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PEOPLE CENTRIC MOBILE DEVICES MANAGEMENT

Master of Science Thesis

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ABSTRACT

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Smartphones and tablets are spread all over the globe; their users are from different age groups and are found at different sectors within society (employees, business men, politicians, students, and soldiers). Mobile devices offer their users a variety of functionalities: communication, instant messaging, social networking, video gaming, and browsing online. There is a possibility that another person other than the owner of the mobile device helps the owner to manage his device. In a group, the mobile device could be used as a tool for informing other members about the user's current context. The application of those functionalities requires trust between group members. Families and companies are examples of groups where members can assist each other within regards to mobile device usage.

In this thesis, previous studies are extended where mobile devices management (MDM) has been applied within companies. Families were chosen as the first 'informal' group of people where MDM could be applied. In companies, employees are forced to follow the rules but in an informal group, people need to be motivated to adopt the concept. A mobile solution was designed and implemented to demonstrate the functionalities of MDM that could be applied within a family.

During the study, ideas were developed and designed for the usage of MDM in an informal group of people. A mobile application was implemented to demonstrate the concept within a group. Windows phone 8.1 is the platform of development, SQLite is used to store information on the mobile device and Windows Azure (Cloud) allows the exchange of information between many mobile devices. The main functionalities on the mobile application are: exchanging information about the physical context between users, changing mobile device information between family members, and allowing family members to regulate their activities on mobile devices. The concept of virtual coin (vCoin) was developed to motivate children to assist their parents with daily chores and software configurations.

The software implemented is as an experimental tool for testing the application of MDM in an informal group of people such as a family. During the study, five families were interviewed. It resulted that the concept of MDM was accepted by family members. They find it as a way to regulate the activities of their group on mobile devices. During the demonstrations of the application, the team covered the main ideas developed in the design phase. The studies made were targeted on families, but they could be extended to other informal groups of people such as students.

PREFACE

The supervisors of the thesis were Kaisa Väänänen, Professor and institute director of the Tampere University of Technology Institute of Human Centered Technology and Tommi Mikkonen, Professor and the head of the institute of Pervasive Computing. They guided me through comments, feedback and suggestions on how to improve the work.

The thesis work was done collaboratively between Tampere University of Technology and Microsoft (Tampere, Finland). Microsoft research team participated in every phase, from idea creation through to implementation. They give their points of view, comments and suggestions during each phase. They also performed usability tests.

Tampere, 26.12.2015

Armand Thierry DJAPPI

CONTENTS

SYMBOLS AND ABBREVIATIONS

Api	application programming interface
Android	a mobile operating system developed by Google.
Brainstorming	a group creativity technique by which efforts are made to find a conclusion for a specific problem
Circle	group of persons retained for our studies
Database	An organized collection of data
fCoin	family currency used within an MDM group
Gamification	usage of game elements in a non-gaming context
IOS	a mobile operating system created and developed by Apple Inc.
IT	Information technology
LOB	line of business
Master user	a person having the rights of monitoring the group activities
MDM	mobile devices Management
Microsoft Azure	platform and infrastructure, created by Microsoft, for building, deploying and managing applications and services through a global network of Microsoft-managed and Microsoft partner hosted datacenters.
Mobileservice	Service allowing the exchange of information between mobile devices and a server
Mockup prototype	an early sample, model, or release of a product built with a specific software to test a concept or process
MVC	model view controller
Navigation diagram	diagram displaying the navigation between the views of an application
Release packages	packages ready to be deployed in a Windows phone device
Scenario	series of events which can occur, usually scripted
SQLITE database	a relational database management system contained in a C programming library which is embedded into the end program
Storyboard	is a graphic organizer in the form of illustrations or images displayed in sequence for the purpose of pre-visualizing a motion picture, animation, motion graphic or interactive media sequence
TUT	Tampere University of Technology
Usability testing	systematic observation under controlled conditions to determine how well people can use the application
Use cases	logical succession of events
UX	user experience
vCoin	virtual currency used within an MDM group
Windows phone 8.1	operating system running on windows mobile

1. INTRODUCTION

Back in 2010, a few months after iPad's release, Steve Jobs predicted that tablets would eventually overtake PCs. In 2015, this theory came true. Sales are estimated at 320 million tablets, versus 316 million PC sales (desktop and laptops) [1].

The comparison above only takes into account the number of tablets and the number of personal computer (laptops and desktops), but mobile devices include tablets and smartphones. Currently, the number of mobile device owners is larger than the number of personal computer owners. Mobile devices offer many functionalities (communication, video games, instant messaging and browsing). These functionalities make mobile devices closer to a personal computer in terms of usage capabilities. In fact, more and more people use their mobile devices to handle professional tasks (emails, meetings with stakeholders, etc.). In February 2015, Christina Bonnington wrote an article stating that *"In less than two years, your smartphone will be your only computer."* [2]

Employees use mobile devices to read files related to their job, and to access the server of their company. Accessing a company's server using mobile devices increases the level of vulnerability of the company's information system. Thus mobile devices have to be protected and its activities must have the same security level as personal computers.

Mobile devices management is a concept that allows companies to monitor their mobile devices in the same way as a network administrator does with a personal computer. The company provides its employees with mobile devices and they define a list of software applications that could be installed on the device. They restrict the installation of other software applications that are not compatible with the company's LOB (line of business). The company can switch off a mobile device, find its location, and also remotely unlock it. The last task is very useful for both company and employees. Just imagine that you forget the password of your smartphone, it could be very helpful if someone is able to unlock it remotely. Solutions have been implemented to make the mobile devices management possible in a company. AirWatch [3] is an MDM solution implemented by Nokia for Nokia Lumia. It allows the enrolment and retirement of a mobile device to an MDM group.

Mobile devices management is an important part of company's operation; the usage of mobile devices is not only limited to professional life but can also be used in other instances for various activities (entertainment, study, etc.).

Users of mobile devices are found in different user groups such as young kids (under twelve years old), teenagers, and adults. The members of the first group (kids) are sensitive. In fact, certain websites accessed by kid can affect their mental development pro-

cess. The abuse of mobile devices usage can also affect the kid performance at school. In fact, i.e., a teenager who uses mobile devices all the night could fall asleep during class on the following day.

In this work, a gamification concept of the MDM will be implemented. The mobile application developed will satisfy the main need of an informal group of people. The mobile devices management will be implemented in groups such as families, friends, and tourist groups. In a family, parents wants to regulate the activities of their kids in mobile device i.e., Parents could define the numbers of hours their kid is allowed to spend on their smartphone each week. A group of friends could easily help each other in terms of configuring and installing software in each other's mobile devices. Tourist group members could locate each other so that they can assist one other to find their way in an unknown place. Mobile devices management applied in an informal group of people will turn its usage into a tool allowing mutual help between members in the group.

Studies will be done mainly with families as they offer the best recruitment of participants. A key issue during the study is to find ways to motivate people. The first step in this thesis is the literature review of related work to obtain a clear perspective on what has been done previously. Following that is a brainstorming session, interviews and observations. In Chapter 3, the concept will be defined and the study leading to the creation of ideas for people centric mobile devices management will be elaborated.

In Chapter 4, the use case and scenarios that will be prototyped and implemented will be explained. In Chapter 5, the low fidelity prototype will be created using Balsamiq which allows for an interactive prototype. The test user will be implemented so that feedback can be collected.

Chapter 6 and 7 will be based on the implementation and the presentation results. Finally the chapter 8 will display the result of our work. A client application of our concept is being implemented using windows 8.1 platform and it will follow the agile method of development with short iteration and meetings with stakeholders. The platform consists of Windows phone devices (Nokia Lumia 735/635), SQLITE database, and Microsoft Azure server.

2. LITERATURE REVIEW

The overall goal of this chapter is to investigate previous work related to mobile devices management in general and decide which field could benefit from further research. The method of literature review chosen was the concept based review.

2.1 Mobile devices management solutions

The market of mobile devices management (MDM) is made by companies building concepts and solutions for enterprises. Enterprise mobility management is growing quickly and the vendor landscape has changed significantly. [4, p 1] Enterprise mobility management existing solutions include: Absolute Software; AirWatch; BlackBerry; Citrix; Globo; IBM; Landesk; MobileIron; SAP; Soti, Symantec; Tangoe.

Figure 2.1 *Magic Quadrant for Enterprise Mobility Management Suites[4]*

Figure 2.1 shows AirWatch as the leader of mobile devices management solutions. Thorough explanations of the main functionalities of AirWatch are also provided. i.e., how someone can create a group or retire from a group.
In 2013 Nokia expert center published the first version of the article: "How Nokia piloted AirWatch MDM for Nokia Lumia" [4]. The mobile devices management solutions include use cases for enrolment and communication between the user and MDM server. In fact, the user enrols his mobile devices through a client application determining the device ownership and authentication. The location of the user is mandatory for the enrolment. Once enrolled to AirWatch, the user benefits from all the technical support from his company (configuration of devices and software installation); the device could also be unlocked remotely by the company. The retirement of a device from mobile device management solution could be done by the end user, automatically according to predefined criteria. AirWatch is secure and compatible with Windows phone platform, but AirWatch has been developed only for companies and employees, not for normal users. The goal of the thesis is to bring MDM solutions from a group of formal users to more informal groups (families, hobby club, etc.).

2.2 Gamification as an interaction style

The first idea that came up was to gamify an MDM solution. Deterding et al.[6, p 24-25]; defines gamification as an informal umbrella term for the use of video game elements in a non-gaming systems so that the user experience and user engagement will be improved. When applying gamification in an application, elements such as challenges in executing certain tasks, competitions between players and rewards are introduced. The client applications also have to be designed as user friendly as possible to improve the effect of 'like'. A user friendly application provides internal motivation, whereas reward and challenges are external motivators. Mekler et al [7] wrote about intrinsic and extrinsic gamification when using a software application. Intrinsic gamification is an internal motivation of the user to use a product because he enjoys it. Extrinsic gamification is related to rewards, challenges, etc.

2.2.1 Gamification principles

Gamification principles are being applied in companies to improve employees' productivity. Gamification of a system is dependent on the software application implemented. The quality of the software designed is a key element to success in terms of developing proper gamification. Steve Dale [9, p 84], says that 80% of gamification projects fail due to poor design of the application but during the implementation of a gamified application the development team involved in the project faced two challenges. Firstly they have to implement the working functionalities, and they have to apply the design elements that will make the software application playful. Researchers from game design said that there are three main gamification principles to follow:

- Mechanics: setup mechanics, rule mechanics and progression mechanics are important for gamified experience. Mechanics involve elements such as goals, rules, and rewards.
- Dynamics: it is about how players enact the mechanics.
- Emotions: A positive emotion should occur after the game.

American Idol is a TV show in America illustrating how different gamification principles can motivate desired behaviour changes among employees and customers.
Gamification systems existed many years ago before the introduction of software application to the public. Competition among financial traders, leader boards for salespeople in company and participation badges for employees are examples of gamification elements existing in professional environment since many decades. The gamification experience can also involve participants from outside of a firm. In this case, the goal is to control the experience, and increase loyalty and engagement. Nowadays the presence of software application changes the gamification process. Gamification software application is present in many professional contexts, such as healthcare, transportation, government, and education.
Another key element in producing an intrinsic gamified application is to have data regarding the targeted people who will use the gamified application. This data is in regards to people's opinions, feelings and behaviours. Today there are technological facilities whose purpose is to collect those types of data. Gamification is successful when there is a repetition of desired outcomes. The reinforcements are important to transform a desired output into a habit. A well-designed gamification experience should include reinforcement which is either positive or negative i.e., Start the game from the beginning after failure. In a game, the player experience is also an important factor to study. In fact, there are four types of people involved in gamification experience: players, designers, spectators, and observers.

2.2.2 Gamification User type

Positive feedback and repetition are gamification elements. The first is a game mechanism used to motivate users continuing to try until they succeed. Positive feedback reduces the aspect of bad experience. The second is used to increase positive cognition. The reaction of users from gamification experience is difficult to predict. It is not everyone who reacts in the same way to the same stimulus. In fact, certain users might learn faster when the system is playful and other users are goals or tasks orientated and might find a playful system boring, whereas other users like challenges. Gamification of a system is intimately related to game design and the user of a gamified system is also a game player. Marczewski [10] differentiates eight gamification user types: philanthropists, socializers, free spirits, achievers, self-seekers, consumers, exploiters, and networkers. He also defines four core motivation drivers: relatedness (social factors), autonomy (choice and freedom), mastery (learning/achievement) and purpose (meaning

and knowing why). The table 2.1 shows the relationship between the gamification user type and motivation drivers, as well as some common thoughts for each user type.

Extrinsic Motivated	
User type	**Gamification Emphasis**
Free spirit + reward	Exploiter
Gamification user type identification questionnaire statements	
I like to try and find exploitable loopholes in a game I don't see any good reason to report a bug provided it doesn't hamper my progress I will engage with team based game interactions if it provides me with a reward I like to use cheat codes to further my progress in games	
Networker	Socialiser + Reward
I enjoy playing as part of a group in gameplay I like being identified as a member of a certain group based on its competitive reputation I don't enjoy playing online game modes on my own I enjoy working on team based objectives whilst playing games	
Consumer	Achiever + Reward
I like to display badges I receive on my player profile I enjoy playing sequels to games that reward me for playing previous games in the series I prefer to only use a system when I can clearly see its benefits I don't enjoy learning when there are no rewards available	
Self-Seeker	Philanthropist + Reward
I enjoy receiving experience points and gaining new levels in games I enjoy having badges/avatars to display as status symbols in games I like to use leaderboards to see how I'm performing against others I work in groups in games purely to get rewards, not to build friendships	
Intrinsically Motivated	
Free Spirit	Autonomy
I enjoy creating custom pictures for my online profiles I prefer freedom to explore rather than a story when playing a game I like to create and upload content to sites like Instagram, YouTube and Pinterest If I found a bug in a game that let me win I would exploit it rather than report it	
Socializer	Relatedness
I use social networking on a regular basis In social media, I enjoy watching/following people as opposed to talking to others	

I have more people following me than people I follow I enjoy sharing content with my friends/followers	
Achiever	Mastery
I enjoy taking learning courses purely because I want to I tend to work at learning activities until I perfect them Winning is more important than taking part I like to display rewards I receive	
Philanthropist	Purpose
I like to help people who are struggling with progress in learning I like to contribute to module forums to share my knowledge with others I like to volunteer my time to help maintain online communities I do not like sharing knowledge that may give me an edge with my classmates	

Table 2.1 : *Gamification user type identification questionnaire [27]*

Table 2.1 shows that there are different user's types and when designing a concept, designers have to carefully study the user group. Elements as the context of use of the system and the task that will be performed have to be studied carefully too.

2.3 Essential elements of mobile concept design

The research team studied elements as the task to perform by end user and the context in which the client application will be used. In fact, a mobile application is used in different physical contexts.

2.3.1 Context of use

The study is based on Mobile devices. The contexts of use of the application and the potential users, or user group are key factors to study during the research. The contexts of use involve:

- Physical context: the places where people could use the application are the physical context. The application could be used everywhere: at home, in class, in office, in the street, inside transportation. The application is supposed to be used under different lights intensity. Thus the colours and the icons of the user interface of the application have to be chosen carefully. According to Murch, a well-known human factors researcher, "Colour can be a powerful tool improving the usefulness of an information display in a wide variety of areas if colour is used properly. Conversely, the inappropriate use of colour can seriously reduce the functionality of a display system." [11]

- Social context: the social context involves the environment where the application must be used. The application could be used by anyone alone in a quiet place, in a public place as: inside the train, the bus, in the supermarket. Therefore, the application has to be designed to captivate the attention of the user.
- Technical context: this involves the technical requirements needed for the application. Internet access is a main requirement for the application. A device used for the application must have a good internet capacity.
- Cultural context: it is the context in which the application is supposed to be used. It is also an important requirement for the success of the application.

2.3.2 Task

Mobile devices are multitasking and offer many ways to enter data into an application. It could be by typing data from the keyboard or automatically collecting user data such as the location or other information on the device.
In the task context, the focus is on the input method. User could type the desire information, he could click on a specific area of the user interface to have a specific response, and he could draw, and use his voice to enter data into the application.
There are basically two types of keyboards: the physical keyboard and the touchscreen. The physical keyboard is only limited to enter input data by typing, touchscreen offers users the capacity of typing, drawing, quickly touch any data on a small interface, enlarging a specific interface for a better visibility. Contrary to the personal computer where the usage of mouse could make things faster, in a small screen as the mobile device, the usage of finger leads user to gain in time. The key point for a developer when he designs a user interface is to have a beautiful and easy to use interface. F. Balagtas-Fernandez, J. Forrai, and H. Hussmann say in an article that "Automated tool support which gives the developer assistance on which specific UI elements to use with their applications would also be useful."[30, p.4]. In the application, the main methods of collecting data from user will be typing and touching. In fact, the mobile devices used for the project are only touchscreen. Data as the mobile device location could also be automatically collected.

2.4 Windows Phone 8.1 platform

The design and implementation of the application for people centric mobile device management is based on windows phone 8.1 platform. C# is the programming language. Bob Tabor [22] gives an overview of the process to follow so that we could implement a Windows Phone 8.1 application in his book. He tells about what is needed for Windows phone development. Bob Tabor, Clint Rutkas, Larry Lieberman wrote "Windows Phone 8 development for absolute beginners" [23] which contains the detailed explanations of the implementation of WINDOWS PHONE 8.1 application.

Due to the requirements of the company partner (Microsoft), the research team chose to implement the application in the windows phone platform rather than in Android or IOS (Apple mobile device platform). There were also technical reasons leading the team to adopt Windows phone 8.1 as the platform for development. Actually the Windows phone platform is totally compatible with Microsoft Azure [27] and Microsoft Azure gives us facilities to integrate mobileservices into the client application allowing the exchange of information between windows phone devices. The team wanted to also compare Windows phone capacity with other platform in terms of speed and easiness in the development.

3. USER STUDIES OF PEOPLE CENTRIC MDM

People centric mobile devices management is a concept that focuses on enhancing the usage of mobile devices in a group. This concept encourages members of the same group to assist one other in the usage of mobile devices i.e., it would be interesting if someone in the same group could help another member to recover a forgotten password. In this concept, mobile devices are not only limited to communication and bounded to individual usage, but is rather enlarged to group's usage.

In the earlier phases, existing mobile device management solutions were reviewed and it was found that this area of research was open to further study in terms of applying ideas about mobile devices management in an informal group of people. Following this, ideas were gathered and the data was collected regarding the point of view of other people about the mobile device management concept itself. It was then discussed as an application within an informal group of people. The main focus of the users' studies was to define:

- What group of people the mobile device management could be applied to, and within this group, who could be the group administrator?
- What functionalities of mobile devices can be managed in the group?

3.1 Idea creation

Idea creation was done in two phases. The first phase was the brainstorming session then face to face interviews of families members followed. The process leading to the creation of ideas is represented in Figure 3.1.

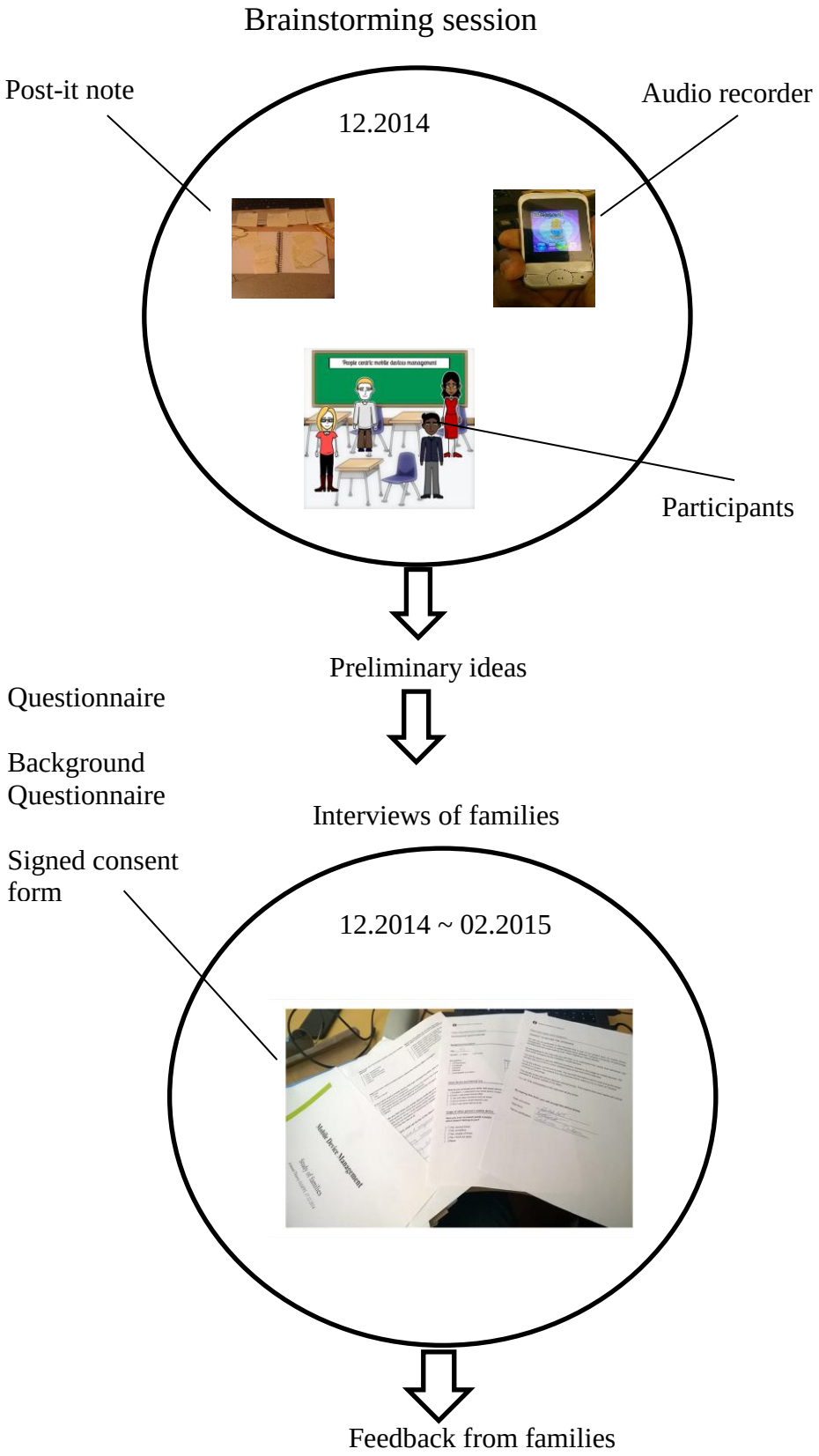


Figure 3.1*: User study process*

3.1.1 Brainstorming Session

The brainstorming session took place in late November 2014. Participants of the session were gathered together in the same room. They debated about the feasibility of the concept and gave their feedback. The main points of the session are summarized in table 3.1.

