CHAPTER 1

SYSTEM TESTING

This chapter describes the testing stage of the system. Testing ensures that the system is free of errors and bugs and delivers expected results. Different types of testing methods have been applied on the system which are: unit testing, integration and regression testing, performance and stress testing, test cases and user acceptance testing.

7.1. UNIT TESTING

7.1.1. WEBSITE

Function Class	Component to be tested	Component description	Result
General	C1	Register in the system	Pass
Functions	C2	Log in the system	Pass
	C3	Update profile info	Pass
	C4	Display LED(s) on map	Pass
	C5	Display LEDs' Statistics	Pass
	C6	Log out of the system	Pass
Region	C7	Add region	Pass
Management	C8	Update region details	Pass
	С9	Delete region	Pass
LED	C10	Add LED	Pass
Management	C11	Update LED details	Pass
	C12	Delete an LED	Pass
Content	C13	Upload content	Pass
Management	C14	Update content details	Pass
	C15	Delete content	Pass
	C16	Link content with LED	Pass

Table 1: Website Unit testing

7.1.2. APPLICATION

Function Class

Component to be tested

	C1	Register in the system	Pass
	C2	Log in the system	Pass
General Functions	C3	Log out of the system	Pass
	C4	Edit profile	Pass
	C5	Contact Us	Pass
	C6	Upload content	
	C7	View users contents	Pass
Users/Admin content	C8	View admin contents	Pass
Functions	С9	Save content to favorite list	Pass
	C10	View favorite list	Pass
Region	C11	View all regions	Pass
Functions	C12	View region	Pass

Table 2: Mobile Application Unit testing

7.2. INTEGRATION AND REGRESSION TESTING

7.2.1. INTEGRATION TESTING

a. WEBSITE

There are four groups of components that have been tested individually in the previous section (Unit Testing). These groups are: group 1, which contains general functions, group 2 includes the region functions, group 3 contains content functions and group 4 contains LEDs functions. In this section, we integrate the components one by one for each group and test the integration of the components to make sure it works as expected.

Test sequence			
Test Number	Test 1	Test 2	Test 3
Component	Integrating C1 and C2	Integrating C3 and Test1	Integrating C4, C5 and Test2
Description	Test Register and Login.	Test Update profile info with component of Test1	Test Display LED(s) on map and Display LEDs' Statistics with component of Test 2
Graph		$\begin{array}{c} C1 \\ C2 \\ C3 \end{array} - T2 \end{array}$	C1 - T1 C2 - T2 C3 - T2 C4 - T3 C5 - T2
Status	Pass	Pass	Pass

Table 3: Website Integration testing 1

Test sequence			
Test Number	Test 4	Test 5	Test 6
Component	Integrating C6 and Test 3	Integrating C7,C8 and Test4	Integrating C9 and Test 5
Description	Test Logout with component of Test 3	Test Add region ,Update region with component of Test 4	Test Delete region with component of Test5

Graph	$ \begin{array}{c} C_1 & T_1 \\ C_2 & T_2 \\ C_3 & T_2 \\ C_4 & T_3 \\ C_5 & T_4 \\ C_6 & T_4 \\ C_6 & T_6 & T_6 \\ C_6 & T_6 & T_6 & T_6 \\ C_6 & T_6 & T_6 & T_6 & T_6 & T_6 & T_6 \\ C_6 & T_6 & $	$ \begin{array}{c} 1 \\ - \\ 2 \\ - \\ - \\ - \\ $	$ \begin{array}{c} c_{1} \\ c_{2} \\ c_{3} \\ c_{4} \\ c_{4} \\ c_{4} \\ c_{4} \\ c_{4} \\ c_{5} \\ c_{7} \\ c_{7} \\ c_{8} \\ c_{7} \\ c_{8} \\ c_{7} \\ c_{9} \\ c_{9} \\ c_{9} \\ c_{1} \\ c_{1} \\ c_{1} \\ c_{1} \\ c_{1} \\ c_{1} \\ c_{2} \\ c_{1} \\ c_{2} \\ c_{1} \\ c_{2} \\ c_{1} \\ c_{2} $
Status	Pass	Pass	Pass

 Table 4: Website Integration testing 2

Test sequence			
Test Number	Test 7	Test 8	Test 9
Component	Integrating C10,C11 and Test6	Integrating C12 and Test 7	Integrating C13, C14 and Test8
Description	Test Add LED and Update LED details with component of Test 6	Test Delete LED with component of Test 7	Test Upload content Update content details, with component of Test 8

Graph	$ \begin{array}{c} 1 \\ 22 \\ - \\ $	$ \begin{array}{ccccccccccccccccccccccccccccccccc$	$ \begin{array}{cccccccccccccccccccccccccccccccccccc$
Status	Pass	Pass	Pass

 Table 5: Website Integration testing 3

Test sequence			
Test Number	Test 10	Test 11	
Component	Integrating C15 and Test 9	Integrating C16 and Test 10	
Description	Test Delete content with component of Test 9	Test Link content with component of Test 10	



Table 6: Website Integration testing 4

b. APPLICATION

We applied the integration testing in the application by the following steps:

Test sequence			
Test Number	Test1	Test2	Test3
Component	Integrate C1 and C2	Integrate C3 and Test1	Integrate C4 and Test2
Description	Test Register and Log in.	Test Log out and component of Test1	Test Edit profile and component of Test2
Graph	C1 C2 T1	$\begin{array}{c} C1 \\ C2 \\ C3 \end{array} $ $\begin{array}{c} T1 \\ T2 \end{array}$	$\begin{array}{c} C1 \\ C2 \\ C3 \\ C4 \end{array} = \begin{array}{c} T1 \\ T2 \\ T3 \end{array}$
Status	Pass	Pass	Pass

Table 7: Application integration testing 1

Test sequence			
Test Number	Test4	Test5	Tes6
Component	Integrate C5 and Test3	Integrate C6 and Test4	Integrate C7 and Test5
Description	Test Contact us and component of Test3	Test Upload content and component of Test4	Test View users content and component of Test5
Graph	C1 - T1 C2 - T2 C3 - T2 C4 - T3 C5 - T4	$ \begin{array}{c} c_1 & & \\ & & \\ c_2 & & \\ c_3 & & \\ c_4 & & \\ c_4 & & \\ c_5 & & \\ c_6 & & \\ \end{array} $	$ \begin{array}{c} c_1 \\ c_2 \\ c_3 \\ c_4 \\ c_4 \\ c_5 \\ c_6 \\ c_7 \\ c_7 \\ c_7 \\ c_6 \\ c_7 \\ c_7 \\ c_6 \\ c_7 \\ c_6 \\ c_7 \\ c_7 \\ c_6 \\ c_7 $

StatusPassPassPass	
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Table 8: Application integration testing 2

Test sequence			
Test Number	Test7	Test8	Tes9
Component	Integrate C8 and Tes6	Integrate C9 and Test7	Integrate C10 and Test8
Description	Test View admin content and component of Test6	Test Save content to favorite list and component of Test7	Test View favorite list and component of Test8
Graph	$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	$ \begin{array}{cccccccccccccccccccccccccccccccccccc$
Status	Pass	Pass	Pass

Table 9: Application integration testing 3

Test sequence						
Test Number	Tes10	Tes11				
Component	Integrate C11 and Test9	Integrate C12 and Test10				
Description	Test View all regions and component of Test9	Test View region and component of Test10				



Table 10: Application integration testing 4

7.2.2. REGRESSION TESTING

Regression testing is a type of software testing carried out to ensures that previously tested code is still performs the way it should be after new changes. Changes may include enhancements, patches, configuration changes.

We applied the regression test by testing the whole functionalities of the system after any change or update, to make sure that the system functionalities are still working as expected.

7.3. TEST CASES

7.3.1. WEBSITE

1. Register Test Cases

Test Case: #1	Description	Action	Expected Result				
Leave empty fields	The user leaves some or all fields empty	Click on Register button	An error message will be displayed prompting the user to complete all fields				
	Actual Result						
Lum	iComm						
	Logi	in	Register				
	Please fill all the	required fields					
	Afnan						
	Last name						
	Ра	ass?					
	Y	Yes					

Table 11: Register test case with empty field

Test Case: #2	Description	Action	Expected Result	
Enter invalid email	The user enters an email in an incorrect format.	enters an Click on An error message will t an incorrect Register button enter a valid email		
	Actua	l Result		
Lumi	Comm	jin	Register	
	O Please enter a v	alid email address		
	Afnan			
	Aljaser			
	a			

Table 12:	Pass?
Register test case with	Yes

Table 13: Register test case with registered email

empty field

Test Case: #3	Description	Action	Expected Resu	ılt
Enter email that is already registered	The user enters a registered email	Click on Register button	An error messa the user that the already register	ge will notify e email is red
	Actual	Result		
Lumi	Comm			
	Logi	n	Register	_
	C This email is alrea	ady registered		
	Afnan			
	Aljaser			
	afnan@gmail.con	1		
	Pas	ss?		
	Ye	es		
in Test Cases				

Table 14: Failed log in test case

		Log	in Test Ca	ses		
Test Case	:#1 Description		Action		Expected Re	sult
Enter va inputs	lid The user ente	rs valid	Click on I in button	Log	The user will be redirected to dashboard.	
		A	ctual Result			
Q Lumi	Comm =					Afnan Alj
Welcome, Afnan Aljaser	Numbers and Sta	atistics	_		_	
🔀 Dashboard	3 Begions Create	4	Registered	2 Con	tent Added	61 Content Uploaded
Manage Region	Most visited Regio	ONS Based on amount of content uplo	paded by users in the region	Mos	st visited LEDs Based on amou	nt of content uploaded by users to the LED
Manage Conte	nt 👻					
	Riyadh Zoo		— King Abdullah Park		LED 2	LED 5
					LED 4	LED 3
		Tahlia s	treet			
	King At	duliah Park 🗾 Tahlia street	Riyadh Zoo		LED 5 LED 3	LED 4 LED 2
			Pass?			
			Yes			
st Case: #2	Description	Acti	on	Exp	ected Result	
Leave an	The user leaves so	me or Clic	k on	An e	error message v	will be
npty fields	all fields empty	Log butte	in on	disp com	layed prompt	the user to
			D14	Com		
		Actual	Result			
l na	miCog					
		Logi	in		Register	
		8 Please fill all the	required fields			
		Email				
		Pas	ss?			
		Ye	es			

