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Title:

Personalized and ubiquitous learning system for healthcare support

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Summary

Abstract

The health care is considered one of the most important fields in our world, because people get ill, accidents and emergencies do arise and the hospitals are needed to diagnose, treat and manage different type of ailments and diseases. And as it is knows, improving the health care system is considered as one of the biggest and important things to do and the most challenging one. Providing such a new technologies, researches and techniques will definitely lead to a better system which will increase the performance and the impact of every part of it. As the health care domain advances, new technologies and techniques are used, new surgical procedure are created, new medicines are invented and even new diseases and ailments are discovered, thus it is necessary and obligated that our hospitals and our doctors and every single part of the health care system to stay up to date to those changes, to keep learning about them, to enrich their knowledge about them in order to reach a better performances and impacts and for sure to reach the maximum level of professionalism.

In order to fulfill this goal, we decided to create a learning system that relays on Ubiquitous learning paradigm and achieve what is mentioned earlier.

Les soins de santé sont considérés comme l'un des domaines les plus importants de notre monde, car les gens tombent malades, des accidents et des urgences se produisent et les hôpitaux sont nécessaires pour diagnostiquer, traiter et gérer différents types de maladies. Et comme on le sait, l'amélioration du système de soins de santé est considérée comme l'une des choses les plus importantes et les plus importantes à faire. Fournir de telles nouvelles technologies, recherches et techniques conduira certainement à un meilleur système qui augmentera la performance l'impact de chaque partie de celui-ci. Au fur et à mesure que le domaine des soins de santé progresse, de nouvelles technologies et techniques sont utilisées, de nouvelles procédures chirurgicales sont créées, de nouveaux médicaments sont inventés et même de nouvelles maladies et maladies sont découvertes, il est nécessaire et obligatoire que nos hôpitaux et nos médecins le système de santé doit rester au courant de ces changements, continuer à les connaître, enrichir leurs connaissances à leur sujet afin d'atteindre de meilleures performances et impacts et d'atteindre le plus haut niveau de professionnalisme.

Afin de réaliser cet objectif, nous avons décidé de créer un système d'apprentissage qui se base sur un paradigme d'apprentissage omniprésent(ubiquitaire) et réalise ce qui est mentionné plus haut.

Introduction

At the beginning of the 21st Century, our society world knows several new features, characteristics and needs such as: rapid rate of technological and social change rapid lifestyle and the people are occupied the most time. These technological advancements allow fast communications and information processing that support new social patterns. Therefore, the researchers and communities have to take into account the new interest and preferences, work patterns, and opportunity.

According to the Global Digital report, almost two-thirds of the world's population currently has a mobile phone, and more than half of this uses smartphones; in addition, over half of the world's web traffic currently comes from mobile phones [9]. So, we are experiencing the huge spread of the mobile devices (smartphones, tablets ... etc) around the world (low-cost of mobile phone). Also the spread of portable information and communications technology (ICT) with the relatively recent advent of small, portable mobile devices that provide telephone, Internet, and data storage, mobile telephony, removable memory chips, diaries, email, Web, basic word processing and spreadsheets, and data input, storage, and transfer.

The new social structure is deeply influenced by the mobile information and communication technologies. In the domain of Learning, the researchers have exploited the new technologies: Mobile technology, wireless networks (WiFi access in all public sectors schools and companies ...etc), information and communication technology (ICT) as a mean to improve deeply our ways of communication and learning. These technologies are the key to strengthening and facilitating learning and teaching in the 21st century. As a result, this emerging technology and mobile devices reveal a new way of learning known as Mobile learning (M-Learning). In M-learning environments, the learning process becomes more sophisticated, faster and efficient with a minimum of problems: gain of time, economy of transport costs and accommodation, always available, no specific schedule of learning, flexibility, interactivity... etc.

Using a mobile learning process, the learners are isolated and sometimes disoriented. In addition, the learners are generally heterogeneous so that they have different abilities, preferences, cultures, characteristics, intellectual capacities... etc. Thus, Mobile learning system should provide a set of features to be adaptable with new methods: ease of use, reuse and adaptation of the learning content, take into account the needs and levels of learners (backgrounds, objectives, levels of abilities... etc), personalized content, contextual representation of user's information.

Our goal is to create Ubiquitous learning system that enables users to learn within the hospital environment. Using different kinds of technologies such as wireless communications, sensors and even QR code scanning methods, this helps the user to get a reliable and an efficient way to learn and to expand his knowledge.

In the first chapter, we present general information about Ubiquitous Computing, Context awareness and Ubiquitous learning, in the second chapter we present the mobile operating system where our system is functional(Android) and the related works. In the third chapter we present general and detailed architecture of our system and both sequence and class diagrams, In the last chapter we present our system implementation and its different kinds of functionalities.

Chapter I: Ubiquitous Learning

I.1 Introduction

The need to disseminate education efficiently imposed that classrooms should no longer be confined within four walls. So distance learning came into being. Then as technology evolved, lessons were not only delivered to mailboxes but also reached learners on their computers. Thus electronic learning developed. And now, because learners are no longer tethered to their desks (the rise of the remote and mobile workforce), learning is being delivered to their hand-held devices where they can consume it everywhere, every when.

I.2 E-learning, M-learning and A-learning

I.2.1 Meaning of Electronic-learning

I.2.1.1 Definition

E-Learning is learning that is enabled or supported by the use of digital tools and content. It typically involves some form of interactivity, which may include online interaction between the learner and their teacher or peers[4].

E-Learning opportunities are usually accessed via the internet, though other technologies are also used in E-learning. E-Learning environments can be rich, interactive, dynamic and customized, connecting learners with an almost limitless wealth of information. New patterns of learning are starting to emerge as a result. We are seeing an increasing emphasis on information literacy, increased flexibility as to where, when and how people learn, and exploration of new ways in which learners can be empowered to structure and manage their own learning experiences[4].

I.2.1.2 Characteristics

The E-learning is considered as a more planned and organized system of learning in which it covers a large mass of information and provides a flexible learning which is more effective and efficient in an environment considered friendly and economic[4].

I.2.2 Meaning of Mobile-learning

I.2.2.1 Definition

Mobile learning is the ability to obtain or provide educational content on personal pocket devices such as PDAs (Personal Digital Assistants), smart phones and mobile phones. In other words, mobile learning decreases limitation of learning location through the mobility of portable device. M-learning is convenient in the sense that it is accessible from virtually anywhere, which provides access to all the different learning materials available. It is also collaborative, sharing is almost instantaneous among everyone using the same content, which leads to the reception of instant feedback and tips[4].

I.2.2.2 Characteristics[4]

- Permanency: The information remains unless the learners purposely remove it.

- Accessibility: The information is always available whenever the learners need to use it.

- Immediacy: The information can be retrieved immediately by the learners.

- Interactivity: The learners can interact with peers, teachers, and experts efficiently and effectively through different media.

I.2.3 Differentiating e-learning from m-learning

E-learning can be real-time or self-paced, also known as "synchronous" or "asynchronous" learning. Additionally, e-learning is considered to be "tethered" (connected to something) and presented in a formal and structured manner. In contrast, mobile learning is often self-paced, UN-tethered and informal in its presentation.[13] The following table shows the major differences between E-learning and M-learning:

E-learning	M-learning
lecture in classroom or internet labs	learning anywhere, anytime
e-mail to e-mail	instantaneous messaging
private location	no geographic boundaries
travel time to reach to internet site	no travel time with wireless internet connectivity

Table I.1: The major differences between E-learning and M-learning

Because mobile devices have the power to make learning even more widely available and accessible, mobile devices are considered by many to be a natural extension of e-learning[13].

I.2.4 Adaptive learning

The concept is that an individualized method of teaching will help students to learn at a faster pace, more effectively, and with greater understanding. Some of the elements of adaptive learning include: monitoring student activity, interpreting the results, understanding students' requirements and preferences, and using the newly gained information to facilitate the learning process[8].

Adaptive learning can offer great advantages in providing students with specific and personalized knowledge as and when required. It is believed that the development of such systems that allow for the integration of the concepts and theories of education and information technology can "provide or support effective learning experiences for a wide range of learners across a broad spectrum of knowledge domains"[8].

I.3 Ubiquitous Computing, Ubiquitous Learning and context-awareness

I.3.1 Ubiquitous Computing

The concept of ubiquitous computing was originated by Mark Weiser (1991), who said that: "The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it".[1]

I.3.1.1 Definition

Ubiquitous computing is the term given to the third era of modern computing. The first era was defined by the mainframe computer, a single large time-shared computer owned by an organization and used by many people at the same time. Second, came the era of the PC (Personal Computer) which is primarily owned by one person, and dedicated to them, The third era, Ubiquitous Computing, representative of the present time, is characterized by the explosion of the small networked portable computer products in the form of smart phones, PDAs (Personal digital assistant), and embedded computers built into many of our own devices.[1]

Ubiquitous computing is considered as a concept in software engineering and computer science where computing is made to appear anytime and everywhere (pervasive). In contrast to desktop computing, ubiquitous computing can occur using any device, in any location, and in any format. A user interacts with the computer, which can exist in many different forms, including laptop computers, tablets and terminals in everyday objects such as a refrigerator or a pair of glasses.[1]
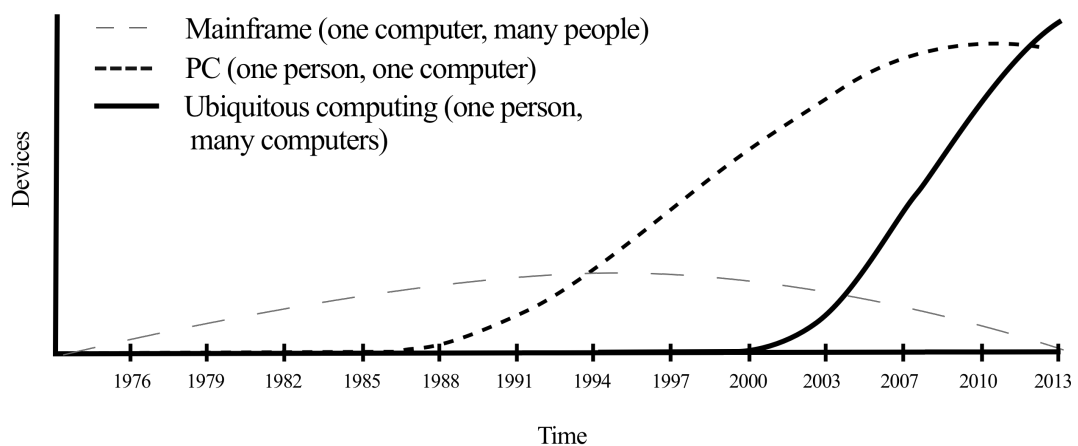

Figure I.1: graph conceptually portraying the three era of modern computing

I.3.1.2 The main aim of Ubiquitous Computing

create an environment in which the connectivity of devices is embedded in such a way that the connectivity is unobtrusive and always available. Weiser's vision involves introducing computers into people's lives, that is, putting computers into a daily living environment and instead of representing the everyday living environment in the computer. When computing becomes ubiquitous, applied to learning, learners may acquire computational learning aid ubiquitously and depending on the actual situation of the learner, i.e. the learner does not then need to suffer a cognitive load (even if small) to switch between a task at hand and the need to learn something about the task itself.[1]

I.3.1.3 What Ubiquitous Computing Isn't?

Ubiquitous computing is roughly the opposite of virtual reality. Where virtual reality puts people inside a computer-generated world, ubiquitous computing forces the computer to live out here in the world with people. Ubiquitous computing is a very difficult integration of human factors, computer science, engineering, and social sciences.[1]

I.3.1.4   Ubiquitous Computing notions

- The "authorized access to anytime-anywhere-any device-any network-any data".

- "Invisible" resources.

- It is computation that's freely available everywhere.

- Machines sense user's presence and act accordingly.

I.3.1.5   Ubiquitous Computing technologies[1]

- Computing ('devices') - used devices are likely to assume many different forms and sizes, from hand held units (similar to mobile phones) to near-visible devices set into 'everyday' objects (like furniture and clothing).

- Communications ('Connectivity') - This can be achieved via both wired (such as Broadband (ADSL) or Ethernet) and wireless networking technologies (such as Wifi and Bluetooth).

- User interfaces - new user interfaces are being developed that will be capable of sensing and supplying more information about users, and the broader environment, to the computer for processing.

I.3.1.6   Ubiquitous Computing Functional Layers[1]

1-task management layer :

- To monitor user task, context and index.

- To map user's task to need for the services in the environment.

- To manage complex dependencies.

2-environment management layer :

- To monitor a resource and its capabilities.

- To map service need, user level states of specific capabilities.

3-environment layer :

- To monitor a relevant resource .

- To manage reliability of the resources.

I.3.1.7   Key features of ubiquitous computing[1]

- Consideration of the human factor and placing of the paradigm in a human, rather than computing environment.

- Use of inexpensive processors, there by reducing memory and storage requirements.

- Capturing of real-time attributes.

- Totally connected and constantly available computing devices.

- Focus on many-to-many relationships, instead of one-to-one, many-to-one or one-to-many in the environment, along with the idea of technology, which is constantly present.
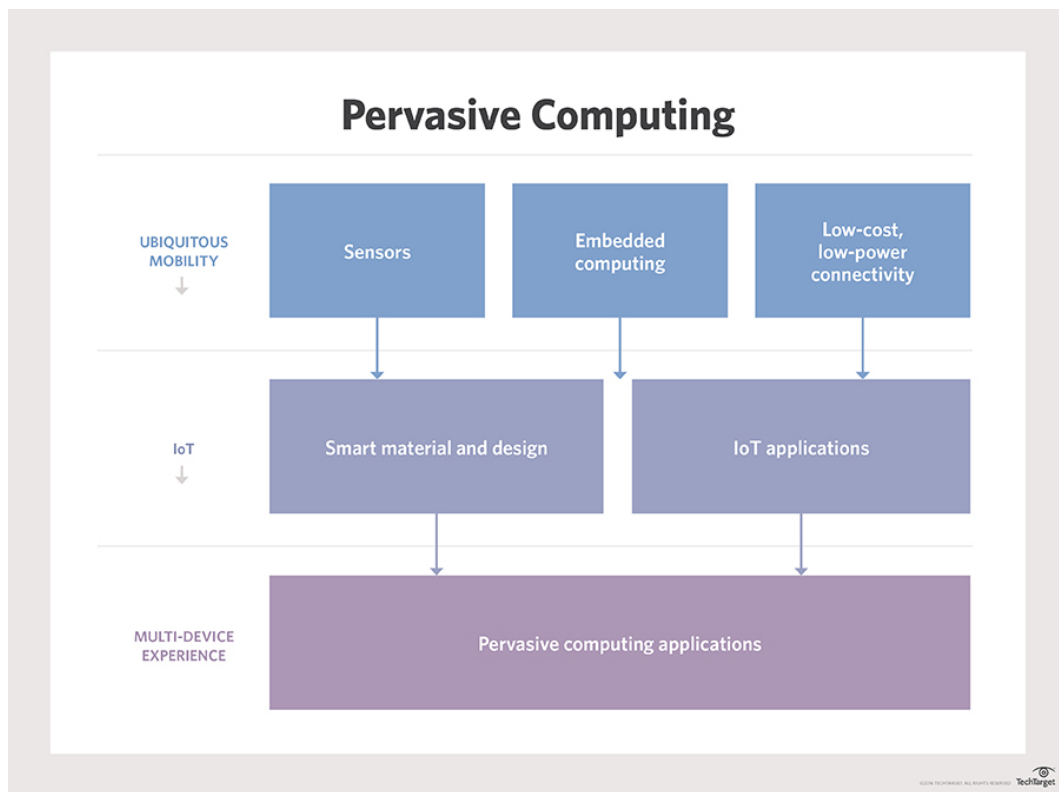
I.3.1.8   General layers of ubiquitous computing

Figure I.2: graph conceptually portraying the three era of modern computing

I.3.2 Context awareness

I.3.2.1   Definition

Dey and Abowd definition was: "Context is any information that can be used to characterize the situation of an entity. An entity is a person, place, or object that is considered relevant to the interaction between a user and an application, including the user and applications themselves."[18]

Context awareness in Computer Science: In computer science context awareness refers to the idea that computers can both sense, and react based on their environment. Devices may have information about the circumstances under which they are able to operate and based on rules, or an intelligent stimulus, react accordingly.[18]

Context awareness in Ubiquitous Computing: It's a property of mobile devices that is defined complementary to location awareness. Whereas location may determine how certain processes around a contributing device operate, context may be applied more flexibly with mobile users, especially with users of smart phones. Context awareness originated as a term from ubiquitous computing or as so-called pervasive computing which sought to deal with linking changes in the environment with computer systems, which are otherwise static.[18]

I.3.2.2   Qualities of context

Various categorizations of context have been proposed in the past. Dey and Abowd distinguish between the context types location, identity, activity and time. Kaltz et al. identified the categories user & role, process & task, location, time and device to cover a broad variety of mobile and web scenarios.[18]

I.3.2.3   Acquiring Computing Contexts

Computing contexts are normally collected by software routines. Most mainstream operating systems provide primitives for developers to get related run time information about the device hardware, and reduce the work involved in development.

In order to interact completely with the environment (Context) it is preferable to use many technologies such as (Temperature sensor, Heat sensor, Magnetism sensor ...) to acquire more information about the last one, acquiring data or information will help understanding the context of the studied subject and use a different view aspects, thus, this will lead to gain knowledge about how to act towards both the studied subject and its contexts.[18]

Type of Sensor	Context Sensed	Sensor Examples
Temperature Sensor	Temperature	Thermometer, Thermocouple, Thermistor
Heat Sensor	Heat	Bolometer,Calorimeter
Magnetism Sensor	Orientation	Magnetic Compass
Pressure Sensor	Altitude,Speed	Altimeter,Barometer
Mechanical Sensor	Acceleration,Position	Acceleration and Position Sensor

Table I.2: Type of sensors used in a Context-aware system

I.3.2.4   Architecture of a context-aware system

The following figure shows the abstract layered architecture of a context-aware system[1]:
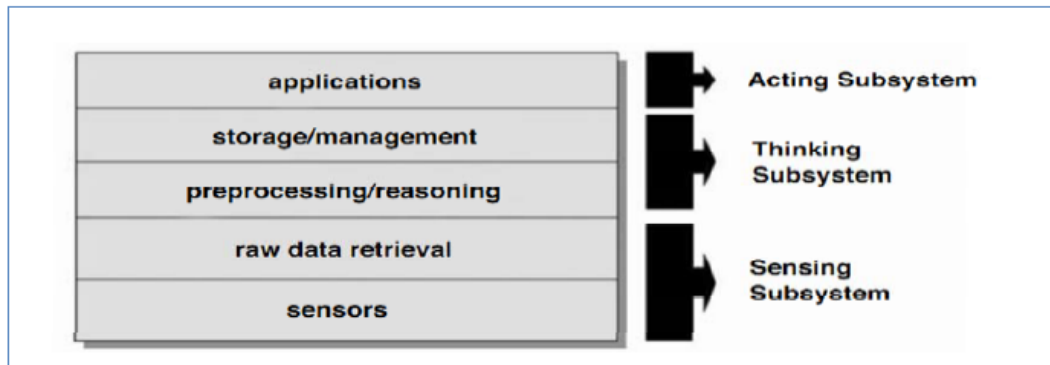

Figure I.3: graph conceptually portraying the three era of modern computing

I.3.2.5   The term of use of Context awareness (Applications)[18]

1. Application in situational or social awareness: Context awareness has been applied to the area of computer-supported cooperative work (CSCW) to help individuals work and collaborate more efficiently with each other.

2. Application in health care: Modern integrated voice and data communications equips the hospital staff with smart phones to communicate vocally with each other, but preferably to look up the next task to be executed and to capture the next report to be noted.

