



King Abdul-Aziz University
Faculty of Engineering - Girls' campus
Department of Electrical and Computer Engineering
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Final Report

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	University No:		Specialization:	Electrical and Computer Engineering

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1. Introduction

1.1 The student's mission statement for the training activity

The mission of the training activity is to realize the concept of internet of things and the ability to implement it into real life.

1.2 Expected Training Learning Outcomes

By the completion of the training activity, the expected learning outcomes will be:

1. Understand the concept of internet of things.
2. Understand the concept of cloud computing, its advantages and disadvantages.
3. Explain the security of internet of things, artificial intelligence and machine learning.
4. Describe Azure platform and its services and advantages.
5. Come up with ideas that applied the concept of internet of things.
6. Use Visual Studio program to write a program and make a connection between the cloud and the device explorer (simulator device).
7. Describe the external characteristics of mbed board and implement simple internet of things project which is temperature alert with Azure IoT Hub using mbed board.
8. Describe the external characteristics of raspberry pi 2 board and implement simple internet of things project by sending a message (data) from a raspberry pi 2 to the Azure IoT hub.
9. Describe the Xamarin platform and implement a mobile application in Visual studio program.
10. Build a warehouse-manager application with a barcode scanner and database.
11. Debug and fix the errors.
12. Deal with many software and hardware.
13. Write a professional Documentation.

2. The Company

2.1 Historical Background

KAU established the Deanship of Information Technology as a center in 1396 A.H. (1976 A.D.), and then turned into a Deanship by a ministerial decree issued in 1429 (2008) to be beacon of technology on campus, and the backbone of localizing modern technologies. The main activities of the deanship include offering technical support to all KAU students, employees and faculty members in addition to automating procedures and transactions, and developing communication mechanism inside the university [1].

2.2 Organizational Structure

Organizational structure is a system that consists of explicit and implicit institutional rules and policies designed to outline how various work roles and responsibilities are delegated, controlled and coordinated. Figure 1 represents a

diagram that outlines the internal structure of the Deanship of Information Technology [2].

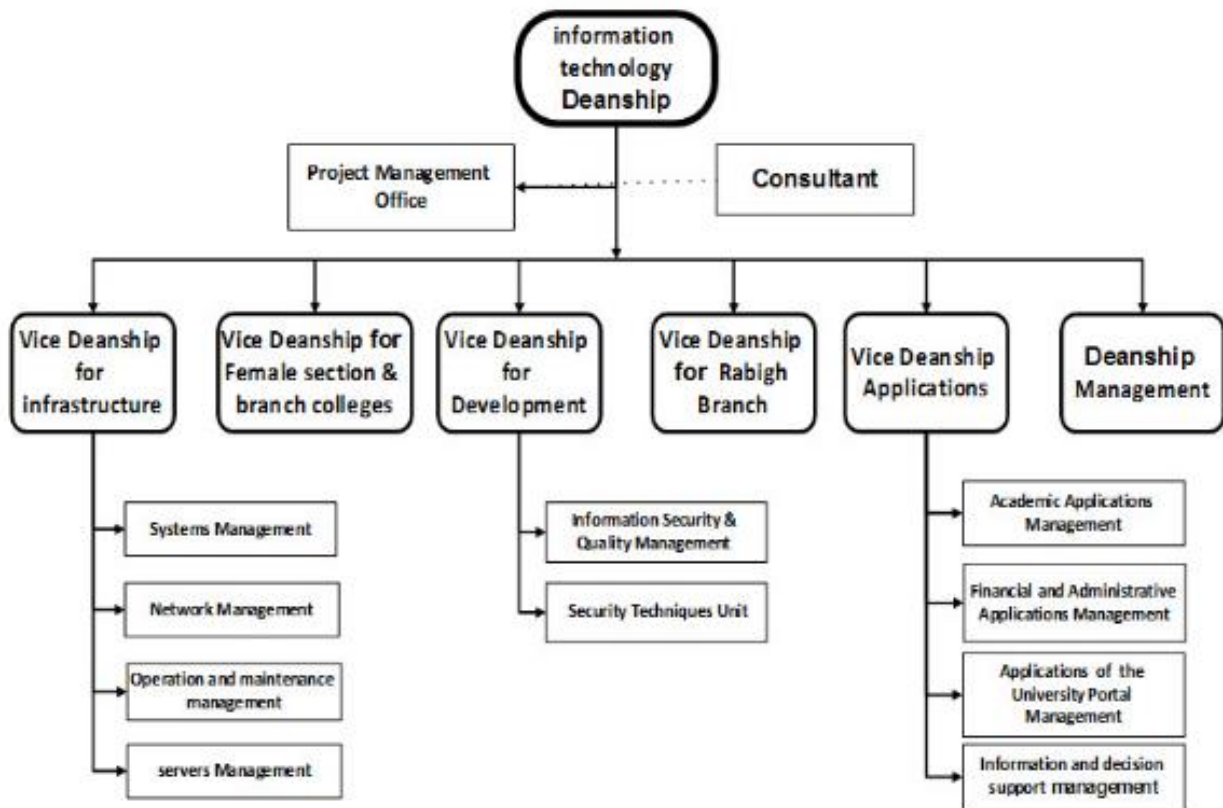


Figure 1. Deanship of information technology organizational structure

2.3 Products

Deanship of Information Technology seek to make available safe integrated information services and resources to facilitate education, scientific research and management at KAU. It is also keen to satisfy beneficiaries with quality services and responsiveness to their needs, as well as try to predict their needs. The major services they are responsible for are [3]:

1. User account and email.
2. Services of sections and academic members Websites' and forums.
3. Academic applications such as: academic services, system support Odus Plus and provide licensed software.
4. Network services for LAN and wireless.
5. The security policies and information security instructions and awareness brochures.
6. Services about E-Transaction and E-Archiving system.
7. Maintenance and support services for KAU devices.
8. Develop the King Abdul Aziz University application for smart phones, which provide us with a means effective, fast and direct communication with the university.

[2] <http://it.kau.edu.sa/Pages-org-structure1.aspx>

[3] http://it.kau.edu.sa/Default.aspx?Site_ID=223&lng=AR

9. Develop the Learning Management System Blackboard in safe and user friendly learning environment.

2.4 Customers

Deanship of Information Technology seek to deliver integrated secure IT solution to enhance the instructional, cultural, research and administrative sectors. It is also seeking to create a smart E-University empowered with knowledge at world-class level to all KAU students, employees and faculty members.

2.5 Engineering Units

Deanship of Information Technology is the beating heart at King Abdul Aziz University, it serves all sectors of the university and its members. It doesn't have engineering unit but it has two units which are Security Techniques Unit and Academic Applications Management unit support the programing field for electrical and computer engineer to work on.

- **Security Techniques Unit**

Security techniques unit was created by a decision of the Dean of Information Technology in 04/05/1435 H. It is responsible for the development, Implementation and maintenance of information technology security programs. The Unit plays a leading and unique role sharing with other IT departments. Security techniques unit is responsible for the following tasks [4]:

1. Supervision to control and monitor access to resources.
2. Apply Web Application Firewall on the various IT Web systems of Deanship of IT
3. Correlate events resulting from systems to know the probability of the Presence of security breaches
4. Monitor the performance of information security systems across a range of Programs
5. Conduct tests on all systems to ensure the security of information.

Figure 2 represents a diagram that outlines the internal structure of the security techniques unit.

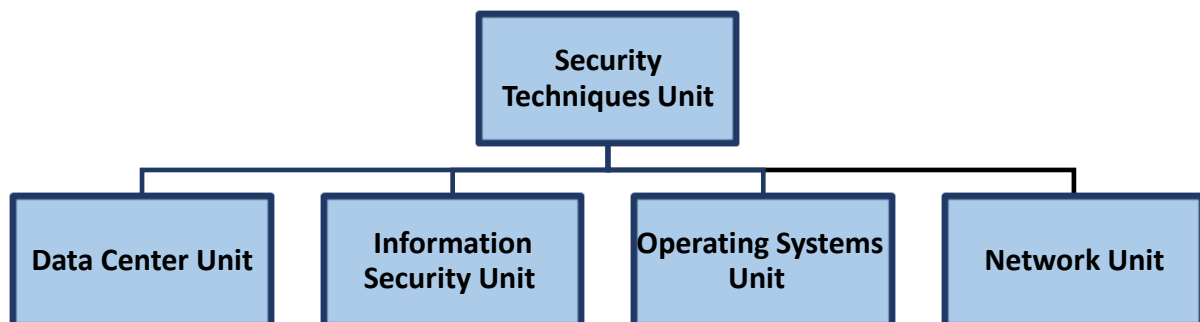


Figure 2. Security techniques unit organizational structure

▪ Academic Applications Management

Academic applications management unit is one of the important managements in the deanship. It is considered the artery providing software in line with the objectives of the university and all the different sectors within which the management functions and has many objectives.

The management team seeks to achieve all they can about the implementation, operation and maintenance of all electronic services related to the development of financial, administrative, academic systems, and other, and all related agencies facilitating performing its job properly and optimally. The administration also tries to achieve the main goal and work to add many new services. It contains several sections depending on the management of the software and applications life cycle, which are: a section of systems analysis, programming, testing, and support systems and programs, it also contains a special section for programs licenses. The administration's functions vary depending on the nature of the work. Academic applications management unit is responsible for the following tasks [5]:

1. Develop procedures to be followed in each section.
2. Application of technical standards and international models.
3. Monitor the implementation of procedures and standards.
4. Test the new electronic programs and make sure they conform to the needs of beneficiaries.
5. Coordination with other departments on the technical infrastructure.
6. Provide the necessary training for the use of application systems.
7. Find the integration of application systems.
8. Follow-up licenses for ready-made programs.
9. Systems Analysis.
10. Development of systems.
11. Testing the systems.
12. Operation and follow-up.
13. Maintenance of the systems.

Figure 3 represents a diagram that outlines the internal structure of the academic applications management unit.

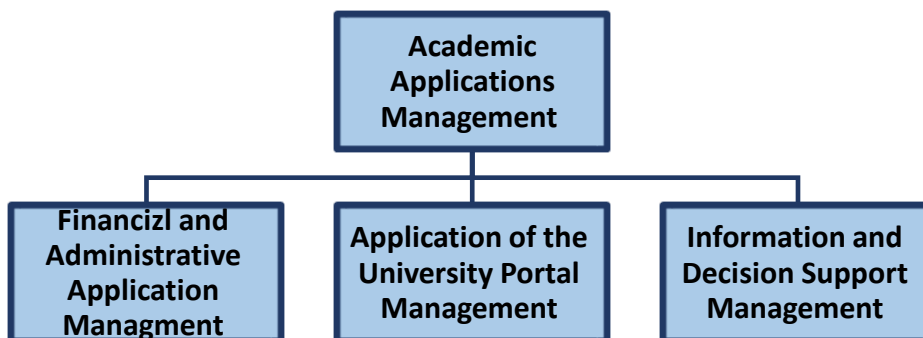


Figure 3. Academic applications management organizational structure

2.6 Industrial Process

Industrial process is a systematic series of mechanical or chemical operations that produce or manufacture something. Figure 4 represents a diagram that outlines the industrial process of the deanship of information technology [6].