Brainstorming Session					
Method	Group discussion		Participants		
Date	27.11.2014		Number	Age group	Individual description
Duration	01:30		6 participants 3 men 3 women	25~35	Researcher has a kid and husband.
					Researcher has a family.
					Master student, professional IT, has a family.
					Doctoral researcher.
					Master student in IT.
					He is Professional IT and a master student too.

***Table 3.1**: Summary of the brainstorming session.*

Results of the brainstorming session

The study of the data gathered during the brainstorming session showed that there are three main dimensions retained to evaluate the circles.

1. Management of software applications/devices settings: the software could be communication software (instant messaging), video games i.e., parents would like to know how long his kids spend on playing video games in a week. Mother would like her son to remotely install communication software in her device.
   Management of device settings involves ideas such as group members would like to be able to turn others member's mobile devices off, in silent mode or to increase the volume on i.e., parents would like to know in which status her kids' mobile devices are so that they could know why they are not giving any answer to their calls.
2. Knowing the context of users: it includes that members of a circle would like to know the context where another members are in currently.
3. Dynamism of the group: this dimension was related to the duration that members can possibly stay together i.e., a good group for the study is the one that members are intended to stay together for at least six months.

Four circles with the possible master user (the one who is responsible for the management) were chosen for our preliminary studies.

1. Family living together with both parents as potential master user, but kids can sometime help in the management.
2. Student class with teacher or the principal as master user.
3. Tourists' group with tourist guide as master user.
4. Regular hobby club/People gathering in an event as concert.

The dimensions chosen for the study and the main circles retained were put on a table (table 3.2). For each circle, the team evaluates the need for a specific dimension.
The need will be ranked from 1 to 5.
0: they don't need at all.
1: limited need.
5: very important need.

Circles	Main dimensions of people centric MDM		
	Management of Software applications /devices settings	Knowing others members context	Dynamism of the group
Family living together	4	4	5
Student class	2	1	3
Tourist groups	1	5	1
Regular hobby club	1	4	1

Table 3.2: *User groups and their needs resumed into a table*

Interpretation of the result of the brainstorming session

The target in this interpretation is to find the optimal informal group of people (circle) in which the concept could be applied. The optimal circle must satisfy the following criteria:

- In the circle, there should be a need of knowing the group members' context
- In the circle, there should be a need for managing software application/devices
- The dynamism of the group should be long (at least six months) enough so that the study will be possible.

The main circles (family living together, student class, tourist groups, and regular hobby club) were put inside a triangle. The corners of the triangle represent the main requirements of the concept. The closer a circle is to a corner, means that it fulfils the requirement of the dimension in that corner.

C1, C2, C3 and C4 are names than the team assigned respectively to:
C1: Family living together.
C2: Student class
C3: Tourist group
C4: Regular hobby club

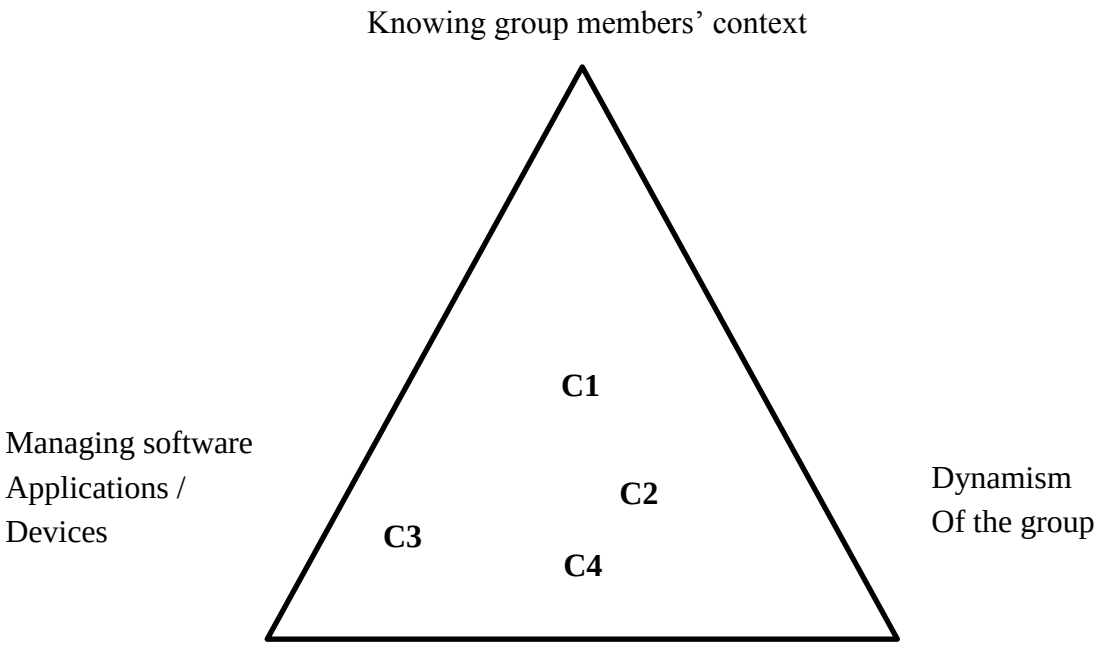


Figure 3.2*: Circles and main requirements for the concept*

In Figure 3.2, it came out that the family living together is the main circle in which the research team will concentrate the studies. Family is thus our choice.

3.1.2 Interviews of families/parents

Five interviews of three hundred minutes have been conducted with the same duration (sixty minutes each). The Interviews were recorded and participants signed a concern form before the beginning of the interview. At the end of each interview participants were asked to fill a background questionnaire. In Table 3.3 the details about the interview are displayed.

Interviews	Date	Place	Participants/outcome of the interviews
1	3.1. 2015	Family's home Lille/France	Number : 4 (father, mother, 2 kids)
			Kids' age : 10~15 years old
			Outcome : • Enhancing mutual help between family members for software/ devices installation or configuration.
2	26.1. 2015	Family's home Tampere/ Finland	Number : 4 (father, mother, 2 kids)
			Kids' age : 4~6 years old
			Outcome : • Managing applications from distant place.
3	27.1.2015	TUT campus Tampere/ Finland	Number :1 (Mother having 4 kids)
			Outcome : • Knowing the context of others members
4	23.2. 2015	UTA campus Tampere/ Finland	Number :1 (Mother having 2 kids)
			Outcome : • Control of control, parents or user could decide when their need MDM to work. • Possibilities to remotely change the ringing mode of mobile device.
5	25.2. 2015	TUT campus Tampere/ Finland	Number :1 (Mother having 3 kids)
			Outcome : • Making information visible to all user of the circle.

Table 3.3: *resume of the interviews from different families*

3.2 Ideas retained for 'people centric mdm'

The user's studies helped to elaborate ideas that will be implemented in family.

- Mutual help between family members: a distant installation or configuration of software application into others family member devices.
- Participation of family members in daily life of the family: deliver letter at the post office; cleaning dishes.
- Knowing others family members physical context
- Presence of the master user of the group

Master(s) user of the group is not an idea but rather an important requirement for the ideas developed. In fact someone in a group has to be responsible of defining important details that will be seen or unseen by others. All those ideas and mainly the two first could be efficiently implemented or applied in family if a motivator factor is added. Here comes the introduction of a concept of vCoin (virtual coin). The role of family members is also important in the concept, since it is everyone that should have the ability to do everything. A specific user or a mechanism will be put in place to give privileges to family's members to execute certain task. Two basic roles are defined: master user, normal user.

3.2.1 Mutual help between family members

In a family, there are often different levels of expertise related to the usage of mobile devices. People Centric MDM, would like to give opportunities to family members to support each other in their daily chores through mobile devices. Helping the family can be by executing a manual activity as: deliver letter at the post office by a kid. In this study, two types of help are defined: Support in software and device configuration and installation, participation in the family daily activities by executing defined tasks.

Support related to software installation and devices configuration
During our first interview, it happens that a ten years old boy was the best at configuring software applications in the family and usually, his mother asked him to help her to configure her mobile devices or install mobile software in her device. At the same time, the child also needs support from his parents to configure or install learning language software applications. Parents could do it remotely if the family is enrolled into an MDM group. Thus they could also be able to switch the device on/off. The circle of help between members of the family is illustrated in Figure 3.3. In fact, the help can be between a parent and a kid, kid and the parent, kid and kid, the parents themselves.

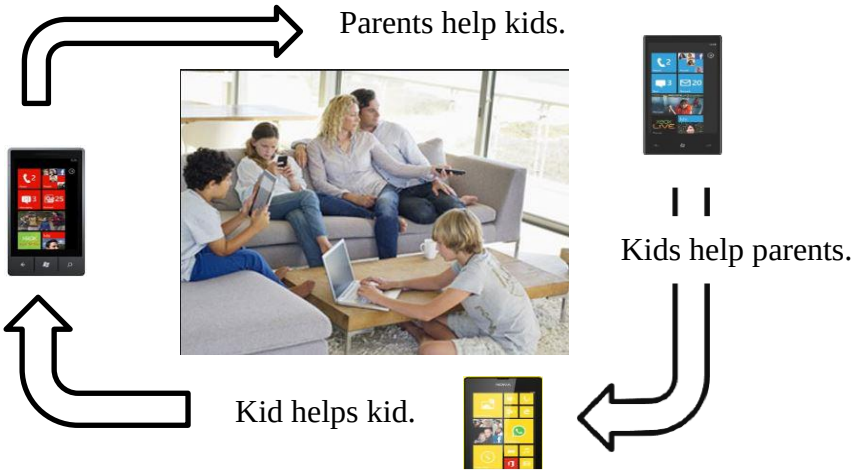


Figure 3.3: *Mutual help between family members.*

In the table 3.4, the issues related to mutual help between family members are shown.

Issues related to the ideas	Possible Solution
• Is it normal for a kid to be the master user in a family and manage others' mobile devices? In fact, to help his mother, the kid should have the complete right to monitor functionalities the device of any member.	• Kid could be granted the role of expert user for specific functionalities since they are the one that could be the most helpful in the family. • The expertise of the kid has to be confirmed by parents (default master user). • The parent can decide to remove kid's expertise. • Sensible actions have to be made under parents' authorization.
• How to motivate user to help others by using People Centric MDM?	• Motivate parents by giving them tools to monitor their kids' activities. • Motivate kid by rewarding them.

***Table 3.4**: Issues and possible solutions related to the ideas of Mutual Help.*

Helping the family by participating in daily activities

Mutual helper incorporates the fact that kid helps his family by executing a manual task set up by the master user such as deliver a letter, cleaning the garage, empty the garbage, etc. In this case parent could define the task in the system so that everybody could read and execute it for the good of the family. In Figure 3.4, an illustration of a kid who received 1.5 Fcoin is shown.

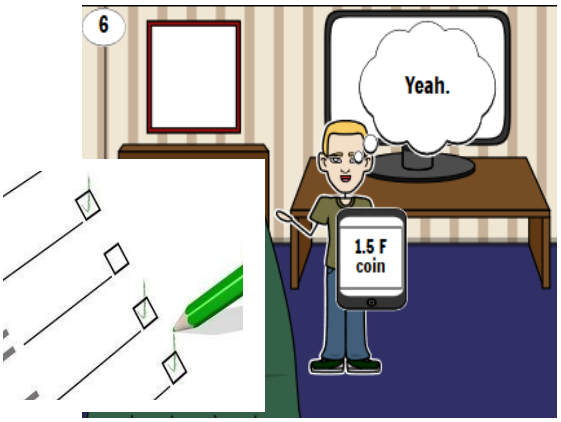


***Figure 3.4:** Participation in the family daily task.*

During the interview, a major condition to realize the concept was to motive family members to use the system. User is rewarded after executing a defined task in the system. Reward could be given in form of free time to the user so that he can use his devices for entertainments purposes, it could also be electronic money so that the family member could use it to do online purchase. For demonstration purpose, vCoin(Virtual

currency) is used within families i.e., the electronic transaction is not implemented in this work.

3.2.2 Knowing the context of family members

The user studies showed that one of the main preoccupations of family members was to know where other members are currently. In Figure 3.5, a mother acknowledges her family member's physical context i.e., the husband is inside a train, travelling; kid is in school.

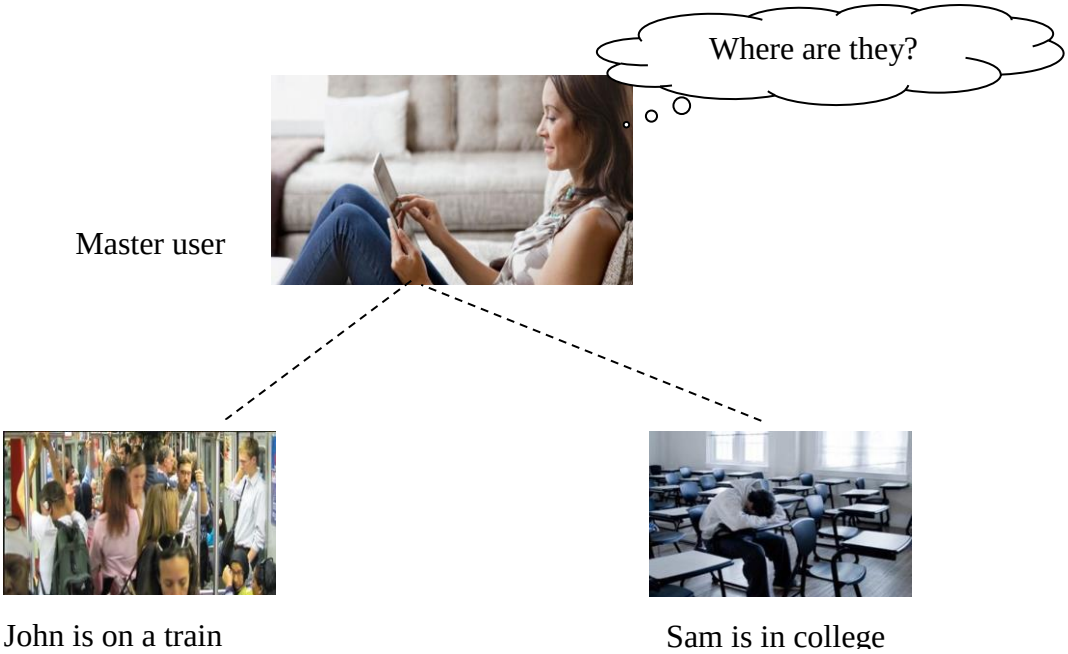


***Figure 3.5**: A mother viewing other family member's context*

In table 3.5, issues related to knowing the family member's physical context and the possible solutions related to the issues are listed.

Issues related to the ideas	Possible Solution
• Family members might not want others to see their context all the time.	• Possibility to control their visibility. • One solution is to give the possibility to master user to increase the volume of other members' mobile devices.
- Making the information available to everyone.	• Display the information to every member of the family.

***Table 3.5**: Issues and possible solutions related to the ideas of Mutual Help.*

The ‘context’ could also be the physical context of certain parameter of the device, such as the volume or status of the phone i.e., mom's mobile device is silent. Dad’s mobile device is off.

3.2.3 Virtual coin (Electronic currency used within family)

Defining Virtual coin

The value is defined by the group owner or the master user. In fact, parents are the default master users in the family. This role can be changed anytime. The parent can define Virtual coin as free time for entertainment i.e., if a kid has 1 vCoin in his account, it means that he has one hour to spend playing video games, or 1 hour to spend on instant messaging software applications. The parent can also define Virtual Coin value as electronic currency. 1 vCoin is 1 €. This money can be used for online purchases.

Earning Virtual coin (vCoin)

Virtual coin is earned after accomplishing a task defined by the master user, or by receiving vCoin from another family member. The process is done as follow:

- Master user defines a task leading to a reward and the task is accounted for in the system.
- A user acknowledges the task and performs it.
- The master user finally approves the task and the normal who have executed the task receives his virtual coin.

Spending Virtual coin

The amount of vCoin of any user could be manually reduced by the master user (parent). It could also automatically be reduced after spending time playing video games or on instant messaging software, or by doing online purchases.

4. DEVELOPING THE CONCEPT OF PEOPLE CENTRIC MDM

The previous work made in this study helped the research team to define the group of people that could benefit from the MDM concept and the functionalities which could be managed in mobile devices. In this phase, the research team will develop and design the ideas in collaboration with all the parties (project partner and potential end user) involved in the project.

4.1 Overview of the concept

People centric mobile devices management is a concept encouraging people to help each other through their mobile devices. The concept takes it origin in the mobile devices management system which is actually in use in many companies. It works in this way: in a company, employees are provided with mobile devices but the employer or the IT administrator of the company is able to remotely manage certain functionalities of the mobile devices. These include: remotely unlocking or locking the mobile devices, switching the mobile devices off, defining the company lines of business, which is the list of software that is allowed for installation and usage in company devices (mobile devices or personal computer). People centric MDM is an extension of MDM which is applied within informal groups of people.

During the research, the team has focused on families as the first informal group in which the efforts have to be concentrated. In fact, families give us certain parameters that are beneficial for the implementation of the concept. In a family, there is a group of people that typically stay together for long period of time (years), whereas in a group of people, such as friends, it is not uncommon that the group will split up over a period of time. A student's class could be also an optimal group, but this study is limited by administrative requirements that have the potential to delay our work.

The focus was on families living together and the challenge was to motivate family members to use the concept. The system is "gamified" in order to make the system more fun, engaging and motivating for the family members, especially kids since the system can sometimes be restrictive for them i.e., parents are able to limit their time in mobile device usage. The ideas that will be developed and implemented are:

- Mutual help between family members: the mutual help is a concept where users could receive reward after accomplishing tasks relevant to the family. Tasks could be: helping other family members to install or configure software application in their devices or helping the family by doing a daily activity. The reward

is given to the family member after executing a task and the task has to be approved by the master of the group who is often parents.

- Knowing the context of family members: in this idea, family members are aware of each other's context, in fact, at any time parents could be aware of the physical context of theirs kids. Others members of the family could also have the same information but the information is not exactly the location with exact precision rather it is the information about the context i.e., Dad is in the rain.
- vCoin: it is a virtual currency created in the scheme and can be used within family groups to materialize reward. Virtual coin value is defined by the master of the group. It could be free time to play video games or real electronic money to make online purchases.

4.2 Storyboarding and use cases

At this point, the concept main ideas have been developed. In the storyboarding, the ideas developed are illustrated through texts and drawings. The research team proceeds as follow. Firstly, the scenarios are described then represented with drawings. The uses cases came at the end. Due to the lack of manual drawing skills in the team, storyboardthat [8] is used to illustrate the scenarios.

4.2.1 A kid is rewarded after executing a daily task

The first use case shows the step leading a kid to get reward after doing a task in his family.

4.2.1.1 Scenario illustrating getting vCoin after executing a daily task

"Sam comes back to school and realizes that he does not have any homework. He decides to spend time playing his favorite video game on his mobile device. He does not have enough free time on his mobile device within his family MDM. In fact, his mobile device has been enrolled to the family group on 'People Centric MDM' and his free time is managed daily, weekly, monthly by his parents (master/expert users).
To earn free time, he has three options:

- **Doing approved tasks defined by parents and the task has to be a rewarding task**.
- Helping someone with software configuration/device settings.
- Acquiring a vCoin from another family member.

