# Sistemas Ubíquos

# Projeto

2019/20 (1º Semestre)

## Tópico geral do projeto: **As cidades inteligentes**

As cidades inteligentes são um contexto atual para a criação e desenvolvimento de serviços inovadores com base em tecnologias de informação e comunicação. Os cidadãos bem informados e participativos podem promover a discussão e consciencialização sobre problemas fundamentais que afetam uma cidade no contexto da gestão, planeamento e utilização dos recursos urbanos, como por exemplo os seus espaços habitacionais, de lazer, os transportes públicos, os serviços públicos ou o trânsito. Este objetivo poderá ser alcançado se capacitarmos os cidadão com meios para recolher, analisar e disseminar dados relevantes para eles e para todo o ecossistema da cidade através da utilização de tecnologia moderna. Exemplos dessas tecnologias são os dispositivos móveis pessoais, os ecrãs públicos, as redes de sensores ou qualquer outro tipo de tecnologia urbana.

Os desafios subjacentes à criação de serviços inovadores para as cidades inteligentes são inúmeros e vão desde desafios tecnológicos até desafios económico-sociais. O Objetivo deste projeto é estudar a utilização da tecnologias de informação e comunicação no contexto das cidades inteligentes. O projeto poderá ser desenvolvido numa perspectiva de concepção e prototipagem de um serviço inovador para os habitantes e visitantes de uma cidade e/ou numa perspetiva de avaliar as tecnologias de suporte à concepção desses serviços.

## Plano de trabalhos

| **Date** | **Deliverable** |
|---|---|
| 15/10/2019 | Project overview |
| 14/11/2019 | Intermediate report and discussion |
| 16/01/2020 | Final report and discussion |

# Introduction

The project provides a key learning context for the course Ubiquitous Systems, a field in which practical experimentation is recognised as crucial for an effective learning and for the development of a critical view on the wide broad of issues and technologies involved. The project should give students the opportunity to learn and practice a number of competences, while exploring in more detail a specific topic that interests them. The project is a substantial part of this course and students are expected to spend a considerable effort throughout the semester to achieve the project goals.

The execution of the project is structured around different phases that aim to promote a balanced distribution of the effort between the various tasks of the project and also a more balanced distribution of that work throughout the semester. This guide explains the key deliverables associated with each phase of the project and what is expected from each of them. It is meant to help students to organise their work and adopt important best practices in the execution of the project deliverables.

# A. Project Overview

The first milestone is a short overview of the project topic and goals. The initial topic suggestion is very high level, and teams should present, as their first task, a two pages report describing, in their own words, what the project is going to be about. The first page of the report should simply indicate the team members (with their photos), the title of the project and a short acronym for being used as a project reference.

# B. Intermediate Report

The intermediate report summarises the team's progress at a phase where the main design decisions should have been done. At this stage, students should know more about the topic and should have completed a number of design steps that enables them to clearly describe what their project is going to be like. The intermediate report should present a detailed description of the major decisions and the respective rationale and these should be able to inform the remainder of the development activities in the project. More detailed guidelines for this report are available in the guidelines section.

## Guidelines for writing the Intermediate Report

The intermediate report is a key milestone in the project. At this point, teams are expected to have made their key design decisions and completed the specification of their systems. The intermediate report should clearly describe the problem, the main alternatives approaches to address the problem, the key assumptions being made and the proposed approach. The team should also describe any design methodologies that may have been used to reach the proposed solution. This report should also specify exactly what the team plans to do for the remainder of the project, including all the tasks and milestones that must be completed to successfully finish the project.

### Motivation

The report should begin with introductory sections that clearly define the project's motivation, scope and objectives. Describing the motivation is to say what is the problem being addressed and why it is important. Defining scope is to reduce the problem by saying exactly which parts of that potentially complex and vast problem are really being considered in this project. The motivation should provide a simple but clear description of the concept that the team intends to explore. In summary, this is the part that will normally be used to explain someone else what the project is all about.

### Objectives

The objectives describe what will be the purpose of the work that will be carried out in the project. Objectives should be strongly linked to the motivation, but should clarify exactly what the team intends to achieve with their work on this project. At the end, objectives will also be the basis for the results and conclusions of the work. Therefore, when defining an objective, students should ask themselves if by the end of the project they will be able to argue from their results that they have achieved that objective. Ideally, there should be some type of quantifiable success criteria that allows the degree of success of the objective to be evaluated. Students should be particularly careful not to confuse objectives with tasks in the project.

