# Experiment‘s Material

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## 1 Object 1 - AutomaGREat

### 1.1 Description

AutomaGREat proposes an intelligent environment for the Seminar Room of the GREat lab. In the seminar room, lectures, weekly meetings, defenses and other activities happen. Several objects in this room are handled by the group employees who are using the room, such as air conditioners and lights. In this scenario, a development team proposed the AutomaGreat project, in which the goal is to create an application to facilitate the use of room devices: air conditioners and lamps. Thus, users can manipulate these objects remotely through a mobile application. In addition, the system can automate tasks commonly performed in this environment.

### 1.2 Functional Requirements

The functional requirements of this application are:

1. The system must allow user authentication
2. The system should allow the user to set their preferences regarding air conditioning and lights
3. The system must allow the user to configure the system operation mode: manual or automatic
4. Manual mode should allow air and light control directly by the user.
   (a) The system must allow the user to turn on the seminar room air conditioner
   (b) The system must allow the user to turn off the seminar room air conditioner
   (c) The system must allow the user to change the seminar room air conditioner temperature
   (d) The system must allow the user to turn on the seminar room lights

(e) The system shall allow the user to turn off seminar room lights

(f) The system shall allow the brightness of the seminar room to be manipulated

(g) The system must allow the color of the seminar room lights to be changed

5. Automatic mode should allow air conditioners and lamps to be triggered from room presence detection and user preferences

## 1.3 Non-Functional Requirements

The non-functional requirements of this application are:

1. Invisibility: refers to merging technology into the user's physical environment or decreasing the interaction workload;

2. Security: degree to which a product or system protects information and data so that people or other products or systems have the degree of access to data appropriate to their types and levels of authorization;

3. Performance: performance against the amount of resources used under established conditions;

4. Interaction efficiency: resources spent on the accuracy and completeness with which users reach goals; and

5. Reliability: degree to which a system, product or component performs specified functions under specified conditions for a specified period of time.

## 1.4 Invisibility SIG

Figure 1 shows the Invisibility SIG constructed for AutomaGREat.