3. Application in industrial production: Context-aware mobile agents are a well suited host implementing newer context-aware applications. Modern integrated (voice and) data communications equips the workshop or production line staff with smart phones to communicate data with production control for feedback.

4. Application in mobile multimedia devices: Museums and archaeological sites sometimes provide multimedia mobile devices as an alternative to the conventional audio guide. A context aware device will use the location, current user interactions and the graph of connected objects to dynamically tailor the information presented to the user.

5. Application in Ubiquitous learning: can be considered any Application that uses its location and its surrounding environment or other systems (systems that use the environment as its first source to operate and act) to navigate through and to provide different contents for the sake of learning to the user using different kind of technologies such as (Tags, RFIDs and QR Codes), for example (Based on your location in a zoo , the application provides a map of locations to different kind of animals where you can find QR code that helps you obtain full information about them).

I.3.3 Ubiquitous Learning

I.3.3.1 Definition

Ubiquitous learning or u-learning is a new learning paradigm. It is said to be an expansion of previous learning paradigms as we move from conventional learning to electronic-learning (E-learning) and from e-learning to mobile learning (M-learning) now we are shifting to u-learning. According Lyytines & yoo. "The evolution of ubiquitous computing has been accelerated by the improvement of wireless, telecommunication capabilities, open network, continued increases in computing power, improved battery technology and the emergence of flexible software architectures."[19]

I.3.3.2 The Proposed Definition of U-learning

The terms "anywhere and anytime learning" and "learning with ubiquitous computing technology" raise confusion between readers about the ubiquitous learning. Thus, better if we propose the following definition of u-learning. U-learning is a learning paradigm which takes place in a ubiquitous computing environment that enables learning the right thing at the right place and time in the right way.[19]

I.3.3.3 Ubiquitous Learning Characteristics

We summarize the characteristics that have been put forward by the researchers and discovered, we propose five characteristics from the combination of the researchers ideas and take into account the major differences, the characteristics are[19]:

- Permanency: The information remains unless the learners purposely remove it.

- Accessibility: The information is always available whenever the learners need to use it.

- Immediacy: The information can be retrieved immediately by the learners.

- Interactivity: The learners can interact with peers, teachers, and experts efficiently and effectively through different media.

- Context-awareness: The environment can adapt to the learners real situation to provide adequate information for the learners.

- Adaptability: Getting the right information at the right place for the right student.

Permanency, accessibility, immediacy and interactivity are considered as common characteristics of u-learning. But, we also agree that context-awareness is the major characteristic that distinguishes u-learning from other paradigms such as (M.L).

In a ubiquitous learning environment, it is difficult for a learner to know that the other learner has the same knowledge even that though they are at the same location. In this case, the learner needs to be aware of the other learners' interests that match his interest. Therefore, it is obvious that adaptability, situating of instructional activities and seamless learning characteristics are part of context - awareness characteristic.[19]

I.3.3.4 Why Do We Need Ubiquitous Learning?

U-learning is a paradigm that allows people search and navigate for the sake of learning, but with out limitations (unlike the E-learning and the M-learning), and with a lot of help where U-learning extracts its capabilities and its contents and reactions from the context of the learner which is more efficient, because the usage of of the learner's environment nature and his surroundings will play a major role in his learning journey since the context-awareness will make it easy and clear (the usage of common things in his environment and his surroundings for his benefits).[17]

I.3.3.5   Comparison of Learning Paradigms

1-Comparison based on some criteria[19]:

Criteria	U-learning	M-learning	E-learning
Concept	learn the right thing at the right place and time in the right way	learn at the right place and time	learn at the right time
Permanency	Learners can never lose their work	Learners may lose their work. Changes in learning devices or learning in moving will interrupt learning activities.	Learners can lose their work.
Accessibility	System access via ubiquitous computing technologies	System access via wireless networks.	System access via computer network.
Immediacy	Learners get information immediately	Learners get information immediately in fixed environments with specified mobile learning devices.	Learners cannot get information immediately.
Interactivity	Learners' interaction with peers, teachers, and experts effectively through the interfaces of u-learning systems.	Learners can interact with peers, teachers, and experts in specified learning environment.	Learners' interaction is limited.
Context-awareness	The system can understand the learner's environment via database and sensing the learner's location, personal and environmental situations.	The system understands the learner's situation by accessing database.	The system cannot sense the learner's environment.

Table I.3: Comparison based on different criteria

Synthesis:
Unlike the E-learning and the M-learning, the U-learning:

1. Has the perfect learning method based on the location and the time of the user.

2. Has a great permanency of data.

3. Has its own computing technology (Ubiquitous Computing).

4. Is an immediate information provider.

5. Has a large interactivity between its (learners, teachers, peers ...).

6. Is aware of the learner context in order to provide the right content.

2-Comparison based on theoretical and practical variables[19]:

Theoretical and practical variables	Electronic-learning	Mobile-learning	Ubiquitous learning
Major LT tools	PC, Notebooks and internet-supported devices.	Mobile devices (eg, PDA, cell phone, etc) with wireless communications.	Sensor technologies (eg, RFID readers, tags and GPS) with mobile devices and wireless communications.
Learning Scenarios	Passive online learning context.	Real world and passive online learning context.	Real world and more active online learning context.
Applicable academic and industrial fields	Almost every field and discipline	Learning declarative knowledge, such as the observations and the classification of set of target objects	Learning procedural knowledge, such as learning to complete complex experiments
Locus of control	Self-direct user	Active user	Active user or sensor-motivated user
Major sources of information	Wired server	Wireless server and authentic objects	Wireless servers and authentic objects with embedded sensors

Table I.4: Comparison based on different criteria

I.3.3.6   Ubiquitous learning application

The next figure depicts the scenario of u-learning. For instance, when a student gets into the lab or stands in front of an instrument, the devices will sense and detect the situation of the student and transfer the information to the server. All the related rules and procedures will be displayed to the student based on the information received.[19] Currently, ubiquitous learning is carried out in various educational settings
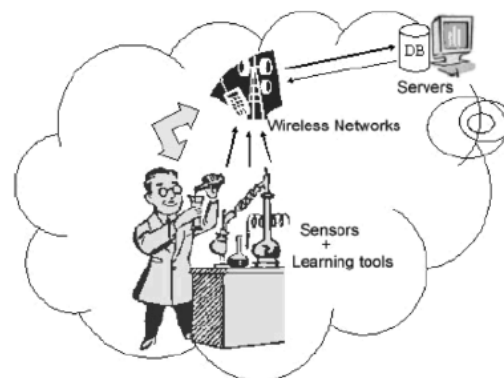

Figure I.4: The concept of Ubiquitous learning

and investigated in different directions such as ubiquitous pedagogy, classroom-centered u-learning mode, specific curriculum centered u-learning mode, faculty education for the implementation of u-learning, development standards of u-learning resources and development of u-learning instructional management system.[14]

I.3.3.7   Ubiquitous Learning Environment

A ubiquitous learning environment is any setting in which students can become totally immersed in the learning process. To define:

Ubiquitous = pervasive, omnipresent, ever present, everywhere Learning = educational, instructive, didactic, pedagogical Environment = surroundings, setting, situation, atmosphere So, a ubiquitous learning environment (ULE) is a situation or setting of pervasive (or omnipresent) education (or learning). Education is happening all around the student but the student may not even be conscious of the learning process. Source data is present in the embedded objects and students do not have to DO anything in order to learn. They just have to be there.[8] The following figure shows the existence of the students within the U-space:
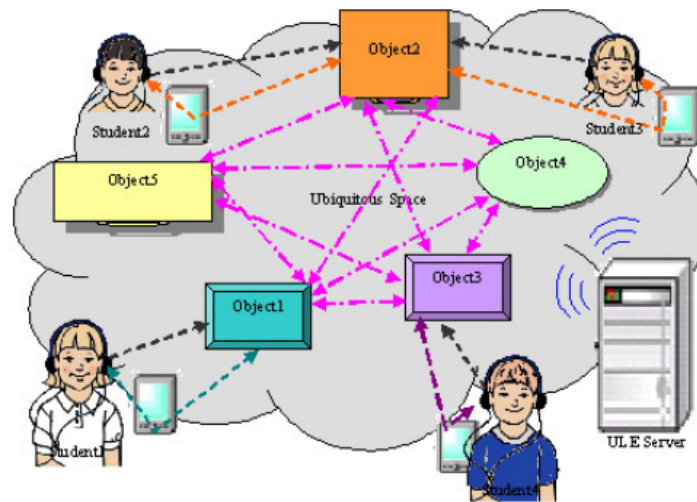

Figure I.5: The concept of Ubiquitous learning

In the up-figure: if Student1 is interacting with Object1, all devices that are part of the network are aware of this interaction. However, for each student the relationship is unique and their interaction is uninterrupted by the interaction of others. This also allows each student to progress through the learning experience at their own space.[8]

The application of learning theories is an important consideration. The usage of learning theories in educational design helps to create a relationship between the information, the learner, and the environment. And when this relationship does occur there is a greater chance that the student will retain the information within their own knowledge base. The information has more relevance and therefore more meaning for the learner if it is taken from his/her knowledge base rather than just being said as a true fact.[8]

I.3.3.8   The Ubiquitous Learning Environment Model

The two main factors of designing a ULE model are: 1- The model itself which resembles an interactive learning gallery and uses a wireless network with both Bluetooth and wifi technologies. 2- The inclusion of a pedagogical information which is based on constructivist theory, allowing students to create knowledge from what they see, hear, read and perceive. Students using the ULE will intuitively interpret their surroundings and construct their own knowledge.[8]

The ULE model is not unlike the interactive guides currently being produced and implemented for example (in large museums). Electronic museum guides provide an information service to aid museum culture and tend to mimic or replace human guides.[8]

However, this model is designed for use in the education sector rather than entertainment or enrichment. Also, the source information is meant to be both adaptable and flexible, allowing updates to be applied through the network's database. In this way curriculum changes can be easily achieved.[8]

I.3.3.9   Components of the ULE

1. Microprocessors with memory will be embedded in every object/device. The information each microprocessor will hold will be about the object. When a student approaches, the sensor detects their presence and will start relaying information to the student's PDA.[8]

2. ULE Server Module will include the Server, the Educational Strategies Unit and a Database:

   - The ULE server manages the network resources.
   - The Educational Strategies Unit allows for the application of strategies to reinforce and aid student understanding through interaction and feedback.
   - Database stores all the data about the 'objects/devices', the users and the interactions that occur.

3. Wireless technology this will be in the form of Bluetooth and WiFi.

4. Sensors will be used to detect any changes in surroundings. These will be placed adjacent to the objects/devices and will be used to recognize the presence of students. The sensors used will include proximity, to detect movement, and light, to detect changes in light intensity

I.3.3.10   The ubiquitous learning centre

We can say that the U-learning centre is considered as the space that contains the different parts of an interaction such as the learner with his/her device of learning (Mobile devices, PDAs) and the objects to interact with. The ULE Server Module tracks and locates each student within the u-space by the use of sensors. When a student approaches an object, sensors wirelessly access the intranet and ULE Server Module and transmit information about the object. The data is then transmitted from one of the objects in the Ubiquitous Learning Centre to the student's hand held device.[8]

1. Seamless interaction between learner and device:

   The next figure is an example or a scenario about the seamless interaction that happens between a student, a device and an object:
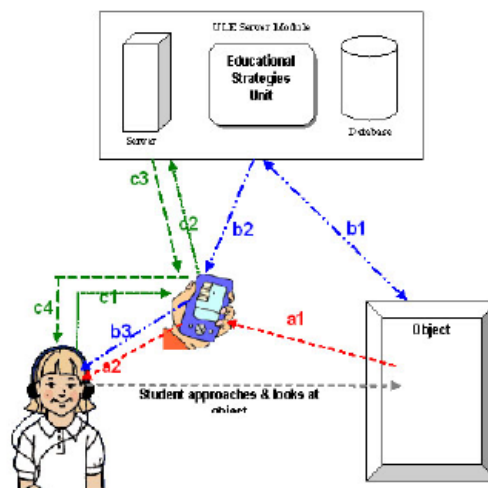

Figure I.6: Seamless interaction between student, device and object.

(a) Here the student approaches and observes the object. The sensors detect the student's presence and send data about the object to the student's Device (a1). The transferred date turns into a form of texts, images and sounds (a2). At the same time, the object will access the ULE Server Module (b1) and request information about the student.

(b) In order to know if the student understood the topic of the object, a discreet quiz is sent to the student's device then to the student (b2, b3). The student's responses are transmitted to the ULE server (c1, c2) and get analyzed by the educational strategies unit.

2. Communication between Objects/Devices:

The next figure illustrates the communication between the devices and the objects or the objects between themselves:
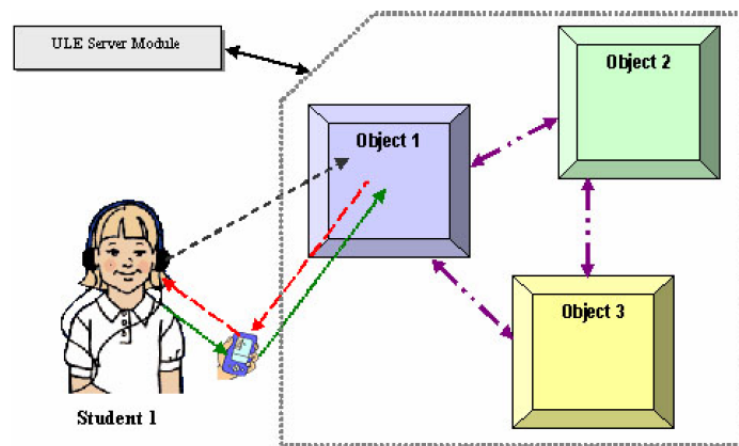

Figure I.7: Seamless interaction between student, device and object.

The student, Student1, approaches and observes Object1. A number of points relevant to Object1 are conveyed, possibly in the form of text, images or sound delivered to the student's hand held device. When the system receives a response from Student1, it can review the information and unobtrusively 'test' the student's understanding. Once this is analyzed, Object1 relays this information to the other objects, in this case, Object2 and Object3, within the u-space. This allows the ULE Server Module and the objects to download relevant information to the student. The sequence would be as below[8]:

(a) Object1 is approached by Student1

(b) Information are sent to Student1

(c) Object1 analyses the student's responses and hence understanding of the topic (with help from the ULE server module)

(d) This information is relayed to all other objects within the u-space, for example. ('Student1' understands 7/10 points on the topic).

This way the other objects will have much information about the student knowledge, and try to interact with him based on it.

I.3.3.11   Ubiquitous Learning Environment development

The development of a ubiquitous learning environment combines the advantages of an adaptive learning environment with the benefits of ubiquitous computing and the flexibility of mobile devices. Students have the freedom to learn within a learning environment which offers adaptability to their individual needs and learning styles, as well as the flexibility of pervasive and unobtrusive computer systems.[8]

I.3.3.12   Technologies used in U-learning Environments

What makes the U-learning unique and special is the usage of different kind of technologies in order to provide a simple and efficient way of learning and interaction between the learner and his/her environment. Thus, many technologies were used in other domains are now integrated in both the learner's device and his/her surrounding objects.[8] The most used technologies are 2D Bar Codes such as (QR Codes), RFIDs and NFC.

1. 2D Bar Code technologies in Ubiquitous learning:

   A 2D (two-dimensional) barcode is a graphical image that stores information both horizontally – as one-dimensional bar codes do – and vertically. As a result of that construction, 2D codes can store up to 7,089 characters, significantly greater storage than is possible with the 20-character capacity of a uni dimensional barcode.

   2D barcodes are also known as quick response codes because they enable fast data access. 2D barcodes are often used in conjunction with smart phones. The user simply photographs a 2D barcode with the camera on a phone equipped with a barcode reader. The reader interprets the encoded URL, which directs the browser to the relevant information on a web site or display it on the user's main application. This capability has made 2D barcodes useful in a lot of domains such as mobile learning, mobile marketing, etc. One of the most used 2D barcodes in the world is the QR Code (Quick Response Code).

   The next figure illustrates the decoding of a QR Code using a barcode reader on a learner's device:

   Figure I.8: The decoding of a QR Code using a barcode reader

   The barcode reader transfers the QR code into a clear content for the user such as (Texts, Images, Sounds and even videos). What actually happened is that after the barcode reader has analyzed the QR Code, it invoked a function that download corresponding teaching materials according to that internal information of the QR Code.

   The next figure illustrates the Based location search function of the QR Codes:

   Figure I.9: The Based location search function of the QR Codes

   Since we are working on the Ubiquitous learning environment, the main goal is still finding the Ubiquity in every single aspect of our work. The design of tags searching function was based on the foundation of u-learning. It was designed to provide a location-aware learning environment for students.[8]

   The function has access to the position of other tags around students in their learning circumstances. Thus, all the data about the tags positioning are integrated into an electronic map to provide more prompt information for students.

The tags searching function enables students to discover 2D barcode tags that are in their proximity (It displays the electronic map, which locates proximity to tags in the map area on the screen of mobile devices). It will help them gain access to more learning materials which most of the time matches their current learning tags.[8]

Through the local-aware application, students can fully integrate themselves into the u-learning environment.

2. RFID technologies in Ubiquitous learning

Radio frequency identification (RFID) tag is a re-writable IC memory with non-contact communication facility. RFID uses electromagnetic fields to automatically identify and track tags attached to objects.

The tags contain electronically stored information. Passive tags collect energy from a nearby RFID reader's interrogating radio waves. Active tags have a local power source (such as a battery) and may operate hundreds of meters from the RFID reader. Unlike a barcode, the tag need not be within the line of sight of the reader, so it may be embedded in the tracked object. RFID is one method for Automatic Identification and Data Capture (AIDC).[8]

The next figure shows the different kind of components used in the RFID technology:
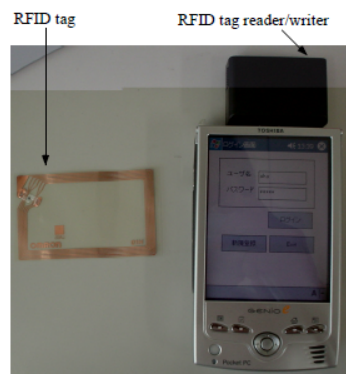

Figure I.10: Components used in the RFID technology

There are two organizations for promoting this technology:

First, the Auto-ID Center is "designing, building, testing and deploying a global infrastructure - a layer on top of the Internet - that will make it possible for computers to identify any object anywhere in the world instantly. This network will not just provide the means to feed reliable, accurate, real-time information into existing business applications; it will usher into a whole new era of innovation and opportunity."[8]

Second, the Ubiquitous ID Center "aims to establish and spread core technology to automatically recognize "things", and eventually realize a ubiquitous computing environment.

Since the Ubiquitous computing plays the bigger part in the Ubiquitous learning, the usage of RFID technology is considered one the best solution to facilitate the learning phase for any learner. With the presence of the RFID tag reader in the learner's device and the presence of the RFID tags around him/her, the learner can get access to a lot of learning materials that could help him/her in many aspects.[8]

The general modules in a Ubiquitous learning environment that is based on RFID technology:

(a) Learner model: This module has the learner's profile such as name, age, gender, occupation, interests, etc, and the comprehensive level of each word or each expression about an object. The learner does the examination, and enters the comprehensive level. In addition to this explicit method, The system used detects learner's comprehension during the system use.

(b) Environmental model: This module has the data of objects, rooms and buildings, and the link between objects and expressions in the learning materials database.

(c) Educational model: This module manages words and expressions as learning materials. The teacher enters the fundamental expressions for each object. Then, both learners and teacher can add or modify them during system use.

(d) Communication tool: This tool provides the users with a chat tool, and stores their logs into a database.

(e) Tag reader/writer: This module reads the ID from a RFID tag attached to an object. Referring to the ID in the object database, the system obtains the name of the object and provides a learning material about it.

