

# **Socially enabled community: proof of concept e-Guardian Angel**

**Runa Alam**

**(440528427)**



THE UNIVERSITY OF  
**SYDNEY**

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**Supervisor**

**Dr. Simon K. Poon**

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## **Abstract**

Guardian angel is the concept where a system or individual is assigned to a specific person to actively and passively look after and monitoring of that specific person. eGuardian Angel is the concept to facilitate this guardian angel process with a mobile application and social interaction via the application. This project tried to implement a proof of concept iOS (iPhone) app for socially enabled guardian angel community. Guardian Angel platform can be implemented in different type of network topologies. In this project, the Guarding Angel platform is enabled onto a ring network where each person is responsible for another individual as guardian.

Application of eGuardian Angel is possible where guardian angel system could be implemented like disease monitoring, addiction and other social problems. This app will provide ample opportunities to meaningful interaction between the Guardian and the Child (to the person the Guardian is assigned) with functionalities to restrict the flow of information as wished by the child.

The developed app has additional functional features than previous works. Functionality wise it provided a broad range of functions – logbook for activities, medication and diet; blog posting with privacy options; messaging between Guardian and child; and finally child monitoring facilities for the guardian.

This proof of concept app can be extended in the future by adding more features and user studies could be undertaken to gauge the effectiveness of eGuardian Angel platform. Also this app can be customized sustainably to suit any other group of participants.

## **Acknowledgement**

Thanks to my supervisor Dr. Simon K. Poon for being supportive and flexible during the course of this project. Thanks to my family for staying beside me and for their patience while I complete this project.

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# 1. Introduction

## 1.1 Motivation

(Peter Szolovits, 1994) introduced the guardian angel concept in 1994 for providing mutual support and monitoring for diabetics patients. There, they system was used to collect data from the patients and store those and provide alert functionalities based on the collected data. Therefore, the system was acting as a 'guardian angel' to the patients and used by the medical professionals in the event of health issues requiring further attention.

The eGuardian Angel system is first proposed by (Carpo, 2014) where a simple Android application is developed to allow Guardian/child both seamless and both way interaction. While the application proved useful in user evaluations done as part of the research, a more feature rich application is needed to allow effective interaction between Guardian and child. So the main motivations are:

- Create a Guardian Angel system for the mass without expert knowledge.
- Provide opportunity to socially relate Guardian-child with various forms of communication and activity sharing.
- Develop a useful proof of concept iOS (iPhone) app ready to be trialed in further studies in the future.

## 1.2 Definitions

**Guardian Angel system:** A system that uses the Guardian Angel concept, where one user provides support and monitoring for another user to help him/her achieve a goal.

**Guardian User:** User of the system who will be given a Child user to monitor. Their main goal is to assist the Child user in reaching their goal.

**Child User:** This is the basic user of the system who has a goal that they want to achieve.

**eGuardian Angel (eGA):** This is the iOS (iPhone) mobile application that is developed in this project, which will use both Guardian users and Child users to provide interaction in a socially enabled way.

### **1.3 Project Contributions**

Contributions of this project are as follows:

- For the first time eGuardian Angel is developed in iOS using the newly introduced Swift language with sophisticated iOS UI elements.
- eGA app provides monitoring options for daily activities like diet, physical activities, medications as well as blog posting and messaging.
- eGA provides push notification options for various elements.
- eGA is unit tested for important functionalities.
- eGA web app provides easy way to create and manage users, networks and groups.
- This project provides the feature comparison with the previous Android app.

## **2. Related existing mobile systems**

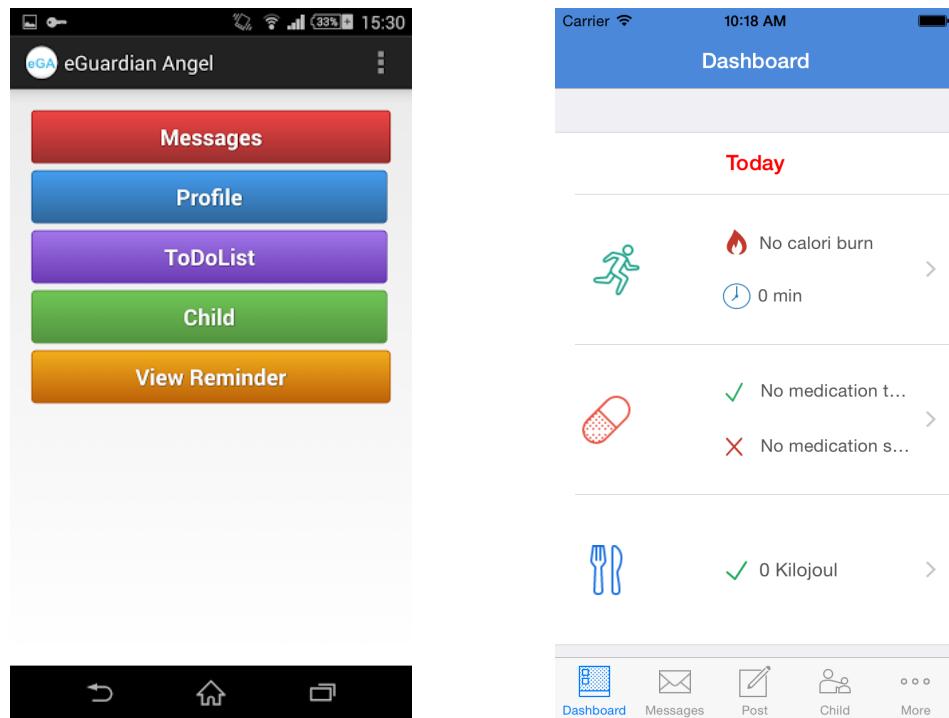
With the wide scale popularity and adoption of powerful mobile devices, mobile computing is now a norm. More and more people do a lot of computing work in mobile, which previously can only be done in a workstation. Due to their mobility, it allows for a versatile use, which was not possible by carrying around the workstation computers. In this section some of the eGuardian Angel related mobile applications will be discussed.

The systems proposed by (Rens Scheepers, 2006) can be classified as an example of eGuardian Angel where the goal was fixed – work productivity. Core feature of the system are client interaction recordings, messages and information retrieval. The difference is that the system does not limit interaction among users; any user can interact with any other users. In eGuardian Angel, the motivation is to keep the interaction between child and guardian focused and effective and minimize noise in communication. As a result interactions are limited between child and guardian. Results obtained by (Rens Scheepers, 2006) showed that overall users were mostly satisfied using the system and specifically found the use of mobile device convenient and effective. Since the eGuardian Angel design will be similar to this design, the key takeaway is that eGuardian Angel also should be effective on a mobile device if designed effectively and will be applicable to different domains.

In learning domain, (Popescu, 2014) proposed similar innovative mobile computing systems. The eMuse system was introduced by (Popescu, 2014), which was designed for the student to self-monitoring and evaluation in a social context. Students can keep track of their studies, collaborate and often engage in healthy competition by seeing other's encouraging progresses. The teacher would able to track all the students and interaction, so adult supervision is present if required. The difference with eGA is again the interaction among child (students) is not limited and network follows the hub and spoke model (teacher being the hub). In eGuardian Angel we followed the ring network. However, eMuse system found to be effective, specifically the use of social features. This motivates us to introduce socially enabled eGuardian Angel.

(Mark Donnelly, 2010) introduces the application to help Alzheimer patients through the provision of frequent memory cues in the form of video reminders delivered via mobile phones. This application is similar to the Guardian Angel concept as there was one caregiver for the group of participants. The caregiver had to prerecord the series of videos that would remind each of the Alzheimer's patients to remember aspects of their daily lives under the guidance of a technical researcher and a nurse. This could be described as more controlled interaction than our suggested eGuardian Angel platform. Similar to eGA, this application has a common goal for the participants namely to aid in maintaining their memory.

The eGuardian Angel system proposed by (Carpo, 2014) where a simple Android application is developed enabled few social interaction features, though it's goal was to develop a working prototype of eGA. The eGA iOS application, which is developed as part of this project, took the 'social context enablement' central to its design. In figure 1 home screen of both apps are shown and in table 1, corresponding features are compared.



**Figure 1 eGA Android and iOS app home screen side by side**

Features	eGA Android app	eGA iOS app
Network definition	Manually in the database	By using eGA web app*
Facebook Login	No	Yes
Chat/Messaging	Yes	Yes
To Do List	Yes	No
Reminders	Yes	Yes, integrated in activities*
Physical activity tracking	No	Yes
Medication tracking	No	Yes
Diet Diary	No	Yes
Blog post	No	Yes
Profile pictures	No	Yes
Push notifications	Yes	Yes

**Table 1: Feature comparison eGA Android and iOS app**

### **3. eGuardian Angel Platform**

In this section, first the three main entities of the eGuardian angel platform – users, groups and networks will be discussed along with the formation strategy of groups and networks.

#### **3.1 Group**

Groups are created with the users following or sharing a common goal or symptoms. For example from a cohort of possible Child and Guardians, a group could be formed with diabetics patients who wants to change their lifestyle to keep the disease in control. Another group could be formed for the persons who would need mental health support.

#### **3.2 User**

There are two types of users in eGuardian Angel platform- Guardian and child. These user types are not exclusive means one user can be both Guardian (for another user) and Child (have another user as Guardian).

