Imperial College
London

IMPERIAL COLLEGE LONDON

DEPARTMENT OF COMPUTING

An intelligent digital interface for sharing diagnostic medical imaging with patients

— BACKGROUND AND PROGRESS REPORT —

by
Laura Hagege

Supervisor: Fernando Bello

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1 Project Overview

1.1 Supervisors

My direct supervisor is Dr Fernando Bello, he is is a computer scientist and engineer working at the intersection of medicine, education and technology. He is a Reader in Surgical Computing and Simulation Science at Imperial College London, where he co-directs the Centre for Engagement and Simulation Science, leading a multi-disciplinary research group aiming at building suitable models and simulations of clinical processes, including clinical examination, clinical diagnosis, interventional procedures and care pathways. Dr Bello proposed my project as entitled ”An intelligent digital interface for sharing diagnostic medical imaging with patients”.

I will also be working with William Cox, which is currently working on a PhD project investigating the extraction of novel benefit from diagnostic radiological images through sharing images with patients.

Together Dr Bello and Mr Cox he will be supporting my project and providing me specification for it’s realization.

1.2 Project Goal

The aim of this project is to create a graphical user interface (GUI) that allows MRI, CT-scan, X-Ray patient to access their datas with different levels of benefits. Data acquisition should be valuable for patients. Following the first meeting with my tutors main criteria of success have first be defined as considering the following points:

- Patient should be able to understand provided images
- Patient could explore the data in different ways/ different images orientation
- Patient should have the possibility to ask questions to doctors/ specific assigned people

Those criterias were for me the basis to create further specifications that will be developped later in this document.

2 Background Work

2.1 Project field apprehension:

Towards the first meeting with my supervisors, document has been sent to me from William in order to get me familiar with the context in which my project is part of. Those documents includes:

- William PhD late stage review report discussing the benefit of creating a patient oriented interface
- A Litterature review document called ”Patient Health Record Systems Scope and Functionalities”
- A Litterature review document called ”Patient Portal Preferences: Perspectives on Imaging Information”
- A research article entitled ”Imaging informatics for consumer health: towards a radiology patient portal”

2.2 Project frame and specifications definition:

Before starting to write any piece of code, I have decided to get the clearest specifications defined with my tutors in order to be sure that the future produced work will fit theirn needs. Specification should be done concerning:

- Interface oriented spec:
  - Content
  - Functionalities
  - Design
- Data Providing:
  - What can be provided?
  - How to provide it?

2.3 DICOM Data familiarization

Imaging datas are provided in a specific format called DICOM - Digital Imagine and Communication in Medicine. This is a standard format for storing and transmitting informatic data related to medical images. It has been widely adpoted by most hospitals in order to standardise data transmission between different radiology tools such as scanners servers, worksation, printers, network hardware and PACS (see below) and different stakeholders.
DICOM data readers can be found on the internet as it is a huge format to deal with. My first work is then to find out about those readers and pick one that could suits my project

2.4 Choose accurate implementation method:

Multiple GUI tools are provided on the net provided with tutorial and specification to create interfaces for begginers. Before starting to implement I need to determine the tool I will use to developp my interface. Exploring the internet the objective is to make a short comparison between the current extisting tools and choose the one that I feel the most confortable with and the most suitable for my needs.

