American International University-Bangladesh (AIUB)
Department of Computer Science
Faculty of Science &Technology (FST)
Spring 22-23

Section: C
Software Quality Assurance and Testing

Software Testing in IoT
A Report submitted
By

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Under the supervision of
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Software Test Plan

for

Software Testing in IoT

Version 1.0 approved

Prepared by

PRANTO BORMON

T.M RAGIB SHAHRIER

MD. AMIMUL AHASUN ANAS

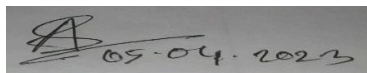American International University-Bangladesh

07th April 2023

Checked By Industry Personnel

Name: Avik Sarkar

Designation: Lead Engineer(Quality eXperience Group)

Company: Samsung R&D Institute Bangladesh

Sign: 05.04.2023

Date:05.04.2023

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Revision History

Revision	Date	Updated by	Update Comments
0.1	2023.04.07	Pranto Bormon	Project Discussion
0.2	2023.04.10	MD. Amimul Ahasun Anas	System Features & Quality Attributes Defined
0.3	2023.04.18	T.M Ragib Shahrier	System Interface & Requirements Defined
0.4	2023.04.20	T.M Ragib Shahrier	Test Case Design
0.5	2023.04.26	Pranto Bormon	Risk Management Analysis
0.6	2023.04.30	MD. Amimul Ahasun Anas	Project Responsibility & Schedule Diagram
0.7	2023.05.02	T.M Ragib Shahrier	Reference's added & UI updated

1. TEST PLAN IDENTIFIER: STIOT-1

2. REFERENCES

o Software Testing and Quality Assurance –Theory and Practice -Kshirasagar Naik & Priyadarshi Tripathy
o "The Internet of Things" by Samuel Greengard
o https://saucelabs.com/ , https://testlio.com/ - A website for software testing

3. INTRODUCTION

3.1 Background to the Problem

The Internet of Things (IoT) may be a quickly developing organize of interconnected gadgets and sensors to trade information and perform robotized errands. As the number of IoT gadgets proceeds to develop, so as well does program complexity and the require for proficient testing. Subsequently, it is vital to create compelling testing strategies and apparatuses for IoT computer program so that the quality, unwavering quality, and security of these interconnected gadgets can This extend points to address these challenges and create a comprehensive system for IoT program testing.

3.2 Solution to the Problem

To solve the problem of software testing in IoT, a number of solutions can be proposed, specifically- Develop a testing framework that supports a variety of IoT devices and software platforms, including standardized protocols and interfaces that enable seamless integration and interoperability between devices. Develop a comprehensive security testing framework including penetration testing and vulnerability assessment to ensure the IoT system is secure and resilient to cyber threats.

These solutions are feasible to meet the business objectives, as they can help organizations reduce the risk of software bugs and security vulnerabilities in their IoT systems, improve the overall quality of their products, and enhance customer trust and satisfaction. The relevant benefits, objectives, and goals of this software include - Ensuring the reliability, safety, and security of IoT systems through comprehensive testing.

Including: Automated testing tools like selenium, Appium, Test Studio used for the project. We used basically selenium application. Test automation frameworks that can support a wide variety of IoT devices and software platforms.

Therefore, there is a need for a comprehensive and integrated testing framework that can address the unique challenges and complexities of IoT software testing.

4. REQUEIREMNT SPECIFICATION

4.1 System Features

1. **User Registration**

   1.1 The software shall allow users to register an account with their username, email address, and password.

   1.2 The software shall validate the user input and ensure that the username and email address are unique.

   1.3 The software shall send a confirmation email to the user to verify their email address.

   Priority Level: High

   Precondition: The user should have an email address and access to it.

2. **User Sign In**

   2.1 The software shall allow registered users to sign in to their account using their username and password.

   2.2 The software shall validate the user input and authenticate the user before allowing access to the system.

   2.3 The software shall provide a "forgot password" function to allow users to reset their password.

   Priority Level: High

   Precondition: The user should have a valid username and password.