Sam opens MDM client software, checks the different messages and decides to help his mother by delivering letter at the post office.
This task is worth two hours of free time. He does the task, the mother approves and he receives two hours to play video games." Storyboard 1 illustrates this scenario.

4.2.1.2 Storyboard of the scenario

Storyboard 1: Sam receives vCoin by delivering a letter at the post office.

4.2.1.3 Use case illustrating the scenario

Use case 1: Sam receives vCoin by delivering a letter at the post office.
In table 4.1, only the actions that could be implemented in the application are stated.

User	Sam, Sam's Mother
Goal	Sam wants vCoin by delivering a letter to the post office
Pre Condition	• Sam and his mother are enrolled into a MDM group. • The mother has sent a request related to the delivery of a letter at the post office as a rewarded task.
Trigger	Sam starts 'mutual helper' from his mobile device
Steps	
1.	Sam realizes that he does not have vCoin.
2.	Sam checks the 'Mutual helper' to see the list of information
3.	Sam takes the task and takes a picture when he delivers the letter
4.	Sam's mother receives information that Sam has done the task
5.	Sam's mother approves the task after viewing the picture.
6.	Sam receives 1.5 vCoin and can use it to play video games.

Table 4.1*: Use case of the scenario: Sam receives vCoin by delivering letter to post office.*

4.2.2 Mutual help between family members regarding software

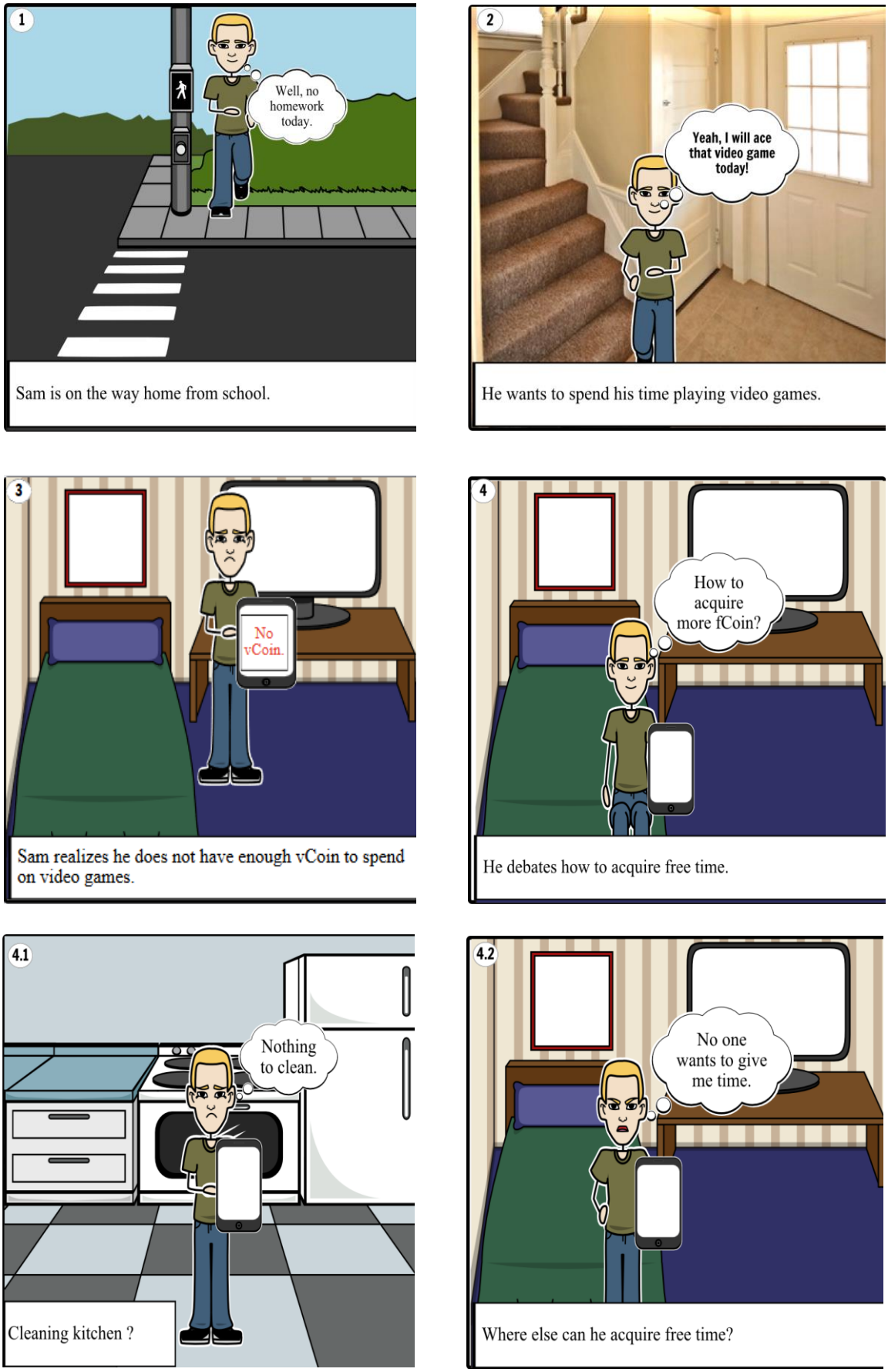
The process goes in the same way as in 4.2.1. The scenario is described then sketched in a storyboard and at the end the use case of the scenario is illustrated.

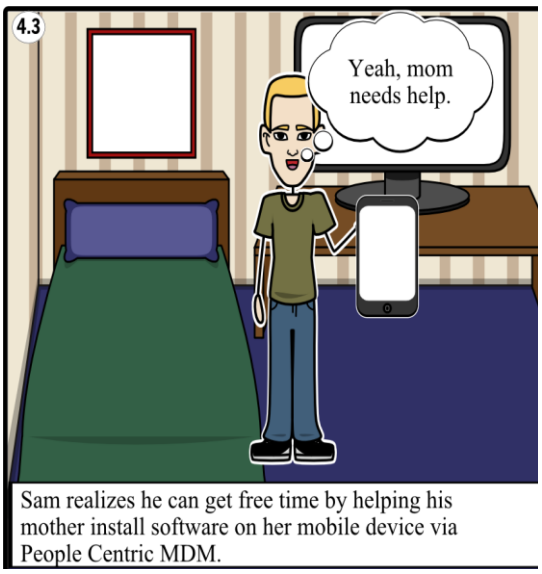
4.2.2.1 Scenario illustrating mutual help

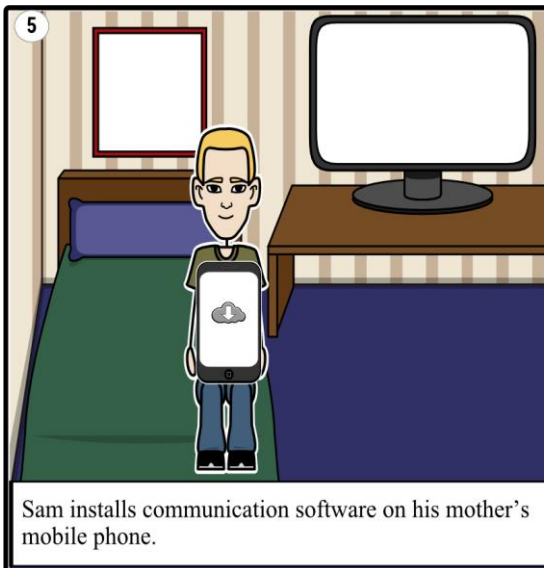
See the scenario 4.2.1.1 with the difference below:
A family member helps someone with software configuration/device settings.
Sam opens MDM client software, checks the different messages and decides to help his mother by remotely installing software into his mother mobile device. This task is worth two hours of free games. He does the task, the mother approves and he receives two hours to play video games." Storyboard 2 illustrates this scenario.

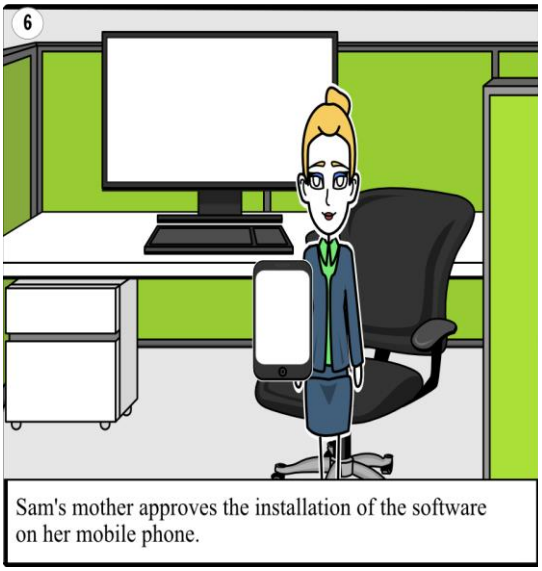
4.2.2.2 Storyboard of the scenario

Storyboard 2: Sam receives vCoin by remotely installing communication software in his mother device.









4.2.2.3 Use case illustrating the scenario

Table 4.2 shows the use case of the scenario, only the actions that could be implemented in the application are stated.

User	Sam, Sam's Mother
Goal	Sam wants vCoin by remotely installing software in his mother's device
Pre Condition	• Sam and his mother are enrolled into a MDM group • The mother registers delivery letter as a rewarded task • There is a communication software among the family list of software
Trigger	Sam starts 'mutual helper' from his mobile device
Steps	
1.	Sam realizes that he does not have vCoin
2.	Sam checks the 'Mutual helper' to see the list of information
31.	Sam verifies if there is a communication software in the family list of software.
32.	In case that there is no communication software in the group, Sam sends a request to master user to add communication software in the family list of software.
4.	Sam installs the chosen communication software in his mother's device.
5.	Sam's mother approves the task.
6.	Sam receives 1.5 vCoin and can use it to play video games.

***Table 4.2**: The use case of the scenario: Sam receives vCoin after remotely installing communication software in his mother's mobile devices.*

4.2.3 Knowing the context of others family members

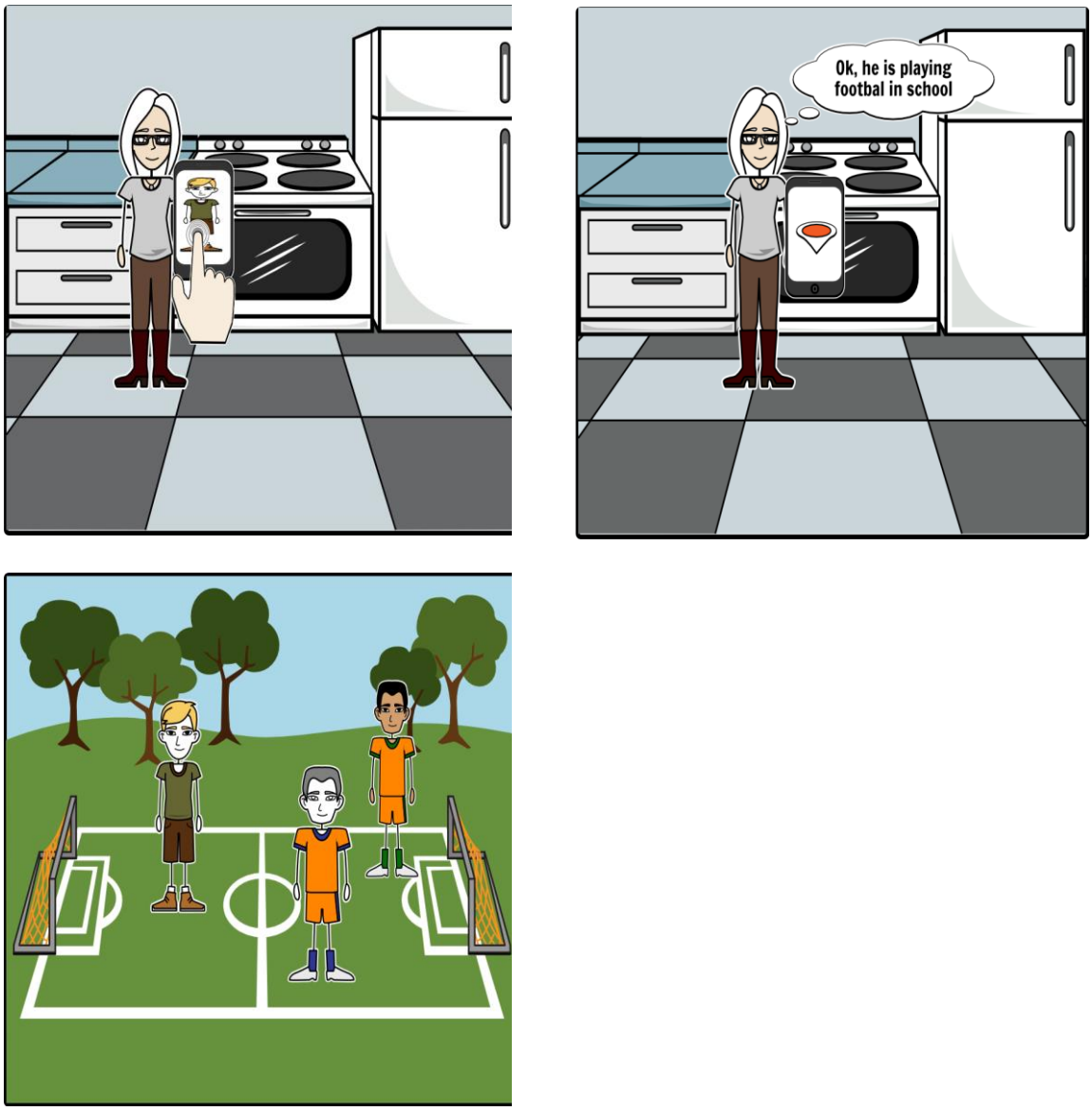
In this idea, the team demonstrate how the physical context of family members could be shared within family.

4.2.3.1 Scenario illustrating knowing the context

"Sam stays longer at school to play in a football tournament. Sam's mother is worried because he is usually home earlier after school and she doesn't know where he is. By using 'People Centric MDM' client application running in her mobile device, she acknowledges that Sam is still in school." The storyboard 3 illustrates this scenario.

4.2.3.2 Storyboard of the scenario

Storyboard 3: Mother acquires Sam's location.



In the illustration above (storyboard 3), mother uses her mobile devices to acknowledge her son physical context. She clicks on Sam picture, clicks on the location icon then she realizes that her kid is playing football. In table 4.3, the use cases that will be implemented are displayed.

4.2.3.3 Use case illustrating the scenario

User	Sam, Sam's mother
Goal	Sam mother
Pre Condition	Sam and his mother are enrolled into a MDM group
Trigger	Sam's mother would like to acknowledge Sam's current physical context.
Steps	
1.	The mother starts Mutual helper client application
2.	Mother clicks in the menu where are listed the current information of the family.
3.	Sam's mother sees the last location of Sam in the system

Table 4.3*: The use case of the scenario: Sam's Mother would like to acquire her son current physical context.*

5. INTERACTIVE PROTOTYPE

The storyboarding was a good way to present our concept to other parties involve in the project. At this step, there were no tangible feedbacks from the people outside the project. The data collected during the brainstorming session and the interviews were only based on people thoughts and believe but not feedback on an existing product.
A fast an accurate method of collecting data from outsiders of the research team was the sketch of the prototype. Balsamiq [15] was used to sketch the ideas. It offers users the possibility to realize an interactive prototype.

5.1 Mockup in balsamiq

Balsamiq is available online. It could also be installed in a personal computer. During the study, the online version of Balsamiq is used. In fact, Tampere University of technology offers to the research team an online account on Balsamiq. The main advantage with the online account is that a team of designers can work in the same project in the same time. Figure 5.1 shows a view of balsamiq in a web page.

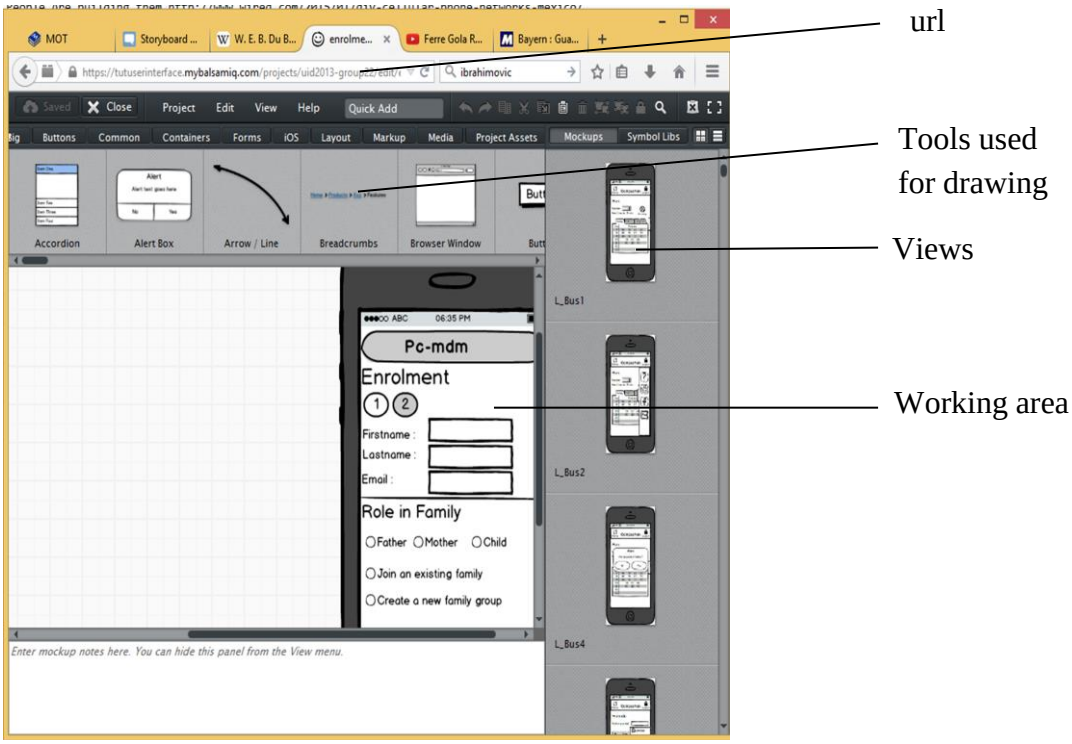


***Figure 5.1**: User Interface of Balsamiq online tool*

5.1.1 Preliminary mockup prototype

The research team follows a vertical prototype principle to design the user interface. The vertical prototype consists of sketching a module from the beginning until the end rather than focusing of sketching the whole application.

The use case tested was: “Sam receives fCoin(Previous name) after remotely installing a communication software in his mother’s mobile devices.” [2.2.2 Storyboard of the scenario]

Step 1: Initial main page of the mobile application

The view of the Figure 5.2 shows the main page of the mockup prototype before the user tests. In this view, the main functionalities are: listing the information of the group, adding a new request to the system. The button “+” surrounded with a red circle is used to add a new request to the application.

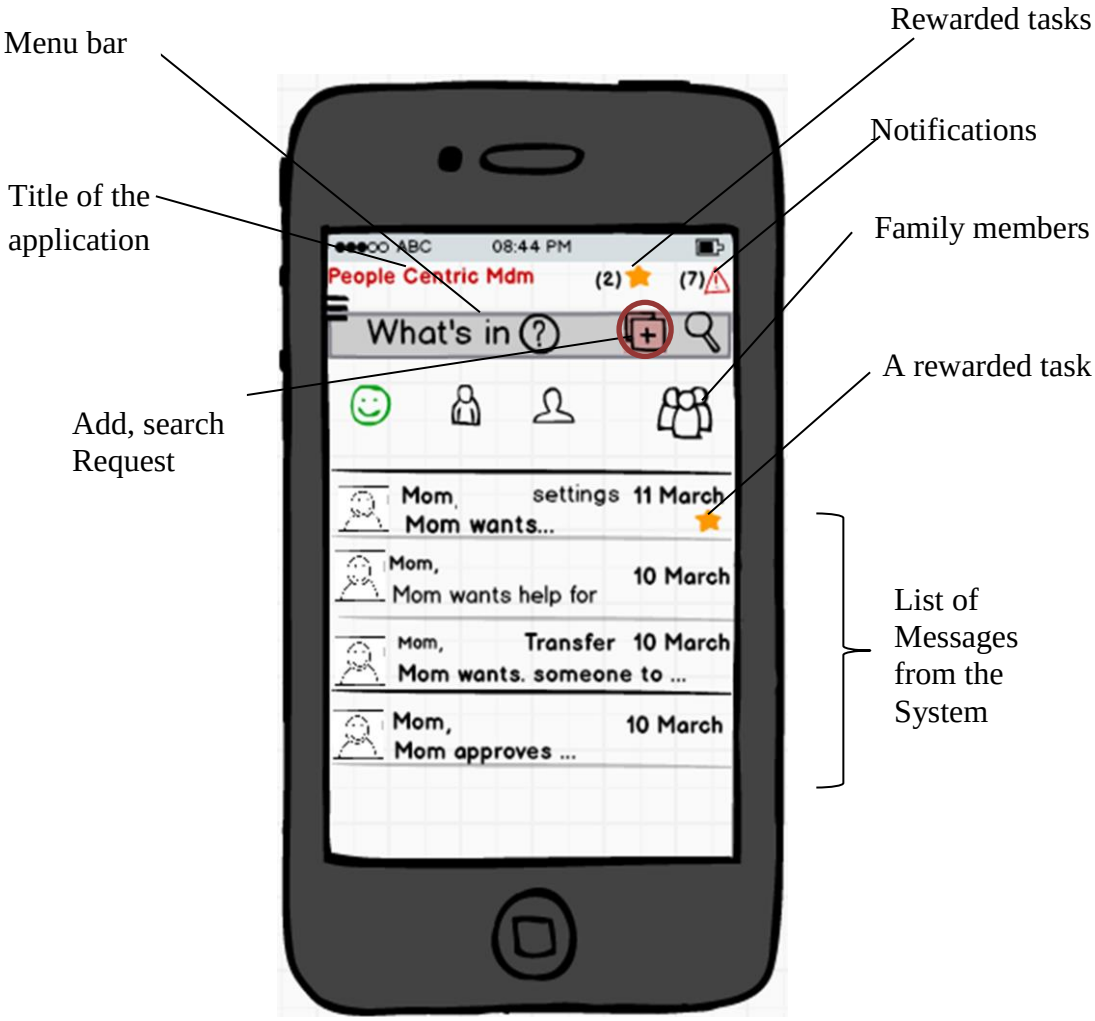


***Figure 5.2**: Main page*

In the next stage, a simulation of adding a request to the system will be shown.

