GAIA - Green Awareness In Action

D3.1 – Applications Prototypes

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Author(s)	Nelly Leligou, Manos Zacharioudakis, Jimm Lerch, Joerg Hofstaetter, Jochen Kranzer, Andreas Friedl, Georgios Mylonas, Dimitrios Amaxilatis
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4/2/2017	1.0	Georgios Mylonas	Final contributions

Abbreviations

Abbreviation	Expression
BMS	Building Management System
DoW	Description of Work
EC	European Commission
EPB	Ethics and Privacy Board
GA	General Assembly
IoT	Internet of Things
IPR	Intellectual Properties Rights
KPI	Key Performance Indicator
PhC	Phone Conference
PIR	Passive InfraRed (sensor)
PM	Person Months
RoI	Return of Investment
SC	Steering Committee
TC	Technical Committee
TCB	Trials Coordination Board

Executive summary

Research in GAIA aims to undertake 6 fundamental operational activities: Education, Development, Utilization, Engagement, Competition and Operation. Each of these activities contain specific services and/or applications that support a wide-ranging set of participatory activities for the primary target groups. These applications will also make use of data being collected by GAIA's IoT infrastructure, or, in some cases, directly supplied by participants in such a way that they may gain a better understanding of energy consumption issues resulting from their behavior/decisions.

This deliverable summarizes the work conducted thus far in Work Package 3 of the project, by describing the state of development regarding the abovementioned applications, clarifying the work that has been performed thus far in the three Tasks of this Work Package:

- *Task 3.1* – Community Engagement and Social Networking Game.
- *Task 3.2* – Educational Serious Game.
- *Task 3.3* – Application for Building Managers.

Overall, since these tasks correspond to the implementation of 3 applications for the project, this document provides insight to the state of their design, which has been discussed to a certain degree in Deliverable D1.1 of the project, and implementation.

With respect to the objectives of WP3, as described in the DoW, this document addresses the following:

Application	GAIA Objective
Building Managers Applications	• Development of a participatory sensing application specialized for the needs of GAIA. • Development of a direct visualization application depicting in various forms and various aggregation and analysis levels energy consumption information. • Development of a web-application for building managers
Educational Game	• Development of the educational-serious game for the students of schools and universities.
Social Networking Application	• Development of social networking applications interfaces for diffusing information from GAIA to the general public.

The integration of the educational-serious game with the social networking applications and social networking competition games is also progressing, and the related concepts will be further refined during the first trials period of the project in the coming months. Overall, the applications discussed in this document, by using the appropriate services of WP2, provide a set of functionalities that aim to make the whole participation in GAIA more personal, useful and enjoyable.

Finally, the applications prototypes for WP3 are online, since most of the functionality has been implemented as a set of online websites. This online presence is being accompanied by the provision of a large part of the source code used in the implementation of these prototypes, as discussed in Section 6 of this document.

Contents

1. Introduction

This deliverable comprises the first version of the GAIA applications which are developed in the framework of WP3 (all its three tasks). As it is of demonstrator type, this document is accompanying the open source code of the applications which are stored and openly available through GitHub. This document presents the specifications of the prototype. It summarizes the work of task T3.1, 3.2 and 3.3.

Methodology

GAIA aims at improving energy efficiency by increasing awareness of specific target groups. To achieve this goal, we exploit the infrastructure available at schools and enrich it towards gathering information. This information is used by a set of applications to guide energy efficient behavior which is assessed through the continuous monitoring of building energy consumption.

GAIA application set includes three applications: applications for building managers, educational games and social networking applications. These three applications and the fundamental operational activities they contribute to, are shown in the following table.

Table 1: The contribution of the GAIA applications in GAIA's fundamental activities

	Education	Development	Utilization	Engagement	Competition	Operation
Social networking		√		√	√	
Educational serious games	√	√		√	√	
Apps for building managers			√			√

The methodology we follow towards designing the GAIA applications and achieving our goals with the predefined budget and timeline consists of:

Step 1: We present the GAIA applications from a user perspective describing representative use scenarios.
Step 2: We use these scenarios to identify technical requirements.
Step 3: We specify the applications from a technical point of view defining also their interfaces/interactions with the GAIA cloud platform.
Step 4: We provide guidelines for exploiting the GAIA applications towards achieving the KPIs described in D1.1, which can also be considered as a validation step in an attempt to make sure that the application which will be developed will actually contribute towards the specified KPIs.

Structure

The structure of the deliverable follows the methodology described previously. In each chapter a separate section per GAIA application is included. Finally, conclusions are reached in the final chapter.

2. GAIA applications- concepts and use scenarios

As stated in the DoW, WP3 is engaged with the development of end-user applications for GAIA. This chapter provides a conceptual overview of the software applications either on interactive installations, on the Web, on smartphones or using social networking applications for engaging users (students, teachers, building managers, etc.) in order to successfully share information with the general public. The Community Engagement and Social Networking Game, the Educational Serious Game and the Application for Building Managers have all been designed with the a various group of end-user's in mind and utilize a wide variety of techniques to engage those users.

2.1 Community Engagement and Social Networking Game (Scavenger Hunt)

SocNetComEn Game

Scavenger Hunt #Hashtag game
The *Community Engagement and Social Networking Game (SocNetComEn game)* and *the Educational Serious Game* have to be distinguishable entities to be compatible with the DoW (and to avoid confusion and problems). However, there is a strong overlap of ideas and goals that go hand in hand with each other, such as the concepts of raising awareness, sharing information, expressions of creativity and competition. In an effort to promote the similarities, yet remain separated we will be using a mobile-responsive website that functions like an app on smartphones and tablets and as a website on computers that will host the SocNetComEn game, a type of web scavenger hunt using #hashtags for tracking purposes, and will also have additional GAIA-related resources available as well as a place where we can share the student-created content from the educational serious game.

Through the use of the game, utilizing various social networks and websites, the Community Engagement Social Network Game aims to:

- Make the offerings of GAIA known to a wider audience;
- Raise awareness about energy efficiency among users that, through active participation, promotes behavioral change;
- Create a unique environment to participate with GAIA;
- Attract a wider base of participants beyond the target groups within the trials;
- Provide an additional means to interact with our community;
- Allow for our metrics, methods and results to be shared across more social networks;
- Promote return/continued visits;

● Motivate the community, even trial participants in the Educational Serious Game, to engage and play; and
● Be fun!

Gameplay

As mentioned above, the SocNetComEn Game will be a web-based scavenger hunt where players will be asked within the game to do one of the following on a weekly basis:

● Look for a specific thing or things,
● Find an answer to a question,
● Complete a certain task,
● Create a unique image/GIF/video, or
● Analyze and share something.

The idea is based around a type of web-based scavenger hunt where online players from different countries are asked to answer certain weekly questions or undertake certain activities via their respective personal social media accounts (primarily Facebook, Instagram and Twitter, but others can be used as well). Their responses to these weekly scavenger hunts will include two types of #hashtags. One hashtag will be specifically related to each particular question/activity, while the other hashtag will signify the user's respective country. The question/activity hashtag will be used to track the question and the country hashtag will be used to track the score for that country which will be shared on our project website as well as through social media in order to provide for some motivation to participate through a type of national competition. The intended goal is that this game will ask the players to do some work finding the answer by conducting deeper exploration of information on not only project-centered information on our website and various social networking accounts, but also other online locations so that they may learn more about issues central to GAIA's goals in order to effect behavioural change due to increased issue awareness. Examples are shared below or may be directly accessed in the demo app.

This platform has been tested and used by EDOC for a few years now without any major technological flaws that hampered its usability. Additionally, there are various sections within this application for SocNetComEn game that will be expanded upon, section by section, in this document.

● **GAIA Scavenger Hunt** - This is the SocNetComEn game
● **GAIA Challenge Weekly Gallery** - This is a collection of some of the student-created content from the Educational Serious Game (T3.2).
● **Participating Schools** - Has some information about all of our trial schools
● **Meters/Data** - This is a placeholder section where we hope to have live metering data available (depending on the lag it may generate) and information about the GAIA meters/sensors.
● **GAIA Website** - Will directly open the GAIA Website.
● **Twitter** - Will directly open to the GAIA Twitter page to allow for direct posting.
● **Facebook** - Will directly open to the GAIA Facebook page to allow for direct posting.

Additional sections may be added later (such as a polling feature for direct player interaction and feedback), but this app is not intended to mirror our website, but to be an additional tool/resource to direct players to discover our website and social media presences as well as to persuade the players to explore other website dealing with the core issues of our project. Also, at this stage we are trying to keep the app pretty lightweight to prepare for the streaming of metering data. A more in depth look at all sections is presented in Chapter 4.

Use Cases

Use Case 1: Teacher shares the #ScavengerHunt link with their class
This is the optimal scenario for the use of this game as it will enhance the educational experience with some online searching and solving scenarios.

Use Case 2: Student tells friends, parents, and/or family members about the #ScavengerHunt
This will increase not only the level of information spread, but also encourage return visits along with the opportunity to raise awareness through discussion.

Use Case 3: Random person online sees Tweets or FB/Instagram posts with interesting hashtags and participates
This scenario is important for the level of information spreading and viral penetration.

Use Case 4: GAIA content manager uploads latest hunt
The interface is easy to use for the addition of the weekly challenges in multiple languages across all platforms,

Social Networks Overview

Finally, as social networks are the key to this game, it is critical to understand which social networks will be used and how. Social network pages created for information sharing relating to Tasks 3.1 and 3.2 with an explanation of how each will be used follows:

- Facebook
    - As stated in the DoW, this will be one of our primary outlets for sharing not only Project-wide dissemination information, but also daily posts, the latest Scavenger Hunt challenge and promoting overall GAIA engagement and interaction.

○   The hope is that students, parents, teachers, community members will follow our page. Once they have followed, any posts that we make will show up in their respective newsfeeds (the heart and soul of FB), unless they have their notifications turned off.

○   The goal will be for them to "like" and/or "comment" on our post(s). Whenever there is an interaction like that, the post may gain further reach and could show up in the newsfeeds of their friends (FB algorithm controls this). If they decide to "share" our post, it will certainly show up in the newsfeeds of their friend and possibly friends of friends.

○   Scavenger Hunt participants will receive some monthly "shout outs" on #FollowerFridays.

○   Now that FB has live stream capabilities for verified pages, our followers can be notified when we are casting and join in the conversation (similar to Periscope mentioned below).

○   The tracking of reach is easily seen through FB analytics and may further be tracked via #hashtags.

○   An addition to the general Facebook page will be the addition of a specific "Tab" that will allow us to prominently display some metering information directly to Facebook.

● Twitter

○   Also mentioned in the DoW, this will serve a similar as FB as this will also be one of our primary outlets for sharing not only Project-wide dissemination information, but also daily posts, and promoting GAIA engagement and interaction.

○   The hope is that students, parents, teachers, community members will follow our account so that our tweets will show up in their individual newsfeed.