3. **Device Compatibility Testing**

   3.1 The software shall support compatibility testing of different IoT devices with the software platform.

   3.2 The software shall allow users to create test scenarios based on different device configurations and parameters.

   3.3 The software shall generate a report on the compatibility test results.

   Priority Level: High

   Precondition: The IoT devices should be connected to the system and should be ready for testing.

4. **Performance Testing**

4.1 The software shall support performance testing of IoT devices and software platforms.

4.2 The software shall allow users to create test scenarios based on different load conditions and network conditions.

4.3 The software shall generate a report on the performance test results.

Priority Level: High

Precondition: The IoT devices should be connected to the system and should be ready for testing.

5. **Security Testing**

5.1 The software shall support security testing of IoT devices and software platforms.

5.2 The software shall allow users to create test scenarios based on different security vulnerabilities and attack vectors.

5.3 The software shall generate a report on the security test results.

Priority Level: High

Precondition: The IoT devices should be connected to the system and should be ready for testing.

6. **Test Automation**

6.1 The software shall support test automation for IoT devices and software platforms.

6.2 The software shall allow users to create and execute automated test scripts.

6.3 The software shall generate a report on the automated test results.

Priority Level: Medium

Precondition: The test scripts should be developed and stored in the system.

7. **Reporting and Analysis**

7.1 The software shall provide detailed reports on the testing results.

7.2 The software shall allow users to analyze the test results and identify areas for improvement.

7.3 The software shall provide visual representations of the test results.

Priority Level: Medium

Precondition: The testing should be completed and test results should be available in the system.

4.2 System Quality Attributes

The quality attributes that describe how well the software testing framework for IoT should perform are as follows:

- o   Reliability: The software shall be able to handle large volumes of testing data without crashing or producing errors.
- o   Performance: The software shall be able to run tests quickly and efficiently, and provide timely feedback on test results.
- o   Scalability: The software shall be able to handle a growing number of IoT devices and software platforms without compromising on performance or reliability.
- o   Security: The software shall ensure that test data and user information are kept secure and protected from unauthorized access or use.
- o   Usability: The software shall be user-friendly and easy to navigate, with clear instructions and feedback provided to users.
- o   Maintainability: The software shall be easy to maintain and update, with clear documentation and guidelines provided to developers.
- o   Portability: The software shall be able to run on different operating systems and hardware platforms, with minimal changes required.
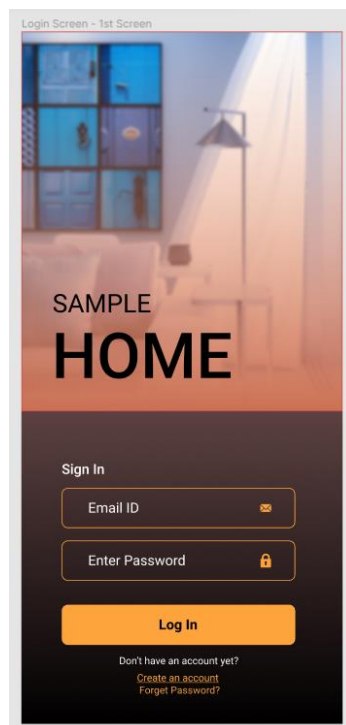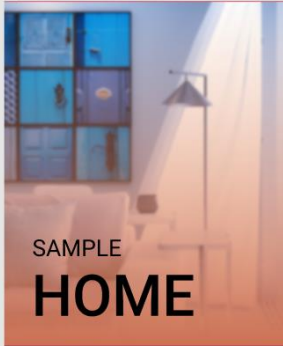
4.3 System Interface

