

Marker-less Augmented Reality Interactive Furniture Layouting (Furniture suggestions sub-system)

Software Requirement Specification
Project ID: 16-105

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Declaration

I hereby declare that the project work entitled “Marker-less Augmented Reality Interactive Furniture Layouting” (Furniture suggestions sub-system) submitted to the Sri Lanka Institute of Information Technology, is a record of original work done by our group under the guidance of Mr. Udara Samaratunge (Supervisor) and Mr. Tharindu Perera (Co- Supervisor), and this project work is submitted in the fulfillment for the award of the Bachelor of Science (Special Honors) in Information technology Specialization in Software Engineering. The results embodied in this report have not been submitted to any other University or Institute for the award of any degree or diploma. The diagrams, research results and all other documented components were developed by myself and I have cited clearly any references I have made.

Name : Jayathilaka D.G.T.K

Signature:

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Software Requirements Specification

1 Introduction

1.1 Purpose

The purpose of this document is to provide the user requirements, system requirements, functional requirements and non-functional requirements for the Markless furniture layouting system. This document is intended for customers who wish to interact with the Markless furniture layouting system and for the software engineers developing and maintaining the system. The user requirements have been explained in natural language making it easy to understand by an ordinary user.

Expected audience of the document: customers, furniture dealers, system developers, project managers

1.2 Scope

Markless furniture layouting system mainly intended for the customers who wishes to buy furniture for their residence. The proposed system provide web based and mobile based system to overcome the issue of “designing and buying furniture according to exact requirements of the customer”, which always been a large problem in furniture industry.

The Markless furniture layouting system uses augmented reality technology to project the selected furniture to real world scene in their correct size. The proposed system is capable of marker less projection of furniture which is an emerging technology in the field of augmented reality.

The proposed system is capable of recognizing the user commands and operate according to user commands. This value added feature enables the customer to easily modify the furniture details during the augmented projection.

This document mainly covers the furniture suggestion feature of the MarkLess furniture layouting system. The furniture suggestion feature suggests the customer

suitable furniture matching his environment based on the prominent colors present in the viewing environment and from the user ratings from previous sales. Effective furniture suggestions increase the customer satisfaction by selecting a furniture that suits their environment best.

Benefits of the proposed system

- Increased customer satisfaction due to less burden in purchasing and matching for customer's requirements.
- Improvement of the quality of the future products due to customer feedbacks.
- Less burden in furniture transportation and returning.

1.3 Definitions, Acronyms, and Abbreviations

Unity3D	Unity 3D development environment
VS 2015	Visual Studio 2015
OpenCV#	Open Computer Vision C# Library
SRS	System Requirement Specification Document
API	Application Presentation Interface
H+(HSDPA)	H+ stands for HSDPA (High-Speed Downlink Packet Access) .Its Enhanced 3G or referred sometimes as 3G+.[1]
Accelerometer	Accelerometers in mobile phones are used to detect the orientation of the phone.[2]
Magnetometer	Magnetometer provides mobile phones with a simple orientation in relation to the Earth's magnetic field.[2]
Gyroscope	The gyroscope, or gyro for short, adds an additional dimension to the information supplied by the accelerometer by tracking rotation or twist.[2]
Database	A digital data storing place.

Table 1 : Acronyms & Definitions

1.4 Overview

The final product is mainly targeted for furniture dealers and the customers wish to purchase furniture. The final application allows customers to download specific furniture from the store and augment them on their environment. Using the features added in the Markless furniture application the customer can experience the real feeling of how it matches to environment before purchasing.

The overall description of the system will be described in next chapter(chapter 2).The chapter two describes the existing software related to proposed system, interfaces of proposed system , constraints and the operations of the final product.

The third chapter provides in-detail description of the specific requirements of the final system. This section is mainly targeted for the developers and project managers in development and managing phases in the system life cycle.

3.5.1. Content of the SRS

This SRS document provides description of Markless augmented furniture layouting system and mainly covers the suggestion delivering feature of the proposed system.

3.5.2. SRS organization

This SRS document is organized according to IEE SRS document guidelines and consist of functional and non-functional requirements of the system along with the overall description of the system.

2 Overall Descriptions

2.1 Product perspective

The proposed system is an enhanced version of the applications currently exists in the market.

Augment [1]

This is an application for sellers to showcase their product catalog in augmented format to customers. “Augment” facilitates marker-less augment projection of objects but not facilitate in-app purchases, voice recognition and furniture suggestions.

VIUTEK-uDecore [2]

uDecore is an application that can used as a customizable 3D Room Planner for visualizing multiple 3D objects. The main drawback of this application is that it does not support android operating system which is a main operating system among smart phone users.

The **Sayduck**[3] and **Augmented Furniture**[4] applications does not support marker-less AR features. The following chart describes the features of the existing applications and the features in the final product.

Features	Augment	VIUTEK uDecore	Sayduck	Augmented Furniture	Our Solution
 Marker-less AR	✓	✓	✗	✗	✓
 Support multiple objects	✓	✓	✗	✓	✓
 Support customization	✓	✓	✓	✓	✓
 In app user feedback	✗	✗	✗	✗	✓
 Suggestion feature	✗	✗	✗	✗	✓
 Voice recognition	✗	✗	✗	✗	✓
 In app purchasing	✗	✗	✓	✓	✓
 Augmented object details	✗	✗	✗	✗	✓
 Support android	✓	✗	✗	✗	✓
 Scale detection	✗	✗	✗	✗	✓

Figure 2: Existing product comparison

2.1.1 System interfaces

The Markless furniture layouting application uses “FurnAR” API developed by the development group in order to access the shared database and furniture suggesting processes. This “FurnAR” API can be extended further to interact with any system in future development processes. The API is accessible through web link <http://furnarapi.azurewebsites.net/> .

