BSc in Web Technologies & Programming

Cross Platform Mobile Application Development

Project Name: UVallApp

Student ID: G00293624

Name: Alex Acquier

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Introduction

This application is a calculator to assess the energy performance of dwellings. It allows the user to calculate the U-Values of the different components of the dwellings (walls, roof, floor and windows) by inputting the thicknesses and conductivities of the components or selecting its type. The user can also determine the amount heat lost and its associate cost for each components and for the whole dwelling by inputting the area of the components, the set point temperature of the dwelling (temperature that you wish the air in the dwelling all year around), the cost of one kilowatt-hour in Euro (it is assumed in this application that the dwellings will have an electrical heating system) and the monthly average outside temperatures. All the inputted data are stored in the local storage.

The user has the possibility to record the GPS coordinates of the dwelling, he would also be able to take a picture of the dwelling if he wishes so. If a mistake has been made in the input, the user has the possibility to clear the data of each of the inputs, he can also clear all the data all at once even if stored.

There are one sidebar and three screens in the app:

- The side bar contains shortcuts for each of the screens (Input 1, Input 2 and Results) and three buttons. The first button allows to determined the GPS coordinates of the dwelling, the second allows to take a picture and the last one allows to clear all the data.
- The first screen allows the user to either input data on the different components or selecting their type (depending on the nature of components) to calculate their respective U-Values.
- The second screen shows the calculated U-Values and allow the user to input the area of the components as well as the set point temperature of the dwelling, the cost of one kilowatt-hour in Euro and the monthly average outside temperatures which will allow the calculation of the total heat losses and their associated cost.
- The third screen displays the cost of heat losses for each of the components and for the whole dwelling, the GPS coordinates and picture of the dwelling.

NB: A splash screen has been attempted by the programmer but it did not work very well, this is why a black screen will appear during a few seconds before the app appears when opened.

Device Functionality

Two device functionalities provided by ngCordova are used in this app: the geolocation and the camera.

The code on the geolocation was sourced from this link:
http://ngcordova.com/docs/plugins/geolocation/

The work on the camera was sourced from this link:
http://ngcordova.com/docs/plugins/camera/

Usage

1 - The sidebar

  The sidebar is present on the left part of each of the screens, it is activate by dragging the user finger from the most the left part of the screen to the right and it should look as shown in Figure 1.
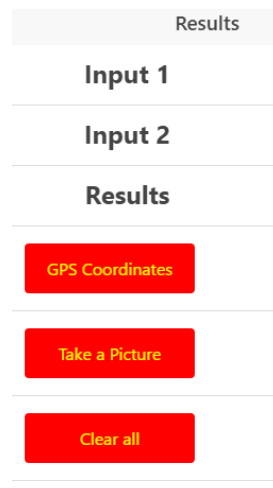

Figure 1

NB: For some reason the sidebar is only active on a limited part of the first screen (Input 1), it is only active on the header of the ion-content and at the level of the icons, it should be dragged only at the parts showed in Figure 2.
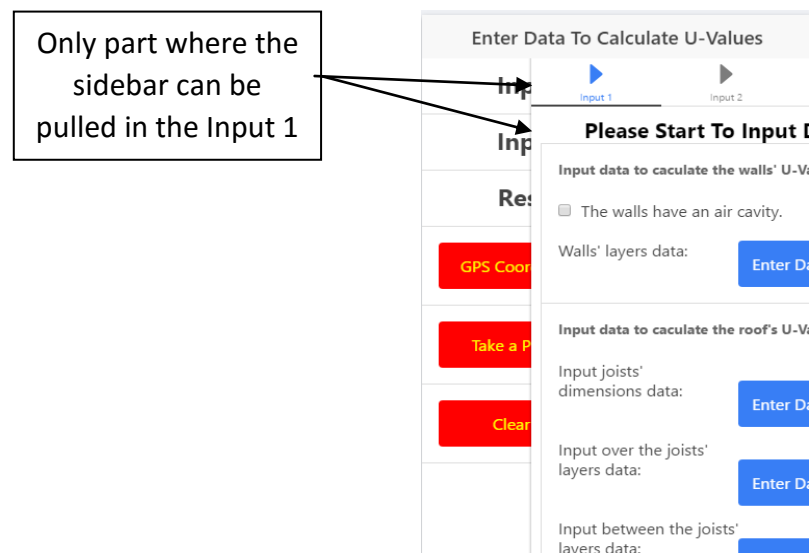