Step 2: Mother sends a request related to software installation

Adding a request requires to press the add button (Figure 5.2). Then the user is directed to the view below of figure 5.3. In this view, information such as the subject, the description of the request is mandatory so that a request can be added. The request type is not mandatory but it is very informative. In fact, the type dictates the steps that the user should follow so that it could get the reward from the task.

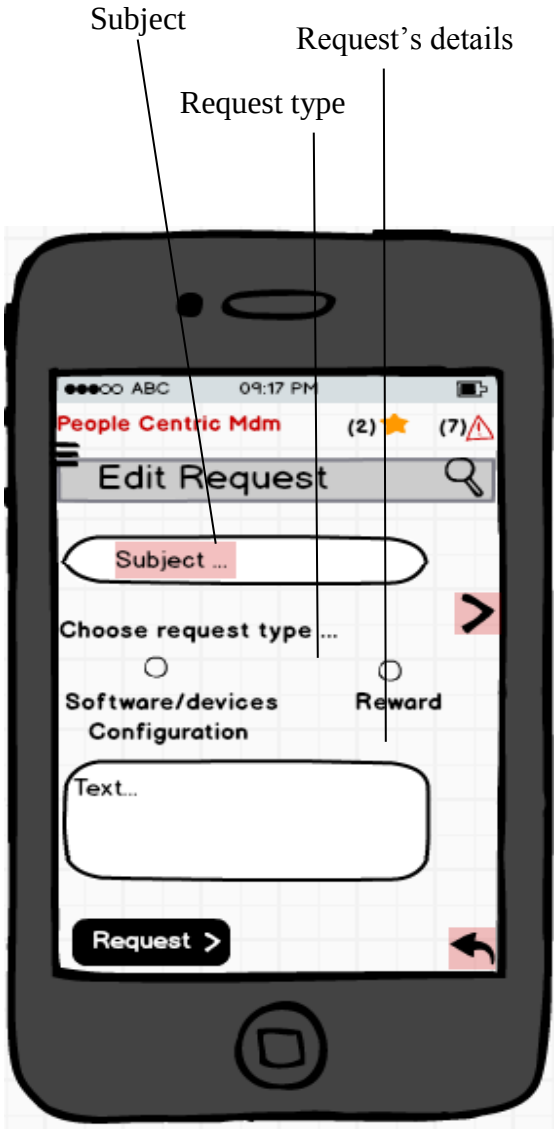


***Figure 5.3**: Edition of the request by a family member*

Step 3: kid opens the rewarded request sent by his mom and decides to install the software in his mother's mobile devices.

In Figure 5.4, the message related to the task to be executed is displayed.

***Figure 5.4**: Kid accepts the task posted by his mother*

Step 4: Installation of the software into mother's device.

Figure 5.5 shows that the communication software is being installed in mother's mobile device. Information about the installation is shown in a "pop pup screen".

***Figure 5.5**: Installation of the software in mobile device of the mother*

Kid acknowledges that he is rewarded.
Figure 5.6 is the same than the main view (Figure 5.2). In this screen, a notification that the user executed a task and the task has been approved by the master user of the group.

***Figure 5.6**: Reward information*

5.1.2 User tests

The research team organized user tests, after sketching the preliminary mockup prototype. The participants were tested in tandem consisting of two people. The moderator takes part of the test to guide the participants. One user acts as a kid and a second user

acts as a parent. The tests were done in a quite friendly atmosphere to stimulate relaxation and creativity. The main points tested were: navigation between the screens, terminology and the position of elements. In table 5.1, details about the user tests will be summarized.

Test users.				
Method	Tam tests		Tests	
Duration	00:45		Date	Participants
Place	TUT campus Tampere/ Finland		24.3.2015 10:30	1 researcher 1 student
			24.3.2015 16:30	2 students
			25.3.2015 15:00	1 researcher 1 student

***Table 5.1**: user tests' description*

During the user tests, the following tools were used:

- Audio recorder: it was useful since people were giving feedback by speaking while participating to the user test.
- Video projector: the Mockup prototype was made in a web application and projected to a screen to different users.
- Tasks to be performed in a paper sheet: The tasks were given to participants in a paper sheet.
- Balsamiq framework.

5.1.3 Results of the user tests

In the table 5.2, the lists of feedback are displayed and the affects in the design will be shown in table 5.3. In overall, the participants of the users test found that it was easy to perform a given task in the system.

List of feedback from user test's participants

	Feedback
1.	Family members have to be able to change their profile picture
2.	Family members could view data uploaded in the cloud
3.	Family members could share their interests in the application
4.	Possibility to bargain between the master user and other family members regarding the value of the reward.
5.	Surprise reward for the family members
6.	Colours of the application has to be well chosen
7.	What's in? (Is it a good title)
8.	There could be an icon of a smiling face , for kids
9.	Status of family member has to be shown
10.	The icon of send request has to be changed, may be an 'envelope icon'
11.	Accepting the task has to be more fun: 'ok, I will do it.'
12.	A reply message to request has to be displayed too.
13.	Possible scoreboard to boost family members
14.	Managing user rights to install a software into the family list
15.	Possibility to recommend certain software for installation
16.	Presence of guidance message as: 'This has already been installed'
17.	Notification for master user to approve a pending task
18.	Different colour or presence of icon to show the task done or pending.

***Table 5.2**: feedback collected from user tests participants.*

The feedbacks receive help the team to update the existing user interface. The most important changes will be displayed in the Table 5.3.

Changes applied in the user interface design after the users test

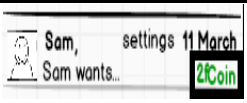
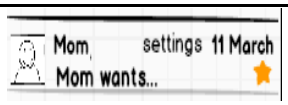
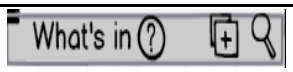
Before test		Reasons	After test
Icon			
Send request		It looks as 'send email' to an external entity than send request to the system.	
Rewarded request		'2fcoin' at the bottom right is not encouraging for kid. We have to keep the surprise factor. Also give the possibility to bargain.	
Alert sign		Need of a symbol to represent alert messages	
Title			
		The tile is confusing. i.e., 'Sam receives 2fCoin' is not a request.	
			

***Table 5.3**: Changes applied after the users tests.*

The user interface of the mockup prototype has been updated after the users test. In general, the user interface will be updated after the user test along the development process. The difficulties faced in this phase were to gather unknown participants together and perform the test. During the test it was also difficult to make the participants focus on the task to be done rather than to discuss on some minimal error in the design. The tests went well and the participants requested to see advanced view of the application running on real mobile devices.

5.2 Advanced user interface

The advanced user interface consists of the views designed on physical mobile devices. In the study, Windows phone 8.1 was used as the development platform. At first the navigation diagram of the application is designed, and then the ui follows. Changes on the user interface were made based on the feedback of usability team of our project partner.

5.2.1 Navigation diagrams between views

The navigation frame [16] shows the overall navigation between screens in the application. Figure 5.4 shows the navigation between the main view and the modules of the application.

- Legend:

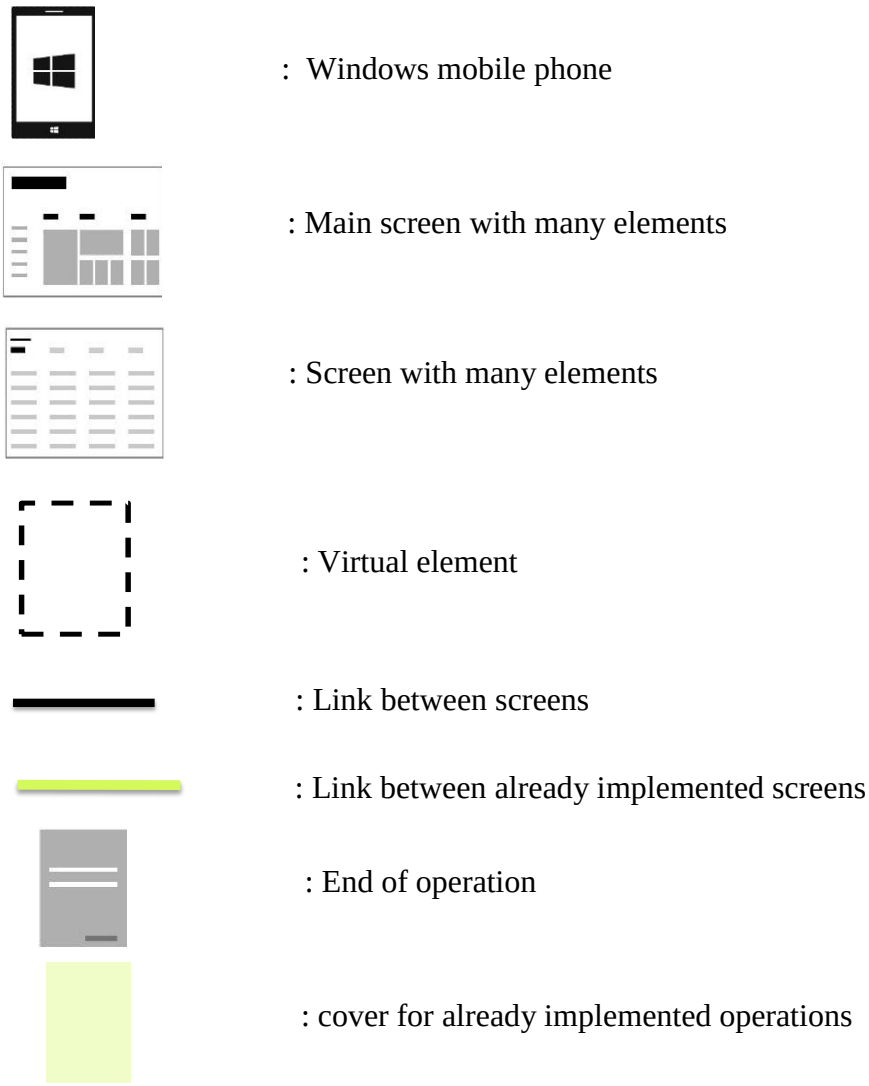


Figure 5.5 shows the overall navigation of the application, the user interface of the application will be built based on the navigation diagrams.

Main page:

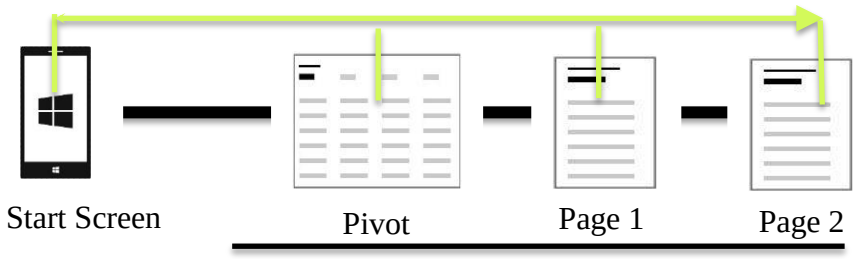


***Figure 5.4**: Navigation in the main page*

Overall picture of the navigation

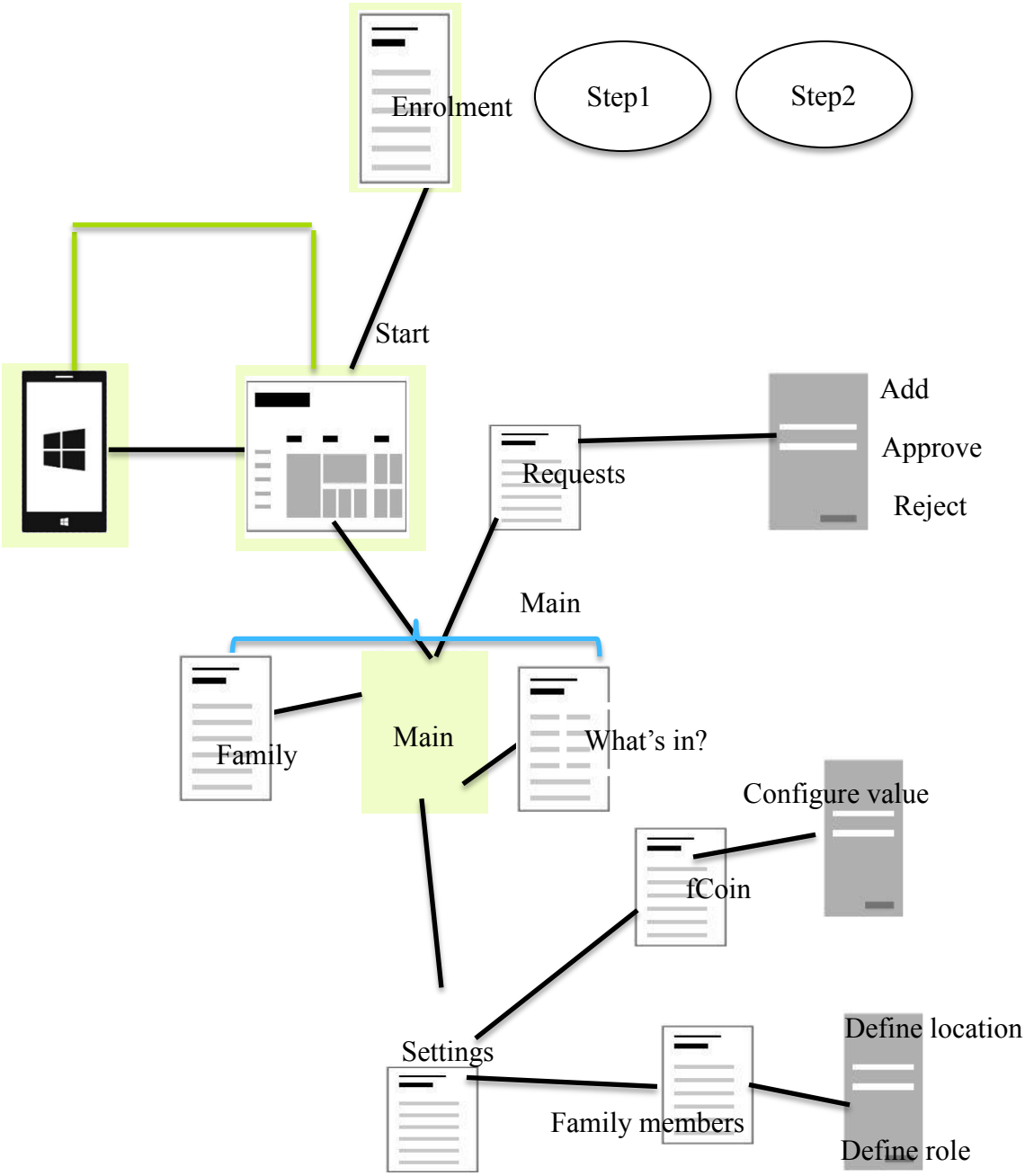


***Figure 5.5**: Overall navigation of the mobile application*

5.2.2 User interface on windows phone 8.1

Having a user interface of the application in a mobile device was a proof that the concept reaches a level of expectation. Visual studio 2013 and C# were used for programming. xaml is the language used to design the views. GIMP (Genuine Image Manipulation Program) where used to draw icons.

Preliminary user interface

The following devices: Nokia Lumia 735; Emulator 8.1 WVGA 4 inch 512MB; Nokia Lumia 535; Nokia Lumia 635 were used for testing. The preliminary ui is evaluated by the usability teams. Figure 5.6 shows the first step for enrolment.
Use case 1: Sam Smith enrolls his mobile device into an MDM group.
Step 1: Sam Smith fills his personal information

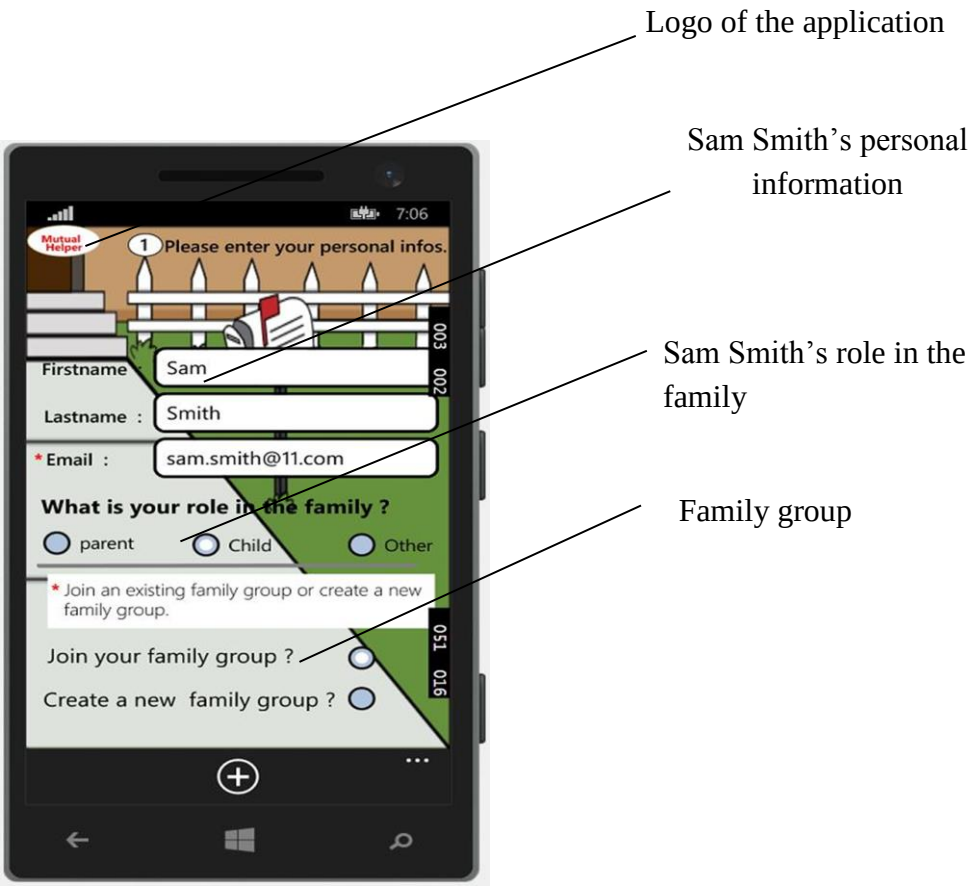
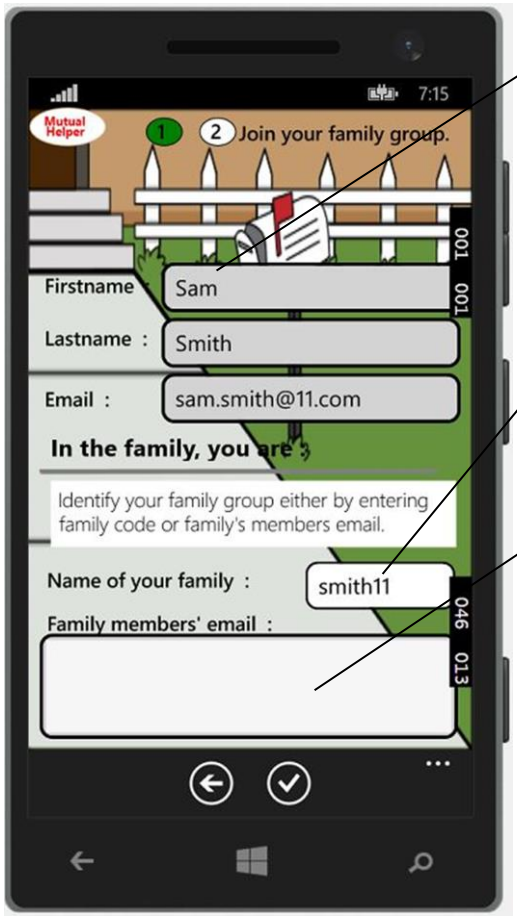


***Figure 5.6**: Enrolment step 1*

Step 2: Sam Smith enters his family name

Figure 5.7 shows the second step of the enrolment process. At this step, a user decides to join an existing family group (Figure 5.7). A condition to join a family group is to know the family name. The family name is the only data which has to be filled by user in this view.



