VIRTUAL DRESSING ROOM

By

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ABSTRACT

Shopping for garments is a common activity. A Shopper usually tries on some selected dresses and examines how well they fit .A common practice for this purpose is to queue up and take turns to use the fitting rooms. Due to the limited number of in-store fitting rooms, shoppers usually have to spend most of their shopping time on queuing up. This causes a lot of problems to both the customers and shop keepers. Virtual dressing room is a desktop application using which Shoppers would be able to see the visual image of how they look like by trying on clothes virtually. To use this VDR environment, the customer needs to stand in front of an interactive LED with a Microsoft Kinect sensor mounted on it. Customer can see his/her video on the LED and a menu as well, in which dresses are listed. Customer selects the dress and it will be automatically mapped on his/her avatar Kinect is used to scan the skeletal points of the customer which will be used for dress mapping and size recommendation. The project also includes maintaining a database of the system. This will allow the manager to add, delete or update the dresses. The platform of the project will be Microsoft Windows and it will be developed using C#.

The target population of our project includes Shopping malls, clothing stores. It will help the customers to save time and it will also be a help to the handicapped persons who face difficulty in trying out the dress. The scope of our work is limited to 2D mapping of the dress on the user. The user interface design evaluation and final system evaluation have been done carefully to show the system usability. The project purpose is to enhance users’ shopping experiences by using the system, so that they can spend less time on queuing for fitting rooms

DECLARATION

No portion of the work presented in this dissertation has been submitted in

Support of another award or qualification either at this institution or elsewhere.

DEDICATION

In the name of Allah, the Most Merciful, the Most Beneficent.

To our parents, without whose constant support and cooperation
a work of this magnitude would not have been possible.

To our supervisor Dr. Seemab Latif who has given us great support
and valuable suggestions throughout the implementation process.

And finally to our Friends and siblings for their encouragement.

ACKNOWLEDGEMENTS

There is no success without the will of ALLAH Almighty. We are grateful to ALLAH, who has given us guidance, strength and enabled us to accomplish this task. Whatever we have achieved, we owe it to Him, in totality. We are also grateful to our parents and family and well-wishers for their admirable support and their critical reviews. We would like to thank our supervisor. Dr. Seemab Latif, for her continuous guidance support and motivation throughout the course of our project. Without her help we would have not been able to accomplish anything.

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INTRODUCTION

1 INTRODUCTION

1.1 Overview

Dressing is way of Life. Shopping for dresses is a common daily activity. Shopper usually tries on some selected dresses and examines how well they fit and then makes the choice. To try on some selected dress shoppers queue up and take turns to use the fitting rooms. Due to the limited number of in-store fitting rooms, shoppers usually have to spend most of their shopping time on queuing up. Prolonged waiting time leads to lower customer satisfaction and then the stores' losses of potential sales. In order to deal with this situation, people are keen on looking for strategies and techniques. Then, an idea called "Virtual Try On" is put forward. Customers would be able to perceive the visual image of how they look like by trying on clothes virtually, so that they make choice without taking turns to use the dressing rooms. Compare with "Physical Try On", "Virtual Try On" takes much less time. Thus, it increases the shopping efficiency for all customers, hence, enhances the shopping experience.

This thesis report describes an interactive visual computer system called "Virtual

Dressing Room" which implemented the concept of "Virtual Try On" by using Microsoft's Kinect sensor. The following sections give further details about this project in terms of its objectives, related works, system design, development tools, implementation iterations, evaluations and feedbacks

1.2 Problem Statement

To build a desktop application for shopping stores in order to assists the customers in virtually trying out different dresses within no time.

1.3 Approach:

In-store and online shopping is a common practice now a days. An in-store shopper usually tries on some selected dresses and examines how well they fit. While an online shopper usually checks how well the dresses fit the models in the online pictures. That is, a customer will usually make a decision after he/she perceived the visual image of a given dress. This was the main Idea behind developing VDR that customers should be able to see themselves in a particular dress with in no time. Microsoft Kinect track the skeletal points and the gestures of the customer which helps in dress mapping. An interactive Interface will be helping the customers to check the dresses.

1.4 Scope:

The Virtual Dressing Room shall provide an interactive environment which will enable the user to select the dress by simple hand gestures. This application will provide an intuitive and interactive menu structure that allows the user to navigate and select different dresses. It has four modules. The first module is to get the skeletal points of the customer using Kinect sensor and to provide the size recommendation services. Second module is to check that whether the selected dress is available in the specified size or not and the third module is to map the dress on the customer's body according to the skeletal points whereas the last module shall be specific to use for the customers and the company authorities.

It is a Kinect based application satisfying following objectives.

- Mechanism for size recommendation according to the user skeletal points
- Display of the dress on to the screen mapped with customer's body
- User interface for customer having the samples of the available stock
- Use of the augmented reality by gesture oriented functionality
- Display of guidelines for using the VDR
- Automation of the skeletal point assessment

1.5 Aims & Objectives:

- Using software engineering techniques for gathering requirements during the development process, designing the software, implementing and testing requirements gathered.
- To understand the concept of XAML and WPF that will be used in the project to design interface for display on screen.
- To learn application's hardware (Kinect sensor for Xbox 360) and software (Visual studio 2013, Kinect SDK v1.0, SQLite) architecture.
- To learn about databases and how to integrate them with the application

1.6 Organization:

The first part of thesis is the abstract which describes the main details of Virtual Dressing Room, followed by the introduction section which specifies the problem statement, approach, scope and objectives. The literature review section state the various resources read online before the start of the project. The design and development part illustrate the diagrams which describe the detailed design of Virtual Dressing Room, its components, interfaces and data necessary for the implementation phase. The analysis and evaluation part give details of the black box testing, unit testing and system integration testing; actual results against expected results. The future work gives states the enhancements that can be applied to the application.

1.7 Deliverables:

Deliverable Name	**Deliverable Summary Description**
Software Requirements Specification(SRS) Document	Complete Description of **what** the system will do, who will use it. Detailed description of functional and non-functional requirements and the system features.
Design Document	Complete description of **how** the system will be implemented i.e. the detailed design.
Code	Complete code with the API.
Testing Document	The whole system is tested according to the specification described in the SRS document. Black box, unit and System integration testing is done.
Complete System	Complete working system.

Table 1.1

CHAPTER:2

LITERATURE REVIEW

2 Literature Review

Now a days, shopping has become an important part of one's lifestyle. Customers makes a choice out of a variety and then buys a dress. Buyer needs to try the dress to check itsfitting, size and style.A common practice for this purpose is to use Dressing rooms in stores. Problem with in store Dressing rooms is:

- They are not always available.
- They have security issues.
- They are time consuming.

Many Studies and researches have been done by several people regarding its solution. Technology is improving at a rapid pace, as many things are possible today that were not possible 10 years ago even if we tried our best to make it happen.Today, some of the impossible things are rising to the occasion in the form of Augmented Reality and Virtual Reality. One best solution is to use the concept of augmented reality using Kinect.