Fig: Login

Fig: Registration

Fig: Forgot Password

Fig: Home Screen
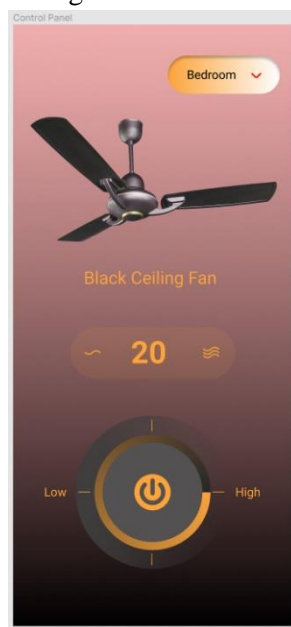
Fig: Control Panel

4.4 Project Requirements

Considering,
Project testing time = 8 months
Number of people for testing = 3 members
Estimating Budget:
Working days = 6 days in a week
Working hours per day = 6 hours
Working hours in 1 week = (6*6) = 36 hours
Salary for each member:
Per hour = 300 Taka
Per week = (300*6*6) = 10800 Taka
For 4 weeks = (4*10800) Taka = 43,200 Taka
For 8 months = (8*43,200) Taka = 345,600 Taka
Now, Salary for 3 members for 8 months = (3*345,600) Taka = 1,036,800 Taka
Office rent for 8 months = (8*10,000) = 80,000 Taka
Electricity and other bills = 30,000 Taka
Maintenance Cost = (3* 6* 1000) = 18,000 Taka
Total Estimated Cost = (1,036,800+ 80,000+ 30,000 + 18,000) = 1,164,800 Taka
20% profit of total estimated cost = (0.2*1,164,800) = 232,960Taka
Total Estimated Budget is = (232,960+1,164,800) = 1,397,760 Taka

5. FEATURES NOT TO BE TESTED

The list of areas that will not be specifically covered in the IoT Software Testing Framework include:

Customer-specific applications:
Any applications or software developed by customers using the testing framework will not be tested directly as they are outside the scope of this project. However, necessary data format information will be provided for customers to extract data and test their applications.

Hardware test:

The testing framework will focus on software testing and will not include hardware testing, such as physical testing of IoT devices.

Third-party software:
Any third-party software used in conjunction with the testing framework will not be directly tested. However, the compatibility of the testing framework with these software's will be guaranteed. Network test:
The testing framework will not include network testing, such as testing of network protocols and configurations.

Test use:
While usability is one of the quality attributes, the testing framework will not specifically address usability testing. However, the interface and user experience of the test framework will be designed to be user-friendly and easy to navigate.

Test the performance of individual IoT devices:
While the testing framework will ensure the compatibility of IoT devices with software and the entire system, performance testing of individual IoT devices will not be directly tested.

These areas will be tested indirectly as part of other testing efforts, and the testing framework will be designed to ensure overall IoT system compatibility and reliability.

6. TESTING APPROACH

6.1 Testing Levels

We will test our built-in features in four testing levels. These are 1. Unit Testing, 2. Integration Testing, 3. System Testing, 4. Acceptance Testing.

1.Unit Testing:
This level of testing involves testing individual software components or units of code to ensure that they function as expected. Developers will be responsible for performing unit tests and providing test proof to the development team lead.

2.Integration Testing:
After the individual units of code have been tested, they must be combined and tested together as a system to ensure that they work together as intended. Integration testing will be performed by the Test Manager and the Development Team Lead with support from individual developers as required.

3.System Testing:
At this level, the entire IoT system will be tested to ensure that all software components and hardware devices work together as expected and meet the system requirements. The test manager will direct this testing effort.

4.Acceptance Testing:
This level of testing involves testing the IoT system with real end users to ensure that it meets their needs and requirements. Acceptance testing will be performed side-by-side with the existing manual process for some time after the system testing is complete.

6.2 Test Tools

List of testing tools that use –
- Selenium (Version 4.8.2) for testing
- Chrome Web Driver (Version 112.0.5615.137) for running test codes.
- Desktop (OS Windows 11)

6.3 Meetings

The test team will meet once in every week to evaluate progress to date and to identify error trends and problems as early as possible. The test team leader will meet with development and the project manager once every two weeks as well. These two meetings will be scheduled on different weeks. Additional meetings can be called as required for emergency situations.

7. TEST CASES/TEST ITEMS

The test process will be completed once the initial set of distributors have successfully sent in reassigned.