The Sam Smith's personal info is already filled in this screen and the text boxes are read only.

Sam Smith's family name

Sam Smith could use this option to join the group.

***Figure 5.7**: Enrolment step 2*

Step 3: Welcome to the family group

Figure 5.8 shows the main page of the application. At this stage, the views are still coming from the emulator. In the top of the screen, the user has the possibility to open the menu (left top) and change the application settings i.e., the role member, the value of vCoin. In the top right, there is the search and the add request button.

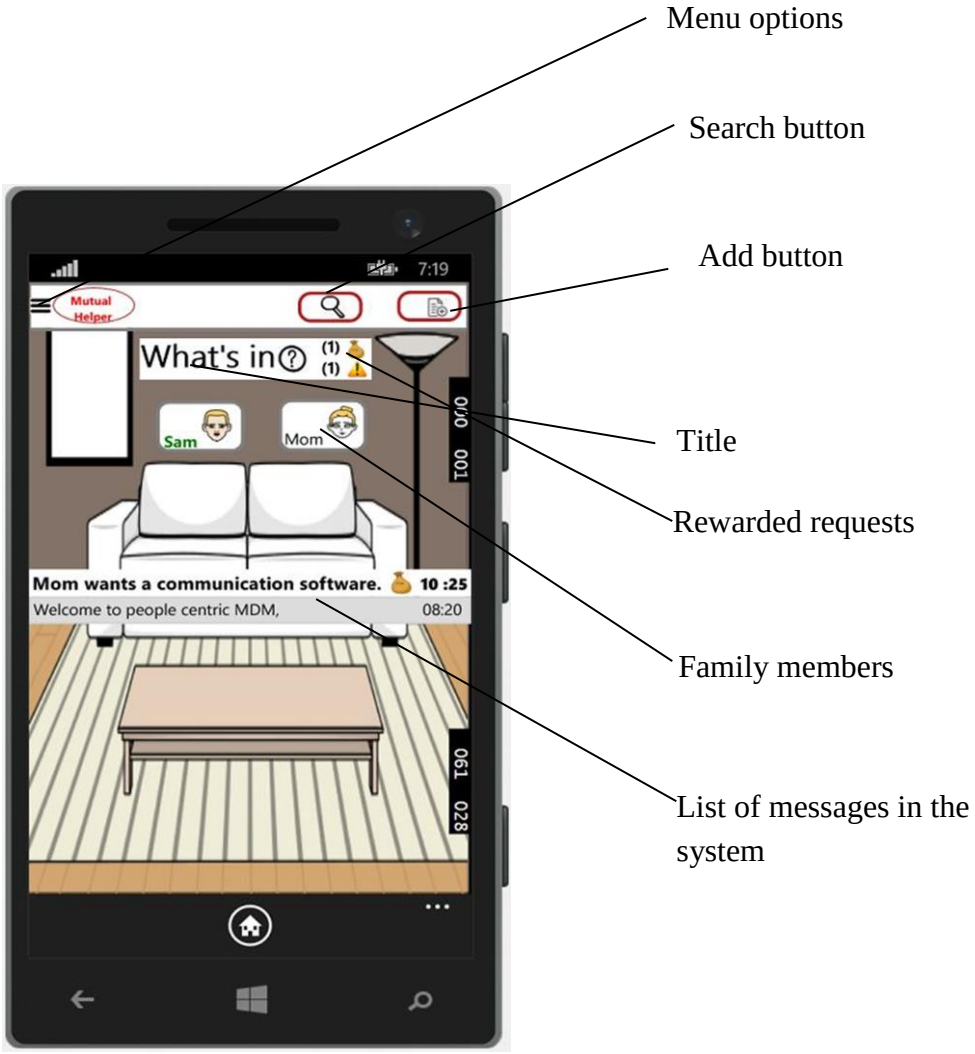


***Figure 5.8**: Main page*

The next step, after drawing the preliminary ui was to collect the feedback from the usability team of the project partner regarding the preliminary ui. The feedbacks collected are summarized in Table 5.4.

	Feedback
Step 1: Sam Smith fills his personal information	
1.	The landing page must explain what the application is about and there should be some kind of header
2.	In overall enrolment logic works nicely but some adjustments needed, keep it simple
3.	In general there's no need to input so much content to a single view, instead have more very simple screens
4.	The youngest kids that would be using the app are around 6-7 years old. Thus the cartoon background image is good.
5.	This view is mixing logging in and first time use. It could be better to have "start here OR login here" –type of functionality
6.	In final UI, focus on putting objects in line and use either capital first letter or not
7.	The cartoon background image is too bright. Lighter colour would make it looks more like a background image, now the screen is too fuzzy, and there's too much contrast
8.	Why "+", is it changing if you are joining a family group?
9.	What's here?
Step 2 : Sam Smith enters his family name	
1.	The best option is to identify the user who could be a token (limited validity time) based solution, for demonstration purposes
2.	This information should not be visible
3.	In which phase does the user receive the code? Or is it a part of the email invitation? Is it always valid or will it expires?
4.	Where is this needed?
5.	Wouldn't it be enough if only the "owner's" email is requested, then the

	owner can approve it?
6.	At this point it is enough to have group owner to define the family members, in later phase it might make sense to add a feature to allow people requesting access to a group (e.g. “Event MDM”)
Step 3: Welcome to the family group (Main page)	
1.	What options do you have in the menu?
2.	What can you search in the app?
3.	What’s up?
4.	Where do you define fCoin? Please consider having repeated requests as well
5.	How do the alerts work? Is it more like notifications, e.g. “Sam has completed his math exercises?” Alerts could be used if there’s a deadline for a request (e.g. homework, read for an exam etc.)
6.	This is a great idea, somehow to have parents, children and other people’s faces there
7.	One notification takes quite large space. – Perhaps background should be transparent
8.	You should be able to see also how much fCoins you have and see a “pricelist” of different activities you can decide to do as a child (e.g. playing games 1h costs 2 fCoin)
9.	Where in this UI can you check or see the context of a family member? It should be visible in this screen

***Table 5.4**: feedbacks from the usability team of our project partner*

The design phase went well but it takes more time than expected due to the fact that in this phase, there were many feedbacks from the usability of the project partner. Feedbacks were mainly related to the readability of the user interface, the colours and the navigation between user interfaces. At this stage, the development team started to face a dual problem. Firstly, the actual functionalities of the application have to be developed and this task was not easy since the team encountered several issues when starting to

work on the windows 8.1 platform. In fact, the expertise of the team in Windows platform was limited in the beginning. There were also many bugs when the team started the implementation. Several meetings and working sessions were held to solve the issue. One of the problems that delay the work is the fact that Visual studio 2013 requires the administrator right for the user of the computer so that the emulator could be used for testing. At university, the developer of the project has limited user rights on his computer. It resulted that nothing could be done in the beginning and the situation was really frustrating. Later on, when developers had the user rights there were still many bugs due to the previous situation. The solution was to repair the emulator in the control panel. The second problem faced was to design a gamified application whereas the basic functionalities of the application were already difficult to implement. The success of this phase was the main step which motivates the team to start the implementation phase. The good thing was that Visual studio 2013 offers to developer the possibility to quickly implement a nice user interface but due to the requirement and the limited amount of time, the team did not work on the scalability(one user interface could fit on the screen of mobile devices with different sizes) of the user interface.

6. IMPLEMENTATION OF THE CLIENT APPLICATION

The demonstration of the concept requires implementing an application running on mobile devices. In this chapter, the different steps crossed to implement the application and the problems faced during the implementation will be explained. In the appendices, the print screens of certain bugs are displayed too. The application runs on the Windows phone 8.1. The mobile devices used for testing were Nokia Lumia. In fact, Microsoft mobile devices and the recent version of Nokia mobile devices (Nokia Lumia) use the Windows Phone mobile as the operating system. The data manipulated internally was stored in SQLite database. Microsoft Azure api is used for exchanging information between mobile devices.

6.1 Project goals

The goals of the project were defined by the Tampere University of technology and Microsoft research teams.

6.1.1 Goals of TUT research team

Tampere University of Technology research team were made by

- Professor. Tommi Mikkonen
- Professor. Kaisa Väänänen
- Armand Thierry DJAPPI is involved in the project as thesis worker/Assistant researcher.

The goals for the study were: designing ideas, implementing the ideas, and produce a master thesis document from the project.

6.1.2 Goals of the project partner

The project partner was: Microsoft research team located in Tampere, Finland. The main goal of the project partner was to have: a working prototype of the concept; an executive summary of the project, a list of pending issues related to the application and a version of the thesis document.

6.1.3 Goals and deliverable of the project

The application must fulfil the project partner requirements: mobile application running on windows 8.1 and allowing the exchange of information within many entities.

6.1.4 Ending criteria

The project has a fixed period of seven months and has been granted an additional month for further implementation. It is defined for the duration of a master thesis.

6.2 Project management

Many tools were used during the project. Trello was used to manage the meetings and deadlines. In table 6.1, 6.2 the tools used and the documents produced are shown.

6.2.1 Methods and tools

Change management in this project is done manually. Documentation is stored locally and edited either with Microsoft Word or Microsoft Power Point. Trello [17] is used to manage tasks and of the project. In table 6.1, the lists of tools used are shown:

Program	Purpose
Microsoft online	Communication
Skype for business	Communication
Microsoft word	Documentation
Microsoft Power point	Documentation, presentation
Trello	Tasks/Baglog
MyScreenApp	Presentation
Microsoft Azure	Mobile api/database/ billing

***Table 6.1**: Programs used in the project*

6.2.2 Documents

Table 6.2 shows the summary of the documents produced during the research.

Documents	Purpose	Responsible person
Requirements documents	Listing requirements	Research team + project partner
Navigation diagram	Design	Armand T.DJAPPI
Architectural description	Implementation	Armand T.DJAPPI
Executive summary of the project.	Description of the project	Research team
Flow of the user interface	Flow of the user interface in the application	Armand T.DJAPPI
Thesis document		Armand T.DJAPPI

***Table 6.2**: Documents edited during the project*

6.2.3 Monitoring and guidance

Communications inside Tampere University of Technology research team and between Tampere University of Technology and Microsoft research team are made via email; face to face meetings, online meetings (skype). During meetings, new findings were presented and the ideas were discussed between research teams.

6.3 Project iterations and timing

6.3.1 Iterations

The project is divided into six iterations. The duration of the iteration depends on the complexity of the tasks to perform. The longest iteration lasts eight weeks and the shortest four weeks.

Date	Deadline. What should be ready
18.11-31.12/2014	Preliminary ideas
01.1-31.01.2015 extended until 25.02	Interviews of family and feedback collections
26.2-27.3	Design of the concept
28.3-20.5	Preliminary user interface and the navigation flow
21.5-30.6	Final product
01.9-31.9	Final product , documentation , user interface flow; executive summary of the application

***Table 6.3**: Iterations of the project*

Most of the entities involved in the project contributed actively in the execution of the task. Four deadlines out of six were respected. The first deadline was extended due to the difficulties of finding families living together willing to participate in the interview. At the end of the fifth iteration, the mobileservice was not working thus the final product could not be delivered. In fact, the expertise was limited in both teams regarding Microsoft Azure mobileservice. The fifth iteration was postponed to a sixth. During the project, a total of thirty-one meetings have been held. Table 6.4 shows the summary of the meetings and working sessions held during the work.

Description	Numbers	Location
Meeting between TUT research team and Microsoft research team.	6	Onsite
Internal meetings inside TUT research team	17	Onsite
Working session between TUT research team and Microsoft research team	6	Online
	2	Onsite

***Table 6.4**: Meeting between the research teams*

6.4 Architecture of the client application

The architecture of the application is made by: Windows phone 8.1 mobile, C# for programming language which follows the model view controller logic. SQLite and Microsoft azure (cloud) database to store information and Microsoft Azure webservice to communicate between mobile devices. The high level architecture is displayed below:

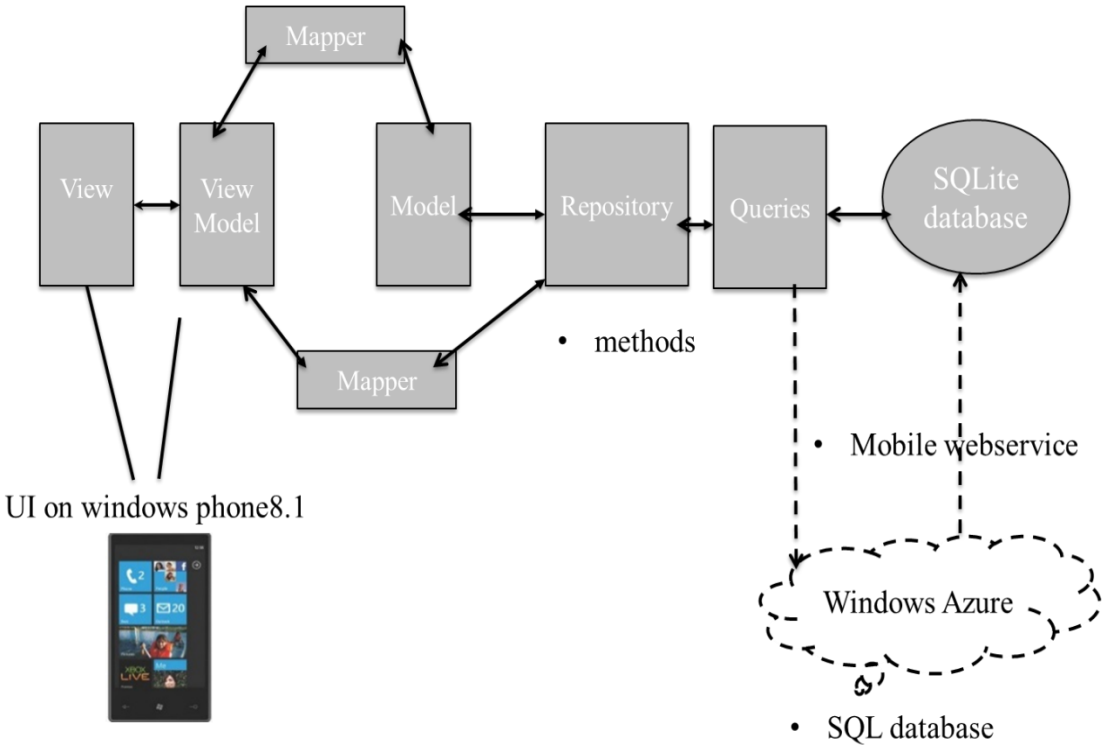


***Figure 6. 1**: High level architecture*

6.4.1 Windows phone

The devices used to develop the application were Windows phone mobile devices. The operating system running in the devices is windows phone8.1 Operating system. The computer used to code should also runs on windows 8 operating system. During the development and testing we used the following devices: Nokia Lumia 735; Nokia Lumia 635; Nokia Lumia 535. The usage of a Windows phone device for development purpose needs to follow certain requirements:

- The developer should have the administrator rights in his computer.
- The developer should be register as a Microsoft application developer [21].
- The mobile device used should have an activated SIM card.
- The mobile device has to be unlocked.

6.4.2 Microsoft Visual studio 2013

Microsoft visual studio 2013 is the tool used to edit the code. The team has used the Framework 4.5. The code is written following the mvc (model view controller) logic. In Figure 6.2, the view leading to the creation of a visual studio 2013 project is shown. *Windows phone project is created on Visual studio 2013.*

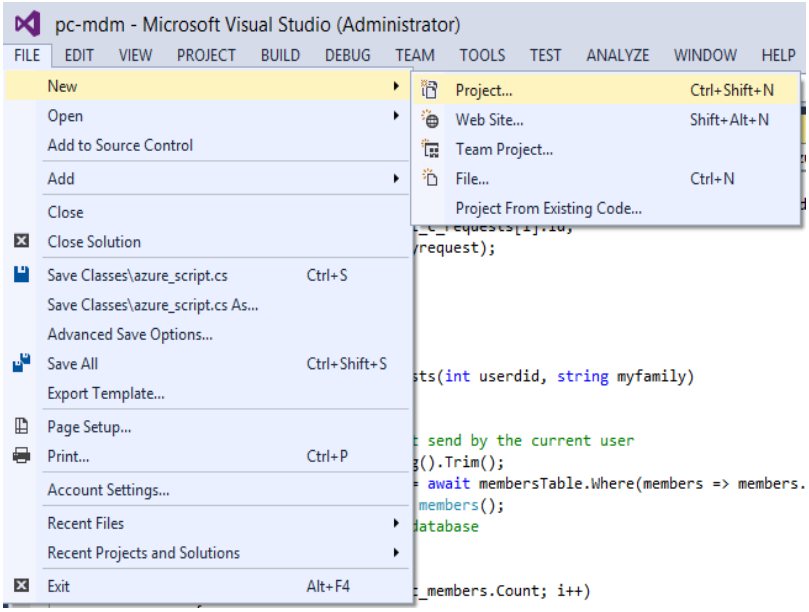


***Figure 6.2**: Adding a new project*

A file with xaml extension is created on visual studio 2013 with another file ending with .xaml.cs extension i.e, in Figure 6.3, the file Mainpage.xaml is created at the same time with Mainpage.xaml.cs.

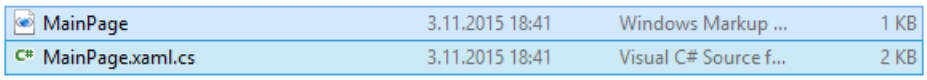


***Figure 6.3**: Two extensions of the MainPage file.*

The MainPage.xaml contains the script for the user interface design. The MainPage.xaml.cs contains the C# code implementing the functionalities related to the page.

Advantage of using C# and visual studio

- C# is an imperative language and follows the object oriented logic. This type of language is quite popular in the academic environment. Thus it does not take a long time for a novice developer to familiarize himself with the language.
- C# is a compiled language and it syntax is similar to C++ which is used at university during the course data structure and algorithm. In this study, the developer didn't have to implement any optimized algorithm. In fact, the prototype was

made for demonstration and developers were supposed to manipulate only limited amount of data.

- The Framework 4.5 offers to developer many libraries which allow reusing the existing code and managing certain element of the ui.

i.e., the calendar and camera functionalities are already implemented inside the Framework 4.5. The developer should only import the specific libraries.
The implementation of the same calendar could take many days in another platform that windows phone 8.1.

Problems faced with C# and visual studio 2013

- Visual studio 2013 has many uncommon bugs and errors [Appendices A] and certain require repairing the SDK in the control panel.
- The usage of the emulator requires having the administrator rights in the computer. It is really difficult when the work is made in an institution where is not common for employees to have those rights. It could take weeks so that the administrator right is granted to a developer.
- It is complex to integrate external element as SQLite database to visual studio 2013.
- It was difficult to apply the MVC logic of programming for certain functionalities. One challenge where to display a list of information retrieved from the database in a view level then gives the action to a specific element.

I.e., at certain point developers have to display the list of request sent in the system by family members then give possibility to user to click and open a specific request in a different view. In fact contrary to certain language (as php) there is absolutely no place in the view where C# code could be inserted. The view is only made by xaml code.

- It is possible that a wrong compilation destroyed a whole version of the project. It is more secure to back up a certain version before integrating a new element.

I.e., an unsuccessful integration of Bing map application crashed a whole version.

6.4.3 SQLITE

SQLite is a software library that implements a self-contained, serverless, zero-configuration, transactional SQL database engine. SQLite is probably one of the top five most deployed database engines in the world [25]. During the study, SQLite has been used as internal database that should be deployed alongside the client application. Once deployed in the mobile devices the user can already use a prototype of the application and can also check the data present in the system even if his mobile device is not connected to internet or he is connected but has a limited internet capacity. In the line below details are given related to the usage SQLite database with Windows Phone 8.1 platform [26].

Installation of SQLite Engine

SQLite [25] needs to be downloaded and properly installed so that it could be use in SQLite application. Once the engine is downloaded a developer could integrate the engine in a Windows phone8.1 application.

Adding SQLite to a windows phone 8.1 application.
The user needs to open the solution explore, right click on References then clicks on Add Reference (Figure 6.4).

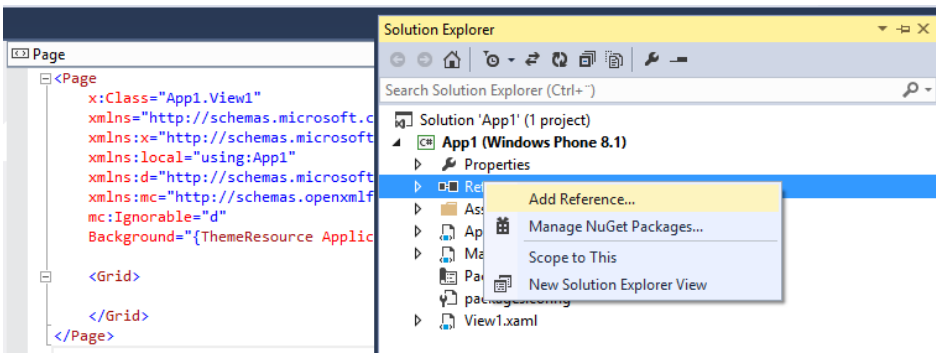


***Figure 6.4**: two extensions of the MainPage file.*

User has to add a reference to SQLite since it is a new library. The SQLite extension is shown in the screen only when the extension is properly installed (Figure 6.5).

