Mobile application to support nurses’ workflow

**Bachelor project**

***Session 2015***



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**External expert :** Frédéric Ehrler

**Major :** logiciels et systèmes complexe

**Foreword**

Document’s structure

This thesis was developed with the help of the **Universitary Hospital of Geneva** (**HUG**).

This thesis will start by a context description, what was the initial issue, how it was solved up until now and why a better solution was needed. It will also explain how the current informatics architecture of the **HUG** works.

It will then explain what technologies will be used to reach the overall goal and describe the new nurses workflow. This first part will end by the description of all the restrictions and issues working in a distant place with sensitive data imply and what were the main challenges coming along with it.

The second part will be an in depth description of all the technologies and protocols I’ve used. How they work alone and together to produce a “native app” on both **Android** and **IOS.**

The third part of this thesis will describe the application in itself; it will contain a lot of illustrations and schemas to help understanding exactly what everything does. It will also describe in detail how the **HUG** data are structured and how I accessed, manipulated and displayed them to ensure the best user experience (**UI**).

It will then end with the possible enhancing mostly in terms of user experience (**UX**).  
It will talk about the issues and problems encountered during the creation process and finish with the conclusions drawn out of the entire project.

Text formatting/Manual of style

To allow an easier understanding and readability of the document some text formatting rules will be applied:

* Names, acronyms and company names will be in **bold**.
* Important words will be in *italic*.
* References to code and/or file/folder will be between [**brackets in bold**]

Special thanks

I would like to start by thanking **Mr. Glück Florent** for his guidance and help during the entire thesis.

I would also like to thank **Mr. Ehrler Frédéric** for his availability, help and advices, as he was my main source of information for the entire **HUG** related questions. He also provided me with a desk within the **HUG** mainframe.

# Introduction

## Initial problem

Currently, the nurses dispose of a desktop application that helps them with their everyday work.

Nurses have complicated changing schedules, when they get to the hospital; For the sake of example, the nurse will be called **Francis** and the person responsible for rewriting all the medical information into the system will be **Sam**.