Test Case: #3	Description	Action	Expected Result
---------------	-------------	--------	-----------------

Enter invalid email or password	The user enters invalid inputs	Click on Log in button	An error message will be displayed prompt the user to ent valid inputs	er
	Α	ctual Result		
LU	miComm)		
		Login	Register	
	S Invalid Io	ogin information		
	afnan@g	mail.com		
		Pass?		
		Yes		

3. Manage Content Test Cases

These test cases show the different scenarios that a user may experience when trying to **add** or **update** a content in the system.

Manage Content Test Cases					
Test Case: #1	Description	Action	Expected Result		
Enter valid inputs	The user enters valid information	Click on Add / Update content	The content will be added/updated and a success message will be displayed. If <i>add</i> : the user will be redirected to all content page. If <i>update</i> : The user will be redirected to view content page.		
Actual Result (Add)					

Table 16: Log in test case with invalid field

Vetcome, Atrian Alaser 28 Dashboard 29 Manage Region ~ All Content All Content Ald Content	Manage Content / Add Add Content Category * Choose Category What would you like to upload? Marmun marinters attward to 255 Write your description here	Content	ssfully!			Alnan Aljaser -
Lumic Omm Welcome, Afran Ajaser 20 Dashboard	All Content Admin Content User	Content				Afnan Aljasor ~
Manage Content	Select	Title	Category	Link	Edit	Delete
All Content	0	منباع طفلة	Emergency	°₀	ß	Û
Add Content		Electricity Cut-off	Notifications	ď	٢	
ŶLEDs ✓	Celect All					
		Pas	s?			
		Ye	S			

Test Case: #2	Description	Action	Expected Result			
Leave empty fields	The user leaves some or all fields empty	Click on Add / Update content	Error messages will be displayed prompt the user to complete empty fields.			
		Actual Result				
LumicQm	n ≡		Afnan Aljaser \vee			
Welcome, Afnan Aljaser	Manage Content / Ad	d Content				
🙆 Dashboard	Add Content		^			
Manage Region	Category * Choose Category	Title *				
Manage Content	This value is required.	This value is required.				
	Pass?					
		Yes				

Test Case: #3DescriptionActionExpected Result	
---	--

Exceed the accepted number of characters of content description field	The user enters more than 255 character in content description field	Click on Add / Update content	Content description field will be blocked and its border color will be changed to red.
		Actual Result	
Welcome, Afnan Aljaser 20 Dashboard 21 Manage Region 22 Manage Content All Content Add Content 22 LEDs	Manage Content / Ad Add Content Category* Advertisements What would you like to upload Meaimum characters alowed is 255 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	d Content Title * New ad ?* XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	Afnan Aljaser ~
		Pass?	
		Yes	

4. Manage Content Test Cases

These test cases show the different scenarios that a user may experience when

Manage Region Test Cases			
Test Case: #1	Description	Action	Expected Result
Enter valid inputs	The user enters valid information	Click on Create / Update region	The region will be added/updated and a success message will be displayed. If <i>add</i> : the user will be redirected to all regions page. If <i>update</i> : The user will be redirected to view region page.
	А	ctual Result(Add)	

trying to **create** or **update** a region in the system.

Add Region Massage Contact Image Contact Image Contact Image Contact Im	esetives allowed is 103	Completed Successfully!			
LumicQmm E Welcome, Afnan Aljaser	E				Afnan Aljaser ~
🔁 Dashboard					^
Manage Region Y	Select	Region Name	Number of LEDs	Edit	Delete
		Afnan's Region	2	đ	Û
Add Region		King Abdullah Park	0	đ	1
		Pass?			
		Yes			

Table 17: Manage Content test Cases

Test Case: #2	Description	Action	Expected Result
Leave empty fields	The user leaves some or all fields empty	Click on Create / Update region	Error messages will be displayed prompt the user to complete empty fields
	Actua	l Result(Add)	
LumicQmm	Ξ		Afnan Aljasor \sim
Welcome, Afnan Aljaser	Manage Region /Add Region		
🕉 Dashboard	Add Region		^
Manage Region All Regions Add Region	Region Name * Riyadh Zoo Region Description *	City * Enter city name This value is required.	1.
		Pass?	
		Yes	

Test Case: #3	Description	Action	Expected Result
Exceed the accepted number of characters in region	The user enters more than 90 character in region description field	Click on Create / Update region	Region description field will be blocked and its border color will be changed to red

description field	
	Actual Result (Add)
 Manage Region All Regions Add Region Manage Content LEDs 	Region Name * City * Tahlia Street Riyadh Region Description * Maximum characters allowed is 100 X000000000000000000000000000000000000
	Pass?
	Yes

 Table 18: Manage Content test cases 2

5. Manage LEDs Test Cases

These test cases show the different scenarios that a user may experience when trying to

add or update a LED information.