○   The goal will be for the target audience(s) to like and, especially, retweet our posts so that the post would show in the private newsfeeds of their respective followers.

○   Scavenger Hunt participants will receive some monthly "shout outs" on #FollowerFridays.

○   An interesting feature is that we can make a list of any twitter accounts (individuals, companies, organizations, etc.) that we believe have an interest in what we are undertaking in GAIA. This will begin our digital building of the Network of Stakeholders as well as reach accounts we may not normally reach (everyone like being added to a list and often follows).

○   An additional interesting feature is that we can use their add-on, Periscope, for monthly live conversations, if that is desired.

○   The tracking of reach is relatively simple with direct info on each post, but also via the #hashtags we will use.

● Google+

○   This network is not actively used by many people, but it is worth using due to the simplicity of sharing information, tracking reach and potentially reaching people in other "circles" that are interested in the issues GAIA is addressing.

○   Easy tracking of reach and also #hashtag friendly

● Vine

○   This is also a relatively small network, but it has a passionate base group of users with which we can reach.

○   This is also a fun network where we can utilize their unique system for creating unique, user-created content like GIFs relating to the Scavenger Hunt.

○   Easy tracking of reach and #hashtag friendly

- Snapchat
  - This is where the kids are...ALL across Europe. While many have the other social networks mentioned here, studies are continually showing more and more time being spent in this time limited, fun-filtered, photo-sharing network.
  - The goal is to have an on-demand geo-filters account where our snapchat followers will easily be able to share our messages with their friends.
  - Not #hashtag friendly, but reach is trackable otherwise.
- Instagram
  - A popular photo-sharing network that has a gallery where we will share our Snapshot messages in .jpg form to a wide audience with the smart usage of specific green awareness related #hashtags.
  - Obviously, #hashtag friendly.
- YouTube
  - Video sharing network where we can create/publish our own videos explaining any number of activities/items within the project.
  - Also we can highlight student-created videos and/or create playlists relating to various topics important to GAIA.
  - Easy tracking of reach and very #Hashtag friendly
- Reddit
  - Reddit is a chat forum that is divided into various sections (subreddits), where people from around the world discuss, often at length, very issues that is important to them. This is where we will host a subreddit on green awareness under the /r/environment section.
- Imgur
  - This is a fun network for sharing images and memes. Our main use here would be when we decide to have a meme creation competition for the Scavenger Hunt.

2.2 Educational serious game (GAIA Challenge)

2.2.1 Concept

2.2.1.1 Introduction

The educational serious game, as specified in the DoW, is expected to fulfil a range of tasks: creating awareness on the ubiquity of energy consumption, creating awareness on our responsibilities in regards to environmental habits, reinforcing the message that behavioural change can have an influence on energy consumption as well as teaching concrete measures on how energy consumption can be optimized.

Although these objectives can without a doubt be targeted in the form of a video game, a critical factor needs to be addressed with a rather high priority: The accessibility, the ease of use and the availability of the game to the students and their social surroundings (family, friends, teachers, etc.) should be as high as possible in order to reach the widest possible audience.

Presumably, no other medium besides the Internet shares the same amount of appeal and popularity that videogames have to our target group. Especially community driven online portals are very popular among young students of all age groups.

Computer- and mobile games often require powerful hardware, quite some local storage space (which might usually not be a problem on computers but it's still an issue on Tablets) and an installation process (which is an often an underestimated inhibition threshold). In contrast, web based applications benefit from a more or less one-click access.

The above mentioned factors led us to the design of the GAIA challenge. It is a gamified online challenge which aims to raise students' as well as teachers' energy awareness relating to their school building. It will be accessible through web browsers on desktop computers and mobile tablets.
The challenge utilizes gamification mechanics to motivate all participants to:

- engage with energy saving topics,

- work on online quests,
- participate in real life activities,
- experience their impact on the school building's energy consumption over the course of the challenge,
- compete and compare against other school communities (even from other countries) and share their experiences with their peer group.
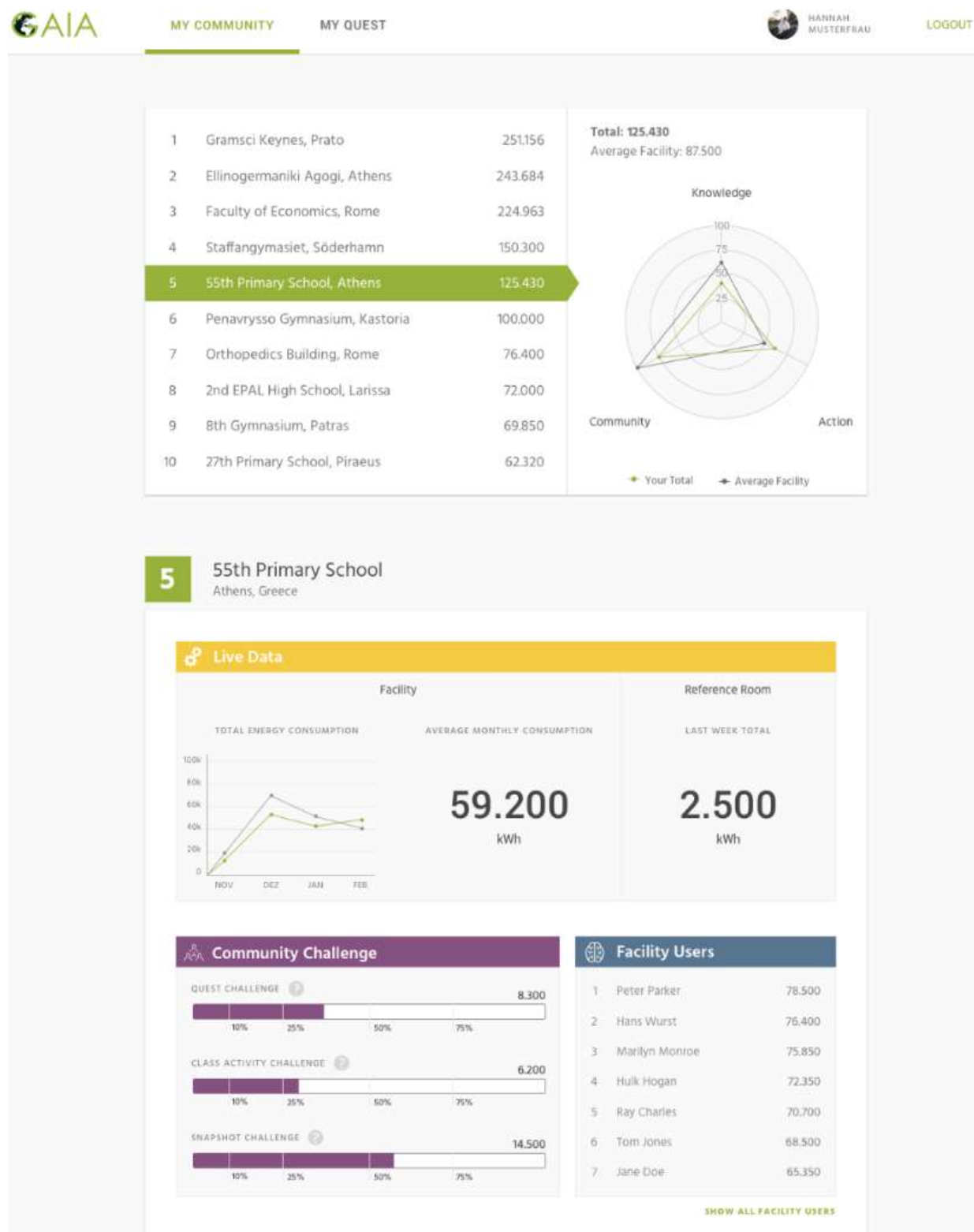
An integral part of the GAIA Challenge is the visualization of live data from sensors in the buildings. It is used in order to visualize a real life impact of the participants behavior, build collaboratively (within a school) and competitive (between schools) gamification elements upon the real life impact.
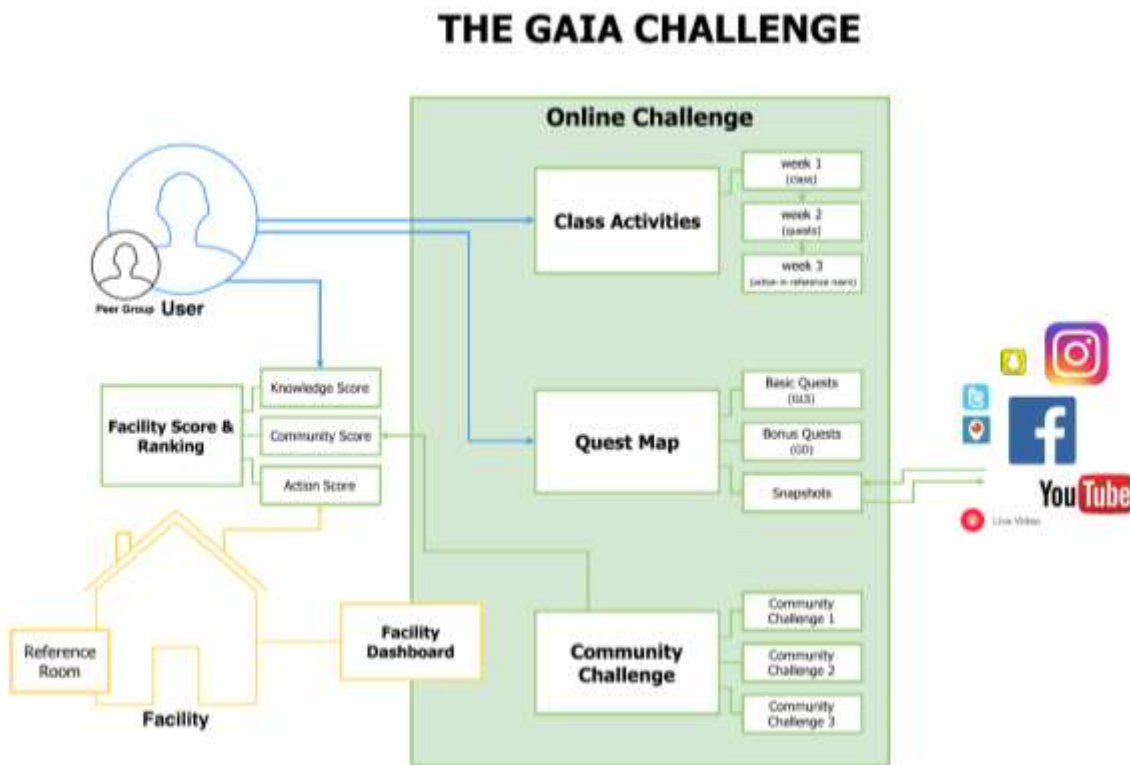
- Challenge Dashboard – "My Community"

The challenge dashboard is the main hub of the GAIA Challenge. It's a page on the website which shows a list of all participating schools and their scores. The user can select a school from the list and inspect the building's data, progress in the community challenges and the user ranking. Also a list of recent snapshots by the school's students is shown.

