

# **GWAP Final Report**

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## **Introduction**

When we are looking for approaches to reduce our household energy usage, one may ask "Why is it important to conserve electricity and water?". Besides saving money on the energy bills each month, there are plenty of reasons why conserving energy is a good idea. And the most important one is probably that they are both the most important resources on earth which are necessary for everyone's daily life.

The idea of conserving energy means that you should use it only when necessary and avoid wasting it. This could be achieved through changing daily behaviours and habits, such as turning off the lights when you leave a room, as well as more involved processes, such as replacing standard light bulbs, take a shower instead of a bath if possible and replace household appliances which consume less energy. Although perhaps little impact would be noticed on your day-to-day life for the short term when you make these changes, the impact on environment as a result of your actions will be much more profound.

Our GWAP project aims to raise public awareness of energy saving problems and provide new ideas for more efficient use of power. While playing the game, people can have detailed ideas of how to save energy in their daily lives by doing specific simple things. For example, in our prototype, you can learn knowledge such as top three power-consuming kitchen wares, which will help players to be aware of power consumptions and remind them to only turn them on when necessary.

In the subsequent sections, we will explain the ideas which motivated our project and the problems we aim to solve, as well as some previous work or applications focusing on energy saving compared with our project. In order to form a clear understanding on the overall game design and mechanics, the main part of this report will concentrate on the way in which our game is designed and describe some supported technical architecture along with some supported diagrams and screenshots. Then we will explain some approaches as to evaluate and improve the performance of the project such as the reuse of the outputs collected and so on. In the end, there will be conclusions on lessons we learned from the designing process, including what achievements we have gained and what improvements can be done in the future to make the game more playable and enjoyable.

## Motivations & Target Problem

There are many motivations to improve energy efficiency.

Not only will lower energy usage contribute to more sustainable development, but to financial saving on household energy costs if the energy savings offset any additional costs of implementing an energy efficient technology. Reducing energy use is also seen as a solution to the problem of reducing greenhouse gas emissions. According to the International Energy Agency, improved energy efficiency in buildings, industrial processes and transportation could reduce the world's energy needs in 2050 by one third, and help control global emissions of greenhouse gases.

The reason why energy saving and energy efficiency are challenging is probably that most people lack the knowledge of energy conservation and have not realised the potential of recyclable and renewable energy. For example, when we talk about energy, perhaps the first thing comes to our mind is big power plants or other powerful devices which produce huge amount of energy. However, they seldom pay attention to questions such as:

- Do you know that leaving appliances plugged in will still waste electricity and cost you money even when they are turned off?
- How much energy and budget will be saved annually by replacing the traditional incandescent bulbs with energy-efficient lighting such as LEDs (light-emitting diodes)?

Such questions lead to the challenges we are currently facing. Energy efficiency can be achieved so long as we pay more attention to our daily habits on energy use and take measures to prevent power waste and deal with the electrical devices which consume more energy than they should.

All in all, our project will be designed as a quiz style game and provide questions involved in the energy saving problems. In order to increase interests, players will be set in different animated scenarios which simulate our daily lives and are combined with energy quiz. After answering the questions, the correct answers as well as some advice on improving their behaviours will be given to the players based on the questions they made mistakes on.

Moreover, the results collected from the players will significantly improve the performance of this application and be used in mainly three aspects:

1. In the game, we treat mistakes like boosting in Machine Learning. Allocate higher weight on those problems which people have more chance to make mistake on, and give them larger chance to show up in other players' tests.
2. Find out the devices that consume more energy than they should or people expect, and propose to the manufacturers to give clearer notices or warnings on the surface of the device to remind customers to pay more attention and turn them off when idle.
3. As for the problems with daily energy using behaviors, we can design or propose some public service ads to let more people know about these facts and start to save energy.

## Related Work

There is a similar quiz test about energy saving knowledge incorporated in the official website of a publicly traded international oil and gas company called ExxonMobil [1]. This website provides several rounds of quiz with answers and explanations after each question. The quiz includes several categories of energy, gas, electricity and water. In comparison, our project has several more features. For instance, we implement a series of scoring functions which makes the game more interesting and competitive. What's more, in terms of using GWAPs or Collective Intelligence, our project will collect users' results in order to improve on the efficacy of the project, for example, if the results show that a question is more likely to be answered incorrectly, which indicates people generally lack cognition on this topic, it will be shown to the players more frequently. Besides, our project will conclude the devices which consume more energy than expected and suggest the device manufacturers to print clearer notices or warnings on the device to notice the customers to pay more.