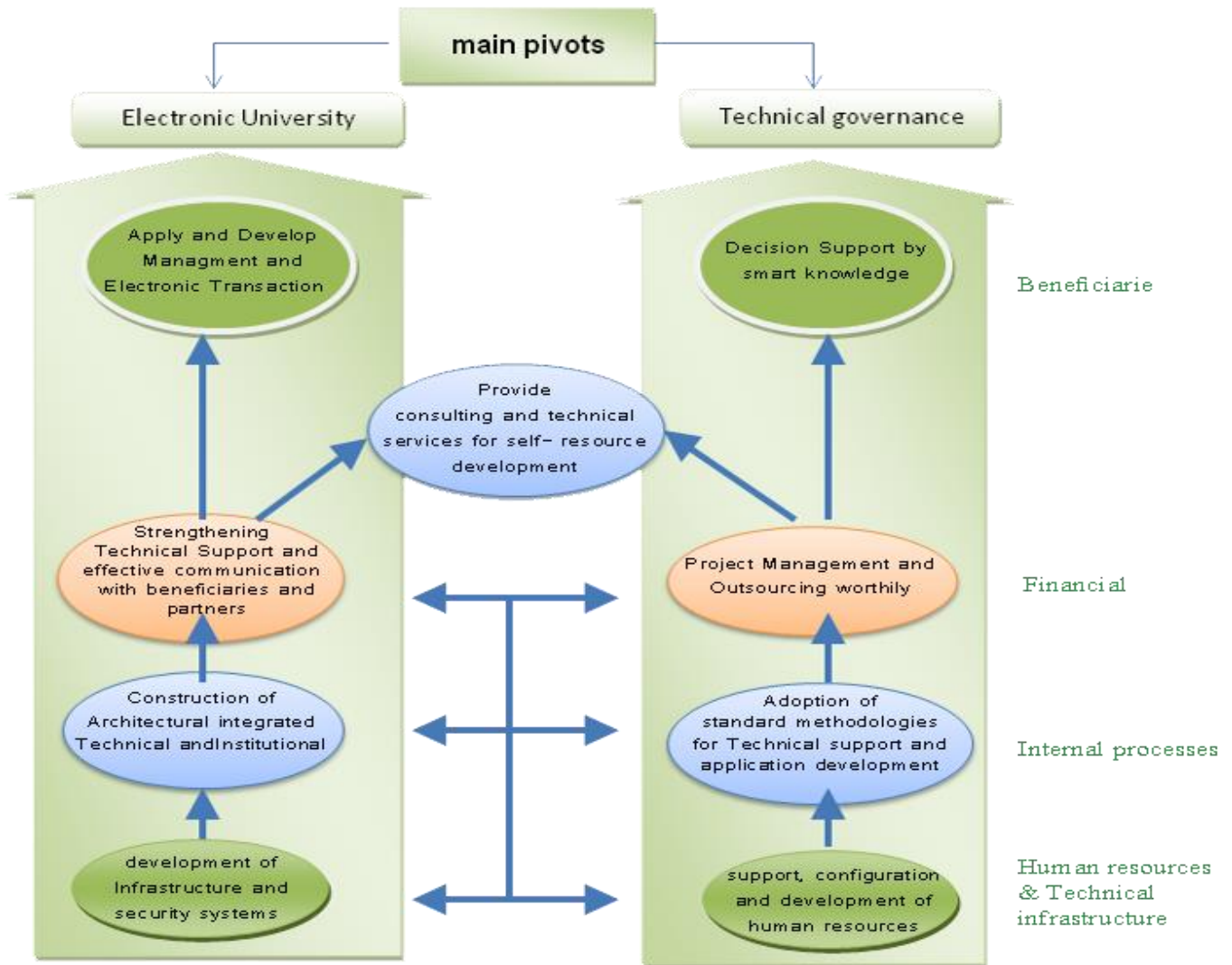


Figure 4. Deanship of information technology industrial process

2.7 Environmental and Social Impact

The environmental and social impacts of the company are:

1. Offering technical support to all KAU students, employees and faculty members in addition to automating procedures and transactions, and developing communication mechanism inside the university.
2. Developing the scientific intellect of the information technology in order to serve the country in specific and the information technology in general.

3. Accomplish the technological scientific communication among the faculty members.
4. Creating a conducive environment for those working in the field of information technology that leads to boosting the scientific progress and facilitates the scientific and intellectual exchanges among the specialists in this field.
5. Creating a bridge of cooperation and communication between the society and the different technological sectors regionally and internationally.

2.8 Quality System

Deanship of Information Technology is working continuously on improving quality in all the university units so as to achieve the mission and the strategic objectives of the university fully including spreading, supporting and applying the quality concepts.

The deanship seeks to transform KAU university to a safe e-university and to provide integral e-services for the university employees, students, customers, and community, depending on the principle of ensuring the customers satisfaction and to enhance the deanship's role in training, disseminating the technical awareness, upgrade the experience level of the university employees and students, and to provide an attractive environment of experienced national cadres in the field of IT and communication.

Information technology deanship applies the quality system according to (ISO-9001:2000), periodical reviewing, self-control of the work procedure and service prevision level. Also they are keen to satisfy beneficiaries with quality services and responsiveness to their needs, as well as try to predict their needs. Therefore, the deanship ensures the following [7]:

1. Spreading the culture of quality in the university and making it an essential option for improvement and development.
2. Working on supporting and adopting the quality applications in all the university units.
3. Encouraging and supporting the university obtaining quality certificates through qualifying it to get the accreditation.
4. Working in parallel to qualify the university and its programs to get the institutional and program accreditation, and coordination with the bodies and agencies donating these accreditations regionally and internationally.

3. The training environment

3.1 Work environment

In the summer training I have worked in the security techniques unit and academic applications management unit. The nature of the activities carried out by the security techniques unit are development, implementation, control and monitor access to resources, apply Web Application Firewall on the various IT Web systems of Deanship of IT, monitor the performance of information

security systems across a range of programs, conduct tests on all systems to ensure the security of information and maintenance of information technology security programs.

Academic applications management unit works in providing applications that supports the electronic services provided to beneficiaries such as students, employees and faculty members. It includes the following departments:

- Department of E-Learning (Blackboard).
- Department of Student Information Systems (Odus Plus).
- Department of Administrative Applications.
- Department of portal and software.

The nature of the activities carried out by the academic applications management unit are search in best technical solutions regarding to applications and develop them to keep up with the university needs and provide them in better performance and less cost, manage and supervise the systems and work on develop the systems and upgrade them with the necessary updates.

3.2 Regulations and standards

In the information technology deanship, it is important to follow all deanship's regulations and standards in the work to be a good trainee. The regulations and standards of the deanship are [8]:

1. Come to deanship on time (8 AM).
2. Wear
3. Follow the privacy policy and electronic publishing for KAU web site.
4. Follow the privacy policy for university email.
5. Follow the policy of information security and quality.
6. Employees shall build their professional reputation on the merit of their services and shall avoid unfair competition with others.
7. Employees shall continue their professional development throughout their careers, and shall provide opportunities for professional development to technicians under their supervision.
8. Employees shall be objective and truthful in presenting their judgments, statements or testimony, which shall be restricted to their areas of competence and professional specialty.
9. Employees shall hold paramount the principles of safety and environmental protection in discharging their professional duties with an ultimate goal of maintaining individual and public interests.
10. The priorities in the work are defined as follows:
 - Government regulations and judiciary rules precede professional by-laws
 - Professional by-laws precede business contracts and personal interests

3.3 Training Timeline

A linear timeline shows a picture of events as they occurred in a certain period of time. Figure 5 represents a time plan of the whole training activity in the information technology deanship.

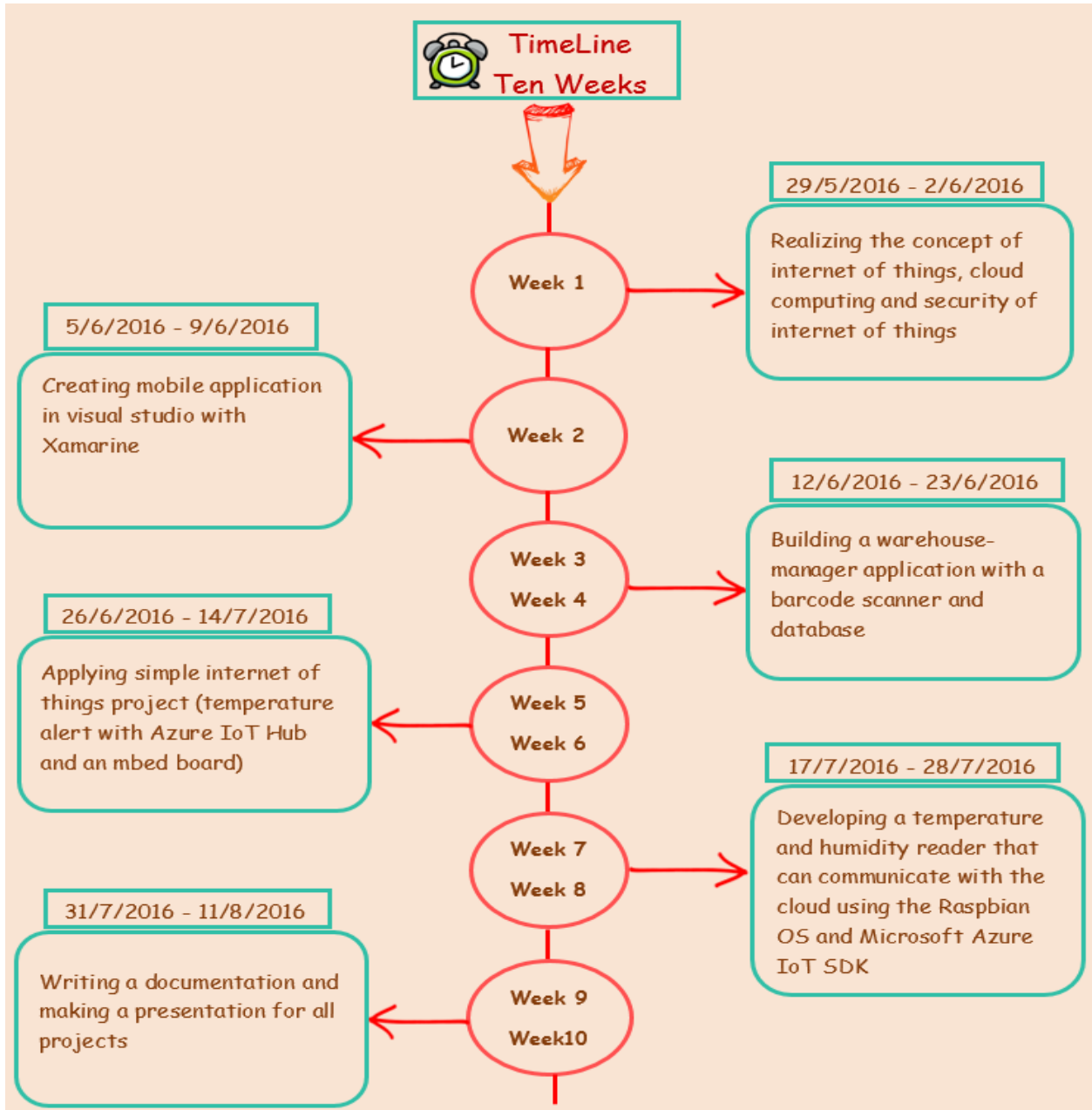


Figure 5. The time plan of the whole training activity

4. Assigned task(s)/project(s)

4.1 Problem definition

The main problem of the deanship information technology is that it is wasting of time and effort to update the databases that contain the barcodes of the computers and its peripherals manually. They want to update and connect all the databases of all the sectors automatically by a mobile application and to present them in anywhere and anytime by using the cloud computing concept.

4.2 Literature review and data collection

The main objective behind making this project is applying the internet of things into an effectively designed mobile application. A deeper understanding on how the project will function was getting by focusing on researching about the internet of things concept, cloud computing platform, how to build an app with barcode scanner to scan a product then search the database for that code and which a suitable platform or rather operating system the project has to be implemented.

- **Internet of things (IoT)**

- **What does Internet of Things (IoT) mean?**

Internet of things (IoT) is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction [9].

- **What the Internet of Things is doing?**

- ✓ Data Collection
- ✓ Information Sharing
- ✓ Changes in Online Security

- **What does Internet of Things Hub (IoT Hub) mean?**

Internet of things Hub (IoT Hub) is a site focused on the growing connectivity between software, the cloud, and the devices we use in everyday business operations.

- **Example of Internet of Things Hub (IoT Hub)**

Sending and receiving messages between mobile and cloud.

- **Cloud computing**

- **What is the cloud computing?**

In the simplest terms, cloud computing means storing and accessing data and programs over the internet instead of your computer's hard drive. Figure 6 represents the structure and the services of the cloud [10].

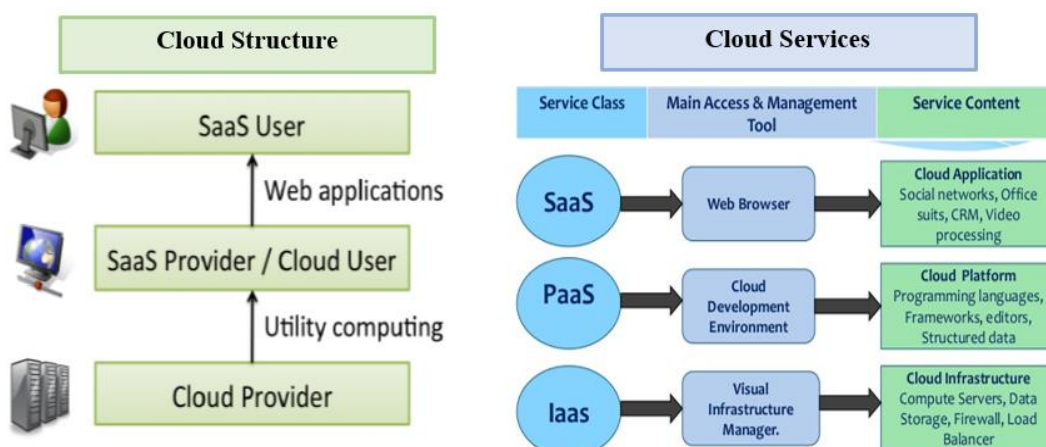


Figure 6. The cloud structure and services

- **What are the advantages of the cloud computing?**

- ✓ Unlimited storage capacity

[9] <http://internetofthingsagenda.techtarget.com/definition/Internet-of-Things->

[10] <http://searchcloudcomputing.techtarget.com/definition/cloud-computing>

- ✓ Increased data reliability
- ✓ Universal document access
- ✓ Latest version availability
- ✓ Easier group collaboration
- ✓ Device independence

• **Microsoft Azure: Cloud Computing Platform and Services**

Microsoft Azure is Microsoft's public cloud computing platform. It provides a range of cloud services, including those for compute, analytics, storage and networking. Users can pick and choose from these services to develop and scale new applications, or run existing applications, in the public cloud. Figure 7 represents the cloud services in Azure Microsoft platform and figure 6 represents the advantage of Azure.