Figure 2

The three items Input 1,Input 2 and Results are shortcuts to the different screens of the app and can be used as an alternative to the icons, they can be activated by tapping an them (see Figure 3).
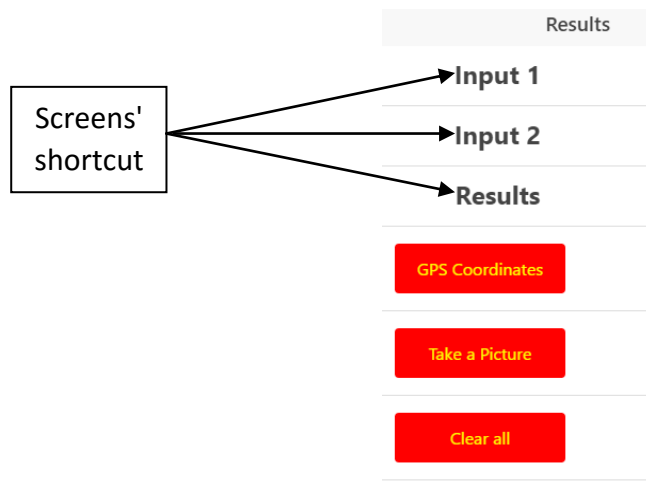

Figure 3

By pressing **GPS coordinates** button as shown in Figure 4, the dwelling GPS coordinates can be obtained, a pop up box would show the coordinates and they would show more permanently in the third screen (Results).

By pressing **Take a Picture** button as shown in Figure 4, the camera is activated and allow to take a picture of the dwelling which would show in the third screen (Results), the picture will be stored in the mobile device. This functionality has shown itself to be capricious one, very often the first picture taken does not appear, it is advised to try several times until the picture appears or for the best results take only a picture in the third screen.

By pressing the **Clear All** button allows the user to clear all the data even if they are stored.
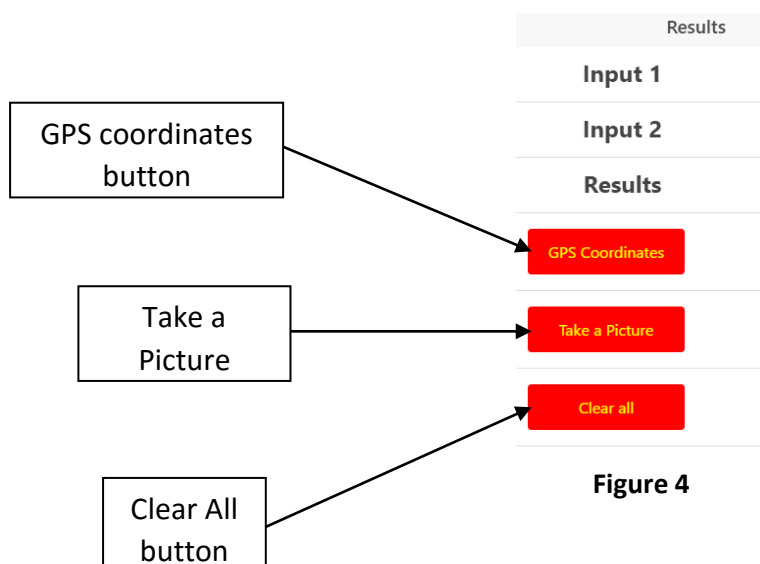

Figure 4

2 - The input 1 screen

This screen is designed to take input data which allow the calculation of the different components' U-Values. The U-Value is the amount of heat lost expressed in watts per meter squared and degree Kelvin of difference of temperature between the inside of the dwelling and outside (unit: W/m^{2}K). This screen is divided in four distinct section: the walls, the roof, the floor and the windows. It is assumed that the floor and roof of every dwellings is a joisted. The Input 1 screen is as shown in Figure 5a and 5b.

Figure 5a

Figure 5b

2.1 - The walls section

The walls section is as shown in Figure 6.

Figure 6

It is composed of two elements: one checkbox which should be checked if the walls have a cavity and a button which allow to input the thickness and conductivity of each of the layers of the walls. When the **Enter data** button is pressed two dialog boxes appear successively (see Figure 7a and 7b), the first one ask for the thickness in meters of the layer and the second one for its conductivity in W/mK. The operation should be repeated as many time as there is layers.

| **Figure 7a** | **Figure 7b** |

If the cancel button is pressed or if no data is entered the message in Figure 8 should show up and no data will be used or stored.