##### **3.2.1 Child user**

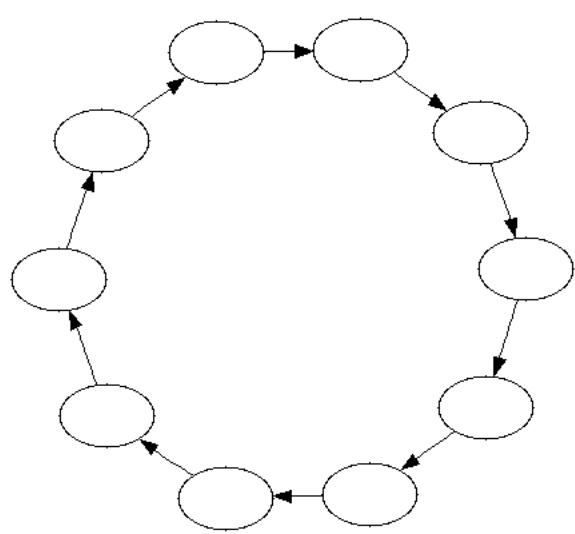
Child user is the basic user of the app who is given a goal to achieve by increasing the general wellbeing of his/her life. Different aspect of his/her daily activities can be captured using the app. The app will also track historical information of these activities over a period. Child user can communicate with the Guardian user via 1-1 messaging. S/he can communicate with the outside world (other than guardian) by setting appropriate privacy in blog post feature.

##### **3.2.2 Guardian User**

Guardian users of the platform are in charge of monitoring/inspiring the child user. They can see the progress of child user in different activities and medications and can intervene as required. Via 1-1 messaging Guardian can keep close tab on child and provide early warning if the child is going off track from the agreed goal.

### 3.3 Network

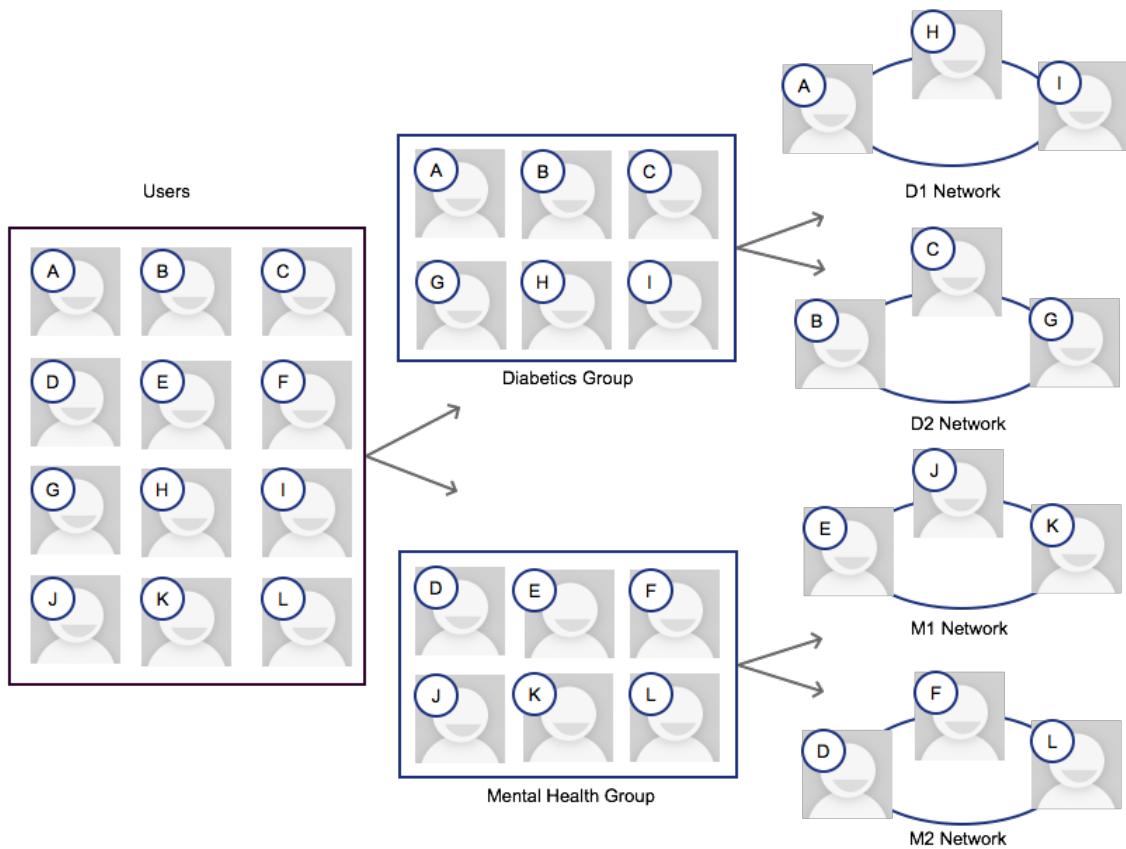
In the design of similar mobile applications use the hub and spoke network design. One user keeps tracks of multiple users in the hub and spoke network design. As a result, general distribution and sharing of knowledge is heavily dependent on that specific user (Walatka, 2012). (Carpo, 2014) designed the network as ring network (figure 2) to take the burden off that main user and share it among the other users. So in this arrangement it is possible for the same user to be Child and Guardian.



**Figure 2: Ring Network from (Carpo, 2014)**

Each node in the above diagram represents a general user of the eGuardian Angel platform. Each general user points to another general user in a cyclic fashion. The node from which the relationship arrow starts is the Guardian user and it is pointing to the Child user.

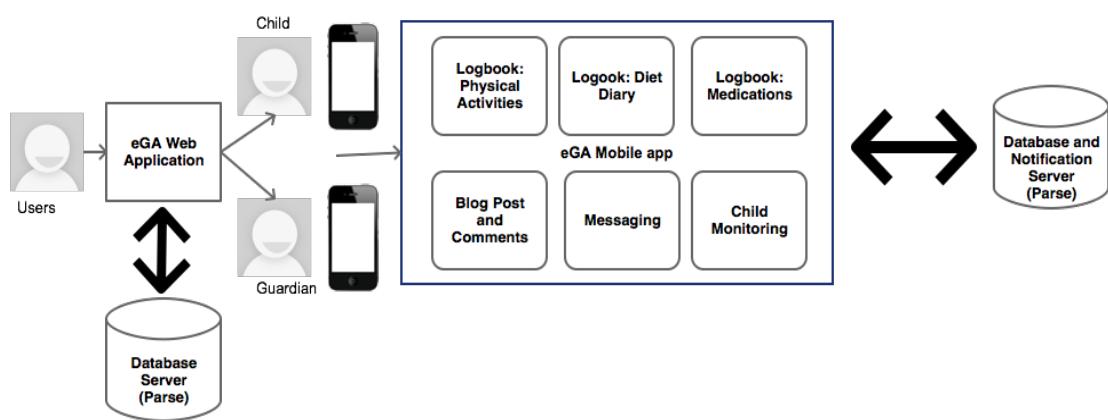
Entities described above are depicted in the following figure 3 and an example is given for few sample users, groups and networks.



**Figure 3 Sample Users, Groups and Networks**

## 4. System Design

Figure 4 shows the main components of eGA system, which are described as follows:



**Figure 4: eGA Architecture**

### 4.1 eGA Web Application

User/group/network is assigned using eGA web application. Note, due to time constraint eGA web is designed but not implemented in full and manual database insertion is used to create groups and networks.

eGA web application provides features to create/update and show lists of users, groups and networks.

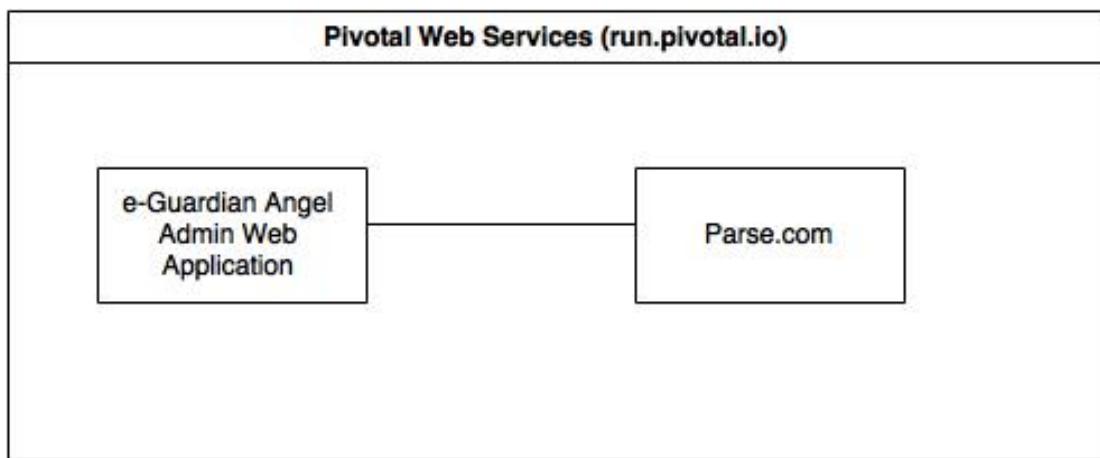


Figure 5: eGA web application schematic

#### 4.2 eGA iOS App

The iOS app interacts with Parse (Parse) as a backend and also for sending push notifications.