Visitors who do not participate in the challenge have to select a school from the list for further investigation. Logged in users have their school preselected but can also inspect other schools.

GAIA   MY COMMUNITY   MY QUEST   HANNAH MUSTERFRAU   LOGOUT

1	Gramsci Keynes, Prato	251.156
2	Ellinogermaniki Agogi, Athens	243.684
3	Faculty of Economics, Rome	224.963
4	Staffangymasiet, Söderhamn	150.300
5	55th Primary School, Athens	125.430
6	Penavrysso Gymnasium, Kastoria	100.000
7	Orthopedics Building, Rome	76.400
8	2nd EPAL High School, Larissa	72.000
9	8th Gymnasium, Patras	69.850
10	27th Primary School, Piraeus	62.320

Total: 125.430
Average Facility: 87.500

Knowledge

Community   Action

→ Your Total   → Average Facility

5 55th Primary School
Athens, Greece

Live Data

| Facility | | Reference Room |

TOTAL ENERGY CONSUMPTION   AVERAGE MONTHLY CONSUMPTION   LAST WEEK TOTAL

100k
80k
60k
40k
20k
0
NOV   DEZ   JAN   FEB

59.200
kWh

2.500
kWh

Community Challenge

QUEST CHALLENGE   8.300
10%   25%   50%   75%

CLASS ACTIVITY CHALLENGE   6.200
10%   25%   50%   75%

SNAPSHOT CHALLENGE   14.500
10%   25%   50%   75%

Facility Users

1	Peter Parker	78.500
2	Hans Wurst	76.400
3	Marilyn Monroe	75.850
4	Hulk Hogan	72.350
5	Ray Charles	70.700
6	Tom Jones	68.500
7	Jane Doe	65.350

SHOW ALL FACILITY USERS

School Ranking

The school ranking is a list of all participating GAIA schools. The radar chart as well as the other widgets on the page update their data when a school is selected from the list. The radar chart shows details on

the school's score and how it is computed from the three sub-scores (bright colors). The average school's sub-scores (dark colors) allow easy comparison.

Scores

The total score (which rates the overall performance of the school within the challenge) is computed by three sub-scores:

Knowledge Score

The knowledge score is the sum of EXP of all school users divided by the school's individual EXP maximum. Each user is rewarded with EXP (experience points) for their performance on completed online quests. To ensure comparability between schools a school's individual EXP maximum is computed via the potential school maximum user count (this is the average number of students + school staff from the previous years) times the maximum EXP a single user can earn in the challenge.

Community Score

The community score is the sum of all community challenge points. The community challenges are already computed relative to potential school user count; therefore, the score is comparable between schools.

Action Score

The action score is computed from the building's meters/sensors. In order to ensure comparability between buildings the utilized algorithm is based on a building-specific baseline. In the beginning of the GAIA Challenge an initial baseline computed from the first year observation will be used as a reference. Once the GAIA Challenge has started and new energy data is available, a new goal threshold will be computed on a monthly basis. This new adaptive baseline will be used to compute the action score.

The algorithm works as follows:

- goal threshold = (last month's goal threshold + last month's actual value) / 2
- delta = goal threshold – actual value
- score += max(0, delta)
  - in months where the actual value was higher than the goal threshold no negative score is added
  -
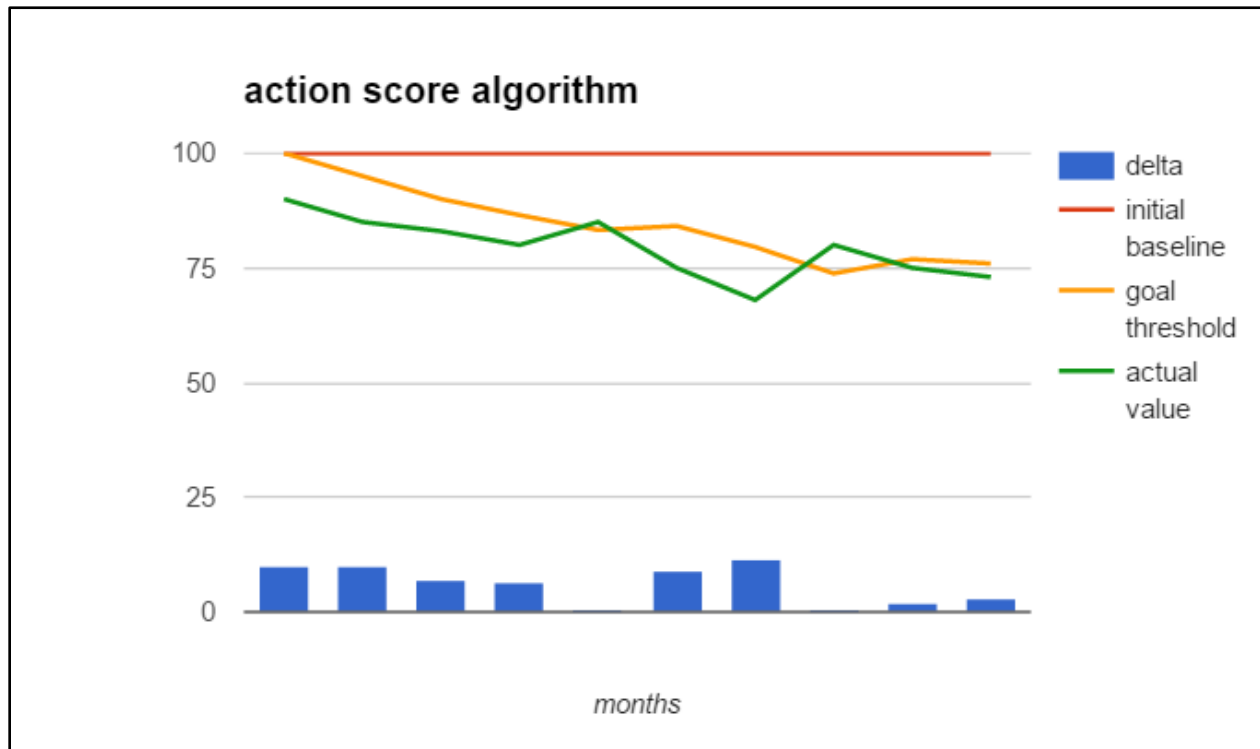
The algorithm's aim is to reward action points only as long as the energy consumption is continuously falling. If the consumption level was falling during a month but stayed on the same level the next couple of months there will only be a substantial reward for the first month because the goal threshold is adapting to the actual value over time. In the following months the rewards will continuously decrease until in the month where the goal threshold reaches the actual value there won't be any reward at all.

Live Data

The Challenge Dashboard will contain a widget showing information about the current and past energy consumption of the user's school building:

Data	unit	update interval
Total building energy consumption of the last (~6) months. The current month is not shown.	kWh	monthly
Average monthly energy consumption of building	kWh	monthly

Building live energy consumption data	W	every n minutes

We are open to suggestions about data to show in the GAIA Challenge dashboard. However, we have to keep in mind that the main purpose of the GAIA Challenge dashboard is be to provide easily readable and understandable data/graphs which gives the students an idea about how their behavior has an impact on the energy consumption.

- Quest Map

The Quest Map is an interactive visual representation of the user's progress in the challenge. It's a page on the website which symbolizes the user's journey from the start (top) to the finish line (bottom) of the challenge. The map is divided into seven topics (five regular topics and two class activities). Each topic features a number of quests which can be started by clicking on the associated quest node on the map. In the beginning of the user's journey the map is covered completely with clouds and only the Quest Nodes are visible. By playing and completing quests the user slowly uncovers the map and all its details and animations.

Topics (Curriculum)
The quest contents are categorized into the following regular topics:
- Introduction
- Heating
- Transportation
- Electricity
- Collaborative Use of Resources

Additionally, there are two topics which are only available during class activities.

Quest Gameplay
The core gameplay of the GAIA challenge is located in the quests and the quest map: Each quest holds multiple tasks which are played sequentially directly in the browser. When a player clicks on a quest node on the map the quest is started and the first task appears.

A task has one of several types:
- Text Quiz (Single Choice)
- Text Quiz (Multiple Choice)
- Image Quiz (Single Choice)
- Image Quiz (Multiple Choice)
- Image Drag and Drop
- Cloze
- Number Slider
- Map Search
- Image Picker
- Items Rearrange

Fruit salad

There are so many different kinds of fruits.

Which are your favourite kinds of fruits? (select multiple)

Stand by me!

Each household usually has a couple of electronic devices such as Computers, TVs and DVD Players. Your family probably uses them on a daily basis. However, these devices are usually not required to run all day, so your turn them off. But what actually happens when you press the red button on the remote?

What happens if you turn off your TV with your remote?

- ✓ It switches into sleep mode (stand-by).
- ☐ It powers off completely.
- ✗ It does not consume any power anymore.
- ☐ It does still consume a little energy.
- ☐ It does still consume a lot of energy.

Most electronic devices such as PCs, TVs and remote controlled devices switch into sleep mode (also called stand-by mode). Many devices signify this mode with a small red colored light. Be aware that even in this mode the device still does consume some little energy.

The user submits his answer to a task and immediately receives feedback. Then the next task appears and so forth. Eventually, after all tasks have been answered there is a result screen summarizing the users' performance and EXP score on the quest. When the user comes back to the quest map the quest node is marked as completed, the gained EXP is immediately added to the user's personal score and the quest map reveals a previously hidden area.

As each quest has a playtime of approximately 10-20 minutes the user can freely decide whether to split the gameplay into many small sessions or into few large sessions. Through the immediate feedback on their performance it is easy for the student to see the impact their performance has on the community and school scores. In order to allow students to try again and improve their score, quests can be replayed as often as they wish.

- Class Activities

Class Activities are crossovers of learning directly in class, engaging in the online challenge and on-site engagement in the school building. A Class Activity requires a teacher and on-site engagement. Thus, only students of a school can participate. A teacher can start a Class Activity for his/her class at any time during the online challenge. Class Activities are optional as it is not guaranteed that every school has teachers that are willing to participate.

A Class Activity is divided into three parts (1 week each):
- Learning the theory (week 1)
  - The teacher focuses on a specific topic with his/her class directly in the classroom.
  - The GAIA consortium provides learning materials which will be downloadable (PDF file) for teachers.
- Consolidating the knowledge (week 2)
  - The respective Class Activity on the Quest Map unlocks for students of the class.
  - The students of the class play the online quests which are all related to the topic from week 1.
- Applying the knowledge (week 3)
  - The teacher and the students apply the acquired knowledge in the school building on-site.
  - They can track their impact through the visualized tracking data on the challenge dashboard.
  - Optionally, as a windup the teacher creates a Snapshot and thereby documents the outcome of the Class Activity.

Class Activities need to be scheduled in a way that the rooms which are equipped with the sensors for metering the class activity impact are available for the class in week 3. It is therefore up to teachers to schedule the class activities.