We find another online game which has some similarity with our “Practical” mode of the game. Here is the official description of the game: “ENERGY BITS is a cross-media project on sustainable energy and energy saving, supported by Intelligent Energy Europe (European Commission), with the aim to stimulate behavioral change and promote innovative practices among the 14-18 years old. Its resource platform proposes a collection of 24 documentaries, a web documentary, participative tools and a serious game in 9 languages.” [2]

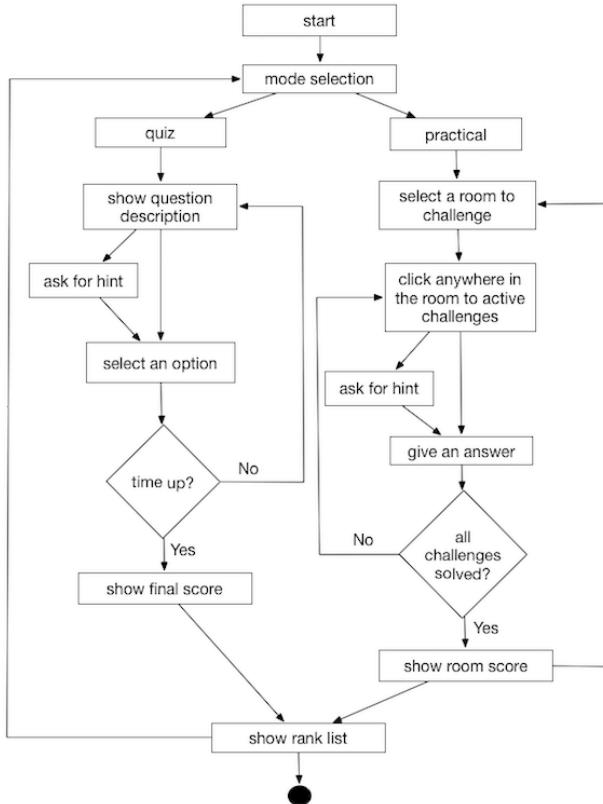
This game starts by providing some situations in which players are asked to help save energy, such as in a garage or in a holiday trip. In the pictures, players will need to find out what is wrong, how to save energy and prevent wasting. It also embeds different scenarios with questions compared with our GWAP project. We give players an overview of the house with a lot of household applications. The players can randomly select a room to start, and there will be several tasks for the players to complete. So, the logic between Energy Bits and the “Practical” mode of our GWAP project is similar and both of them allow to link with social media and share between friends.

## Game Design & Mechanics

### 1. Game Description

- Flow Chart of Game Process

The detailed flow chart of our GWAP process is shown in figure 1.



**Fig. 1.** Flow Chart of Game Process

- Scoring Functions
  - a) Basic scoring function: In both energy-saving quiz and practical on energy usage games, essentially, if a player answers correctly, 10 points will be rewarded to their score chart. However, the scores will not be deducted if the answer is wrong.
  - b) Exchange for hint: After the users have obtained some points from previous plays, they can start employing the hint feature to help them make which will give them some tips on each question they find tricky at the cost of 5 points. There are two forms of hint: one is showing the percentage of each option which is collected from previous users' results; the other is eliminating one incorrect option, which is only available for questions with more than two options.
  - c) Leaderboard: At the end of every round in either quiz or practical, a leaderboard will be presented to show players' points and ranks among other Facebook friends who have also played this game, which can stimulate competition among friends and thus make the game more playable and enjoyable.

- d) Sharing reward: In order to publicise our GWAP app, users are encouraged to invite more of their Facebook friends to play and gain knowledge together. When they share, an invitation code will be given to their friends, as many apps work nowadays such as Airbnb. The successful users will be awarded 20 points to their accounts after their friends use the code to sign up. However, this feature has not been implemented in the following game demonstration.
- Example of Game Demonstration



**Fig. 2.** Startup View of the Energy Game Application

By clicking on “Login with Facebook” banner, users can connect their information with Facebook accounts, mainly including their public profiles, friend relationships and so on. In order for the users to share something they find helpful or interesting or invite their friends to play together during the quiz-taking process, it is strongly suggested to sign in with Facebook.