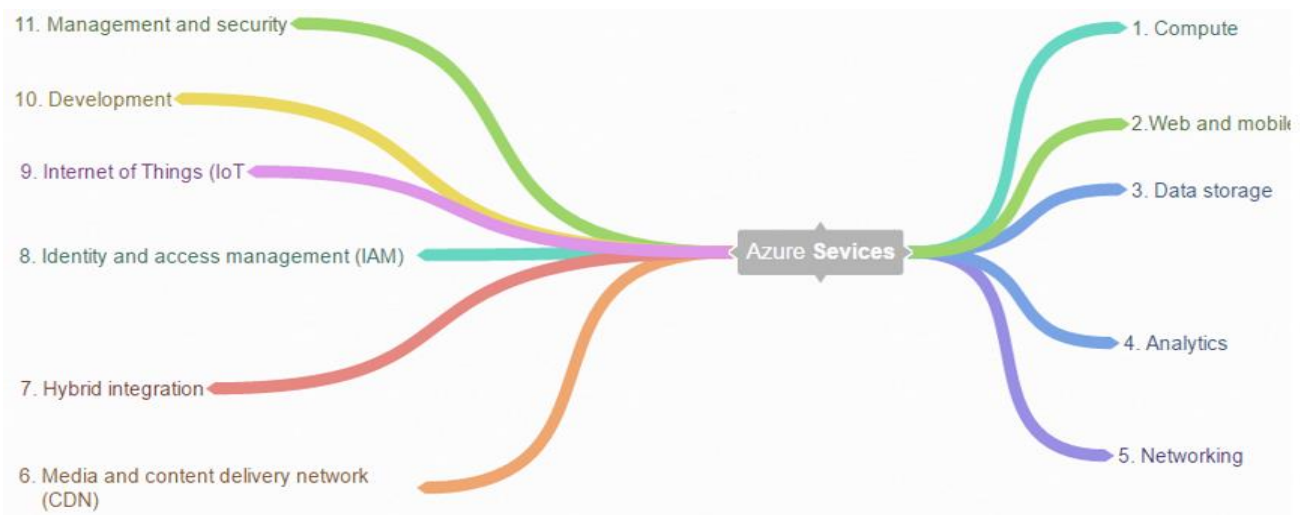


Figure 7. The Azure Microsoft platform services

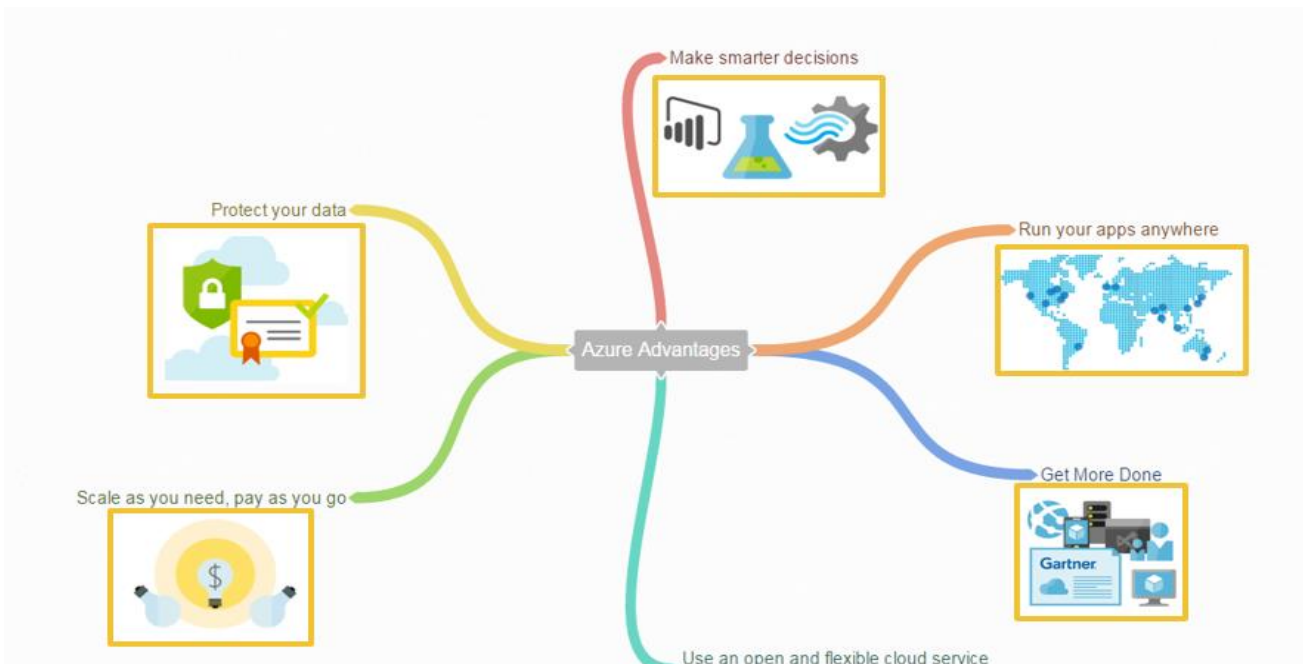


Figure 8. The Azure Microsoft platform advantages

[11] <https://azure.microsoft.com/en-us/overview/what-is-azure/>

- **Microsoft Visual Studio**

Visual Studio is a programming environment from Microsoft in which a programmer uses a graphical user interface (GUI) to choose and modify preselected sections of code written in the BASIC programming language. The product suite provides a visual interface for identifying a program as a Web service, forms for building a user interface (including support for mobile device interfaces), features for integrating existing application data, and for debugging. Visual Studio .NET comes with the .NET Framework, including the Common Language Runtime, and includes several programming languages including Visual Basic, Visual C++, and Visual C#. Figure 9 represents the universal application in visual studio [12].

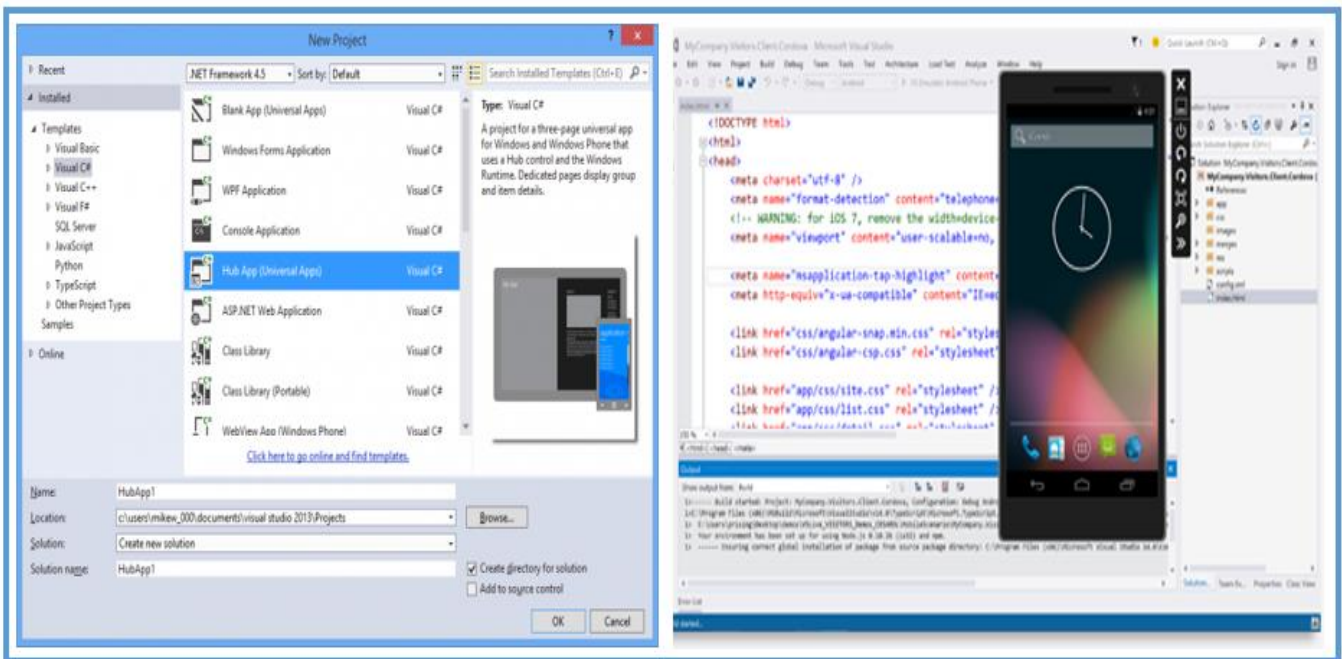


Figure 9. The design of the universal application in visual studio program

- **Apper.io Platform**

Appery.io is a cloud platform that makes it fast and simple to build hybrid and mobile web apps that are connected to APIs. Appery.io is a cloud-platform that has two core components. They are:

- ✓ Backend Services
- ✓ App Builder

The Backend Services consist of:

- Database for storing any app data (this database is in the cloud).
- Push Notifications for sending push messages to the app.
- Server Code for writing app logic on the server using Javascript.

You can create a new database, create, or edit new collections, create or edit new columns in a collection and so on. This all happens during development time or design time. Figure 10 represents the backend services database.

Products

Rename Delete collection Security and permissions Manage indexes Change default ACL

REST API **SHOW**

GET FIND CREATE UPDATE DELETE

Query **HIDE**

+Row -Row Delete All +Col -Col Edit Col Full Sc

<input type="checkbox"/>	_id	name	description	acl	_createdAt	_updatedAt
<input type="checkbox"/>	550b4918e4b...	water	75010592007...	{**":{"write":tr...	2015-03-19 22...	2015-03-19 22...
<input type="checkbox"/>	550b484be4b...	Android	Nexus 5	{**":{"write":tr...	2015-03-19 22...	2015-03-19 22...
<input type="checkbox"/>	550b446fe4b...	Phone	iPhone 6 plus		2015-03-19 21...	2015-03-19 21...

Figure 10. Appery.io Backend Services: Database (development and runtime)

The App Builder is where the design, build and develop the app. The App Builder is an IDE (Integrated Development Environment) in the cloud. Figure 11 represents the app builder.

The screenshot shows the Appery.io App Builder interface. On the left, there is a sidebar with a 'CREATE NEW' button and a project tree. The main area is divided into three sections: a 'PALETTE' of controls (Buttons, Input, Datepicker, Link, Radio, Checkbox, Slider, Toggle, Select, List, Image, Grid, Navbar), a central design canvas showing a mobile app screen with a purple header 'Warehouse', a 'Name' input field, a 'Description' text area, a 'Save' button, and a 'Label' with a right arrow, and a right sidebar with 'PROPERTIES - Screen' settings including 'Zoom Level', 'Show Header', 'Show Footer', 'Switch', and 'COMMON' properties like 'Name', 'Custom Size', and 'Dimension'.

Figure 11. Appery.io App Builder (development time)

The technologies are used to build the app:

- HTML, Javascript, CSS
- jQuery Mobile
- Bootstrap, AngularJS
- Apache Cordova (PhoneGap)
- Any custom HTML, Javascript (or libraries), CSS

4.3 Knowledge integration with course work

The summer training was taking as the opportunity to test out the skills we developed in college and see how they work in the real life. The courses that benefit and help us in the training are:

1- IE 201 – Introduction to Engineering Design

The engineering design process is a series of steps that engineers follow when they are trying to solve a problem and design a solution for something, it is a methodical approach to problem solving.

The five steps used for solving the problem (mobile application) are:

1. Define the problem
2. Gather pertinent information
3. Generate multiple solutions
4. Analyze and select a solution
5. Test and implement the solution

2- EE 364 - Advanced Programming (Java)

There are numerous benefits from learning Java; however, the most important benefit is that the Java programming language is recognized worldwide and used in a multitude of applications, including advanced scientific systems and operating systems. By completing this course, we become able to write sophisticated Java and C applications. So, the advanced programming course helps us in creating the mobile application.