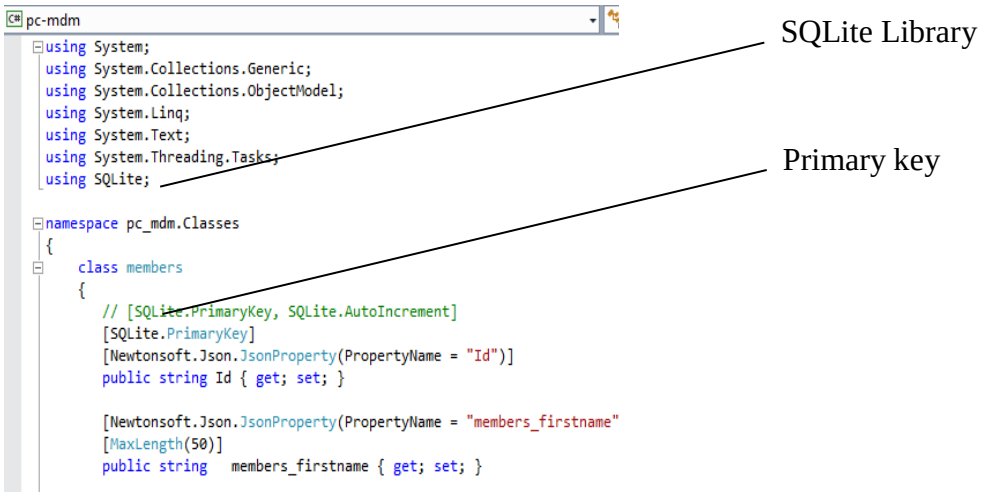


***Figure 6.5**: SQLite into windows phone application*

Working with SQLite database is quite easy once it is properly installed. It is a relational database. A SQLite query seems a bit different in structure to a traditional SQL language query. The main advantage with SQLite is it size. It is quite small in terms of size and could be deployed along with the application inside a mobile device. As a drawback, SQLite is external to the Windows platform of development thus certain bugs

could be generated during the integration. It is also difficult to keep the coherence between a table rows on SQLite and Microsoft Azure SQL table in the same time.

6.4.4 Microsoft Azure

Microsoft Azure is a very important tool for the concept. It allows the exchange of information between windows phone devices. The family members have to exchange information through the devices. The main reason the team chosen Microsoft Azure is that: it is developed by Microsoft and it is compatible with Windows phone devices. Basically, for development, it requires: a server, a mobileservice and a database. Below are the steps followed by the development team to add a mobileservice to an existing mobile application.

Adding mobile service to an existing application[20]
At first the developer has to create the service in Microsoft Azure (Figure 6.6, 6.7)
Create a Mobile service from Microsoft Azure portal

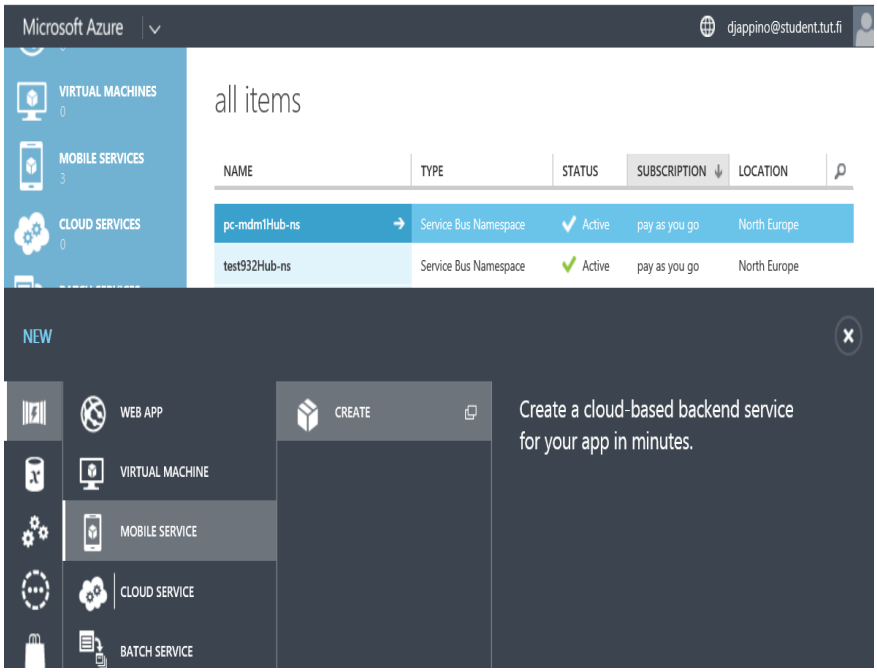


***Figure 6.6**: Create a Mobile service in Azure Portal*

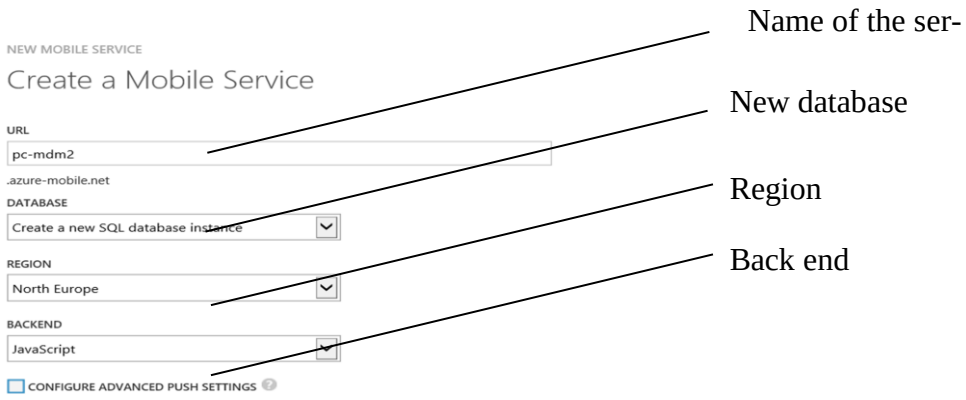


***Figure 6.7**: Create a mobile service with JavaScript backend*

Creating a database from the mobile service previously created.

There are many ways to create a database in Microsoft Azure. The method of creation through Visual studio 2013 is chosen by the team. The developer once he has Visual studio 2013 clicks on “TOOLS” then on “Connect to Database” as it is in Figure 6.8.

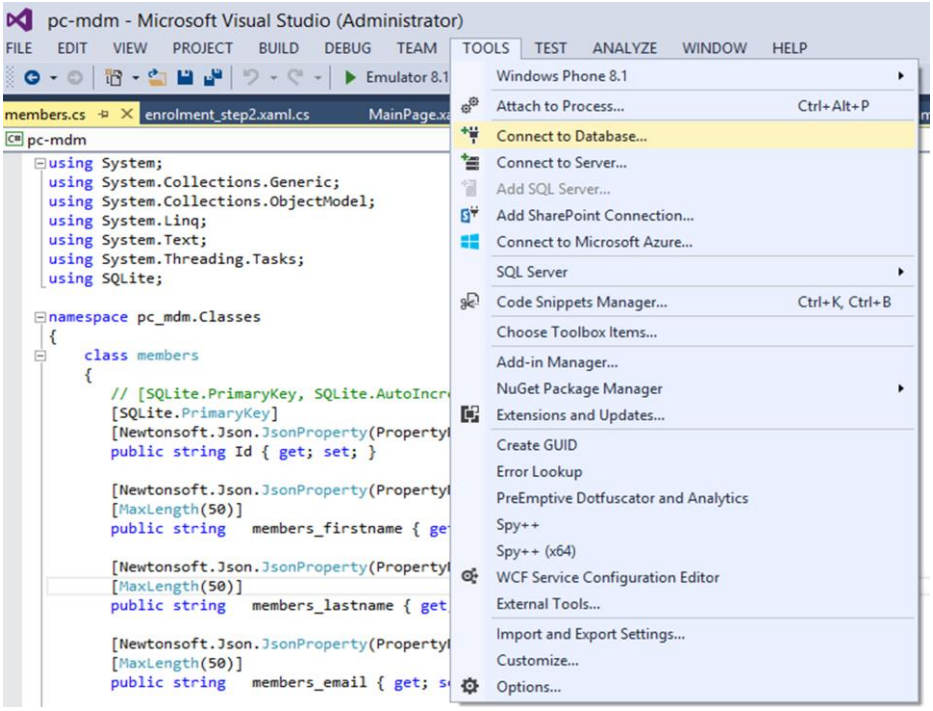


***Figure 6.8**: Connect to Database through visual studio 2013*

In the case that the connection with Microsoft Azure server is established, the developer can see Azure server in his screen. The next step is to enter the credentials and the developer can start working with Microsoft Azure (Figure 6.9).

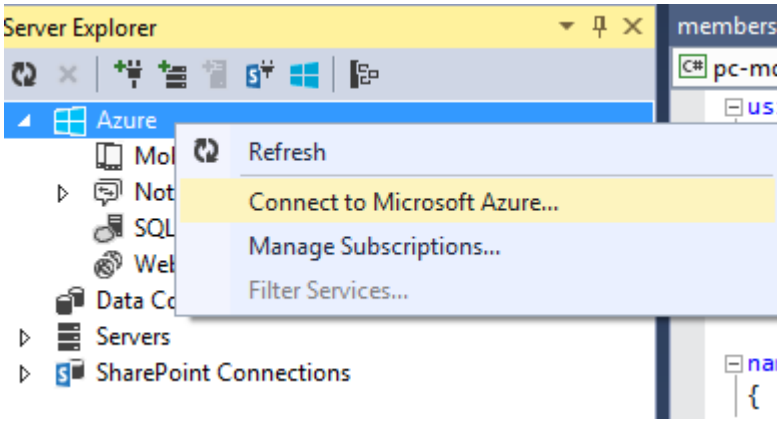


***Figure 6.9**: Connect to Microsoft Azure*

In Figure 6.10, a table for a specific mobileservice is created. The list of tables created for the project is displayed in Figure 6.11.

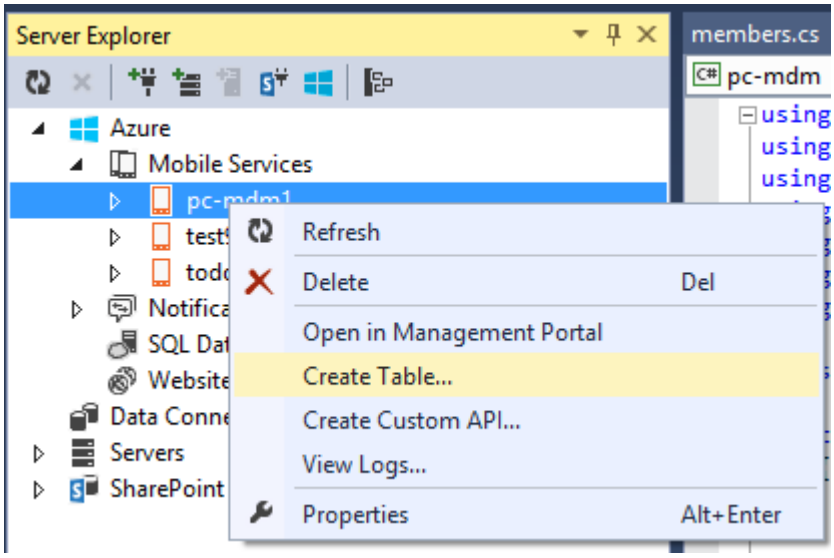


***Figure 6.10**: Create table from mobile services*

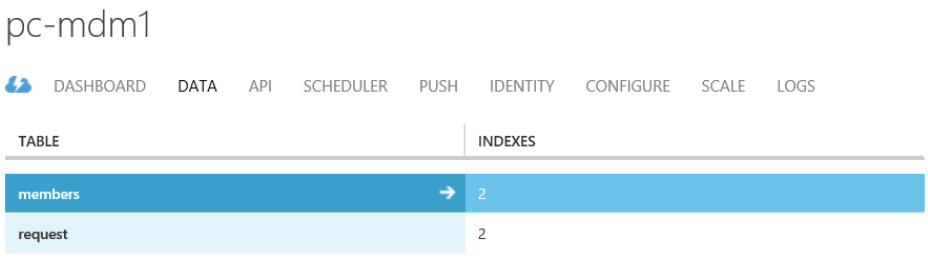


***Figure 6.11**: List of the tables in our mobile service*

Microsoft Azure mobileservices is also external to Visual studio 2013, thus developer has to import it in our project. Figure 6.12 shows the script to import it.

```
using Microsoft.WindowsAzure.MobileServices;
using Newtonsoft.Json;
```

***Figure 6.12**: C# code for WindowsAzure.MobileServices*

Advantages of using Microsoft Azure

- Microsoft Azure is compatible with windows phone 8.1 platform of development.
- It is secured.
- Microsoft Azure offers a readymade Javascript and (dot).Net api to developer thus it reduces the time of development.

- The exchange of information between Windows phone devices and Microsoft Azure server is quite interesting in term of speed.

Problems faced with Microsoft Azure

- Microsoft Azure offers a trial to the developer but it requires registering your credit or debit card information. This condition restricts developers to try the product.
- Microsoft Azure api is quite difficult to integrate for a novice. During the project, the development team spent weeks before succeeding integrating the mobileservice.
- There is limited information about the Azure mobileservice integration available online.
- The api code is ready to use but it is very difficult to update. The developer has a feeling that he uses something that he does not have any control on. Rather than develop he has to learn how to use an existing code. Many trials of updating or using the service in a different way produced errors.

6.5 Test and Quality assurance

The quality of the product has been internally rated by the research team and by the usability team of the project partner.

6.5.1 Usability testing

The usability tests have been made during the three different phases of the project.

- Conception phase: during the conception phase, starting with the brainstorming session, until the complete creation of the ideas, the quality and coherence of ideas has been ensured by the research team.
- Design phase: the design phase started with the development of ideas. In this phase, the quality of the product has been evaluated by the research team. Feedback was given by the Microsoft research team involved in the project. User tests were also organized to evaluate the product with external users who were not aware of the concept.
- Implementation phase: this phase was marked by the design of the user interface in the Windows phone 8.1, and the implementation of the back-end. The testing was done by the research team of Microsoft.

6.6 Lessons learned during the implementation

The implementation phase took three months. It was challenging due to the fact that the windows 8.1 mobile platform was new to the team. During this time, the team familiar-

izes itself with Windows platform development process. The developers were at the end of the project able to:

- Preparing a Windows phone device for development
- Setting up a developer account for Windows phone
- Apply the model view controller technology in visual studio
- Integrating Sqlite database into a windows phone application
- Integrate Microsoft Azure mobileservices to an existing application
- Deploy a windows application into a Windows phone device

The team improves it presentation skills by using Microsoft Myscreen to display the mobile device information to the screen for the audience. The team also used to work in a project in which feedbacks are collected from an external entity. Feedbacks were collected remotely also during presentation. In the fifth iteration last version of the application crashed due to a tentative to integrate Bing map features into the application few hours before an end iteration presentation. It shows to the developer that it is important to make a backup version of the application before integrating a new feature.

7. RESULTS

People centric mobile devices management started in December 2014. One of the main requirements was to design and implement ideas for mobile devices management for an informal group of people. Family leaving together was the group of people chosen for the study. The team implemented the following ideas for family:

- Motivate family members to help each other via mobile devices
- Giving to family members, the possibility to know each other physical context via mobile device.
- vCoin as the virtual currency used within family to materialize rewards.

At the end of the project, the ideas were demonstrated to our project partner.

7.1 Deployment of Mutual Helper in windows device

Many steps have been crossed to make the application that could be deployed on windows phone 8.1. The result of the work is presented below.

7.1.1 Generation of the release packages

The installation of an application in a Windows phone device requires the generation of a release package. The process of generating the release package via visual studio 2013 is shown in Figure 7.1.

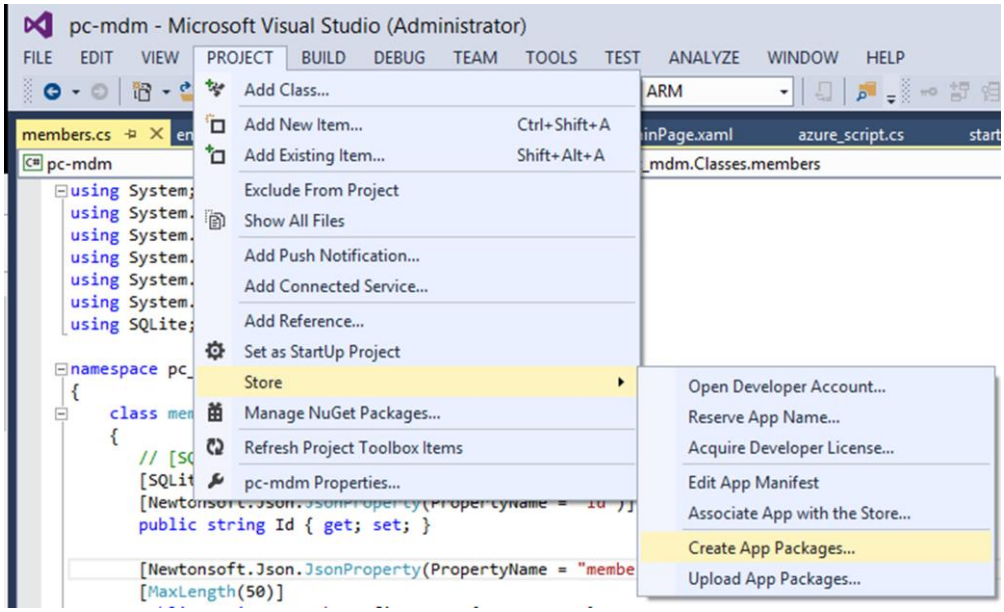


***Figure 7.1**: Generation of the release package from Visual studio 2013*

7.1.2 Deployment of the package in windows phone 8.1 devices

Once the release package has been generated, the next step is to deploy the package in Windows phone 8.1 devices. Windows Phone Application Deployment 8.1 is used. The tool could be found on any computer running on Windows 8 operating system.

7.2 Starting Mutual Helper

The user has to verify if his mobile device is connected to internet so that the exchange of information is possible between mobile devices.

7.3 Ideas implemented

The first idea implemented is the idea of mutual help within family.

7.3.1 Mutual help within the family

Idea 1: kid helps his family by delivering a letter at the post office and gets rewarded. The task has been described in Mutual Helper (People centric mobile devices application). In the demonstration, there will be two users: mother and son. The mother's first name is: mom. Son's first name is: dan. The family name is: hihi;

Mother launches the main pages of the application (Figure 7.2).
There is already the request but the important one is the request of her son to join the MDM group.

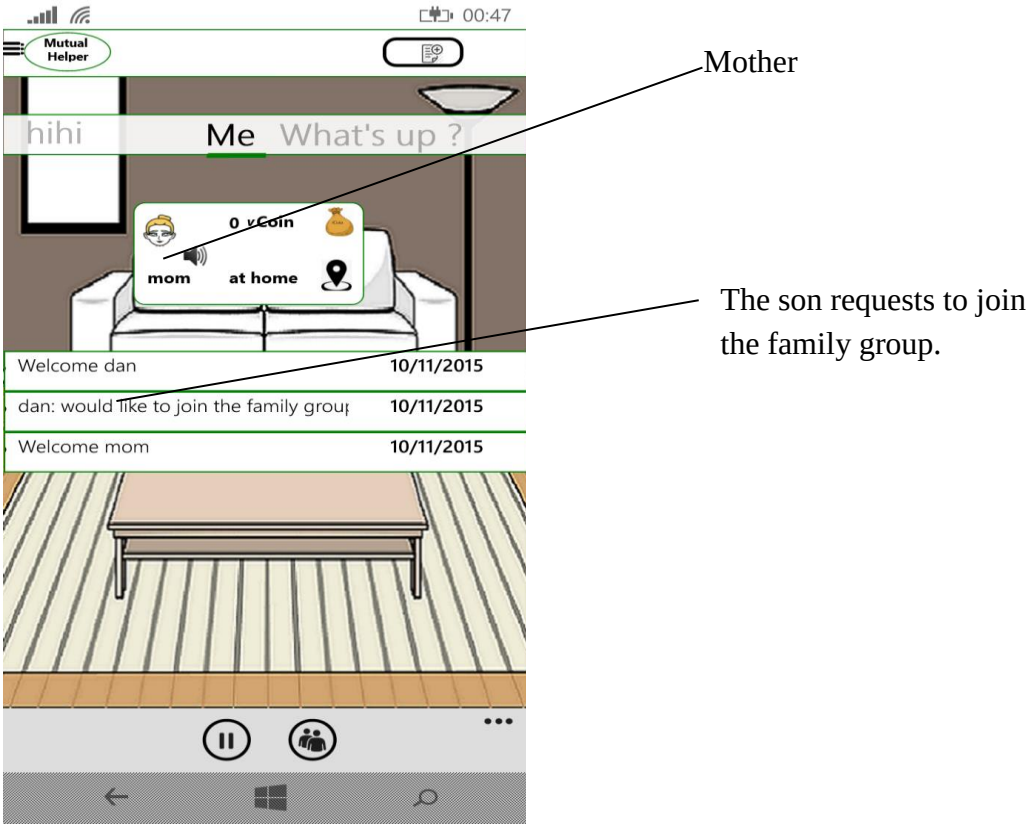


Figure 7.2: *Mother launches the main page of the application*

Mother sends a rewarded request in the application (Figure 7.3).