Figure 8

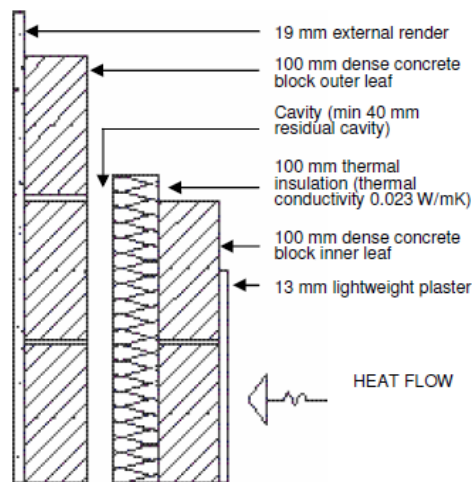An example of a layered wall is shown in Figure 8 and the conductivity of some materials can be found in Table 1.

Figure 9

Material	Density (kg/m³)	Thermal Conductivity (W/mK)
General Building Materials		
Clay brickwork (outer leaf)	1,700	0.77
Clay brickwork (inner leaf)	1,700	0.56
Concrete block (heavyweight)	2,000	1.33
Concrete block (medium weight)	1,400	0.57
Concrete block (autoclaved aerated)	700	0.20
Concrete block (autoclaved aerated)	500	0.15
Concrete block (hollow)	1800	0.835
Cast concrete, high density	2,400	2.00
Cast concrete, medium density	1,800	1.15
Aerated concrete slab	500	0.16
Concrete screed	1,200	0.41
Reinforced concrete (1% steel)	2,300	2.30
Reinforced concrete (2% steel)	2,400	2.50
Wall ties, stainless steel	7,900	17.00
Wall ties, galvanised steel	7,800	50.00
Mortar (protected)	1,750	0.88
Mortar (exposed)	1,750	0.94
External rendering (cement sand)	1,800	1.00
Plaster (gypsum lightweight)	600	0.18
Plaster (gypsum)	1,200	0.43
Plasterboard	900	0.25
Natural slate	2,500	2.20
Concrete tiles	2,100	1.50
Clay tiles	2,000	1.00
Fibre cement slates	1,800	0.45
Ceramic/Porcelain tiles	2,300	1.30
Plastic tiles	1,000	0.20
Asphalt	2,100	0.70
Felt bitumen layers	1,100	0.23
Timber, softwood	500	0.13
Timber, hardwood	700	0.18
Wood wool slab	500	0.10
Wood-based panels (plywood, chipboard, etc.)	500	0.13
Note:		
The values in this table are indicative only. Certified values, should be used in preference, if available.		

Table 1

When all the data for the walls have been inputted, the user has to slide the wall section off the app right to left and two buttons appear. When pressed, the first button (the green one) allows the calculation of the U-Value of the wall when the second one (the red one) allows the user to clear all the data regarding the walls when it is pressed even they are stored (see Figure 10).

Figure 10

Calculates the walls U-Value

Clear the data related to the walls

2.2 - The roof and floor sections

The roof and floor sections work on exactly on the same principle and therefore will be presented together. Those sections are as shown in Figure 11a (for the roof) and 11b (for the floor).