2.1 Augmented Reality:

Augmented reality (**AR**) is a live direct or indirect view of a physical, real-world environment whose elements are *augmented* (or supplemented) by computer-generated sensory input such as sound, video, graphics or GPS data.Augmented reality is the blending of virtual reality and real life, as developers can create images within applications that blend in with contents in the real world. With AR, users are able to interact with virtual contents in the real world, and are able to distinguish between the two.

We've seen several applications with AR, along with video game and hardware devices such as the Google Glass.Augmented reality is ahead of virtual reality, as there are several products already on the market. We are witnessing the rise of AR hardware devices from Google in the form of Glass, and also plans from Microsoft to launch something similar with its $150 million purchase for wearable computing assets.

The field of Augmented Reality (AR) has existed for just over one decade, but the growth and progress in the past few years has been remarkable. In the late 1990's, several conferences specializing in this area were started, including the International Workshop and Symposium on Augmented Reality , the International Symposium on Mixed Reality, and the Designing Augmented Reality Environments workshop. Some well-funded interdisciplinary consortia were formed that focused on AR, notably the Mixed Reality Systems Laboratory in Japan and Project ARVIKA in Germany,IEEE Virtual Reality 2013.

The basic goal of an AR system is to enhance the user's perception of and interaction with the real world through supplementing the real world with 3D virtual objects that appear to coexist in the same space as the real world. Augmented Reality enhances a user's perception of and interaction with the real world. The virtual objects display information that the user cannot directly detect with his own senses. The information conveyed by the virtual objects helps a user perform real-world tasks

Many recent papers broaden the definition of AR beyond this vision, but in the spirit of the original survey we define AR systems to share the following properties:

1) Blends real and virtual, in a real environment

2) Real-time interactive

3) Registered in 3D

AR systems generally require extensive calibration to produce accurate registration. Measurements may include camera parameters, field of view, sensor offsets, object locations, distortions, etc. Accurately tracking the user's viewing orientation, position and location is crucial for AR registration.

The overall requirements of AR are as follows:

1) **Scene generator:** Rendering is not currently one of the major problems in AR. In AR, the virtual images only supplement the real world. Therefore, fewer virtual objects need to be drawn, and they do not necessarily have to be realistically rendered in order to serve the purposes of the application. For example, in the annotation applications, text and 3-D wireframe drawings might suffice. Ideally, photorealistic graphic objects would be seamlessly merged with the real environment, but more basic problems have to be solved first.

2) **Display device**: Since AR does not replace the real world therefore monochrome displays may be adequate for some AR applications. But for VDR we require full color display.

3) **Tracking and sensing**: Accurately tracking the user's viewing orientation, position and location is crucial for AR registration. For this purpose many input devices are used.

We will be using Microsoft Kinect for this purpose.

2.2 Microsoft Kinect:

Microsoft Kinect is poised to shake up the video game console experience. Announced and demonstrated as Project Natal in June 2009, Kinect seems almost magical the way it can "see" every movement of your body and reproduce it within the video game you're playing. Plus, it recognizes your face and voice so it can pick you out in the room and know who you are, even if you're playing with a group of friends.

Kinect is a line of motion sensing input devices by Microsoft for Xbox 360and Xbox One video game consoles and Windows PCs. It enables users to control and interact with their console/computer without the need for a game controller, through a natural user interface using gestures and spoken commands. The first-generation Kinect was first introduced in November 2010 in an attempt to broaden Xbox 360's audience beyond its typical gamer base.[10] A version for Windows was released on February 1, 2012.

2.2.1 Kinect technology:

The innovative technology behind Kinect is a combination of hardware and software contained within the Kinect sensor accessory.

The Kinect sensor is a flat black box that works with a trio of hardware innovations working together.

- **Color VGA video camera** - This video camera aids in facial recognition and other detection features by detecting three color components: red, green and blue. Microsoft calls this an "RGB camera" referring to the color components it detects.
- **Depth sensor** - An infrared projector and a monochrome CMOS (complementary metal-oxide semiconductor) sensor work together to "see" the room in 3-D.The infrared emitter of a Kinect sensor projects a pattern of infrared light. This pattern

of light is used to calculate the depth of the people in the field of view allowing the recognition of different people and different body parts.

- **Multi-array microphone** - This is an array of four microphones that can isolate the voices of the players from the noise in the room. This allows the player to be a few feet away from the microphone and still use voice controls.

A further look at the technical specifications for Kinect reveal that both the video and depth sensor cameras have a 640 x 480-pixel resolution and run at 30 FPS (frames per second). The specifications also suggest that you should allow about 6 feet (1.8 meters) of play space between you and the Kinect sensor, though this could vary depending on where you put the sensor

The Kinect hardware, though, would be nothing without the breakthrough software that makes use of the data it gathersi.e. the "brain" behind the camera lens.

2.2.1.1 **Kinect for Windows SDK:**

Kinect's software layer is the essential component to add meaning to what the hardware detects. The Kinect for Windows SDK provides the tools and APIs, both native and managed, that you need to develop Kinect-enabled applications for Microsoft Windows. Windows SDK and developer’s toolkit provides you many features that helps in developing AR systems using Kinect like background removal, Kinect studio, Kinect fusion , Coordinate mapping etc.Kinect SDK provides support for the features of the Kinect, including color images, depth images, audio input, and skeletal data.

2.3 How does it works?

When you first start up Kinect, it reads the layout of your room and configures the space you'll be moving in. Then, Kinect detects and tracks 20 points on user’s player's body, mapping them to a digital reproduction of that user’s body shape and skeletal structure, including facial details.Skeletal Tracking allows Kinect to recognize people and follow their actions.Using the infrared (IR) camera, Kinect can recognize up to six users in the field of view of the sensor. Of these, up to two users can be tracked in detail. An application can locate the joints of the tracked users in space and track their movements over time. But to get accurate result from VDR only one user can use at a time.

2.4 Previous work:

A lot of similar work has been done worldwide in field of Virtual dressing

Fits.me, a company based in Tallinn, Estonia — a country with one of the highest internet penetration rates in the world — is experimenting with a cutting-edge application that uses sophisticated bio robotics to enable consumers to try before they buy when shopping online. Itenables shoppers to view garments in various styles and sizes on a personalized,FitBot,” that can mimic 100,000 different body shapes, based on user inputs like height, neck, bust, waist, hips and arm measurements.

Webcam Social Shopper from Zugara: In 2009 a company named Zugara have come up with the idea of virtual dressing .Their first version ‘forced’ users to print an AR symbol and hold it in front of a camera so that the augmented reality software would recognize it and add the garment on top. They have debuted the Webcam Social Shopper (WSS) worldwide. The WSS software allows a shopper to use their webcam as a magic mirror to try on items virtually. This helped online shoppers and retailers.

NUS: A project on virtual dressing using augmented reality has been done by Department of Computer Science, School of Computing National University of Singapore in 2012.