3 LSEPI Checklist

	Yes	No
Section 1: HUMAN EMBRYOS/FOETUSES		
Does your project involve Human Embryonic Stem Cells?		x
Does your project involve the use of human embryos?		x
Does your project involve the use of human foetal tissues / cells?		x
Section 2: HUMANS		
Does your project involve human participants?	x	
Section 3: HUMAN CELLS / TISSUES		
Does your project involve human cells or tissues? (Other than from "Human Embryos/Foetuses" i.e. Section 1)?		x
Section 4: PROTECTION OF PERSONAL DATA		
Does your project involve personal data collection and/or processing?	x	
Does it involve the collection and/or processing of sensitive personal data (e.g. health, sexual lifestyle, ethnicity, political opinion, religious or philosophical conviction)?	x	
Does it involve processing of genetic information?		x
Does it involve tracking or observation of participants? It should be noted that this issue is not limited to surveillance or localization data. It also applies to Wan data such as IP address, MACs, cookies etc.		x
Does your project involve further processing of previously collected personal data (secondary use)? For example Does your project involve merging existing data sets?	x	
Section 5: ANIMALS		
Does your project involve animals?		x
Section 6: DEVELOPING COUNTRIES		
Does your project involve developing countries?		x
If your project involves low and/or lower-middle income countries, are any benefit-sharing actions planned?		x
Could the situation in the country put the individuals taking part in the project at risk?		x
Section 7: ENVIRONMENTAL PROTECTION AND SAFETY		
Does your project involve the use of elements that may cause harm to the environment, animals or plants?		x
Does your project deal with endangered fauna and/or flora /protected areas?		x

Figure 1: LSEPI Checklist - part 1

Does your project involve the use of elements that may cause harm to humans, including project staff?		x
Does your project involve other harmful materials or equipment, e.g. high-powered laser systems?		x
Section 8: DUAL USE		
Does your project have the potential for military applications?		x
Does your project have an exclusive civilian application focus?	x	
Will your project use or produce goods or information that will require export licenses in accordance with legislation on dual use items?		x
Does your project affect current standards in military ethics – e.g., global ban on weapons of mass destruction, issues of proportionality, discrimination of combatants and accountability in drone and autonomous robotics developments, incendiary or laser weapons?		x
Section 9: MISUSE		
Does your project have the potential for malevolent/criminal/terrorist abuse?		x
Does your project involve information on/or the use of biological-, chemical-, nuclear/radiological-security sensitive materials and explosives, and means of their delivery?		x
Does your project involve the development of technologies or the creation of information that could have severe negative impacts on human rights standards (e.g. privacy, stigmatization, discrimination), if misapplied?	x	
Does your project have the potential for terrorist or criminal abuse e.g. infrastructural vulnerability studies, cybersecurity related project?		x
SECTION 10: LEGAL ISSUES		
Will your project use or produce software for which there are copyright licensing implications?		x
Will your project use or produce goods or information for which there are data protection, or other legal implications?	x	
SECTION 11: OTHER ETHICS ISSUES		
Are there any other ethics issues that should be taken into consideration?		x

Figure 2: LSEPI Checklist - part 1

4 Progress Sumarry

4.1 Specification Definition

Following several discussions with my tutors, we finally agree on the project specifications - that might evolve during the realization of the interface:

- **Interface content:**
  - Display patient images - images provided in DICOM format to be translated so that the patient can read them
  - Clinical repor(from doctor) and simplifie version
  - Link to NHS website, so that patient could find general informations about their condition
  - Flag informations should be provided while exploring the images
  - Any other relevant informations related to what the DICOM files provides could be added
- **Interface functionalities:**
  The interface should provide:
  - One doctor oriented window: so, they can fill in datas (images, report) and add flag to images at their conveniance.
  - One patient oriented window: read only data (no modification allowed) and the possibility for patient to chat with doctors.

  My first concern (in the context of this project) is to focus on the patient oriented side and see how fare I can take this project; this side can be really time consuming as it might need to be oftently readaptaed as created.
- **Interface design:**
  - Imaging display will depend on the provided images (MRI, CT) but not on the part of the body see below point 2.3.
  - Patient should be able to see flag appearing on the images
  - Provide a side by side or other relevant organization that would allow the patient to get the images and the report together in a relevant way
- **Further precisions**
  - No access to any database will be provided for the current project (security issues)

- Access to the interface will be local patient would be given (upon request) a CD with their images loaded on the interface; this wont change patient access to datas but should make them want to access it
- Interface should include user specification/precisions for patient
- Benefits/specifications will have to be defined before starting implementation
- Interface should be windows portable

4.2 GUI tool choice: Qt

- Tools Comparison
- Choosen Tool aprehension: tutorial

4.3 DICOM apprehension

5 Project Plan

6 Appendix

6.1 Questions