Input data to caculate the roof's U-Value

Input joists' dimensions data: Enter Data

Input over the joists' layers data: Enter Data

Input between the joists' layers data: Enter Data

Input data to caculate the floor's U-Value

Input joists' dimensions data: Enter Data

Input over the joists' layers data: Enter Data

Input between the joists' layers data: Enter Data

Figure 11a   **Figure 11b**

Both sections are composed of three **_Enter Data_** buttons, when the first button is pressed two dialog boxes appear, the first one asks for the distance between the joists in meters (generally it is around 1m) and the second one is asking for the width of the joists in meters (around 0.15m) as shown in Figure 12a and 12b.
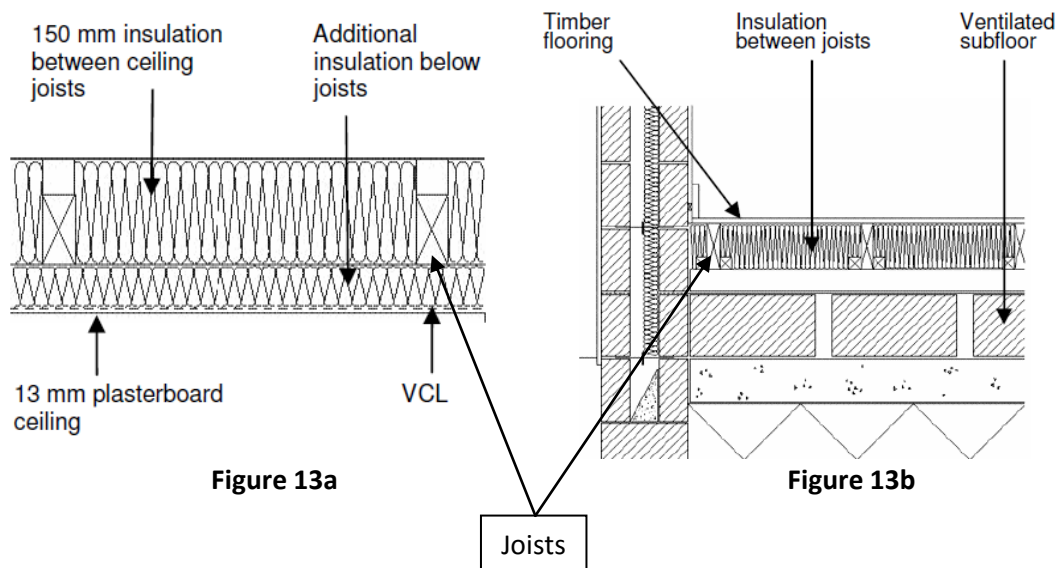
Please enter the distance between 2 joist (center to center) in meters:	Please enter the width of the joists in meters:
1	0.15
Cancel OK	Cancel OK

Figure 12a   **Figure 12b**

For the two other buttons, they work on the same principle that the *Enter Data* of the walls, when pressed two dialog boxes appear successively (Exactly the same than walls, see Figure 7a and 7b), the first one ask for the thickness in meters of the layer and the second one for its conductivity in W/mK. The operation should be repeated as many time as there is layers. Also if the cancel button is pressed or if no data is entered the same message that in Figure 8 should show up and no data will be used or stored. Examples of layered roof and layered floor are shown in Figure 13a and 13b.

150 mm insulation between ceiling joists

Additional insulation below joists

Timber flooring

Insulation between joists

Ventilated subfloor

13 mm plasterboard ceiling

VCL

Figure 13a   **Figure 13b**

Joists

The reason of the different buttons to calculate the U-Values are that the floor and roof lack uniformity and can be observed in figure 13a and 13b. The second button take the measurement over and under the joists when the third button take the measurements between the joists.

As for the walls, once all the data have been entered the floor or roof section must be slided right to left and two buttons appear. When pressed, the first button (the green one) allows the calculation of the U-Value of the roof or the floor when the second one (the red one) allows the user to clear all the data regarding the roof or the floor when it is pressed even if stored (see Figure 14).
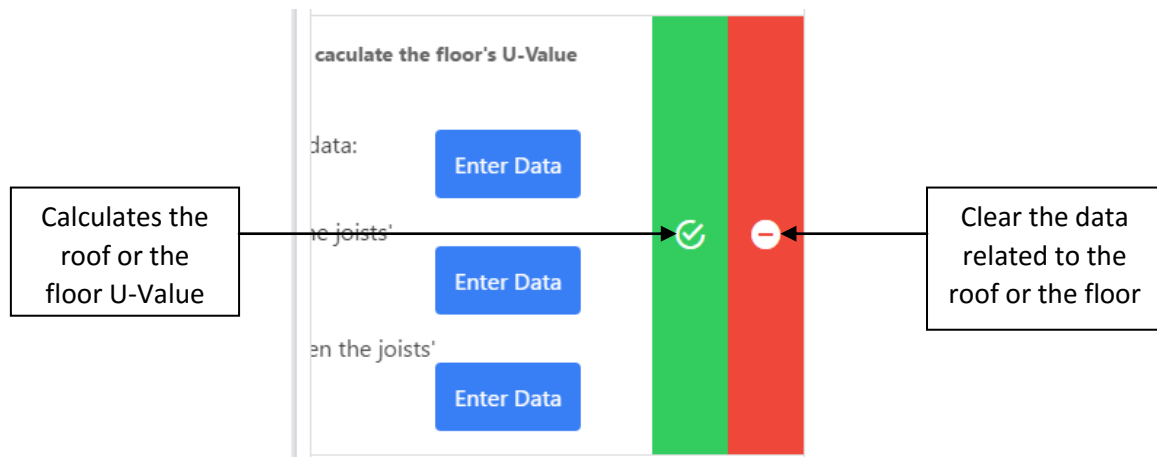
caculate the floor's U-Value

data:

Enter Data

Calculates the roof or the floor U-Value

ie joists'