Virtusize has launched its virtual fitting solution in the UK via a partnership with ASOS. Virtusize's solution requires that a customer already owns a supported garment in order to compare sizes or that they measure a favorite item of clothing at home and enter the data manually

Most of the above solutions were launched for online shopping websites and none of them is available in Pakistan. Moreover they are much expensive. Zugara WSS costs $10,000 USD to $12,000 USD yearly. We aimed to develop a system for stores, shopping malls of Pakistan in less price.

CHAPTER: 3

OVERALL DESCRIPTION

3 Overall description:

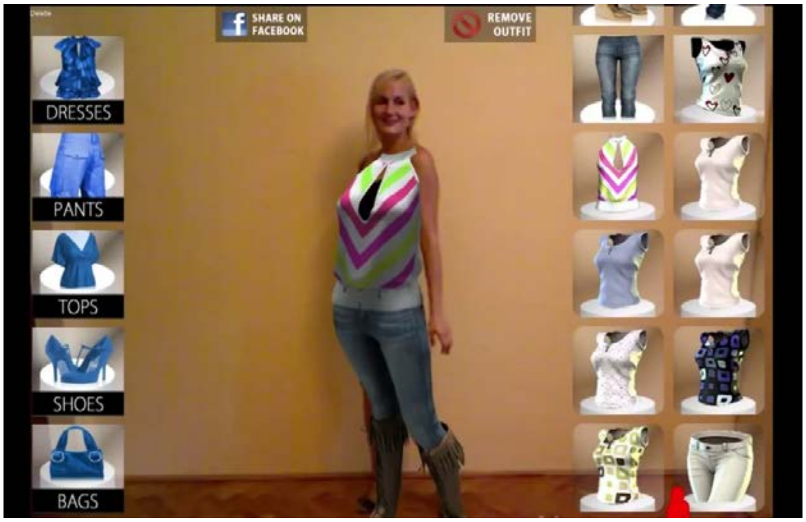


Figure 1Working of VDR

3.1 Product Perspective:

Basic problems in trying /dressing rooms includes:

- Safety and Security issues
- Time
- Availability

VDR is a new technology product that overcomes these issues. The conception of its idea was originated with the aim of providing a real time fitting experience to the shoppers. This product gives an interactive visual computer system called “Virtual Fitting Room” which implemented the concept of “Virtual Try On” by using Microsoft’s Kinect sensor.

3.2 Product Features:

The main features of VDR are highlighted below:

- Menu driven navigation
- To show the available stock according to the user's desired category
- To perform the augmented reality functionality using hand gestures
- Allow user to check the different dresses by virtually trying on with less time and hustle
- To display the results on the interactive LED

3.3 User Classes and Characteristics:

The application can be used by customers interested in buying cloths.

The different types of users are:

- **Shopkeeper** (frequent user) the product will be used by the shop owner and the staff. They will be able to access the visual database of the system to update, delete and insert items into the database.
- **Customers** (frequent user) would be able to use this virtual environment for their own convenience during the shopping which will result in saving customer's time.
- **Developers** (occasional user): The developers will use this system at the developing time and at the time of any defect occurred in the product during maintenance.

- **Tester** (occasional user): The testers will use the product at the time of the testing to make the scenarios to check the functionality of the product.

3.4 Design and Implementation Constraints

- Microsoft Kinect 1.0 has some limitations regarding skeletal points. It takes less number of skeletal points as compared to Microsoft Kinect 2.0
- VDR will not work in a dark room.
- Kinect depth sensor does not work in sunlight
- It is not able to entertain multiple customers at a time.
- The customer should stand straight (should not be bent or sitting) otherwise the skeletal points will not be accurately taken.
- VDR will not work properly without a good internet connection

3.5 User Documentation:

A user manual will be provided to the users in which separate instructions will be given according to the particular user i.e. shopkeeper (company authorities), customers, developers and testers. It will include the details of the system's working. Help documents will also be a part of the system. The project report will also be available for the users which will highlight the system features, working and procedures.

3.6 System Features:

3.6.1 Accessing the Main Menu

3.6.1.1 Description and Priority

Instructions for using the application shall be provided before using the VDR .The instructions shall be written on the screen. After starting the application, the categories (available stock) will be displayed as a main menu. Its priority will be high as without this feature the application will not be navigable and the user will not be able to perform any action.

3.6.1.2 Stimulus/Response Sequences

1. Stand in front of the interactive LED at a feasible distance from Kinect
2. Access main menu (user interface)
3. Select the category from which you want to buy
4. Available stock according to the desired category will be displayed

3.6.1.3 Functional Requirements

REQ-1: The application must be properly installed in the operating environment.

REQ-2: The main menu shall be used to check whether the user is a customer or a shopkeeper (company Authorities)

REQ-3: At any time the user shall be able to move over to the main menu.

REQ-4: At any time user shall be able to exit the application just by moving away.

3.6.2 Skeleton Tracking

3.6.2.1 Description and Priority

The skeleton tracking holds a very high priority since it is a core feature of this application. This shall be done by Skeletal Tracking API.

3.6.2.2 Stimulus/Response Sequences

- The user stands straight in front of the Kinect
- The Kinect automatically takes the skeleton points of the user’s body as a stream of data as shown below

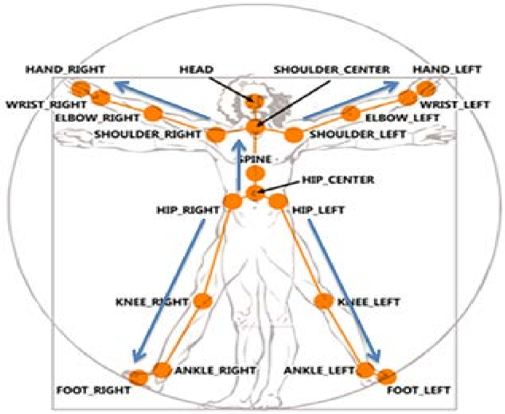


Figure 2Kinect Skeletal Tracking

3.6.2.3 Functional Requirements

REQ- 5: User shall only needs to stand straight in front of the sensor and let the Kinect sensor track the skeletal points

REQ-6: The creation of the image on the LED screen shall make an AVATAR image and the color of the body is saved as the RGB data stream

3.6.3 Search Database

3.6.3.1 Description and Priority

The garments databaseis very important because without this, VDR will be useless. The database contains the items available in the company stock. The company authorities can access the garments database and can insert, update and delete the records.

3.6.3.2 Stimulus/Response Sequences

- First of all, the user will be identified as customer or owner
- The user will select the category by just making gesture
- The selected category will be searched from the available database and available stock will be displayed on the LED
- The database record will be automatically updated.

3.6.3.3 Functional Requirements

REQ-7: The assessment and the response of the database should be fast. The user should not wait for the database response.

REQ-8: The available stock should be properly visible on the screen.

REQ-9: After shopping, the database record will be automatically updated

3.6.4 Change Database

3.6.4.1 Description and Priority

This feature will enable the company authorities to add new stock to their database.

3.6.4.2 Stimulus/Response Sequences

- User shall select the category of owner
- System will ask the user name and password
- User shall make changes and database will be updated.

