Faculdade de Engenharia da Universidade do Porto

FEUP

Mobile Environmental Noise Protection System

Group 3A

VERSION 1.1

System Concept

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November 8th 2012

Version Control

Version	Date	Author(s)	Approved by the Documentation Manager	Modified Sections	Changes
1.0	06/11/12	Team	X	All of them	Document creation
1.1	08/11/12	Team	X	3.2.4, 3.3, 4, 5 and Annexes	Changes reflecting prof. Américo Azevedo's feedback: added Interfaces subsection and introductory text to Chapter 4's tables. Add a new user (Admin) Updated SBS image

Index

List of Figures

List of Tables

List of Acronyms

AJAX - Asynchronous JavaScript and XML
API - Application Programming Interface
FAQ - Frequently Asked Questions
GPS - Global Positioning System
HTML - HyperText Markup Language
M.E.N.P.S. - Mobile Environmental Noise Protection System
REST - Representational State Transfer
SBS - System Breakdown Structure
SDK – Software Development Kit
SOAP - Simple Object Access Protocol
U.I. - User Interface

Chapter 1

Introduction

The definition of the system concept usually occurs at the beginning of the system development life cycle and it is an important stage of any project.

It helps to achieve a general model or overall view of the system before the detailed specification of all the requirements and design elements. The main goal of developing a system concept is to more easily identify the project's overall scope and boundaries.

This report defines the minimum knowledge of the system that all the teams involved should share, identifying the main system blocks and its interfaces with the users and between its subsystems.

This document is divided into four major sections, all related to the system concept:

- the Concept Generation: a mind map created in the brainstorming stage;
- the System Overview: includes a brief explanation of the project, a schematic representation of the overall architecture, the user descriptions and needs and the clarification of the main interfaces;
- the Concept Evaluation: the concept table and the decision matrixes used for evaluating the different parameters of the system;
- the System Breakdown Structure: hierarchical representation of products and life cycle processes of the system.

Chapter 2

Concept Generation

2.1. Brainstorming

In the beginning of the project, a brainstorming session was done. In this session all possible system actors, processes and components were thoroughly thought through, resulting in the following diagram.