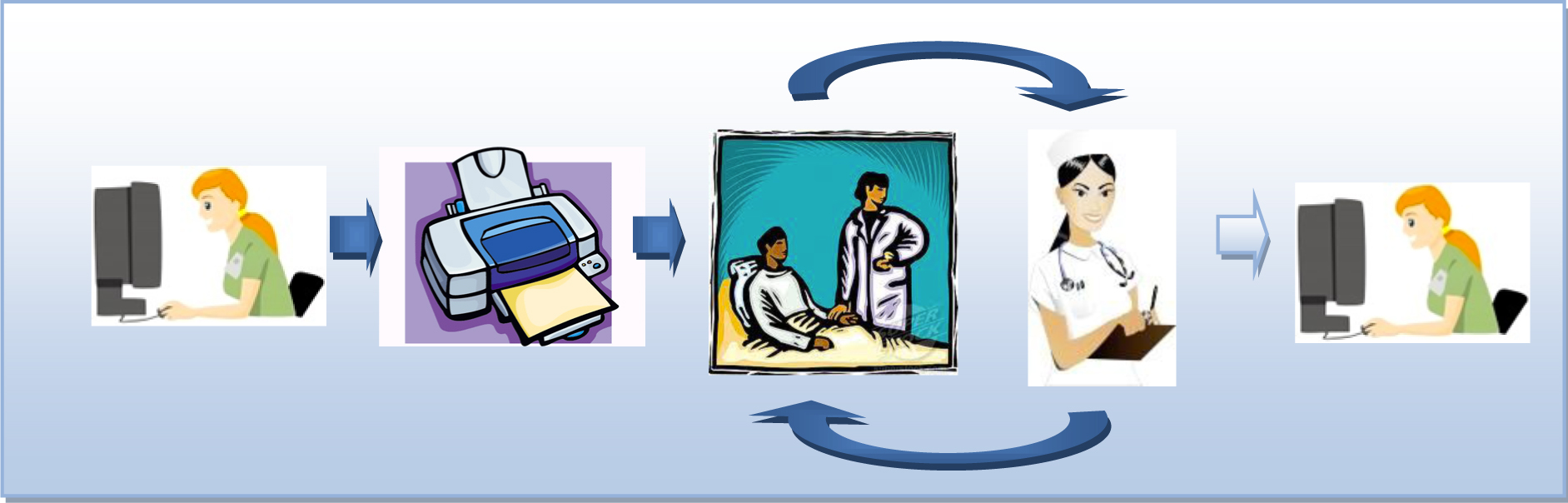


FIGURE 1.1 – NURSES’ CURRENT WORKFLOW

1. **Francis** logs into the desktop application and prints a paper sheet for every patient he has to visit today.
2. **Francis** has now a lot of paper with him, he chooses the one he will use shortly and go visit the patients in different rooms.
3. He notes on those sheets everything he does, when he does it and how the patient reacted if necessary.
4. Once he’s done he goes back and take the next sheets for the next group of patients he will visit.
5. When **Francis** is done visiting everyone he gives all the paper to **Sam.**
6. **Sam** has a lot of paper from **Francis** and his co-workers that have been working for a while.
7. **Sam** takes every paper one by one and rewrites it’s content in the system**.**

Taking apart the fact that this is an old fashion way of working, this workflow presents some very important issues that should be fixed.

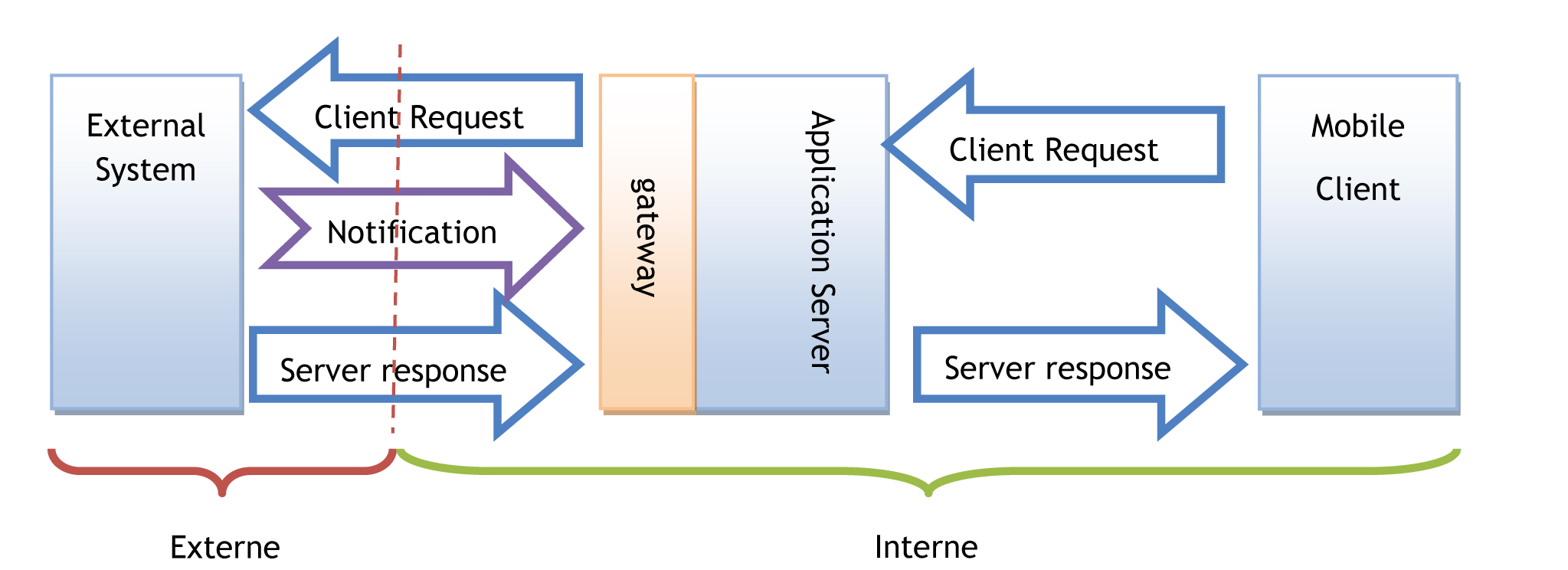
**Francis** and his co-workers each have different way of writing, sometimes they’re tired and just don’t write as well as when they start working. They don’t watch the exact time for every intervention they perform, which means data, can be not accurate and in the medical field, accuracy is primordial.