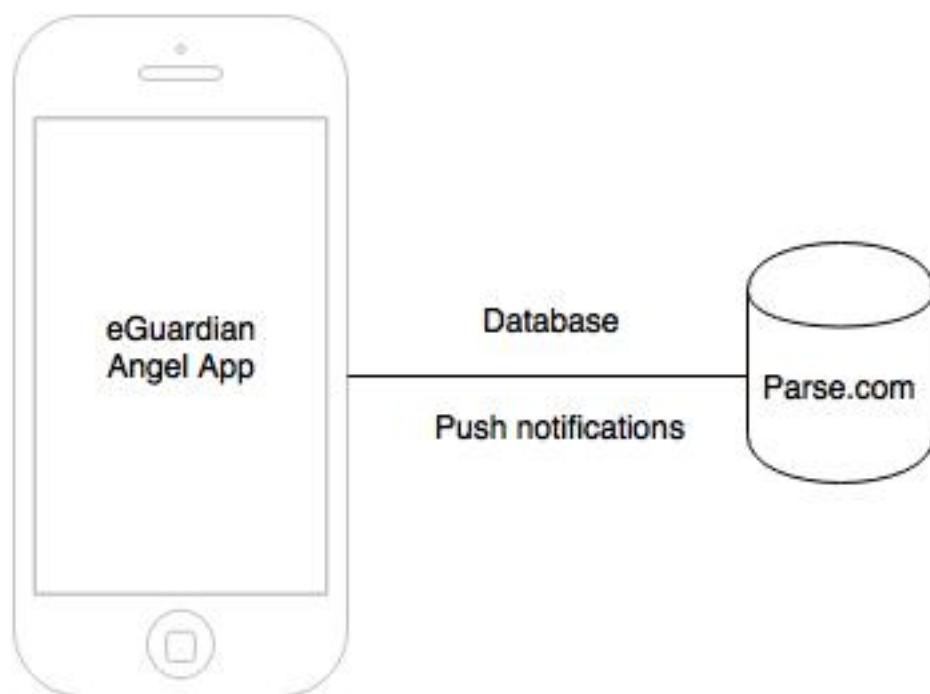
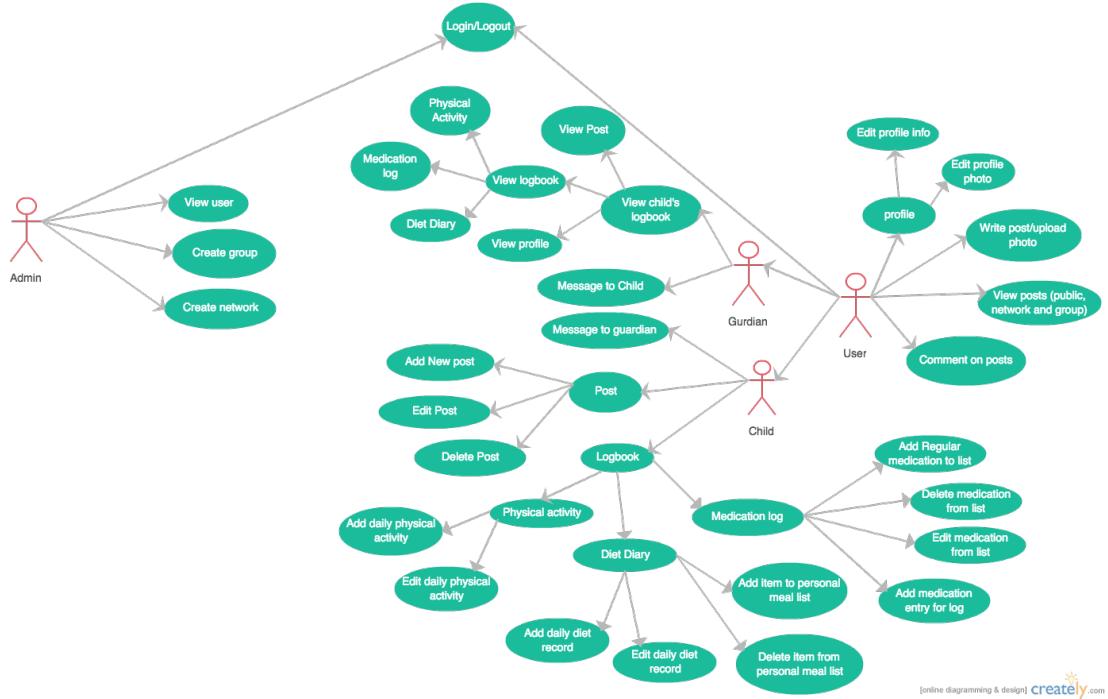


Figure 6: eGA iOS app schematic

### 4.3 Use case diagram

In figure 7, the use case diagram is shown. The actor Guardian and child are showing the use cases available to them. Admin actor is actually the person who will be using the eGA web application to define the network.



**Figure 7: Use case diagram**

### 4.4 Data model

Data model for eGA app is shown in figure 8. Data is stored at Parse, which uses nosql storage solutions. Being a nosql storage it is very easy to store and retrieve data and change schema at any time.

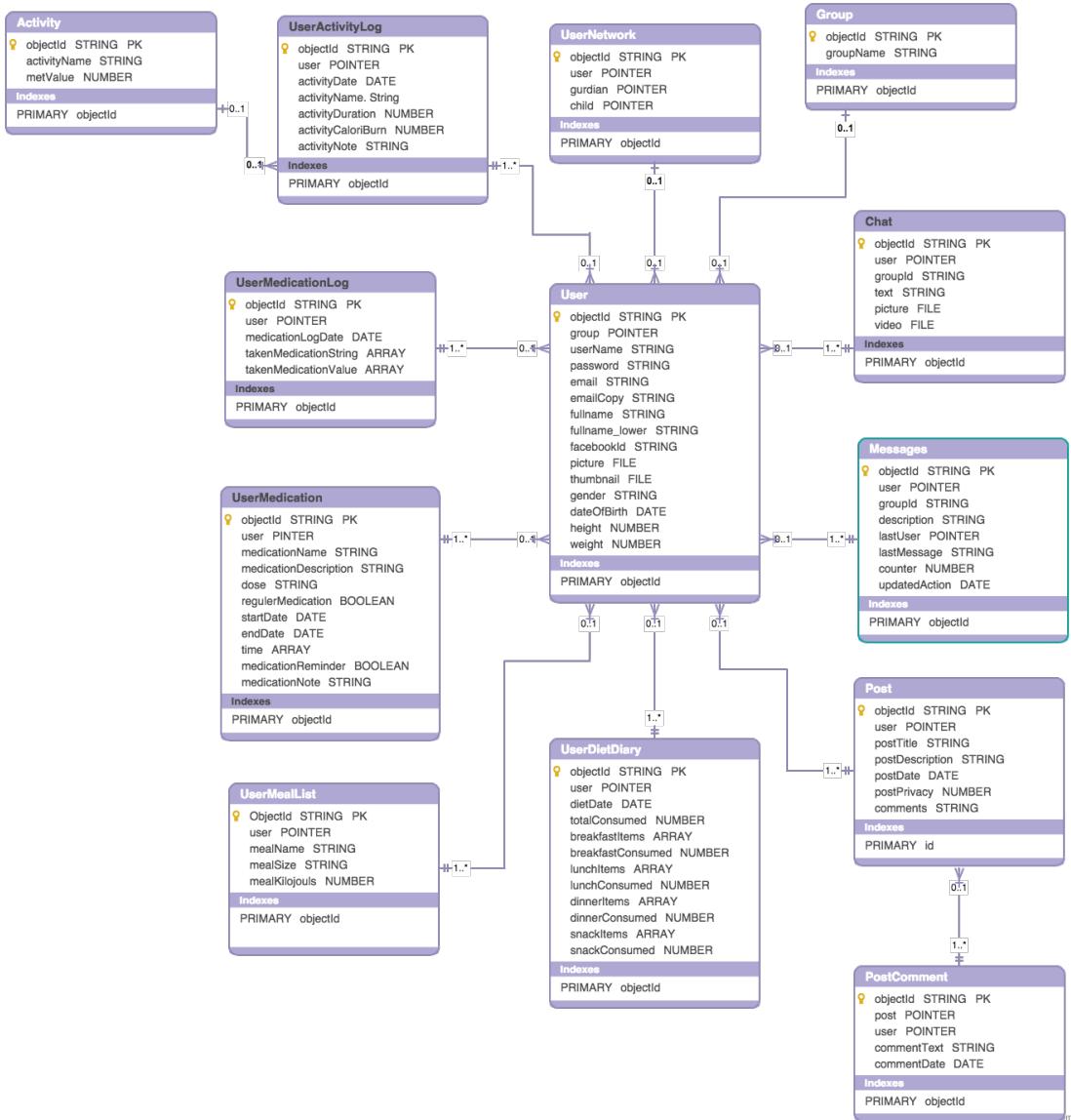


Figure 8: Data model

## 4.5 Cost model

### 4.5.1 eGA web app

eGA web app is hosted in Pivotal Web Services (Pivotal Web Services) which is a cloud service provider based on Cloud Foundry Platform (Cloud Foundry). The web app will only used by the admin user to setup network and is fairly lightweight application. So we anticipate it would be sufficient to run on 128 MB memory and only one app instance. The resulting cost is as follows:

	Memory	App Instance	Price
eGA web app	128 MB	1	2.70 USD/month

**Table 2: eGA web app cost model (PWS pricing)**

#### **4.5.2 eGA iOS app**

eGA iOS app used Parse.com for data storage and push notifications. It is currently running on the free tier of the Parse platform, which has the following limits (Parse Plans):

Parse Core (for data storage): 30 requests/second, 1 background job, 20 GB file storage, 20 GB database storage, 2 TB file transfer  
 Parse Push (for push notifications): 1,000,000 unique recipients.