3- EE 250 - Basic Electrical Circuits

An electric circuit is formed by interconnecting components having different electric properties. It is therefore important, in the analysis of electric circuits, to know the properties of the involved components as well as the way the components are connected to form the circuit.

Basic electrical circuits help us in connecting the circuit which contains sensor, LCD, potentiometer and speaker to the kits (mbed and raspberry pi).

4.4 Safety and environmental issues

The barcode scanner application uses cloud storage to save the databases which is a service where data is remotely maintained, managed and backed up. cloud service is a revolutionary storage method for the data. From music files to pictures to sensitive documents, the cloud invisibly backs up the files and folders and alleviates the potentially endless and costly search for extra storage space. An alternative to buying an external hard drive or deleting old files to make room for new ones, cloud storage is convenient and cost-effective. It works by storing your files on a server out in the internet somewhere rather than on your local hard drive. This allows you to back up, sync, and access your data across multiple devices as long as they have internet capability. According to that, if there is no internet connection, there is no access to the data. This will cause environmental issues in the way of preventing reaching to the databases and affecting the whole process. Likewise, there are concerns with the safety and privacy of important data stored remotely. If the system is hacked through the internet, it will result in large even immeasurable losses.

4.5 Work plan

Week No.	Task	Description	Sun	Mon	Tues	Wed	Thurs
Week 1 29/5/2016 to 1/6/2016	1	Realizing the IoT concept					
	1.1	Generating five ideas that applied the concept of internet of things for the sake of KAU					
Week 2 5/6/2016 to 9/6/2016	2	Creating an azure account					
	2.1	Creating mobile application in visual studio with Xamarin					
	2.2	Debugging the error					
Week 3 12/6/2016 to 16/6/2016	3	Searching in the internet about how to build a warehouse-manager application with a barcode scanner and database					
	3.1	Defining the input, the function and the output of the application					
	3.2	Creating the user interface of the application (start screen, scanning screen and product list screen)					
Week 4 19/6/2016 to 23/6/2016	3.3	Creating the warehouse user database					
	3.4	Creating the warehouse products database					
	3.5	Adding the services (Login service, logout service, list service, update service and query service)					
	3.6	Invoking the services by adding events to the buttons					
	3.7	Testing and launching the warehouse-manager application					
Week 5 26/6/2016 to 30/6/2016	4	Realizing how the IoT Hub is used to ingest data from the device and to notify the device when alerts are triggered by cloud services					
	4.2	Searching in the internet about how to apply simple internet of things project (temperature alert with Azure IoT Hub and an mbed board)					
	4.3	Creating an IoT hub, event hub, stream analytics and storage account					

		to receive data from the device and send commands back to it					
	4.4	Deploying a simple worker role to read alerts from the event hub and forward alerts to devices through the IoT hub					
Week 6 11/7/2016 to 14/7/2016	4.5	Connecting the device to the IoT by creating a unique identity and connection string					
	4.6	Creating mbed project and import the sample code					
	4.7	Testing and launching the project					
	4.8	Debugging the errors in the code					
Week 7 17/7/2016 to 21/7/2016	5	Searching in the internet about how to connect the Azure IoT Starter kit to the Remote Monitoring preconfigured solution from Azure IoT Suite					
	5.1	Searching in the internet about how to use Azure IoT services to create IoT architecture					
	5.2	Searching in the internet about the process of taking the Microsoft Azure IoT Starter Kit for Raspberry Pi 2 and Pi 3					
	5.3	Searching in the internet about how to develop a temperature and humidity reader that can communicate with the cloud using the Raspbian OS and Microsoft Azure IoT SDK					
	5.4	Setting up the environment on Azure using the Microsoft Azure IoT Suite Remote Monitoring preconfigured solution					
Week 8 24/7/2016 to 28/7/2016	5.5	Setting the device and sensors up so that it can communicate with both the computer, and Azure IoT					
	5.6	Setting up the Raspberry Pi with Raspbian operating system					

	5.7	Connecting the Raspberry Pi to a network and giving the device a static IP address					
	5.8	Updating the connection String and the device code sample to include our connection data					
	5.9	Building the modified Sample, testing and launching the project					
Week 9 31/7/2016 to 4/8/2016	6	Writing a documentation and making a presentation for the mobile application with Xamarine project					
	6.1	Writing a documentation and making a presentation for the warehouse-manager application project					
	6.2	Writing a documentation and making a presentation for the temperature alert with Azure IoT Hub and an mbed board project					
Week 10 7/8/2016 to 11/8/2016	7	Writing a documentation and making a presentation for the raspberry pi 2 project					
	7.1	Making the final presentation for the summer training					

4.6 Economic Factors

Barcode scanner application will definitely save the employee time and effort. If this application is applied into wide range to include all the university's sectors it would facility them the most and keep the system organized and updated. On the other hand, cloud services consume higher cost than manual systems for this reason; the university must offer an extra budget to it.

4.7 Implementation

Dividing a project into phases makes it possible to lead it in the best possible direction. The total work of a project is divided into smaller components, thus making it easier to monitor.

The barcode scanner application was built by following the four basic phases which are: analyzing, designing, programming and testing phase. The following paragraphs describe the four phases that has been used in creating the application.



First Phase: Analysing

In this project, we are going to use the Appery.io to build a mobile app that uses a barcode scanner to manage a warehouse. the app will scan a barcode, and update and create new products in a database.

The Appery.io is a cloud-platform that has two core components. They are:

- Backend Services
- App Builder

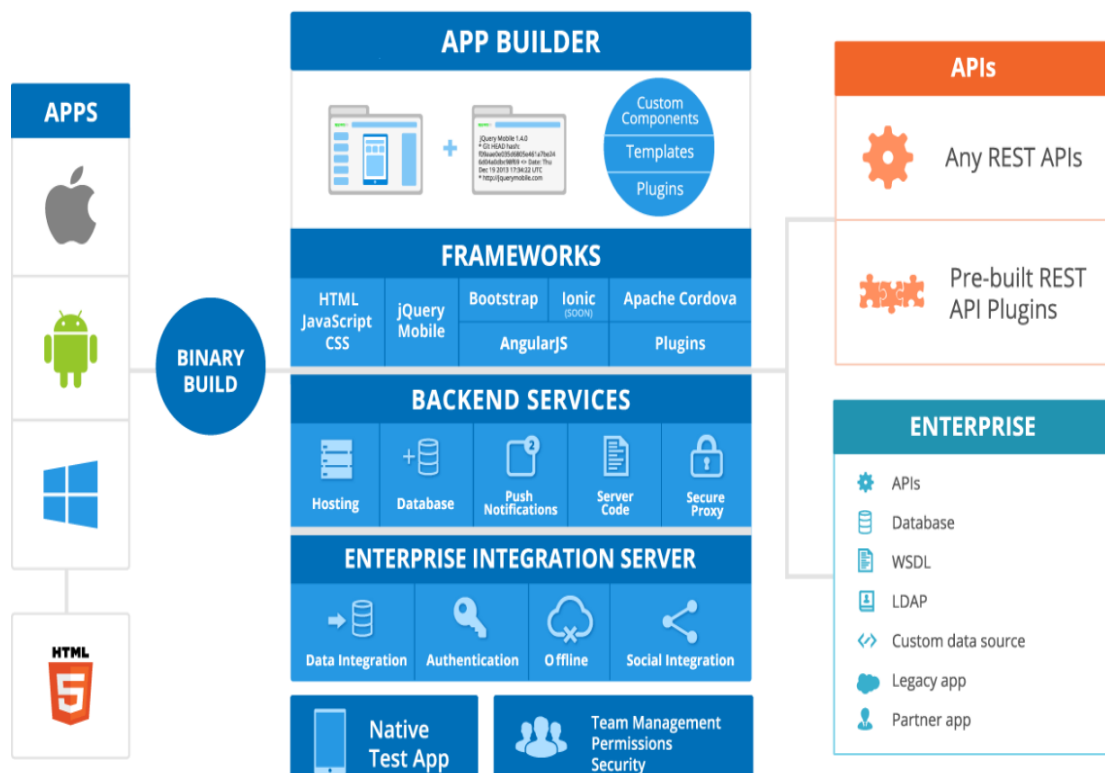


Figure 12. The Appery.io platform overview

The Backend services consist of:

- Database for storing any app data (this database is in the cloud).
- Push Notifications for sending push messages to the app.
- Server Code for writing app logic on the server using JavaScript.

The App Builder is where you design, build and develop your app. You use the App Builder during development. The App Builder is an IDE (Integrated Development Environment) in the cloud. It is pretty much like your standard IDE, but now it's running in the browser. App Builder uses the following technologies to build the app:

- HTML, JavaScript, CSS.
- jQuery Mobile.
- Bootstrap, AngularJS.
- Apache Cordova (Phone-Gap).

- Any custom HTML, JavaScript (or libraries), CSS.

Input:

- an Appery.io account.
- an Appery.io Database which is a cloud database.
- An Appery.io Tester.
- Barcode of any product.

Output:

The output of this application is that adding the barcode of any product to the database or updating the product information if the product is already existed in the database.

Functions:

The main function of this application is that to read the barcode of any product and to add it to the database or update the product data if the product is already existed in the database.

Appery.io database which is a cloud database provides instant storage for your mobile app. It's powerful, scalable, and provides instant integration with the app builder. There are three predefined collections in every database: users, files, and devices. Two collections are need to build this app which are the users collection and new collection for the product data.

An Appery.io tester which is a native app that allows testing Appery.io-built apps. This app makes it very simple to test native apps, as you don't need to install the app each time a change is made. Also it allows sharing an app with users who don't have an appery.io account.



Second Phase: Designing

Design is not just about how the application looks, but it's about how a user will experience the application. Design is a way of making technology useful.

The main features and the approximate layout of the application was sketched (making a rough drawing of how you want your mobile app to look like on smartphone screens) to use it as a reference when designing the user interface. So, by sketching you will have a good idea of what the application will look like, what every element should do, and how users can interact with the application.

The barcode scanner application will have three pages (start, scan and product list page) with different UI. The start page contains six components which are: three labels, tow inputs and one button. The first label asked the user to enter his name in the first input. The second label asked the user to enter his password in the second input. The button (login button) is used to navigate to the next page when the username and password are correct. The third label is used to show the error message which is wrong login or password! When the user enters incorrect information. Figure 13 shows the start screen and its components.

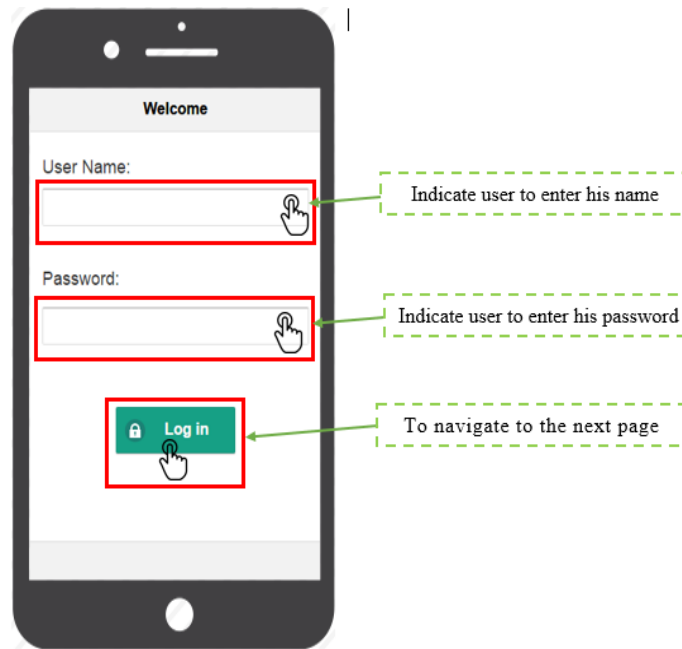


Figure 13. The start page and its components

The second page (scan page) contains seven components which are: three inputs and four buttons. The first and the second input components are used to represent or add the name and the quantity of the product. The third input component is used to represent the scanned code. The scan product button is used to scan the barcode of any product. The update button is used to increase the quantity of the product if it is existing in the list or to add a new product. The logout button is used to logout from the current account and navigate to the start page. The product list button is used to represent the product list. Figure 14 shows the scan screen and its components.