Adding to that, **Sam** can mistype or misread something and enter false data into the system!

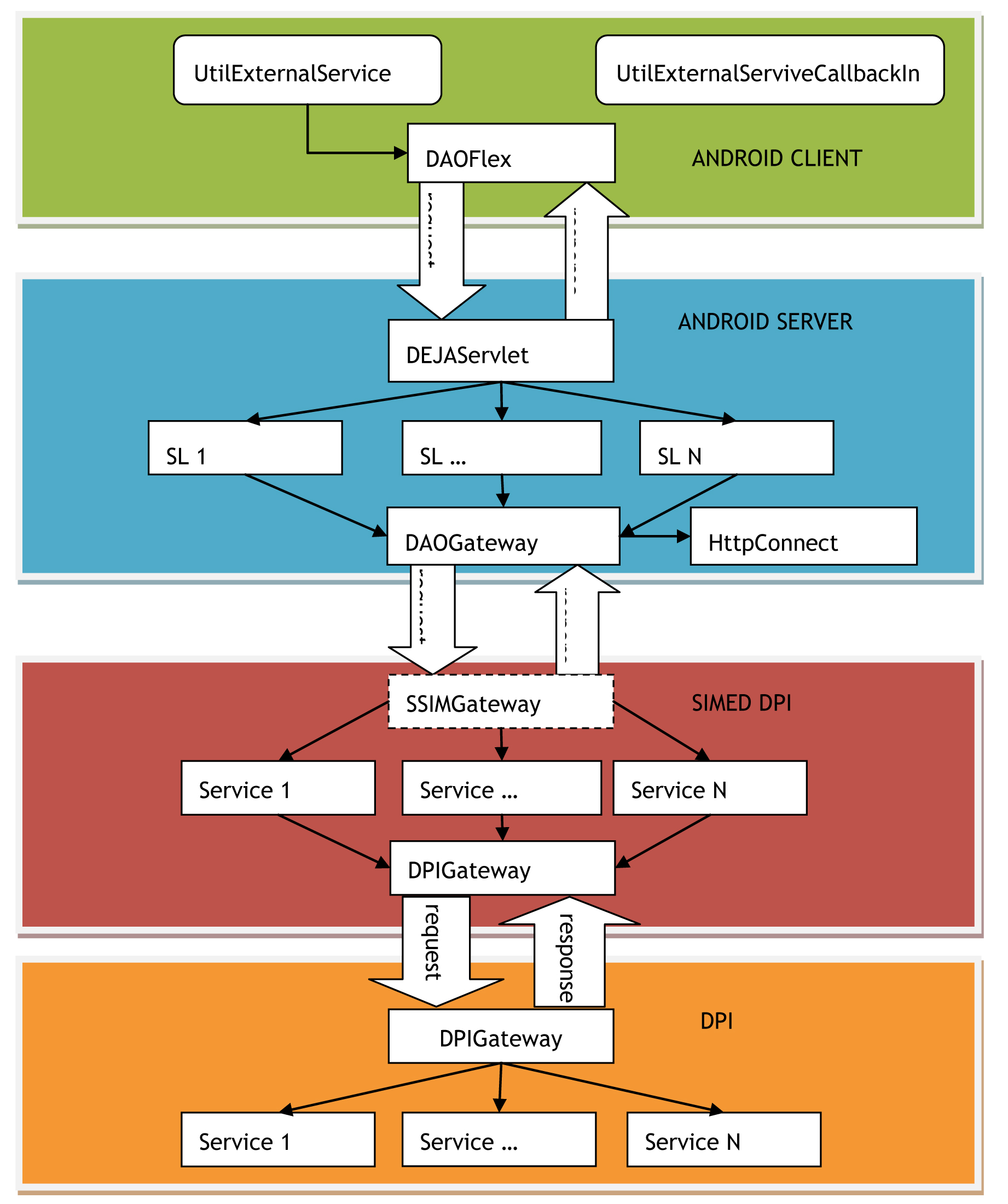
There’s a double risk for errors and that puts a lot of pressure onto **Francis** and **Sam**’s back.