3.6.4.3 Functional Requirements

REQ-10: User shall only be able to change database by providing username and password.

REQ-11: User shall be able to make changes like Add new dress, delete or update the samples.

3.6.5 Display final result

3.6.5.1 Description and Priority:

After the selection of the desired dress, System shall place the dress sample on customer’s avatar image

3.6.5.2 Stimulus/Response Sequences

- Use shall select the dress.

- System shall place the dress sample on customer’s body according to skeletal data points.
- System shall display the user’s avatar virtually wearing the dress.

3.6.5.3 Functional requirements:

REQ-12: System shall display the user’s avatar virtually wearing the dress.

REQ-13: If the Customer wants he/she shall be able to capture the final screenshot

3.7 External Interface Requirement

3.7.1 User Interfaces

- The user interface will be user friendly and the standard English-US will be used
- The input from the user will be taken as the hand gestures made at the required position on the screen.
- The available stock of the user required category will be shown on the screen and the user will be able to virtually try-on the desired dress and can see himself/herself on the screen
- Hand Gesture recognition
- 2D graphical user interface
- Database Navigation

Note:

Screens are subjected to change later in project.

Only basic screen of the application are mentioned above to give a generic idea

3.7.2 Hardware Interfaces

- **LED:**Minimum 22 inches LED with good resolution and colors will be used for the display. Interacting LED holds a high priority since this is a core feature of this application. This is used to display the user image before and after wearing the dress and also used to display the main menu (user interface).
- **Kinect Sensor:** Latest Microsoft Kinect 2 will be used which will have capacity of getting 25 skeleton points at a time.Kinect is Microsoft's motion sensor add-on for the Xbox 360 with a natural user interface that enables the users to interact naturally without any controller. The Kinect system identifies the user through face recognition and voice recognition. A depth camera, which "sees" in 3-D, creates a skeleton image of the user and a motion sensor detects their movements. Gesture recognition enables the tracking of user's movements.
- **Kinect AC Adapter/ Power Supply and Kinect-PC Connector:** It is a charger which takes input voltage. Kinect Adapter has two ports. One ports connects it with the Kinect sensor and other with the PC.

3.7.3 Software Interfaces

- This is a desktop based application which will be implemented in java and C#.
- The database used for the dresses will be MySQL
- Microsoft Kinect SDK to use the Kinect.

Data Input

The input data will be customer's skeletal points which will be 20 or 25 depending upon the type and version of the Kinect used and the choice of the customer that which type of item he wants to purchase. Another input is the customer's selected dress which he/she wants to try.

Data Output

The output data will be the dresses searched from the database according to user choice and size. The selected dress will be mapped on the customer's image on LED.

3.7.4 Communication Interfaces

No Communication interfaces

3.8 Other Nonfunctional Requirements

3.8.1 Performance Requirements

The virtual dressing room (VDR) should be fast and rapid. There should be an alternative source of electricity in load shedding hours. The database response should be no more than 5 second and the body point taking process should be fast enough, so that maximum customers can use this without any wait.

3.8.2 Safety Requirements

If the application crashes during addition, deletion or editing there will be no change in the database. But care should be taken to the supply of electricity. This application works on the gesture recognition so there are very little (negligible) harms or risks to humans.

3.8.3 Security Requirements

The security issue is the main factor in non-functional requirements of the application. The customer's images should not be stored in any place and it should not be possible to hack the application in any way. There should be password protected access to the garments database so that only the shop owner (company authorities) could be able to insert, delete or update the database.

3.9 Software Quality Attributes

3.9.1 Usability:

The graphical user interface of application is to be designed with usability as the first priority. The app will be presented and organized in a manner that is both visually appealing and easy for the user to navigate. The application should use the standard language so that the customers can easily be able to use the application.

3.9.2 Accuracy:

To ensure reliability and correctness, there will be zero tolerance for errors in the algorithm that computes results. The Kinect should be correctly working and the accuracy should be 100%.

3.9.3 Portability:

It is not easily portable. It is difficult to make it portable because one cannot carry all the apparatus (LED, Kinect) but it is not impossible because the application can easily be installed any environment having proper lighting and electricity connection.

3.9.4 Availability

The application will be available at all time provided that the electricity is given to the application. This application is available all the time. One can access it at any time in the shop timings.

3.9.5 Flexibility

The design and architecture of the application will be flexible enough for catering any new requirements, if any at some later stage or for the application enhancement.

3.9.6 Data Integrity

If the app crashes during addition, deletion or editing of the database then there will be no changes in the database. All the data will be consistent and isolated from errors.

3.9.7 Scalability

The application is expected to handle one user at a time. The application will not yield the correct results if there are more than 1 customers standing in front of the Kinect because the skeleton points will be disturbed

3.9.8 Confidentiality

No user's data (pictures etc.) will be accessed without user's permission.