Test Case: #1	Description	Action	Expected Result
Leave empty fields	The user leaves some or all fields empty	Click on Add / Update LED	Error messages will be displayed prompt the user to complete empty fields.
	Actual F	Result(Add)	
 Manage Content LEDs All LEDs Add LED 	LED Description* Mathum character allowed is 100 Write your description here		<i>a</i>
	Р	'ass?	
		Yes	



Test Case: #2	Description	Action	Expected Result
Exceed the accepted number of characters in LED	The user enters more than 100 character in region description field	Click on Add / Update LED	LED description field will be blocked and its border color will be changed to red

description field	Actual Result (Add)
 Manage Content LEDs All LEDs Add LED 	LED Description* Machum chancles allowed is 100 xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
	Pass?
	Yes

Table 20 : Manage Led Test Cases 2

6. View (Region, content and LEDs)

View Test Cases				
Test Case: #1	Description	Action		
Delete (Region, Content or LED)	The user clicks on delete icon to delete a region/content/LED	Click on delete icon		
Expected Result (Delete Region)	Expected Result (Delete Content)	Expected Result (Delete LED)		
A confirmation message will be displayed, if the user presses Yes, then the region will be deleted, and a success message will be displayed. If the user presses No, then the system will display the region	A confirmation message will be displayed if the user presses Yes, then the content will be deleted, and a success message will be displayed. If the user presses No, then the system will display the content	A confirmation message will be displayed if the user presses Yes, then the LED will be deleted, and a success message will be displayed. If the user presses No, the system will display the LED		
	Actual Result (Delete a Region)			
	on	Afran Aljaser		

Are you sure you want to proceed? B Deshboard No Yes	LumicQmm.	▲Confirmation	
22: Destricted No Yes Image Report Image Report Image Report	Afnan Aljaser	Are you sure you want to proceed?	
🕞 Manage Region 🗸 🚽	🚯 Dashboard	No Yes	
	Ø Manage Region – – – – – – – – – – – – – – – – – – –		

	All Regions		Care to add a new one? click here
B Dashboard			^
😡 Manage Region 🗸 🗸	Select	Cumber of LEDS	Edit Detete
All Regions Add Region	Select All	ок	
陆 Manage Content 🗸 🗸	Delete Selected		
		D9	
		Pass:	



Test Case: #2	Description	Action			
Update (Region, Content or LED)	The user clicks on edit icon of an item	Click on edit icon of an item			
Expected Result (Region)	Expected Result (Content)	Expected Result (LED)			
The user will be redirected to update region page	The user will be redirected to update content page	The user will be redirected to update LED page			
	Actual Result (Region)				
Welcome, Anan Ajaser Image Region All Regions Add Region Add Region Add Region Manage Content Image LEDs		Afnan Aljaser >			
	Pass?				
Yes					

Table 22: Update test cases

7. View All (Region, content and LEDs) Test Cases

These test cases show the different scenarios that a user may experience when exploring all region\content\LEDs pages.

Test Case: #1 Description	Action	Expected Result
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Select all checkboxes	The user clicks on select all checkbox		Check on select all checkbox	All checkbo selected	xes will be
Actual Result					
Welcome, Afnan Aljaser	All Regions				
B Dashboard					^
Manage Region ~	Select	Region Name	Number of LEDs	Edit	Delete
All Regions	8	King Abdullah Park	2	8	Û
Add Region	8	Thalia Street	2	C	Û
Manage Content ~	Select All				
♀ Manage LEDs ∽	Delete Selected				
Pass?					
		Ye	es		

Table 23: Select all checkboxes test case



Delete multiple regions test case

Test Case: #3	Description	Action	Expected Resu	ılt
Delete selected Without selecting any region	The user clicks on delete selected button without selecting any region	Click on delete selected button	An error messa displayed prom at least one reg	ge will be pt the user to select ion
	Act	tual Result		
Welcome, Ahran Ajaser 28 Dashboard Manage Region All Region Add Region Manage Content Manage LEDs	All Regions Select Select All Select one or more item		lumber of LEDs I 1 0	Att Delete
	Pass?			
Yes				

 Table 25: Delete selected without selecting any region test case
 Image: Comparison of the selecting and the se

8. Link\uUnlink Content Test Cases

	Link Content Test Cases					
Test Case: #1	Description	Action	Expected Res	ult		
Click on link button	The user clicks on a link button of a content	Click on a link button	The content wi the selected LH button will be	ill be linl ED and t changed	ked with he link to Unlink	
	Actu	al Result				
Wetcome, Ahran Aljaar Image Angen Image Angen Image Angen At Content At Content Ad Content Image LEDs	Link Content / Hargers Atta be deal Desemble Atta be deal The property Atta be deal The property	Location k Q Q	Filter by LED Status: Status Uninkad Uninkad	Select LED Status Action Data Lota	*	

	LED ID	Region	Location	Status	Action
	11	King Abdullah Park	۰	Linked	Unlink
	6	Tahlia street	۰.	Unlinked	Link
C					
		р 9			
		Pass?			
		Ves			
		105			

