Electronics II 2016 – final project instructions

General:

Your task is to design and implement an electric dice, an electric lock for a safe, a heart rate monitor, an electronic Braille translator, a Morse-coder/decoder or a project of your own choosing. The lecturer and the assistants define the requirements for each project. The final project will be implemented using an Arduino micro-controller (you may also use an AVR ATMEGA, a cheaper component that is slightly more challenging to work with). Design and implementation of electronics and software is also part of the project. The project is done in groups of 2-3 persons. In each group there is one contact person that communicates towards the assistant. The first step is to create a first version of a project plan (content defined later in the instructions). The progress is monitored with weekly reports that are sent to the assistant. At the end of the course, a final report and a functioning product are presented. The building of the product is only a part of the project. An equally important part is the documentation and preparation of marketing material. Because of this, the time used for the project is documented and attached in the final report.
Example: 10.3.2014 15:00-16:30: Testing of LCD, Timo Rauhala.
The groups should be formed and reported to the project manager by the end of January.

Platform:

The final projects are built at the facilities of the electronics research laboratory. There is room (location announced later) reserved for the building and programming and storing the electronics. The lab will provide each group with one Arduino Uno micro-controller board. The micro-controller is programmed with the Arduino IDE freely available on the Internet. (If you choose to works with the ARV you will need a different set of programming electronics and software.)

Reports

Plan 1

In total 2 project plans are submitted. Deadline for Plan 1 is on 14.2. at 23:59. The plan must contain the following information:

- Preliminary plan of implementation and testing (schematic and block diagram)
- Partial goals and Gantt-chart
- Required resources
    - Time needed for each task and total work amount
    - Estimated cost of components

Plan 2

Deadline for Plan 2 is on 14.3. at 23:59.

- Updated version of Plan 1
    - Final solution for implementation
    - Re-evaluation of the partial goals
    - Re-evaluation of the resources
- Plan for test procedures
    - Which parts of the final board should be tested
    - How the tests are conducted
    - How to ensure the results
    - Testing must ensure that the required functions are properly implemented
- Preliminary outline for technical documentation and marketing material

The assistant evaluates the plan and if necessary requests corrections. The final product must not strictly follow the plans, but the plans should be followed in rough. Small changes are allowed if they don't alter the principal solution and they should be reported in the weekly reports.

Component order

A list of component needed for the project must be submitted by 21.3. All components must be available and in stock at Mouser Electronics. The list must state each component's:

- Product code
- Product name
- Quantity
- Price + Total price

The budget for the project is 50€ (Remember, 3D-printing can save you a lot of money.)

Weekly reports

A weekly report is sent to the assistant according to the deadline schedule. Failure to submit the report will result in a failed course. The report should in a brief way contain:

- Current progress and status of the project
- Possible changes to the plan
- Time used during the week for project
    - Gantt-chart must be updated if needed
    - Cumulative graph of work hours

If no progress is made during the week, the weekly report should state this.

Final report

The final report must be submitted by 12.5. at 23:59.

The final report must contain:

- A working product
- The idea for implementation
- The properties the product has
- How much time was spent on the project
- The budget (estimated and realized)
- Test results which confirm functionality
- Possible changes to plans 1 and 2
- Instruction manual
- Sales/Marketing brochure

Schedule

14.2. Plan 1

21.2. Weekly report

28.2. Weekly report

14.3. Plan 2

21.3. Weekly report + component list

28.3. Weekly report

4.4. Weekly report

11.4. Weekly report

18.4. Weekly report

2.5. Weekly report

9.5. Weekly report

13.5 @ 12.00 Final report and presentation of the final product

Building phases:

- Schematics must be planned on paper and it must be confirmed that the working principle is correct. The assistant accepts the plan, component list and the case. The components are ordered simultaneously for all groups (see component order).
- The schematics are drawn with Eagle CAD (EAGLE Light available for free).
- For the Arduino users, the microcontroller is programmed with the Arduino IDE

- For AVR users, the microcontroller is programmed and simulated with AVR Studio and testing of wiring and software with prototyping board (STK500)
- Designing and manufacturing a circuit board
- Making an enclosure for the circuit board
- Product assembly for testing purposes
- Product testing and debugging

Topics:

Electronic dice:

Randomly displays a number from set of numbers when a switch is pressed.