CHAPTER: 4

DESIGN AND DEVELOPMENT

4 DESIGN AND DEVELOPMENT

4.1 Work breakdown structure:

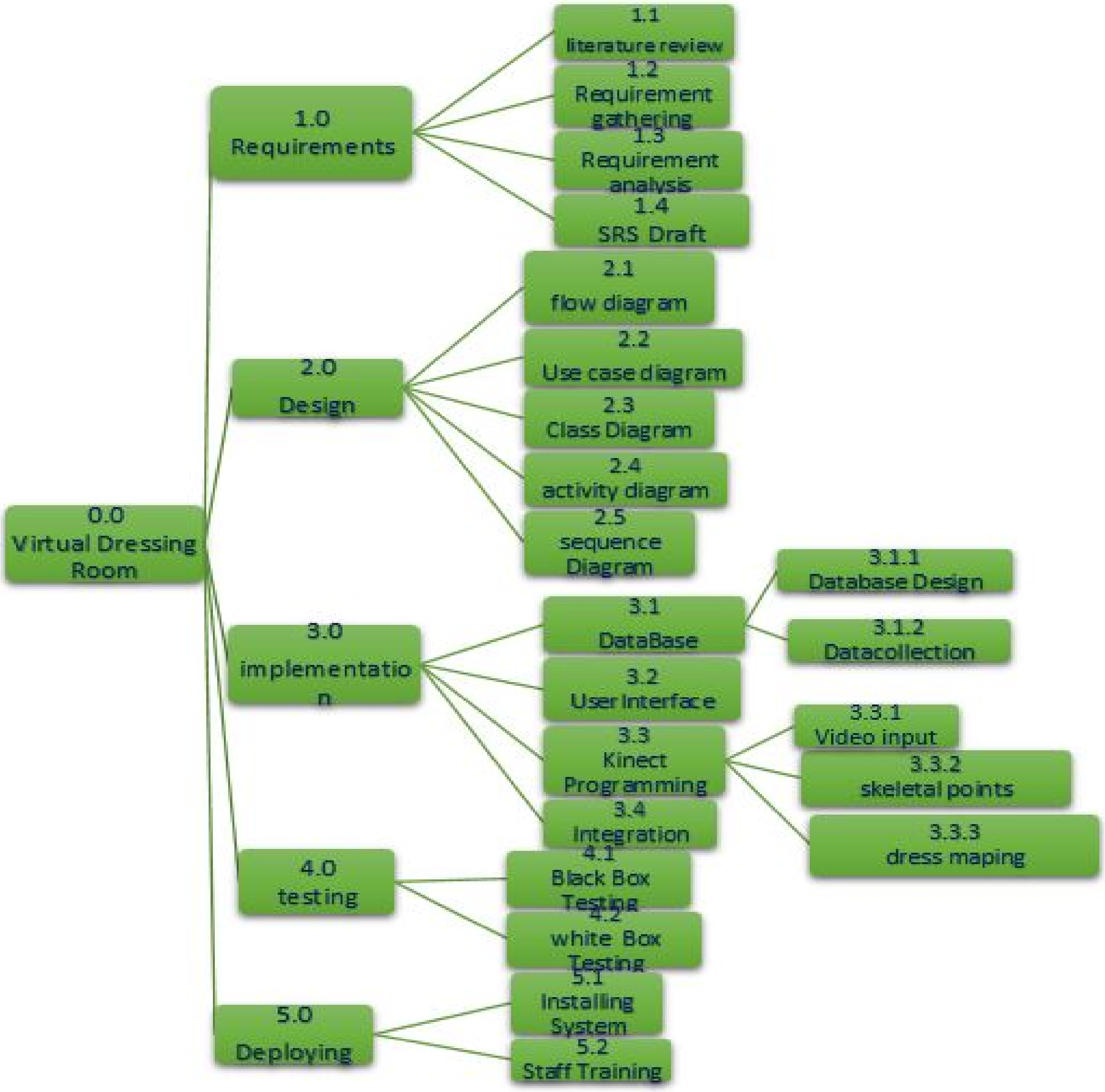


Figure 3work breakdown Structure

4.2 Flow Chart:

Following is the application work flow chart

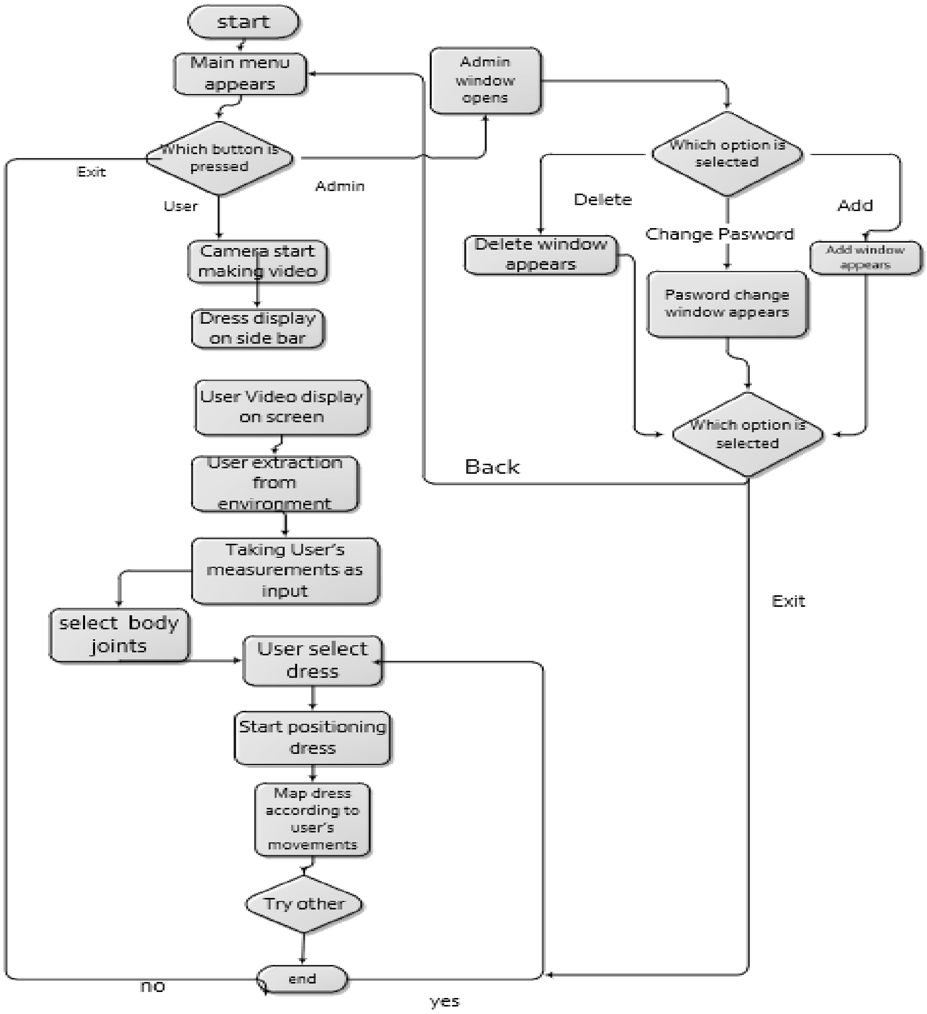


Figure 4 Application workflow

4.3 Architectural Design

4.3.1 System block diagram:

This diagram shows the higher level description of the application. It shows generic working of the application and interaction with the user. In this application, User will interact with the UI of the application, UI will interact with the application logic which will then interact with database. The Kinect sensor will track the gestures of the Customer during trying the dresses.