Table 26: Link content test case

Test Case: #2	Description	Action	Expected Res	ult	
Click on Unlink button	The user clicks Unlink button of a LED	Click on Unlink button	A confirmatio displayed, if the the content wi selected LED be changed to If the user clic will display lin	n message w ne user click ll be unlinke and the unlin link. cks on No, the nk content p	vill be s on Yes, then ed from the nk button will hen the system age.
		Actual Re	sult		
C) Mariana Marina Agazar	Link Content with LE LED ID 11 6	EDS Region King Abdullah Park Tahlia street	Location ©	Filter by LED Status: Status Linked Unlinked	Select LED Status
Dashboard Managa Region Managa Region Managa Context	LED ID	Region	Location	No Yes	Action
	6	Tahlia street	Ŷ	Unlinked	Link
	Pass?				
Yes					

Table 27: Click on Unlink button test case

0 \mathbf{M}	anaga	Drofil	o Toot	Cogog
9. M	anage	FIUII	e rest	Cases

Test Case: #1	Description	Action	Expected Result		
Leave an empty field	The user leaves empty fields	Click on Update Profile button	An error message will be displayed prompt the user to complete all fields		
	Actu	al Result			
Conternit	Image Image </th <th>Afnan Adel Aljaser</th>		Afnan Adel Aljaser		
	Pass?				
	Yes				

 Table 28: Manage profile test case 2

Test Case: #2	Description	Action	Expected Result			
Enter invalid email	The user enters invalid email	Click on Update Profile	An error message will be displayed prompt the user to enter a valid email			
	Actual Result					
Manage LEDs Email * afnan The email	Manage LEDs Email * afnan The email is invalid! Update Profile Update Profile					
	Pass?					
	Yes					

Table 29: Manage profile test case 3

Test Case: #3	Description	Action	Expected Result
Enter incorrect password	The user enters incorrect password.	Click on Reset Password	An error message will be displayed prompt the

		user to enter correct password
	Actual Result	
Reset Password		^
Current Password *		
Current Password		
New Password *		
	Pass?	
	Yes	

 Table 30: Manage profile test case 4

Test Case: #4	Description	Action	Expected Result						
Enter incorrect confirm password	The user enters confirm password that doesn't match with the new password	Click on Press Reset Password	An error message will be displayed prompt the user to enter correct confirm password						
	Actual Result								
New Passwor	rd *								
Confirm Pass	word *								
Password doe	Password doesn't match! Reset Password								
Pass?									
	Yes								

 Table 31: Manage profile test case 5

7.3.2. APPLICATION

1. Register Test Cases

Register Test Cases						
Test case#1	Description	Action	Expected Result	Actual Result	Pass?	

Enter valid inputs	The user enters valid information	Click on Register button	A new account will be created and the user will be redirected to the main activity.	Image: A constrained of the sector Image: A constrained of the sector	Yes
Test case#2	Description	Action	Expected Result	Actual Result	Pass?
Leave empty fields	The user leaves some or all fields empty	Click on Register button	An error message will be displayed prompting the user to complete all fields.		Yes
Test case#3	Description	Action	Expected Result	Actual Result	Pass?
Enter invalid email	The user enters an email in an incorrect format.	Click on Register button	An error message will be displayed prompting the user to enter a valid email.		Yes
Test case#4	Description	Action	Expected Result	Actual Result	Pass?

Enter email that is already registered	The user enters a registered email	Click on Register button	An error message will notify the user that the email is already registered.	e afna. munzshed@gmail.com munzshed@gmail.com REGISTER	Yes
				the email is already registered	

Table 32: Application register test case

2. Log in Test Cases

Log in Test Cases								
Test case#1	Description	Action	Expected Result	Actual Result	Pass?			
Leave empty fields	The user leaves some or all fields empty	Click on Log in button	An error message will be displayed prompting the user to complete all fields	Image: Second	Yes			
Test case#2	Description	Action	Expected Result	Actual Result	Pass?			

Enter invalid email or password	The user enters invalid inputs	Click on Log in button	An error message will notify the user that the email or password is incorrect	Image: State of the state	Yes
				The email not registered	
				e afr@gmail.com 아 년 LOGIN	
				browssed grant/W	

Table 33: Application log in test case

3. Edit Profile Test Cases

Edit profile Test Cases								
Test case#1	Description	Action	Expected Result	Actual Result	Pass?			
Leave empty fields	The user leaves some or all fields empty	Click on save changes button	An error message will be displayed prompting the user to complete all fields	• • • • • • • • • • • • • • • • • • •	Yes			
Test case#2	Description	Action	Expected Result	Actual Result	Pass?			

Enter invalid email	The user enters invalid email	Click on Update Profile button	An error message will be displayed prompt the user to enter a valid email	Afnan Aljaser Afnan Aljaser of	Yes
				Please provide a valid email.	