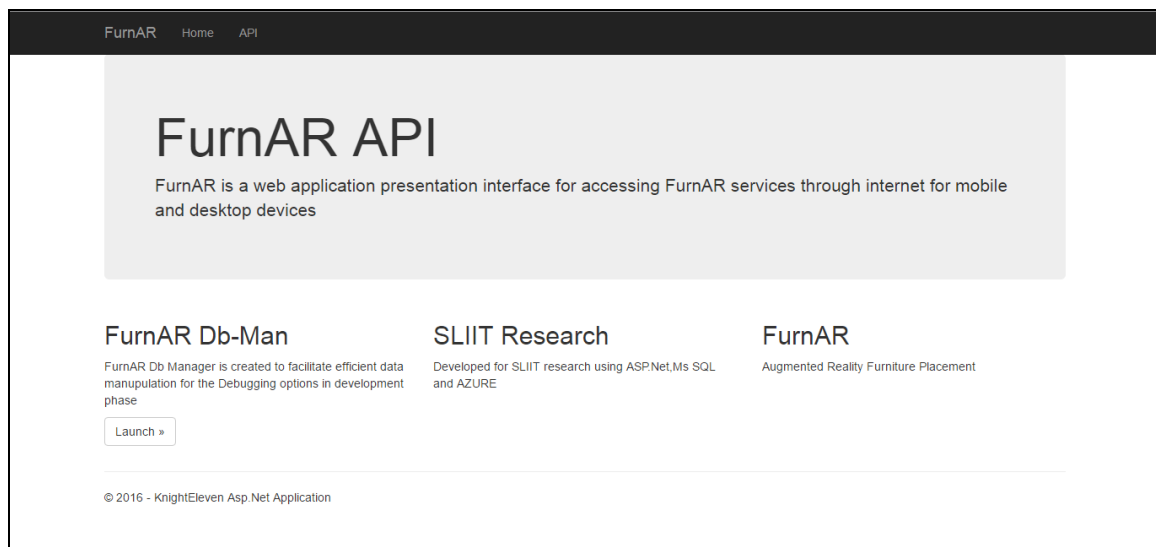


Figure 1 : FurnAR API

2.1.2 User interfaces

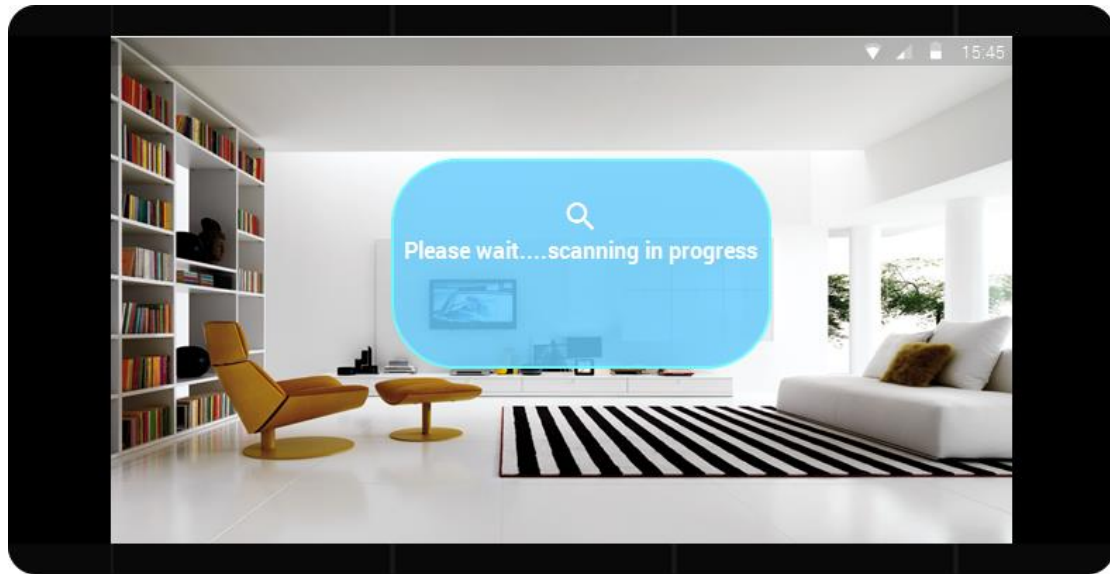


Figure 2 : Initial scan of the room

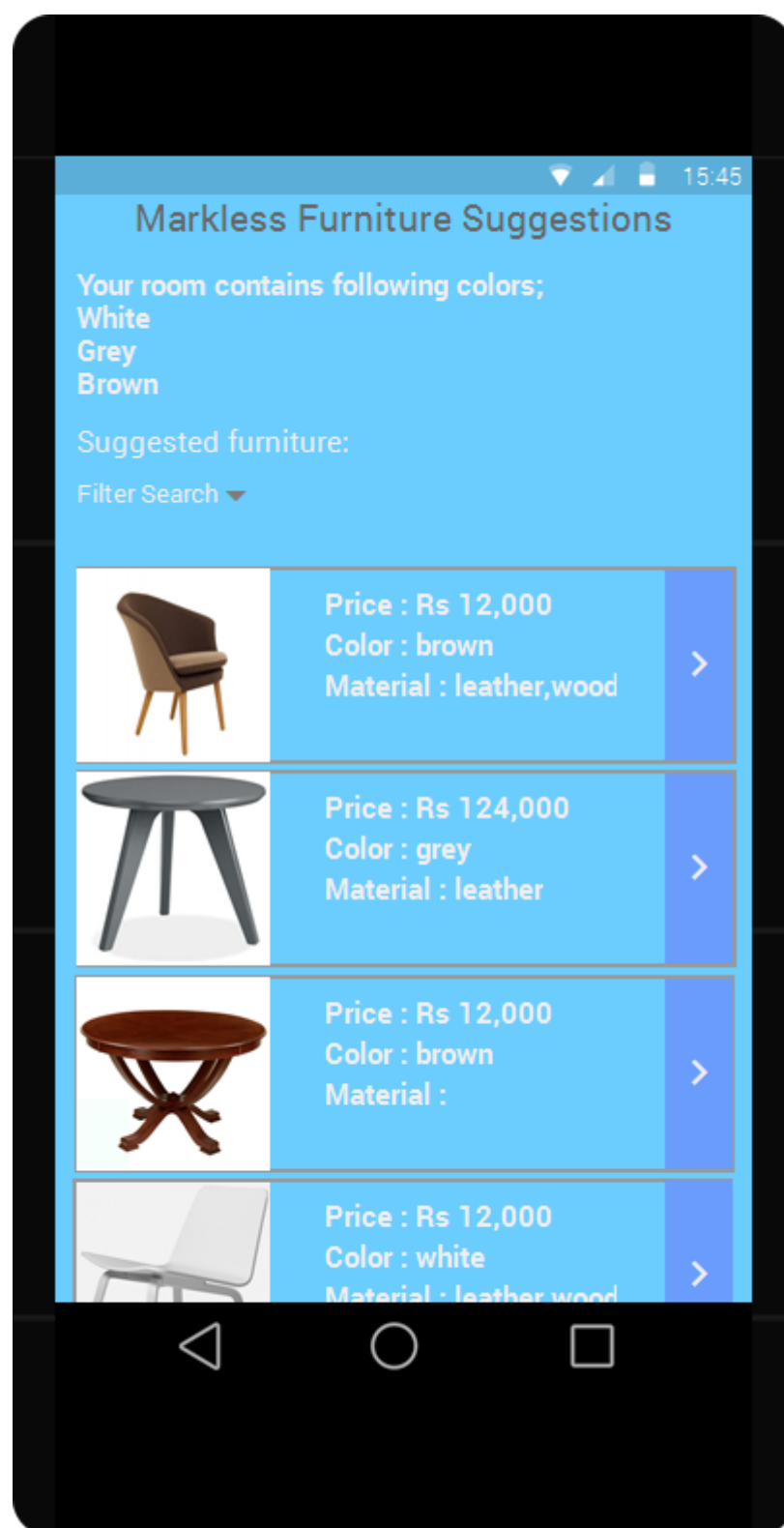


Figure 3 : Screen after scanning

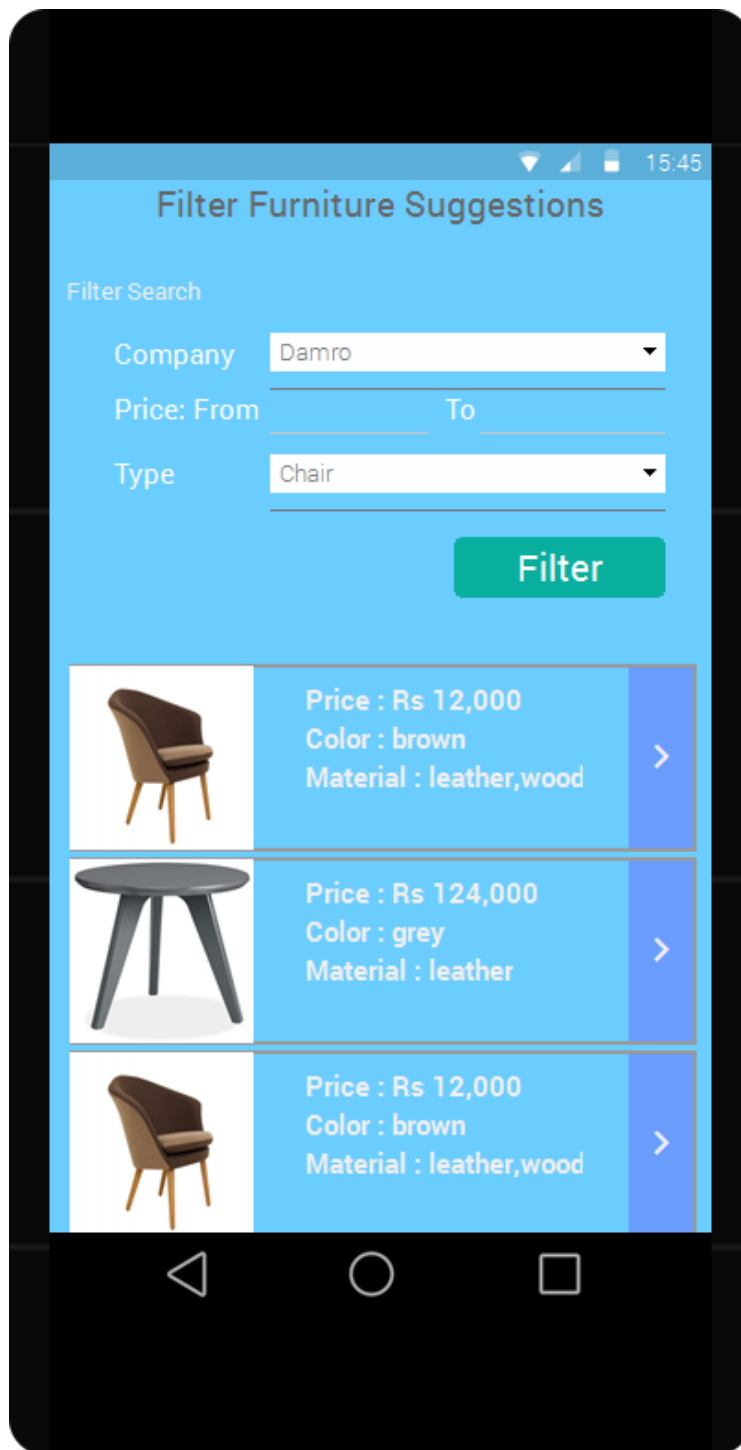


Figure 4 : Filter the suggested furniture

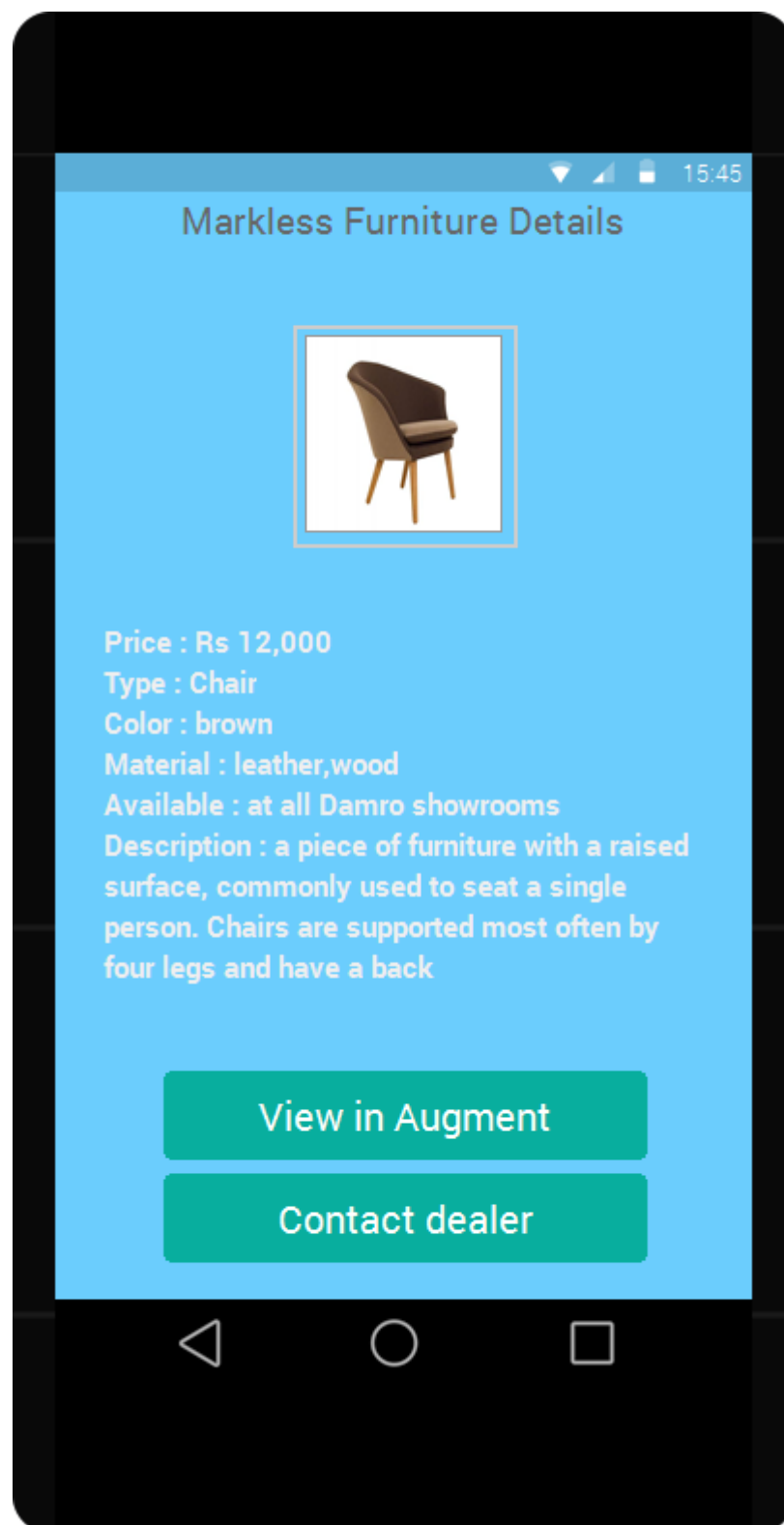


Figure 5 : View more details of the furniture

2.1.3 Hardware interfaces

Mobile device with android operating system will used as the main deployment environment for the proposed system. The mobile device should consist of following hardware specifications;

- Accelerometer
- Magnetometer
- Gyroscope

2.1.4 Software interfaces

- Microsoft azure cloud server
- Azure hosted Microsoft SQL server

2.1.5 Communication interfaces

Active internet connection is required for the system operations and data communications with the server. Minimum required internet bandwidth speed is H+ (HSDPA).

2.1.6 Memory constraints

Mobile application requires 1GB of RAM and 300MB free available disk space.

2.1.7 Operations

The system facilitates two types of users, the furniture dealers and their customers.

The furniture dealers

- The furniture dealers should initially register their company in the system and upload their furniture models.

The furniture customers

- Download and install the application to mobile device from the app store.
- Enable internet connection of the mobile device.
- Download the furniture models using the serial number provided by the dealer.
- Aim the mobile camera at the location the furniture should be placed.
- If needed add multiple furniture models to the scene or move the furniture models.
- If needed change the color, texture of the furniture and view more details.

2.1.8 Site adaptation requirements

The application is released in English language and the information will be displayed only in English language. In later releases of the application, language packs will be used in order to customize the application for native languages.

2.2 Product functions

3.5.1. Furniture suggestion sub system flow

The main flow of suggestion algorithm is as follows. The main system processing is processed in an azure hosted cloud service implemented by the research group. The following figure shows the basic application flow of the furniture suggestion feature.