**Fig. 3.** Select Game Mode

After connecting with Facebook, users can select one of the two game modes to start playing. Users' headshots will be shown at the upper left part to represent their identities. Here, we will start from the Quiz mode first.



**Fig. 4.** Welcome View of Quiz Mode

Entering the energy saving quiz, users will be resumed with their profiles including the points they have earned from the previous games. There are two instruction buttons: one is a "HELP" button explaining how the game will be played,

and the other is a “Click Me” button introducing the feature on how to trade the points for hints if they find a tricky question.

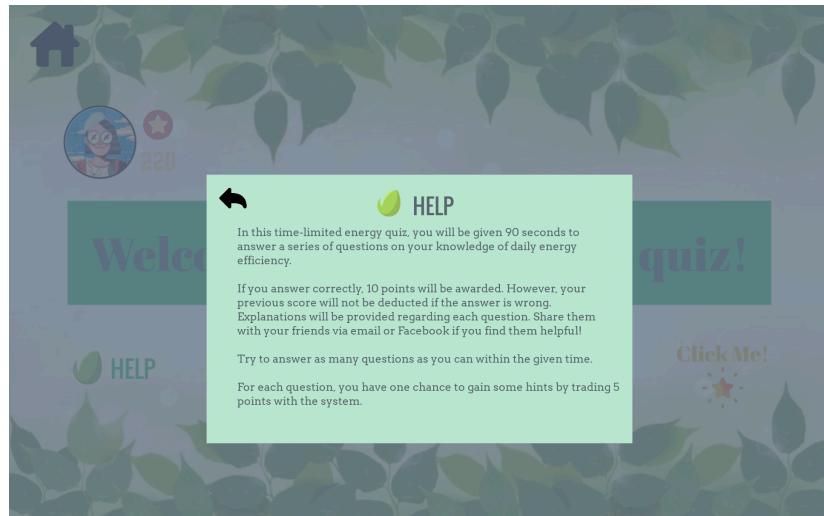


Fig. 5. Help Page on How to Play the Quiz Game

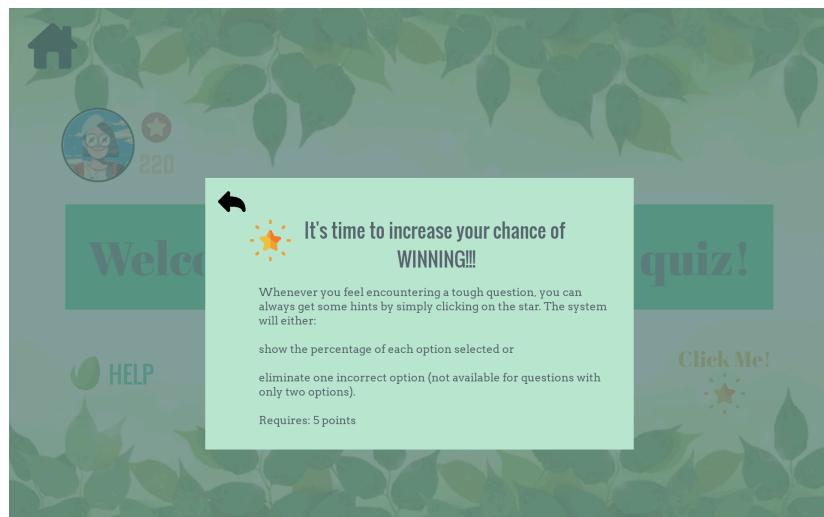
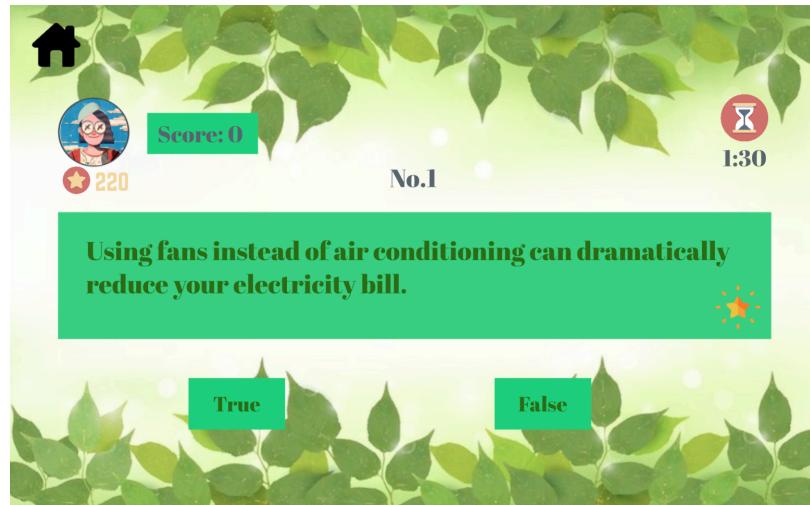
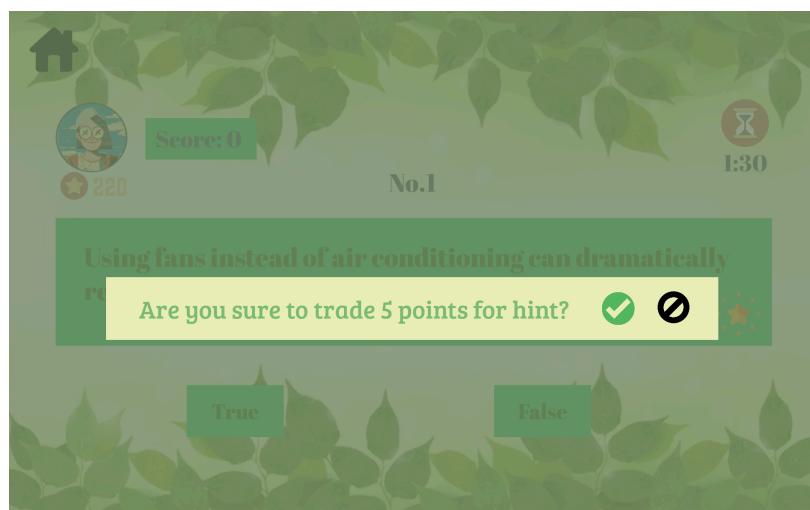