Enter Data

Clear the data related to the roof or the floor

en the joists'

Enter Data

Figure 14

2.3 - The windows section

The windows section is as shown in Figure 15.
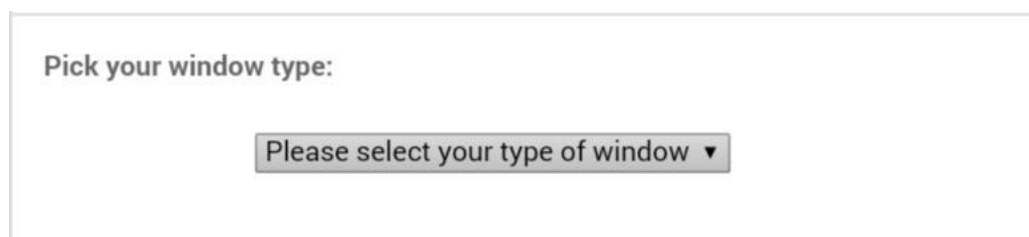

Pick your window type:

Please select your type of window ▼

Figure 15

The windows section is only composed of a dropdown menu. When pressed, a dialog box appears with three choices: single glazing, double glazing and triple glazing as shown in Figure 16, select one of those options. For the need of this app, all the windows are assumed to be of the same type.

Please select your type of window

Single Glazing

Double Glazing

Triple Glazing
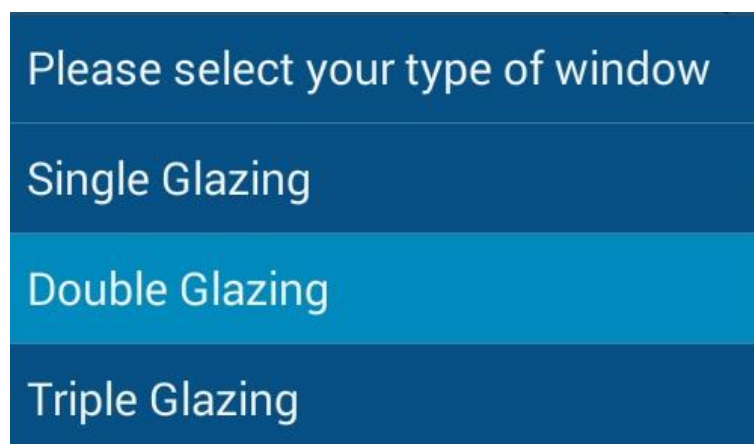
Figure 16

When the user slides the windows section from right to left a red button appears which allows to clear the data related to the windows (see figure 17).

Figure 17

Clear data related to the windows

NB: If a door is in majority composed of glass (over 50% of its surface), it will have to be considered as a window.

3 - The Input 2 screen

This screen is designed to take input for the area of the different components, the dwelling set point temperature, the price of electricity and the monthly average temperature. The component area sections also include their U-Values, the Input 2 screen is as shown in Figure 18a and 18b.

Figure 18a   **Figure 18b**

NB: The doors' U-Value is not demanded in the first screen, instead it is hardcoded in app programming.

3.1 - The components area sections

As the different area component sections work on the principles for the walls, the roof, the floor, the windows and the doors, they will be presented together. It can be observed

that the U-values associated to the components are showing there. Those sections are shown in Figure 19.

Figure 19

When one of the *Enter Area* button is pressed, a dialog box opens asking the user to enter the area of the asserted component as shown in Figure 20.

Figure 20

Finally, by sliding any area section from the right to the left, a button appears allowing the user to clear the area data from the concerned component as shown in Figure 21.
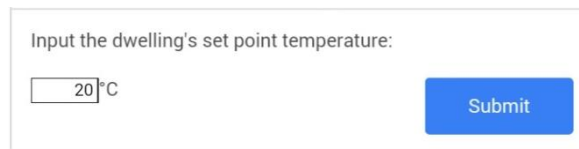

Figure 21

Clear the area data of the walls

3.2 - The dwelling set point temperature and price of electricity sections

As the set point temperature and the price of electricity are based on the same principles they will be shown together. The dwelling set point temperature and the price of electricity are as shown in Figure 22a and 22b.
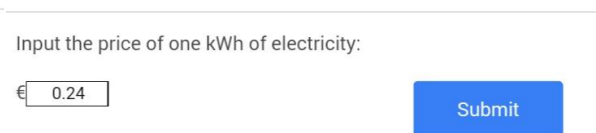