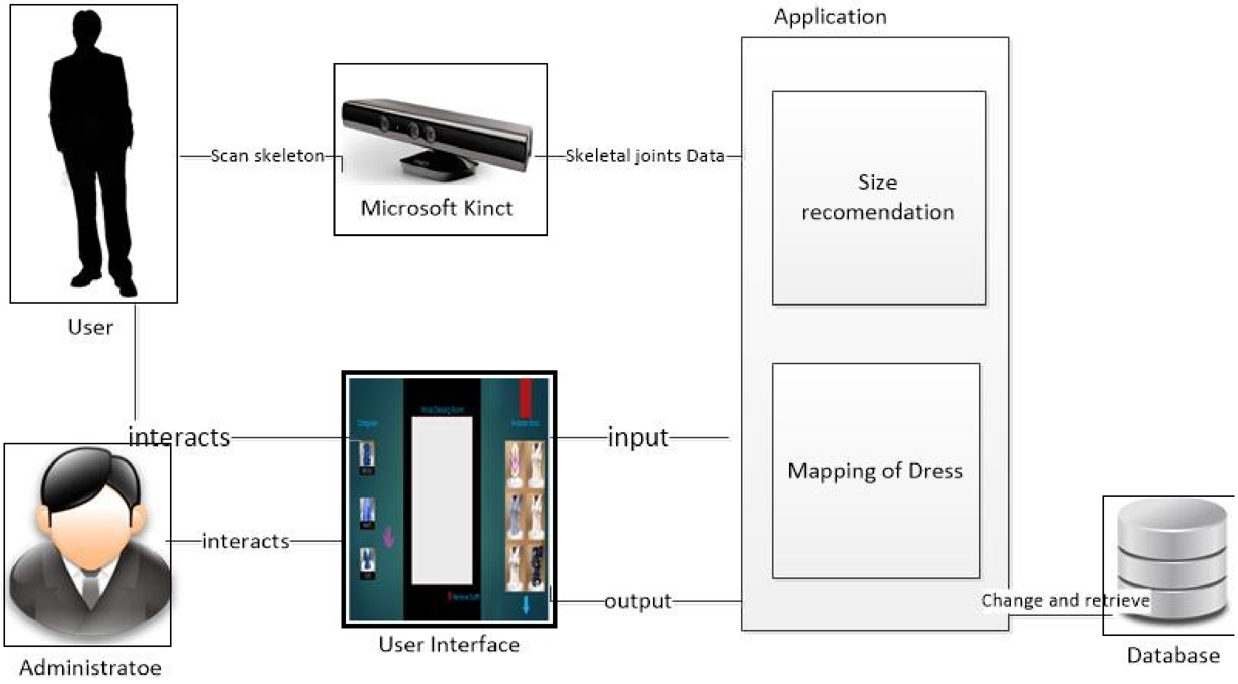


Figure 5 System block Diagram

4.4 Assumption and Dependencies:

Orientation: Customer must be able to move both his hands

Networking: There is no internet or networking required for this application unless we are dealing with a web server Database.

Administration: This application will have just one admin account provided with username and password.

Kinect SDK: At least Kinect SDK v1.0 is required for Kinect sensor connectivity with operating system. Kinect SDK v1.1 - 1.8 can also be used.

Visual Studio: Application will be developed in C# language in Visual Studio 2013.

Kinect Sensor is only compatible with Visual Studio 2012 or higher.

Windows Input Simulator: Input simulator libraries will be included in project for synchronizing Kinect and system input controls.

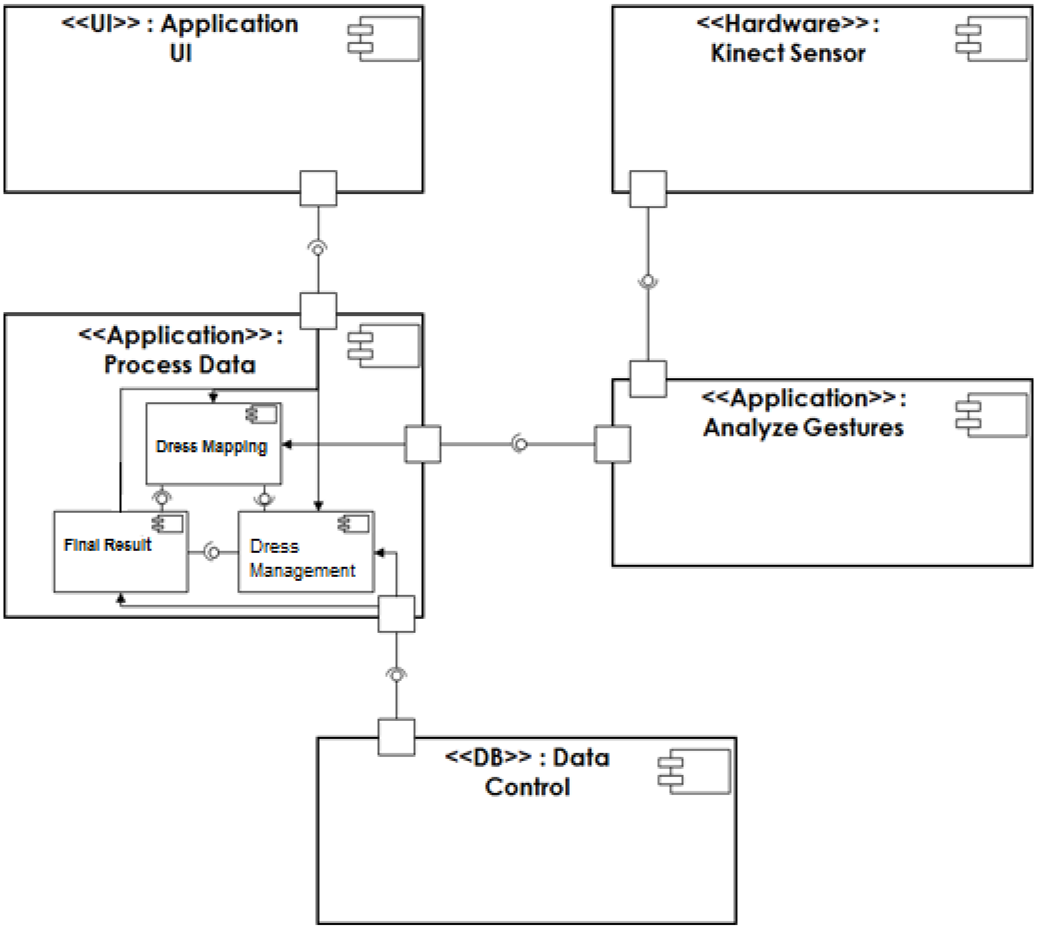
Operating System: Kinect SDK v1.0 is only compatible with MS Windows 7 or higher.

Memory and processor: The hard disk available for the operations and data storage should be 10 GB. The processing power should be 1.6 GHz or higher so that there is minimal or no lag between hand movements and expected responses on screen.

4.5 OVERVIEW OF MODULES/COMPONENTS:

VDR comprises of following components:

- Application UI
- Kinect sensor
- Analyze gestures
- Process data (I) Dress Mapping (ii) Process management (iii)Final Result
- Data control



<<UI>> : Application UI
<<Hardware>> : Kinect Sensor
<<Application>> : Process Data
Dress Mapping
Final Result
Dress Management
<<Application>> : Analyze Gestures
<<DB>> : Data Control

Figure 6Component Diagram

Application UI and Kinect Sensor are parts of presentation layer in the system architecture. **Application UI** acquires all its services from the Process Data module. The user interacts directly with this component and provides an input to the application specifying the action required. The component then displays an output according to that user action.

Kinect Sensor provides image data to the Analyze Gestures module. Process Data and Analyze Gestures modules are present in the application logic layer.

Process Data controls the flow of data between all three layers. It has three sub-components: Dress Management module manages the garment information: addition, deletion and editing data of available stock, Dress Mapping module do the mapping of the dress on customer’s body using Kinect skeletal data, Final Result module send the final result to the interface(LCD Screen) .

Analyze Gestures receives data from the Kinect sensor component and converts it into a meaningful data that can be processed by the Process Data component.

Data Control sits in the database layer of the system architecture and is responsible for keeping record of all dresses in the database.

4.6 Operating Environment Components:

The Kinect based application for enhancement of cognitive abilities contains following operating environment components:

4.6.1 Operating System:

- Windows 7 or Higher
- Visual Studio 2012
- Microsoft SQL Server 2012

- Kinect SDK v1.0 or higher.
- Windows Input Simulator v1.0.0.1 or higher.