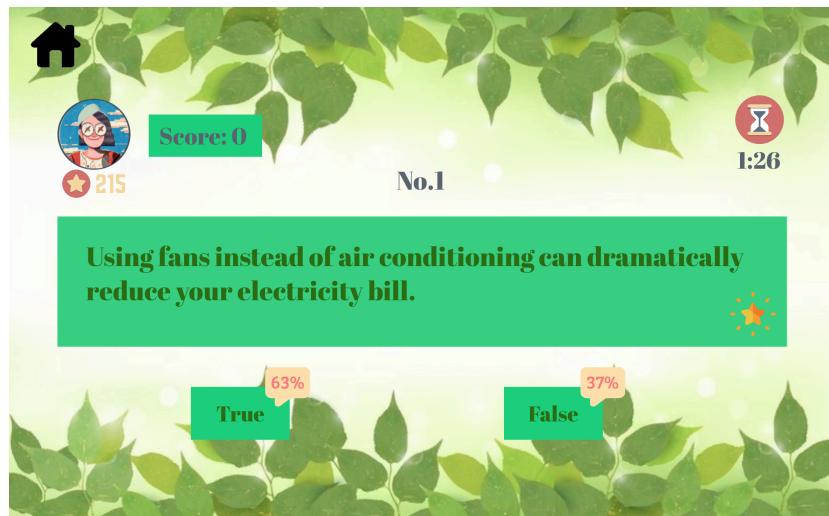
Fig. 6. Instructions on How to Exchange for Hints



