CSC 591/791, ECE592/792
Spring 2022
Course Project

General instructions

- You must do this project in groups, as assigned.
- While utilizing open source code for parts of the project is acceptable, simply adopting a previously developed project from such sources and verifying that it works is not.
- The due date and time for the final project report and code is: April 20, 2022, 11:45pm ET. However, there are several other deadlines that you must meet. See the rest of this document for those dates.

Objectives

The project work is targeted at giving students opportunity to obtain better knowledge and familiarity with sensing and IoT systems. In small groups, students undertake to envision, design and build a system, using the system architecture and platforms introduced in the initial part of the course. Students are expected to target a complete (if small) system that they design and develop themselves. The project is expected to have sufficient scope so that the experience of executing it provides the students with benefit in terms of better understanding of IoT systems, better appreciation of the challenges involved, and ways to overcome them.

Teamwork

Each team, as assigned by the TA, will work on its own project. For a project team, all contact with the instructor must be by the entire team. All emails *must* be copied to all team members - failure to do so may impose penalty on the team grade.

In each team, a person is designated as team leader. The team leader is expected to perform certain coordination tasks for the team. Contact with the instructor is usually initiated by the team leader (but all team members must be involved, as mentioned above). Whenever the team leader (or any other team member if unavoidable) sends an email, the email must be sent under the subject **[59/79 IoT Project] - Team #** so that all emails will lie in a single thread. This will ensure that all email communications of any given team with instructor and or TA can be easily tracked and referenced to, if needed. When a team work product is to be submitted, it must be submitted by the team leader.

The team leader also usually coordinates team meetings. Different teams operate differently, but the following are usually found to be effective measures. During meetings, the team leader facilitates systematic discussion of points on the agenda, and makes sure that every team member receives an opportunity to comment on everything they want to, while also making sure that the team can make progress on the issues discussed. The team leader does *not* have a stronger voice than any of the other members in making design decisions, task allotments, and other project decisions. Such decisions are ideally taken by the team as a whole. *However, many teams find it convenient to have the team leader serve as the final authority who proposes a decision when the team cannot reach consensus.* For team members other than leaders, a convenient rule of operation, when the team leader proposes a course of action (usually after some initial discussion), is to never respond with "Or, we could do X instead of Y, which would be equally good". Only propose an alternative when you are able to say "Instead, we should do X, which is better than Y for the following reasons."

Phases and Work Products

Initial ideas (Deadline: Week of March 21, 2022)

Each team will come up with at least three projects that they would like to work on and discuss them in a team meeting with the instructor in the week starting March 21, 2022. Instructions to sign up will come later in this document. Each project must involve at least two of the following four: sensing, actuation, analytics, cloud computing. During this meeting, the instructor and team will together pick one of the proposed projects and finalize various components of that project that will need to be completed. Immediately after this meeting, the team should start the work on the project. Depending on what you propose, it may turn out that you need to purchase some new sensors/products to carry out the project. Please order any such components/equipment right away.

Missing this deadline will result in a 5% deduction from the final grade for the project.

Distribution of grades for the steps of the demo (Deadline: March 25, 2022)

By the end of day on March 25, 2022, each team will send an email to the instructor **and** the TA (Hassan Khan) using the subject mentioned earlier, i.e., **[59/79 IoT Project] - Team #.**   In this email, the team will specify each step of the demo the team will do on the completion of the project. For each step, write down an appropriate percentage of the grade that you think should be assigned to that step. The sum of the percentage of all steps should be 100. Further allocate each demo step to a team member such that all work is equally divided among all group members. Note that the instructor may change the percentage assigned to each step, may propose to change/add steps in the demo, and may also propose to change the team member responsible for a given step. The instructor will hold 4 additional meetings with each team in the 4 subsequent weeks starting from the week of March 28 till the week of April 18 to discuss the progress of the project. In the email you send, specify the steps of the demo as below:

1. Step 1: *Description* (Percentage out of 100 assigned to this demo step; team member's name taking the lead on the work involved for this demo step)
2. Step 2: *Description* (Percentage out of 100 assigned to this demo step; team member's name taking the lead on the work involved for this demo step)
3. Step 3: *Description* (Percentage out of 100 assigned to this demo step; team member's name taking the lead on the work involved for this demo step)
4. …

Missing this deadline will result in a 5% deduction from the final grade for the project.

Presentation + Demo Video (On: April 20, 2022)

Each team will record a 10 minute presentation along with a video of their demo in a single .mp4 file and submit by April 20. Up to 1 week of extension can be granted if any team requests it and provides a justification for the need of the extension.

A team that does not make a presentation will lose a 5% grade from the final grade the team gets for the project. A team that does not include a video of their demo will lose 5% grade from the final grade the team gets for the project.

Final report and code (Deadline: April 20, 2022)

Each team must submit the final code, the project report, and the presentation slides by 11:45pm April 20, 2022 via Moodle. Up to 1 week of extension can be granted if any team requests it and provides a justification for the need of the extension. The code that you submit should be straightforward for the TA to execute, should he so wish to. You must include a README file with detailed and clear instructions on:

1. Environment settings
2. How to run the code
3. How to interpret the results
4. Any sample input and output files
5. Any other information required to run and understand the code

This final report should be a *self-contained document.* Every report must have a *cover page* containing the course title, submission date, and all names of all team-members. Negative points will be assigned to reports missing or having an incomplete cover page. The second page of each report must detail the breakdown of individual contributions of each team member to the project. Quantify, as a percentage, each student's contribution to each project component such as algorithm design, coding, hardware setup, debugging, report preparation, and any other project-related effort. Assign weightage to each component depending on how complex and effort-consuming that component was. The sum of contributions of the students in group for each project component should be 100%. An example below shows how you will write the breakdown of individual contributions on the second page of the project report. This sample assumes there are 4 students in the team.