4.6.2 Hardware Components:

- Kinect Sensor for XBOX 360
- Kinect AC Adapter/ Power Supply (Kinect-PC Connector)
- LED

4.7 Architectural style:

The Kinect-based VDR is an interactive application. Developing such systems require thorough consideration on the design factors as it might result in complexity problem. A poorly-designed Kinect application results in a system consuming more resources with very little efficiency and a slower response time which directly affects the experience of the target user (refer Section 1.4). Besides this, poor designs make testing and maintenance activities difficult.

Interface of the system is distinct from the application logic. Layered architecture is used to isolate application logic from the user interface. It can be modeled using **Multitier Layered Architecture** consisting of three layers i.e.; presentation, application logic and database. Presentation layer corresponds to elements of the user interface such as text, checkbox item etc., and application logic layer controls the communication of data between the presentation and the database layer, and is the part where the main logic, user actions and working of the system is defined. In general, it controls the complete behavior of the system, while the database layer is responsible for handling and storing of the processed data.

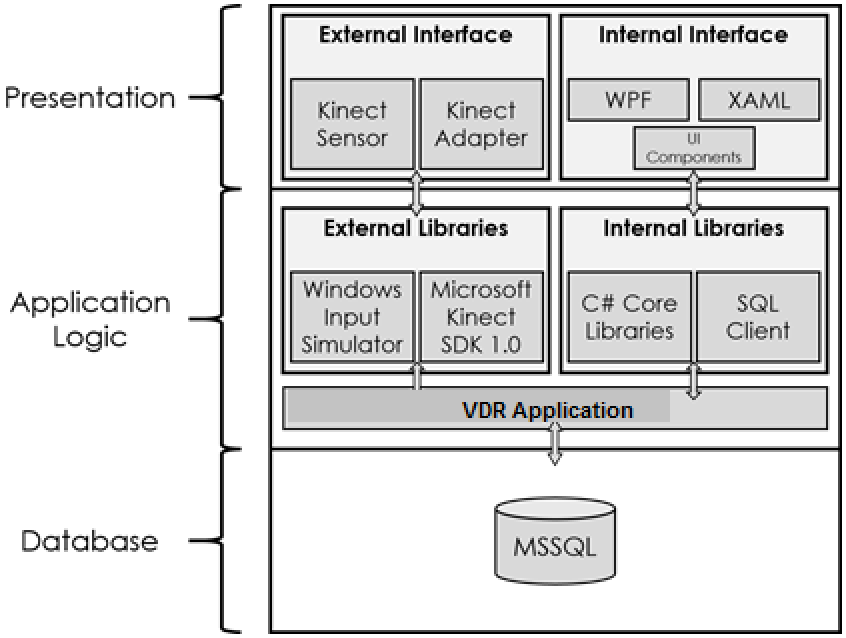


Figure 73-Tier Structure

Presentation layer consists of hardware (Kinect sensor and adapter) and user interfaces of the application, with which the users will be interacting. All video feeds, objects, buttons and form elements (textbox, radio buttons etc.) used in the application will come under view.

The interface of the application will be decorated in Windows Presentation Foundation (WPF) using Extensible Application Markup Language (XAML). All the text, picture-boxes, buttons will be stylized in it.

The data from environment can be sensed into the system using the Kinect sensor present in the presentation layer.

Application logic layer *(aka Business Logic)* includes all the algorithms that will be implemented, handles whatever action is done on the presentation layer. It will communicate with and process the information gathered from the presentation and the database layer. It provides a communication channel between both these layers and also controls the data flow between them. It also controls the information that is to be displayed and the data that is to be stored.

This layer can be further categorized into two:

1. **External libraries will take input from the external interfaces:** External interfaces consist of the Kinect sensor and its adapter, while the *Microsoft Kinect*

SDK v1.0 forms the external library. Kinect SDK provides Kinect capabilities (refer Section 1.4) to developers to build applications **[1]**,

2. **Internal libraries will take input from the internal interfaces:** Internal interfaces constitute of WPF, XAML and other UI Components, while the internal libraries consist of C# core libraries and a SQL client. WPF provides developer with a unified programming model for building rich Windows smart client user experiences that incorporate UI, media and documents **[11]**. The appearance of application's interface is designed in XAML, while the working and back-end functionality is defined in C#. The SQL client will provide a two-way bridge between the database and the application.

   The image data from the Kinect sensor is fed into the Microsoft Kinect SDK 1.0 present in the application layer, which provides us with the Kinect capability of skeletal tracking. The skeletal movement is then mapped on to the screen in form of points

   Database layer is only responsible for storing the processed information into the database. It can contain multiple databases in which data is stored in form of tables. It returns some result to the application logic layer upon request. Microsoft SQL Server 2013 will be used for this purpose.

Kinect-based applications usually don't have a typical application design pattern. They need to run as fast as possible or locked in sync with the refresh of the display. The Kinect has a maximum frame rate of 30 frames per second. Using an event based model doesn't work well for this type of development since it needs to grab the frame of data when it wants, regardless of what Kinect is doing and if it isn't there, it'll catch it next time around. It cannot block the thread that does this update/query cycle. **[10]**

As per the interface and business logic goes, WPF applications follow Model View ViewModel (MVVM) design pattern **[9]**, which is largely based on model-view-controller (MVC) pattern. It is a specific implementation targeted at UI development platforms which support event-driven programming on the .NET platforms using XAML and .NET (C# in our case).

The single most important aspect of WPF that makes MVVM a great pattern to use is the data binding infrastructure. By binding the properties of a View to a View Model, you get loose coupling between the two and entirely removes the need for writing code in a ViewModel that directly updates a view. The data binding system also supports input validation, which provides a standardized way of transmitting validation errors to a view. The other two features that make this pattern so usable are data templates and the resource system. **[9]**

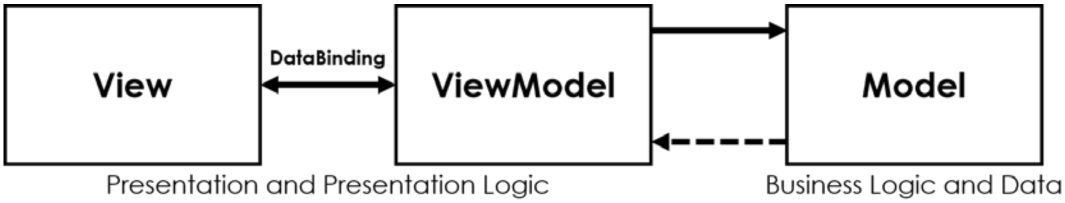


Figure 8MVVM Pattern

MVVM facilitates a clear separation of the development of graphical user interface (View) from the development of the application logic (Model). The ViewModel is a value converter i.e.; responsible for exposing the data objects from the model in such a way that those objects are easily managed and consumed. In this way, the ViewModel is more model than View, and handles most of it not all of the view’s display logic. It also implement a mediator pattern organizing access to the back-end logic around set of use cases supported by the view

4.8 Detailed design:

4.8.1 Database Design

VDR requires admin’s username and password to be recorded in the database. Moreover the dresses’ record is stored in the Database as well.