**Fig. 7.** Example of Quiz Game

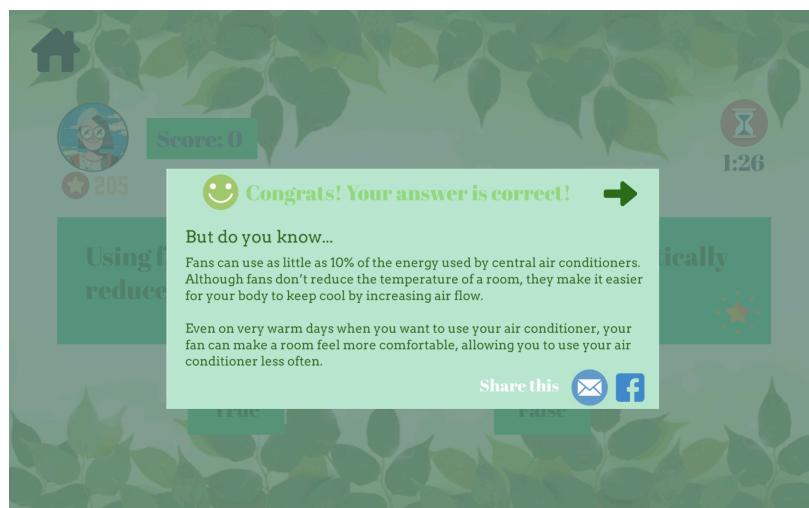
After clicking on the “Start” button of the welcome page of quiz, users will begin with questions about energy efficiency. There will be a “Score” banner next to the headshot recording the points each user has gained during one play, and a timer on the upper right counting down 90 seconds for each round. The questions are placed in the middle with multiple suggested answers. The “hint” feature is placed next to each question in the shape of a yellow star, in case that users would like to trade for some hints. Assume here that the user clicks on the star, and next step will demonstrate its function. All the example questions presented in this project are from a website called Energy Made Easy [3].





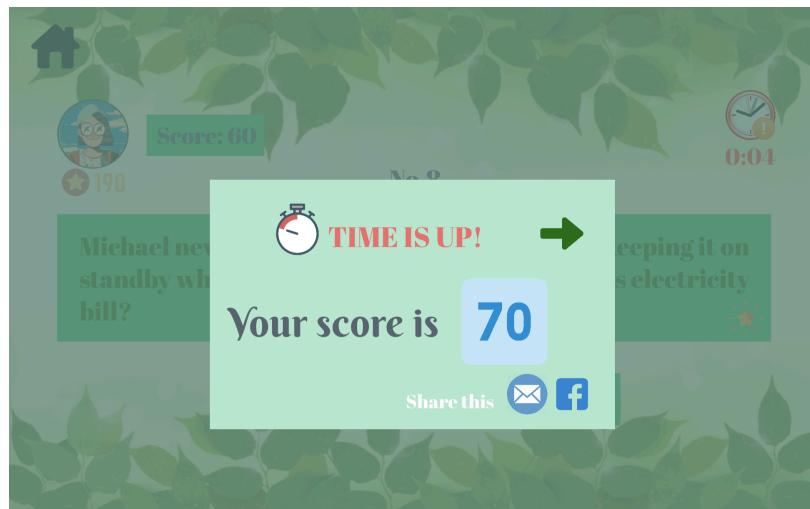
**Fig. 8. & 9.** Examples of Getting Hints in Quiz

If the player clicks on the yellow star, an instruction will pop up asking whether the user would like to deduct 5 points in exchange for the hint. In the above case of only two suggested choices, only the percentage of each option which has been selected by previous users will be provided. Then the user can make their own decision.



**Fig. 10.** Example of Results after Answering

After the player chooses an answer, for instance, he/she selects “True” in the above case, which is the correct answer, a result page will pop up telling the player whether the answer is right or wrong, and some explanations regarding the questions which are expected to help them gain some knowledge on energy-saving, even though they answer correctly, for lucky hits are highly possible. Besides, they can always share the facts they find educational or interesting with their friends via email or Facebook. The score banner will add up 10 points with every correct answer. Time spent on reading the descriptions will not be deducted from the countdown 90 seconds.



**Fig. 11.** Example When the Quiz Time Is UP

When 90 seconds have been used up, the game will stop in the middle of the answering process by showing a pop-up page with the final score one has gained for this round.



**Fig. 12.** Example of Leaderboard

In the end of every round of quiz game, in order to encourage participation, the page will jump to leaderboard where players can check their points and ranks among other Facebook friends who have also played this game.