The hospital wants something that will increase the accuracy of both measures and typing/reading, allow almost real-time data sync for all the working employees and less volatile than paper.

## Hospital architecture

The hospital has several servers delivering data chunk relative to the employee asking for it, in the case of **Francis**, he receives a list of all the patients he has to visit during his current shift.

To read data from the Hospital’s servers, **Francis** needs to use a trusted machine that will ask the servers.



## Solution proposed

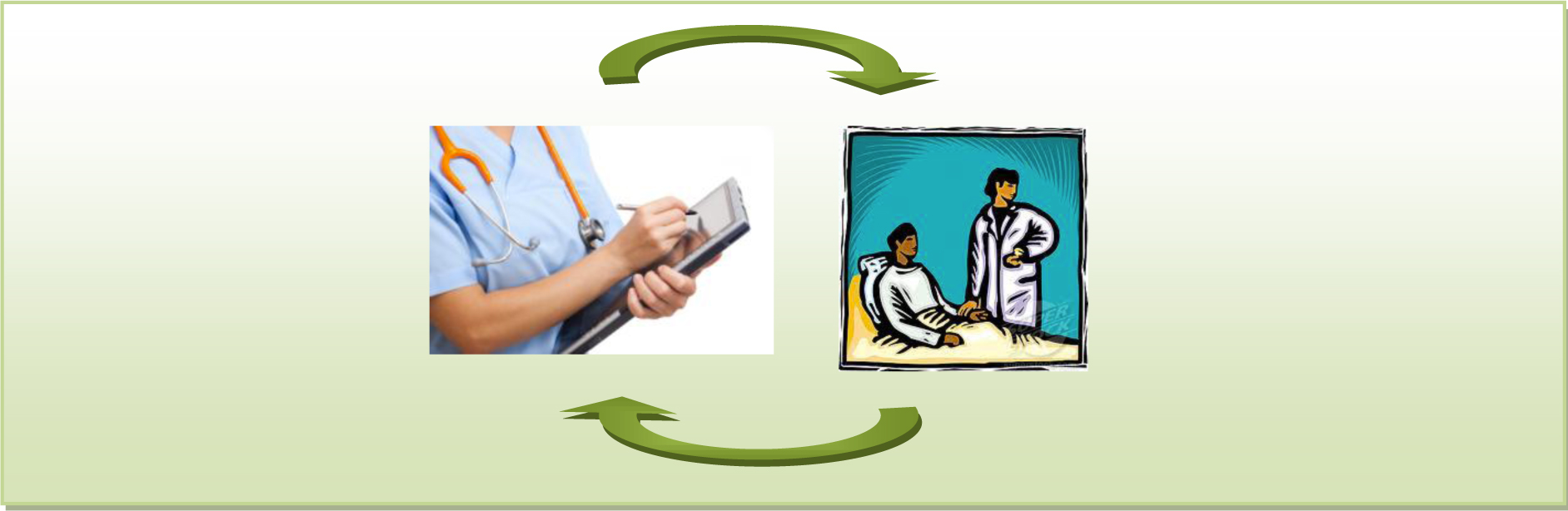
### Existing app

#### Introduction

Mr. Frederic Ehrler and his team have developed a prototype to help enhance the nurses’ workflow.