Project Name: STIOT			Test Designed by: T,M Ragib Shahrier		
Test Case ID: Registration_1			Test Designed date: 18/4/2023		
Test Priority (Low, Medium, High): High			Test Executed by: T,M Ragib Shahrier		
Module Name: Registration			Test Execution date:18/4/2023		
Test Title: Verify registration using valid information					
Description: Test user registration					
Precondition (If any): User must have valid Email address					
Test Steps	Test Data	Expected Results	Actual Results	Status (Pass/Fail)	
1. Go to the website 2. Click on register 3. Enter name 4. Enter email 5. Enter password 6. Enter date of birth 7. Enter sign up	Name:T.M Ragib Shahrier Email: ragibshahriar43@gmail.com Password:ragib DOB:5/1/2001	Account created successfully and go to the login page	As expected,	Pass	
Post Condition: User information added in the database section					

Project Name: STIOT	Test Designed by: T,M Ragib Shahrier
Test Case ID: Login_2	Test Designed date: 18/4/2023
Test Priority (Low, Medium, High): High	Test Executed by: T,M Ragib Shahrier
Module Name: Login	Test Execution date:18/4/2023
Test Title: Verify login with valid username and password	
Description: Test user login	

Precondition (If any): User must have valid username and password				

Test Steps	Test Data	Expected Results	Actual Results	Status (Pass/Fail)
1. Go to the homepage 2. Enter email 3. Enter password 4. Click submit	Email: ragibshahriar43@gmail.com Password: ragib	User should login into the application	As expected	Pass

Post Condition: User is validated with database and successfully login to account. The account session details are logged in the database.

Project Name: STIOT			Test Designed by: T,M Ragib Shahrier	
Test Case ID: Logout_3			Test Designed date: 18/4/2023	
Test Priority (Low, Medium, High): Medium			Test Executed by: T,M Ragib Shahrier	
Module Name: Logout			Test Execution date:18/4/2023	
Test Title: Verify user logout option				
Description: Test user registration				
Precondition (If any): Test the website logout option				
Test Steps	Test Data	Expected Results	Actual Results	Status (Pass/Fail)
1. Go to the homepage 2. Login in to the site 3. Click logout button		Successfully log out	As expected,	Pass
Post Condition: User has successfully logout				

Project Name: STIOT	Test Designed by: T,M Ragib Shahrier
Test Case ID: Reset password_4	Test Designed date: 18/4/2023
Test Priority (Low, Medium, High): Medium	Test Executed by: T,M Ragib Shahrier
Module Name: Reset password	Test Execution date:18/4/2023
Test Title: Put old username and password to set up new password	
Description: Test the website reset password page	
Precondition (If any): User has valid username and password				

Test Steps	Test Data	Expected Results	Actual Results	Status (Pass/Fail)
1. Go to the homepage 2. Enter email 3. Enter password 4. Click submit	Username:ragib Old Password: ragib New password: ragib12	User should change his password	As expected,	Pass
Post Condition: User is validated with database and successfully changed to password				

Project Name: STIOT	Test Designed by: MD. Amimul Ahasun Anas
Test Case ID: Device Connection _5	Test Designed date: 18/4/2023
Test Priority (Low, Medium, High): High	Test Executed by: MD. Amimul Ahasun Anas
Module Name: Device Connection	Test Execution date:18/4/2023
Test Title: Verify the device is able to connect to the network	
Description: Test whether the device can establish a connection to the network	
Precondition (If any): The device is powered on and the network is available	

Test Steps	Test Data	Expected Results	Actual Results	Status (Pass/Fail)
1. Turn on the device 2. Attempt to connect to the network Valid network credentials Device	Device ID: 123456 Wi-Fi network name: "MyNetwork", Password: "myPassword123"	Successfully connects to the network	As expected,	Pass
Post Condition: Device is connected to the network and ready for use				