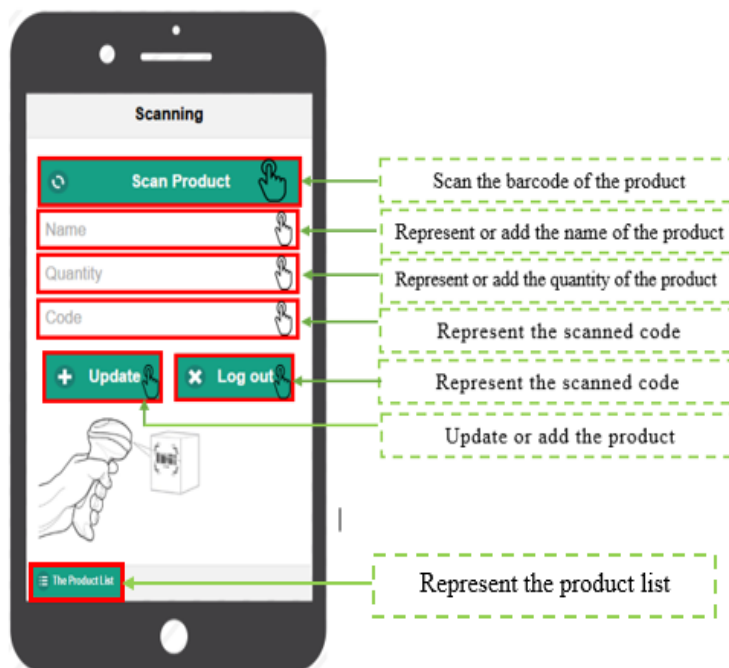


Figure 14. The scan page and its components

The third page (product list page) contains eleven components which are: three grids, four buttons and four labels. The first and the second grids have one row and two columns. Inside the cells there are a label component to represent the name and the quantity of the products. The third grid has one row and two columns. The two buttons inside the grid are named previous and next. The previous and the next buttons are used to load data from a database. The back button is used to navigate to the scan page. The logout button is used to logout from the current account and navigate to the start page. Figure 15 shows the product list screen and its components.

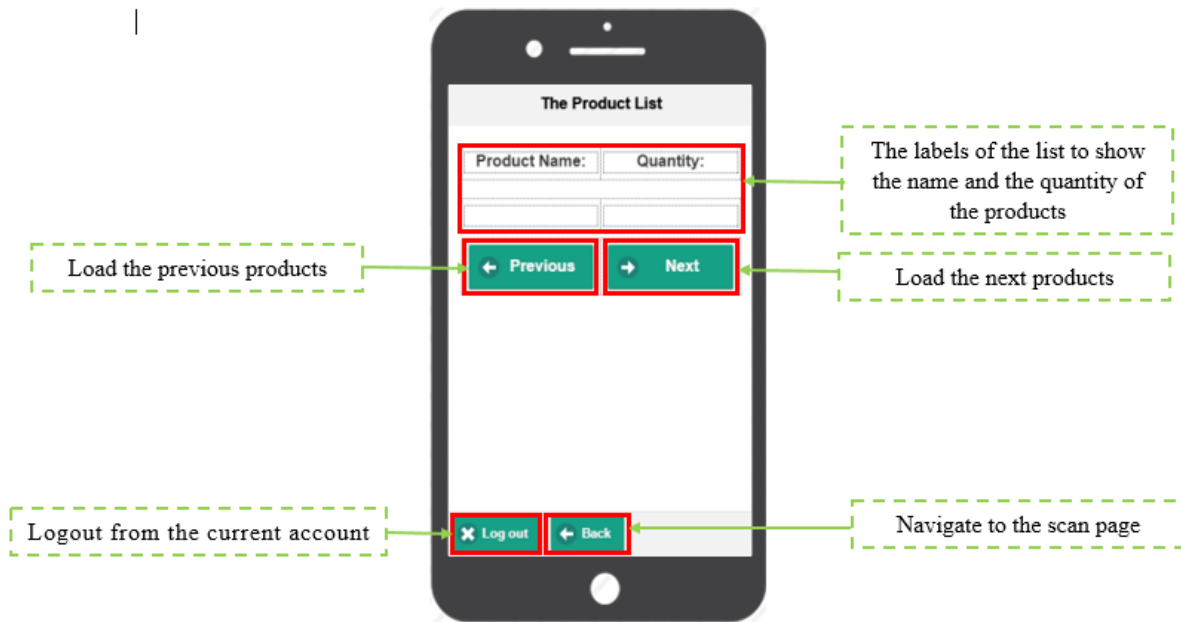


Figure 15. The product list page and its components

- **Collection structure**

The warehouse_db database was constructed. The Users collection is predefined. Figure 16 below shows the users database. The products collection was constructed and represents a simple form of a warehouse database. Figure 17 shows the products database, the name column is name of the product, the code column is the barcode of the product, and the quantity column refers to the quantity of the product.

Users						
Security and permissions						
REST API SHOW						
<input type="button" value="LOGIN"/> <input type="button" value="LOGOUT"/> <input type="button" value="GET"/> <input type="button" value="FIND"/> <input type="button" value="CREATE"/> <input type="button" value="UPDATE"/> <input type="button" value="DELETE"/>						
Query HIDE						
<input type="button" value="+Row"/> <input type="button" value="-Row"/> <input type="button" value="Delete All"/> <input type="button" value="+Col"/> <input type="button" value="-Col"/> <input type="button" value="Edit Col"/> <input type="button" value="Import"/> <input type="button" value="Full"/>						
<input type="checkbox"/>	_id	username	password	acl	_createdAt	_updatedAt
<input type="checkbox"/>	57605ddf4b0...	Majda	(hidden)	{**:{read":tr...	2016-06-14 19...	2016-06-14 19...
<input type="checkbox"/>	57605dd6e4b...	Kholoud	(hidden)	{**:{read":tr...	2016-06-14 19...	2016-06-14 19...
<input type="checkbox"/>	57605dc9e4b0...	Roba	(hidden)	{**:{read":tr...	2016-06-14 19...	2016-06-14 19...
<input type="checkbox"/>	57605dbfe4b0...	Rahaf	(hidden)	{**:{read":tr...	2016-06-14 19...	2016-06-14 19...
<input type="checkbox"/>	57605db4e4b...	Yousra	(hidden)	{**:{read":tr...	2016-06-14 19...	2016-06-14 19...
<input type="checkbox"/>	57605da4e4b0...	Fatima	(hidden)	{**:{read":tr...	2016-06-14 19...	2016-06-14 19...

Figure 16. The Users database

Product_Data

Rename Delete collection Security and permissions Manage indexes Change default ACL

REST API SHOW HIDE

GET FIND CREATE UPDATE DELETE

Query HIDE SHOW

+Row -Row Delete All +Col -Col Edit Col Import Data Full Screen Refresh

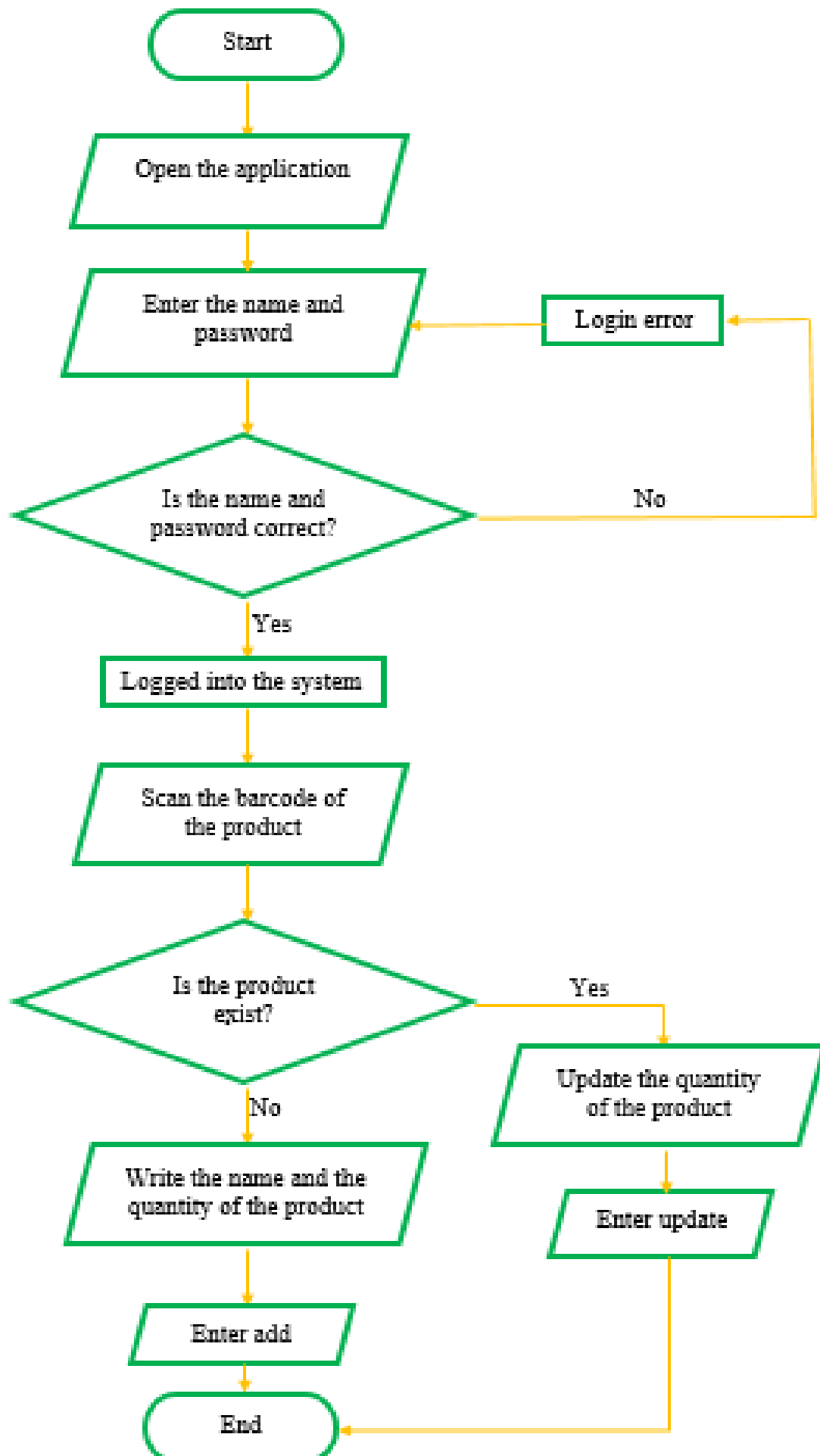
<input type="checkbox"/>	_id	Name string	Quantity number	code string	acl	_createdAt	_updatedAt
<input type="checkbox"/>	57690e88e4b0...	hp PC	1	TRF3470XKW	{**:"write":tr...	2016-06-21 09...	2016-06-21 09...
<input type="checkbox"/>	57690e3de4b0...	DELL Laptop	1	001961910622..	{**:"write":tr...	2016-06-21 09...	2016-06-21 09...
<input type="checkbox"/>	57690db7e4b0...	hp PC	1	CZC42567FR	{**:"write":tr...	2016-06-21 09...	2016-06-21 09...
<input type="checkbox"/>	57690d31e4b0...	hp PC	1	CZC425678N	{**:"write":tr...	2016-06-21 09...	2016-06-21 09...
<input type="checkbox"/>	576855d7e4b0...	Kleenex	8	6281002400478	{**:"write":tr...	2016-06-20 20...	2016-06-20 20...
<input type="checkbox"/>	5767e327e4b0...	Conditioner	2	8690637069604	{**:"write":tr...	2016-06-20 12...	2016-06-21 07...
<input type="checkbox"/>	5767e2e6e4b0...	Body wash	4	667534611876	{**:"write":tr...	2016-06-20 12...	2016-06-21 07...
<input type="checkbox"/>	5767e2bde4b0...	Shampoo	3	8999999511746	{**:"write":tr...	2016-06-20 12...	2016-06-20 12...
<input type="checkbox"/>	5767d622e4b0...	Hand cream	4	3574660149548	{**:"write":tr...	2016-06-20 11...	2016-06-20 11...

Figure 17. The product database

A flowchart is a visual representation of the sequence of steps and decisions needed to perform a process. Each step in the sequence is noted within a diagram shape. Steps are linked by connecting lines and directional arrows. This allows anyone to view the flowchart and logically follow the process from beginning to end.

Flowcharts use simple geometric symbols and arrows to define relationships. In programming, for instance, the beginning or end of a program is represented by an oval. A process is represented by a rectangle, a decision is represented by a diamond and an I/O process is represented by a parallelogram. The Internet is represented by a cloud.

In this part, a flow chart is a diagrammatic representation that illustrates the sequence of operations to be performed to use the application.