- Community Features

Community Challenges

Community Challenges are predefined goals all people related with that a school building (students, teachers, staff, etc.) have to work towards together. During the course of the GAIA challenge each participating school will have three Community Challenges. Each of them is based on a specific metric. Its completion rate is always a percentage value and thus can easily be communicated visually. The progress of each Community Challenge adds to the school's Community Score.

The challenges are:

- The Quest Challenge
  - Users have to complete as many quests as possible.
  - The completion rate of this challenge is the sum of all quests completed by students of the school divided by the potential school maximum quests count (this number depends on the potential school maximum user count)
- The Class Activity Challenge
  - Students have to convince their teachers to start as many class activities as possible.
  - The completion rate of this challenge is the sum of all school's class activities started divided by the potential school maximum class activities count (this number depends on the school's class count)
- The Snapshot Challenge
  - Users have to submit as many Snapshots as possible.
  - The completion rate of this challenge is the sum of all snapshots submitted by users of a school divided by the potential maximum snapshots count for the school (this number depends on the potential school maximum user count)

Snapshots

A Snapshot is a mixture of media content (photo, video) and a description (text). The user is asked to document some aspect of the GAIA Challenge (or the whole GAIA project) in form of a photo or video. Each Snapshot is related to a topic and thus gives the user a rough idea on the subject. Though, Snapshot specifications are held rather broad in order to not limit the users and to allow creativity. Users should be able to use Snapshots to document all kinds of findings, experiments, explorations and Class Activities.
Each Snapshot has a public canonical URL which allows users to share them on social media. Selected Snapshots will also be utilized/shown in the *GAIA Challenge Weekly Gallery* which is part of the *Community Engagement and Social Networking Game*.

Snapshot Gallery

At the very bottom of the Challenge Dashboard each school has its own gallery which shows all Snapshots submitted by its users. The aim of the Snapshot gallery is to provide a centralized location where visitors can read through the students' experiences with the GAIA challenge.

School Building Dashboard

The School Building Dashboard is a separate page on the GAIA challenge website. It features a narrowed down view of the Challenge Dashboard. It shows information on the school's challenge progress. If the infrastructure of the building allows it the dashboard can be shown on a public display in a central room (e.g. the main school hall).

Use-cases

The GAIA Challenge prototypes (D3.1) fulfills the following use scenarios:

Use case – 0: Get general information about the GAIA Challenge
Visitors and users want to get general information about the GAIA Challenge:

- What is the GAIA Challenge and how does it work?
- Which schools are participating?
- How does the scoring system work?

Use case – 1: Registering as a student
Users/Students need to be able to register for the GAIA Challenge and thereby create a user account.

Use case – 2: Registering as a content manager
Content managers need to be able to register and login to the GAIA Challenge Backend in order to access the backend.

Use case – 3: Authoring content as a content manager
Content managers need to be able to author the educational challenge contents. They should be able to edit:

- topics
  - assign quests to topics
- quests
  - assign tasks to quests
  - rename quests
- tasks
  - set task-type
  - set quest-description
  - set solution
  - set images/texts
  - set points

Use case – 4: Edit user profile
All users need to be able to manage their user profile (username, avatar, email). Email address must be optional.

Use case – 5: Interact with educational content

Users/Students need to be able to play quests and work through their tasks (as for D3.1: at least one full topic, 20-30 minutes of gameplay). Users also should be able to replay already solved quests.

Other use cases (planned for D3.2)

More use cases are planned for the ongoing development of the GAIA Challenge for D3.2:

- Assigning student-users to a class
- Registering as a teacher
- Get more detailed information about the GAIA Challenge
    - How many active users are there?
    - What is the current school ranking?
    - What is the current knowledge/community/action score of a specific school?
    - What is the current user ranking in a specific school?
- Create and submit Snapshots as a student-user
- Explore user created content in the Snapshot Gallery as a visitor

2.3 Application for Building Managers

Overview of the application

The application for building managers is designed and developed in task 3.3 and aims to fulfil the following WP objectives:

- Development of a web-application for building managers.
- Development of a participatory sensing application specialized for the needs of GAIA.
- Development of a direct visualization application depicting in various forms and various aggregation and analysis levels energy consumption information

As described in the DoW for task 3.3, this task will develop:

1. A smartphone application for participatory energy metering. This app will be customized **for *all* the targeted audiences**. Apart from students and faculty, building managers are key actors for energy efficiency in buildings.

2. The Operation-Dashboard will be a website that will help building managers to identify saving potentials and malfunctions of their building. The dashboard will allow uploads of energy consumption in typical formats (manual entered monthly readings, file upload of hourly or 15-minute values) combined with metadata on the building such as type, age, size, etc. The dashboard will automatically be fed with all data coming from different schools in order to provide to a school manager the necessary information and recommendations to perform actual energy saving strategies. The application, by using the appropriate services of WP2, will process the data and provide benchmarks on the building performance going beyond state of the art energy management systems by producing detailed benchmarks not only for energy consumption but also indicators for peak and base loads on different days of the week, operation schedules of the building etc. Significant changes in the time series for each indicator will be marked. By using a building database, the dashboard will also provide benchmarks with other buildings of the same type, size, age, etc., thereby combining individual monitoring of historic data and comparisons with a typical sample of buildings.

Use cases

The building manager will be able to perform the following high level actions:

1. Insert building specific information (this will allow for buildings comparisons and anomalies detection)
2. Insert data regarding building status (e.g. sensor readings or occupancy information) realizing participatory sensing
3. Inspect building status and monitor building performance (building analytics)
4. Receive valuable suggestions for energy savings.

5. Communicate through social networks with other building managers and/or experts to get advice on energy savings (to be further discussed)

In the sequel, we elaborate on the information communicated between the building manager application and the involved actors.

Use-case – 0: Registering a user

The user enters the GAIA portal (through either a laptop or a mobile device) and registers himself providing: Full Name, desired username, e-mail address, and the role he intends to play selecting among: Building manager, teacher, student and the relevant school. (We assume here that each actor belongs to the community of one school and not multiple. If this assumption does not hold, a limited number of role/school pairs will be available to select.)
The administrator receives a notification and provides the user with the necessary info.

Use Case- 1: Registering a building

The building manager will be able to insert information relevant to the building including (after successfully logging in). This information includes:

- School name
- Building/area ID (to enable having multiple buildings in each school)
- Number of individual rooms (e.g. classrooms)
- Serial number of the consumption meter
- Geographic location
- Surface (m²)
- Inhabitants (number)
- Floorplan (image file)
- Age
- Whether there was intervention /Date of intervention
- Infrastructure different from classrooms (gym, pool, cantine)
- Orientation
- Energy types available (electricity, gas, petrol)
- Yearly consumption per energy type
- Yearly energy cost and footprint
- Does the school cover student/teacher transfer?
- Name of responsible for consumption monitoring/dedicated building manager or principal
- Average number of hours the school is occupied per day
- Type of windows (single /double glass)
- Type of heating system/energy source used
- Date of heating system installation
- Is there an automated thermostat installed? (Yes/No)

- Which is the threshold value? 20° C?
- Is there cooling system installed?
- Type of cooling system/energy source used
- Date of cooling system installation
- Are there fans?
- Is there an automated thermostat installed for the cooling system? (Yes/No)
- Which is the threshold value for the cooling system? 20° C?
- Are the heating and cooling systems serviced regularly?
- Are the heating and cooling system tubes insulated?
- What kind of bulbs is used for indoor lightning?
- What kind of bulbs is used for outdoor lightning?
- Are they cleaned regularly?
- Operating devices (Number of available PCs, refrigerators, photocopy-fax devices, etc.)
- Is the natural light exploited to the extent possible?
- Are there timers for the lightning systems?
- Load per meter (to define which types of devices are serviced through a specific line and create alerts when the consumption exceeds the calculated rate)

The prototypes of the first year will collect the above information while additional info will be added in the 2nd year of the project, if necessary. For example, in the first year, the association between sensors installed in the buildings and the areas they serve will be inserted and kept in the platform. In the 2nd year, the building manager will have the opportunity to "configure" the infrastructure, i.e. associate sensors with areas in the school premises. It is only the building manager that is capable of defining the number and names of classrooms and spaces of the schools as well as the number and names of metering devices.

Use case -2: Participatory sensing

The building manager will be able to:

- Insert readings from sensors including a) power meters not connected to the GAIA cloud, b) fuel/heating system consumption, c) luminosity, d) indoor and outdoor temperature, e) comfort level for luminosity and indoor temperature.
- The dashboard will allow uploads of energy consumption in typical formats (manual entered monthly readings, file upload of hourly or 15-minute values) combined with metadata on the building such as type, age, size, etc.

It is worth stressing that **the teachers and students will also be eligible for entering sensor readings** or environmental and situational information in the platform fostering the role of crowdsourcing in GAIA. However, it is only the building manager that is capable of defining the number and names of classrooms and spaces of the schools as well as the number and names of metering devices. Additionally, for the first year, one reading per classroom will be eligible (e.g. the teacher enters the luminosity or temperature value). In the prototype of the 2nd year, additional measuring values may need to be "sensed".

Open Issue:
Will the "contribution" of occupants to participatory sensing be taken into account in the games?

Use case – 3: Building inspection and monitoring

The building manager will be able to:
- Inspect real-time energy usage where respective (energy and temperature) meters are available in various timescales (daily, weekly, monthly, yearly).
- Inspect results from comparison with similar buildings or with the same building in other time spans (e.g. previous years) along with comments.
- Inspect alerts log.

The building manager will be able to select from a drop down menu the measurement object and the source type (e.g. electricity consumption from smart power meter 2). He/she also be able to change the timescale and to add/remove curves on the same analytics window. He/she also be able to select from "similar" building so that he/she can compare the performance of the building he manages. "Building similarity" is hard-coded in the first year in the GAIA platform. The monitoring objects include also the indicators for peak and base loads on different days of the week, operation schedules of the building etc.

Use case – 4: Receive energy efficiency recommendations and alerts

The recommendations (as already identified in WP2 documents) can be classified in two groups:
- Behaviour-based recommendations,
- Alerts and
- Technical interventions and building renewal actions

GAIA focuses on behaviour-based recommendations which are produced by the optimization block residing in the GAIA cloud-based back-end. Even within each category of building, the style of the recommendations may largely vary and so do the actions expected from the building manager and the building.

The recommendations that the building manager will receive will aim to improve energy efficiency of all energy types. A subset of them has been decided to be implemented in the first year while the rest or any other identified during the pilot testing will be used to enrich GAIA offerings in the 2nd year. In this table, recommendations like turn-off the light (1st recommendation in the table) requires the cooperation between the building manager, the faculty and the pupils while recommendations like Holiday shutdown imply actions from the building manager only. At the same time, other recommendations require only one action (like the change of the ceiling fan direction) while others require a regular check (like the recommendation "turn off the light"). In principle, the teachers will also receive recommendations while the students will primarily receive notifications triggering participatory sensing. The option for the building manager to disseminate the recommendations via some social network will be explored in the 2nd year.