Required characteristics:

- The user can not affect the outcome (example: pressing of button a certain time always
- gives same result)
- Testing should ensure that the output really is random
- Testing should consist of at least 500 “throws”
- The test report should contain at least a histogram, average, standard deviation and correlation of the test data

Optional characteristics:

- The value can be presented in whichever way, leds, lcd, sound....
- The dice must not be a standard dice. Number of “sides” can be chosen
- Blinking can be used to emphasize the result
- Simple/intuitive user interface
- Functional or original solutions give extra points

Electronic lock for a safe:

Opens a lock when the user inputs the right combination.

Required characteristics:

- The lock opens only with the right combination
- The amount of possible combinations must be at least 1000
- At least 3 different combinations must be programmable
- A combination can be deleted

Optional characteristics

- Simple/ intuitive user interface
- Functional or original solutions give extra points

Implementation of “the key/pin-code” is freely chosen.

Heart rate monitor:

Measures the heart rate of a human being.

Required characteristics:

- Reliable
- The heart-rate is announced as beats-per-minute

Optional characteristics

- Calculation of average hear rate
- Minimum/maximum heart rate
- EKG-curve
- Simple/intuitive user interface

This project hinges on choosing a suitable sensor and analog signal processing (filtering and amplification). The sensors can be chosen freely. Possible solutions include optical measurements or AD620- instrumentation amplifiers.

Braille- translator:

The product reads Braille-writing and presents the text on a screen.

Required characteristics:

- The Braille-writing must the interpreted correctly
- The distance between points can be assumed constant

Optional characteristics

- Reading can be based on mechanical switches or optical sensors
- Simple/intuitive user interface
- Extra credits for machine that can read a book written in Braille
- Functional or original solutions give extra points

A working device requires a good sensor that recognizes the points reliably. The sensor can be chosen freely. The writing can be assumed to be clearly defined and does not need to work universally for all writing.

Morse-encoder

The device converts a text written on the screen to Morse-code and transmits it with sound and an infrared LED.

Required characteristics:

- The message can be written with a keyboard

- A certain button begins the transmission
- The duration of the long and short pulse can be freely chosen, but they must be reasonable

Optional characteristics:

- A PS2 keyboard can be used as keyboard
- Simple/intuitive user-interface
- Connection to computer to allow messages written on computer to be transmitted
- Functional or original solutions give extra points

Morse-decoder

The decoder receives a Morse message transmitted with an infrared LED. The message is shown on an LCD screen.

Required characteristics:

- The device receives a Morse-message and displays it as letters on an LCD-screen
- The length of the short and long signals are provided by the assistant
- Faulty Morse-messages don't cause the device to crash
- Manual transmitter: device to send the Morse-message to the decoder

Optional characteristics:

- Microphone for audio signal (can replace infrared LED-input)
- Simple/intuitive user-interface
- Ability to show the message on a PC
- Functional or original solutions give extra points

Evaluation:

	Points	**Justification**	**Scale**
Plans		Are the plans clear? Do they need corrections?	1-5
Weekly reports		Are all weekly reports submitted?	0/1
Works/ Doesn't work		The product MUST work	0/1
Difficulty		Depending on the topic and implementation	1-5
Testing		How thorough and consistent is the testing?	1-5
Final Report			1-5
***Mandatory info**		Is everything there?	0/50/100
***Style**		Clarity and appearance	0/30/60/100
***To the pointness**		Is it a good report of the project?	0/50/100
***Joker**		Extra credits for good solutions	0-15