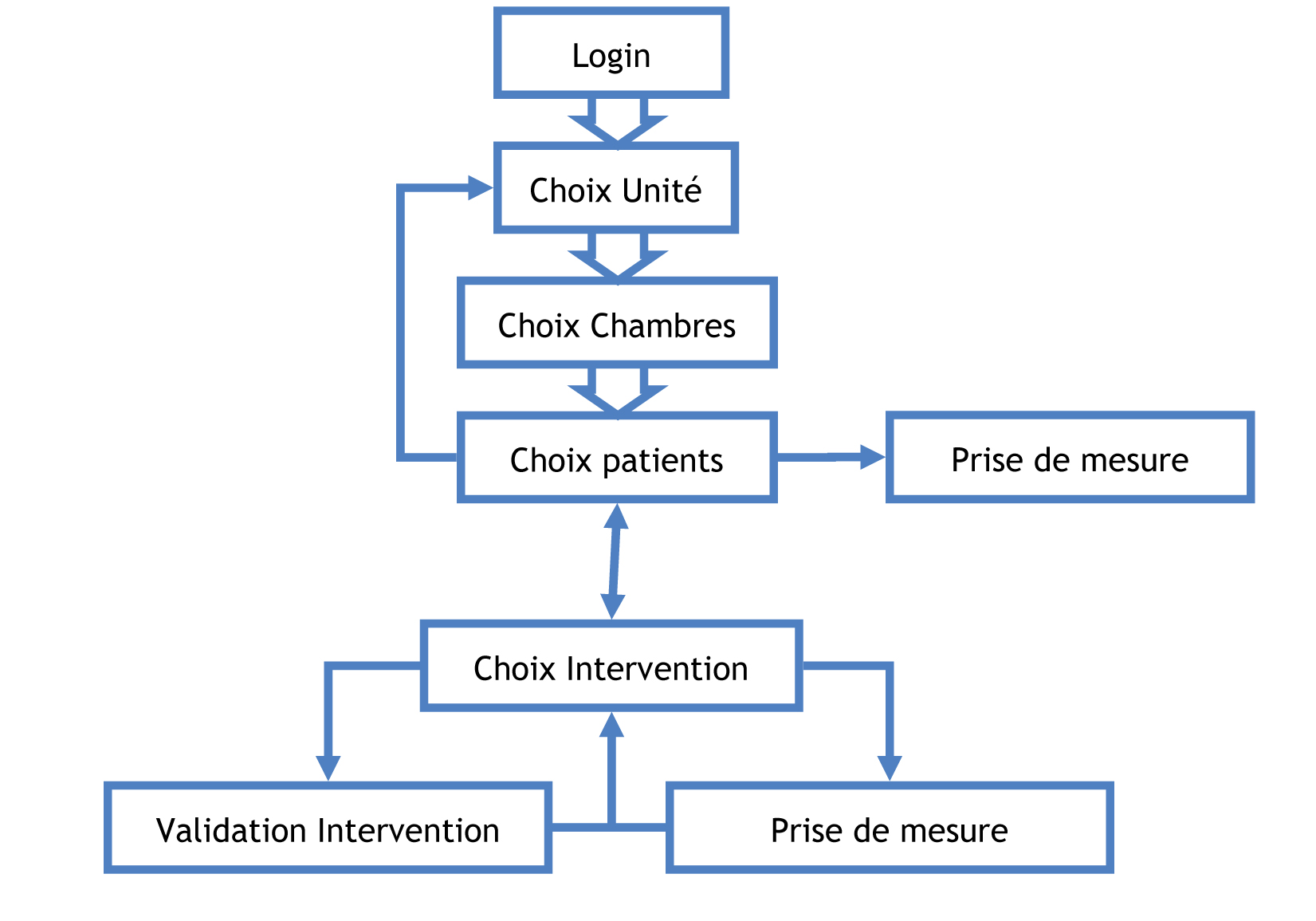
They narrowed the number of steps down to 2 by using the help of a smartphone.