The recommendations/alerts identified in the first year in WP2 include:

Type of notification	Target improvement	User role involved	Action
Notify	Electricity consumed for lighting	Teacher	The luminosity in your room significantly exceeds the international standards for classrooms. Please, turn off the lights.
Notify	Electricity consumed for lighting	Teacher	It seems the weather is sunny. Open the curtains to exploit natural light.
Notify	Energy consumption for heating	Teacher	The temperature in your classroom is over your desired value. Switch off the radiators.
Notify	Energy consumption for heating	Teacher	(for classrooms involved in GAIA that are not equipped with temperature sensors, this occurs periodically). Please, fill in the temperature. (and then, depending on the value, "you can turn off the radiators" or "you need to have heating on".
Notify	Energy consumption for heating	Building managers	Shut down the heating system as the room temperature has reached the comfort temperature (when no thermostat exists based on sensor readings or readings from participatory sensing)
Notify	Energy consumption lightning	Building managers	The classroom X is unoccupied the last 20 min. Turn off the lights.
Notify	Energy consumption for PCs	Building manager	The PC lab is unoccupied the last 20 min but the PCs are turned on.
Notify	Electricity consumed for all purposes	Building managers/Janitors	Present a list with the rooms/devices that need to be checked. (This list will be defined once per school and used as checklist in the end of the day and before the vacations.)
Alert	Electricity consumed for all purposes	Building managers/Janitors	The electricity consumption has exceeded the peak rate witnessed in the last 2 years. Check the cause.

			(The BM will have the opportunity to mark this alert as a) false in which case, the rule will be presented and modified or cancelled or b) false for a specific date of the year so no such alerts will be issued in this date (e.g. ceremonies taking place at specific dates).
Suggestion	Energy consumption for heating	Students	*Suggest to students to be prepared for colder days so that the thermostat temperature is reduced by 1 or 2 degrees. For example, "Usually on Monday it's colder, wear warm clothes" or "Tomorrow it will be a cold day! Be prepared!"*
Notify	Energy consumption for heating	Building manager	Before vacations to shut down energy load providing him/her a checklist
Notify	Energy consumption for heating purposes	Building manager	Before restarting operation after vacations to turn in-time heating on. (HC,ENV, F)
Notify	Energy consumption for heating purposes	Teacher	"use the ceiling fan" (in cold months in reverse direction)
Notify	Energy consumption for heating purposes	Building Manager	To do maintenance (HC, ENV) (The building manager is responsible to enter the maintenance periods to the platform after being advised by an engineer.)
Alert	Water consumption	Building managers	Water leakage sensors (Digital or human)
Alert	Energy consumption for heating and lighting purposes	Building managers	Different comfort (either temperature or luminosity wise) in different rooms; check what happens
Suggest	Energy consumption for heating purposes	building manager	change ceiling fan direction

Possible trial evolution:

The application will have a dashboard with the recommendations active every day/week/month. The building manager will be prompted each week to select among a set of recommendations to realize. Depending on the recommendation he/she selects, he is prompted to i) notify the rest of the community, i.e. faculty and pupils, and ii) to fill in relevant information at the beginning, end and regularly (recommendation/depending if the recommendation needs so). To be able to evaluate the reaction of the building manager, he/she will be asked to fill in relevant forms so that a) the fact that he/she has actually positively reacted to the recommendation can be confirmed and b) the results of the overall GAIA interventions are evaluated.

It is worth stressing that the above list of recommendations:
- Is not exhaustive and GAIA project intends to enrich it.
- Has been formed based on the results achieved in other projects/environments.
- The rules upon which the notifications will be generated are dealt with in WP2.

Use case – 5: Communication with other building managers and/or experts

It is important to allow the building managers communicate because this can enhance their knowledge on actions that can lead to energy savings. In this social network, a contest can be established based on the likes of the achievements and/or suggestions each building manager posts. We plan to update the specs of this social networking activity based on the feedback we will received during the first pilot trials.

3. GAIA application requirements

The Community Engagement and Social Networking Game, the Educational Serious Game and the Application for Building Managers all contain specific services and/or applications that support a wide-ranging set of participatory activities for the primary target groups. While each of these activities makes use of data either previously or currently being collected or, in some cases, directly supplied by participants, all are built in such a way that the users may gain a better understanding of energy consumption issues resulting from their behavior/decisions. Thus, while the requirements for each activity may vary, the end goals remain the same.

3.1 Social Networking and Community Engagement Game Requirements

Considering that the Social Networking and Community Engagement game (Scavenger Hunt) has been created for play by not only trial participants to enhance their participatory experience, but for the entire online community as whole, we have created it in such a way that it will be easy for it to be spread via many forms of social media or even just word of mouth. This make for the game to have the built-in potential to become far-reaching in order to touch a wider audience than our trial schools alone.

The use of the mobile-responsive web application will be promoted, as there is additional information located within it, but it is not required to be used in order to play the game as it is only the #hashtags that are tracked and counted. Also, there is no requirement for downloading or the need for any type of registration other than an Internet connected web browser on an iOS, Android or Windows phone or any computer.

There are no APIs that need to be integrated as the metering information will come directly from the GAIA website. Additionally, the tracking of the hashtags will be done using feature already available on the respective social networks and neatly compiled in Hootsuite (widely used by other projects).

ID	Description	Component Involved	Priority	Relevant Use case
	The GAIA #ScavengerHunt can be accessed through web browsers on desktop computers, laptops (Windows, MacOS and Linux) along with tablets and smartphones (iOS, Android and Windows Phone).	frontend	H	UC-1, UC-2, UC-3
	The GAIA #ScavengerHunt has links to the primary social networks (Facebook, Twitter, Instagram) to be used in the game.	frontend	M	UC-1, UC-2, UC-3

General information about the GAIA #ScavengerHunt can be found on the public GAIA website and game landing page.	frontend	M	UC-1, UC-2, UC-3
The GAIA #ScavengerHunt backend has an easy to use interface for editing and adding weekly challenges on the landing page.	backend	M	UC-4

3.2 Educational serious game requirements

The following requirements to the GAIA Challenge application can be derived from the concept:

ID	Description	Component Involved	Priority	Relevant Use case
1	The GAIA Challenge frontend can be accessed through web browsers on desktop computers, laptops and tablets (Windows, MacOS, Linux, iOS, Android)	frontend	H	UC-0, UC-1, UC-4, UC-5
2	The GAIA Challenge backend can be accessed through web browsers on desktop computers and laptops (Windows, MacOS, Linux)	backend	H	UC-2, UC-3
3	General information about the GAIA Challenge can be found on the public GAIA Challenge landing page.	frontend	M	UC-0
4	The GAIA Challenge backend has a clear and easy to use interface (WYSIWYG editor or similar) for editing the general information about the GAIA Challenge on the landing page.	backend, database	M	UC-0
5	The GAIA Challenge frontend features a user registration form.	frontend, database	H	UC-1
6	The GAIA Challenge frontend features a user login form.	frontend, database	H	UC-1, UC-4, UC-5
7	Users can edit their profile information in the GAIA challenge frontend.	frontend, database	M	UC-4
8	The GAIA Challenge backend allows to set the type of a task.	backend, database	H	UC-3
9	The GAIA Challenge backend has a clear and easy to use interface (WYSIWYG editor or similar) for editing the contents of a task.	backend, database	H	UC-3
10	The GAIA Challenge backend allows to chain tasks as sequences and assign those sequences to quests.	backend, database	H	UC-3, UC-5

11	The GAIA Challenge backend allows to assign quests to predefined topics.	backend, database	H	UC-3, UC-5
12	The GAIA Challenge backend allows to change the order of quests within a topic.	backend, database	M	UC-3
13	The GAIA Challenge frontend features a dynamic quest map which is interesting and fun to explore.	frontend	H	UC-5
14	The quest map shows the user's progress in the GAIA Challenge. It evolves/changes as the user progresses.	frontend, database	H	UC-5

3.3 Building manager requirements

The requirements of the application for the building manager are listed in the following table.

ID	Description	Component Involved	Priority	Relevant Use case
1	The Mobile app and the portal can communicate with the GAIA back-end to register a user.	GAIA cloud backend- User profile database GAIA mobile and desktop app UI	H	UC-0
2	GAIA should be able to discriminate the following four roles: Administrator, building manager, teacher students.	GAIA cloud backend- User profile database GAIA mobile and desktop app UI	H	UC-0
3	GAIA should be able to associate: ● a building manager per school or building. ● multiple teachers per building. ● groups of students using the same building. ● groups of students using the same classroom. ● groups of students associated with a teacher.	GAIA cloud backend- User profile database GAIA mobile and desktop app UI	H	UC-0
4	The information that has to be maintained per building is described in use case 1.	GAIA building database, GAIA API between mobile apps and backend	H	UC-1
5	The building manager will be allowed to enter the building specific information either from a mobile device or from a web application.	GAIA app development	H	UC-1
6	The UI of the GAIA app will be as user friendly as possible and will support multilingual operation. (For the first	GAIA app, database	M	UC-1

	prototype only two languages will be supported; for the final, it will be four.)			
7	The participatory sensing application is available for students and teachers as well.	GAIA app	H	UC-2
8	Each user is capable of storing data regarding inside and outside temperature and luminosity declaring the room he is in.			
9	The building manager is responsible for defining and registering -　　the number and names of classroom and -　　the number and names of spaces of the building campus -　　the number and names of the metering devices available in each school -　　the number and names of values for which the value the community members can enter values (e.g. the fuel consumption) so that the occupants (all types, teacher/students) can enter information	GAIA app (with respect to UI) GAIA database (for storing the information) API between the app and the back-end	H	UC-2
10	The building manager has access to analytics from both the mobile device and a laptop/desktop.	GAIA app front/end technology	H	UC-3
11	The building manager has access to analytics from all measurement sources (smart meters, sensors, e.t.c.) from both smart metering devices and results from participatory sensing, in various timescales. The users should be able to see visualized for their building/school: All the measured values (power consumption, temperature (from sensor and from participatory sensing), humidity,	GAIA app, GAIA database structure, GAIA back-end API	H	UC-3

	luminosity, weather, motion) in different time scales Comparisons with the historic data of these values Comparisons with other schools a) in the first year release, selecting from a drop – down menu among the GAIA schools and b) selecting between similar and dissimilar buildings/schools in the 2nd year.			
12	The building manager can select from a limited set of only "similar" buildings to perform comparisons.	GAIA database (existence of "similarity" field)	H	UC-3
13	The building manager will be able to receive recommendation notification and alerts through either the mobile app or the web-based portal.	GAIA UI, Optimizer (generates the alerts) API (for communicating the alerts) Back-end database for storing recommendation	H	
14	The building managers will be able to communicate through social networks	Interaction with task 3.1 EDOCS	H	UC -5
15	The building manager should be able to upload values in a CSV file format and define at the same time the metric this file contains values about. The building manager should be able to upload values about heating costs and overall electricity bills through a dedicated form.	GAIA desktop or mobile app, back-end database and API	H	
16	The building manager will be able to forward recommendation notifications to the teachers of the school.	GAIA desktop and mobile-apps, GAIA back-end to retrieve notification and to identify associated teacher.	M	

4. GAIA application architecture and interfaces

All three of the activities within this Work Package work in different levels of complexity toward achieving similar goals. This chapter intends to provide a more detailed level of description of the architecture and functionalities of each. Additional informational videos relating to the prototypes are also made available within this chapter.