In Figure 7.3, the mother sends a request to deliver a letter to the post office. The task is worth 2 vCoin. It means that if someone executes the request and if it is approved by a master user (by default both parents), the family members who executed the task will receive 2 vCoin. At this point there are two type of request in the application: “software” and “others”. The type “others” means that the request belongs to a different type than software. In fact, the type software should follow a different step to be executed approved.

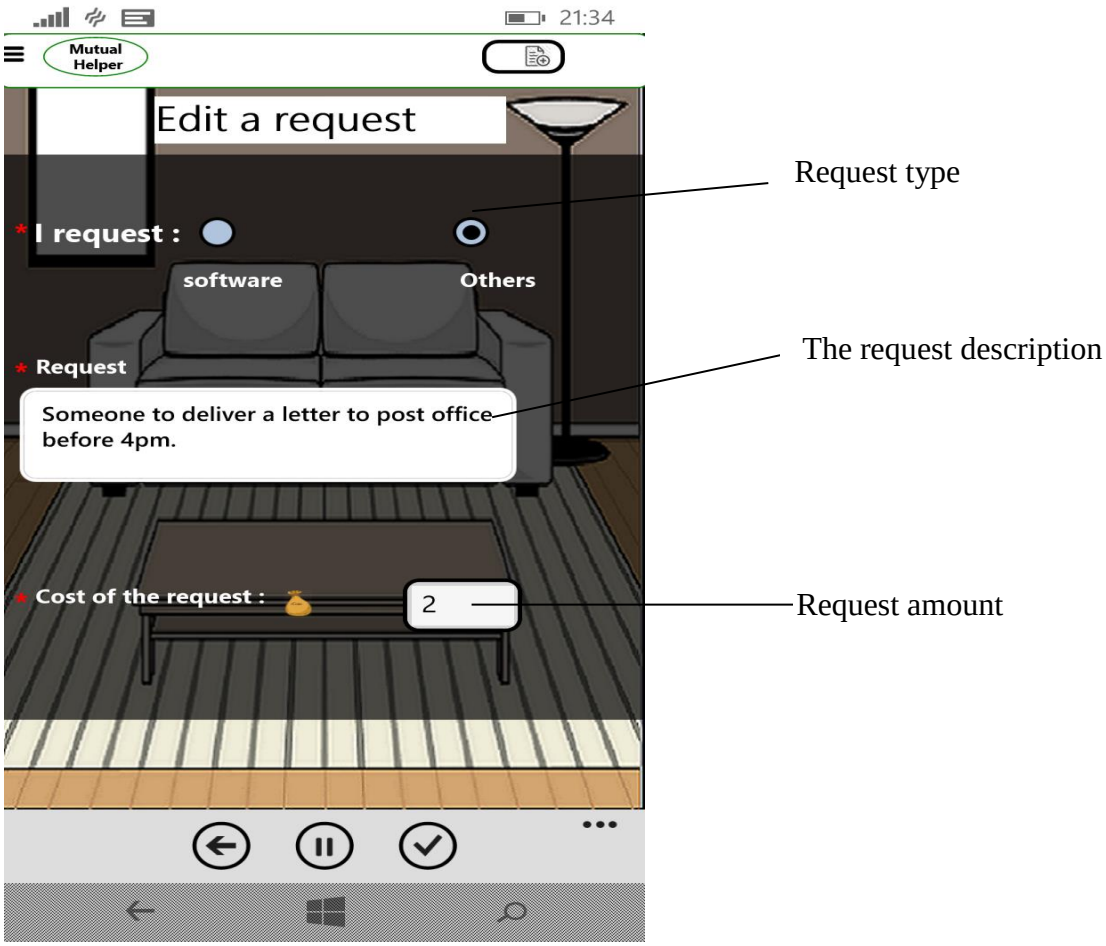


***Figure 7.3**: Sending request*

Dan sees the request

In the previous step, the mother has sent a request in the system. The request description says:" I want someone to deliver a letter to the post office before 4pm."

The request is displayed in the system and every member of the family who is enrolled to the MDM group could see it. In this demonstration, Dan who is the son sees the request from his mobile device (Figure 7.4). In Figure 7.4, in the same line and between the request description and the date, there is an icon of a money bag. A money bag icon means that the request is rewarded.

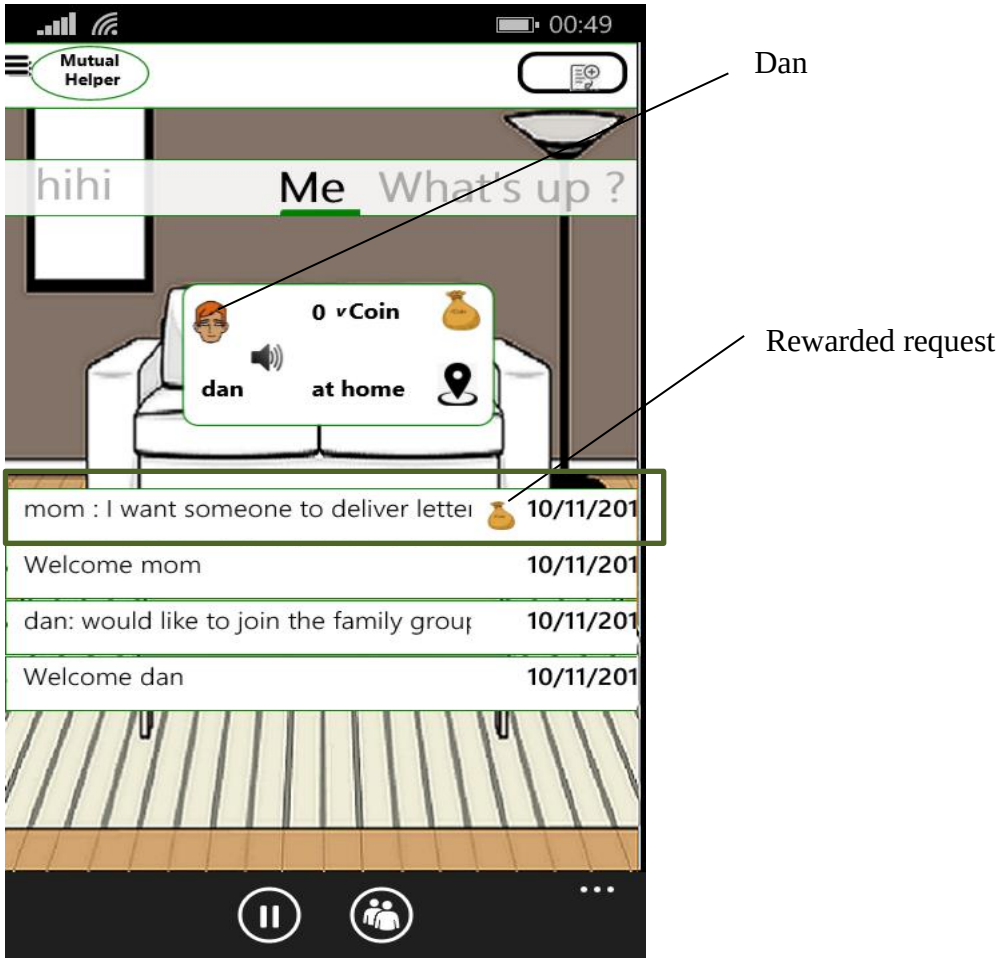
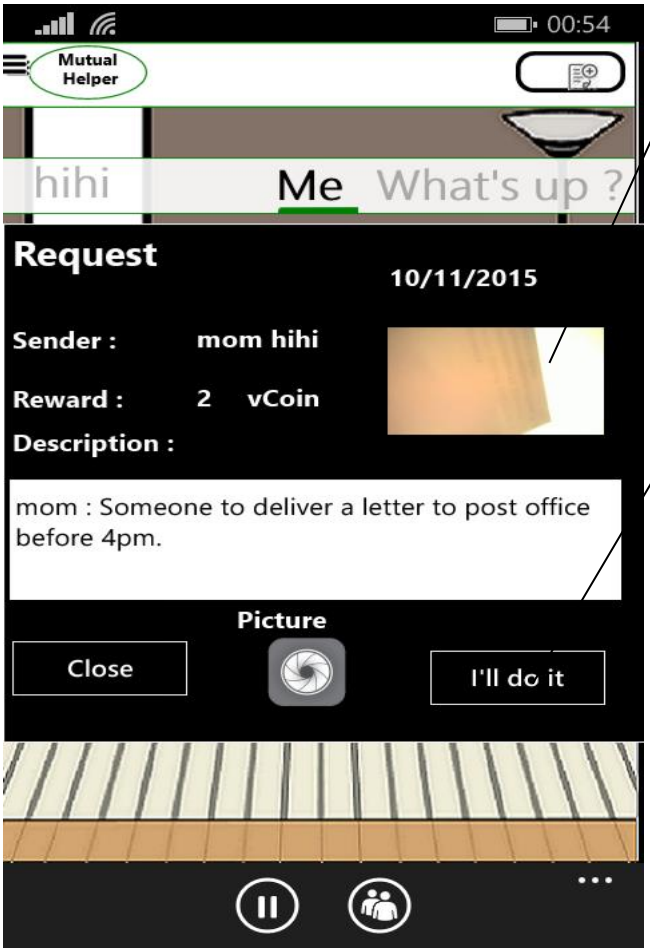


***Figure 7.4**: Dan sees the request in his mobile devices*

Dan executes the task and decides to take a picture

In Figure 7.4, Dan sees the request and he decided to execute it. He also takes a picture when he drops the letter to the box at the post office (Figure 7.5).



Picture took while executing the task

Dan accepts to execute the request.

***Figure 7.5**: Dan executes the task*

Mom checks the task done by Dan

Dan has executed the task and a notification is sent to his mother related to the task done. The notification has a timer icon, meaning that it is pending and waiting for approval. Figure 7.6 shows the mother screen where she sees the notification.

***Figure 7.6**: Mom checks the task waiting for approval*

Mom approves the task

The mother clicks on the notification and if she thinks that the task has been properly executed, she approves the task. Figure 7.7 shows a view when the task is approved.

Button to approve a task

***Figure 7.7**: Mom approves the task done by Dan*

Dan's total amount of vCoin is updated

In Figure 7.7, the mother checks and approves the request. Then, Dan receives the reward related to the request which is 2 vCoin. His total amount is also updated. In Figure 7.8, it is shown that dan has a new total of 7vcoin.

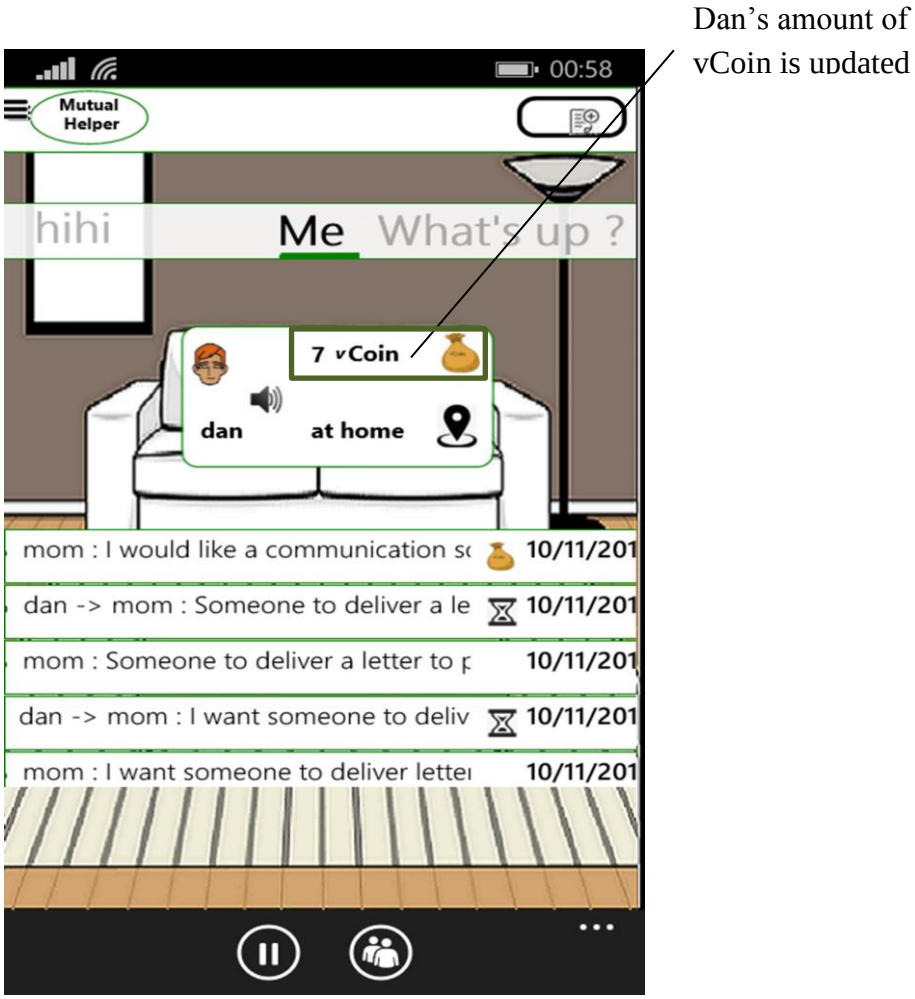


Figure 7.8: *Dan's total amount of vCoin is updated*

The scenario: "**Ideas 1**: kid helps his family by delivering a letter at the post office and gets rewarded. The task has been described in Mutual Helper (People centric mobile devices application)" is demonstrated above. It is an example of the usage of mobile devices as a tool for regulating daily activities within a family. The rewards are used as external motivator element leading kids to adopt the concept of MDM. vCoin value could be set as currency or free time for video games or instant messaging. vCoin is an element leading member to use the concept during a long period of time. In it conception, the vCoin usage is not far from the loyalty card used by a company with the target to keep the fidelity of its customers but vCoin is more fun because it can be decreased or increase depending if the kid is good or bad. The information related to reward is

publicly displayed to every member to create competition. Displaying data about who is doing a specific activity is a type of leaderboard.

Idea 2: kid helps his mother by remotely installing communication software allowing videos call into his mother's mobile device. In the demonstration, the users are: the mother and her son. The same personages are used: mom, dan and the family name is still: hihi.

Mother sends a rewarded request in the application i.e., the request type is: Software. Contrary to the scenario in the idea 1, the request type in Figure 7.9 is software. It means that the mother is requesting software and a different procedure should be followed.

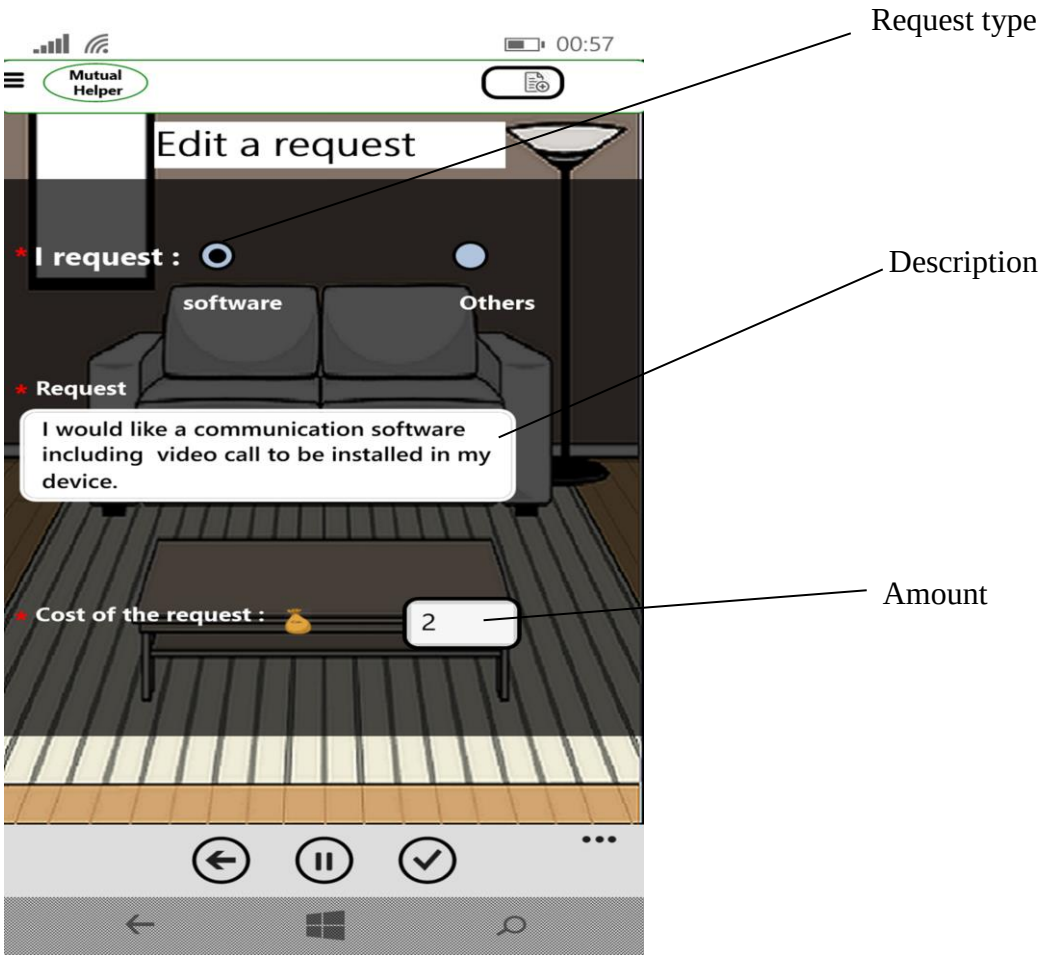


***Figure 7.9**: Mother requests communication software*

Dan sees the request. It is the same as in Figure 7.4.
The only difference here is that, the description of the request has changed. There is the description in the textboxes of the Figure 7.5.

Dan installs Skype into his mother mobile device.
Dan has decided to execute the request and he is installing skype into his mother mobile device (Figure 7.10).

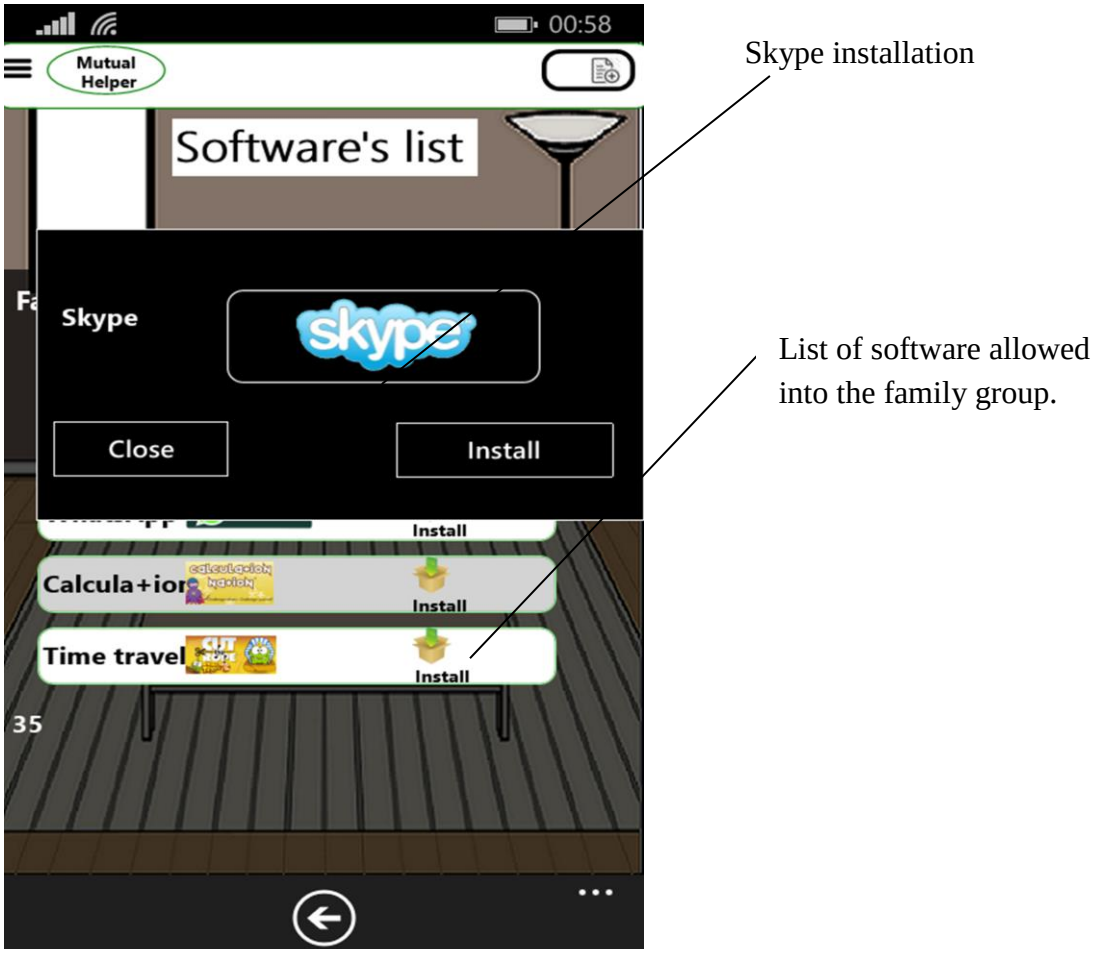


***Figure 7.10**: Installation of skype into the mother device*

Mom approves the installation. The process is the same as in Figure 7.5, Figure 7.6.