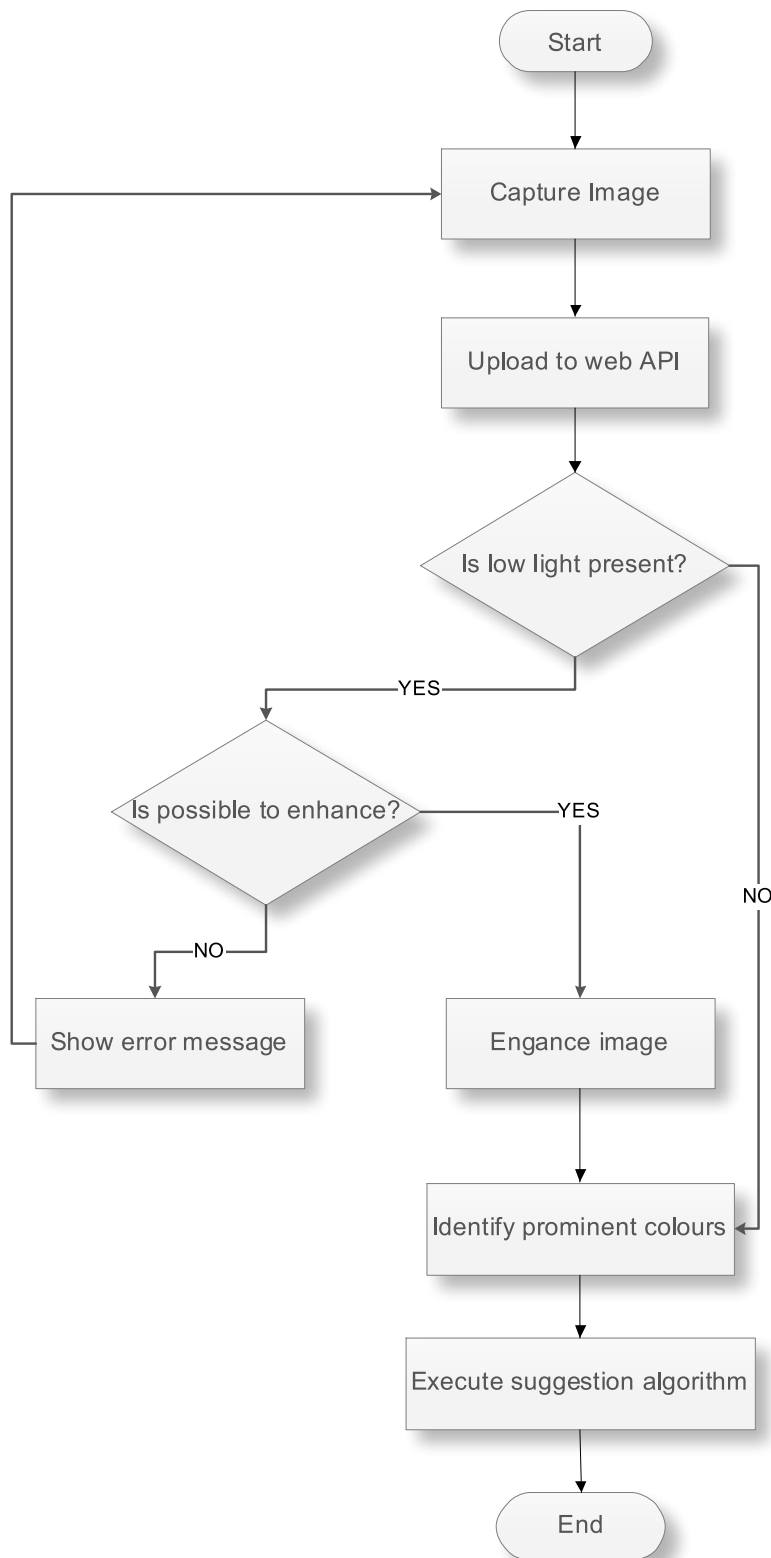


Figure 6 : Furniture suggestion flow chart

Identifying prominent colors in the environment is processed in the cloud server since it is a resource consuming process. The results will be immediately pushed to the mobile device after the processing.

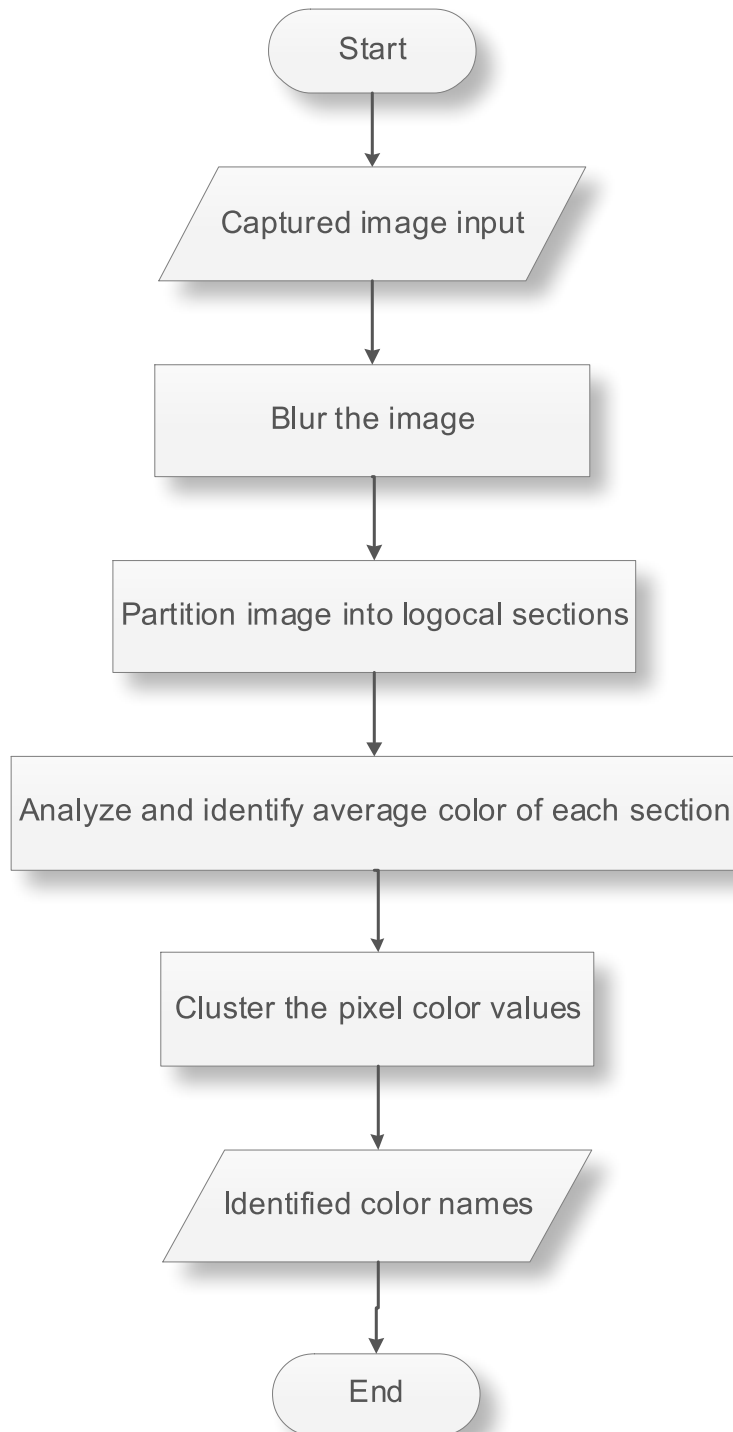


Figure 7 : Color identification flow

The use case diagram for the furniture suggestion sub system is as follows.