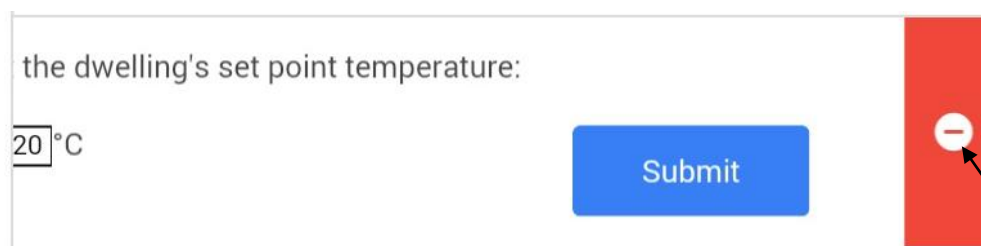**Figure 22a**   **Figure 23a**

The user has to input the set point temperature and to press the Submit button to confirm its input.

A clear button appears when the set point temperature section is slided from right to left to clear the data inputted as shown in Figure 23.

Figure 23

Press to clear the set up temperature

3.3 - The monthly average temperatures

The monthly average temperatures section is as shown in Figure 24.

Figure 24

To input the monthly average temperature, the user has to press the **Enter Data** button then a dialog box will show asking for the average temperature for January as shown in Figure 25.

Figure 25

When the temperature has been inputted press **OK** and another dialog box will show asking for the average temperature for February (see Figure 26) and so on until the month of December allowing to cover the twelve months of the year.

Figure 26

A clear button also appear when the section is slided from right to left to clear the input data as shown in Figure 27.

Clear the monthly average temperatures

4 - The Final Output screen

  The Final Output screen simply displays the cost of the heat losses, the GPS coordinates and the picture of the dwelling as shown in Figure 27a and 27b. There is no user input required as it is the sum of all the previous input.
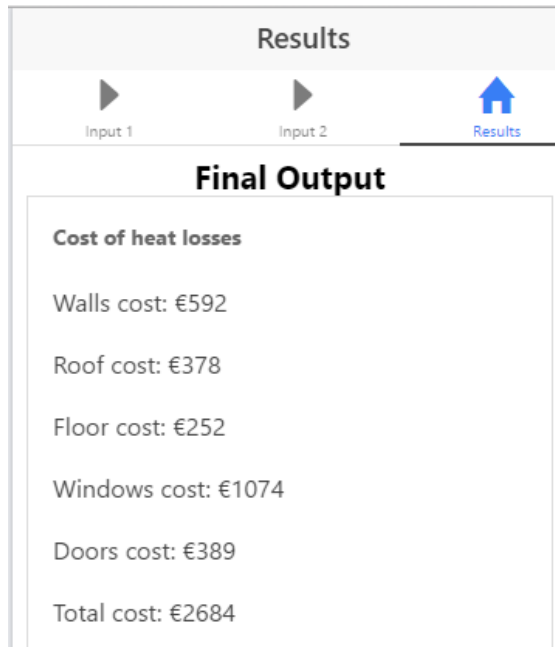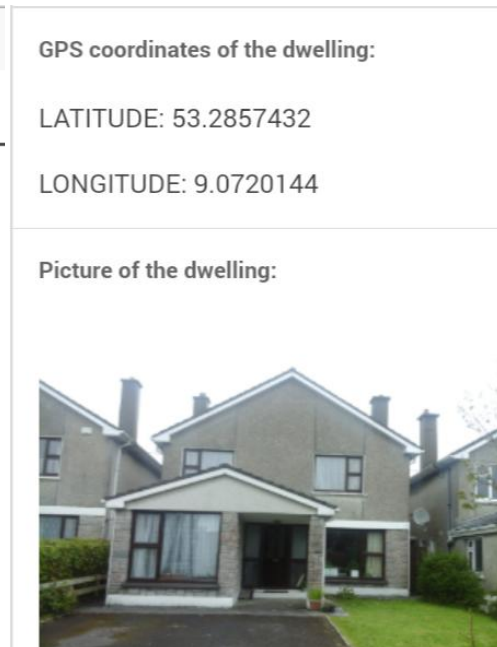

Figure 27a	**Figure 27b**

NB: For the need of this assignment some of the more technical aspect have been left out of the app which makes it not fully accurate even though it close to be. If more technical information are needed please consult the part L of the Technical Guidance Document (TGD) at environment.ie

Link:http://www.environ.ie/sites/default/files/migrated-files/en/Publications/DevelopmentandHousing/BuildingStandards/FileDownLoad,27316,en.pdf