Third Phase: Programming

Since this app can edit the database records it needs special services to help linking and communicating through mapping between the created application and the cloud database figure 18 below illustrates the concept. Appery.io builder provides a built in services which can be imported and all its necessary fields are already created. These services are: settings service, sign-up service, login service, logout service, create service, delete service, list service, read service, update service and query service. Each service consists of four events: before send (to link between the page and the service request), success (to link between the service respond and the page), error and complete which each has its own actions that can be manipulated. This app uses some of the services as the following:

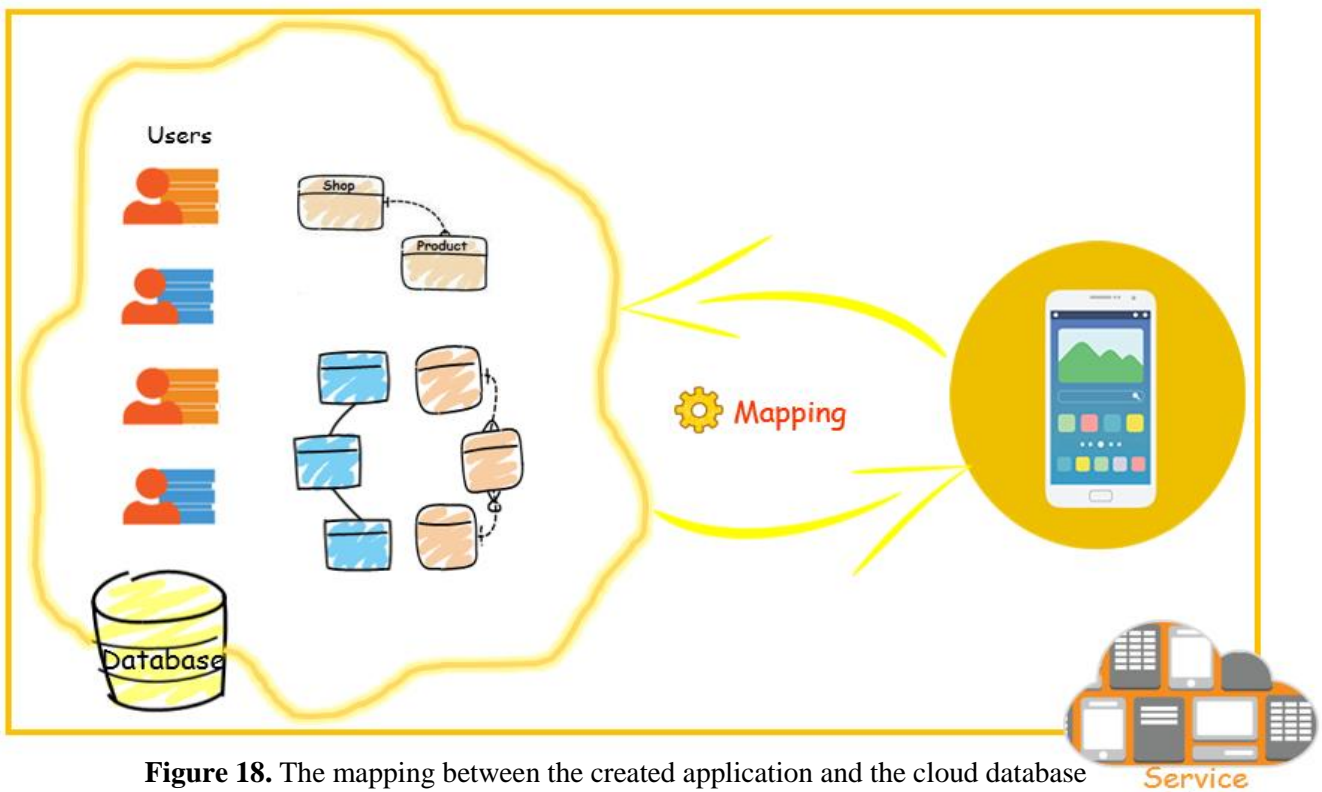


Figure 18. The mapping between the created application and the cloud database

1. Start Page Services

- Login Service

It used for the app authorization, since only the registered users in the users' database (Figure 19) will have the permission to login.

<input type="checkbox"/>	_id	username	password	acl	_createdAt	_updatedAt
<input type="checkbox"/>	57605ddfe4b0...	Majda	(hidden)	{**:{read:tr...	2016-06-14 19...	2016-06-14 19...
<input type="checkbox"/>	57605dd6e4b0...	Kholoud	(hidden)	{**:{read:tr...	2016-06-14 19...	2016-06-14 19...
<input type="checkbox"/>	57605dc9e4b0...	Roba	(hidden)	{**:{read:tr...	2016-06-14 19...	2016-06-14 19...
<input type="checkbox"/>	57605dbfe4b0...	Rahaf	(hidden)	{**:{read:tr...	2016-06-14 19...	2016-06-14 19...
<input type="checkbox"/>	57605db4e4b0...	Yousra	(hidden)	{**:{read:tr...	2016-06-14 19...	2016-06-14 19...
<input type="checkbox"/>	57605da4e4b0...	Fatima	(hidden)	{**:{read:tr...	2016-06-14 19...	2016-06-14 19...

Figure 19. The users' database

In this service 3 events will be used which are:

- **Before send:** which takes input before executing the login procedure and here to log in to the database, provide the user name and password. They will be linked (mapped) to the database as shown in the figure 20 below.

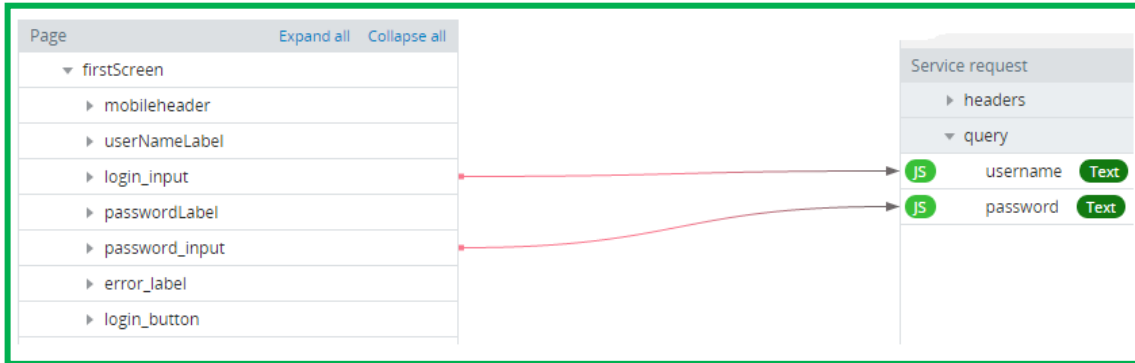


Figure 20. Mapping of the before sent event

- **Success event:** Which is the response after the login procedure. A new parameter was created (sessionToken) to be used in the mapping as shown in Figure 21. Also in this case the user should see the Scan Page hence; an event is added has the action navigate to page.



Figure 21. Mapping of the success event

When the user name and password don't match those registered in the database an error message should appear and this was done by adding an action to the error event which was this simple code `Apperyio('error_label').show();`. Also, the error message need to be hidden when the user tries to log in again thus an event was added to the Login Button that has the code `Apperyio('error_label').hide();`.

Finally, to launch the login service it was invoked to the Login Button in the Start Page when it's clicked.

2. Scan Page Services

- **Scan Item Device**

Since the barcode of the item has to be captured via the camera thus, a device was added to this page has the barcode service. And to show the just-scanned barcode on the page, and store it to a local storage variable to be used

later a new variable was created has the name code and mapped as shown in the figure 22 at the success event.

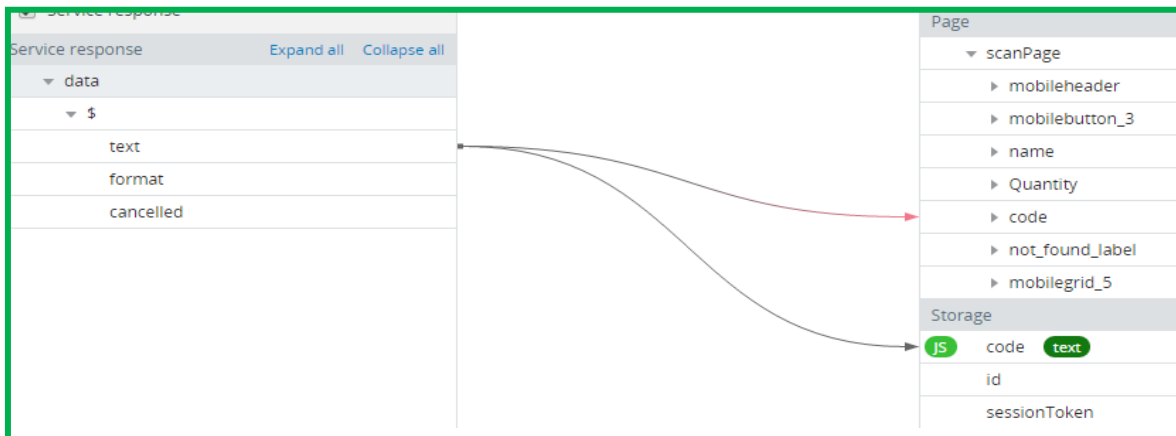


Figure 22. Mapping of the success event

- **Find Item Service**

A new service was created called find item to retrieve product information about the scanned code from the database. A new parameter was made called where to connect between the code area on the scan page and the database through mapping as shown in the figure 23 and the following code was added to it return `{“code”:” + value + “”}`;



Figure 23. Mapping of the before sent event

For the success event (the respond of the service) the following mapping has created as shown in the figure 24 to link between the service respond and the page.

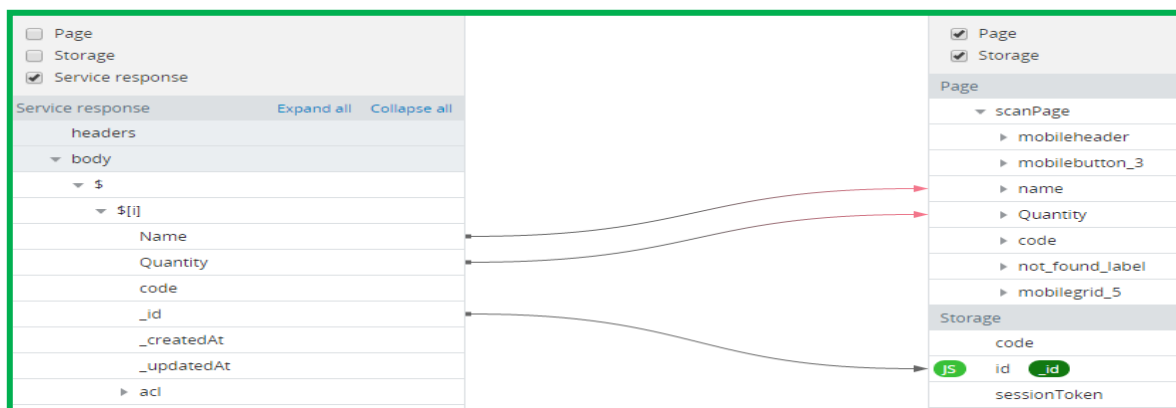


Figure 24. Mapping of the success event

- **Update Item service**

This service was created to update the newly-scanned product info and the mapping of the before sent event was done as shown in figure 25.

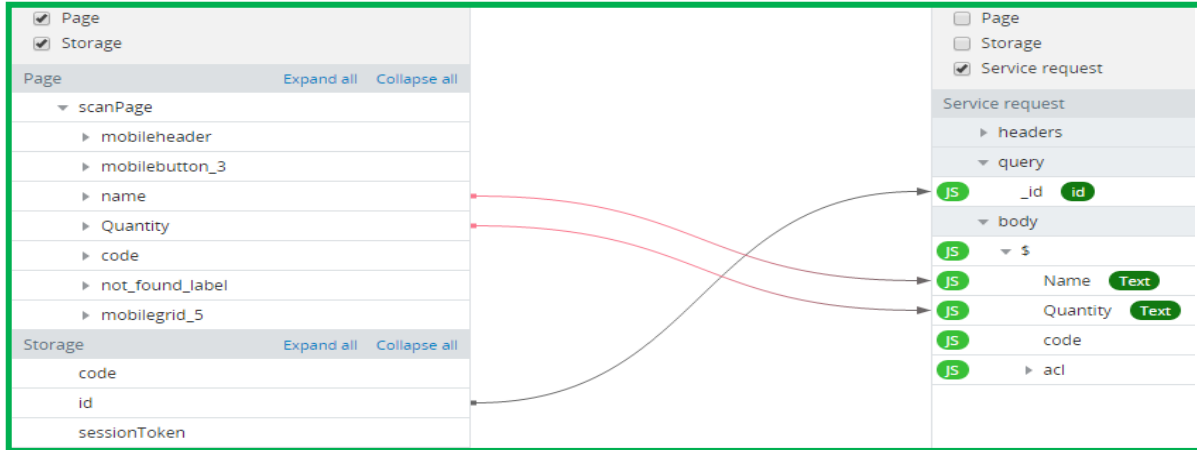


Figure 25. Mapping of the before sent event

- **Save Item Service**

This service was created to add new items to the database if the code scanned isn't found and the mapping of the before sent event was done as shown in figure 26.