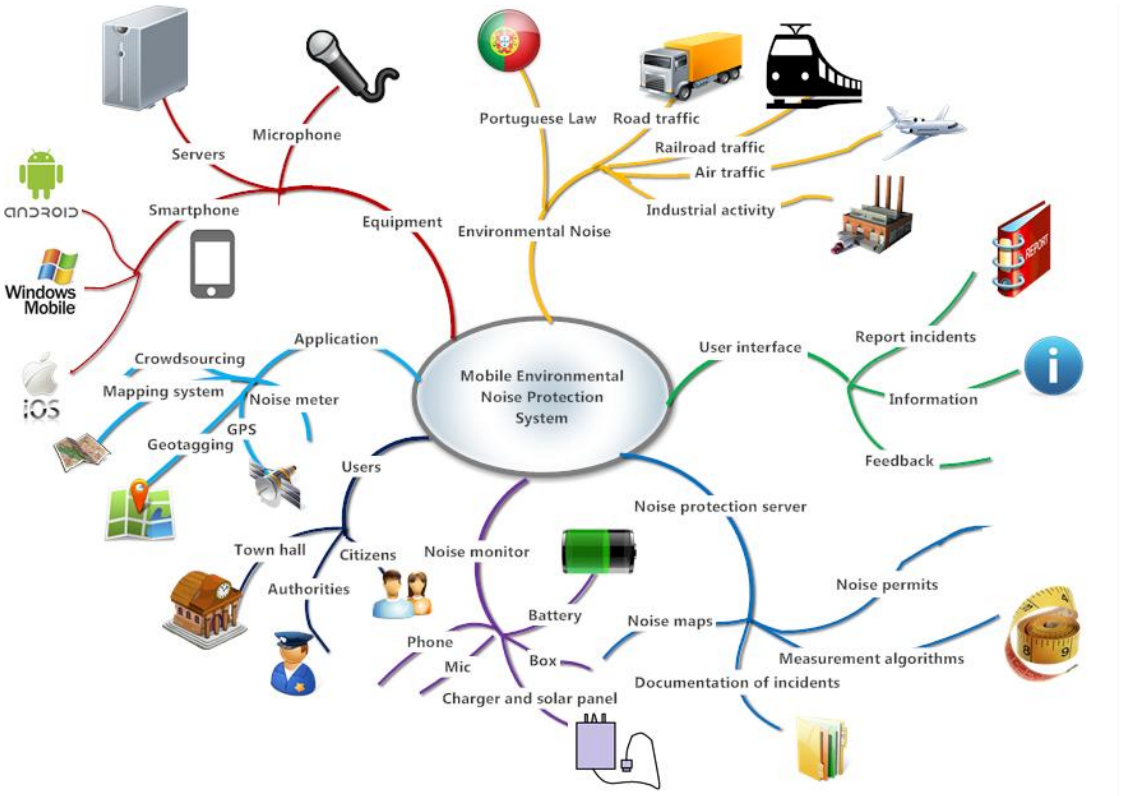

Figure 1 - Concept mind map

Chapter 3

System Overview

3.1. System Description

The Mobile Environmental Noise Protection System is a distributed smartphone based system to protect citizens from illegal noise emissions.

It includes a set of inexpensive and easy to use monitoring boxes that fulfill the legal requirements imposed to noise measuring equipment. These boxes send data to a server that stores and analyses it and the results are displayed to the users through a web page and an Android compatible application.

The M.E.N.P.S. aims to provide a fast interface between city halls that publish licenses for noisy activities, citizens that consult this information and occasionally may want to report noise related incidents, and public authorities that must ensure that legal noise limits are being met. This integrated solution optimizes the response time of authorities to the requests and reports of the population.

The system is divided in three subsystems, corresponding to the three groups presented in figure 2.

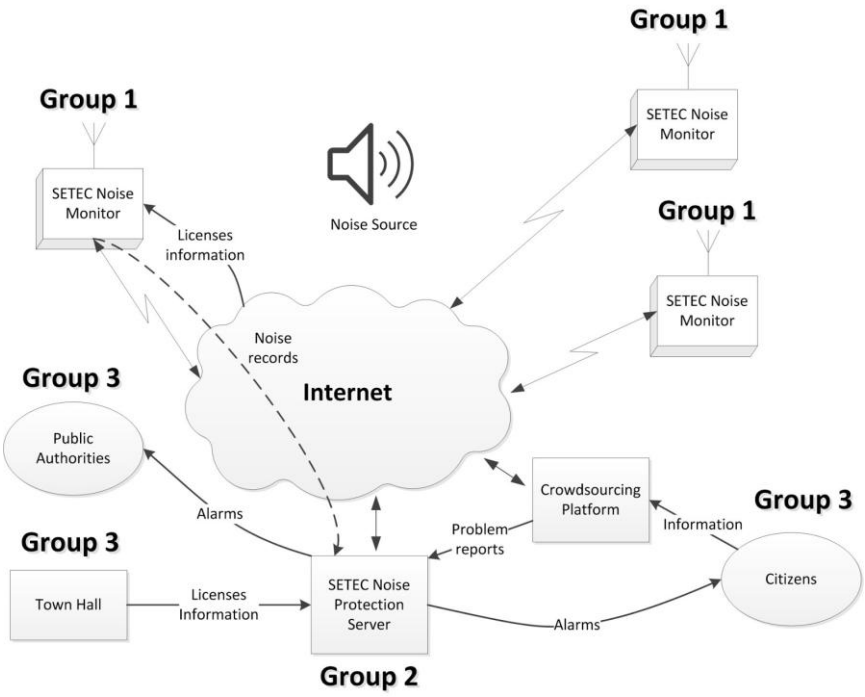

Figure 2 - Overall System Architecture

In this figure a schematic view of the entire system can be shown, enabling a quick understanding of all the system's players - from the measuring boxes to the user interfaces.

G1 - Noise Monitor

- plan, design and build the "noise monitor" hardware, including the box, microphones for sound capturing, a smartphone to transfer data to the server (G2), a battery for long periods of autonomous work and an energy source;
- develop sync-scheme between multiple monitors;
- agree on interface with G2 (noise protection server);
- develop noise measuring application (local part on the smartphone):
    - receive "licenses information" from G2;
    - automatically configure this sub-system (according to license, location, etc.);
    - perform standard measurements (includes influences from temperature, humidity, etc.);
    - cyclically forward data to the server (G2);
    - generate alarms when noise permits are exceeded;
- execute calibration with a reference device.