### **4.6 eGA App Development Environment**

**Editor:** xcode 6.3

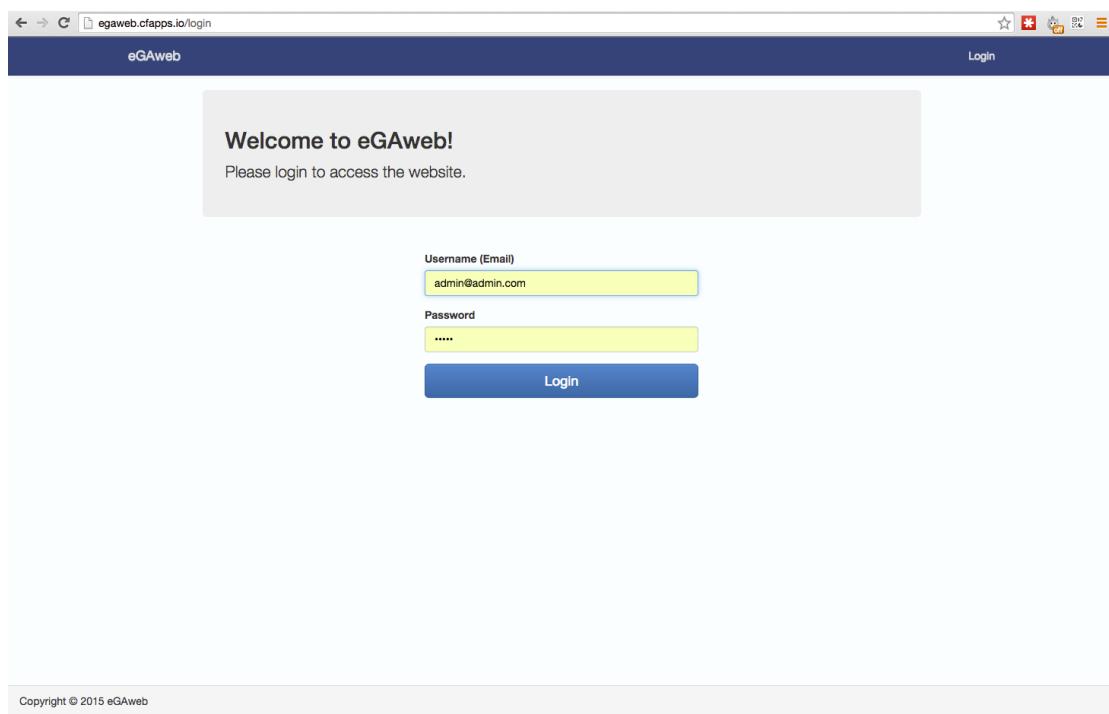
**Hardware:** Macbook Pro 13" Late 2014 model

**Software/Language:** Swift and XLForm library

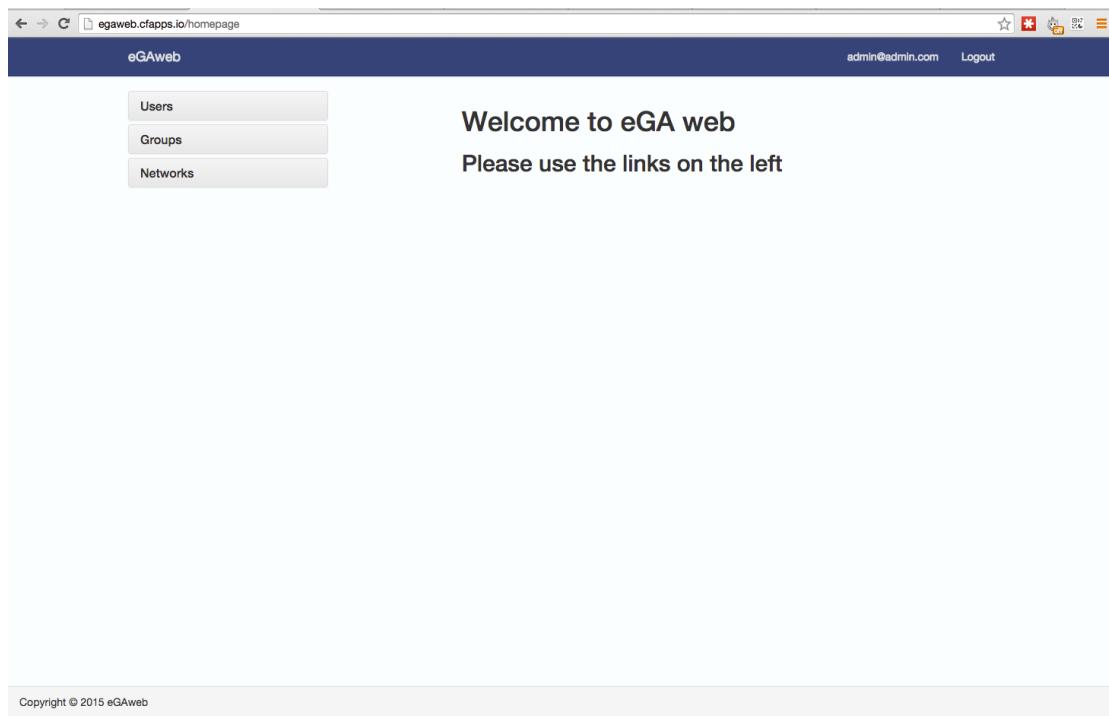
## 5. UI and Implementation Details

### 5.1 eGA web app

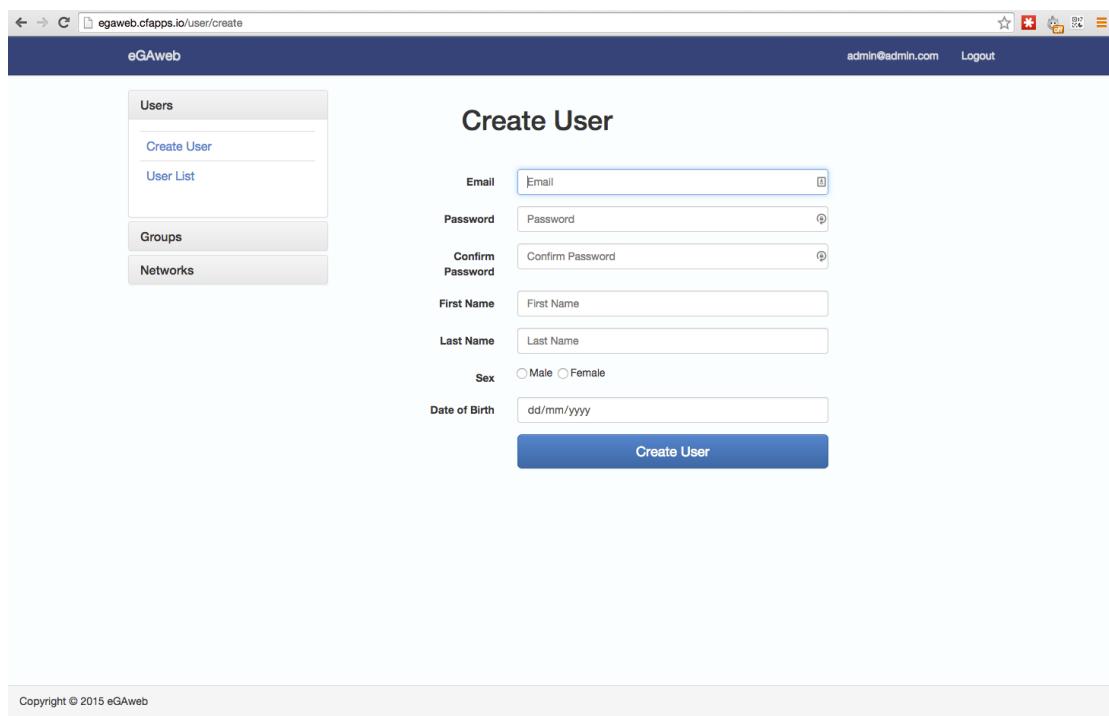
As the web app is only designed, not fully implemented, we are just going to provide the mock designs here, which is self-explanatory. The create user and group page is fairly simple. The design of create network page is bit tricky as it involved assigning the individuals in a group in a ring network. At the end a user list is show with group and network information.



**Figure 9: eGA web application login page**



**Figure 10:** Home page after login



**Figure 11:** Create User page

Copyright © 2015 eGAweb

**Create Group**

Group Name:

Description:

**Save Group**

**Figure 12: Create Group page**

Copyright © 2015 eGAweb

**Create Network**

Network Name:

Group:

Network Size:

Jhon Doe	Robert Frost	Diana Rose	Mike Ross	Harvey Mike	Jenny Doe
----------	--------------	------------	-----------	-------------	-----------

#	Name	
1	Harvey Mike	X
2	Mike Ross	X
3	Jhon Doe	X
4	Robert Frost	X

**Save**

**Figure 13: Create Network page**

The screenshot shows a web application interface titled "User List". On the left, there is a sidebar with "Users" selected, showing options for "Create User" and "User List". Below the sidebar are links for "Groups" and "Networks". The main content area displays a table with the following data:

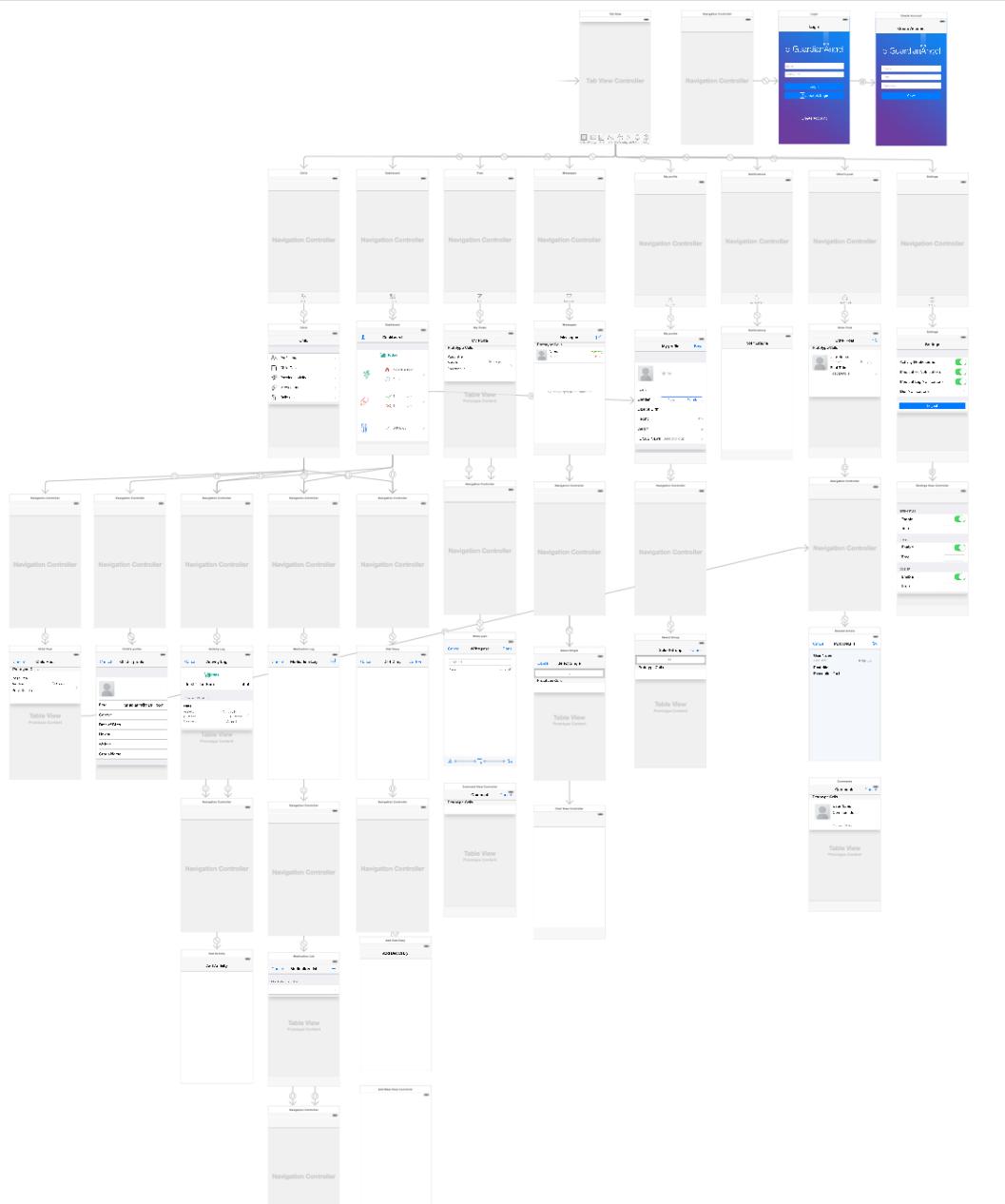
User Name	email	Group	Network	Edit/Delete
User One	user1@user.com	Blood Cancer	BC1	<button>Edit</button> <button>Delete</button>
User Two	user2@user.com	Blood Cancer	BC1	<button>Edit</button> <button>Delete</button>
User Three	user3@user.com	Blood Cancer	BC1	<button>Edit</button> <button>Delete</button>
User Four	user4@user.com	Blood Cancer	BC1	<button>Edit</button> <button>Delete</button>
User Five	user5@user.com	Skin Cancer	SC1	<button>Edit</button> <button>Delete</button>
User Six	user6@user.com	Mental Health	MH1	<button>Edit</button> <button>Delete</button>

Copyright © 2015 eGAweb

**Figure 14: User list**

## 5.2 eGA iOS app

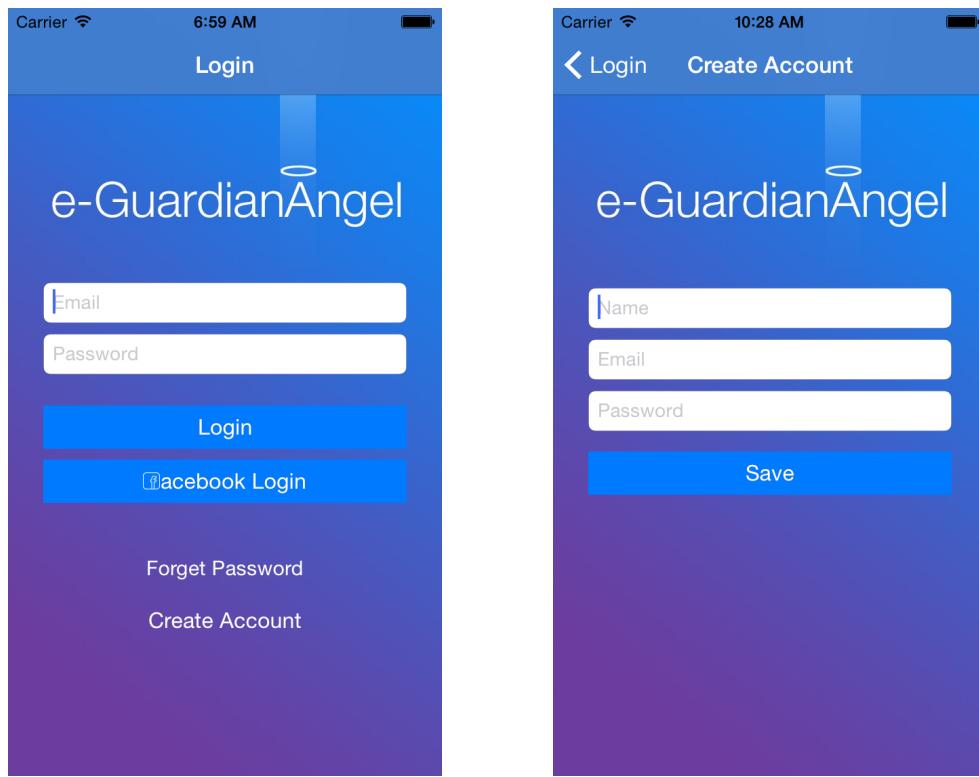
A screen grab from xcode is shown in figure 15, just to give an idea of number of view pages and connection in the iOS app.



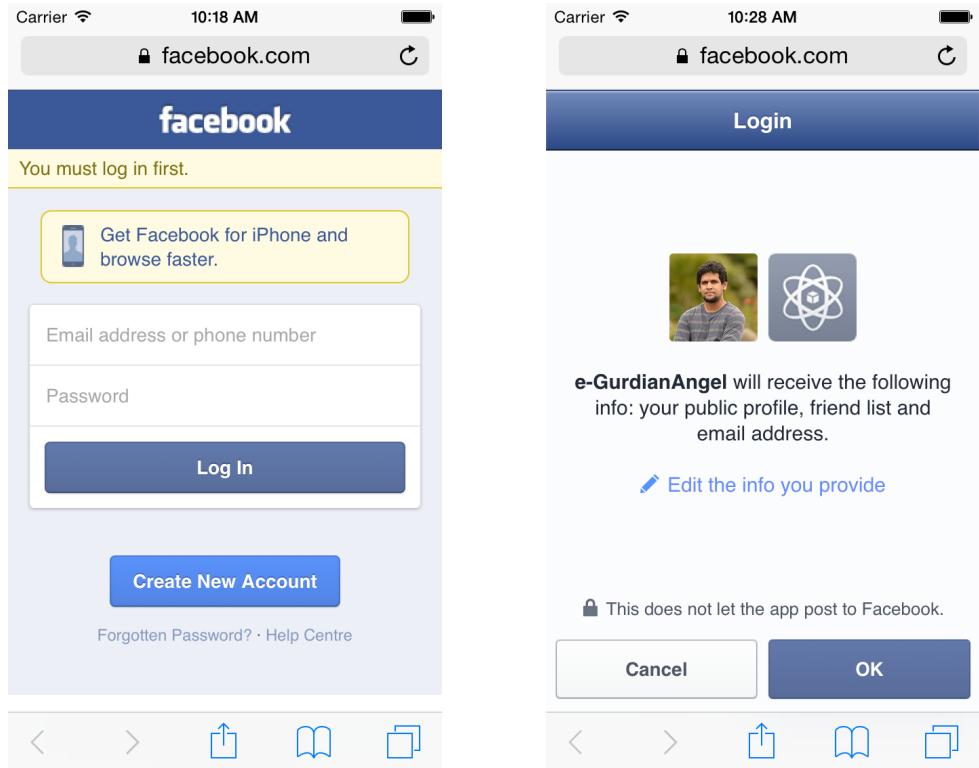
**Figure 15: eGA app screen storyboard connections**

### 5.2.1 Login/Create Account

User can login and create account via the login screen (Figure 16). They can also choose to login using their Facebook credentials, so they don't need to remember a new username/password. For Facebook login they need to authorize the app to login with Facebook (Figure 17).