(f) User interface: This module provides learner different contents such as (learning materials, quiz, questions and answers).

3. NFC in Ubiquitous learning:

Near-field communication (NFC) is a set of communication protocols that enable two electronic devices, one of which is usually a portable device such as a smart phone, to establish communication by bringing them within 4 cm (1.6 in) of each other. NFC Ubiquitous learning Platform: The idea of a suggested NFC U-learning Platform is to apply NFC reader mode, P2P mode and wireless communications (Wi-Fi, Bluetooth) technologies to design a few innovative interactive teaching and learning functions for ubiquitous learning. The platform is consisted by four parts including identification, equipment, function, and application, the next Figure shows those four parts:
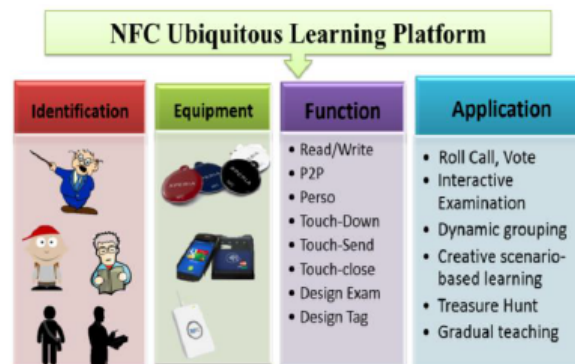

Figure I.11: NFC UL Platform

Several modules are designed to support the proposed NFC ubiquitous learning platform including NFC module, P2P module, UI module, file management module, Bluetooth connection module, read tag module, answer connection module, question modules and tag design modules. Those modules described as the next Table:

Module	Content
NFC reader module	Read the data from the NDEF format NFC tag or smart cards via JSR257 interface.
P2P module	Exchange information between NFC phones in P2P mode.
UI module	UI module is responsible for all the interactions to users through Android App
File management module	File management module is responsible for all Android App.
Bluetooth connection module	It construct a TCP communication channel between smart phone and computer.
Answer connection module	Get the Tag Id through read rand record the selection of student's answers.
Tag design module	Teacher can create customized tags by this module by writing the tag type, tag content, URL in NDEF[8]format

Table I.5: Comparison based on different criteria

NFC U-Learning model can largely enhance the interactive teaching activities which are not supported in most previous models. Teachers can design their own teaching materials with dynamic relationship connected to NFC tags by writing connection URL on them. Through NFC phones and interactive whiteboard, teachers can carry out interactive examinations more conveniently and can immediately review examinations as well. Student uses NFC phones to touch tags with gradual difficulty levels and obtains the spatiotemporal and personal sensitive learning contents.

I.3.3.13 Conclusion

The ubiquitous learning is an upcoming and a more promising paradigm for learning, with its different useful aspects, it helps the learner acquire new information that fits well based on their environment . The ubiquitous learning paradigm creates a whole interactive environment in which the learner gets to learn from the simplest things around him or even more. The wide technologies used within this paradigm makes it perfect to handle different situations and learners based on the availability.

Chapter II: Android & Related Works

II.1 Introduction

In this chapter, we present the different parts of the mobile operating system (Android) we are using for our learning system and also we present some of the related works such as (TANGO, MLSS and CCDS) that use the same learning paradigm as ours (Ubiquitous learning).

II.2 Android Operating system

II.2.1 Definition

Android is a software platform built for mobile devices, it is considered as a Linux Kernal-based operating system with different kinds of characteristics such as (application framworks, multimedia support and multiple telephone functionalities etc).

II.2.2 History

Android was founded in October 2003 by Andy Rubin, Rich Miner, Nick Sears and Chris white. It was intended to be an operating system for digital cameras until the founders decided to direct it to the mobile phones market[10].
After two years exactly, Google the giant company acquired Android and kept on its founders where they joined as part of acquisition. In November 2007, Google announced the creation of a new mobile operating system called "Android", it was baptized in Public Market Equivalent (startup specialized in the development of mobile applications)[10]. On November 5, 2007, the Open Handset Alliance, a consortium of technology companies including Google, device manufacturers such as HTC, Motorola and Samsung, wireless carriers such as Sprint and T-Mobile, and chipset makers such as Qualcomm and Texas Instruments, unveiled itself, with a goal to develop "the first truly open and comprehensive platform for mobile devices". The first commercially available smartphone running Android was the HTC Dream, also known as T-Mobile G1, announced on September 23, 2008[10].

Figure II.1: Android logo used in 2007-2014

II.2.3 Android Versions

Since the release of Android, Google made sure to develop it and maintain it and to provide annual major updates and newer versions of it in a seek for a better system features and functionalities. Until now there are 14 version of android and each of one of them has its minor updates. the next figure displays the available Android versions:
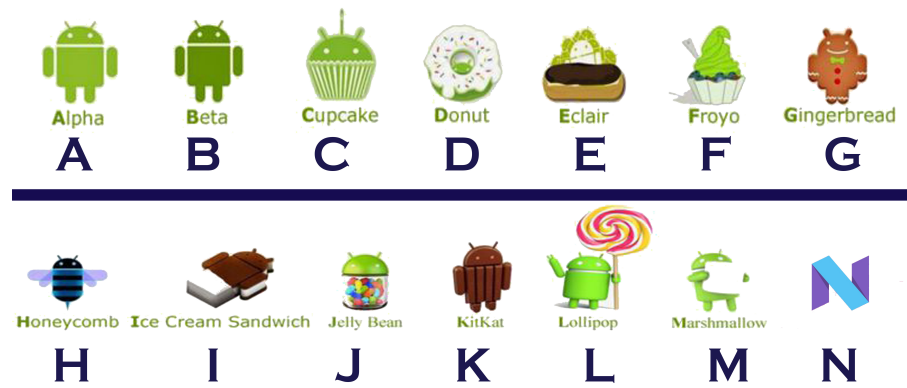
Figure II.2: Android Versions

In the next chart, we display the breakdowns of Android versions, based on devices accessing the Google Play Store in a seven-day period ending on December 11, 2017. Therefore, these statistics exclude devices running various Android forks that do not access the Google Play Store, such as Amazon's Fire tablets[16].
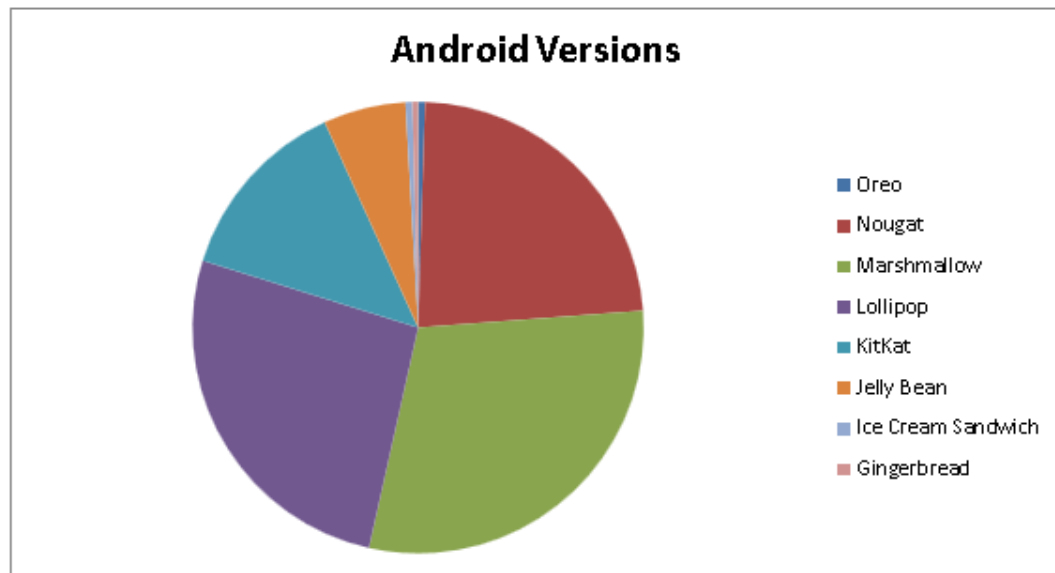

Figure II.3: Simple chart of Android versions breakdowns

II.2.4 Features

II.2.4.1   Interface

Android provides a User Interface that can be interacted with by swiping, tapping and pinching to manipulate what is shown on the screen. Most of the mobiles using Android have a different kinds of sensors such accelerometer that helps manipulate the screen orientation which improves user interaction with the device and helps providing a much flexible way of use[7].

II.2.4.2   Open source

In association with the OHA (Open Handset Alliance), Google made sure that Android will be an open source OS, it released its source code to the public. Android being an open source operating system was a huge benefit and a great factor for it to succeed and go beyond expectations where it gave the chance for powerful companies and individuals (using the Android Open Source Project (AOSP)) the ability to deliver desirable features and to develop and distribute their own modified versions of the

operating system which is something to be reckoned with, especially when it comes to compare it with the traditional, commercial approach to software development.[15]

II.2.4.3   Android Software Stack

Figure II.4: Android's architecture

The Android software stack is consisted of large set of features that makes it without any doubt a huge Operating system. It is consisted of 5 major Layers[6]:

1. **Linux Kernel**: this layer provides an interface to the hardware; manages Android memory, resources and processes. The Linux Kernel also provides an abstraction layer between the hardware and the rest of the stack.

2. **Libraries**: Above the Linux kernel Layer, there's Libraries layer that provides a wide array of libraries to help develop android application which is consisted of several basic C / C ++ libraries running (libc and surface manager), Webkit (considered as a browser engine) used for the integration of a web browser, SSL (Secure sockets layer) for the secure data transmission, Sqlite (native support of databases in mobile devices) and graphic libraries including SGL and OpenGL.

3. **Android Runtime**: this layer is consisted of core Java packages for a nearly-featured Java programming environment and The Dalvik Virtual machine, which employs services of the linux-based kernel to provide an environment to host Android applications.

4. **Application framework**: this layer provides the main services for the Android platform and the main services to access low level hardware API.

5. **Applications**: All applications are built on the application layer using the same API libraries. Native apps provide access to features like email, SMS, phone, calendar, photos, maps, web and third-party apps. The application layer is run by the Android runtime engine and uses the classes and services made available by application framework.

II.2.4.4   Memory management

Since Android devices are usually battery-powered, Android is designed to manage processes to keep power consumption at a minimum.

When an application is not in use the system suspends its operation so that, while available for immediate use rather than closed, it does not use battery power or CPU resources. Android manages the applications stored in memory automatically: when memory is low, the system will begin invisibly and automatically closing inactive processes, starting with those that have been inactive for longest.[10]

II.2.4.5   Licensing[12]

Android was released under two different kinds of open source licences:

- **GNU General Public Licence**: it is required for anyone using the Open source OS kernel.

- **Apache Software Licence**: the android platform without the kernel is licenced under the ASL.

II.2.4.6   Application Piracy

In general, paid Android applications can easily be pirated due to the system being open source poses the problem of (inability the supervise everything) and also due the security issues most of android apps face which something crucial and fatal.[12]

II.2.4.7   Market Share

Research Company Canalys estimation of the Android Market Share development within the quarters of the years 2009-2012, the following graph presents this estimation:
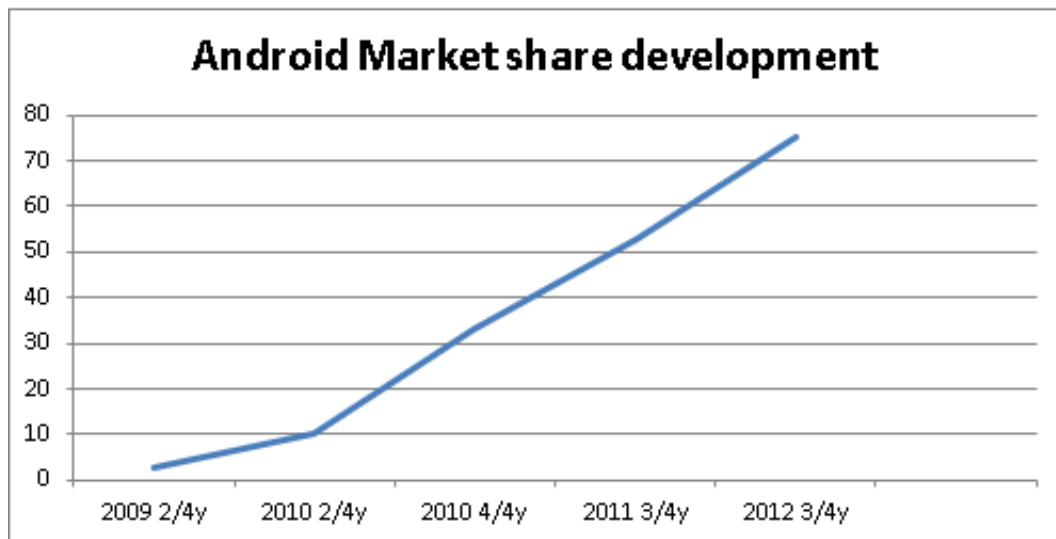
Figure II.5: Android Market Share development 2009-2012

Android devices account for more than half of smartphone sales in most markets, including the US, while "only in Japan was Apple on top" (September–November 2013 numbers). At the end of 2013, over 1.5 billion Android smartphones have been sold in the four years since 2010, making Android the most sold phone and tablet OS. Three billion Android smartphones are estimated to be sold by the end of 2014[10].

According to a January 2015 Gartner report, "Android surpassed a billion shipments of devices in 2014, and will continue to grow at a double-digit pace in 2015, with a 26 percent increase year over year." This made it the first time that any general-purpose operating system has reached more than one billion end users within a year: by reaching close to 1.16 billion end users in 2014, Android shipped over four times more than iOS and OS X combined, and over three times more than Microsoft Windows[10].

According to a Statistica's estimate, Android smartphones had an installed base of 1.8 billion units in 2015, which was 76% of the estimated total number of smartphones worldwide. Android has the largest installed base of any mobile operating system and, since 2013, the highest-selling operating system overall with sales in 2012, 2013 and 2014 close to the installed base of all PCs[10].

According to an April 2017 StatCounter report, Android overtook Microsoft Windows to become the most popular operating system for total Internet usage. It has maintained the plurality since then[10].

II.3 Android Application Content

The android application is usually consisted of[5]:

- **Activity**: it is considered as the main component of an Android application. Activities use views or fragments to form user interfaces that will display graphical user interfaces and respond to user actions.

- **Services**: These are components that work in the background. They are used to perform continuous treatments or do not require the intervention of the user invisibly.

- **Content providers**: They allow to manage and store the data of the application and to interact generally with the SQLite database. A single provider allows you to share data between multiple applications. Any application with the appropriate permissions can add, delete, or update data from another application.

- **Intents**: Intentions are system messages. They allow to start and stop activities and services, or to request the execution of an action on particular data.

- **Widgets**: These are graphic components that are usually added to the home screen. They allow an application to grab a portion of the screen and provide an entry point directly on the home screen.

- **Notifications**: Notifications report information to the user without interrupting the current activity. They are the preferred way to attract the attention of the user from a service or a broadcast receiver. For example, when a device receives a text message, the application alerts by emitting a sound, displaying an icon or message.

II.4 Related works

II.4.1 Mobile Learning Support System (MLSS)

II.4.1.1 Definition

MLSS is a learning system that allows students to access learning materials anytime, anywhere which in most cases it relays on their location and their environment to provide the right content for the right person.[3]

II.4.1.2 Technologies Used

As the pilot system of ubiquitous learning, this system uses camera-equipped mobile phones and 2D barcode tags (QR) to obtain learning information from online websites. By installing the MLSS on their phones, students can scan the tag attached to the corresponding objects to display related multimedia materials on the screen of mobile phones. In addition to that, the MLSS applies also the GPS technology to develop a location-aware environment for the students. GPS technology is used to detect the students' location and identify which 2D Barcode are in their proximity.[3]

II.4.1.3 Overview of the MLSS

The MLSS uses handled devices enabled wireless technology in order to achieve a maximum level of portability and mobility. First MLSS was designed and built in HTC Desire S mobile phone and can be used in on any android 2.3. And in order to provide cross-platform capabilities, the MLSS was developed on the android SDK using java technology.[3] The MLSS is designed to provide three major functions:
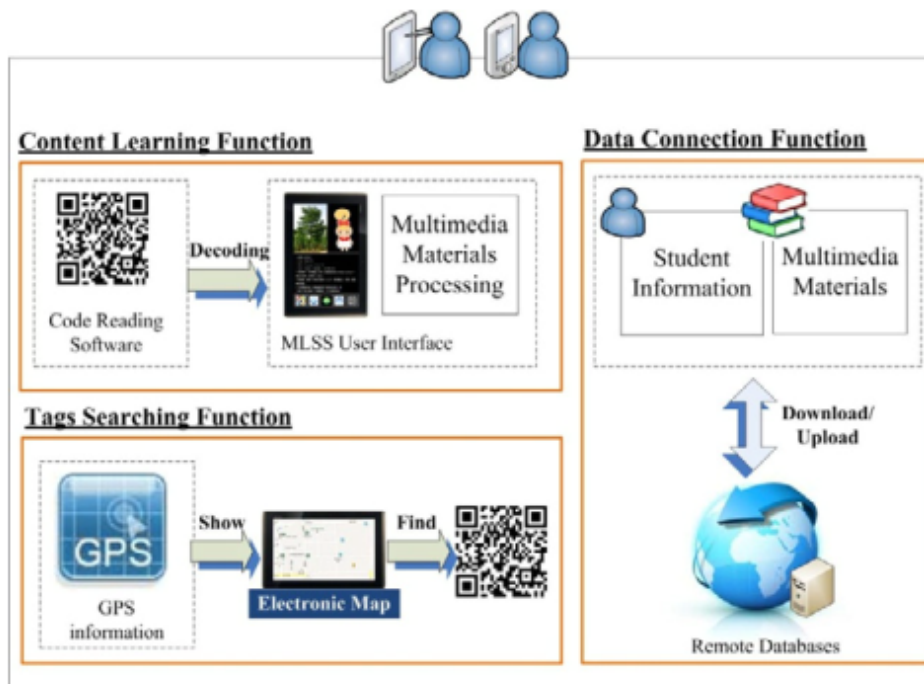
Figure II.6: MLSS three major functions

Database connection function

   this function is designed to provide students with a U-learning environment. In order to achieve learning anytime and anywhere, the MLSS has developed two remote databases on the internet:

First one is used to record the students' information, in which cases those information enables the MLSS to maintain the students' profiles and learning feedbacks via network services.

In the other hand, the other database is used to keep multimedia materials and features the management of the teaching materials and the maintenance of tags' location information. After all, both databases were used to make a built-in web server for students to easily access information in the outdoor settings.[3]
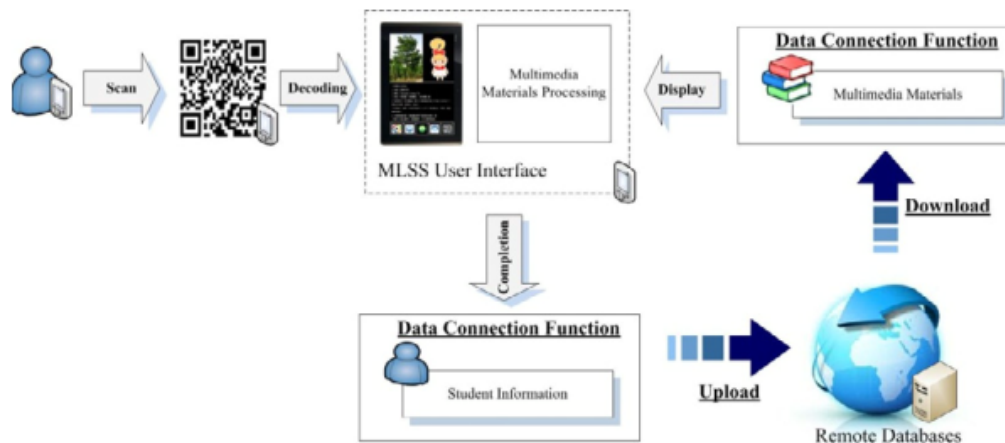
Figure II.7: Detailed Database connection function module

Content learning function

   As shown in the figure, the content learning function enables students to learn teaching materials on mobile devices, and control the learning paces themselves. When students' uses mobile devices to scan 2D barcode tags, the content learning function will decode the internal information of tags. Then this function will require the database function to download the corresponding teaching materials.