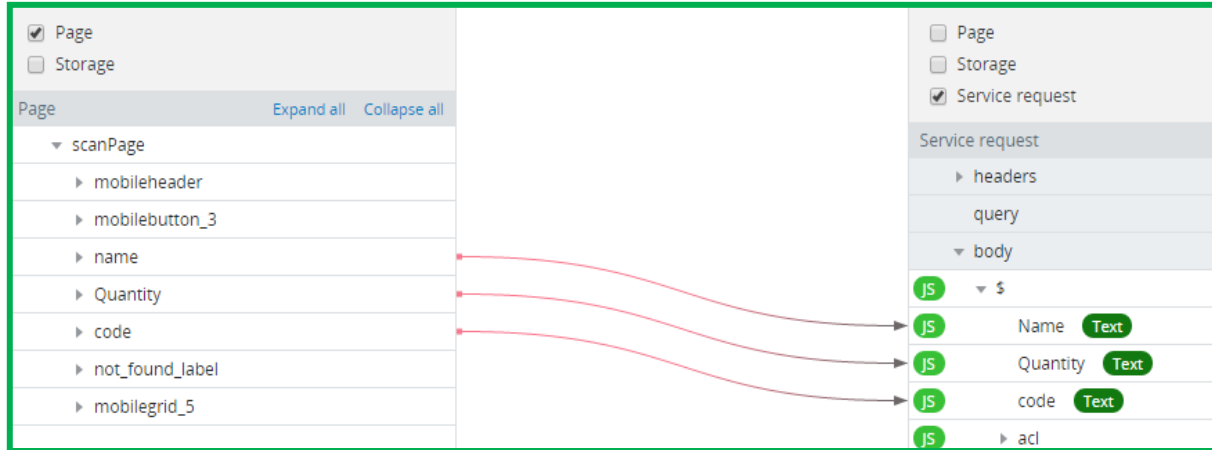


Figure 26. Mapping of the before sent event

- **Logout Service**

The logout service needs a sessionToken, which was retrieved upon log in. so the following mapping was made at the before send event (Figure 27). There is no response after the logout procedure. Also in this case the user should see the start page hence; an event is added has the action navigate to page.



Figure 27. Mapping of the before sent event



Invoking Services

Once the all services are added and mapped, it's time to add events to the buttons in the scan page.

- 1- At the scan button invoke scan item.
- 2- The update button will invoke different services according to the actual situation: if the scanned code is found in the database, it will invoke the update item service; otherwise it will invoke the save item service. Therefore, the following java script code was added to it:


```
if (Apperyio('action_Button').text() == 'Update')
  {update_item.execute({});}
else {save_item.execute({});}
```
- 3- The find item service should be invoked just after the scan item is finished. Once the code is scanned, the database request with the scanned code will be sent immediately. So at the success event of the scan item the find item service was invoked.
- 4- Since the update button will trigger two different services, it's reasonable to change its text according to the situation. The following event will also clear the text areas when the item isn't found in the database. Thus the following code was added at the success of the find item service:


```
if (data.length == 0)
  {Apperyio('not_found_label').show();
  Apperyio('action_Button').text('Add');
  Apperyio("name").val("");
  Apperyio("quantity").val(""); }
else {Apperyio('not_found_label').hide();
  Apperyio ('action_Button').text('Update');}
```
- 5- Once the new item is successfully added to the database, the warning label will be hidden. The following code was added at the success of the save item service.


```
Apperyio('not_found_label').hide();
```

3. The Product List Page

In this page a new service was added to get data from the product database called (get_states). At first two parameters were created (Limit and Skip).

- Limit- sets how many to display. For example, display 5 records at a time.

- Skip – sets at what record to start (or skip). For example, start at record 41 (skip 40).

The mapping action for Before Sent event (Figure 28 and 29) to link the parameters to the page.

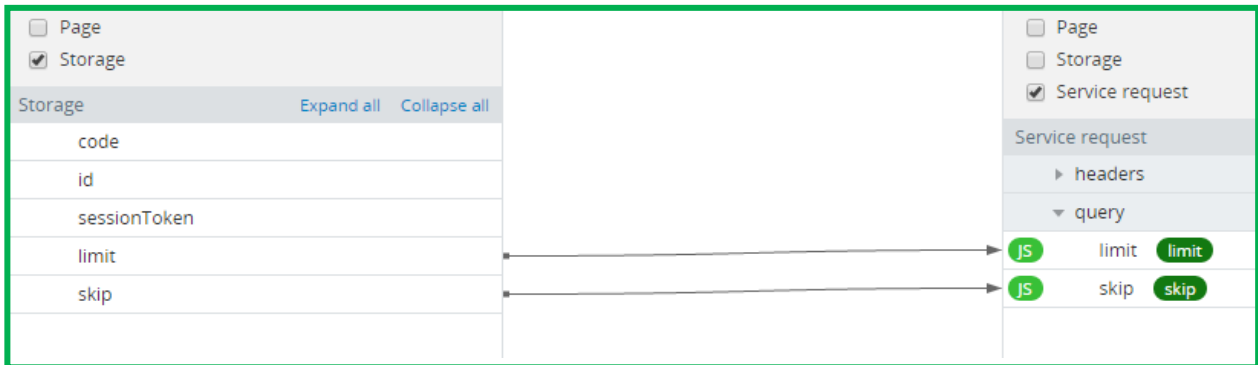


Figure 28. Mapping of the before sent event

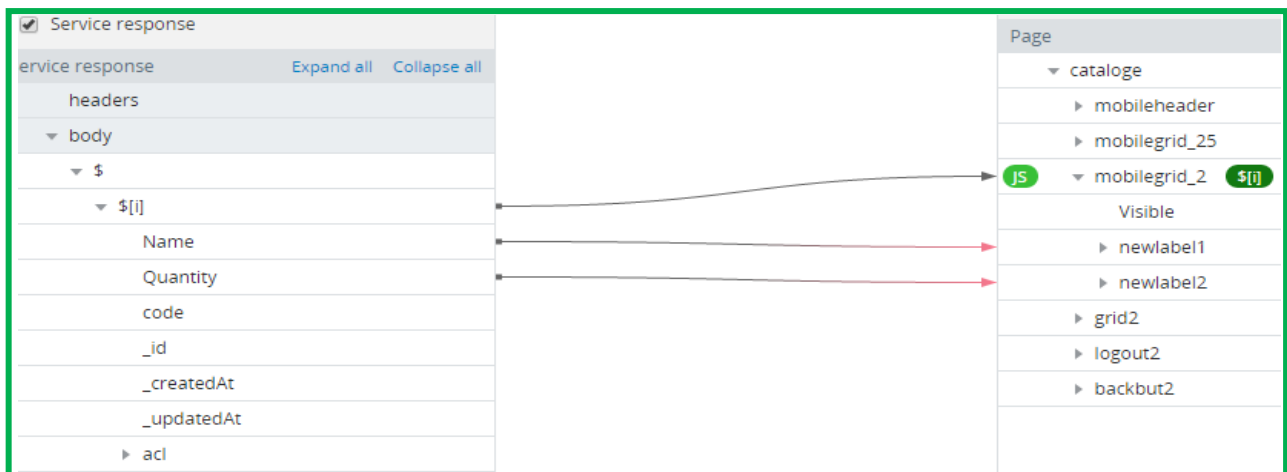


Figure 29. Mapping of the success event

The following events were added to the page:

- 1- This code was added to set the initial values for limit and skip


```
localStorage.setItem('limit', 5);
localStorage.setItem('skip', 0);
localStorage.setItem('total', 50);
Apperyio('prevButton').hide();
```
- 2- The `get_states` service was invoked on the page .
- 3- For the previous button the following code was added


```
var skip = parseInt(localStorage.getItem('skip'));
var limit = parseInt(localStorage.getItem('limit'));
var total = parseInt(localStorage.getItem('total'));
if (limit + skip > 0) {
  localStorage.setItem('skip', skip - limit);
  get_states.execute({});
  if (skip - limit === 0) {
    Apperyio('prevButton').hide();
  }
  if (skip - limit < total - limit) {
```

```

        Apperyio('nextButton').show();
    }
}

```

- 4- For the next button the following code was added
- ```

var skip = parseInt(localStorage.getItem('skip'));
var limit = parseInt(localStorage.getItem('limit'));
var total = parseInt(localStorage.getItem('total'));
if (limit + skip < total) {
 localStorage.setItem('skip', limit + skip);
 get_states.execute({});
 if (limit + skip == limit) {
 Apperyio('prevButton').show();
 }
 if (limit + skip == total - limit) {
 Apperyio('nextButton').hide();
 }
}

```

The last two codes retrieve the current values for skip and limit. Based on these values, we determine what records to display for previous (or next) button click. Also, decide whether to show the buttons based on where you are in the list.

- 5- For the back button an event was added has the action navigate to page (to scan page)
- 6- At the product List button on the scan page an event was added has the action navigate to page (to the product list page).



### **Phase One: Testing**

Will be demonstrated in the evaluation section.

#### **4.8 Impact analysis**

Barcode application will benefit the deanship employees by saving their time and effort. The databases will be automatically updated without any human contact. They will have the ability to accesses into the database anywhere.

The cloud service allows the users to store the files online. So, if there is no internet connection, there is no accesses to the store data. This will cause environmental issues by preventing reaching to the databases and affecting the whole process.

#### **4.9 Evaluation**

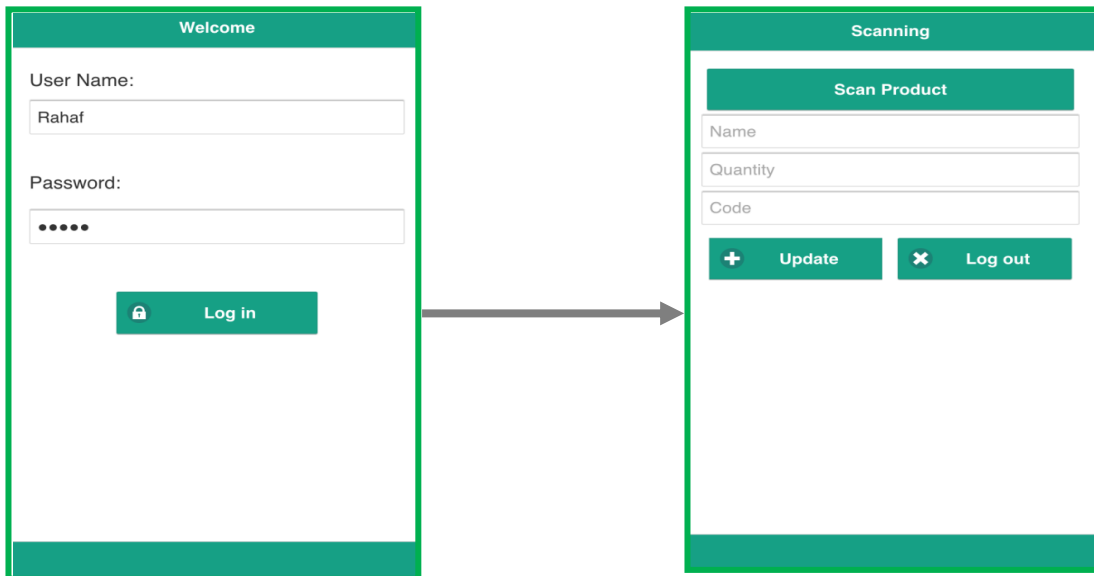
Finally, the application was tested and evaluated by doing the following phase.



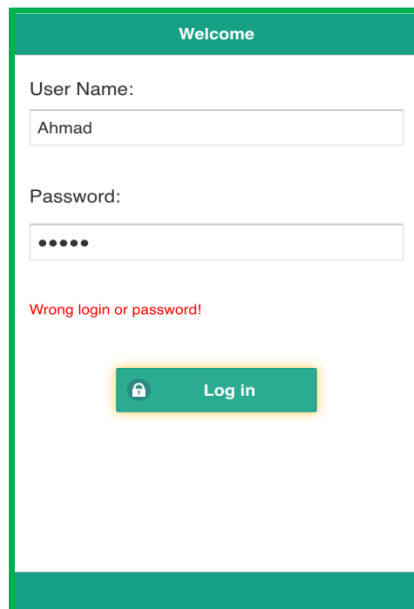
### **Testing**

#### **1- Logging in**

The Users' data base contains 6 users: Majeda, Kholoud, Yousra, Roba, Fatima and Rahaf. If the user name and the password are correct, the user will access to the scanning page. Otherwise, “Wrong login or password” will appear on the screen as shown below.