Project Name: STIOT	Test Designed by: MD. Amimul Ahasun Anas
Test Case ID: Data Transmission _6	Test Designed date: 18/4/2023
Test Priority (Low, Medium, High): High	Test Executed by: MD. Amimul Ahasun Anas
Module Name: Data Transmission	Test Execution date:18/4/2023
Test Title: Verify data is transmitted accurately and timely	
Description: Test whether the device can transmit data accurately and timely to the server	
Precondition (If any): The device is connected to the network and the server is available				

Test Steps	Test Data	Expected Results	Actual Results	Status (Pass/Fail)
1. Send data from device to the server 2. Check the server for the received data Valid data	Temperature sensor reading: 25.5°C, Humidity sensor reading: 45%, Light sensor reading: 350 Lux	Data received accurately and timely	As expected,	Pass

Post Condition: Data is transmitted accurately and timely to the server

Project Name: STIOT	Test Designed by: MD. Amimul Ahasun Anas
Test Case ID: Device Control _7	Test Designed date: 18/4/2023
Test Priority (Low, Medium, High): High	Test Executed by: MD. Amimul Ahasun Anas
Module Name: Device Control	Test Execution date:18/4/2023
Test Title: Verify device can be controlled remotely	
Description: Test whether the device can be controlled remotely from the serve	
Precondition (If any): The device is connected to the network and the server is available				

Test Steps	Test Data	Expected Results	Actual Results	Status (Pass/Fail)
1. Send a control command from the server to the device 2. Check if the device responds accordingly	Temperature threshold value: 30°C, Current temperature reading: 32°C, Alert message: "Temperature is above the threshold value"	Valid control command Device responds to the control command	As expected,	Pass

Post Condition: Device is controllable remotely from the server

Project Name: STIOT	Test Designed by: Pranto Bormon
Test Case ID: Sensor Data Accuracy _8	Test Designed date: 18/4/2023
Test Priority (Low, Medium, High): High	Test Executed by: Pranto Bormon
Module Name: Sensor Data Accuracy	Test Execution date:18/4/2023
Test Title: Verify sensor data accuracy	
Description: Test whether the device is accurately reading the sensor data	
Precondition (If any): The device is powered on and the sensors are functioning properly	

Test Steps	Test Data	Expected Results	Actual Results	Status (Pass/Fail)
1. Read sensor data from the device 2. Compare the read data with the actual data Valid sensor data	Device A sensor data: Temperature: 25°C, Humidity: 50%, Device B sensor data: Light: 400 Lux, Device C sensor data: CO2: 800 ppm	Data is accurate within an acceptable range	As expected,	Pass

Post Condition: Sensor data accuracy is confirmed

Project Name: STIOT	Test Designed by: Pranto Bormon
Test Case ID: Battery Life _9	Test Designed date: 18/4/2023
Test Priority (Low, Medium, High): Medium	Test Executed by: Pranto Bormon
Module Name: Battery Life	Test Execution date:18/4/2023
Test Title: Verify battery life	
Description: Test whether the device battery life meets the expected duration	
Precondition (If any): The device battery is fully charged	

Test Steps	Test Data	Expected Results	Actual Results	Status (Pass/Fail)
1. Activate the device 2. Record the start time 3. Let the device run until the battery is exhausted 4. Record the end time N/A	Verify battery life by running the device with heavy network usage for 6 hours	Battery life matches expected duration	As expected,	Pass

Post Condition: Device battery life is confirmed to meet the expected duration

8. ITEM PASS/FAIL CRITERIA

The entry criteria for each testing phase must be met before the next phase can take place. Now, the pass and fail criteria are given below –
- Under the given scenario, the expected result must happen for the design to be considered successful; otherwise, this criterion must fail.
- If an item is tested ten times, nine times working perfectly and once not working properly, it will be considered a failure.
- System crash will be considered a failure case.

9. TEST DELIVERABLES

- Acceptance test plan
- System/Integration test plan
- Unit test plans/turnover documentation
- Screen prototypes
- Report mock-ups
- Defect/Incident reports and summaries
- Test logs and turnover reports


10. STAFFING AND TRAINING NEEDS

It takes a large number of skilled people to build the "Software Testing in IoT (Internet of Things)" project. Because skilled employees can get the job done on time and under budget. In addition, professional staffs will complete high quality projects on time. Accordingly, personnel should be screened to determine if they are qualified for the project. Training programs can be put in place to help workers improve their skills.