**Figure 16: Login prompt and create account**



**Figure 17: Facebook login and authorization**

### 5.2.3 Dashboard

After login Dashboard will show the current status for todays different activities, medication and diet. User can click on the rows to get/create further information

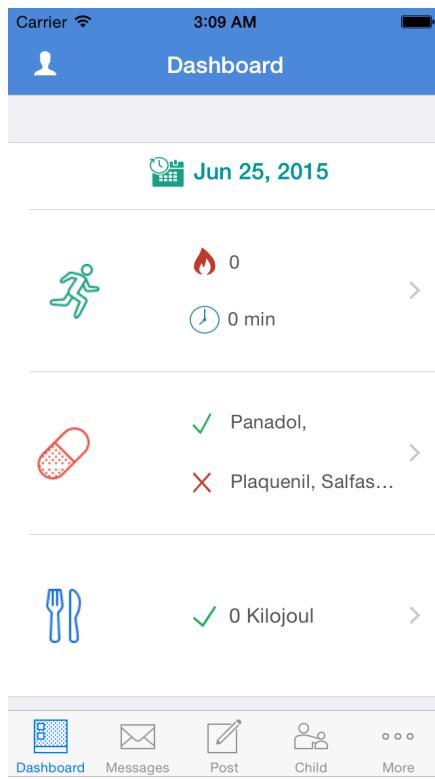
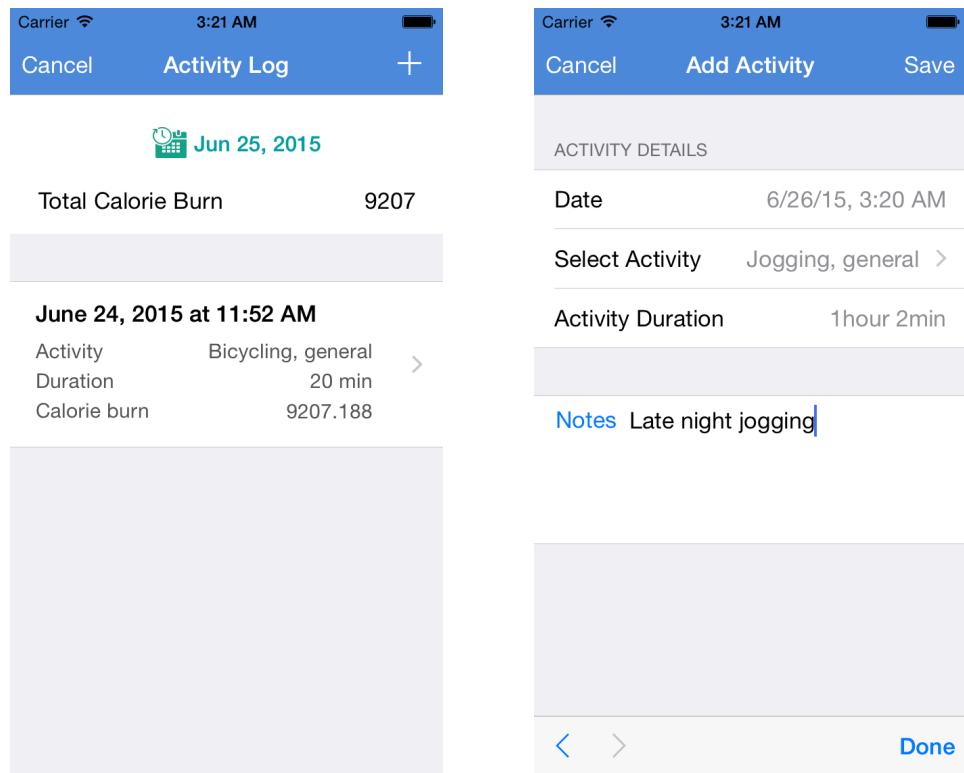


Figure 18: Dashboard

for physical activity, medication and diet. At the bottom they could also use the icons to access message, post and child information. Clicking on more will open the settings screen. In short they could access any features from the dashboard.

### 5.2.4 Activity

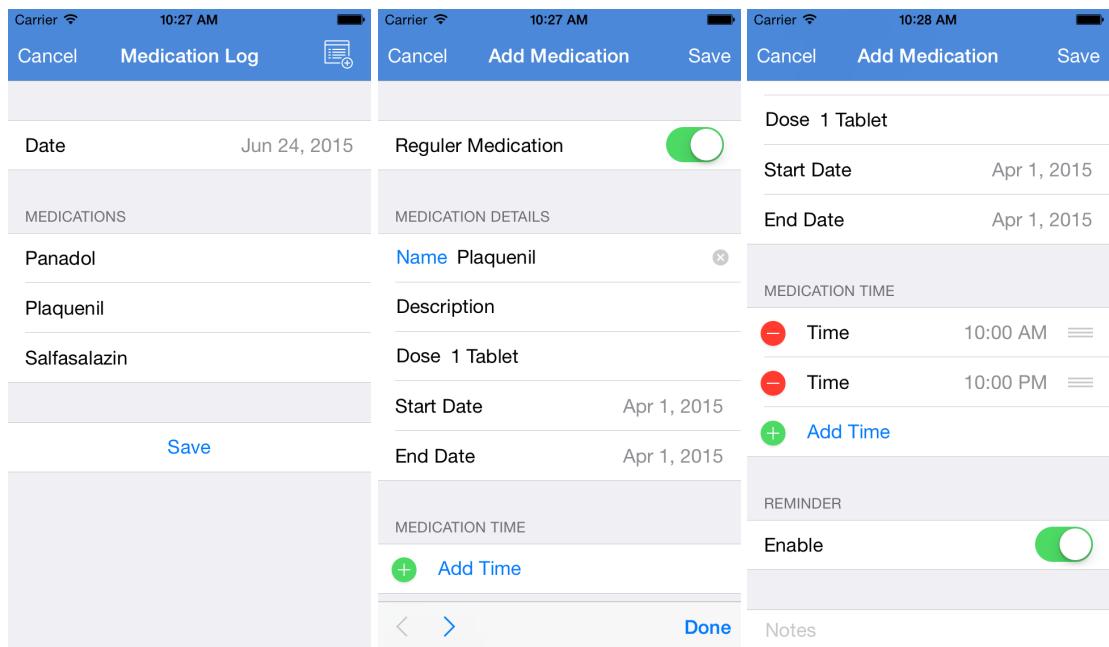
Clicking on activity icon will take the user to the screen where recent activities are shown and they can also add new activity clicking on the + sign. From the activity MET (MET values) values along with user's height/weight/age info, the app will calculate the 'Calorie Burn' value using a formula (Calorie Burn Formula, 2015). So the user can keep track exactly how much active s/he is day to day.



**Figure 19: Add/view activity**

### 5.2.5 Medication

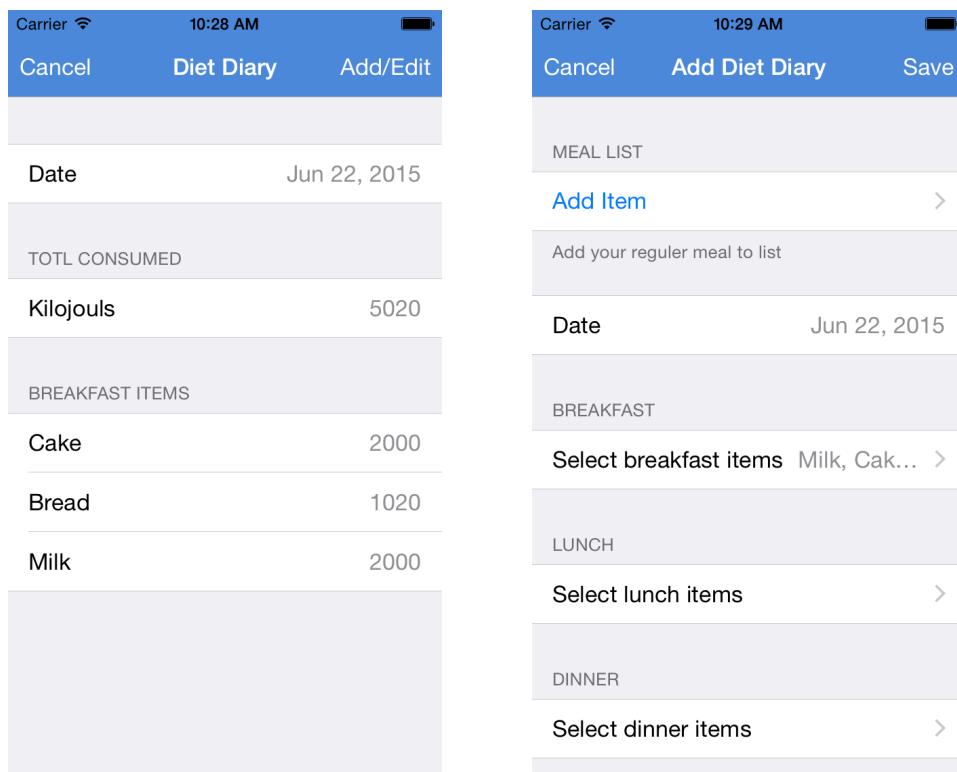
User can add the name of medications along with dosage and time information in the app. They can also select start and end date for a specific medication. When a medication is taken it can be marked as such. So the app will keep track of the medications logs (whether a specific medication is taken on a specific day or not). This information will most likely help the guardian to remind the child of the importance of taking medications regularly.