### State of the art

Whatever the problem might be, if it is of any relevance at all, then certainly someone has thought about it and addressed it in some way. This section should provide a brief overview of the state of the art concerning the proposed problem, analyzing key related work and enabling technologies. The main goal is to mention other possible alternatives and build on what others have already done, rather than wasting resources doing what has already been done before. This section should include references to at least five papers that relate to the work in the project.

### Work Plan

The intermediate report should also include a detailed workplan for the remainder of the project. This workplan should describe the key tasks and their schedule, including development, deployment, evaluation and report writing. A particular attention should be given to the identification and estimation of the tasks involved in the development phase.

# C. Final Report

This is the report that describes the project work and results. The focus of the report should be to clearly describe the objectives, approach, results and conclusions of the work. The size limit for the report is 6000 words, and therefore any material that does not make a clear contribution to that goal should go into the annexes, including any detailed technical descriptions of the system or data collected during deployment. The final report should be delivered with any code, manuals or configurations created during development. A more detailed description of this report can be found in the guidelines section. The creation of a video demonstrating the use of the system is optional, but may be considered as an added-value that will also be useful for the presentation. The report should also include a web page where part of the project information can be made available for dissemination.

## Guidelines for writing the Final report

### Motivation

Updated version of the similar section in the Intermediate Report

### Objectives

Updated version of the similar section in the Intermediate Report

## State of the art

Updated version of the similar section in the Intermediate Report

## Technical Description

This section should describe the technical characteristics of the system that was created. The description should include the system architecture, the key functionality supported, the environmental assumptions and an overview of how it can be used. The use of diagrams is not required, but normally results in more effective descriptions.

## Evaluation (if applicable)

This section describes the experimental setting that has been created, the evaluation procedures that have been conducted, and the respective results. Evaluation results are crucial for enabling some evaluation of the system and sustaining any conclusions. The deployment should have been made in such a way that generates results that may contribute towards the objectives of the project. A proper and rigorous presentation of results is fundamental and students should be prepared to spend some time with the analysis of the data.

## Conclusions

"*And so what?*" This question should not be in the mind of someone who had just finished reading the final report. After reading the report, people should have learned something significant about the problem domain that the team has been exploring. Even though taking conclusions is to a certain extent what the project is all about, they are often a nightmare for students who often end-up with such useless conclusions as saying that they have enjoyed the project. Therefore, a good way to start explaining what conclusions should be like is to say what they are not. They are not about saying that this project was a nice, rewarding, satisfying or enriching experience. They are not about saying, without proper arguments, that you feel you have achieved the project goals.

What the conclusions are about is using the results obtained from the project to evaluate what you have achieved regarding the objectives that were initially set for the project. The project team must clearly understand that their goal is not to defend the base idea of their project as being very good. Their goal is to explore the idea, evaluate its viability from multiple perspectives, identify the key technical challenges involved, and highlight the main design alternatives and trade-offs. Anyone starting on the same problem immediately afterwards should be able to use your conclusions as a starting point to try other alternatives to the problem, rather than just starting from scratch. Technical excellence is needed to sustain the analysis of the technical alternatives or limitations, but per se, will not make a limited idea a good one. Therefore, students should not see negative conclusions about the original idea as something negative for their project outcome.

The conclusions should refer back to the project objectives and indicate to what extent those original objectives have been met. However, not all the outcomes of the project can be predicted in advance, and it is very likely that there will also be relevant results that do not directly correspond to any of the initial objectives. There may be lessons learned on how to build such system that emerged from the practical development or there may be limitations of the proposed approach that had not been anticipated, but emerged during the implementation. All those results may be very relevant and should also be summarised in the conclusions.

## Future work

No project ever addresses all the issues that are involved in solving any problem. In fact, a project such as this will greatly expand the team's understanding of the problem domain and as a consequence will uncover many new issues.  This section should provide an outline of those issues that were identified but not addressed in the project, and therefore may be the subject of future work.

## Generic guidelines for Scientific Writing

The proper writing style for a technical or scientific document must satisfy important requirements of clarity and rigor that are not common in other forms of writing. This project should be seen as a perfect context for training general competences of scientific writing. This is a list of some resources that students are encouraged to explore for that purpose.