G2 - Noise Protection Server

- implement the different noise measurement aspects as defined by the law:
    - implement various measurement algorithms;
    - consider special noise permit rules;
    - automatically configure the system according to location of noise monitors;
    - document incidents;
    - produce life and past event noise maps and visualizations;
- agree with G1 (noise monitors) on an interface;
- agree with G3 (crowdsourcing and user interfaces) on interfaces.

G3 - Crowdsourcing and User Interfaces

- design and implement all user interfaces:
  - citizens (report incidents, information, etc.);
  - town-hall (report planned incidents, information from citizens, alarms);
  - public authorities e.g. Police (information from citizens, information related to licenses, noise alarms, etc.) for PC and smartphones;
- implement an integrated crowdsourcing platform:
  - geotag incident reports from citizens;
  - give feedback to citizens;
  - produce incident blogs.

From this point forward the focus will be given to Group 3's work.

3.2. User Descriptions and Needs

3.2.1. Citizens

This is the most common type of user. Citizens can have a general perception of the city's noise levels via a noise heat map. Once registered, the general population can report incidents of disturbance in the noise levels via either the system's webpage or the Android application. Citizens can also view the status of their own incident reports.

3.2.2. Law Enforcement

Once authenticated, law enforcement is able to access a detailed city noise heat map with every incident reported. Law enforcement is also notified whenever a box registers a noise level that is considered illegal according to the law.

3.2.3. City Hall

The Environmental Department or equivalent department within the City Hall, once authenticated on the M.E.N.P.S.'s website, can not only view noise heat maps and every incident reported but also submit licenses and request noise measurements.

3.2.4. Admin

Only the Admin can create high-level accounts for Authority and City Hall users. He can also edit and delete them.

3.3. Interfaces

The subsystem assigned to Group 3 will provide two interfaces: the one for the final user and another for communications with the server from Group 2.

The users will either interact with the system via the website (in the case of all users) or by using an Android application (in case of the citizens). This interface will provide a way for users to use all the systems capabilities, according to their user level.

In order to send and receive information from the server, the subsystem will also use a communication protocol. This channel will provide a way to send user data, receive mapping images and license information and will deliver the sound measurement information to the users.

Chapter 4

Concept Evaluation

In order to make an informed decision and to choose the best tools and technologies for the M.E.N.P.S. user interface, the following concept table and inherent decision matrixes were created.

4.1. Concept table

With this concept table the most prominent solutions were identified for each of the project's development stages.

Application programming	Website programming	Communication protocol
Java	HTML	REST
C	Flash	SOAP
C++	AJAX	

Table 1 – Design choices

4.2. Decision matrixes

To help with the decision making each Design Option was scored according to the following criteria:

- Code familiarity: the teams' kinship with each programming language
- Code simplicity: how easy it is to implement an idea on code
- Support and documentation: availability of quality reference material and supporting libraries
- Performance: how well the final code runs
- Standard API compatibility: how compatible the language is with the Android SDK
- User experience: how pleasant using the software will be for the user
- Security: how safe the communication channel will be.

4.2.1. Application programming

Criteria	Weight	Design Option/Score (1-5)		
		Java	C	C++
Code familiarity	1	4	4	3
Code simplicity	3	5	3	3
Support and documentation	2	5	4	3
Performance	3	5	5	5
Standard API compatibility	2	5	3	3
Score		54	42	39

Table 2 – Application programming decision

4.2.2. Website programming

Criteria	Weight	Design Option/Score (1-5)		
		HTML	Flash	AJAX
Code familiarity	2	5	3	2
Code simplicity	3	5	3	2
Support and documentation	2	5	4	3
Performance	3	4	2	4
User experience	3	5	3	5
Score		62	38	43

Table 3 – Website programming decision

4.2.3. Communication protocol

Criteria	Weight	Design Option/Score (1-5)	
		REST	SOAP
Code familiarity	2	4	4
Code simplicity	3	5	3
Support and documentation	2	5	4
Performance	3	5	4
Security	3	4	4
Score		60	49

Table 4 – Communication protocol decision

Chapter 5

System Breakdown Structure

The system breakdown structure gives an overall view on the system's hierarchy of products and processes that incorporates the system's architecture.