**Fig. 13.** Interior View of House

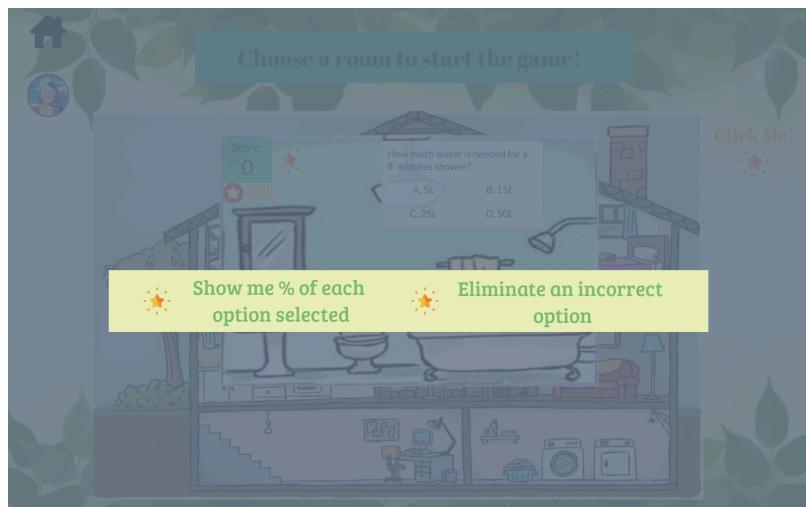
If the “Practical” mode is selected, an interior view of different rooms in a common house simulating our real lives will be shown, and questions related to energy usage will be incorporated with various household appliances. Likewise, there will be users’ headshots and points they have gained on the left side. Also, players can

always check the instructions by clicking help button and hint button on the right side. Players need to choose a room they would like to challenge to begin the game.



**Fig. 14.** Example of Taking Questions in a Room

Suppose we start the practical game from the bathroom, remember that questions are always embedded with house appliances. For example, in the above case, a player searches the bathroom and finds a question popped up from the shower head asking its usage.





**Fig. 15. & 16.** Examples of Getting Hints in Practical

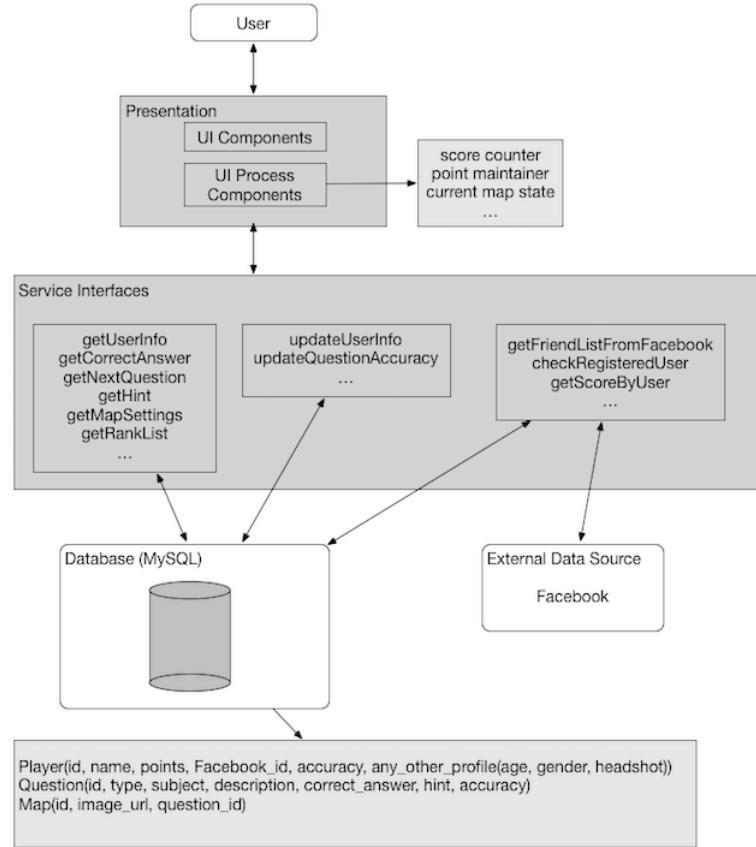
Suppose that one is uncertain about the answer, he/she turns to the hint button, asking whether to trade 5 points for the hint and in which form the hint should be given. In this case, the player requires to discard an incorrect choice among the four suggested ones, and the corresponding 5 points has been deducted from the previous points.

## 2. Game Mechanics

The technical architecture of our GWAP is shown in figure 18.