It allows **Francis** (the nurse)to visualize all the interventions he has to perform during his shift, validate them, take vitals measurements in real time and enter them into the system. Such an application would greatly ease the work of Francis, by allowing him to bypass the previous mandatory extra steps of printing – carrying all patients’ sheet with him – taking notes – entering it again into the system.



#### Processus

The overall application is client centered and assumes a nurse takes care of one patient at a time. Thus, all the interventions are organized by patients, patients are regrouped by room and rooms in units. The aim is to allow fast and intuitive navigation towards one patient and another.



**Login:** User logs in and is identified.  
**Units:** Once identified the user choose which unit he wants to work with.  
**Rooms:** Nurses are not responsible for the whole unit so they can choose the room they want to work with.   
**Patients:** The nurse will choose the first patient and be able to switch between one and the other easily.   
**Interventions:** Once a patient is selected, a list of all the interventions will be displayed for the nurse to choose what to do first.   
**Intervention validation:** Depending on the intervention type a simple or a more complete validation will be required.  
**Measurements:** Some interventions demands measures to be taken, they will be entered in real time in the application.

#### Terminology

Interventions

All the interventions are described in a separated file and organized hierarchically which ease the displaying process. There are 22 categories of intervention of “high level” (they will be listed in French as the application is in French)

* Alimentation
* Cognition-Perception
* Communication
* Développement – Concept de soi
* Environnement socio-familial
* Sommeil-Repos
* Spiritualités
* Gestion de la santé
* Hygiène
* Mobilisation
* Peau & Téguments
* Respiration
* Thermo-neurorégulation
* Enseignement
* Examens
* Bilans
* Surveillances
* Traitements
* PRESCO
* Equipement
* Rendez-vous

Vital signs

Vital signs represent all measurements done on the patients in order to know his or her health state.

All measures are taken in person, which is why it’s very important that nurses can enter those measures right after they’ve performed them.

There are plenty of different measures that can be taken:

|  |  |
| --- | --- |
| Le pouls   * Rythme   + Non précisé   + Irrégulier   + Régulier   + Autre * Lieu   + Non précisé   + Radial gauche   + Radial droit   + Rétro-malléolaire gauche   + Rétro-malléolaire droit   + Pédieux gauche   + Pédieux droit   + Fémoral gauche   + Fémoral droit   + Poplité gauche   + Poplité droit   + Cardiaque   + Autre   La température   * Lieu   + Non précisé   + Rectal   + Buccal   + Axillaire   + Inguinale   + Tympanique   + Cutané   + Autre   Saturométrie   * Fio2 * Status * Air ambiant * Peak-flow   Selles   * Status   + Non précisé   + Absence de selles   + Présence de selles * Consistance   + Non précisée   + Dures   + Liquide   + Moulées   + Fausse diarrhée / fécalome * Volume   + Non précisé   + Petit   + Moyen   + Grand | La tension   * Prise   + Non précisé   + Debout   + Couché   + Assis   + Après effort   + Autre * Lieu   + Non précisé   + Bras gauche   + Bras droit   + Jambe gauche   + Jambe droite   + Autre   Fréquence respiratoire   * Rythme   + Non précisé   + Régulier   + Irrégulier   + Apnée   + Cheynes-Stoke   + Kusmmaul   + Autre * Observation   + Non précisé   + Dyspnée   + Tachypnée   + Sibilance   + Tirage   + Balancement thoraco-abdominal   + Paradoxal   + Stridor   + Autre |