4.1 Social game architecture and interfaces

Functions

The prospective player will be directed to scan the QR code for our app or may directly type the website into the browser of either their mobile phone or their computer. Considering this is built as a flexible mobile responsive website, this will function like an app that is Android, iOS and Windows phone compatible and also works on tablets. It also functions on desktop computers. Once the App opens, the player will be asked to choose their language. At this stage, the demo is only available in English, but Italian and Greek versions will be rolled out soon and Swedish still needs to be developed. Also, the app itself may identify the player's preferred language from their mobile and make the language choice for them, but they will always have the option of switching languages at will.

After the language has been chosen the main screen will appear. Please note, the final version will most likely look and feel a bit different from this demo version, but the basic elements should remain, more or less, the same. The CSS is completely customizable, so we will probably move to a more modern feel that can have some similarities with the layout of the Educational Serious Game to provide a sense of cohesion, but to not be confused with it. This platform has been tested and used by EDOC for a few years now without any major technological flaws that hampered its usability.

Taking a look at the images below, you will see the current (but likely to change) landing page for the Community Engagement and Social Networking game.
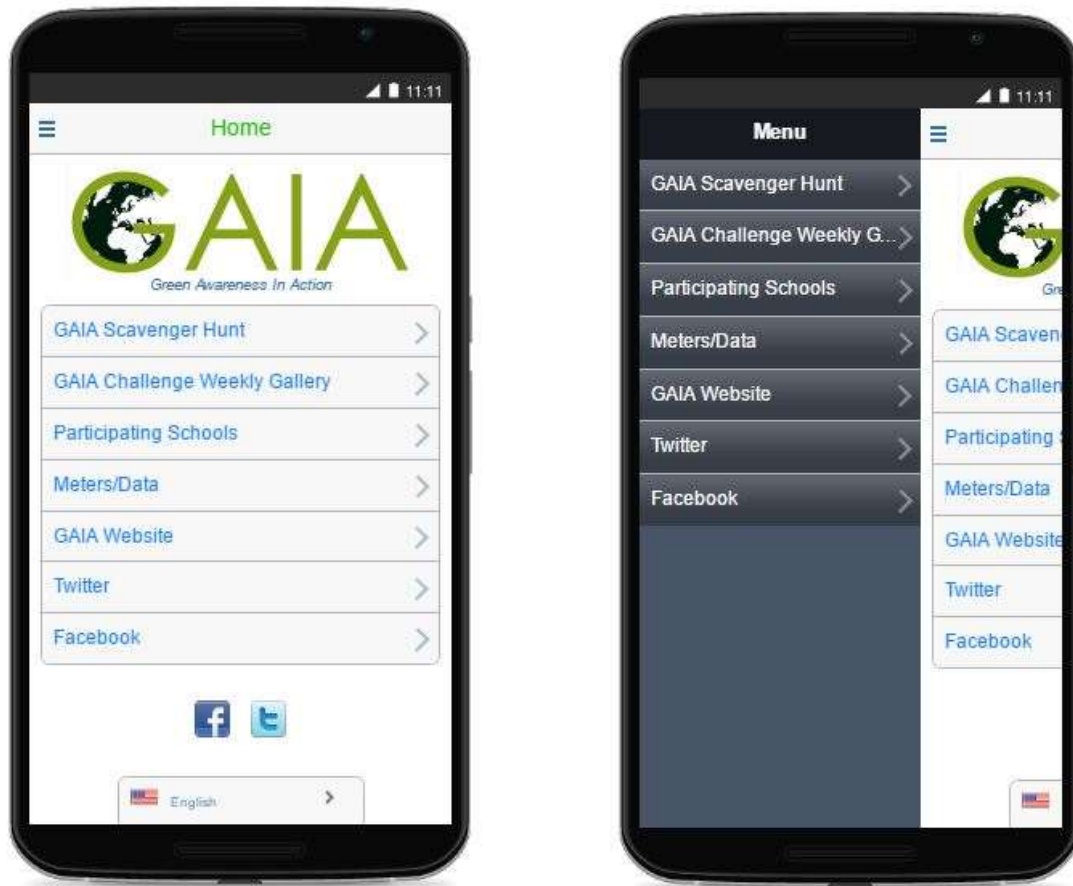
The image on the left is the initial landing page, while the image on the right demonstrates what will happen when you press the menu button on the top left of the navigation bar. The menu button is locked in that position throughout the app for ease of navigation. The menu may be closed by pressing the button again or swiping left on the screen.

As you can see, there are a few buttons to guide you deeper into the app. We will briefly state what they are for and will go into more detail, section by section.

- **GAIA Scavenger Hunt** - This is the SocNetComEn game
- **GAIA Challenge Weekly Gallery** - This is a collection of some of the student-created content from the Educational Serious Game (T3.2).
- **Participating Schools** - Has some information about all of our trial schools
- **Meters/Data** - This is a placeholder section where we hope to have live metering data available (depending on the lag it may generate) and information about the GAIA meters/sensors.
- **GAIA Website** - Will directly open the GAIA Website.
- **Twitter** - Will directly open to the GAIA Twitter page to allow for direct posting.
- **Facebook** - Will directly open to the GAIA Facebook page to allow for direct posting.

Additional sections may be added later (such as a polling feature for direct player interaction and feedback), but this app is not intended to mirror our website, but to be an additional tool/resource to direct players to discover our website and social media presences as well as to persuade the players to explore other website dealing with the core issues of our project. Also, at this stage we are trying to keep the app pretty lightweight to prepare for the streaming of metering data. Let's look more in depth at each section.

GAIA Scavenger Hunt

Once the button has been pressed, the instruction screen for the Scavenger will appear and the initial sample hunts may be swiped up. The #ScavengerHunt game will function as follows:
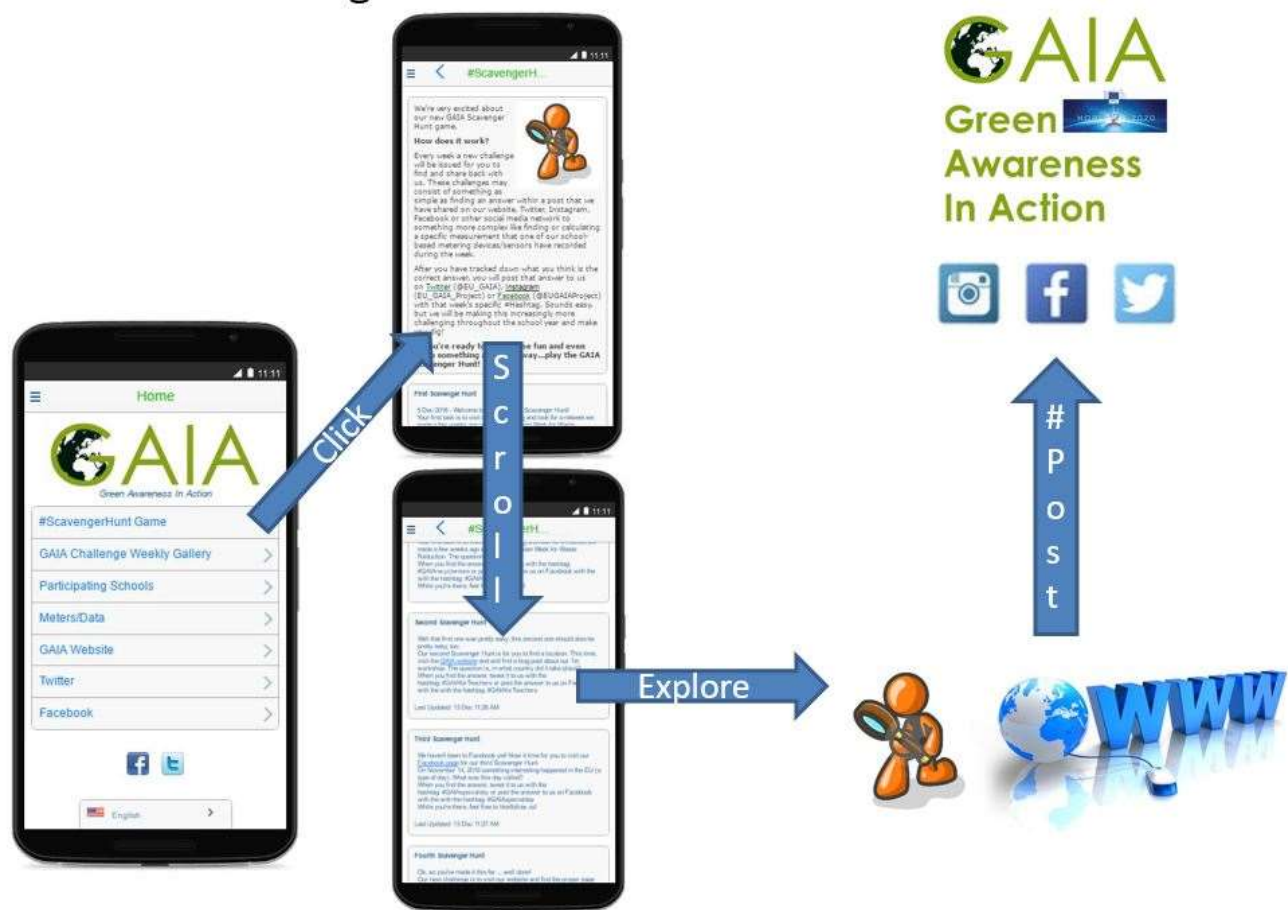
Below the instructions on how to play the game, will be the list of Scavenger Hunts. We are intending to add an additional every week, but that may be increased depending on subject matter and popularity. Each hunt will attempt to coincide with the topic in the Educational Serious game and/or teacher