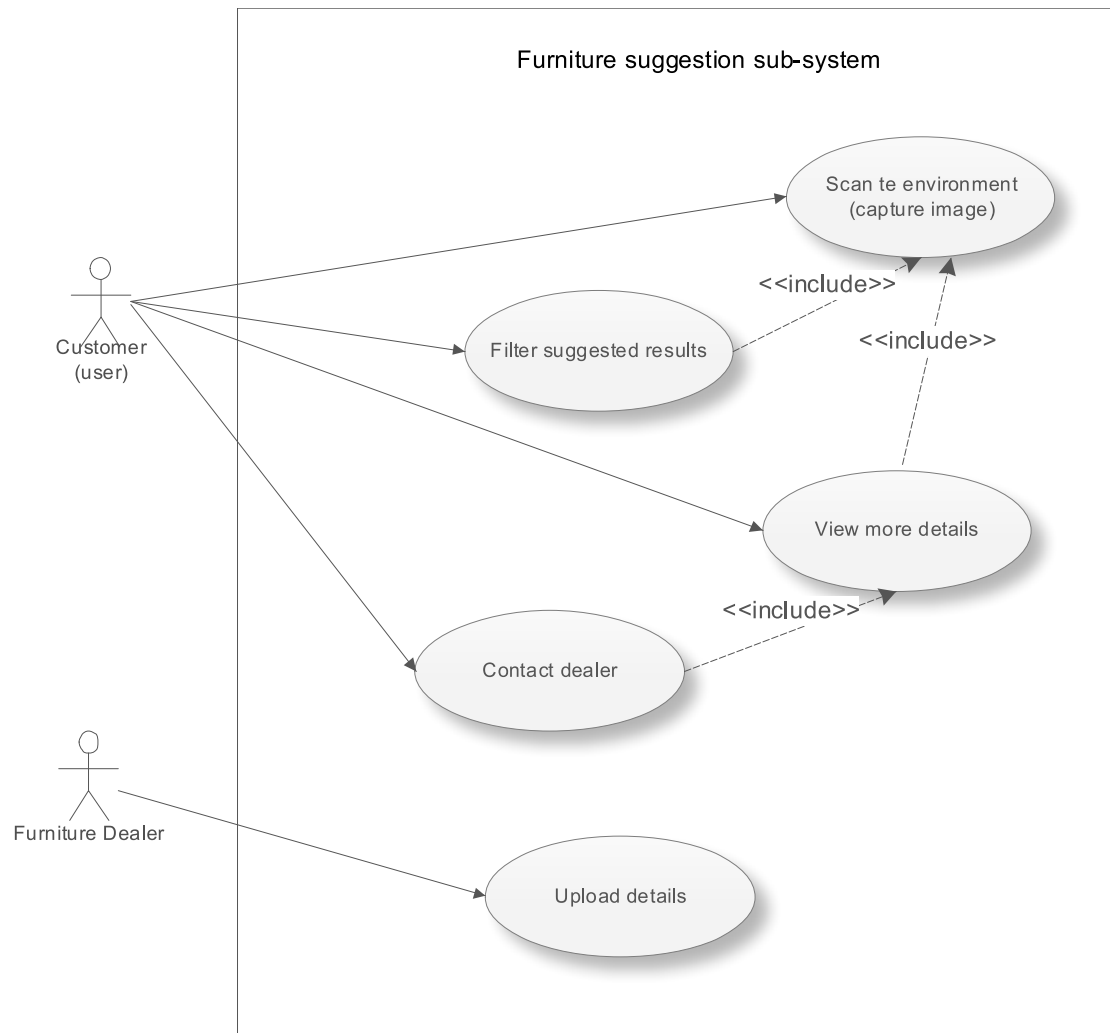


Figure 8 : Use case diagram-furniture suggestion

Use case Scenarios

Use case 01: Capture image of environment

Use case 01	Capture image of environment
Primary Actor(s)	User (Customer)
Pre-Condition	Mobile device should connected to the internet.
Post-Condition	Captured image is sent to “furnAR” web API
Main Success Scenario	1. Use case starts with the launching application. 2. User click suggest button and open the suggestion view. 3. User click on the capture button.
Extensions	2.a Disconnected for internet, system displays a message to reconnect.

Table 2 : Use case 1

Use case 02: Select suggested Furniture and view details

Use case 02	Select suggested Furniture and view details
Primary Actor(s)	User (Customer)
Pre-Condition	Mobile device should connected to the internet. Furniture suggestions should be received.
Post-Condition	More details view opens.
Main Success Scenario	1. Use case starts with user click on “view more details” button. 2. User select the suggested furniture.
Extensions	2.a Disconnected for internet, system displays a message to reconnect.

Table 3 : Use case 2

Use case 03: Filter suggestions

Use case 03	Filter suggestions
Primary Actor(s)	User (Customer)
Pre-Condition	Mobile device should connected to the internet. Furniture suggestions should be received.
Post-Condition	Suggestion details view opens.
Main Success Scenario	1. Use case starts with user click on “filter” button. 2. User enter filter criteria to text box. 3. User click “filter” button. 4. System shows filtered suggestions.
Extensions	4.a If no data found, popup an error message.

Table 4 : Use case 3

Use case 04: Contact dealer

Use case 04	Contact dealer
Primary Actor(s)	User (Customer)
Pre-Condition	Mobile device should connected to the internet. Furniture suggestions should be received. User should navigate to furniture detail view screen.
Post-Condition	Suggestion details view opens.
Main Success Scenario	1. Use case starts with user click on “contact dealer” button. 2. Call manager initialize the call.
Extensions	4.a If no dealer contact found, popup an error message.

Table 5 : Use case 4

2.3 User characteristics

The system is mainly target on two users, furniture dealers and their customers.

The customers should have basic knowledge in operating a smart mobile device and no other special skills needed.

The furniture dealers should have good knowledge in data entry operations and general knowledge in browsing web sites.

2.4 Constraints

- The server should be up and running 24/7.
- The server should be capable of handling multiple users at the same time.
- The response time of the system should be less than 10 seconds. But the response time may depend on the internet connectivity of the mobile device.
- The user interface language should be implemented in English.
- Unity IDE is used to create android application and .NET technologies to implement the server side implementations.

2.5 Assumptions and dependencies

The mobile device should meet following minimum hardware requirements.

- 1GB RAM
- 300MB free disk space
- Accelerometer
- Magnetometer
- Gyroscope
- Internet connectivity

The speed of internet connectivity should be of H+ (HSDPA) or higher.

3 Specific requirements

3.1 External interface requirements

3.1.1 User interfaces

Figure 2: Initial scan of the room

Name of the item	Scan button
Description of purpose	Display a notification alerting user that scan initialized and in progress.
Source of input or destination of output	Touch
Valid range, accuracy and/or tolerance	N/A
Units of measure	No
Timing	No
Relationships to other inputs/outputs	No
Screen formats/organization	Screen center
Window formats/organization	Center of screen
Data formats	N/A

Table 6 : User interface description

Figure 3: Screen after scanning

Name of the item	More(>) button	Filter button
Description of purpose	Display a window showing more details of the selected furniture.	Display a panel consist of filter criteria.
Source of input or destination of output	Touch	Touch
Valid range, accuracy and/or tolerance	N/A	N/A
Units of measure	No	No
Timing	No	No
Relationships to other inputs/outputs	No	No
Screen formats/organization	Screen right	Screen top

Window formats/organization	Left of each furniture suggestion	After the color values text.
Data formats	N/A	N/A

Table 7 : User interface description

Figure 4: Filter the suggested furniture

Name of the item	Company drop down	Price from/to text box	Type drop down	Filter button
Description of purpose	Display a list of available companies	Used to input price range	Display a list of available furniture types	Generate filtered data
Source of input or destination of output	Touch	Touch keyboard	Touch	Touch
Valid range, accuracy and/or tolerance	N/A	Non negative numeric value	N/A	N/A
Units of measure	No	Rupees	No	No
Timing	No	No	No	No
Relationships to other inputs/outputs	No	No	No	No
Screen formats/organization	Screen center	Screen center	Screen center	Screen center
Window formats/organization	Screen center	Screen center	Screen center	Screen center
Data formats	N/A	Float/Double	N/A	N/A