Indice de la douleur  
Poids  
Taille  
Bilan

Measures values

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Affiché | | Possible | | Incr | T unit | T range | Unité |
|  | Min | Max | Min | max |  |  |  |  |
| Pouls | 40 | 160 | 1 |  | 1 | 1 m | 10 m |  |
| Tension diastol | 50 | 250 | 0 | 350 | 1 | 1 m | 10 m |  |
| Tension systole | 50 | 200 | 0 | 250 |  | 1 m | 10 m |  |
| Température | 36 | 41 | 26 | 42 | 0.1 | 5 m | 50 m |  |
| Fréquence cardiaque | 30 | 220 |  |  |  | 1 m |  |  |
| Saturométrie | 80 | 100 | 40 | 100 | 1 |  |  |  |
| FI02 |  |  |  |  |  |  |  |  |
| Peak-flow |  |  |  |  |  |  |  |  |
| Selles |  |  |  |  |  |  |  |  |
| Indice de la douleur | 0 | 0 | 10 | 10 | 1 |  |  |  |
| Poids |  |  |  |  |  |  |  |  |
| Taille |  |  |  |  |  |  |  |  |
| Bilan |  |  |  |  |  |  |  |  |
| Glycémie |  |  |  |  |  |  |  |  |

#### Application

### Requirements

### Technologies

* AngularJS
* Ionic
* ngCordova
* HTML 5
* CSS 3
* Javascript
* IBeacons
* **BLE** (Bluetooth low energy)

## Restrictions

## Challenges

The project is directly related to a client (**HUG**) represented by **Mr. Ehrler** thus bringing a lot of challenges on the client – developer relation. Understanding the exact needs of the client, communicating on a regular basis to check the project’s progress.

Rework on some features to make them more adapted or more user friendly depending on what the nurses are use to.

Moreover, the project is managing medical data, which is very sensitive and private.  
That situation forced the whole project to be based on sample development data coming from a single XML file. Even if the file is an exact copy of the structure of real data, all the interactions with **HUG**’s servers and proxy were put aside.

The main scope was to have a working usable application, validate it in front of the nurses and doctors and hospital administration and then only connect it to a real stream of data from actual patients.

On top of that, medical data can only be accessed from within the mainframe of the **HUG** which means part of the work had to be done there.

# Framework

## Ionic

Ionic is a framework based on **Angularjs,** an open source **MVC**   
(model - view - controller) JavaScript framework maintained by **Google** and **Apache Cordova,** a platform for building native mobile (**Android**, **IOS** and much more…) application using **HTML, CSS** and **JavaScript.**

Ionic framework enables development of hybrid native mobile applications, it’s particularity is it’s **Angularjs** coreand support for **SASS** (Syntactically Awesome Style Sheets) CSS extension.

Its goal is to simplify both development and testing of such applications by providing a framework for client-side model–view–controller (**MVC**) architecture, along with components commonly used in rich internet applications. It’s pretty darn fast, it uses an extremely simple syntax (at least compared to **Backbone** or **Knockout**) and like **jQuery**, has a large number of 3rd party plugins and extensions. **Angular** comes with jqLite if you need to access the DOM, or you can always load **jQuery** (I would advise sticking to **jqLite**, it has a much smaller memory footprint than full-fledged **jQuery**).

Ionic provides you with a set of **Angular** driven widgets, they aren’t web components and aren’t usable outside of Ionic/**Angular** (this is not something that should worry you). In addition to widgets, Ionic will provide you with every other required mobile functionality, like touch recognition, animation logic, and asynchronous communication and native packaging.

## Angularjs

## Plugins / Modules

## IBeacon

## OAuth

# Application

## Navigation and architecture

## Wireframes and functionalities

## Hospital data structure

## Sensitive patient data handling

## Data transmission

# Conclusion

## Possible enhancing

## Problems and challenges

## Conclusions

# References

# Annex