In case of “Wrong login or password”.



## 2- Scanning

a- If the product is existing in database,

Query  HIDE

+Row -Row Delete All -Col -Col Edit Col Import Data Full Screen Refresh

| _id             | Name              | Quantity | code            | acl                 | _createdAt       | _updatedAt       |
|-----------------|-------------------|----------|-----------------|---------------------|------------------|------------------|
| 57610b4ce4b0... | Pc                | 1        | 001920547545... | [**]({"write":tr... | 2016-06-15 08... | 2016-06-15 08... |
| 57610379e4b0... | Pen               | 2        | 490277891377... | [**]({"write":tr... | 2016-06-15 07... | 2016-06-15 07... |
| 57606863e4b0... | Gum               | 3        | 102855022165... | [**]({"write":tr... | 2016-06-14 20... | 2016-06-14 20... |
| 576063bee4b0... | Pencils           | 12       | 400781712255... | [**]({"write":tr... | 2016-06-14 20... | 2016-06-14 20... |
| 5760630ee4b0... | Agatha christi... | 9        | 628107207967... | [**]({"write":tr... | 2016-06-14 20... | 2016-06-14 20... |
| 575fdc36e4b0... | Note              | 70       | 24412759        | [**]({"write":tr... | 2016-06-14 10... | 2016-06-15 08... |



1-After scanning the barcode, the name and the quantity will appear on the screen.

2-After editing the quantity, we clicked 'update'.

1- Refreshing the Database.

| _id             | Name              | Quantity | code           | acl                 | _createdAt       | _updatedAt       |
|-----------------|-------------------|----------|----------------|---------------------|------------------|------------------|
| 57610b4ce4b0... | Pc                | 1        | 001920547545.. | {**};("write".tr... | 2016-06-15 08... | 2016-06-15 08... |
| 57610379e4b0... | Pen               | 2        | 490277891377.. | {**};("write".tr... | 2016-06-15 07... | 2016-06-15 07... |
| 57606863e4b0... | Gum               | 3        | 102855022165.. | {**};("write".tr... | 2016-06-14 20... | 2016-06-14 20... |
| 576063bee4b...  | Pencils           | 12       | 400781712255.. | {**};("write".tr... | 2016-06-14 20... | 2016-06-14 20... |
| 5760630ee4b0... | Agatha christi... | 9        | 628107207967.. | {**};("write".tr... | 2016-06-14 20... | 2016-06-14 20... |
| 575fd36e4b0...  | Note              | 100      | 24412759       | {**};("write".tr... | 2016-06-14 10... | 2016-06-15 08... |

b- If the product is not existing in database,

1-This transformer does not exist in database.



2-After scanning the barcode.

3-Write the name and quantity of the product. Then, click Add.

**Scanning**

**Scan Product**

Transformer

4

1480968410402311

This item is not found in your database. Add the item's Name and its Quantity then enter Add!

+ Add
✕ Log out

4-Refreshing the database.

Query HIDE

+Row
-Row
Delete All
+Col
-Col
Edit Col
Import Data
Full Screen
Refresh

| _id             | Name              | Quantity | code            | acl                | _createdAt       | _updatedAt       |
|-----------------|-------------------|----------|-----------------|--------------------|------------------|------------------|
| store           | store             | number   | store           | store              | store            | store            |
| 57611308e4b0... | Transformer       | 4        | 148096841040... | ("*")("write"tr... | 2016-06-15 08... | 2016-06-15 08... |
| 57610d4ce4b0... | Pt                | 1        | 001920547545... | ("*")("write"tr... | 2016-06-15 08... | 2016-06-15 08... |
| 57610379e4b0... | Pen               | 2        | 490277891377... | ("*")("write"tr... | 2016-06-15 07... | 2016-06-15 07... |
| 57606863e4b0... | Gum               | 3        | 102855022165... | ("*")("write"tr... | 2016-06-14 20... | 2016-06-14 20... |
| 576063bee4b0... | Pencils           | 12       | 400781712255... | ("*")("write"tr... | 2016-06-14 20... | 2016-06-14 20... |
| 5760630ee4b0... | Agatha christi... | 9        | 628107207967... | ("*")("write"tr... | 2016-06-14 20... | 2016-06-14 20... |
| 575f8c36e4b0... | Note              | 100      | 24412759        | ("*")("write"tr... | 2016-06-14 10... | 2016-06-15 08... |

### 3- Showing the products from the database

**Scanning**


**Scan Product**

Name

Quantity

Code

+ Update
✕ Log out



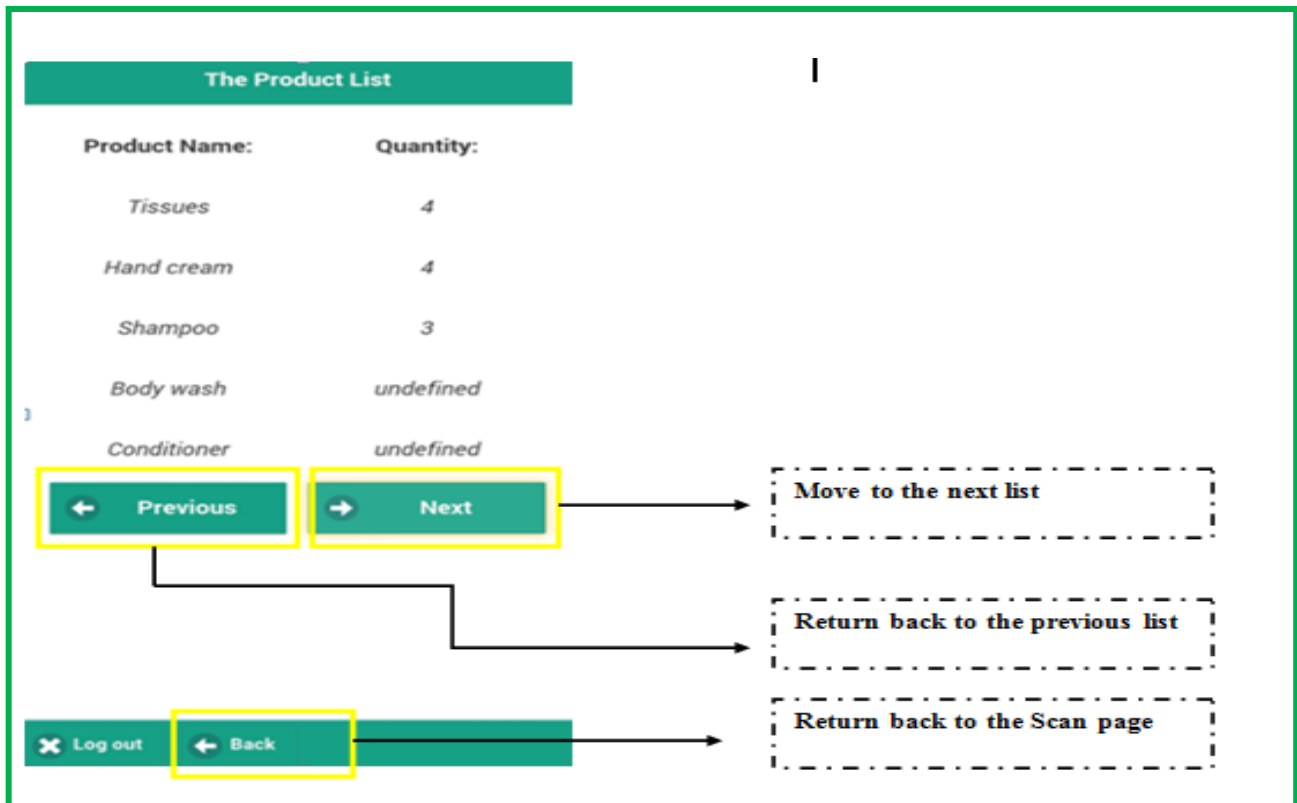
**The Product List**

| Product Name:               | Quantity: |
|-----------------------------|-----------|
| <i>Note</i>                 | 70        |
| <i>Agatha christie book</i> | 9         |
| <i>Pencils</i>              | 12        |
| <i>Gum</i>                  | 3         |
| <i>Pen</i>                  | 2         |

→ Next

☰ The Product List

✕ Log out
← Back



## 5. Conclusions and Recommendations

### 5.1 Achievement of expected learning outcomes

The student is able to present convincing evidences that all of his learning outcomes were achieved by the end of the training period.

Learning outcomes are statements that describe significant and essential learning that trainee have achieved and can reliably demonstrate at the end of the program. In other words, the learning outcomes identify what the trainee will know and be able to do by the end of the program. The expected learning outcomes of our summer training at IT-Deanship were,

#### 1. Understand the concept of internet of things.

Through the implementation process, we had a deep understanding on how the internet of thing is used in real life.

#### 2. Understand the concept of cloud computing, its advantages and disadvantages.

Through the implementation process, we had a deep understanding on what is the concept of the cloud computing, its advantages and disadvantages.

#### 3. Explain the security of internet of things, artificial intelligence and machine learning.

Through the implementation process, we had a deep understanding on what is the security of internet of things, artificial intelligence and machine learning.

#### 4. Describe Azure platform and its services and advantages.

Through the training period, we had a deep understanding on what is the Azure platform and its services and advantages.

**5. Come up with ideas that applied the concept of internet of things.**

By realizing the concept of the IoT and cloud computing, we came up with five ideas that applied the concept of internet of things for the sake of KAU and could be implemented in the following systems and facilities: library, attendance system, golf cart, temperature and patient monitoring system.

**6. Use Visual Studio program to write a program and make a connection between the cloud and the device explorer (simulator device).**

We used many concepts studied in EE 364 course that are similar to the Visual Studio language (#C). we had an ability to use the visual studio and what is the importance of the cross platform.

**7. Describe the external characteristics of mbed board and implement simple internet of things project which is temperature alert with Azure IoT Hub using mbed board.**

A new microcontroller is learned which is mbed board. The mbed IoT Device Platform, simply, is for writing software that controls hardware that can connect to the cloud - it is an easy way of creating embedded connected solutions. The main components of the mbed board is studied by knowing its function and structure. Then, simple internet of things project which is temperature alert with Azure IoT Hub is applied using mbed board.

**8. Describe the external characteristics of raspberry pi 2 board and implement simple internet of things project by sending a message (data) from a raspberry pi 2 to the Azure IoT hub.**

Another new microcontroller is learned which is raspberry pi2. Raspberry Pi is a fully-functional single-board computer with a Broadcom processor, while others are microcontroller-based physical computing platforms. On Raspberry Pi, you can run operating system like Linux, FreeBSD, and even Windows 10 from a micro SD card. Plug it into a monitor, keyboard, and a mouse, you have a full graphical user-interface of an OS of your choice. You can think of Raspberry Pi as a low-cost little computer with programmable I/O pins where you can attach physical devices and sensors. The main components of the raspberry pi 2 is studied by knowing its function and structure. Then, simple internet of things project which is sending a message (data) from a raspberry pi 2 to the Azure IoT hub is applied.

**9. Describe the Xamarin platform and implement a mobile application in Visual studio program.**

Through the implementation process, we had a deep understanding on how to use the Xamarin platform in designing the application and how to use the Visual studio to program the application.

**10. Build a warehouse-manager application with a barcode scanner and database.**

This learning outcome was achieved through the submission of the barcode scanner application in secure way.

#### **11. Debug and fix the errors.**

Our skills in debugging and fixing the errors is improved in a great way. Also, debugging and fixing the errors help us in improving our programming skills.

#### **12. Deal with many software and hardware.**

This learning outcome was achieved by dealing with mbed board, raspberry pi 2, Visual Studio program, Xamarine platform, device explorer, Azure platform, Appery.IO, SD card formatter, Putty and remote connection.

#### **13. Write a professional Documentation.**

This learning outcome was achieved through the submission of a written final documentation for the application.

### **5.2 Recommendations to enhance future training in this company**

Below are some specific rational recommendations to enhance the future student's training experience at IT-Deanship,

- Supply the internet with all the hardware, because the network of the KAU is protected.
- Increase the number of the periodic meeting with the training supervisor to solve all the emerging problems.
- Instead of assigning many projects to each student, I recommend to assign one project to each student to do the best by focusing in one project.
- Increase the resources of the internet of things because the online resources are few.
- Prepared a suitable place to host the trainees.

### **5.3 Recommendations to enhance future training of KAU engineering students**

Below are some specific rational recommendations to enhance the future training of KAU engineering students,

- Improve the communication between the training unit with the organization to follow up their training.
- The training unit must ask the organization to provide a job description before approving the job for the student.
- The training unit must supply the company with the training duration in advanced.

## 6. References

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