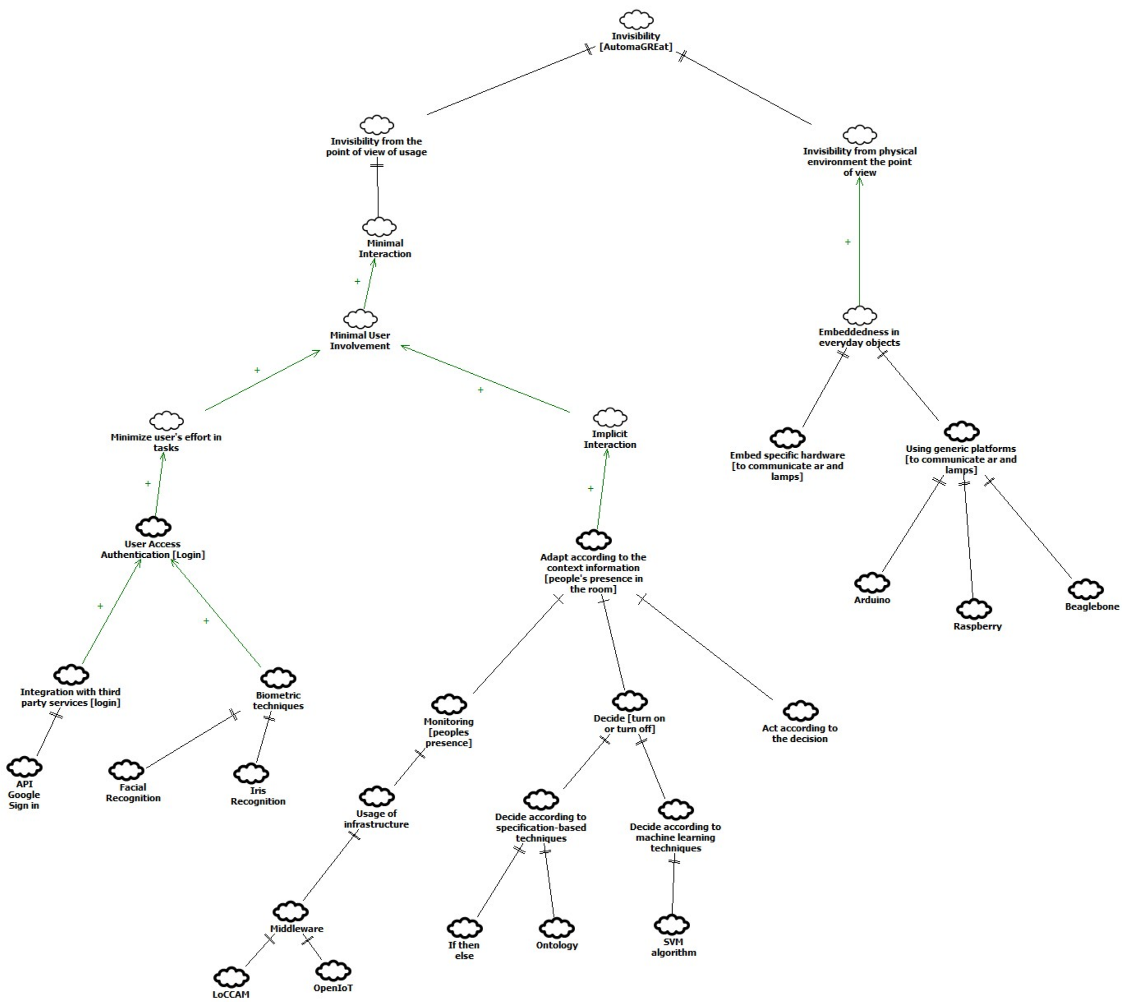


Figure 1: Invisibility SIG for AutomaGREat System

Description of the operationalizing softgoals in the last level of the SIG:

1. Google Sign in API: API that allows authentication with Google data;
2. Facial Recognition: Technique to identify the user based on their face;
3. Iris Recognition: Technique to identify the user based on their iris;
4. LoCCAM: Middleware for managing and acquiring context information. It can run on a single device or can be distributed across devices;

5. OpenIoT: A natural extension for cloud computing implementations, allowing access to IoT-based features, and functions as sensor middleware;

6. If-then-else: Modeling and implementation of adaptation decisions;

7. Ontology: Generic, formal and explicit way to capture and specify domain knowledge with its intrinsic semantics through consensual terminology and formal axioms and constraints. Provide a formal way of representing sensor data, context, and situations in well-structured terminology;

8. SVM algorithm: Supervised learning model that analyzes data used for classification and regression analysis.

9. Action: Execution of the decision

10. Embedded hardware: Acting and sensing specific embedded hardware on objects;

11. Arduino: Open source electronic platform based on hardware and software;

12. Raspberry: Small size single card that plugs into a computer monitor or TV and uses a standard keyboard and mouse; and

13. Beaglebone: Low power open source single board computer.

## 1.5 Tasks

Tasks performed by the participants in AutomaGREat:

- Task 1: Given the set of operationalizations in the last level of the Invisibility SIG, analyze if they have positive and negative impacts with Security, Performance, Efficiency and Reliability.

- Task 2: Choose and describe the operationalizations that maximize the positive impact and minimize the negative impact to the required NFRs.

## 1.6 Part of the Correlation Catalog for AutomaGREat

Figure 2 presents the part of the correlation catalog received by the participants when they had to perform the experiment's tasks in AutomaGREat

| Strategy | Type | Quality Characteristic |
|---|---|---|
| Google Sign-in | HELPS | Efficiency |
| Google Sign-in | HURTS | Privacy |
| Google Sign-in | HURTS | Security / Confidentiality |
| Facial Recognition | HELPS | Usability / Accessibility |
| Facial Recognition | HURTS | Functional Suitability / Functional Correctness |
| Facial Recognition | HURTS | Privacy |
| Facial Recognition | HURTS | Performance Efficiency / Time Behavior |
| Facial Recognition | HURTS | Efficiency |
| Facial Recognition | HURTS | Security / Authenticity |
| Iris Recognition | HELPS | Security |
| Iris Recognition | HELPS | Usability/Accessibility |
| Iris Recognition | HURTS | Performance Efficiency / Time Behavior |
| Iris Recognition | HURTS | Efficiency |
| OpenIoT | HELPS | Functional Suitability |
| LoCCAM | HELPS | Functional Suitability |
| LoCCAM | HURTS | Privacy |
| LoCCAM | HURTS | Performance Efficiency |
| LoCCAM | HURTS | Security |
| LoCCAM | HURTS | Reliability |
| if then else | HURTS | Context Coverage / Flexibility |
| if then else | HURTS | Reliability |
| Ontology | HURTS | Performance Efficiency |
| Arduino | HURTS | Reliability |
| Arduino | HURTS | Performance efficiency / capacity |
| Raspberry | HURTS | Reliability |
| Raspberry | HURTS | Security |
| Beaglebone | HURTS | Reliability |
| Beaglebone | HURTS | Security |
| Embedded hardware | HELPS | Reliability |