Table 34: Application edit profile test case

4. Explore Test Cases

	Explore Test Cases							
Test case#1	Description	Action	Expected Result	Actual Result	Pass?			
Click on LED Feed (in range of a LED)	The user clicks on LED Feed when he is in a range of a LED	Click on LED Feed	The linked admin content will be displayed. If no content linked with the LED, a message will be displayed indicating that no content has been linked with the LED.	Constraints of the constrain	Yes			
Test case#2	Description	Action	Expected Result	Actual Result	Pass?			
Click on LED Feed (not in range of a LED)	The user clicks on LED Feed when he isn't in a range of a LED	Click on LED Feed	An error message will be displayed indicating that there is no Li-Fi signals found.	COMPAGE COMPA	Yes			
Test case#3	Description	Action	Expected Result	Actual Result	Pass?			

Add content to favorite list	The user add a content to his favorite list	Click on heart icon	The selected content will be saved in the user's favorite list	<image/> و عاد الله الله الله الله الله الله الله ال	Yes
Test case#4	Description	Action	Expected Result	Actual Result	Pass?
Click on Timeline (in range of a LED)	The user clicks on Timeline when he is in a range of a LED	Click on Timeline	The linked user content will be displayed. If no content linked with the LED, a message will be displayed indicating that no content has been linked with the LED.	Content have been added yet by again late:	Yes
Test case#5	Description	Action	Expected Result	Actual Result	Pass?
Click on upload content button in Timeline	The user clicks on upload content button	Click on upload content button	The user will be redirected to upload content activity.	Vhat's happening?	Yes
Test case#6	Description	Action	Expected Result	Actual Result	Pass?

Click on Timeline (not in range of a	The user clicks on Timeline when he isn't in a range of a	Click on Timeline	An error message will be displayed indicating that there is no Li-Fi signals	A PERSON ON OPPORT OF A PERSON Timeline	Yes
LED)	LED		found.	Whoops! No Lift signals found	

Table 35: Application main activity test cases 1

5. Favorite List Test Cases

	Favorite list Test Cases							
Test case#1	Description	Action	Expected Result	Actual Result	Pass?			
View favorite list (logged in)	The user clicks on Favorite when he is logged in.	Click on Favorite	The user's favorite list will be displayed.					
Test case#2	Description	Action	Expected Result	Actual Result	Pass?			
View favorite list (not logged in)	The user clicks on Favorite when he isn't logged in.	Click on Favorite	An error message will be displayed prompting the user to log in to view his favorites list.	You Should Log in Provide Provide	Yes			
Test case#3	Description	Action	Expected Result	Actual Result	Pass?			

Remove content from favorite list	The user delete a content from his favorite list	Click on heart icon of a content	The content will be removed from the list.			Yes
				⊕ Regions	Explore Favorite	

Table 36: Application main activity test case 2

6. Upload Content Test Cases

Upload content Test Cases					
Test case#1	Description	Action	Expected Result	Actual Result	Pass?
Enter valid inputs	The user enters valid inputs	Click on Share button	The content will be linked with the LED, and the user will redirected to the Timeline	Hello World 1 SEND O	Yes

Table 37: Application upload content test cases

7.4. PERFORMANCE AND STRESS TESTING

7.4.1. PERFORMANCE TESTING

Performance testing is a type of testing intended to determine the responsiveness, throughput and reliability of an application under a given workload. It's typically done to help establish a baseline to estimate the hardware configuration required to support the application when it goes live to production operation [49].

a. Test Environment

Android Profiler is a tool in android studio to provide real-time data for the application CPU, memory, and network activity. It is used to perform sample-based method tracing to time the application code execution, capture heap dumps, view memory allocations, and inspect the details of network-transmitted files [50]. Hardware used:

- Huawei P9 Plus CPU: Hisilicon Kirin 995, RAM 4.0 GB, Android version 7.0
- 2. Geo-LiFi LED
- 3. Dongle

b. Performance acceptance criteria

- 1. Ensure the app under test is running in parallel with other apps; there should be no interference.
- 2. Ensure realistic user experience under several network conditions.
- 3. Ensure the application does not get crashed.
- 4. Ensure the RAM is required for utilizing this app does not exceed 10% of the mobile RAM.

Android Profiler	\$- ±
HUAWEI VIE-L29 (YED7N16602006968) 🔻 com.example.android.lumicomm (9990) 🔻 🗙 🖂 🕀)
u ui.n ui.main.MainActivity - s ui.le ui.user_feeds.UserFeedsActi ui.upload_content.U uu ui ui ui ui ui.introdu ui.main.MainA ui ui	
CPU	0%
- 100%	
-50	
MEMORY	115.63 MB
- 256 MB	
NETWORK - Sending: 0 KB/S - Rec - 128 KB/S	ceiving: 0 KB/S
a. Test results	

During the run time of 15 min, we found that highest memory usage was 194.8MB, the lowest is 72MB and the average was 150MB. From these results we can see that the RAM does not exceed 10% of the mobile app so, we can safely say that the application is light on the devices memory. Also We tried to run the application in parallel with others apps and this does not affect in the app performance. In addition,

Figure 1:application performance

we tried to perform all application functionalities and the application never crashed. Finally, the app gave a realistic user experience with a slow Internet connection, the app receives contents but, the only multimedia contents take more time to appear on the screen. From the previous result we found that our application passed the performance testing.