Dan's total amount of vCoin is updated. It is the same as it is in Figure 7.6.
The idea 2 shows the support that kid could give to parents in terms of the mobile device installation and configuration.

7.3.2 Knowing the context of family members

In this idea, family members share their physical context to each other.
Idea 3: Family members publish their context and their mobile device's mode into the group.

Figure 7.12 represents the mobile device of any family's member. It displays the list of common information that family members will share to others members. The exchange of information is very important. In the interview, one of the major problems of mothers interviewed was: the member would like to know in which context other members are at a specific time i.e., Why are they so late to come back? Why are they not picking their mobile phone when I call them?

At this stage of the implementation, this information is just sent in the system by pressing a specific button in the main page but those functionalities could be automated.

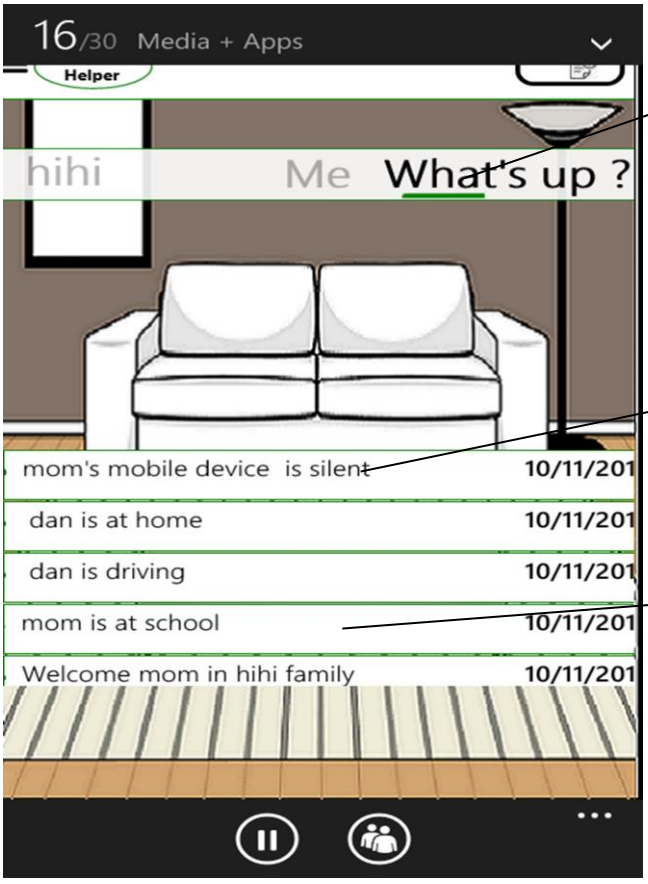


***Figure 7.11**: Family member's context and volume mode*

8. SUMMARY AND CONCLUSION

8.1 Summary

People centric mobile devices management is a practical case of the application of mobile device management in an informal group of people. An informal group of people refers to groups where members are more "free" to do as they please, to an extent. In the study, members are not forced to participate or to adopt the concept as it could be in a company; rather they are motivated to do so. The research was collaboration between Tampere University of Technology research team and Microsoft research team. The project was initially fixed for a period of seven months but allowed for one month of extension for further development. The research was done at the Tampere University of Technology and Microsoft Tampere premises. The project aim was to define which group of people the mobile devices management could be applied, knowing that mobile devices management is already applied in companies and defined and designed ideas that could be applied in the group. At the end, we have to implement a working prototype of the ideas in Windows phone 8.1 platform of development thus test them in Windows phone devices.

The study was devised in three main parts: At first, ideas to be put forth in both the design and implementation phase were developed. The idea creation commenced with the organization of the brainstorming session in which, preliminary ideas of the concept were collected. This also allowed the researchers to view the future challenges. These included the cultural difference between participants, especially in terms of choosing a master user for each group. Certain participants said it should be the father while others said that it should be both parents. Others said that it should be the person with the most expertise in a specific activity i.e., in a family of four people, there was a 14 year old child who seemingly should be the master user for the functionality of management and installation of software application for family members' mobile devices because he was the most skilled in this domain, within his family. Face to face interviews with family members or parents of families was the second step in the idea creation process. Five families were interviewed, two families living together and three individual parents. Ideas which came about included the following:

- Enhancing mutual help between the family members.
- Giving the possibility to family members to publish their physical context to other family members.
- Giving the possibility to family members to publish their mobile devices mode. I.e., Mother's mobile device is : silent; off;

- Usage of reward as a motivation factor to encourage young members to use the concept.
- User friendly and playful design for the user interface.

The points above were the main ideas gathered after the 'ideas creation process' and will be used in the design.

The second step of the project was the design phase. In the design phase, the team firstly sketched the low fidelity prototype of our concept. Balsamiq software allowed the team to easily and quickly draw the interactive user interface. The user tests were organized to evaluate parameters such as the terminology of words, the easiness of the navigation between the user interface, the icons used and the simplicity to accomplish an easy task. Participants were more enthusiastic to participate in the user tests rather than in the interview. Three user tests involving six participants were organized. The mockup was updated based on feedback collected which was related to the original design and changes were applied and discussed in a meeting involving both research teams. The design of the advanced user interface was the second part of this phase. In this phase the navigation diagram was designed as well as the preliminary user interface but without working functionalities. The usability tests were done by the Microsoft research team involved in the project. The updates were done in relation to the feedback that was received from the Microsoft research team.

The technical implementation was the last phase of work. In this phase, a native Windows phone application working on windows 8.1 is implemented. The goal of the application is to demonstrate the ideas retained and developed during previous phases.

The application was implemented with Visual studio 2013. Windows phone 8.1, SQLite was used to internally store data as well as Microsoft Azure cloud. Microsoft Azure provided tools including Web Server, SQL database, and Mobiles service. These tools allow for the exchange of information between Windows phone devices so that ideas could be demonstrated within a family group. Usability tests were also made by both research teams involved in the project. The main requirements defined at the beginning of the project were met at the end of the project but there were still areas for improvement in some aspects such as the optimization of the mobilewebservice, the realization of user tests with the actual client application.

8.2 Conclusion

Mobile devices management has been in existence for many years. AirWatch [3] is an implementation of MDM used within companies. To this day, the MDM concept is quite unknown by majority of the population. The research study concluded that many participants did not know about MDM, but they were all really interested in the topic. This shows that MDM has the possibility to grow and expand in today's market; an application for informal groups, such as family will also be needed. Our main goal during the study was to design ideas and develop a working application which can demonstrate the mobile device management within an informal group of people as family. From the

interview process and the research it was noted that many children under the age of thirteen own mobile devices and due to the fact that the abuse of usage of mobile devices, or even certain information could have a big impact on children's mental development, parents are willing to monitor the usage of mobile devices of theirs kids for the safeguarding of their health. Parents wish to regulate their kids' activities in mobile devices so that this usage could affect them in a positive way i.e., the kid's mobile devices have to be switch off at 10:00 P.M. Parents could know their kids physical context from the kids' mobile devices. In this case MDM could be used by parent as a tool to regulate live style of their kid but the implementation of this functionality was only simulated. It could not be fully implemented in the study because Windows phone device does not allow us to remotely switch off a mobile device.

The involvement of external participants during the project provided for an in depth understanding regarding the importance of the concept nowadays, and also the challenges regarding its adoption. One of the main fears of people interviewed was that they might lose their privacy i.e., "I don't want my location to be published in the group." This is the reason why it was decided to publish the physical context instead of the exact location. Another challenge faced was to motivate kids who could find the restriction to use their mobile device after certain hours of the day very irritating. The solution found was to include gamification design (reward, competition, badges) in MDM. The Client application was implemented in Windows platform. During the project the research group found that many parents would also like to regulate the expense of the kid with mobile device. vCoin was adopted as virtual currency that should be used in family. In our concept it is only used to define reward after accomplishing a task but it could be extended to online transaction via mobile device thus help master of group to regulate the family expense in mobile transaction. The project went well from the early phase till the end. The team efforts were concentrated to reach the requirement also the possible areas [Appendices B] of improvement regarding the application was discussed during the project.

8.3 Discussion

Implementation of the client application was the phase which allows the research team to demonstrate the findings to people outside the project. Numerous issues arose during that phase including bugs and errors and most of them appeared without meaningful information from Visual studio 2013 [Appendix A]. In some case, it took days or weeks to solve the issue. In fact, the documentation about the Windows phone 8.1 platform and mainly related to the integration of Microsoft Azure api is not popular in contrary to Android platform. In some cases, emails were sent to the Microsoft research center for more information. Excluding the bugs and errors, the time restriction did not allow the team for the organization of technical tests to evaluate the client application regarding:

- The Response time of a request sent to Microsoft Azure server through Microsoft Azure mobileService.
- The Fidelity of the response regarding a data saved into the Microsoft Azure database and the same data into the SQLite database.
- The evaluation of the usability of the application and the evaluation of the user experience of participants with a working prototype.

Another factor that impacted on the implementation is that, Microsoft api are closed [Appendix B] to external developers for certain functionalities i.e., a developer is not allowed to retrieve a list of software installed into a Windows device. The restrictions faced did not stop the team to satisfy the requirements fixed at the beginning of the project. In fact, the team implemented the main ideas developed in the design phase. The design and implementation of those ideas were possible due to the education level and the expertise of the team members and participants (both internal and external) of the project i.e., the expertise and the devotion of the research teams motived and energized me as thesis worker to familiarize with Windows 8.1 mobile platform of development within a few weeks. During the research approximately thirty-two meetings and working sessions were held. The working sessions had the main target to solve issue related to the implementation and the user interface design. As experienced developer, I could say that except the uncommon bugs and the difficulties of integrating external development tools such as SQLite, the Windows phone 8.1 development platform is easy to learn and nice user interface elements could be inherited from the libraries. The implementation of Microsoft Azure mobileservice is important for the demonstration i.e., without working mobileservice the exchanges of information between Windows phone 8.1 devices through the client application is not possible but the study of Microsoft Azure (cloud) started late in the project. If I had to do something different from what I have done during this study, I would have started researching on Microsoft Azure (cloud) earlier perhaps at the same time as the interviews phase. In fact, many interviews meetings were cancelled or postponed due to the difficulties of arranging interviews with all the families' members present at the same time. The sessions were cancelled or postponed and we could not progress in the design phase rather we could have done further research on Azure mobileservice while waiting for interview. In other hands, the feedbacks collected during interviews(five) were really fruitful and one of the findings were that family members (parents) wanted to regulate theirs kids daily activities of theirs kids in terms of usage of mobile devices. At the same time, kids were motivated to help parents in terms of mobile devices installation and configuration. The team found that a novelty has to be introduced in families. The family currency, which is called vCoin (virtual Currency) is created to materialize rewards i.e., vCoin earned after performing a task could be used to make the online purchases via mobile device. A further implementation of the vCoin which could be converted in real currency such as euro (€) or dollar ($) to perform online transactions will be important for the adoption of the concept and it will add more value for MDM. At the moment, vCoin is only defined as free time for kid to play video game or to be used for instant messaging application.

In comparison with existing MDM solutions such as Airwatch, Globo, which are already in used in companies, and are targeted to the companies' needs to secure their important data, the concept people centric MDM is more human-centered in it conception and his design. Family members using the concept are free than employees using MDM. Family members are motivated to adopt and used the concept but the employees are provided with mobile devices where MDM application has been already installed and there is no need to motivate them to adopt the concept but they have to accept it. The interviews shows that MDM solutions are still unknown by the mass. In fact, most of the external participants of the project did not know about MDM but they all approved the ideas developed for families with the main condition that they should not lose their privacy when using the client application and they could be free to retire from a MDM group.

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APPENDIX A: UNCOMMON ERRORS FROM VISUAL STUDIO 2013

During the implementation of our project with VISUAL STUDIO 2013, we faced a list of uncommon errors with limited information related to debugging and it literally slow down our work.

Error 1: this error happens sometime when we would like to compile our application. The solution here was to go in Windows 8.

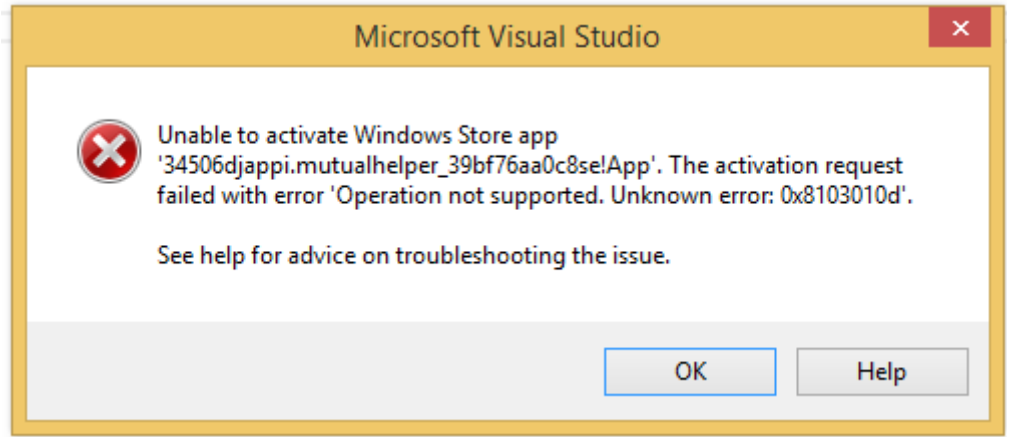

***Figure A1**: Unable to activate Windows store application*

Error 2: the below error happens when trying to manipulate SQLite

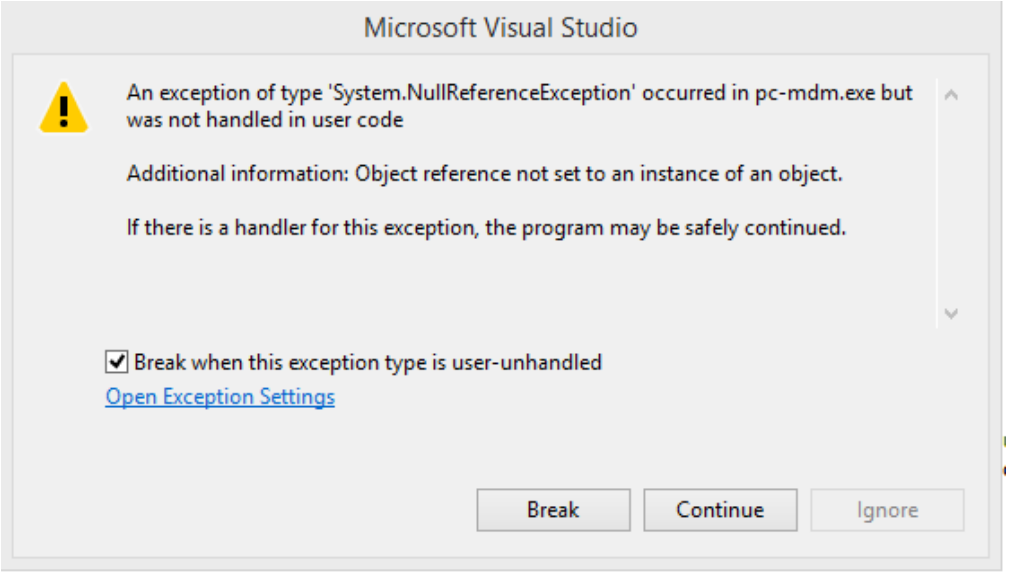

***Figure A2**: 'System.NullReferenceException'*

Error 3: The below error was common when starting to use Azure MobileService

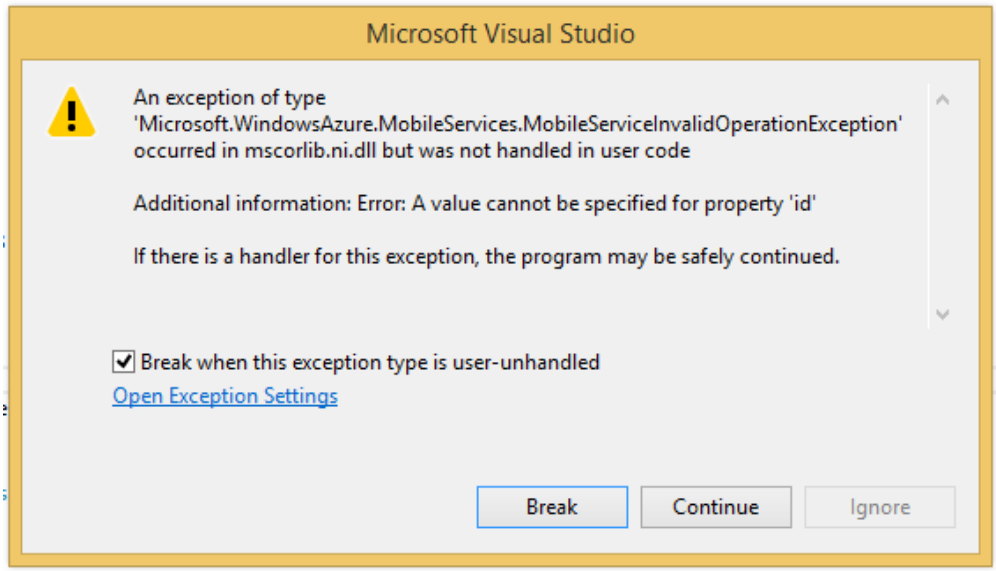

***Figure A3**: Azure MobileService exception*

Error4: The below error happened when trying to update .Net mobile service code generated by Microsoft Azure.

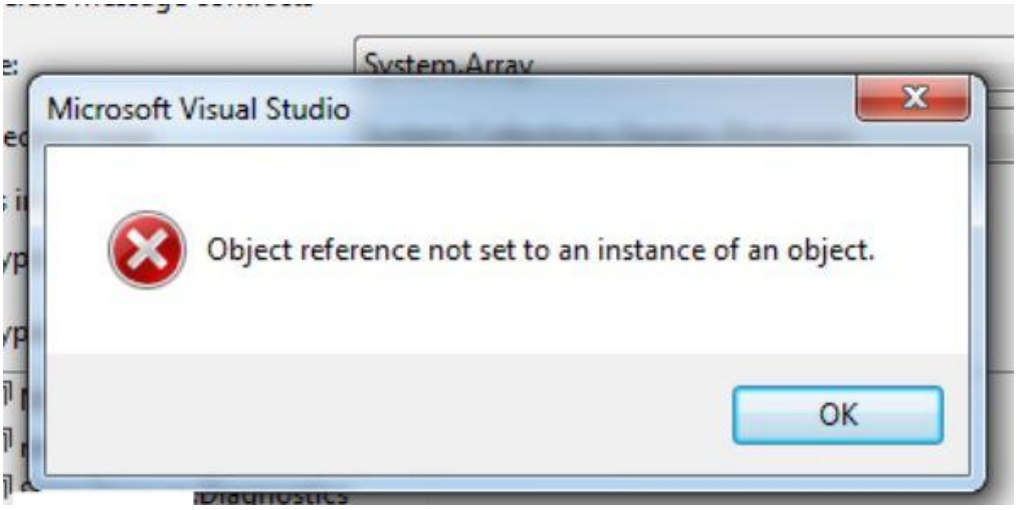

***Figure A4**: Object reference errors*

APPENDIX B: PENDING ISSUES

In the table below, we will define the list of pending issues that could have been further implemented in the scope of this project.

Issues	Reasons
Usability test with users to evaluate the client application	Time restrictions
Automated tests to test the quality of code and the functionalities	Time restrictions
Scalability of the user interface so that the application will be compatible with different screen size.	Require further research
Uploading pictures taken from mobile devices into Azure server.	Require further research
Thoroughly define vCoin (virtual coin) usage.	Require further research
Integration of Bing map functionalities into the application	Require further research
Inviting group members to join the group by email	Time restrictions
Contact list are not retrieved from Windows phone	This api is closed for Windows phone device
It is not possible to define a list of software available for an mdm group.	This api is closed for Windows phone device
It is not possible to restrict a mobile device to install a specified software application	This api is closed for Windows phone device
Retrieving the time spent using an application has not been implemented.	Require further research
Switch a mobile device off or silent mode	This api is closed for Windows phone device

Table B1: *List of pending issues*