**The Elements of Style. William Strunk, Jr.**
This is a classical book that provides general guidance on writing in plain English. Since it addresses many common writing errors it may be especially useful for non-native English writers. It is widely available in many formats. ::http://www.bartleby.com/141/ :: http://www.crockford.com/wrrrld/style.html ::

### Citations and References

The use of information sources is an integral part of scientific and technical writing, and making proper references is a key competence for that process. The usual procedure for references is very simple and basically consists in including a reference key in the proper place in the text and at the end of the document place a list with those keys and the respective reference information.

A much harder competence is to know what cite, when to cite and how to cite. The first major guideline is to stress that any source that has been relevant for the content of the document, by bringing a definition, an idea, an argument, an example or any other type of contribution that is not obvious, should be cited, whether it is a journal article, a Web page, a technical manual or any other source. This serves two main purposes. The first is to give proper credit to the respective authors and avoid plagiarism. Even though it is perfectly normal to build on what others have done and written about, it is mandatory that we make it clear that we are using those external contributions. This may be a simple mention to existing work or a transcript of content from other sources. In all cases, the content obtained from the external source should be clearly marked as such, and leave no ambiguity regarding its origin. The other important reason for including references is to enable readers to find additional information that they may themselves want to verify or explore further.

A second recommendation is to be careful with the transcription of content from other sources. Normally, such transcripts do not add much value to the report and therefore only transcriptions that are really relevant should be included. A final recommendation is to be fair with the cited work. A typical problem is when citations are used in a way that may fit very well in the line of what is being written, but does not correspond to the original context of where they were taken from. They are placed out of context and possibly with a meaning that may not correspond to the meaning in the original work.

For more information on how to cite source read the following documents:

- http://www.writing.engr.psu.edu/workbooks/documentation.html
- https://www.plagiarism.org/

### Reference Management Software

Handling citations and references manually is perfectly feasible when creating documents that have only just a few references. However, as the number of citations in the text increases, the process of maintaining the coherence between citations and their references may quickly become too cumbersome and lead to all sorts of citation errors. To help with this process there are a number of reference management software tools that enable the insertion of citations in the text and the automatic creation of a references list from those citations. They also support the creation of a personal database of bibliographic references that can be easily re-used in many documents. In addition to saving time and reducing errors in the bibliography, this automatic process is also important because there are many bibliography styles that define completely different guidelines on how ro format citations and references. With automatically generated lists, it becomes very simple to choose from multiple alternative styles or change the style being used. Some popular options for managing references:

For Microsoft Word and Mozilla users, a good alternative is Zotero (http://www.zotero.org/), which has the particularly nice feature of retrieving bibliography data automatically from the web pages of the references. Mendeley (www.**mendeley**.com/*)* is another alternative available for Windows and Mac. Yet another popular tool for Microsoft Word users is EndNote, but is only commercially available. A simpler alternative is to use the features that Word 2007 offers for citing sources, creating a bibliography, and managing the sources. See the information on http://www.fgcu.edu/support/office2007/word/references.asp. If using Latex, then Bibtex is the tool that enables the generation of references list. A software like JabRef (http://jabref.sourceforge.net/) may help with the process of managing references. Zotero can also be used with latex, but only to generate bib files.

## Best Practices

Based on previous editions of this type of student projects and also in general guidance on this type of work it is advisable to consider the following best practices when developing this project.

### Implementation Strategy

Making the right choice on **what to implement** is probably the most critical and influential decision on the project. Deciding to implement too much necessarily extends the implementation phase at the expense of the following phases, such as the evaluation. This brings many risks to the project. The first is that by the end of the project a lot of effort may have been done in the implementation, but nothing in the system is completely done. The second is that there is no time to make a proper deployment and evaluation. Both circumstances will severely affect the conclusions of the project and the respective grading. Deciding to implement too little also brings its own risks and with similar consequences. The first is that there will be less work done to be evaluated in the implementation, which may affect the final grade. The second is that, if too many features are missing, the proper deployment and evaluation of the system may not be feasible, which will also impact negatively on the ability to take conclusions from the project. To make a balanced management of implementation risks, students are advised to focus very early on the implementation of the core features of the system, creating prototypes that work properly enough to be deployed in a semi-controlled environment. Those prototypes can be then evolved iteratively with the inclusion of new features.

### Messiness as part of the problem

Technical limitations exist with every technology. Typical examples may include GPS errors, RFID detection failures, communication failures or long initialisation times. These limitations are an integral part of the problem being addressed and should not be ignored as something that is not the team's responsibility. Instead, students are encouraged to propose solutions that fully embrace those limitations and their implications for the system design.