Furthermore, a control panel was designed to display a set of buttons on the user interface of the MLSS for students to operate multimedia materials as it is shown in the the figure.[3]

Figure II.8: Detailed Content learning function module

Tag searching function

The design of tags searching function was based on the foundation of u-learning. This function was designed to provide a local-aware learning environment for students. As it is shown in the figure, the MLSS adopted the GPS technology in order to access location and time information by connecting with satellites for developing the tags searching function of the MLSS.

In the essence, the tags searching function enables students to discover the 2D barcode tags that are in their proximity.[3]
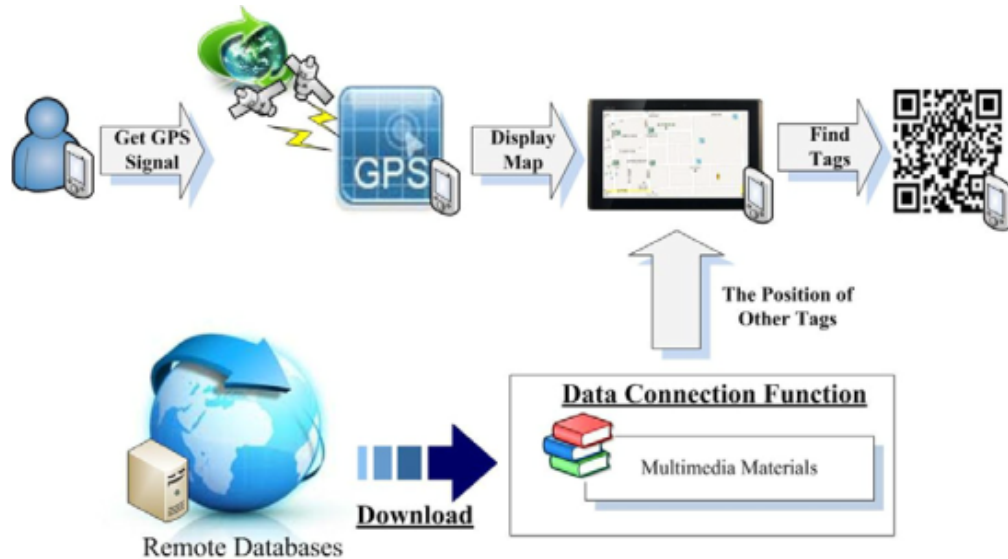
Figure II.9: Detailed Tag searching function module

II.4.2 Course Content Delivery System (CCDS)

II.4.2.1   Definition

CCDS is a system that helps the teachers to build an engaging ubiquitous learning environment and in another way generate interest and promote acceptance of combining u-learning materials into an existing coursework. It is also considered as a useful tool to motivate the students learning outdoor teaching activities.[2]

II.4.2.2   Technologies used

Since the ubiquitous learning has the ability to detect contextual information in the real world and adapt accordingly to provide customized learning content through mobile devices in response to different contexts or situation, the best solution was to use the QR (Quick Response) codes as it is considered as an important technology. In this matter, it allows students generate QR codes and download related learning materials directly onto their mobile devices.[2]

II.4.2.3   Overall system architecture of the CCDS

II.4.2.4   CCDS Modules

Syllabus Management System: This module is used by the admin.It is up to him to upload the syllabus and create others for a particular subject in the website. The admin also has to ability to allocate the syllabus to a particular professor.[2]

Course content sharing server: After logging in to the website, the professor will use his allocated syllabus in order to upload the core content and the relative content for it.[2]

Context-aware U-learning System: After the core content is uploaded by the professor, the professor click on "create multimedia material" button. The materials after that are compressed into zip file and
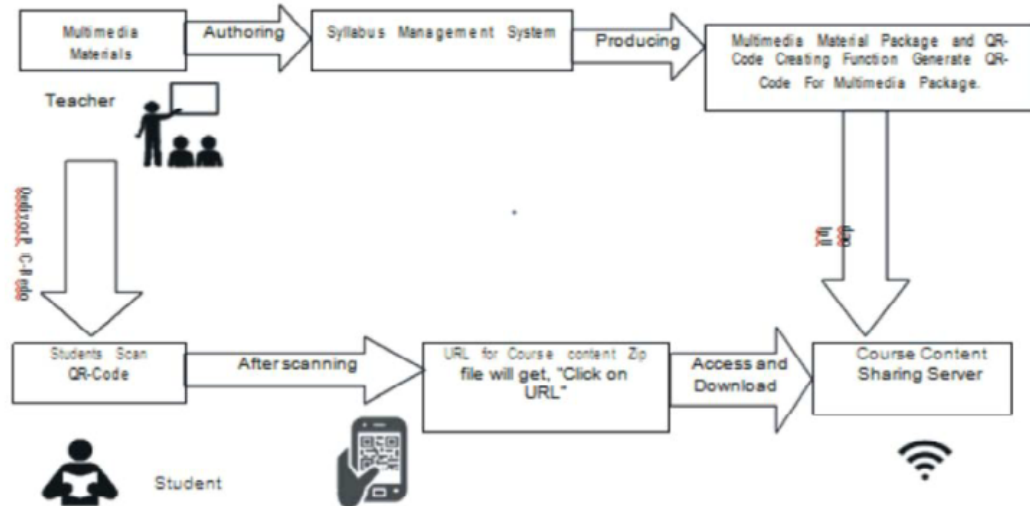
Figure II.10: CCDS Architecture

create a new java server page and their QR code will be generated afterwards which will be used by the student in order to extract the content wanted.[2]

II.4.3 Tag Added learNinG Objects (TANGO)

II.4.3.1   Definition

TANGO is considered as a CSUL (Computer Supported Ubiquitous Learning), which is a ubiquitous learning environment that is supported by embedded and invisible computers in everyday life. It was proposed to tackle the issues of learning in the right place and the right time. Its main objective is to provide a good source to learn vocabulary.[11]

II.4.3.2   Technologies used

One of the most important technologies used by TANGO is the RFID technology. The RFID technology has a high level of embeddedness; it can be used in every object and every shape in our daily lives because it can bridge them with information in a virtual world. And in order to get in touch with the RFID tags used, RFID tag readers are a must, where they are used while connecting to a smartphone or a PDA.[11]

II.4.3.3   Features

Vocabulary learning anyplace anytime: it is assumed that RFID tags will be attached to a lot of products in the future, thus, TANGO will enable people to learn vocabulary anytime anywhere. [11]

Authentic learning: Since TANGO uses real life objects as learning materials, the system will allow to learner to feel and touch them for a better impact.[11]

Collaborative learning through objects: TANGO facilitates to share knowledge about real-world objects with question, answers and comments.[11]

Adaptive learning environment: learner's record will be created when the system is used. The asked questions will be based on different levels base on the learner's history.[11]

Personalized learning: According to the learning records, TANGO ask suitable questions to the learner.[11]

II.4.3.4   Overview of TANGO

TANGO is based on six modules as it is shown in the next figure:
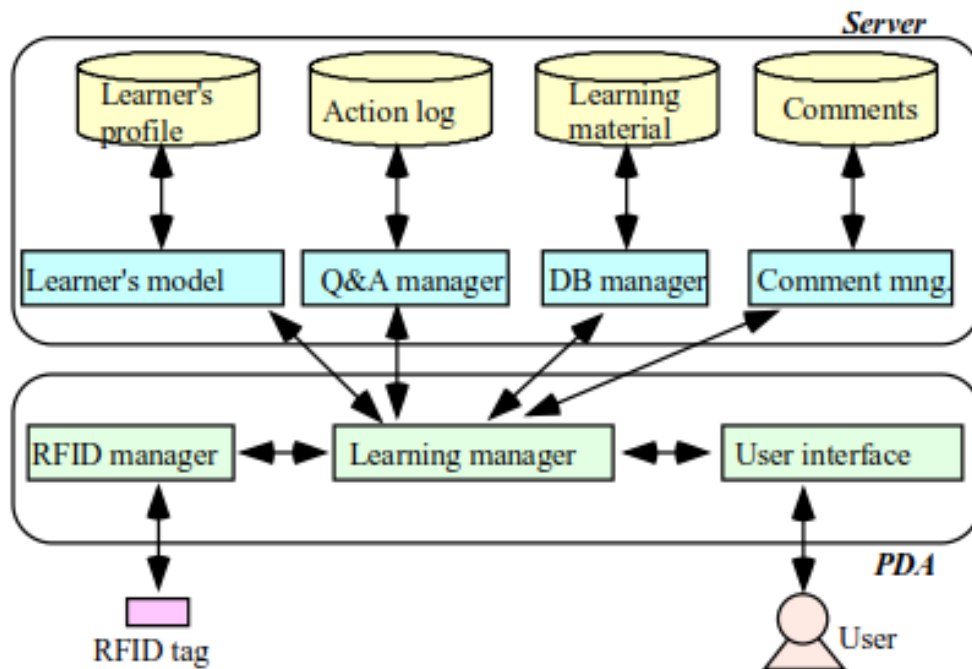
Figure II.11: TANGO Architecture

Learner model: this module contains the learner's profile such as name, age, gender and or the comprehensive level of each word and each expression of an object.[11]

Environment model: this module has the data of objects, rooms and buildings, and the link between objects and expressions in the learning materials database.[11]

Educational model: this module manages words and expression as learning materials.[11]

Communication tool: this tool provides the user with BBS (bulletin board system) and a chat tool.[11]

Tag reader/write: this module reads the ID from RFID tag attached to an object. Referring to the ID in the object database, the system obtains the name of the objects.[11]

User interface: this module provides the learner with question and answers.[11]

II.5 Conclusion

In this chapter, we presented Android different parts and features and why it makes a suitable Operating system for our system and also we presented three related works with their different structures and functionalities.

Chapter III: Application Design

III.1 Introduction

In this chapter, we present the different aspects and steps for the designing of our ubiquitous learning system and clarify each used part and component.

Our system is basically considered as an environmental learning system. In our case, the environment here is supposedly being 'A hospital'.

In order to explain our work, we will present:

- The general architecture which will give a wide sight and cover up some major questions about our system.

- The detailed architecture which will give an insight about each component and submodule used in each module presented in the general architecture and how it's functioning and reacting within the system.

- The diagrams which allow for more understanding and clarification of every functionality in our system.

III.2 General Architecture
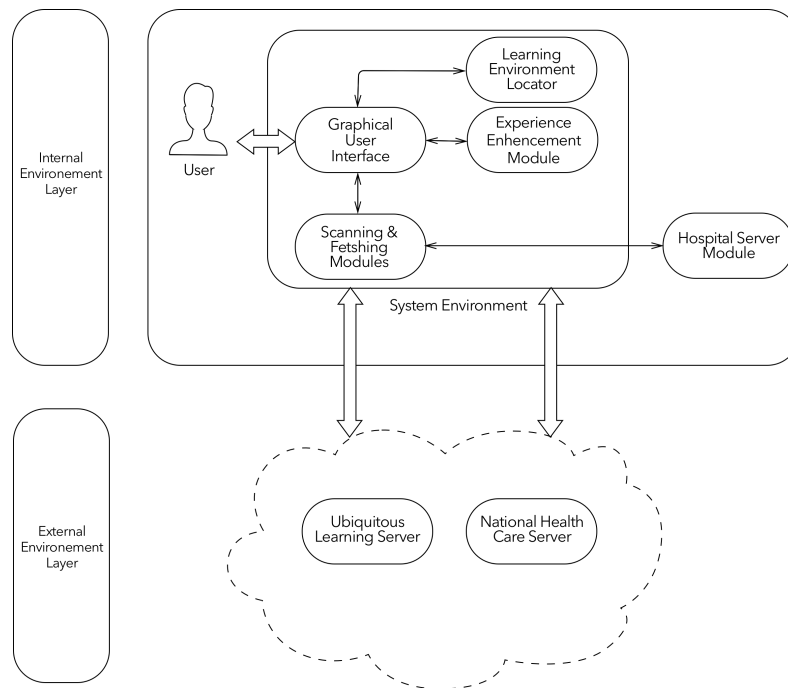
Figure III.1: The system general architecture

As it is noticed, our architecture is divided into two large layers:
Internal Environment Layer: this layer represents the user's environment in which the learning is taking an action. It is consisted of several components and modules such as:

- User: considered as the person who's using the system.

- Graphic User Interface: Allows the user to interact and use every functionality of our system.

- Experience Enhancement Module: contains all submodules that will enhance and improve the learning experience of the user.

- Learning Environment Locator: this module allows the user to find the learning environment in which the leaning is taking an action.

- Scanning and fetching module: this module is considered the most important part so far, in which it allows the user to interact and obtains learning materials based on his environment adaptive and ubiquitous learning).

- Hospital Server: this module provides extra information for the user.

External Environment Layer: this layer represents the outside environment in which our system reacts based on the user's choice. This Layer in consisted of two modules:

- National Health Care Server module: this module will provide to the user with extra information.

- Ubiquitous learning server module: this module provides all the learning materials for the user based on some actions taken in the previous layer.

III.3 Detailed Architecture

In this section, we present our detailed architecture in which we describe and define the functionality of each module and submodule used in our learning system.
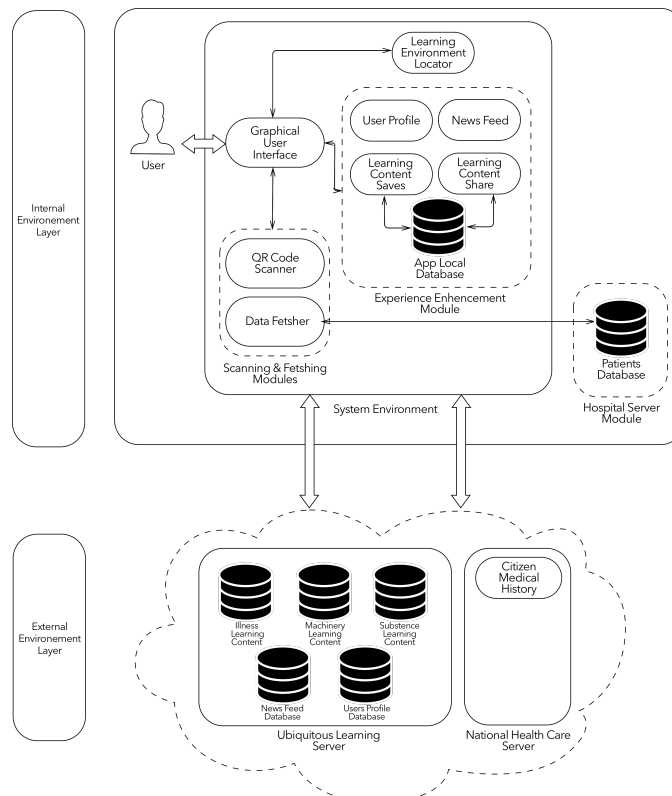
Figure III.2: The system detailed architecture

As it is noticed our system is consisted of set of modules and submodules that work perfectly in harmony to achieve the goal which is providing the user or the learner with the right learning content and materials.

III.3.1 Internal Environment Layer

this layer is consisted of 5 modules:

III.3.1.1   Graphic User Interface

this module is considered one of the key parts of our system since it provides the user with a graphical interface that allows him to interact and navigate through each part of our system and use all the provided functionalities.

This module is basically connected to all the functioning parts as it noticed in the detailed architecture in which case it provides the user with admirable experience in the learning process.

III.3.1.2   Learning Environment Locator module
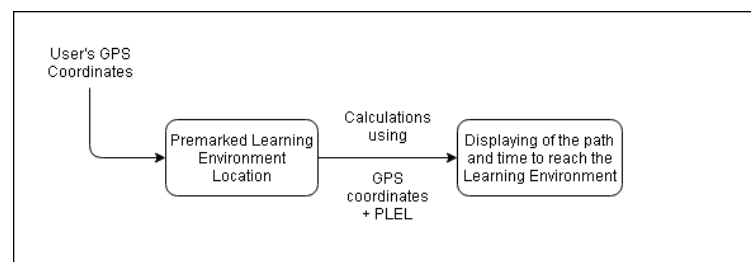
Figure III.3: Learning Environment Locator functionality

Basically, this module is used to show and to guide the user to the Learning Environment Location (could be many environments) where our system is functional, by providing the closest path and the minimum time to reach the location displayed on a map.

For the functioning, this module uses the User's GPS coordinates obtained by the mobile and the Premarked Learning Environment Locations that are stored in the app online database and using Google map API to draw the possible paths from the user location to the learning environment location and estimate the time to reach the location for each path. This module helps the user if he is clueless about the learning Location but it stays optional if he is aware of it.

III.3.1.3   Experience Enhancement Module

This module is consisted of several submodules. Those submodules are being used to improve both the usage and the learning experience for the user.

User Profile

This submodule is basically consisted of the personal information of the user such as (Name, Profession, Social number, Address and social media accounts, etc) and gives him the right privileges of the system usage. The User profile is filled with the right information based on the figure shown up.
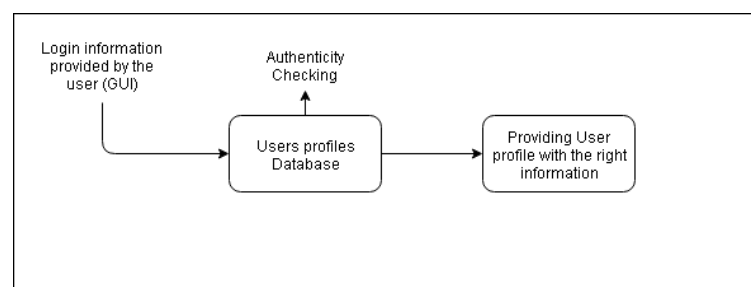

Figure III.4: User profile functionality

After the user provides his login information (E-mail and password) a query is sent to the Ubiquitous Learning Server (Users Database) to check the authenticity of the user. After the query success, the user profile is provided with the right information.

News Feed

this submodule is used to provide any news that is related to the healthcare system. The news feed is updateable whenever the news is ready. After an action to access this submodule, a request is made in
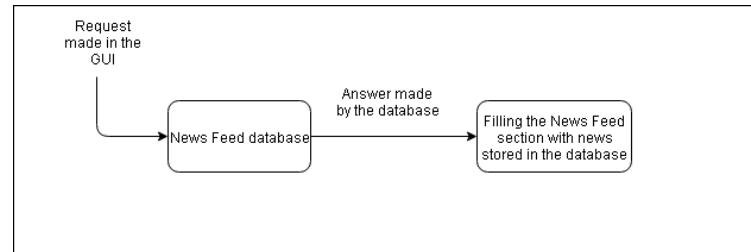

Figure III.5: News Feed functionality

the GUI and then sent to the Ubiquitous Learning Server (News Feed database) which will end with an answer or a result. The result is consisted of the news that will be filled to the submodule.