curriculum, but that may not always be the case. Occasionally, there will be holiday week or topical weeks that will receive attention, like energy consumption over Christmas or awareness regarding Earth Day.
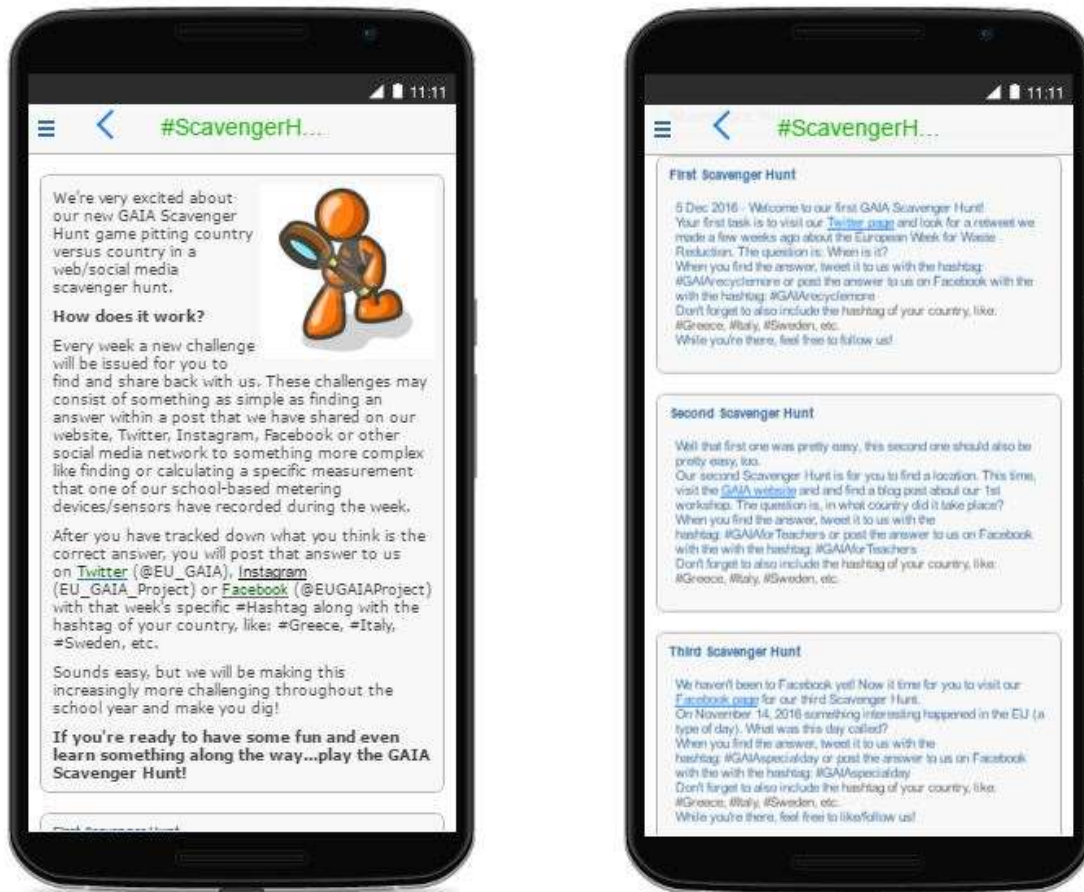
As mentioned previously, we will make use of a wide variety of social networks for a couple of reasons. We want to increase our scope of reach (casting a wide net) beyond our trial participants to include not only the local community where the schools are located, but also the wider community of potentially interested stakeholders on the web that may not otherwise be aware of our project. Also, different social networks have different abilities regarding the use of #hashtags. Further below is an overview of the various social networks that will be used with regard to the Scavenger Hunt and their specific abilities to recognize hashtags.

GAIA Challenge Weekly Gallery

This section will handle the Social Network sharing activities within Task 3.2. It involves the modification, editing and sharing of student created Snapshots to various forms of social media without any identifying aspect of the student(s) involved in the creations. To be more precise (and as mentioned within the DoW), along with obvious sharing on the GAIA website and through the larger channels of Facebook and Twitter, the edited/modified snapshots will also be shared to Vine, Snapchat and Instagram along with a periodic (weekly or monthly) montage on YouTube.

Participating Schools

This is a bit of a placeholder for now and this section will be modified from its current form prior to full release. We do not want to replicate information that is already available on the GAIA website, but rather enhance it with some fresh, new information as the trials begin/progress. This may be meter/data related or gameplay driven, but for the sake of the demo it is a placeholder listing our participating schools ordered by country.

Meters/Data

This is more of a place holder section for now, but once the metering devices are active on the website, a simple HTML <iframe> tag will pull the data to the app. We will need to test how many we can have running with multiple users to avoid lag issues.

GAIA Website

Jump-off link to our project website.

Twitter/Facebook

Jump-off link to our Primary Social Networks.

4.2 Educational serious game architecture and interfaces

The GAIA Challenge is being built with the web technologies listed below.

General Setup

- Apache Web Server (64bit OS)
- PHP 5.6.x+ (we might migrate to PHP 7.x+)
- MySQL 5.x+
- phpMyAdmin 4.x+
- MongoDB
- Zend Framework 3
- Doctrine (Object Relational Mapper & Database Abstraction Layer)

Server Software

- Redis server (http://redis.io/)
- ImageMagick 6.8+: (http://www.imagemagick.org)
- jpeg-recompress (https://github.com/danielgtaylor/jpeg-archive)
- pngquant (https://pngquant.org)
- gifsicle (https://www.lcdf.org/gifsicle)

Frontend

- Backbone Relational

Backend

- Ext JS

User Registration Process

- Double Opt Email Verification (optional)

Interfaces

As for D3.1 the GAIA Challenge prototype will not communicate with other GAIA applications or services.

4.3 Building manager application architecture and interfaces

4.3.1 Interface with the GAIA cloud-based platform (developed in WP2)

The two applications to be developed in task 3.2 which focus on the building managers but are also available to the faculty members and the students use a number of interfaces/APIs to store and retrieve information. We organize the information exchange per purpose as follows:
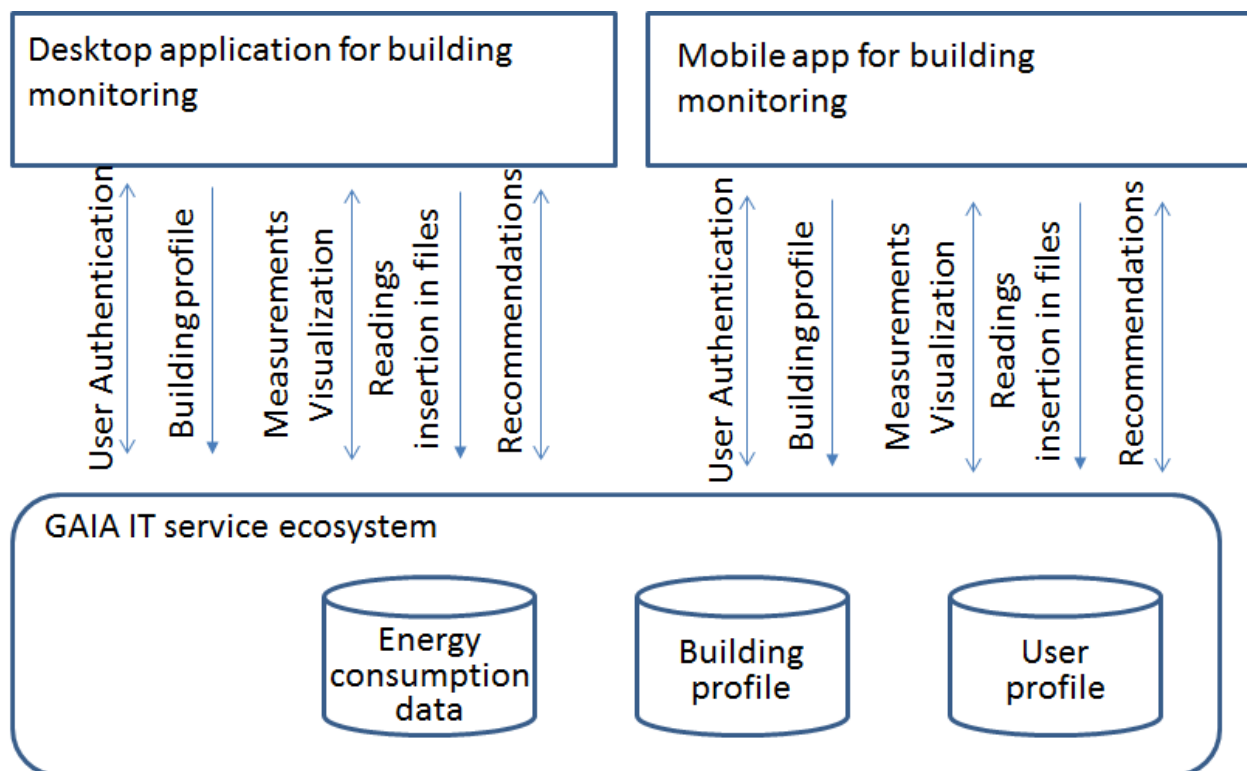
4.3.1.1. User authentication/authorization

The Authentication & Authorization mechanism is based on the OAuth 2.0 authorization protocol. The building manager application uses the Gaia IT Service ecosystem as a 3rd party application, requesting to authenticate itself every time a user tries to access the application.

The process starts with a RESTful API call using a unique client id and client secret key while the Authentication mechanism sends back a token - which will be used to the next calls in order to achieve the needed accessibility.

The building manager application supports three different user roles, the building managers, the tutors and the students. This diversity distinguishes the different capabilities, responsibilities and accessibility offered to each user.

	Building Manager	Teachers	Students
Measurement Visualization	X	X	X
Sensorial Component (Manual)	X	X	
Sensorial Component (Participatory sensing)	X	X	X
Recommendation Component	X	X	X
Alerting Component	X		

Technology & Installation Guide

The GAIA building manager application is being developed using state-of-the-art technologies. Specifically, the user interface is based on HTML5, CSS3 and on the materialize CSS (material design) framework. Also AngularJS framework version 1.5 is used for the further necessities.

4.3.1.2. Building profile

Each building has its own characteristics and features. This information constitutes the building profile which consists of the information described in section 2.3 (building registration). The building manager is responsible to provide the needed information to the application during the building registration. Also, while the building manager uses the Gaia application he/she is able to update this information through user interface. To achieve that, Gaia offers a RESTful API which is described thoroughly in deliverable 2.1.

This information includes:
- School name
- Building ID (to enable having multiple buildings in each school)
- Number of floors/areas in the building
- Number of individual rooms (e.g. classrooms) in the floor/area
- Serial number or ID of the consumption meter per area/floor or building or total
- Geographic location
- Surface (m²) per area
- Inhabitants (number) per school or area
- Floorplan (image file) per building (up to four per school)
- Age per building
- Whether there was intervention /Date of intervention per building
- Infrastructure different from classrooms (gym, pool, canteen)
- Orientation
- Energy types available (electricity, gas, etc.)