7.4.2. STRESS TESTING

Stress testing determines the upper limits and the sizing of infrastructure by causing the application or its supporting infrastructure to fail. It is hard to perform stress testing manually, since it is difficult to simulate multiple user inputs and interrupts fast enough to strain the system. However, with the use of tools it can simulate these test scenarios easily. To perform stress testing, Neoload tool is used. Neoload is an automated test tool for measuring applications and web and API performance. Using Neoload tool, two tests have been applied to measure our application's performance.

a. First result

Summary			
Results summary			
Name Description	16:15 - 28 Apr 2018	Project Scenario	LumiCommTest scenario1
Status Start date	Passed Apr 28, 2018 4:15:25 PM	Load Policy	 The population Population1 is constant with 10 users. The population poulation 2 is constant with 10 users.
End date Duration	Apr 28, 2018 4:17:25 PM 00:02:00	Stop Policy	Population Population1 : immediate. Population poulation 2 : immediate.
Termination reason LG Hosts	Execution policy localhost:7100	Filters Debug	None Disabled

Figure 2 : first stress test result

It can be seen in Figure 107, that our application has passed the first test, under the user of 20 users within two minutes. 20% of the users used Motoral X android level 6.0, 30 % used Samsung Galaxy S7 android level 6.0 and the last 50% used Samsung Galaxy S6 Android level 5.0.

b. Second result

Results summary			
Name	17:30 - 28 Apr 2018	Project Scenario	LumiCommTest
Status Start date	Passed Apr 28, 2018 5:31:02 PM	Load Policy	 The population Population1 is constant with 20 users. The population poulation 2 is constant with 20 users.
End date Duration	Apr 28, 2018 5:46:03 PM 00:15:00	Stop Policy	Population Population1 : immediate. Population poulation 2 : immediate.
Termination reason	Execution policy	Filters	None
LG Hosts	localhost:7100	Debug	Disabled

Figure 3: second stress test result

As we can see in Figure 108, the application handled a heavy load. The number of users have been increased from 20 to 40 active users, and the duration time has been increased to 15 min. The application showed no signs of bugs, or memory leaks and did not crash from the load.

7.5. USER ACCEPTANCE TESTING

The objective of the user acceptance testing is to confirm that the system under test meets its requirements and to provide confidence that the system works correctly and measure its usability before it is delivered to the end users [54]. The usability of the system was measured in three criteria:

- Effectiveness: by measuring the number of errors detected when the user performs a specific function.
- Efficiency: by measuring the time that the user takes to perform a specific function.
- **Satisfaction**: by using a survey to discover the users' feedback about the system.

The total number of users who participated in the acceptance testing are ten users: five of them tested the website and the other five tested the application.

To test the efficiency and effectiveness of our system, the average time the users need to complete a specific task was computed and the average numbers of errors they have made was registered. The results are shown in Table.106 for the website and in Table.109 for the application.

To measure the user satisfaction of the system, a survey was made that measures different aspects of the system such as *ease of use and learnability, feedback and errors, consistency and screen displays, efficiency* and *subjective satisfaction.* The questions were constructed as seven-point rating scales. Users were asked to rate agreement with the statements, raging from strongly disagree to strongly agree. The questions were chosen based on several HCI rules measuring usefulness, reliability, usability, consistency, learnability, robustness and satisfaction. The questions included in the survey are as appears in Table 104.

Survey Questions					
	Ease of Use and Learnability				
1	It is easy to use				
2	I easily remember how to use it				
3	It require the fewest steps possible to accomplish what I want to do with it				
	Feedback and Errors				
4	I can recover from mistakes quickly and easily				
5	System messages are meaningful and jargon free				
6	It makes it difficult to make mistakes				
	Consistency and Screen Displays				
7	I can easily identify where I am				
8	Suitable choice of screen and font colors				
9	Widgets locations and colors are consistent across displays				
10	Wording is consistent across displays				

11	Icons and symbols reflects intended task			
12	I don't notice any inconsistencies as I use it			
	Efficiency			
13	It does everything as I expect it to do			
14	Shifting among windows is easy			
15	Guidance information always available			
16	I successfully accomplished tasks every time			
Subjective Satisfaction				
17	I am overall satisfied with it			
18	It works the way I want it to work			
19	It is designed for all levels of users			

Table 38: Survey Questions

7.5.1.WEBSITE TESTING

The table below shows the testing users ages and genders:

Participant No.	Age	Gender
1	28	Male
2	45	Male
3	31	Male
4	24	Female
5	26	Female

Table 39: Users' ages and gender1

Function	Average number of errors	Average time in seconds
Register	0.2	40.04
Log in	0	17.8
Update profile info	0	12
Display LED(s) on map	0	3
Display LEDs' Statistics	0	1

Add region	0	53.48
Add LED	0.2	128.68
Add content	0	88
Update region details	0	23
Update LED details	0.2	33.48
Update content details	0	66.76
Delete region	0	23
Delete LED	0	24.4
Delete content	0	52.4
Link content with LED	0	48.8
Log out	0	2