Learning Content Saves

After accessing the learning materials, the user has the ability to download them from the Ubiquitous Learning Server and save them in his local database provided by the app. This feature is very useful since it allows the user expand his knowledge about the things that he is learning about and also allows him to learn outside the learning environment that he chose.
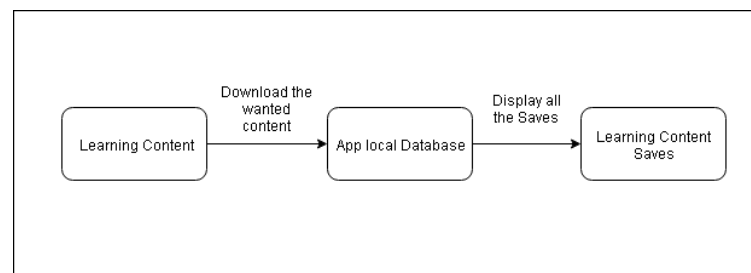
Figure III.6: Learning Content Saves functionality

Basically, what is going on here, is that the user after accessing his wanted learning materials such as (Illness, Machinery and Substances Learning materials), he has the ability to download them as it is shown in the figure and store them in his local database for further use. Learning Content Saves submodule provides those saves by extracting them from the local database and displaying them to the user using the Graphic User Interface. The Saves properties are: SNumber, Type, Name, Status and Date of the save.

Learning Content Share

In order to improve and enhance the learning experience, and after the learning content has been saved, the Learning Content Share module helps the users to share what they have learned between them so they can help each other to acquire more and more information.
This sub module is actually consisted of two scenarios:
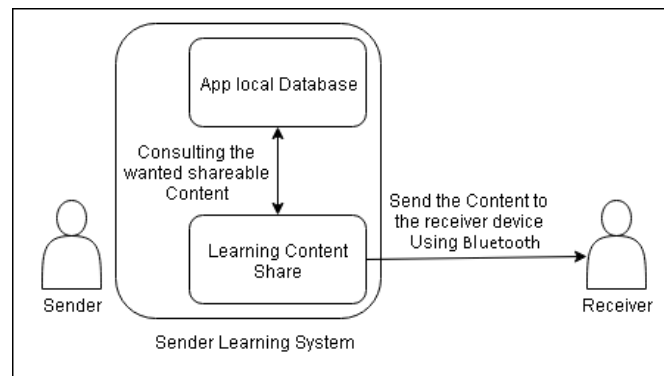
- The Learning Content Sender:

Figure III.7: Sender Scenario functionality

Using the Learning Content Share submodule, the sender consults the App local database for the content that both he and the receiver agree to share. After selecting the wanted shareable content, the sender uses the bluetooth technology to send the content to the receiver.
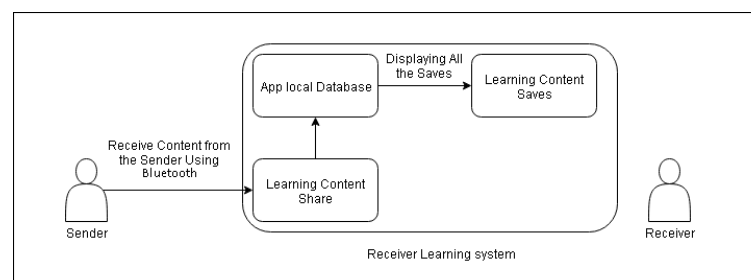
- The Learning Content Receiver:

Figure III.8: Receiver Scenario functionality

Using the Learning Content Share submodule, the receiver gets the wanted learning content from the sender using the Bluetooth technology. The received Learning content will be Stored in the App local database and will be displayed as a Save using the Learning Content Saves module.

App local Database sub module

This submodule is considered as a simple database that stores information about learning materials so they can be accessed easily later on by sending that information as a query to the ubiquitous learning Server and retrieve the learning content corresponding to it.
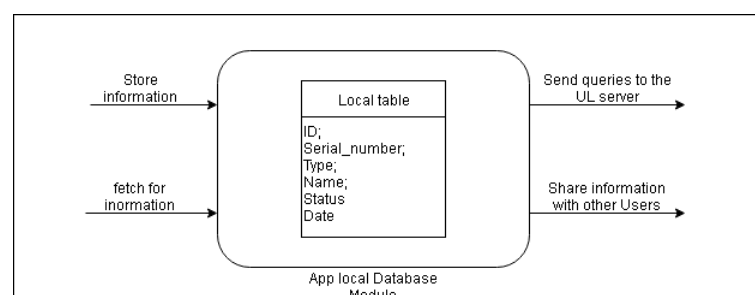
Figure III.9: Application local database functionality

As it is noticed, many scenarios are expected, the information can be both stored and fetched, and also can be sent as a query to Ubiquitous Learning server to retrieve learning content and also to share it with other users so they also can access the learning content.

III.3.1.4   Scanning and fetching modules

This module is considered the key feature of our system. It provides the user with the learning content using his surroundings (patients, machines, substances), those three surroundings are our subjects of learning. Our app provides learning materials for the three of them:

- Patients: Personal Information + Medical History + Treatment Progress + Illness Learning Content.

- Machinery: Information Card + Machinery Learning Content.

- Substances: Information Card + Substances Learning Content.

This module is consisted of two sub modules:

1. QR Code: : this submodule uses the phone camera in order to decode the two dimensional image stuck in the learning content objects situated in the user's environment.
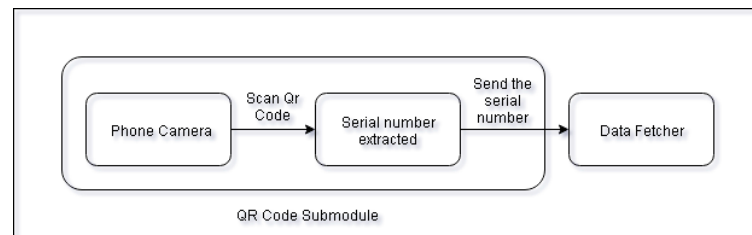
Figure III.10: QR Code functionality

After scanning the two dimensional QR code image, a serial number is extracted and sent to the Data fetcher, in which this submodule will do its work.

2. Data fetcher: this submodule collects the information and the learning content from the Ubiquitous learning server, national health care server and the hospital server if needed. The submodule collects them based on the serial number sent by the QR code submodule.
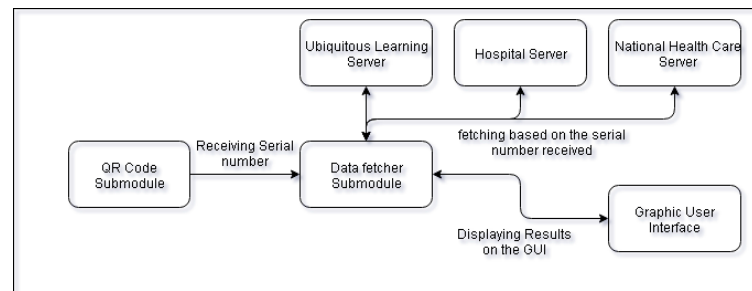
Figure III.11: Data fetcher functionality

After receiving the Object serial number from the QR code submodule, the data fetcher module sends queries that have the serial number to the three servers (UL server, hospital server and NHC server) and collects data from their databases and displays the results (Learning Content) on the Graphic User Interface.

III.3.1.5   Hospital Server Module

Since our main learning environment is the hospital, that makes the existence of his module a need. This module is consisted of several submodules, but the one we are interested of is the patient's database submodule which is related the learning object "the patients".

This sub module is consisted of two parts:

- The Personal information part: provides the personal information of each patient within the hospital.

- The Treatment progress part: provides the treatment progress of each patient within the hospital.
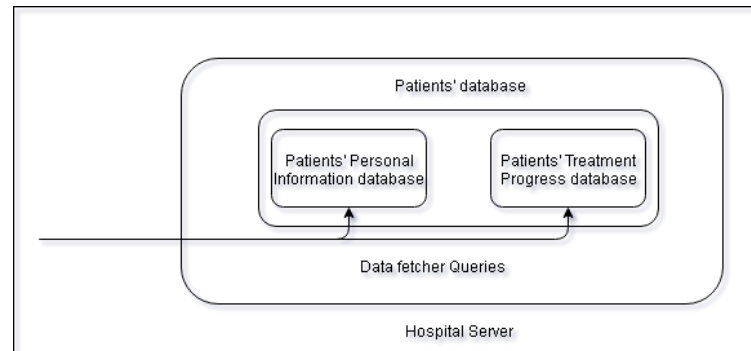

Figure III.12: Hospital Server functionality

The patient's database can be retrieved by the Data fetcher functionality (the sent queries) shown in the up figure.

III.3.2 External Environment Layer

this layer is consisted of 2 modules:

- National Health Care Server: just like the Hospital Server Module, this module is consisted of several modules, but the one we are interested of is the Citizens Medical History which is also related to one learning object "the patients". This submodule contains the medical history for the wanted patients which makes the learning more efficient and meaningful. The patients' medical history can be retrieved by the Data fetcher functionality (the sent queries) shown in the figure.

- Ubiquitous Learning Server: : this module represents our system and app server. It is considered as the main source of (information, learning contents etc) for our system. It provides different databases with different structures. It is consisted of 5 submodules (News Feed database submodule, Users' profiles database Submodules, Illness Learning Content submodule, Machinery Learning Content submodule, Substances Learning Content submodule).

The functionality of this module is represented as the follow:
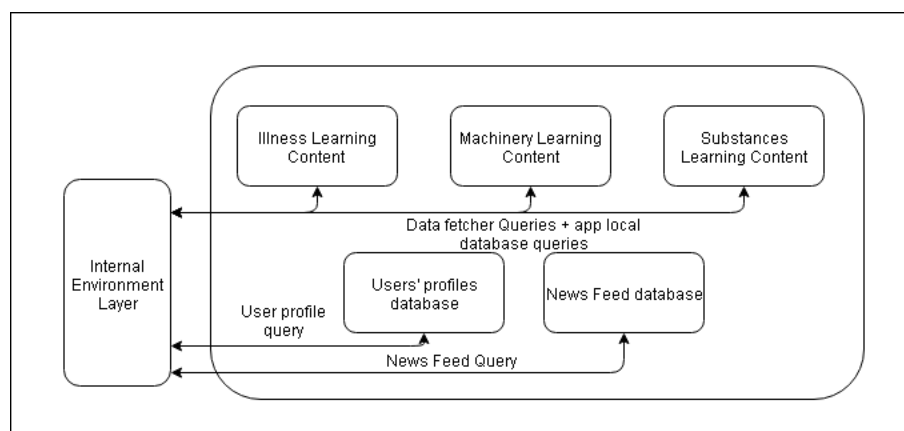

Figure III.13: Ubiquitous Learning Server functionality

1. News Feed database: : this submodule provides news. It can be accessed from the internal Environment Layer, specifically from the News Feed submodule.

2. Users' profiles database: this submodule provides personal information considering our system users. It provides a background authenticity check. It is accessible from the internal Environment Layer, specifically from User profile submodule.

3. Illness Learning Content: this submodule provides learning materials about a large set of illnesses. This module is related to one learning object "the patients". It gives specific information about them such as (summary, symptoms, diagnosis, treatments etc) also, it provides media content that explains how the illness works and how to treate or avoid it.
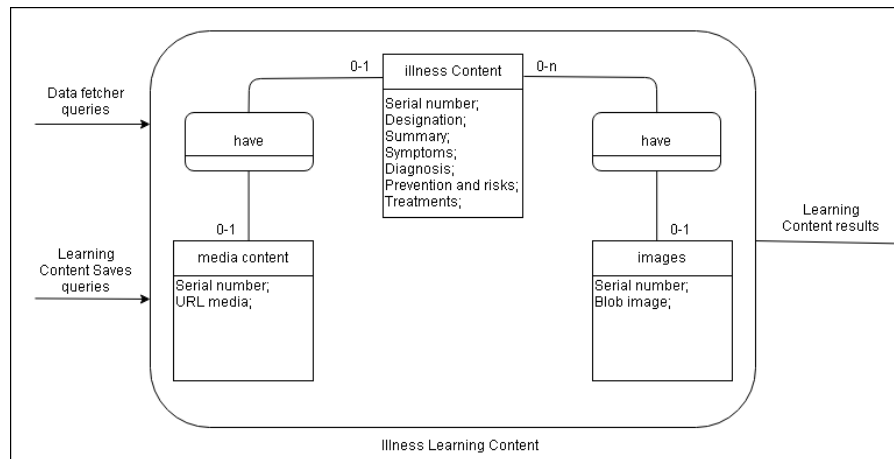
Figure III.14: Illness Learning Content functionality

4. Machinery Learning Content: this submodule provides learning materials about machines used within the hospital such as (their mechanism, their functionalities etc). A media content is also provided to show how to use those machines.
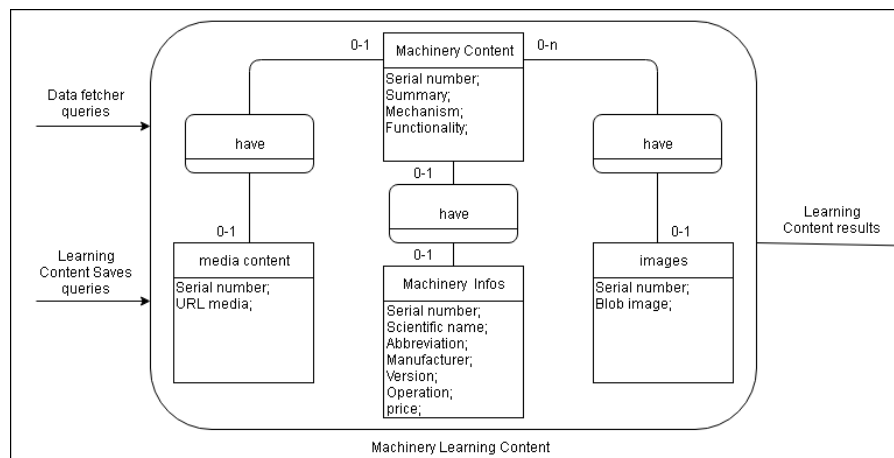
Figure III.15: Machinery Learning Content functionality

5. Substances Learning Content: this submodule provides learning materials about the substances such as (medicines, liquids etc) used within the hospital. The learning materials is consisted of (summary, pharmaceutical, clinial trials etc).
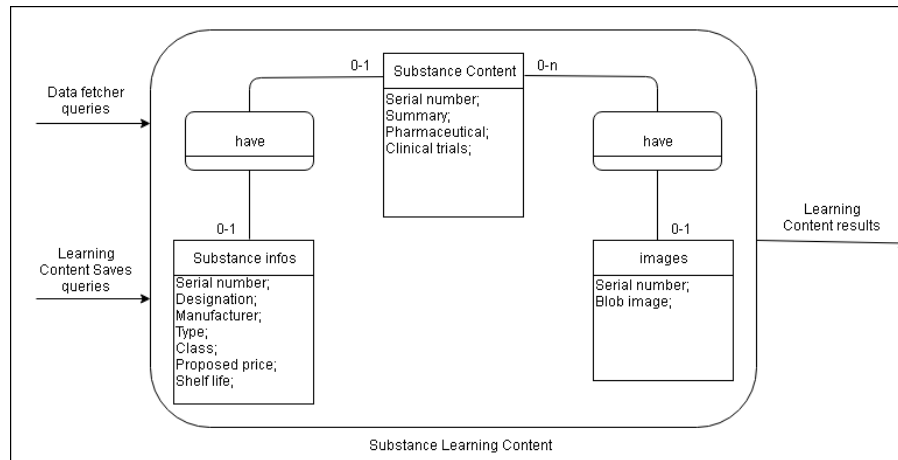

Figure III.16: Substances Learning Content functionality

The last three submodules can be accessed by both the data fetcher submodule and Learning contents saves module within the internal environment layer.

III.4 Diagrams

III.4.1 Sequence Diagrams

III.4.1.1   User Interaction with the Graphic User Interface scenario

As it is noticed the first thing that ever happens is the interaction between the user and his device (GUI). The GUI provides a set of choices and functionalities that the user can choose in order to achieve his goal which is getting learning materials.
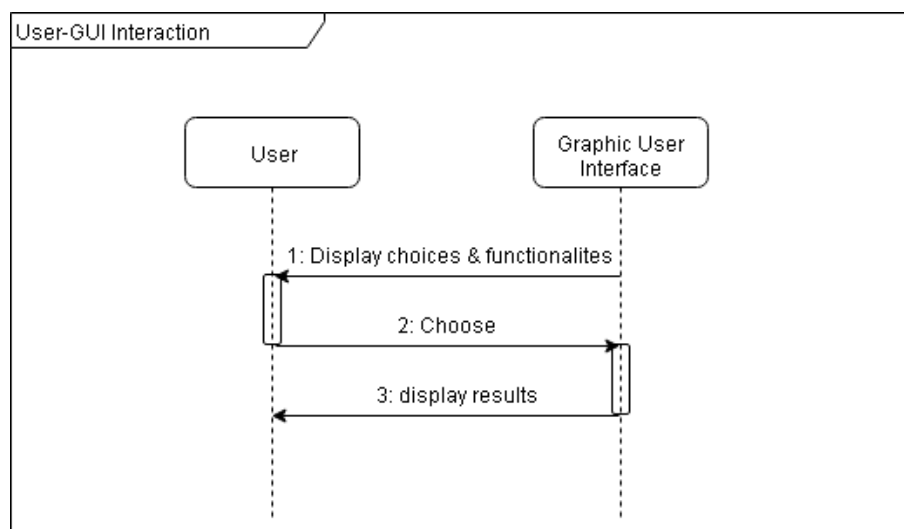
Figure III.17: User - Graphical User Interface Diagram

III.4.1.2   Learning Environment Locator scenario

After the User chose his choice, one of the choices is the Learning Environment Locator. When the user selects his destination on the map, the following scenario happens:
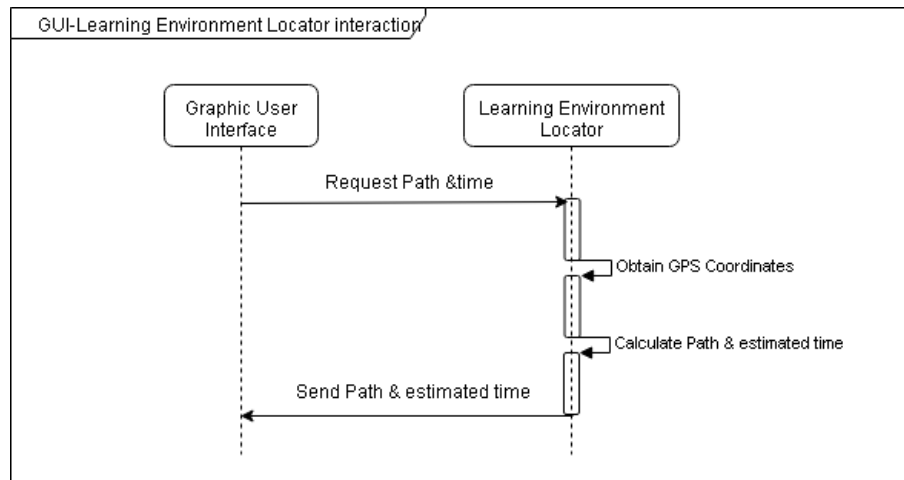

Figure III.18: GUI - Learning Environment Locator Diagram

After sending a request, Learning Environment Locator obtains GPS coordinates using user's mobile and calculates the path and the estimated time to reach the destination.