11. RESPONSIBILITIES

	TM	PM	Dev Team	Test Team	Client
Acceptance test documentation & execution	X	X			
System/Integration test documentation & execution	X	X			X
Unit test documentation & execution	X	X		X	X
System Design Reviews	X	X	X	X	X
Detail Design Reviews	X	X	X	X	
Test procedures and rules	X	X	X	X	
Screen & Report prototype reviews			X		X
Change Control and regression testing	X	X	X	X	

12. TESTING SCHEDULE

Time has been allocated within the project plan for the following test activities. Specific dates and times for each activity are defined in the project planning timeline.
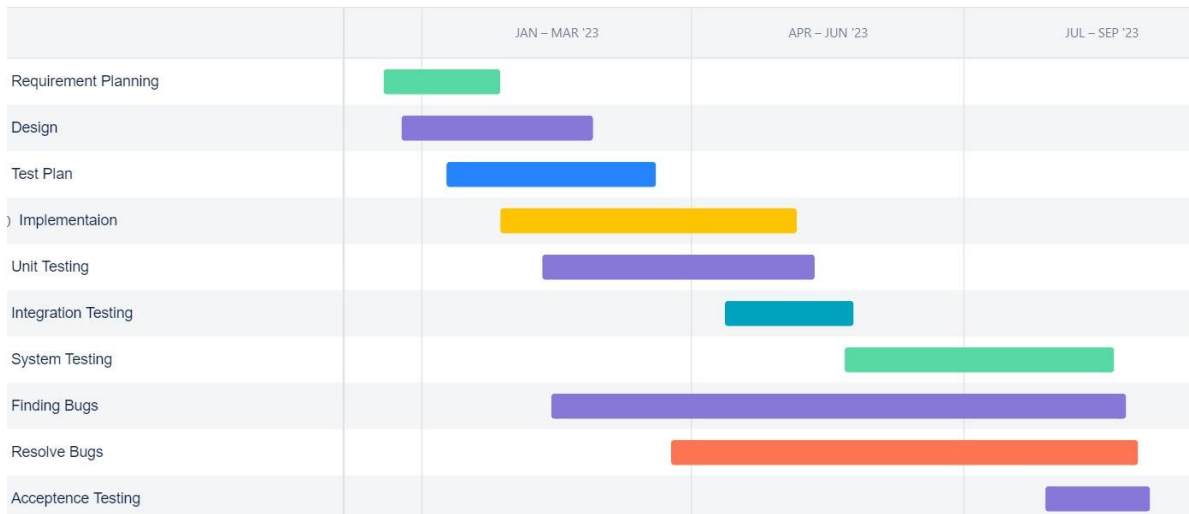
13. PLANNING RISKS AND CONTINGENCIES

Risk	Category	Probability	Impact	RMMM
Delivery deadline will be tightened	BU	40%	2	
Lack of experienced stuff	ST	30%	2	
Operation risk	DE	60%	2	
Large number of user than panned	PS	30%	3	
Performance degradation	T	30%	1	
Staff turnover will be high	ST	60%	2	
Communications risk	PR	60%	2	
Technical risk	PS	80%	2	
Lack of training tools	PS	50%	3	
Product is complex to implement	TE	40%	2	

Impact Values:

1. Catastrophic
2. Critical
3. Marginal
4. Negligible

14. APROVALS

Project Sponsor – Pranto Bormon	Approved
Development Management – T.M Ragib Shahrier	Approved
Edi Project manager – MD. Amimul Ahasun Anas	Approved
RS Test Manager – Pranto Bormon	Approved
Rs Development Team Manager – T.M Ragib Shahrier	Approved
Reassigned Sales – MD. Amimul Ahasun Anas	Approved
Order Entry Edi Team Manager – T.M Ragib Shahrier	Approved