Table 40: Measuring system effectiveness(website)

The table above shows the average time users need to complete each function in the website and the average numbers of errors they have made in each function. It can be seen from the table that the average number of error occurred in *register* and *add LED* functions is 0.2, while it's 0 in the other functions. The add region function took 53.48 second on average, and the related functions such as: *update region details* and *delete* region took between 23 to 33.48 second to be completed. The add LED function took 128.68 second on average, and the related functions such as: update LED details and delete LED took between 24.4 to 74.64 second to be completed. Finally, the add content function took 88 second on average, and the related functions such as: update content details, delete content and link content took between 48.8 to 66.76 second to be completed. Notice that adding LEDs to the system took the highest amount of time since it requires more steps to accomplish. This could lead to the consideration of enhancing the interfaces to make them easier and more accessible. In addition, since the interfaces of the main functions (add\delete\update) for the regions, LEDs and content are consistent among all windows, there's a noticeable drop in the number of seconds taken to accomplish the tasks. For instance, the "update form" is identical to the "add form", due that, the number of seconds taken to add a region (53 seconds) is relatively higher than updating it (23 seconds). While performing the test, we noticed that the number of seconds taken by all the test users to accomplish the same task is almost the same. From this we conclude that the easiness of use of the system is in the same level for different types of user, regardless of their skills and background.

Managing LEDs time taken dropped from approximately 128 seconds in "Add" to 33 seconds in "Update". Which means once the user got familiar with the interfaces the easiness of use increase.

It can also be seen that the number of errors encountered while completing any if the tasks is almost zero. This indicates the level of ease and learnability of the system. As mentioned earlier, the user must fill a survey after testing any of the subsystems. Some of the significant survey results regarding the admin web-panel appear in the tables below.





Table 41: Survey Results(website)

Regarding the results of the survey, the majority of users "strongly agree" that the website is easy to use, requires the fewest steps possible to accomplish the tasks and they can easily remember how to use it. This relates to the results obtained from measuring time taken to accomplish the tasks. Consistency plays an important rule to gain these results, as it entails the ease of use, learnability and familiarity. It can be seen that 3 out of 5 users "strongly agree" that they can recover from mistakes quickly and easily. This sentence concerns how the system notifies the user about incorrect

input, missing fields and unintended actions. Add to that, 4 out of 5 users "strongly agree" that the messages provided to them in case of mistakes are meaningful and jargon free. When considering the screen displays style and consistency among windows, all of the user "agree" that the choice of screen and font colors is suitable, widgets locations and colors are consistent across displays, wording is consistent across displays, icons and symbols reflects the intended tasks. That verifies the result concluded from analyzing the obtained measurement in Table 106, which is the acceptable level of consistency achieved throughout the pages.

However, most users reported that guidance information is not always available in all pages which may highlight the need to provide more guidance on how to use the system. Finally, 80% of users overall satisfied with it.

7.5.2. APPLICATION TESTING

Participant No.	Age	Gender
1	28	Male
2	24	Male
3	23	Female
4	22	Female
5	22	Female

The table below shows the users ages and genders:

Table 42: users ages and genders2

Function	Average number of errors	Average time in second
Register	0	40.2
Log in	0	19.5
Edit profile	0	28.1
Upload content	0.2	29.4
View users content	0	4
View admin content	0	5.2
Save content to favorite list	0	3.3
View favorite list	0	3.31
View all regions	0	2.2

View region	0	2
	7	

 Table 43: Measuring system effectiveness(application)

The table above shows the average time that users need to complete each function in the application and the average numbers of errors they have made in each function. It can be seen from the table that the average number of error occurred in *upload content* is 0.2, while it's 0 in all the other functions. That could refer to the fact that uploading content requires more steps than other tasks. The *upload content* function took 29.4 second on average. In addition, *view users and admin content* took between 4 to 5.2 second on average, and the related functions such as: *save content to favorite list and view favorite list* took between 3.3 to 3.31 second. Finally, view all regions and view specific region took between 2 to 2.2 second on average. Registering in the system required the highest number of seconds among the functions. When the user first downloads the application, the first function to interact with is registration. According to that, it requires some time until the user gets familiar with how the application works; justifying the gained result. The other functions took noticeable low amount time to accomplish.

Regarding the results of the survey, most of users "strongly agree" that the application is easy to use. However, all of them "strongly agree" that it requires the fewest steps possible to accomplish the tasks, and they can easily remember how to use it; confirming learnability and ease of use of the application. Concerning robustness of the application, it can be seen that most of users "agree" that they can recover from any mistakes they make quickly and easily and the the provided messages are meaningful and jargon free. 90% of users "strongly agree" that the choice of screen and font colors is suitable, widgets locations and colors are consistent across displays, wording is consistent across displays and icons and symbols reflects the intended task. Furthermore, most users "strongly agree" that the application does everything they expect it to do, and shifting among windows is easy. However, 4 out of 5 users reported that guidance information is not always available. Moreover, most of users "strongly agree" that it works as the way they want it to work, and that it is designed for all levels of users. Finally, 80% of users overall satisfied with the application.