Table 8 : User interface description

Figure 5: View more details of the furniture

Name of the item	“View in augment” button	“contact” button
Description of purpose	Display a window showing augmented furniture	Display call manager window
Source of input or destination of output	Touch	Touch
Valid range, accuracy and/or tolerance	N/A	N/A
Units of measure	No	No
Timing	No	No
Relationships to other inputs/outputs	No	No
Screen formats/organization	Screen bottom	Screen bottom
Window formats/organization	Screen bottom	Screen bottom
Data formats	N/A	N/A

Table 9 : User interface description

3.1.2 Hardware interfaces

- Accelerometer
To identify the orientation of Camera to the real-world
- Magnetometer
To identify the direction to which the camera is pointed and changes the augmented 3D object direction to match.
- Gyroscope
To identify the orientation of the floor and the 3D objects compared to the camera.

3.1.3 Software interfaces

- UNITY 3D

Unity 3D development environment is used as the main integrated development environment for developing the mobile application.

- Microsoft Visual Studio 2015

Microsoft Visual Studio 2015 is used as the main development environment for developing web API.

- Kudan AR

Kudan AR is used as the augmented reality software toolkit to implement the marker less augmented reality features.

- Microsoft Azure Cloud web API

Azure hosted web API is used to interact with the hosted database and image processing controllers through the internet.

3.1.4 Communication interfaces

- Internet

Used as the communication medium between the mobile device and the server processes.

3.2 Classes/Objects

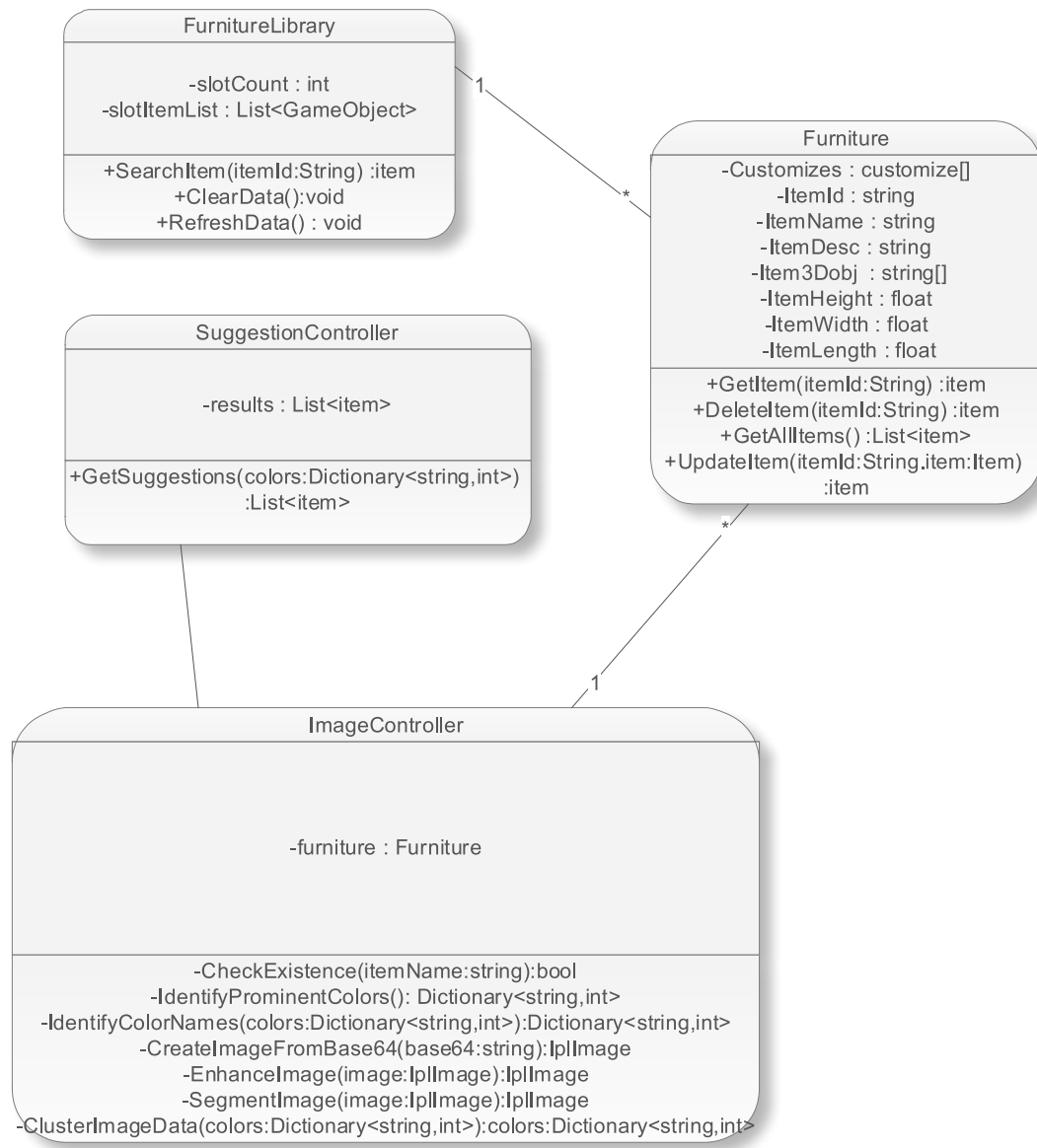


Figure 9 : Class diagram

The activity diagram for the suggestion feature of the system is as follows.