Figure 2: Correlation Catalog received by the participants for AutomaGREat tasks

# 2 Object 2 - GREatBus

## 2.1 Description

GREatBus proposes an intelligent system for passengers and bus drivers. Overall, the project aims to facilitate bus-related tasks. For the driver it is important for example to know if the people who are at the stop will take the bus. For the passenger it is important to know estimates, bus capacity, among others.

## 2.2 Functional Requirements

The functional requirements of this application are:

1. The system must be able to receive or request information about the number of bus requests per stop;

2. The system shall be able to calculate the estimated bus arrival time based on the distance from the bus to the user and the speed of the vehicle;

3. The system must be able to inform the capacity of the bus; and

4. The system must be able to indicate that at that location there is a passenger requesting the bus.

## 2.3 Non-Functional Requirements

The non-functional requirements of this application are:

1. Invisibility: refers to merging technology into the user's physical environment or decreasing the interaction workload.

2. Privacy: the state or condition of being free to be observed or disturbed.

3. Accessibility: the degree to which a product or system can be used by people with the widest range of features and capabilities to achieve a specified goal in a specified context of use.

## 2.4 Invisibility SIG

Figure 3 shows the Invisibility SIG constructed for GREatBus.

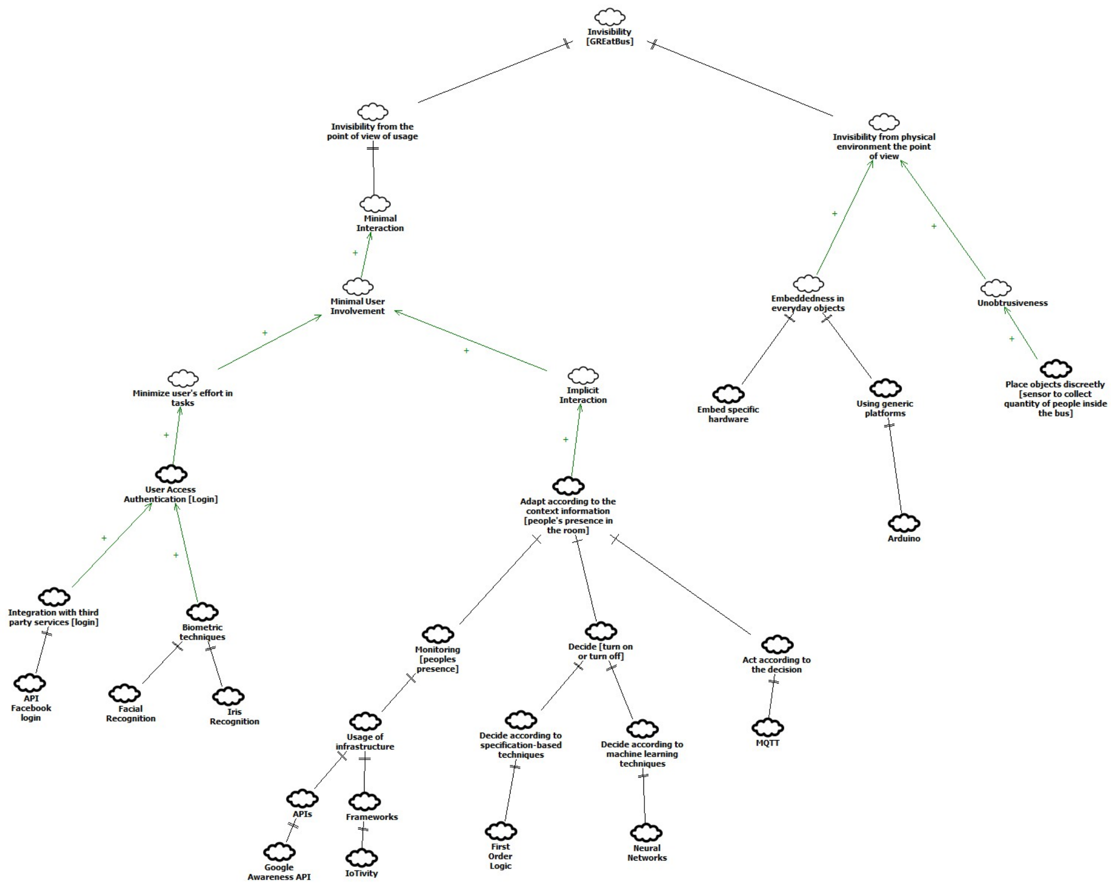


Figure 3: Invisibility SIG for GREatBus System

Description of the operationalizing softgoals:

1. Facebook Log in API: API that allows authentication with Facebook data;
2. Facial Recognition: Technique to identify the user based on their face;
3. Iris Recognition: Technique to identify the user based on their iris;
4. IoTivity: Open source framework that enables device to device connectivity to meet emerging IoT needs;
5. First order logic: Mathematical logic used to specify system states and operators / functions to apply to those states. They provide reasoning support to identify complex contexts and situations;

6. Neural Network: Technique that presents a mathematical model inspired by the neural structure of intelligent organisms that gain knowledge through experience;
7. MQTT: Machine-to-machine (M2M) / "IoT" connectivity protocol. Designed as a publish/subscribe message transport.