III.4.1.3   Experience Enhancement Scenario

We've divided into 4 expected scenarios:

User profile scenario

When the user tries to connect to the app, an authenticity check is required in order to determine whether the user is authentic or not. The following scenario explains how it's done:
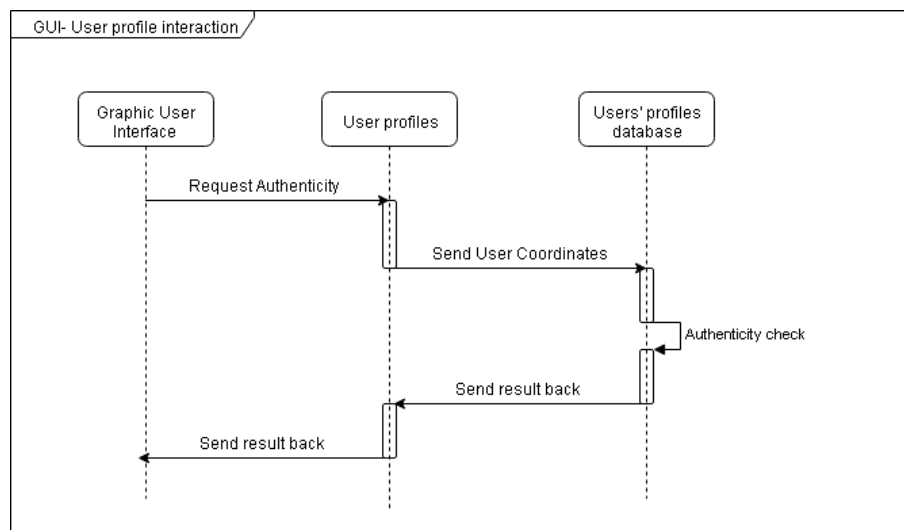

Figure III.19: GUI - User Profile Diagram

News feed scenario

News feed provides also learning materials for the user, the background interaction happens as follows:
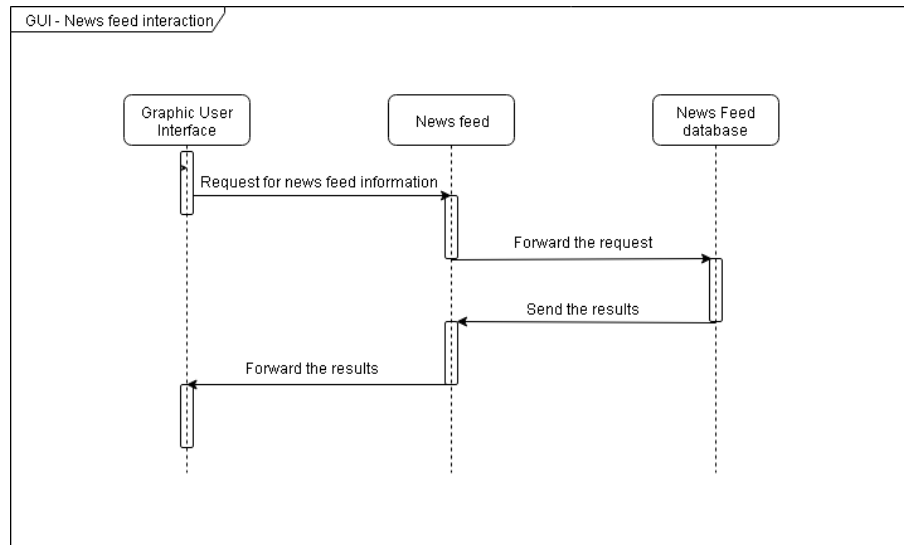

Figure III.20: GUI - News Feed Diagram

After receiving the results, the GUI displays them to the User as a journal with a "head title" and small titles afterwards.

Learning Content Saves Scenario

This scenario is a bit complicated due to the large interaction happening, Two Scenarios are expected to happen when the user chooses to work with Learning Content Saves.
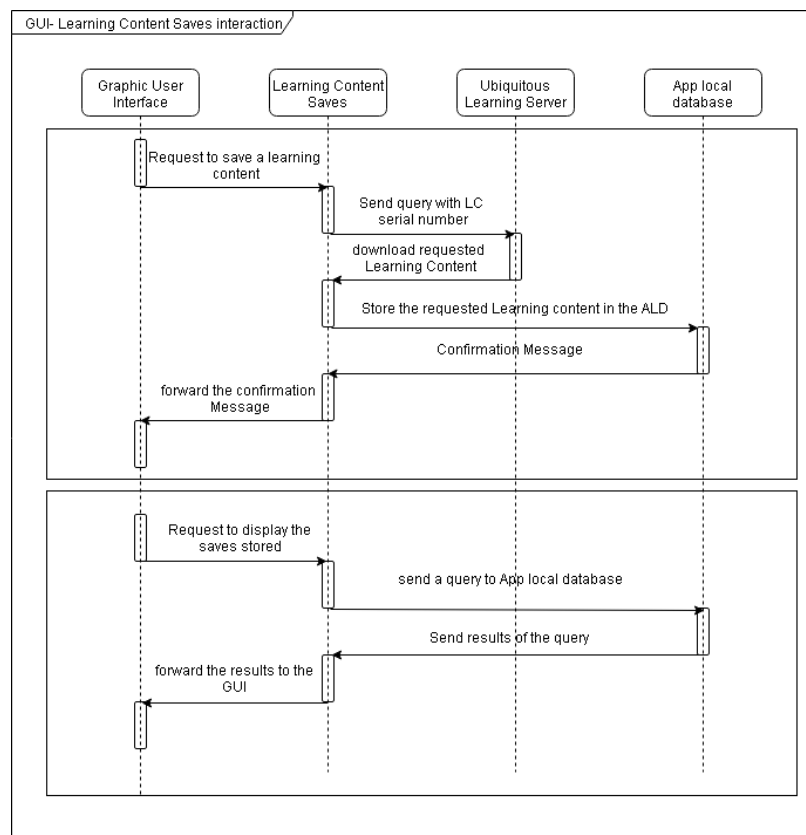

Figure III.21: GUI - Learning Content Saves Diagram

The first scenario happens when the user wants to store the wanted learning content. A serial number of it is sent as a query form to the Ubiquitous Learning Server in which will respond the Learning content and will be downloaded and stored to the app local database, A confirmation message is sent after that to confirm the process.

The second scenario is when the user wants to check his saves and display them.

Learning Content Share

So basically, when the user wants to share his saves (stored learning content) with other users, the following scenario happens:
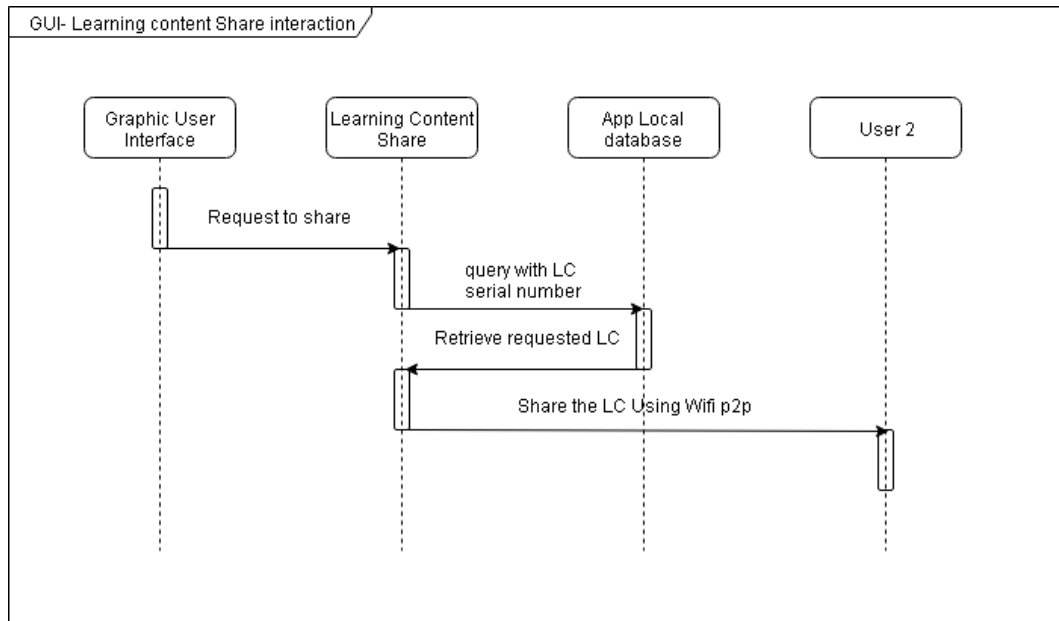

Figure III.22: GUI - Learning Content Share Diagram

The Learning Content Share module retrieves the requested learning content by its serial number then shares it with the other user.

The sent learning content will be stored in the app local database of the other user.

QR code and and data fetching

It is separated into 3 parts (patient, machinery and substances).

1. Patient Sequence diagram:

    After scanning a patient's QR Code, A serial number is retrieved and the collect of information is based on it. The following diagram explains how it's done:
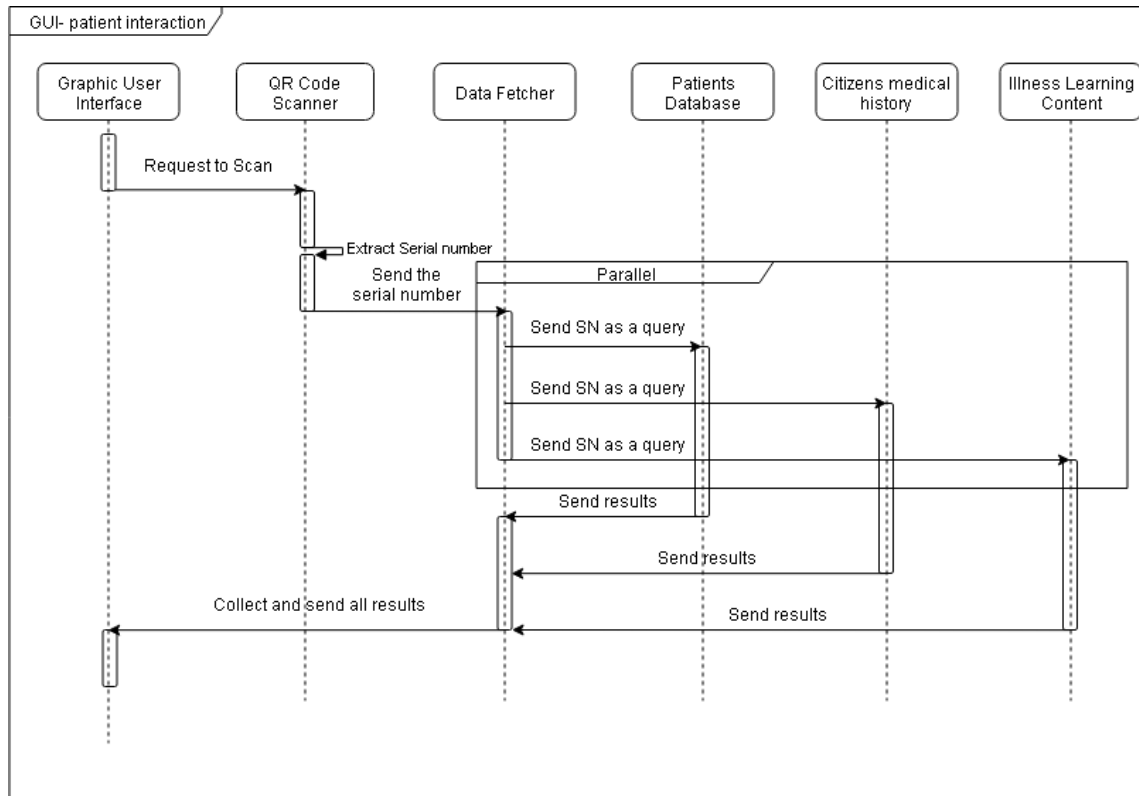

Figure III.23: GUI - Patient Diagram

A set of queries is sent to the patients' database, citizens medical history database and illness learning content to retrieve the full set of information and learning content, that will be displayed, after that, in the GUI.

2. Machinery Sequence diagram:

   After scanning a Machine QR Code, A serial number is retrieved and the collect of information is based on it. The following diagram explains how it's done:
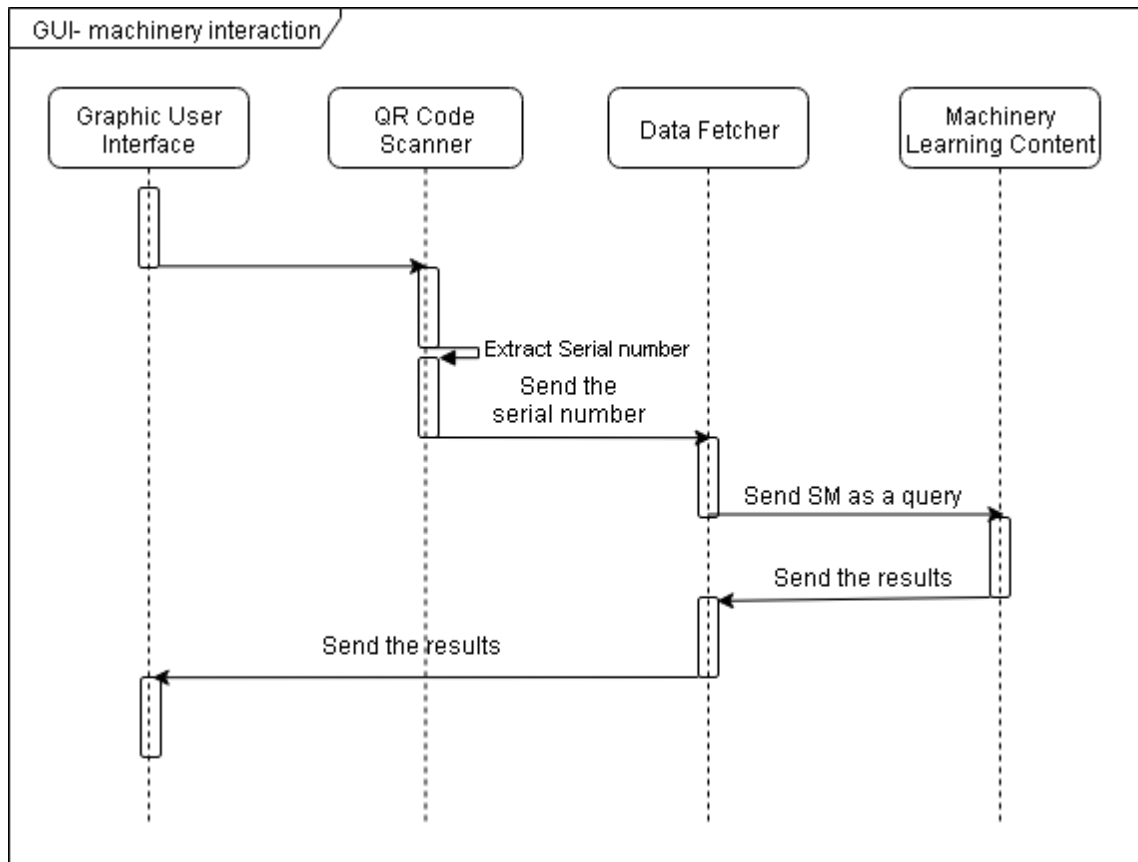

Figure III.24: GUI - Machinery Diagram

A query is sent to the Machinery learning content database and the results are displayed after that in the GUI.

3. Substance Sequence diagram:

   After scanning a Substance QR Code, A serial number is retrieved and the collect of information
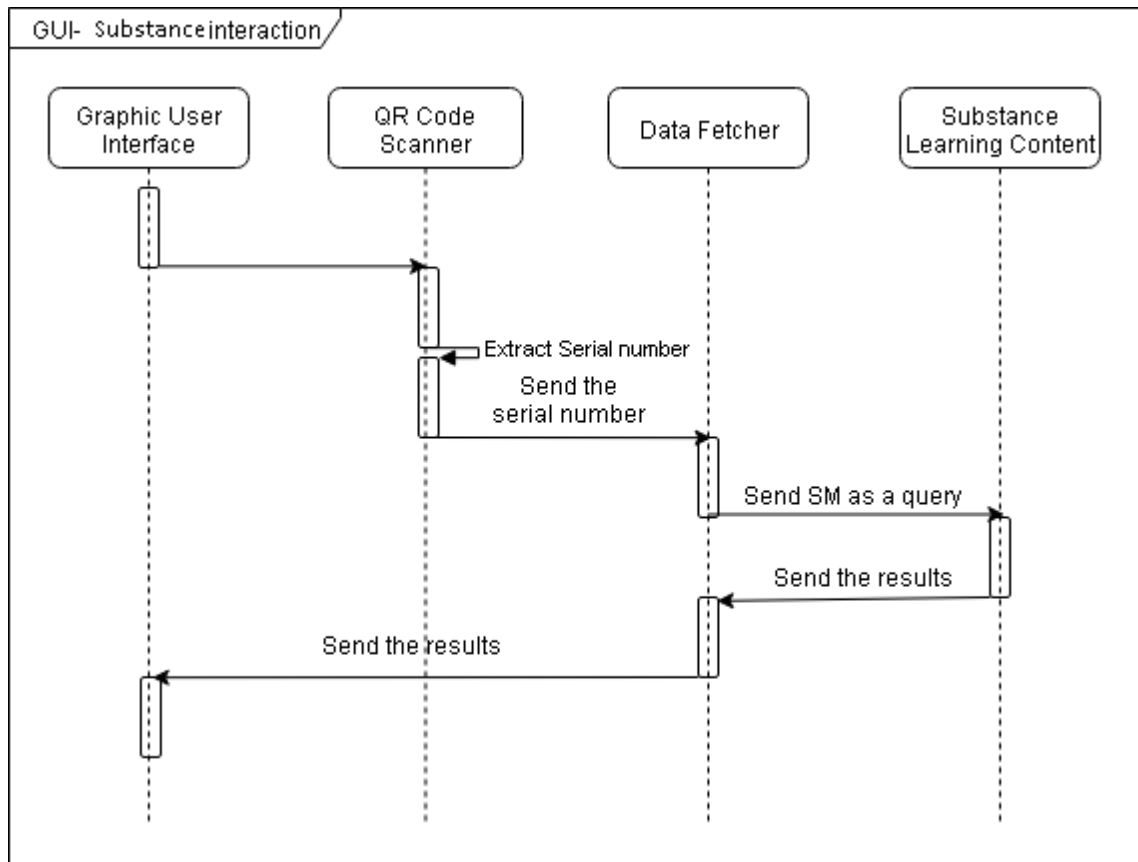   is based on it. The following diagram explains how it's done:

Figure III.25: GUI - Substances Diagram

Same thing for the substance, where a query is sent to the Substance learning content database and
after the result are retrieved, they will be displayed in the GUI.
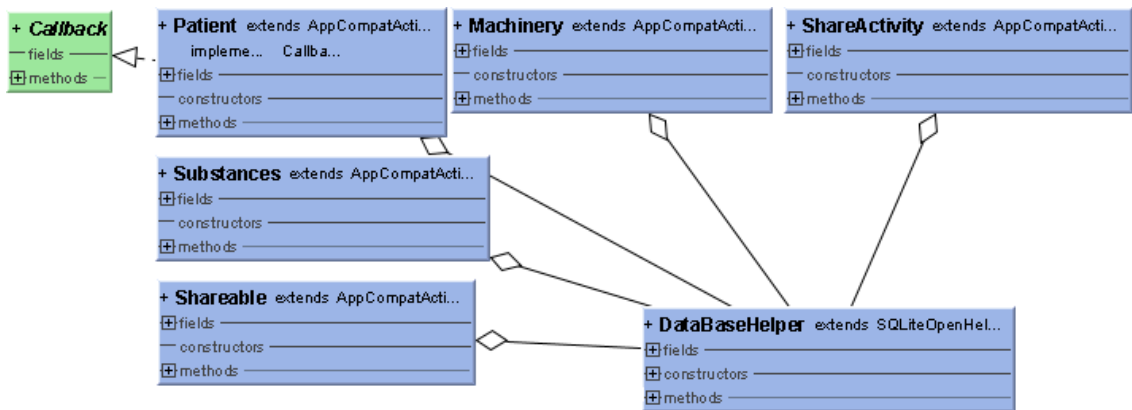
III.4.2 Class Diagram