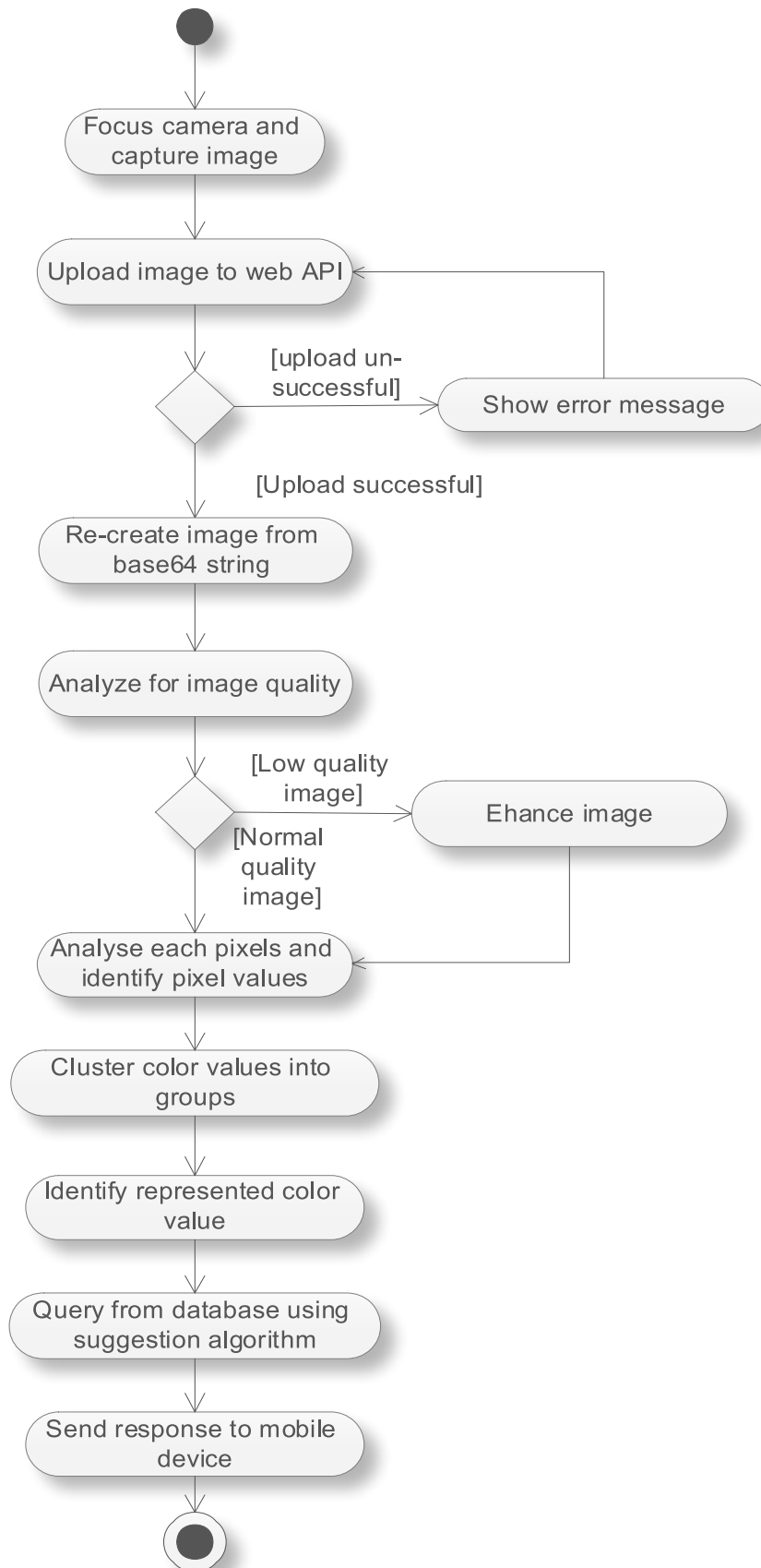


Figure 10 : Activity diagram

3.3 Performance requirements

The response other than downloading a furniture model should reach the mobile device within 15 seconds.

Time for downloading a furniture model depend on the model size and the internet bandwidth speed. However a model should be downloaded less than 2 minutes.

Interacting with furniture models should not freeze the view of the mobile device.

3.4 Design constraints

The color themes of the application User interface should be simple enough not to disturb the view of the main camera. The user interface components should be accessible by any general smart phone user without any problem and the User Interfaces should be self-explanatory for any user of the system.

3.5 Software system attributes

3.5.1 Reliability

- The data exist in the database should not be corrupted in any occasion.
- The data should not be corrupted during uploading to the server.
- The passed data should be validated according to the database schema.
- The downloaded furniture models should exist in mobile device until erased/deleted by the user even without the internet.

Test cases

1. Capturing image for suggestion algorithm

Test case #	Description	Pre-conditions	Test Steps	Input	Expected output
01	Capture image and upload	• Active internet connection • Good lighting conditions	1. Click “suggestions” button. 2. Click “scan” button	N/A	• Image capture and automatically upload to server without error.

Table 10 : Test case 1

2. View more details of a furniture

Test case #	Description	Pre-conditions	Test Steps	Input	Expected output
02	View more details of a selected furniture	• Active internet connection • List of furniture suggestions	1. Click “View more” button.	N/A	• Display detailed description of the selected furniture.

Table 11 : Test case 2

3. Contact furniture dealer

Test case #	Description	Pre-conditions	Test Steps	Input	Expected output
03	Contact furniture dealer to get more details over phone.	• Active internet connection • List of furniture suggestions	1. Click “View more” button. 2. Click “Contact dealer” button	N/A	• If contact number available initialize call manager. • If no contact number available alert user.

Table 12 : Test case 3

4. Filter suggestions

Test case #	Description	Pre-conditions	Test Steps	Input	Expected output
04	Filter suggestions	- Active internet connection - List of furniture suggestions	- Click “filter” button. - Select company as “damro” - Enter “price from” = 1000 - Enter “price to” = 20000 - Select type as “chair”	Company = “damro” From = 1000 To = 20000 Type = “chair”	Filtered chairs having company as “damro” and price range from 1000-20000.

Table 13 : Test case 4

3.5.2 Availability

- The Azure hosted “furnAR” web API should be available 98% of the time.
- Requests from mobile device to the web API through internet should not fail 98% of the time.
- Downloaded furniture models should available any time unless deleted by the user

3.5.3 Security

- Customer details will not be published to any application service other than the registered application.
- The confidentiality of the furniture models will be maintained using proper authorization levels and authentication of furniture serial numbers.
- The dealer information will be authenticated using proper login techniques.
- The sensitive data will be kept encrypted in the database.

3.5.4 Maintainability

- The system should log each process execution and the exceptions generated for future reference.
- Mobile application should be organized to cater higher maintainability for future upgrades.
- The server should be well organized so that modifications do not directly affect the executions of the other features of the server.

4 Supporting information

4.1 References

[1]"Sensors - Mobile terms glossary - GSMArena.com", *Gsmarena.com*, 2016. [Online]. Available: <http://www.gsmarena.com/glossary.php3?term=sensors>. [Accessed: 30- Mar- 2016].

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