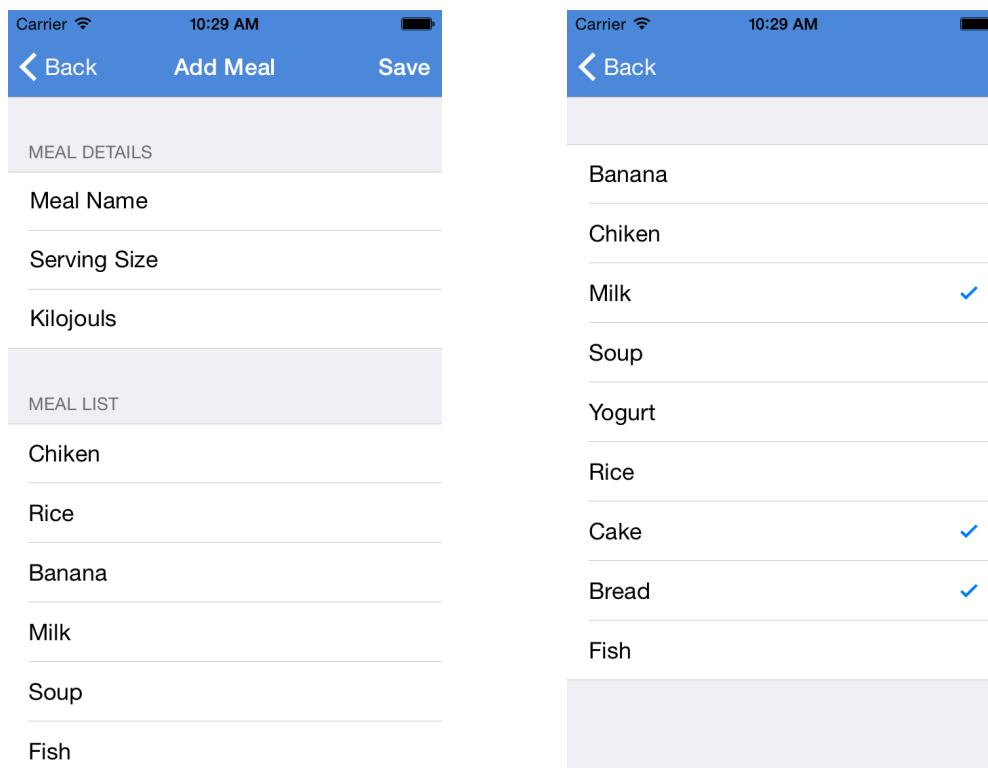
**Figure 20: Medication log and add medication**

### 5.2.6 Diet Diary

The user to keep track of his/her diet throughout the day can use diet Diary. Meals can be added with serving size and energy information and can be selected for a specific diet like breakfast, lunch, dinner or snack. When a specific diet is taken the app will keep track how much kilojoules is consumed. So if a child has a weight loss program part of his/her goal, s/he and the guardian can get insights from the diet information.



**Figure 21: Diet diary**



**Figure 22: Add meal item and Select breakfast item from meal list**

## 5.2.6 Messaging

Messaging feature can be used only between guardian and child. This provides the opportunity for focused 1-1 communication between the guardian and child. The guardian can often send message to check on the child and the child can send a message if s/he has any questions or concerns.

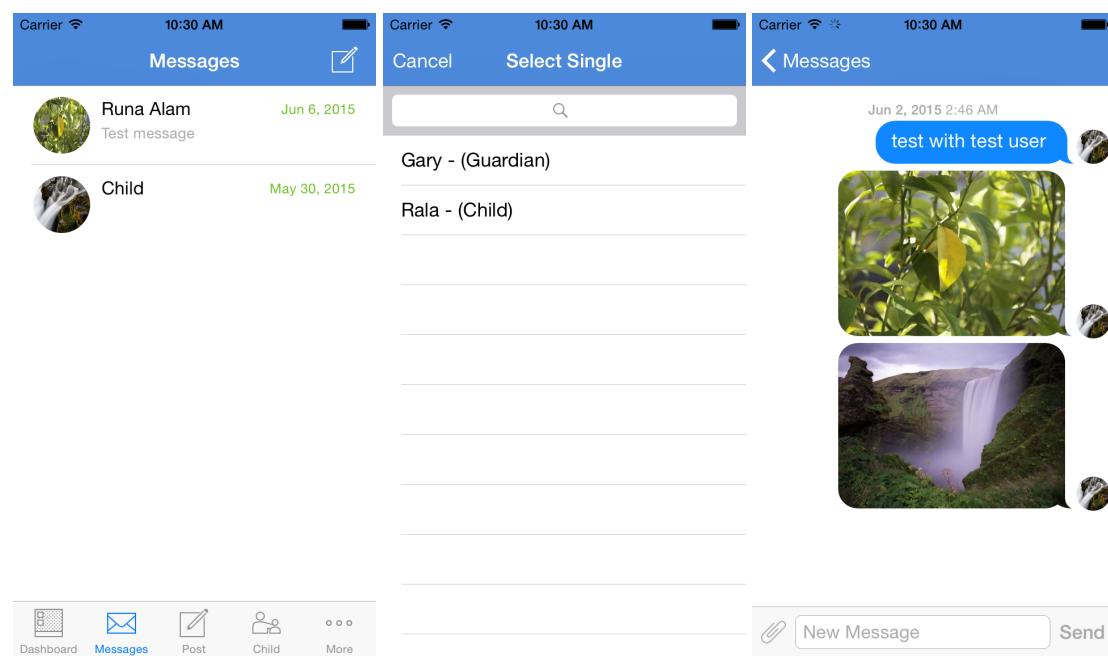
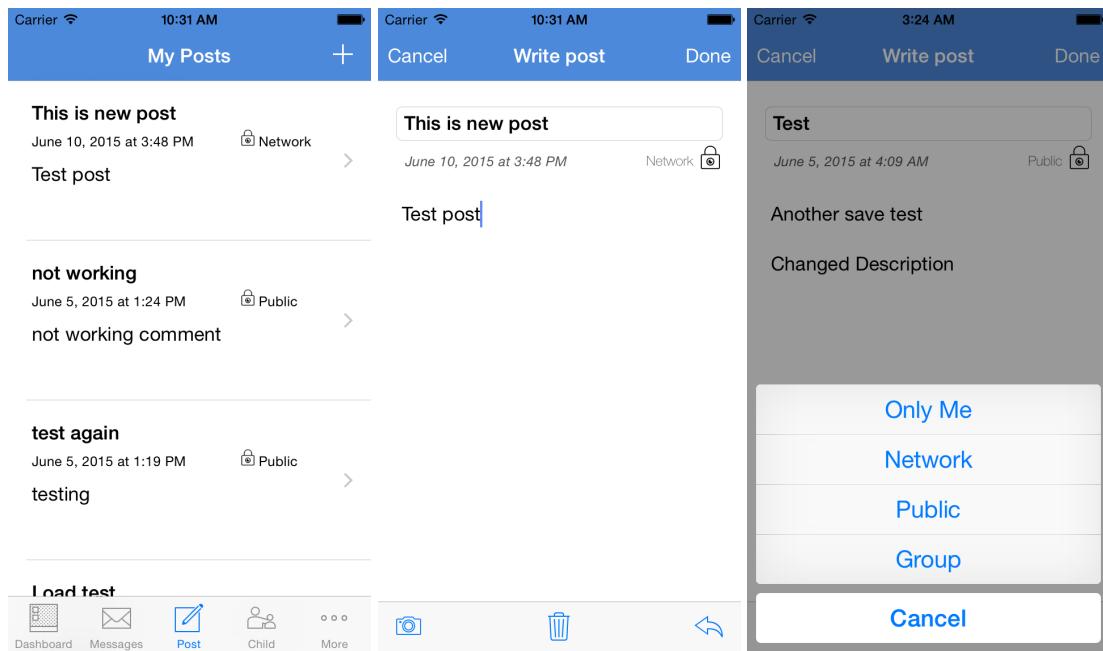


Figure 23: Guardian/Child messaging

## 5.2.7 posts

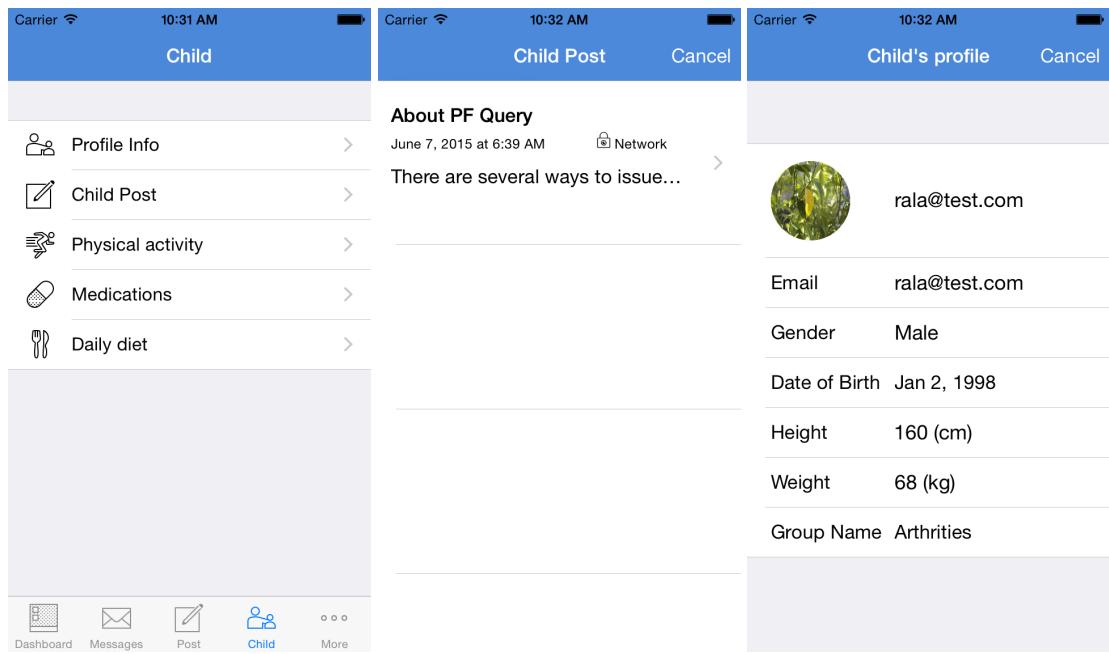
Blog posts help people to express their opinion and learning and often act as journal. So the post facility will encourage the child to express itself and the guardian can see child's posts. Child can select to share the post with only himself/herself or with the group/network or with everyone else.