8. Embedded hardware: Acting and sensing specific embedded hardware on objects;
9. Arduino: Open source electronic platform based on hardware and software;
10. Place objects discreetly: If hardware devices cannot be fully hidden, they must be discreetly placed in the physical area. Therefore, places where the user does not need to perform actions such as wall and roof corners are ideal.

## 2.5 Tasks

Tasks performed by the participants in GREatBus:

- Task 1: Given the set of operationalizations in the last level of the Invisibility SIG, analyze if they have positive and negative impact with Privacy and Accessibility.
- Task 2: Choose and describe the operationalizations that maximize the positive impact and minimize the negative impact to the required NFRs.

## 2.6 Part of the Correlation Catalog for GREatBus

Figure 4 presents the part of the correlation catalog received by the participants when they had to perform the experiment's tasks in GREatBus.

| Strategy | Type | Quality Characteristic |
|---|---|---|
| Facebook Log-in | HELPS | Efficiency |
| Facebook Log-in | HURTS | Privacy |
| Facebook Log-in | HURTS | Security / Confidentiality |
| Facial Recognition | HELPS | Usability / Accessibility |
| Facial Recognition | HURTS | Functional Suitability / Functional Correctness |
| Facial Recognition | HURTS | Privacy |
| Facial Recognition | HURTS | Performance Efficiency / Time Behavior |
| Facial Recognition | HURTS | Efficiency |
| Facial Recognition | HURTS | Security / Authenticity |
| Iris Recognition | HELPS | Security |
| Iris Recognition | HELPS | Usability/Accessibility |
| Iris Recognition | HURTS | Performance Efficiency / Time Behavior |
| Iris Recognition | HURTS | Efficiency |
| Awareness | HELPS | Functional Suitability |
| Awareness | HURTS | Privacy |
| IoTivity | HELPS | Functional Suitability |
| First order logic | HURTS | Performance Efficiency |
| Neural Network | HELPS | Efficiency |
| Neural Network | HELPS | Performance Efficiency |
| Neural Network | HELPS | Context Coverage / Flexibility |
| Neural Network | HURTS | Usability / Learnability |
| MQTT | HELPS | Performance Efficiency |
| Embedded hardware | HELPS | Reliability |
| Place objets discret | HELPS | Satisfaction |
| Place objets discret | HURTS | Usability / Operability |
| Arduino | HURTS | Reliability |
| Arduino | HURTS | Performance efficiency / capacity |

Figure 4: Correlation Catalog received by the participants for GREatBus tasks