- Yearly consumption per energy type per building
- Yearly energy cost and footprint per building
- Does the school cover student/teacher transfer?
- Name or user ID of responsible for consumption monitoring/dedicated building manager or principal
- Average number of hours the school is occupied per day
- Type of windows (single /double glass)
- Type of heating system/energy source used
- Date of heating system installation
- Is there an automated thermostat installed? (Yes/No)
- Which is the threshold value? 20° C?
- Is there cooling system installed?
- Type of cooling system/energy source used
- Date of cooling system installation
- Are there fans?
- Is there an automated thermostat installed for the cooling system? (Yes/No)
- Which is the threshold value for the cooling system? 20° C?
- Are the heating and cooling systems serviced regularly?
- Are the heating and cooling system tubes insulated?
- What kind of bulbs is used for indoor lightning?
- What kind of bulbs is used for outdoor lightning?
- Are they cleaned regularly?
- Operating devices (Number of available PCs, refrigerators, photocopy-fax devices, etc.)
- Is the natural light exploited to the extent possible?
- Are there timers for the lightning systems?
- Load per meter (to define which types of devices are serviced through a specific line and create alerts when the consumption exceeds the calculated rate)

The prototypes of the first year will collect the above information while additional info will be added in the 2nd year of the project. For example, in the first year, the association between sensors installed in the buildings and the areas they serve will be inserted and kept in the platform. In the 2nd year, the building manager will have the opportunity to "configure" the infrastructure, i.e. associate sensors with areas in the school premises. It is only the building manager that is capable of defining the number and names of classrooms and spaces of the schools as well as the number and names of metering devices.

4.3.1.3. Measurements visualization
The API through which the requirement 11 is satisfied is described in the sequel. The desktop or mobile app defines the school and provides a list of available measurements. The use selects which to view, on the same or different graphs.

The users should be able to see visualized for their building/school:

- All the measured values (power consumption, temperature (from sensor and from participatory sensing), humidity, luminosity, weather, motion) in different time scales
- Comparisons with the historic data of these values
- Comparisons with other schools a) in the first year release, selecting from a drop –down menu among the GAIA schools and b) selecting between similar and dissimilar buildings/schools in the 2nd year.

4.3.1.4. Data storage through participatory sensing

Each user is capable of storing data regarding:

a) power meters not connected to the GAIA cloud,
b) fuel/heating system consumption,
c) occupancy relevant readings,
d) luminosity,
e) indoor and outdoor temperature,
f) comfort level declaring the room he is in.

Before storing this information, the eligibility to store such value for the addressed building is checked, to prevent students enter values for school they do not inhabit. This information is kept separately from the values measures by the sensors. In the 2nd year, we will address the issue of storing highly different values for the same classroom from different inhabitants to assess the quality of selected data.

The building manager should be able to upload values in a CSV file format and define which metric this file contains values. Additionally, the building manager should be able to upload (apart from those that can be uploaded by all users) values about heating costs and overall electricity bills through a dedicated form.

4.3.1.5. Recommendations and alerts

We need to specify an API here for communicating the recommendations and alerts from the platform to the apps. (SPARK)

5. GAIA applications contribution towards KPI achievements

This chapter will associate each of the applications developed within this Work Package with both behavioral-change and education-related KPIs. These have also been linked with GAIA use case descriptions as presented in D1.2.

5.1 Behavioral-change related KPIs

Code	Name	Brief description	Validation Methodology	Gaia target	GAIA components involved
GB.1	Time spent using Web portal	The time spent by end-users on the GAIA portal and web interfaces, as a measure of end-user engagement	Use server-side system logging components, monitoring all related activity, while also having in mind privacy issues	7-10h	GAIA Challenge: external analytics tool (piwik) tracks time spent by unregistered visitors as well as logged-in users on challenge related pages; GAIA #ScavengerHunt: tracks time spent by visitors on various pages
GB.2	persons using web portal	An estimate of the number of different end-users utilizing the GAIA web portal	server-side system logging (see GB.1)	30-40% of target group (mixed: classroom activities 100%; voluntary usage 20%)	GAIA Challenge: database export provides registered and active user count GAIA #ScavengerHunt: Database export provides active user count
GB.3	sessions per user	Average number of separated sessions a user	server-side system logging (see GB.1)	30	GAIA Challenge: database export provides login/visit

		engages with the platform			count for individual users; GAIA #ScavengerHunt: Database export provides login/visit count for individual users
GB.4	session duration	Average session duration of all users and sessions	server-side system logging (see GB.1)	5-10 min	GAIA Challenge: external analytics tool (piwik) tracks logged-in users time spent on challenge related pages; GAIA #ScavengerHunt: tracks user time spent on the various pages
GB.5	cohort analysis	A measure how long a user stays engaged over the course of multiple days (without interruption; meaning: at least one session per day)		3-5 days	GAIA Challenge: database export provides info on individual login dates per user, additionally an external analytics tool (piwik) can track specific user events together with date; GAIA #ScavengerHunt: hashtags will be tracked to provide the the level of engagement
GB.6	#sensing quests completed	A measure of the total gaming activities completed by the end-user community	server-side system logging (see GB.1)	50-70%	GAIA Challenge: database export provides quests completion rate per user;
GB.7	#educators contributing quests	A measure of the engagement of educators with the gamification	server-side system logging (see GB.1)	8	the GAIA Challenge cannot measure educators

		platform, based on their contributions and customizations			contribution. please conduct interviews
GB.8	#knowledge quest Finishing rate	A measure of how many quests, which have been started are actually finished to a valid result.	server-side system logging (see GB.1)	60-80%	GAIA Challenge: database export provides data on started and finished tasks per user;
GB.9	Participants' awareness	A measure of how much change students', teachers' and parents' awareness regarding the energy consumption after the trials	Pre and post trials survey	Increase	

5.2 Education-related KPIs

Code	Name	Brief description	Validation Methodology	Gaia target	GAIA components involved
ED.1	#students directly involved	Number of individual students directly involved with the project, through educational, gamification and other project activities	Student lists from schools	5500	GAIA Challenge: database export provides registered and active student-user count;
ED.2	#students indirectly involved	Number of individual students indirectly involved with the project, participating through educational, gamification and other project activities	Participation lists in workshops and other project activities	500	
ED.3	#teaching staff involved	Number of individual educators directly involved with the project, through educational, gamification and other project activities	Participation lists in workshops and other project activities	900	GAIA Challenge: database export provides registered and active teacher-user count;
ED.4	#educational workshops organized	Number of educational workshops organized by GAIA directly involving and aiming at the educational community	Organization of workshops	3	
ED.5	#educational scenarios and toolkits	Number of educational scenarios and toolkits produced by the project	Availability on the project website	20	
ED.6	#European languages translated	Number of European languages in which the educational material will be translated and be made available at the end of the project	Availability on the project website	4	GAIA Challenge: content; GAIA #ScavengerHunt: content
ED.7	#parents/relatives or friends	Number of parents, relatives or friends of students that have been	Participation lists in	250	GAIA Challenge: external

indirectly involved	informed about the project and related products (e.g., website, game, social presence, etc.)	workshops or press events, or social networking platforms		analytics tool (piwik) tracks time spent by visitors on info landing page; GAIA #ScavengerHunt: hashtags that are tracked outside of the participating countries will provide useful data.

5.3 Educational serious game contribution towards KPIs during the first trials

As for D3.1 only a subset of the planned features will be available in the GAIA Challenge prototype. Instead of the 5 topics planned for the release version the prototype will only have 1 playable topic. Also there won't be any Class Activities and Community Features. Thereby, in the first trials, the GAIA Challenge won't perform with the full potential towards reaching the targets specified in the following KPIs:

- GB.1 (time spent using the web portal)
- GB.3 (sessions per user)
- GB.4 (session duration)
- GB.5 (cohort analysis)
- ED.1 (#students directly involved)
- ED.3 (#teaching staff involved)
- ED.6 (#European languages translated)
- ED.7 (#parents/relatives or friends indirectly involved)

In the course of the first trials the GAIA Challenge prototype, however, is expected to deliver meaningful results for the following KPIs:

- GB.2 (persons using web portal)
- GB.6 (#quests completed)
- GB.8 (#quest finishing rate)

The following KPIs are not in the scope of the GAIA Challenge:

- GB.7 (#educators contributing quests)
- GB.9 (participants awareness)
- ED.2 (#students indirectly involved)
- ED.4 (#educational workshops organized)
- ED.5 (#educational scenarios and toolkits)

6. GAIA Applications and Online Repository

This Chapter contains links to the prototypes of the applications that are discussed in this document, as well as, where applicable, links to the online repository of the open source code. More specifically, the project has set up an online repository on GitHub, which can be found at the following link:

https://github.com/GAIA-project

The repository currently hosts information regarding the following aspects:

- Design and implementation of hardware and software for the IoT infrastructure used in GAIA schools.
- The implementation of the Building Manager Portal.
- Various software modules used to automate parts of the school building monitoring processes.

As mentioned in previous deliverables, GAIA will follow an open-source approach in almost all material developed, including both hardware and software used in the project, to the degree that it does not affect the existing business model of GAIA consortium partners, while staying as open as possible. The source code of the GAIA Challenge from T3.2 will not be published on GitHub, but all relevant educational tasks and game design will be openly available.

Educational Serious Game

The Gaia Challenge is currently hosted online in Austrian servers and is accessible via:

http://ovosplay-gaia.ovos.hybridserver.at/

The consortium will soon register a dedicated domain for the final version of the game, in order to provide a more readable URL. On the landing page the user can select a language. Currently the Challenge is available in both English and Greek, with English set as the default language. On the landing page there a registration and a login form are available, so that anyone interested can register and try the Challenge straight away. Content for the application will be enhanced in the coming weeks before the first trial period begins.

Application for Building Managers

The application for building managers is a responsive web-application (also accessible through mobile devices) offering direct visualization depicting in various forms and aggregation and analysis levels energy consumption information. The building manager is able to perform the following high level actions:

. 　　　Insert building specific information, allowing for buildings comparisons and anomalies detection,

.   Insert data regarding building status (e.g. sensor readings or occupancy information) realizing participatory sensing

.   Inspect building status and monitor building performance (building analytics)

.   Receive valuable suggestions for energy savings.

The application is currently available online for testing purposes on:

http://83.235.169.221/gaia/dashboard-client/#/page/signin

Community Engagement and Social Networking Game

With respect to the demo version of the #ScavengerHunt game is located by typing the following address into any web browser on a smartphone:

http://gaia.eurodocs.net

or, by scanning the QR code below with your mobile phone.

7. Conclusions

Concluding this document, we presented the overall status regarding the implementation of software prototypes regarding the following tasks of the project:

- *Task 3.1* – Community Engagement and Social Networking Game.
- *Task 3.2* – Educational Serious Game.
- *Task 3.3* – Application for Building Managers.

We presented here several of the concepts related to their design and implementation of the abovementioned software, while the related (Web) applications are available online, and will be tested in a more systematic manner during the first, limited, trials period of the project, which will take place during the coming months.

This first set of trials will serve as a way for the project to get feedback for the design and implementation of these prototypes and move towards fine-tuning them for the purposes of the project.

8. References

1.   Valuable EneRgY for a smart School PROJECT, D3.1 School specific optimization scenarios, July 2013

2.   Siemens, Top 10 energy saving tips, available at http://w3.siemens.co.uk/smartgrid/uk/en/Services/mcs/Documents/Top%2010%20energy%20saving%20tips.pdf

3.   http://www.cheapism.com/blog/3939/how-to-reduce-heating-costs#ixzz48MM1vl2f

4.   http://energy.gov/energysaver/fall-and-winter-energy-saving-tips