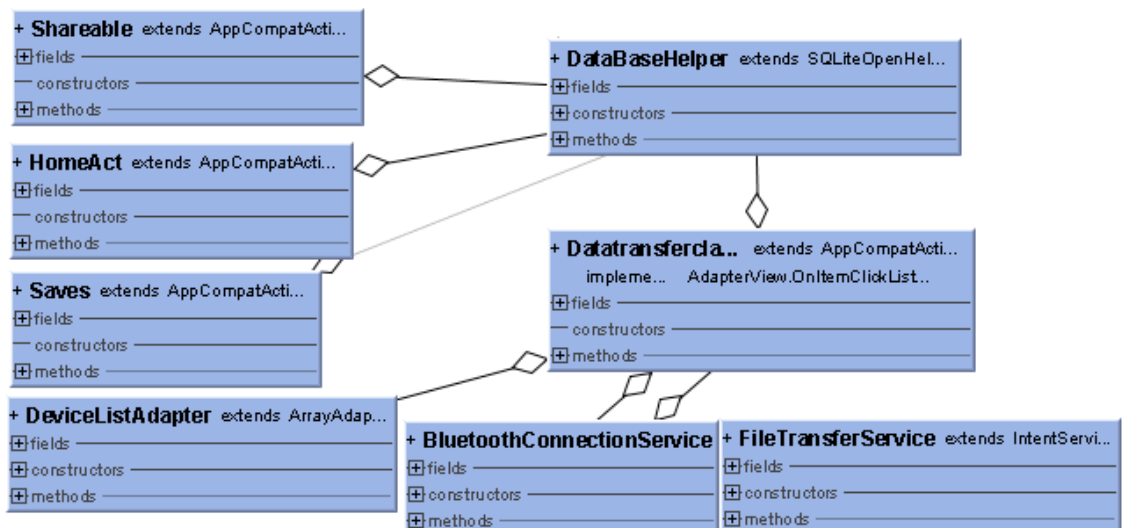Figure III.26: Class Diagram - part 1
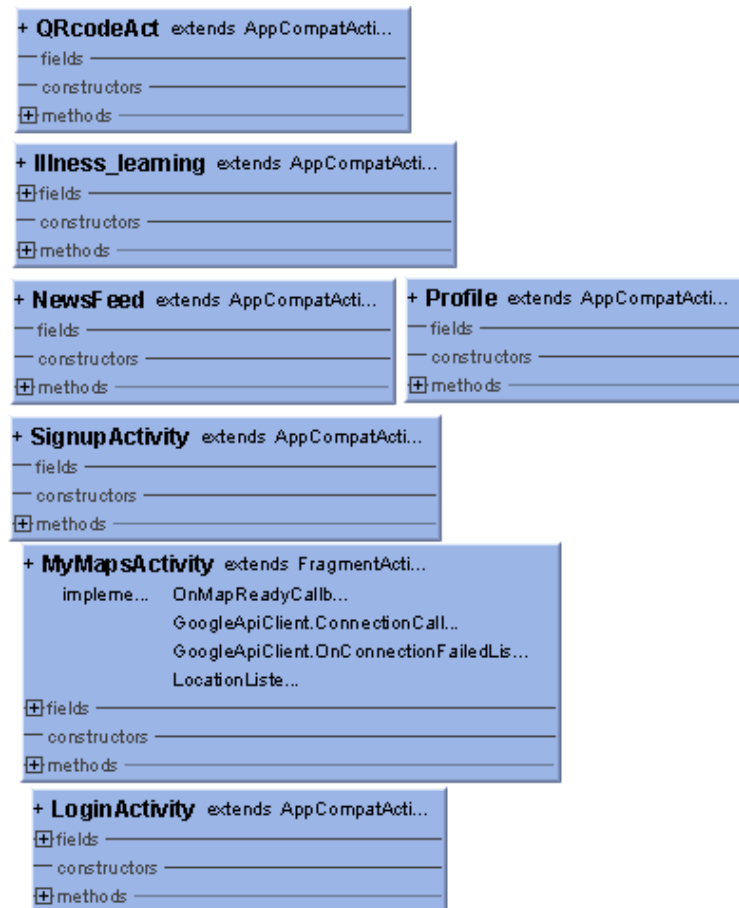

Figure III.27: Class Diagram - part 2

Figure III.28: Class Diagram - part 3

III.5 Conclusion

In this chapter, we presented the general architecture where we displayed the main modules, the detailed architecture where we explained each module, the Sequence diagram and the class diagram.

Chapter IV: Implementation

IV.1 Introduction

In the previous chapter, we presented the general and the detailed architecture of our system. In addition, we presented both the Sequence diagrams and the classes diagram in order to explain the structural and functional aspects of our system. In this Chapter we will present how we implemented our system, the developing tools we are using, the different kinds of software, and different kinds of used databases.

IV.2 Project Description and objectives

Our system is a learning system that provides the learner with different kinds of learning materials and functionalities. The Objective is to take advantage of everything that surrounds the learner, because it is more efficient and helpful to learn from his surroundings and the things located in his environment (Ubiquitous learning).

IV.3 Used tools and materials configuration

IV.3.1 Materials configuration:

The computer used to develop the system is: A Laptop Lenovo g500 with the next characteristics:

- I3 3110M 2.4GHZ CPU.
- 500gb Hard Disk Drive.
- 4gb of RAM.
- Win 10 64bits.

The system was tested on A Condor phone with next characteristics:

- MT6753 1.3 GHZ CPU.
- Phone model: PGN611.
- 5.5 inches Screen size.
- 1920x1080 pixels Screen resolution.
- 3gb of RAM.
- 32gb Storage.
- Equipped with different kind of sensors.

IV.3.2 Used tools

In this section, we present the used development tools, the programming language to implement our system and its various parts.

IV.3.2.1 The Programming language

the programming language we used to develop our system is Java. Java is considered once of the most widely adopted programming languages. It is considered as the main programming language used to develop android apps beside Kotlin that has been added very recently. Java is an OOP (Oriented Object Programming) language that is so close to our reality which makes it easy to deal with and more efficient.

IV.3.2.2 Development Environment

Our system has been developed in one of the most used IDEs for Android development (Android Studio). Android Studio is developed, updated and powered under the company name IntelliJ. It is considered as the official tool to develop applications that is exclusively used in android platform.
Android studio provides a large set of tools and different kinds of functionalities that allow the user to navigate easily and help him create different kinds of applications with different kind of functionalities. Android studio supports bedsides Java, both C++ and Kotlin.
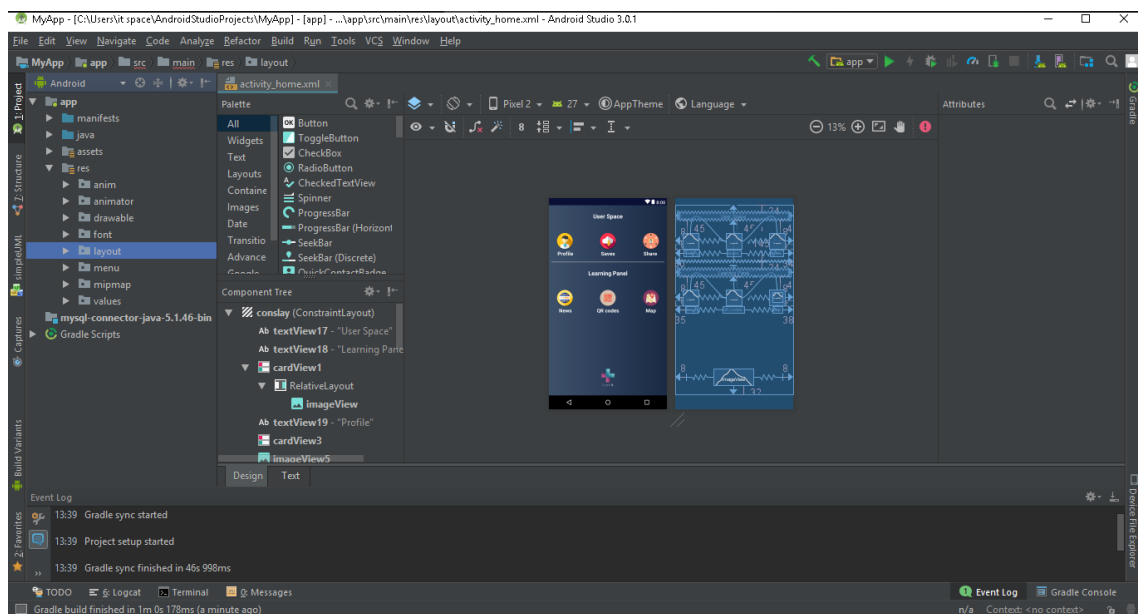

Figure IV.1: Android Studio Interface

IV.3.2.3 Databases

Databases are considered one of the most important parts in our system. they are used to store large set of data such as (Users' profiles,saves, learning content etc) which provides a better usage for the user. In our system 2 types of databases are used:

1. Local database:It is considered as a Sqlite database, as we mentioned previously, it is used to store the learning materials that the users want for further use.
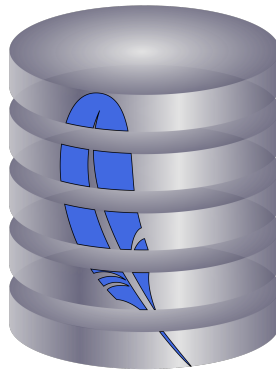

Figure IV.2: Sqlite Logo

2. External database: this database is used to store different kind of data such as (Users' profiles, News feed, Learning content etc). In the early system development we used this database in the local laptop, and after advancing, we used a free web host (heliohost) to store it for more accessibility and portability.

   In order to manage this database, a database management system is needed. the used DBMS is Mysql, with its php admin features , it allows us to manipulate the database content without any problems.

Figure IV.3: Mysql Logo

IV.3.3 Solution Implementation

In this section we will show how we implemented each functionality in our system, starting from the graphics to the last small query done with the databases. As we saw in the general architecture, our system is basically separated into two large layers(External and internal layer). We will be explaining and displaying each functionality based on its interaction in each layer.

IV.3.3.1   Login & Signup

When The user first interacts with the system graphical user interface, he has to sign up.
The sign up phase is done to provide the new user with an account that he can use to access to our system. Like other systems around the world, the accounts has privileges, because not all users have the access to every part and functionality of our system.
the privileges are used to grant security and facilitate the data exchange within the system.

    After the signup phase, the user has to authenticate himself to use the system. The authentication phase is done in the Login activity where the user provides his username and password.
A background check is done by comparing the credentials he entered with the Users' profiles database in the Ubiquitous Learning Server. Since we are using an online free web hosting, a type of connection is required to get the data.
We are using a direct connection with the url of the website and the login credentials. After the background check, he either gets refused or gets access to the system.
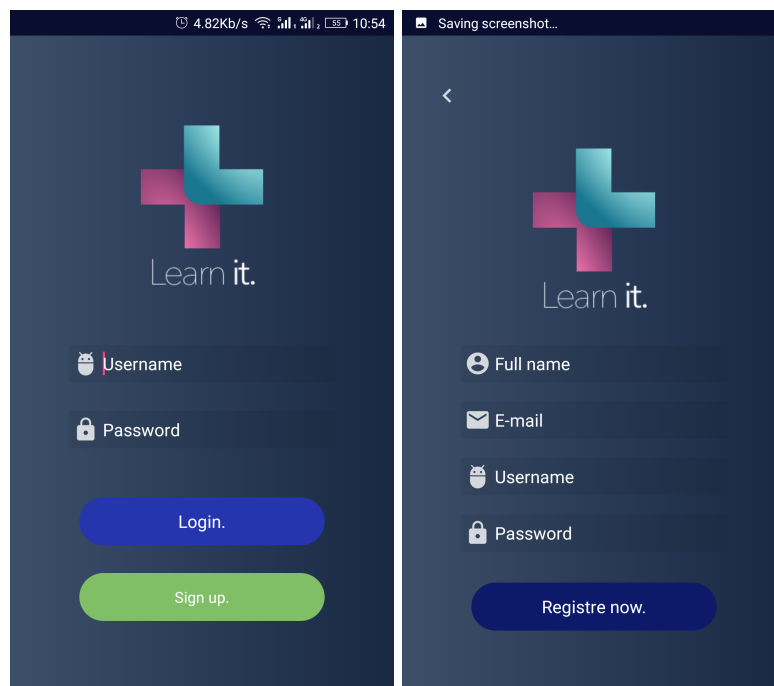

Figure IV.4: Login & Signup activities

IV.3.3.2   Home Screen activity

After the Login phase, A home screen is displayed to the user. The home screen gathers all the functionalities of our system. Being all displayed in the same place, it helps the user and facilitates the interaction and the accessing to every part of our system.

As it is noticed in the next figure, six major functionalities are provided:

- User's profile.

- Saves (Learning Content Saves).

- Share (Learning Content Share).

- News (News feed).

- QR code.

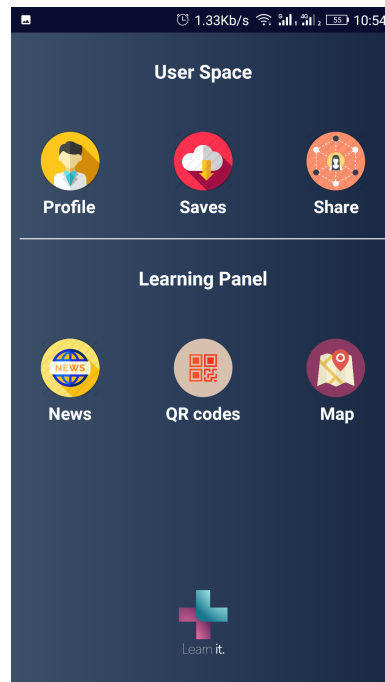- Map (Learning Environment Locator).

Figure IV.5: Home Screen Activity

As we can see, the home screen is divided into two large entities, the user space and the learning panel.

1. The user space: this entity holds the functionalities that matter to the user such as (his profile, saves and what he can share with other users as well).

2. Learning Panel: this entity holds the functionalities that help the user to interact with his environment and provide a direct connection to the learning materials.

in the next section, we will show each functionality, how it looks like and what how it is functioning in the background.

IV.3.3.3   User's Profile

After the Home screen is displayed, it contains many functionalities such as User's profile. the user's profile will display the current user personal information such as (name, profession, age, social number, address etc).
the personal information are retrieved after the login phase. A simple query with a direct connection is done using his social number to retrieve the information stored in Users' profiles database in the Ubiquitous Learning Server of our system.

Beside the personal information, the user can get access to his social media accounts like (twitter, Facebook and instagram).

In addition to that, the user has the ability to change his profile picture with a picture that suits him.

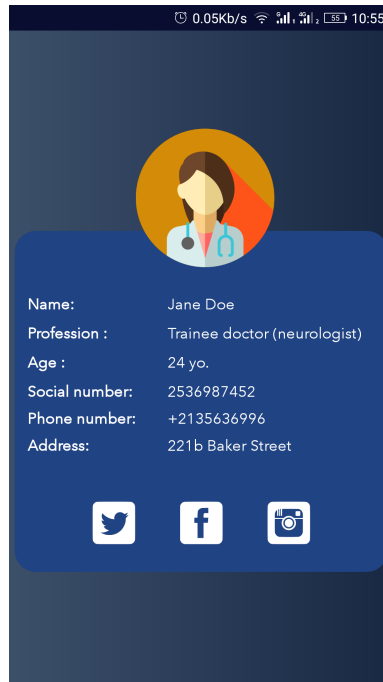Figure IV.6: User's Profile activity

IV.3.3.4   News Feed

This functionality is common among the users, it displays a news feed with the latest news in the health care category. It helps the user to know what's going on in this field, informs him and allows him to get an insight about the upcoming stuffs like (medicines, new surgery techniques, new machines etc).

Figure IV.7: News feed activity

this module is separated into submodules, each submodule holds a news about something specific. The large submodule shown in the head of this activity contains the main news (Important news).
The news displayed by this activity are retrieved with a bunch of queries from the Ubiquitous learning server after a direct connection to it from the application.

IV.3.3.5   Learning Environment Locator

This module or what is called "Map" allows the user to get the location of the nearby learning environment that our application supports such as (Hospitals, etc). Those locations are pre-marked already by the application. This functionality is made in general to help the user to identify and recognize the environments where our system is applicable.
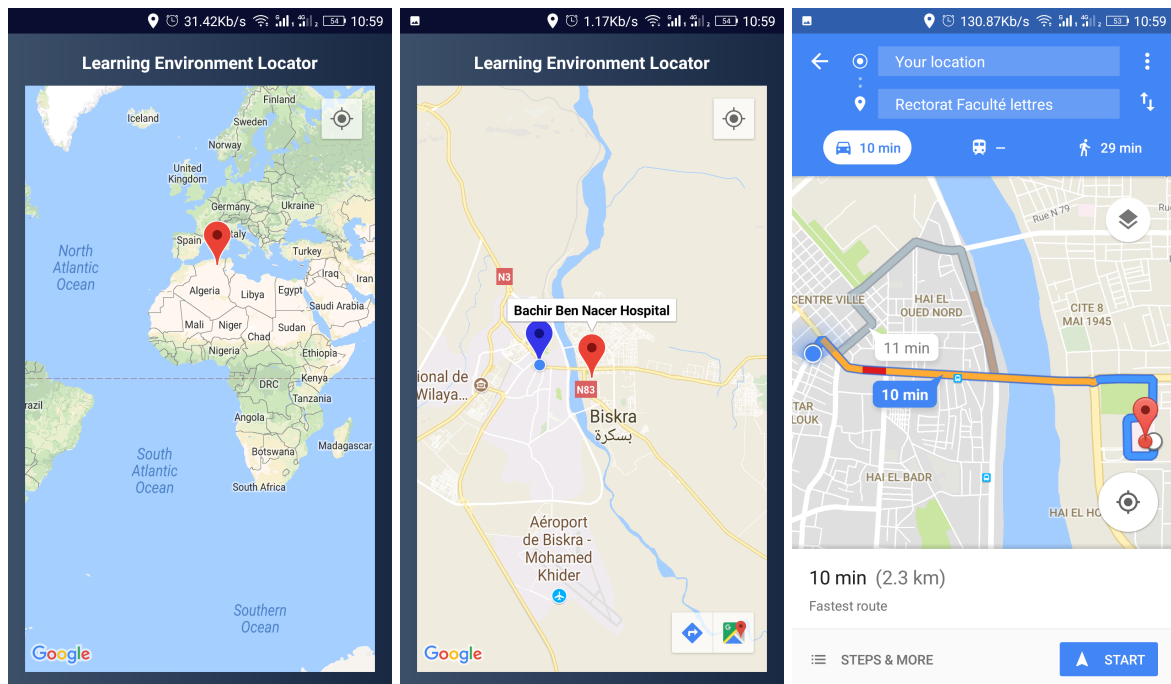

Figure IV.8: Learning Environment Locator (Map) activity

We took "Bachir Ben Nacer Hospital" as our Learning environment(A case study). As it is noticed, the hospital position is pre-marked already with a red marker, the blue marker is considered as the user's position.
With some calculations using the longitude and the latitude of both the user (Obtained using his GPS) and the premarked learning environment position, Google API used by the application allows to draw a path in the map so the user can reach his target.

IV.3.3.6   QR Code

As we mentioned earlier, this functionality considered as our system main functionality, because it allows the user to interact directly with his environment using QR codes.
This module works based on ZXhing API that allows to manipulate and manage everything that has to do with QR Codes. QR Code scanning will result a Serial number that is linked to a specific learning Content. This serial number can be used to retrieve the learning materials using simple queries with a "direct connection" to the database.
This functionality is divided into 3 major categories as we mentioned earlier and as it is shown in the next figure, which are (Patient, Substances and machines).
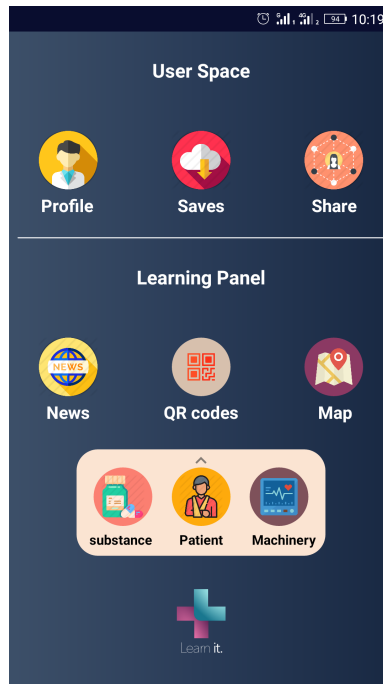
Figure IV.9: QR codes categories

IV.3.3.7 Patient's Panel

one of the categories that the user can choose from the QR code list is the Patient's panel QR code. When the user clicks on the Patient button, the camera scanning is activated which allows the user to scan any patient's QR code within the hospital environment.
After the scanning a Serial number belongs to the patient is retrieved and a data fetching based on it starts using "direct connection" and a list of queries and the results are displayed as it is shown in the next figures:

Figure IV.10: Patient panel activity

The result of data fetching are divided into 4 sections:

1. **Patient's personal information**: this section displays different kinds of information about the patient such (Name, Address,Gender etc).