Component	Component weightage	Student 1 contribution	Student 2 contribution	Student 3 contribution	Student 4 contribution
High level design	0.1	30%	30%	20%	20%
Algorithm development	0.25	10%	20%	30%	40%
Coding	0.35	30%	10%	25%	35%
Debugging	0.20	10%	20%	50%	20%
Report writing	0.1	0%	0%	0%	100%
Per student aggregate contribution		30 * 0.1 + 10 * 0.25 + 30 * 0.35 + 10 * 0.2 + 0 * 0.1 = 18	30 * 0.1 + 20 * 0.25 + 10 * 0.35 + 20 * 0.2 + 0 * 0.1 = 15.5	20 * 0.1 + 30 * 0.25 + 25 * 0.35 + 50 * 0.2 + 0 * 0.1 = 28.25	20 * 0.1 + 40 * 0.25 + 35 * 0.35 + 20 * 0.2 + 100 * 0.1 = 38.25

In this example, student 1 eventually contributed 18% to the total effort of doing the project, student 2 eventually contributed 15.5%, student 3 contributed 28.25%, and student 4 contributed 38.25%. If project receives an overall grade of 80 out of 100, student 1 will get 0.18*4*80=57.6 out of 100 for this project,

student 2 will get 0.155*4*80=49.6, student 3 will get 0.2825*4*80=90.4, and student 4's share becomes turns out to be 0.3825*4*80=122.4. (yes, it is possible to get more than 100; this will happen If a team does the project very well, but major effort came from only one or two students; the maximum a student can get is 110; in the example give above, student 4 will not get 122.4, rather a maximum of 110). Note that the sum of the eventual contributions from all students must be 100. Otherwise, there is a mistake in your calculation of the eventual percentages, and you need to fix it.

For the reports that are missing or having an incomplete contributions breakdown page, the contribution from each team member will be considered equal.

The rest of the report must contain the following sections:
1. **Introduction**: State the objective of your project; provide some background information.
2. **Design**: Describe how your whole system works. Provide a block diagram of your system and describe in detail each block. Specify exactly the user-controllable parameters to be entered when running your system.
3. **Implementation**: Specify the programming language and any other tools used for the development; Describe briefly the content of each source-code file
4. **Results and Discussion**: Present your experimental results (if any) in graphical charts and tables. Each chart/table should have a caption and should be referenced and described in the text. Provide technical explanations and comments on any observations you might have found interesting.
5. **Related Work and references**: Cite the literature or web sources that you have utilized in completing your project (if any). List all the references (books, journal/conference papers), web pages (include URL and webpage title) that have been used in the project.

Report that only contain charts but no description and explanation will receive a poor grade. The length of the report is limited to 6 letter sized pages, double column format, 10pt font, and one inch margin on each side. Note that pages 1 and 2 containing names and effort breakdown do not count towards the 6 page limit. Submit your final report as a pdf. Do not copy text from any other source. It is ok to have a couple of lines copied from some other source with proper citation, but not more than that. All charts, figures, block diagrams, and text should be produced by the team.

Missing this deadline for the project report and/or code will result in a 5% deduction from the final grade for the project.

Final Project Demo (Any time before May 1, 2022)

Each team will do a final demo of their project (in-person or over zoom, whatever the team prefers). Teams will have to do their demos before May 1. During the last weekly meeting, the team will tell what dates they can do their demo on, and the instructor and the team will finalize a time slot during that meeting.

Weekly meetings

Each team will meet with the instructor and the TA once every week, starting the week on March 21, 2022 till the week that starts on April 18. *Every team member must attend the meeting.* Each team can decide whether they would like to meet in person or virtually. The instructor will post a link with signup sheet for meeting timeslots on Moodle by March 8. Please go to that link to sign up for the meeting time slots as soon as possible. In the meeting on March 21, we will discuss project ideas, and in the subsequent meetings, we will discuss the progress on the project and plan the next steps.

Any team member that misses a meeting without a valid reason will lose a 5% per missed meeting from the final grade for the project.

Breakdown of the project grade

- Meeting the deadline for initial ideas with acceptable project ideas: 10% max
- Meeting the deadline for distribution of grades for the steps of demo with acceptable grade distribution: 10% max
- Presentation and demo videos: 15% max
- Final report and code: 15% max
- Final project demo: 50% max

Sample project ideas

Please go through the file **Sample projects.pdf** file, uploaded along with this document. It contains the list of a few projects that the teams in previous years did. This list is only for your reference. You must not do a project that is remarkably similar to one listed in this file. Think about projects that you can later carry on or something that you can continue to use once completed. For example, making all power outlets in your home smart so that you can control all of them from your phone even when you are not at home. Or deploying sensors in your home that monitor which lights in the home are turned on at what times of day and night, and then aggregating the information and presenting in human readable charts for each day, each week, each month etc. This can help one identify sources of wastage of electric power, and consequently take actions to reduce the overall power consumption in home. You will see the term BBBK listed in several of the projects in **Sample projects.pdf.** It stands for Beaglebone Black. Some of the other projects that students did in the past included:

- Smart coffee maker that automatically brews coffee when you wake up
- Smart parking system that can predict how many parking spots will be available on a given date and time.
- People counter in rooms and busses; predict bus occupancy.
- Automatic DJ that infers mood and level of activity of occupants and adjusts music accordingly.