**Figure 24: Post list and write new post**

### 5.2.8 Child monitoring

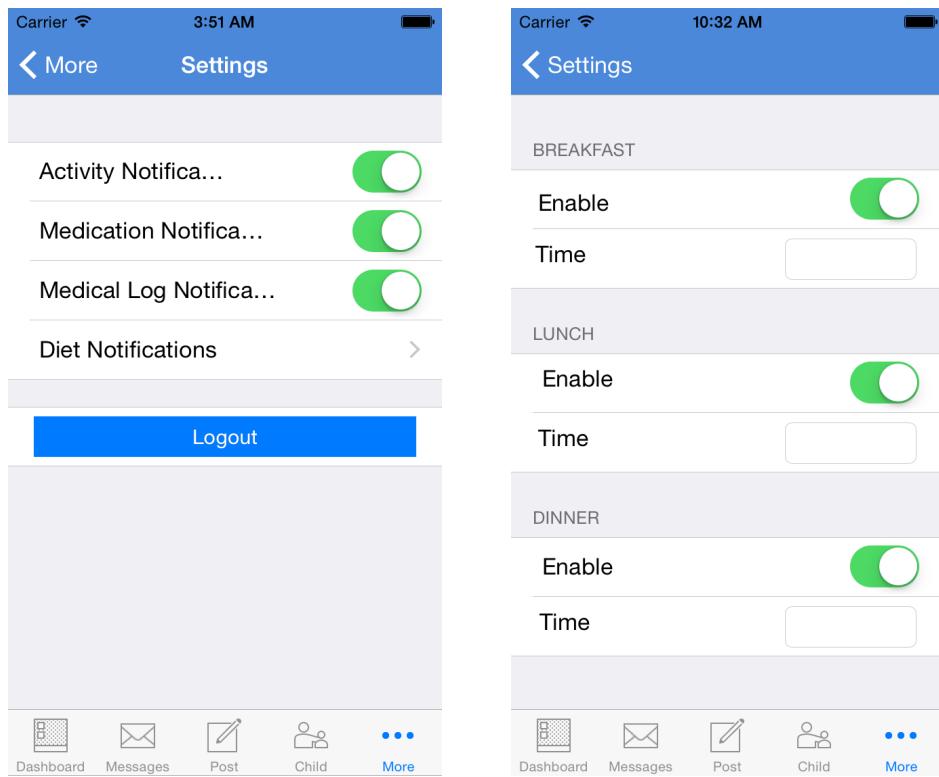
The features and information child can use are available for monitoring via the child tab for a guardian. Guardian can see child profile, posts and all activity, diet and medication logs. So the guardian has really an intimate knowledge of child's wellbeing and can guide him/her accordingly.



**Figure 25: Child monitoring options**

### 5.2.9 Settings

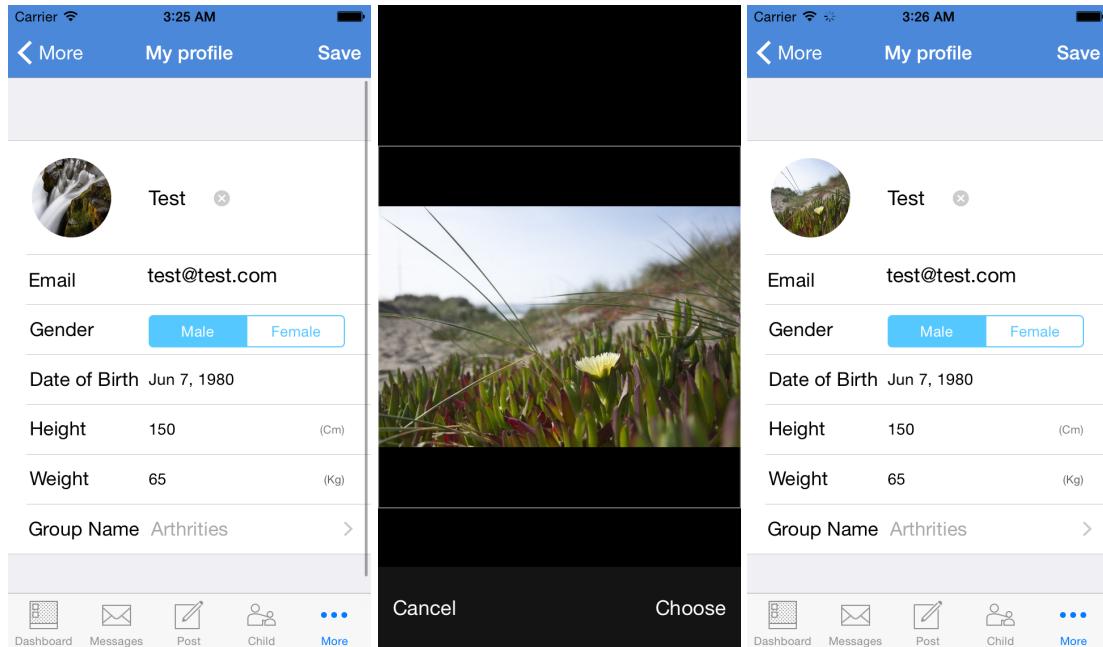
In the settings tab, user can select notification types and can customize diet notification types.



**Figure 26: Settings and diet notification settings**

### 5.2.10 Profile

In the profile tab, user can update his picture and fill in personal information like name, date of birth, height, weight etc.



**Figure 27: Profile and change profile picture**

## 6. Testing

### 6.1 Unit Testing

Testing is done using the XCTest class, which has the format shown in figure 28. The setUp and tearDown methods are used to setup the tests and free the resource after the test. In this project we used unit testing for our calorie burn formula, which is shown in figure 29.

```
class SampleTests: XCTestCase {

    override func setUp() {
        super.setUp()
        // Put setup code here. This method is called
        before the invocation of each test method in the
        class.
    }

    override func tearDown() {
        // Put teardown code here. This method is
        called after the invocation of each test method in
        the class.
        super.tearDown()
    }

    func testExample() {
        // This is an example of a functional test
        case.
        XCTAssert(true, "Pass")
    }

    func testPerformanceExample() {
        // This is an example of a performance test
        case.
        self.measureBlock() {
            // Put the code you want to measure the
            time of here.
        }
    }

}
```

Figure 28: XCTest sample test

```

class EgaTests: XCTestCase {

    override func setUp() {
        super.setUp()
        // Put setup code here. This method is called
        before the invocation of each test method in the
        class.
    }

    override func tearDown() {
        // Put teardown code here. This method is
        called after the invocation of each test method in
        the class.
        super.tearDown()
    }

    func calculateCalorieBurn(age: Float, height:
    Float, weight: Float, gender: String, metValue:
    Float, duration: Int) -> Float {

        var BMR = Float()

        if (age == 0.0) || (height == 0.0) || (weight
        == 0.0) {
            return 0.0
        }

        if (metValue == 0.0) || (duration == 0) {
            return 0.0
        }

        if gender isEqual("Male") {
            BMR = 0.0
            BMR += (13.75 * weight)
            BMR += (5 * height)
            BMR -= (6.76 * age)
            BMR += 66
        } else {
            BMR = 0.0
            BMR += (9.56 * weight)
            BMR += (18.5 * height)
            BMR -= (4.68 * age)
            BMR += 655
        }
    }
}

```

```

    }

        var calorieBurn = ((BMR / 24.00) * metValue
* Float(duration))

            return calorieBurn
}

func testMaleCalorieCalculation() {

    var cal = calculateCalorieBurn(30, height:
150 , weight: 70 ,gender: "Male", metValue: 5.5,
duration: 60)
    var intCal = Int(cal)
    NSLog("cal: %f, intCal: %d", cal, intCal)
    XCTAssertTrue(21665 == intCal,
"testMaleCalorieCalculation calorie count should be
according to the formula")
}

func testFemaleCalorieCalculation() {
    var cal = calculateCalorieBurn(30, height:
150 , weight: 70 ,gender: "Female", metValue: 5.5,
duration: 60)
    var intCal = Int(cal)
    NSLog("cal: %f, intCal: %d", cal, intCal)
    XCTAssertTrue(54433 == intCal,
"testFemaleCalorieCalculation calorie count should be
according to the formula")
}

func testErrorCalorieCalculation() {
    var cal = calculateCalorieBurn(30, height: 0
, weight: 70 ,gender: "Male", metValue: 5.5,
duration: 60)
    var intCal = Int(cal)
    NSLog("cal: %f, intCal: %d", cal, intCal)
    XCTAssertTrue(0 == intCal,
"testErrorCalorieCalculation For any 0 parameter the
result should be 0")
}
}

```

Figure 29: XCTest for calorie burn formula

## **7. Limitations and Future Works**

### **7.1 Limitations**

- eGA web app is designed and mock prototyped, but it is not fully implemented due to timing constraint. So right now as a workaround database scripts are used to create user, group and networks.
- Physical activity/diet contains a small subset of activities to choose.
- Right now reminder service is integrated with medication and diet, it is not possible to set arbitrary reminders.
- Currently blog post can only handle text input.
- User evaluation and user experience study has not been done on this app
- The app functionality is very much dependent on the assumption that Guardian Angel Network connections will be intact. There are no alternate provisions if one user decide to leave the network or become inactive and hence the network is broken in that place rather than a ring.

### **7.2 Future work**

- Complete implementation of eGA web app for user, group and network administration
- Improve the listing of Activity and diet to contain a wide range of items.
- Integrate activity tracking with fitness trackers like Fitbit.
- Implement the feature to set arbitrary reminders other than medication and diet and push notification when the reminder is triggered.
- Implement rich text support for blog posting.
- Write more unit testing and UI testing coverage for the project code.
- Conduct proper use experience and evaluation study to gauge the effectiveness of the app.

## **8. Conclusion**

This project delivers the eGA iOS app using the intuitive and slick UI functionalities of iPhone. To make the Guardian Angel platform in social perspective, it demonstrated a number of features for the child to share easily with Guardian related to physical well-being and avenue for emotional outlet. For the first time an iOS app is developed with such features for Socially enabled Guardian Angel system. There is a lot of scope for its improvement as described in the last section and based on further study it could be more features complete and effective.

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