the student's activity while working on the thesis, his/her punctuality when meeting the deadlines and whether he/she consulted you as he/she went along and also, whether he/she was well prepared for these consultations.

Self-reliance of the student

From your experience with the course of the work on the thesis and its outcome, assess the student's ability to develop independent creative work.

The overall evaluation

Summarize which of the aspects of the FT affected your grading process the most. The overall grade does not need to be an arithmetic mean (or other value) calculated from the evaluation in the previous criteria. Generally, a well-fulfilled assignment is assessed by grade A.