2. **Patient's Illness**: After the patient being diagnosed in the hospital with his illness, the diagnosis (illness) is stored in the database in which it is retrieved now and displayed in this section. this section is the important one, because when the user click on "Learn more"A new activity is shown contains the Learning materials about this illness.

3. **Patient Medical History**: This section will be displayed only to the user with specific privileges. it shows the Medical history of the patient with information retrieved from the National Health Care server(Theoretical).

4. **Patient Treatment Progress**: This section has nothing to do with neither learning nor our system main objective. this functionality facilitates the work of the hospital stuffs that use the application by providing a side note for the patient's treatment progress.

IV.3.3.8   Illness Learning Content

As we mentioned earlier, After the patient's panel is displayed there's an option where the user wants to learn more about the patient's illness by clicking on learn more, a new activity is shown like the next figures:

Figure IV.11: Illness Learning Content activity

This functionality provides different kinds of information about the illness such as:

1. A summary about the illness.

2. The illness symptoms.

3. The diagnosis.

4. The prevention and risks.

5. The treatment.

6. A documentation video (media content) on how the illness works on human's body.

Besides all that, A saving button is provided to help the user to save the wanted learning content.

IV.3.3.9   Machine's Learning Content

A large type of machines are used in the hospital to diagnose and maintain human lives. knowing how these machines work and act is a fatal thing. Thus is category is important.

This category here helps providing the user with a learning content about the machines used within the hospital environment. it functions the same as the earlier functionality, by clicking on the button, a scanning camera appears to scan any machine's QR code with the hospital.

After the scanning the machine's serial number is retrieved and a data fetching based on, it starts using "direct connection" and a list of queries and the results are displayed as it is shown in the next figures:
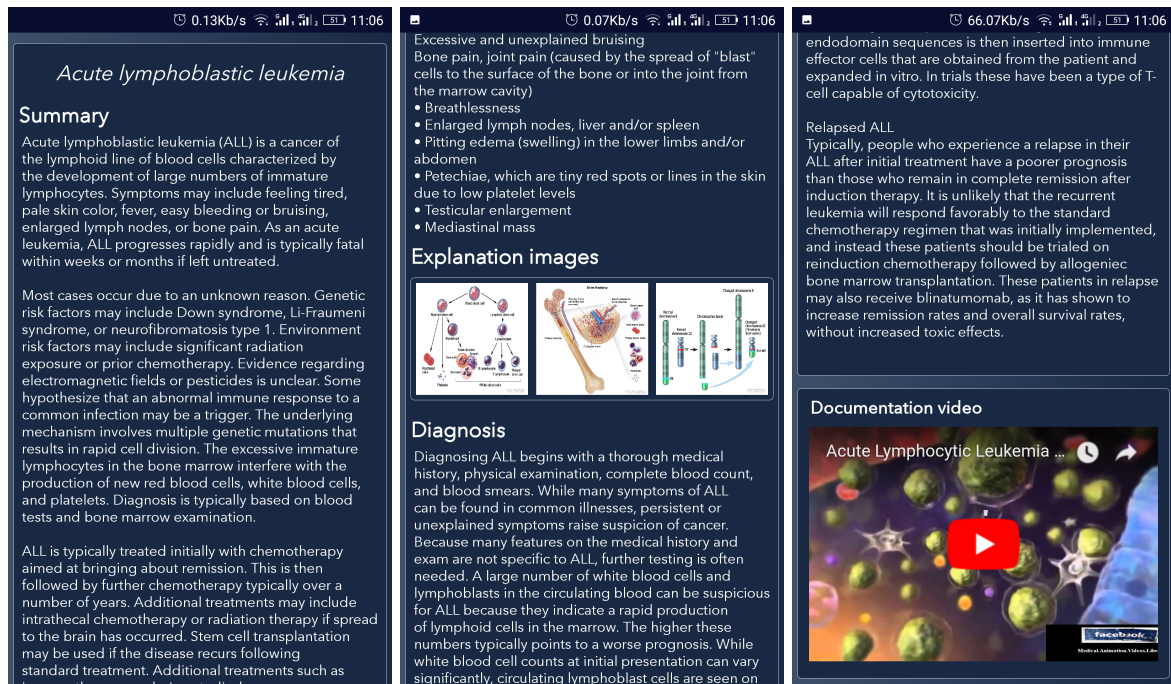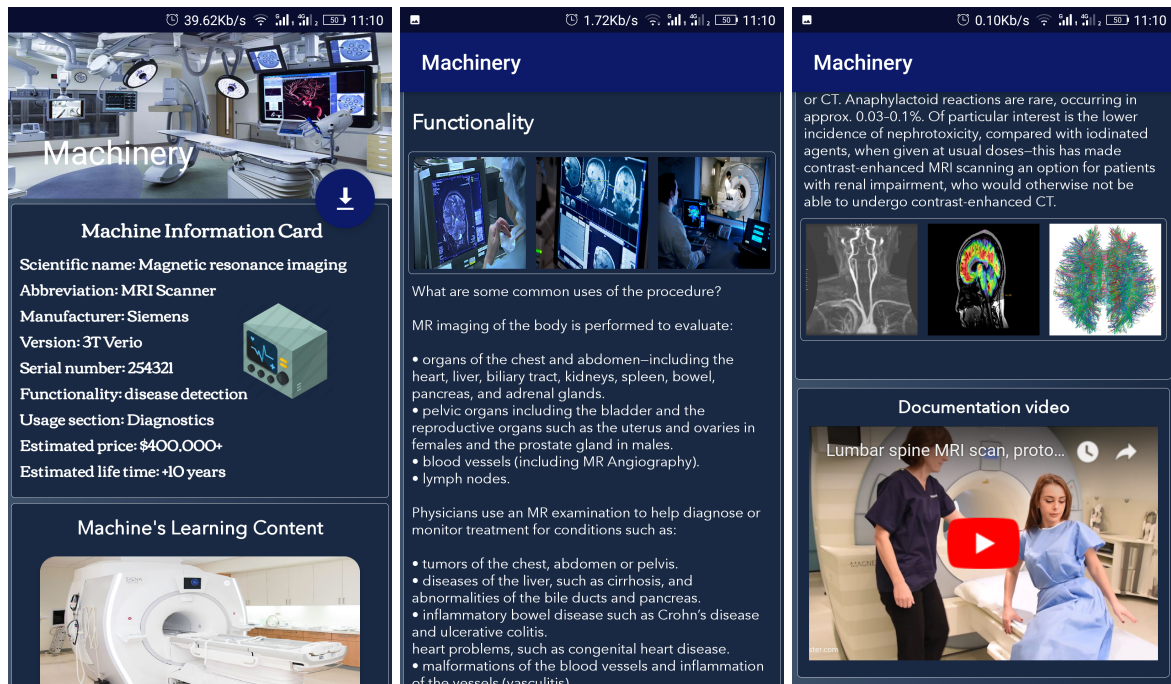

Figure IV.12: Machine Learning Content activity

This functionality provides different kinds of information about the illness such as:

1. The machine card information: contains all the necessary information about the machine such as (Manufacturer, usage section etc).

2. A summary about the machine.

3. The machine's mechanism.

4. The machine functionality.

5. A documentation video (media content) on how the machine works and what are its results.

Same as the earlier functionality, this one also has the ability to save the learning content whenever the user wants to, and that by clicking on the saving button.

IV.3.3.10   Substances' Learning Content

Due to the importance of the substances, the hospital environment acquire a large set of medicine and liquids that are used to cure and sustain human lives, Thus it is really important to gain knowledge on how those substances work and function and what are the consequences of using them.

We get access to this activity by clicking on the Substances button in QR code list, after clicking, a scanning camera appears to scan the QR code of any substance within the hospital environment.

After the scanning, the machine serial number is retrieved and a data fetching based on it starts using "direct connection" and a list of queries and the results are displayed as it is shown in the next figures:

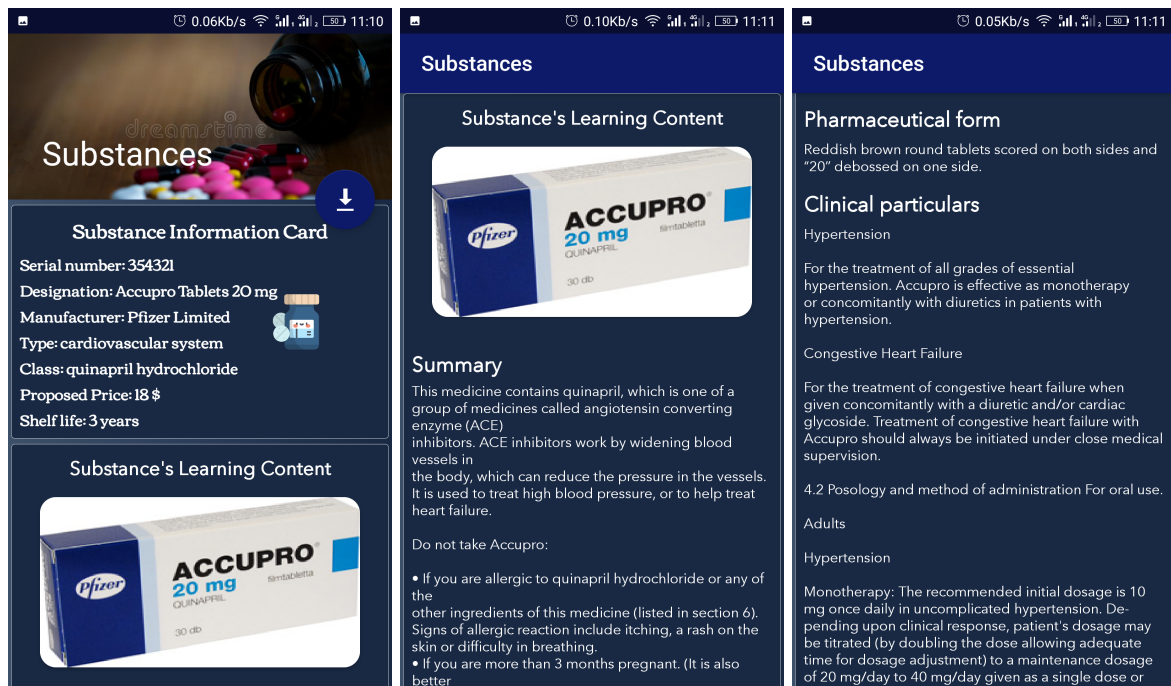Figure IV.13: Substances Learning Content activity

As it is noticed in the figures, the functionality provides different kinds of information about the substance such as:

1. The substance card information: it contains necessary information about the substances such as (Designation, Manufacturer, etc).

2. A summary about the substance.

3. The substance Pharmaceutical form.

4. The substance clinical particulars.

IV.3.3.11   Learning Content Saves

After the user had an access to all types of learning contents, he has the ability to save them just by clicking on the Save button. The saving option is very helpful for the user to keep able to access to different of kinds of learning contents. This functionality displays the saves as a list of modules like the next figure:
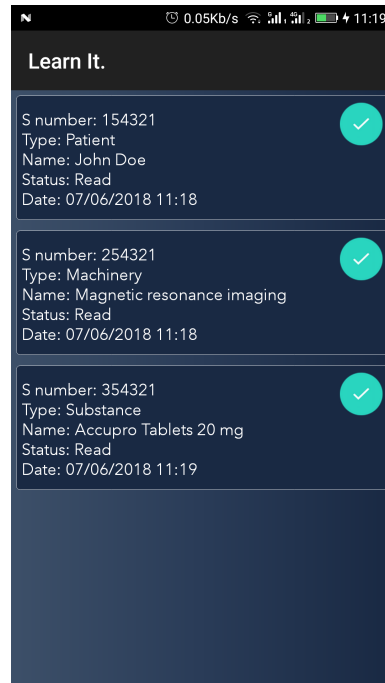

Figure IV.14: Saves activity

As it is shown, each module has a list of information such as:

1. The serial number of the save.

2. The type or the category (Substance,Patient,Machine).

3. Name of the saved type.

4. the status of the save (Read or not read).

5. The saves date.

The user can get access to learning contents just by clicking on the module he wants, where one of the learning content activities that we mentioned earlier will show up (Substance,Patient,Machine). The saves are stored in the application local database of Sqlite type where they can be retrieved by applying some queries using SQL helper class in java.

IV.3.3.12   Learning Content Share

After the user has saved learning materials in his application local database, he has the ability to share them with other users that uses the same application. This utility grants that the user can access as much many materials as possible.
This functionality uses wireless technology standard Bluetooth to share the learning contents between the application users. Using different kind of java classes such as (BroadCast class, etc), it allows a transparent and efficient way to share.

the functionality is divided into two different sides as it is shown in the next figure:

Figure IV.15: Saves activity

1. **Learning Content Sending**: This functionality starts just by clicking on any Save module shown in the list. After clicking on the wanted save module, a new activity starts:
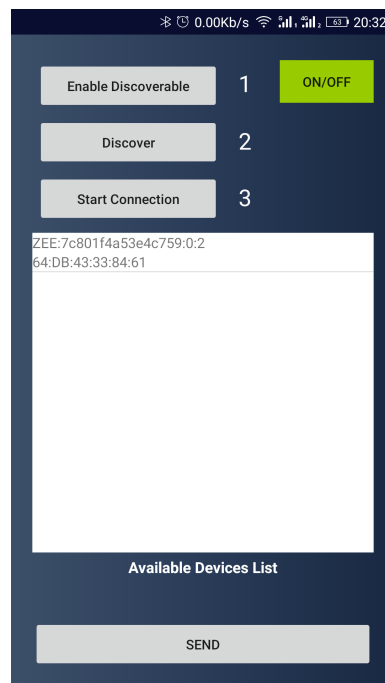

Figure IV.16: Saves activity

- ON/OFF button: starts and shutdown Bluetooth.

- Enable Discoverable: allows the device to be detected by the surrounding devices.

- Discover: Searching function for other devices to pair with.

- Available Devices List: After clicking on the discover button, the list of the available surrounding devices that you can pair with is displayed.

- Start Connection: establish connection between the sender and the receiver.

- Send button: Sends the wanted learning content to the receiver.

after the receiver receives the learning content, the learning content will be stored in his local database as a save.

2. **Learning Content Receiving**: This functionality starts by clicking on the Receive button, where a new activity starts. After clicking on the receiving button, a new activity starts:
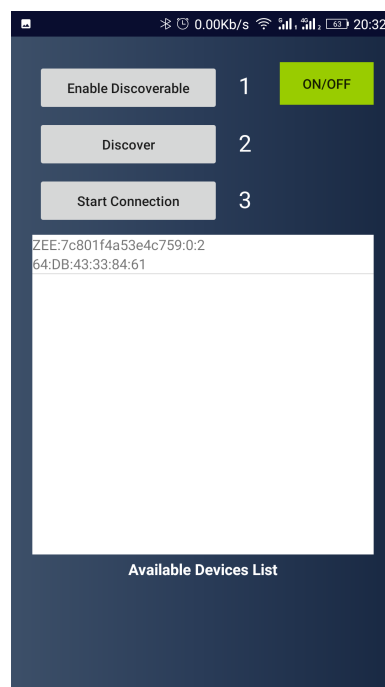
Figure IV.17: Saves activity

Unlike the sending activity, the receiving activity has no send button, but has all other functionalities, the receiver only have to pair with the sending device by establishing a connection, and he will get the wanted learning content as soon as possible.

IV.4 Conclusion

In this chapter we presented the multiple and different functionalities and parts of our system such as (Retrieving learning content using QR code, locating the learning environment, sharing learning content between users etc).

Conclusion

Knowledge is power, and there's no better way to grow your knowledge than learning. Learning new things and information is a treasure we must endure, because learning helps us improve ourselves for the better, and also helps us developing a new skill that will influence the way you do things and behave day to day and they will make doing things quicker and easier, saving time, energy and stress. Learning across our lives is essential for staying up to date in an ever-changing world. If we stop learning things, we can stagnate and actually move backwards, especially in our professional lives.

In order to achieve all of that, we built a system that helps us fulfill those needs. Our system is basically based on one of the largest used learning paradigms beside the Electronic learning and the Mobile learning, this paradigm called "Ubiquitous Learning".

Our system no doubt offers such a valuable amount of information when it comes to the health care system, we basically tried to cover different parts of it by providing rich learning contents and materials of each and everyone of them. Our system will make sure that users with the hospital environment stay up to date and learn about the changes happening around us, know them, and expand their knowledge about them in an efficient and more reliable way.

Appendix A: Source codes

A.1 Direct Connection

```
1       private static final String DB_URL = "database url";
2       private static final String USER = "username";
3       private static final String PASSWORD = "password";
4
5
6   try {
7
8               StrictMode.ThreadPolicy policy = new StrictMode.ThreadPolicy.Builder().permitAll().build();
9               StrictMode.setThreadPolicy(policy);
10
11              Class.forName("com.mysql.jdbc.Driver");
12              Connection con = DriverManager.getConnection(DB_URL,USER,PASSWORD);
13              if (con == null){
14                  msg = "Connection went wrong";
15
16              }else{
17          \\ Do the work
18  }
```

Source Code A.1: Direct Connection to external database

A.2 Google map

```
1   public void onRequestPermissionsResult(int requestCode, @NonNull String[] permissions, @NonNull int[]
    ↪   grantResults) {
2        switch (requestCode)
3        {
4            case REQUEST_LOCATION_CODE:
5                if (grantResults.length > 0 && grantResults[0] == PackageManager.PERMISSION_GRANTED){
6                    if (ContextCompat.checkSelfPermission(this,Manifest.permission.ACCESS_FINE_LOCATION) ==
                     ↪   PackageManager.PERMISSION_GRANTED){
7
8                        if (client == null){
9                            buildGoogleApiClient();
10                       }
11                       mMap.setMyLocationEnabled(true);
12                   }
13               }else{
14                   Toast.makeText(this,"Permission Denied!",Toast.LENGTH_LONG).show();
15               }
16               return;
17       }
18   }
```

Source Code A.2: Google map location displaying method

A.3 QR code

```
1  IntentIntegrator integrator = new IntentIntegrator(activity);
2                          integrator.setDesiredBarcodeFormats(IntentIntegrator.QR_CODE_TYPES);
3                          integrator.setPrompt("scan");
4                          integrator.setCameraId(0);
5                          integrator.setBeepEnabled(true);
6                          integrator.setBarcodeImageEnabled(true);
7                          integrator.initiateScan();
8
9   protected void onActivityResult(int requestCode, int resultCode, Intent data) {
10
11          IntentResult result = IntentIntegrator.parseActivityResult(requestCode,resultCode,data);
12          if(result != null){
13              if (result.getContents() == null){
14                  Toast.makeText(this,"You cancelled the scanning",Toast.LENGTH_LONG).show();
15              }else{
16
17                  String Snumber = result.getContents();
18          \\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\
19          \\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\
20          \\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\}
21  }
22  }
```

Source Code A.3: QR code scanning and data Serial number retrieving

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