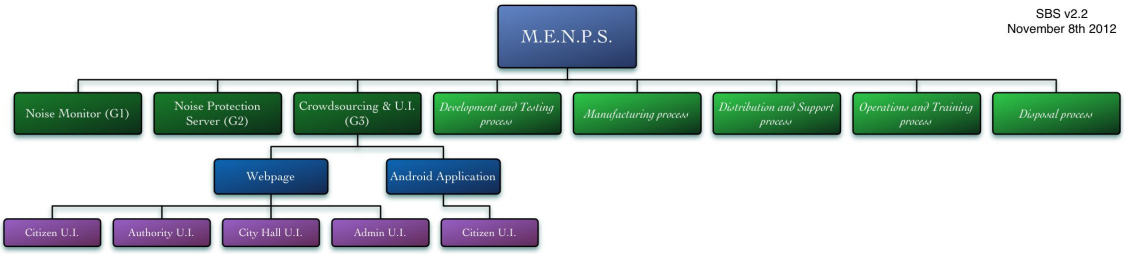

Figure 3 - System Breakdown Structure (cf. Annex 1 for an enlarged view)

- The Development and Testing process consists on building the webpage and the Android application using the tools chosen previously. After the development phase, a thorough testing phase begins, in which programming bugs are detected and corrected. Afterwards, an integration period will take place to incorporate all groups' subsystems into working prototypes.
- Manufacturing process belongs to group's one work.
- The Distribution and Support process pertains to making the software widely available to the public, being this through making the webpage public on the Internet or the Application on Google Play and providing support by updating the webpage or via new application versions.
- In the Operations and Training process the users should be actively using the system, which may require an initial training phase for the top level users. The common citizens may have a help manual and/or a FAQ page.
- In the case of software installed on smartphones, the Disposal process consists simply on uninstalling the application. For each user account there should be an option that allows its removal from the system. There is no Disposal process for the website.

References

[1] AZEVEDO, Américo – "Conceito do Sistema", v1.0, November 6th 2012
[2] http://developer.android.com/tools/index.html, retrieved on November 6th 2012

Annexes

Annex 1 – System Breakdown Structure

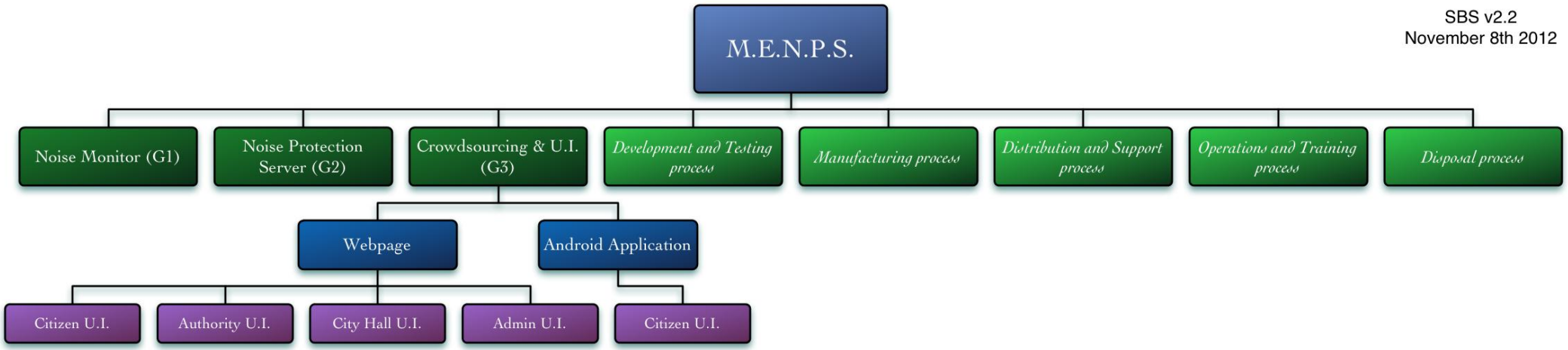

Figure 4 – System Breakdown Structure (enlarged)