- Database: We decided to use MySQL as it's simple and lite. There are 3 tables:
  - a) Player: records the basic information of registered users, including id, name and any other personal profiles such as headshot, age, gender, and related Facebook account. Besides, their current points which could be used to exchange hints in the game, and their total accuracy in the whole game are also recorded in this table.
  - b) Question: records all quiz questions related to our subject, energy saving. It includes id, question description, subject, correct answer, possible hints, and total accuracy summarized from all players' answers.
  - c) Map: records all maps' information in the practical mode, including the image's url which is used in the map, and the question ids set for this map. The details of question are recorded in the assistant table.
  - d) Besides, the open APIs provided by Facebook will also be our data source. The details on this are described in the coming part.
- Service interfaces: We planned to deploy our web service on Tomcat, using RESTful as interface towards clients. The APIs include to get data from database, such as user information, next question for quiz mode, etc, and also update accuracy data for a certain question and user information after a game

finished. As for the rank list after each quiz, the data will firstly be retrieved from Facebook, that is, all friends of current user. After that, we check if they have registered in our game and if the answer is yes, to get their points and generate a ranking list.



**Fig. 18.** The Technical Architecture of Our GWAP

- **UI:** This is the front-end directly towards players, we decided to use HTML+CSS to implement. There is also logic processing part in the UI part, which is responsible for some simple counting work as well as interaction with web services.

## Evaluation

- Enjoyability & Playability  
This could be judged by several methods:

- a) For each competition, including both quiz mode and practical mode, calculate the proportion of games that are entirely finished instead of quit half way. If the proportion is beyond 80%, it should be supposed to be highly attractive, because there will be some situation that might also incur ‘halfway-quit’, for example, network connection failure, or any other emergent things that might happen when a user is playing.
- b) Calculate the proportion of users who has invited their friends to play together, or share the links we provided during the game into any other websites.
- c) Calculate the average frequency of players playing this game
- d) Calculate the average time they spent on this game once they have logged in.
- e) Summarize the number of players playing this game, daily, weekly, and monthly. Are these figures increasing or decreasing?
- f) Counting how many new users registered in our game, daily, weekly, and monthly. Similarly, are these figures increasing or decreasing?
- How to guard players ‘gaming’ the system or cheating
 

There're two possible ways we could think out to cheat: by searching on google, or by recording the questions they have met with and then copying the answer if they meet with the same questions at any other time.

For the first way, we set the challenge to be time-limited, which means they will lose time by searching on google for the correct answer, and as a result they won't answer as many questions as others do in the same time duration.

There's one more method we could come up with to avoid both the two ways of cheating in some sense: by forbidding the question descriptions from being copied, which means they need to pay more for searching or recording because of time wasting.
- How to guarantee the quality of output
 

Since most of the questions, no matter in the quiz mode or in the practical modes all have standard answers, that is, there's almost no open questions in our game. I don't think this is a big problem for us.
- How to make good use of the output
 

First of all, the purpose of our game is for educational use. Thus, in some senses, it's meaningful once there's anyone playing our game.

However, we could definitely get some other useful information from our GWAP. For example, with the gender and age information, we could summarize if males or females have better knowledge of energy saving, people in which age interval have known about energy saving the best; Besides, with the subject of each question, we could summarize which kind(s) of questions are the most misunderstood ones among people. And according to all these summarizations, we could do further things like propaganda and make it more targeted. For instance, if the youngers perform worst on the game, we could put related advertisement on online social media instead of on newspapers, and vice versa.

## **Conclusions and Bibliography**

From this GWAP project, we implemented an application which combines energy conservative and usage problems with two forms of quiz games aiming to raise people's awareness as well as collecting useful information in terms of level of public knowledge about daily power consumption, in the hope to help suggest improving our daily behaviours regarding consuming energy and contribute to sustainable development. We have gained a deeper understanding on how Game with a Purpose and Collective Intelligence could be designed in practical and how they achieve to play an important role in designing, analysing and testing public issues and problems that computers cannot yet tackle on their own, and contribute to the enhancement of computer processing. Our way of thinking has also been greatly promoted through this project, not only from technical view but also how human and computer interact as a whole.

However, there are still many improvement we could make about our project in the future. So far, the project is only available for one-player mode instead of both one- and two-player modes as suggested in the proposal. This feature can be added in both game modes for two players in a quick response style. The first to answer correctly will gain points. Moreover, in terms of enhancing the processing of computers, further functions could be generated in terms of how this project can help people make more sensible decision about saving energy and forming a more sustainable lifestyle.

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