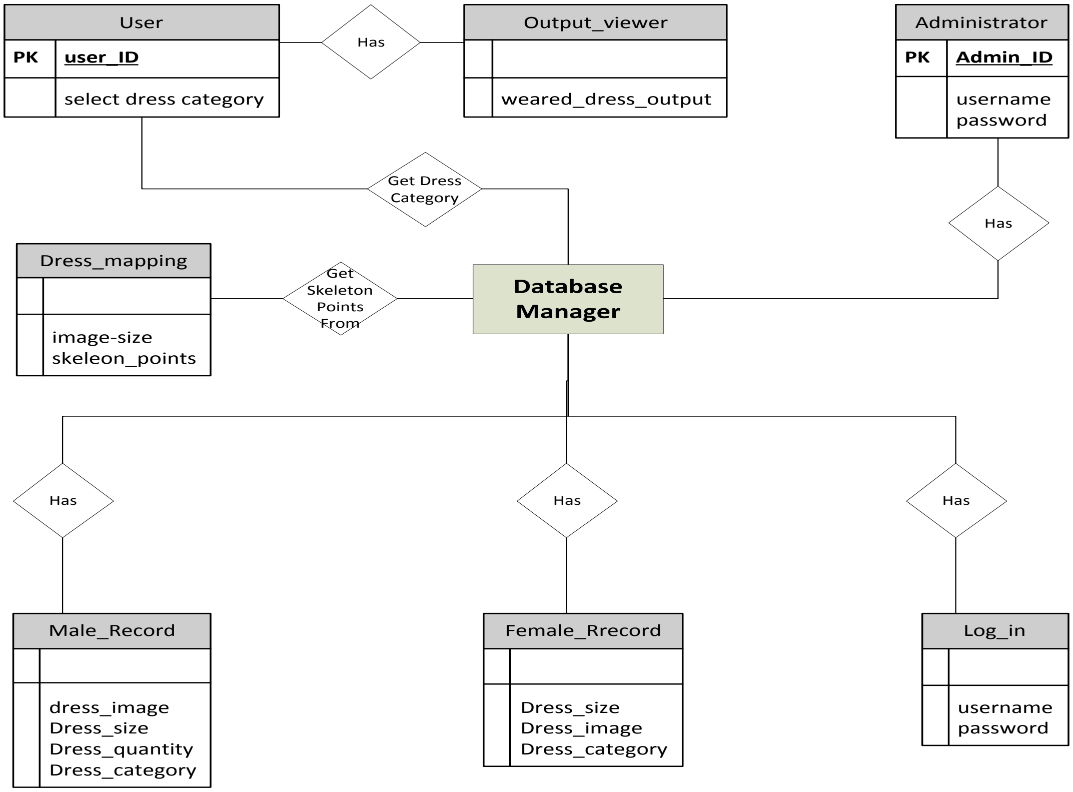


Figure 9Entity Relationship diagram

Figure 4 shows relationship between all the tables in database. The boxes are the entities, ovals are attributes while diamonds show type of relationship.The *Log-in* entity has two attributes. It maintains the usernames and passwords of the admin.The Male record entity has four attributes. It maintains the record information of the dresses for males.The Female record entity has four attributes. It maintains the record information of the dresses for Females.

4.9 UML Diagrams:

4.9.1 Use case Diagram:

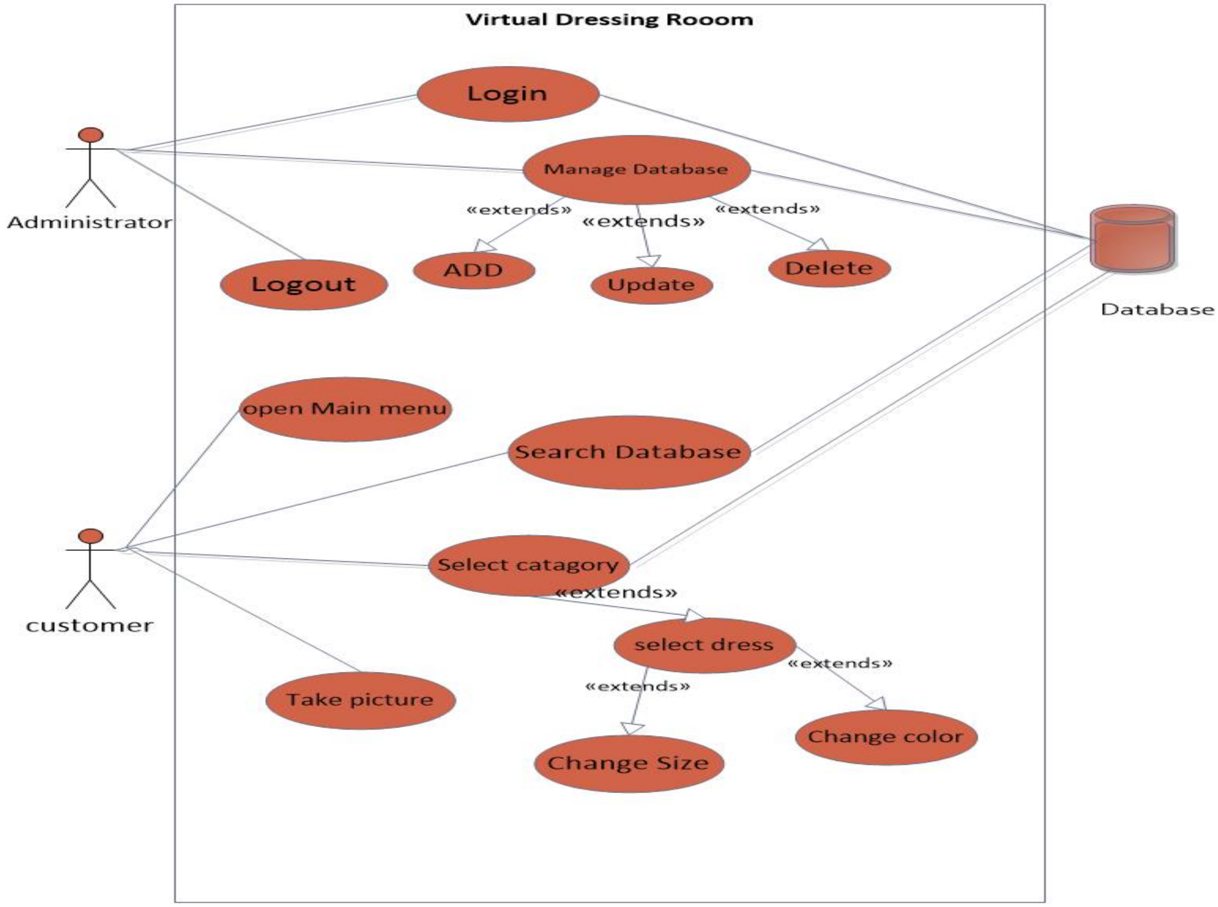


Figure 10Use Case Diagram

Actors:

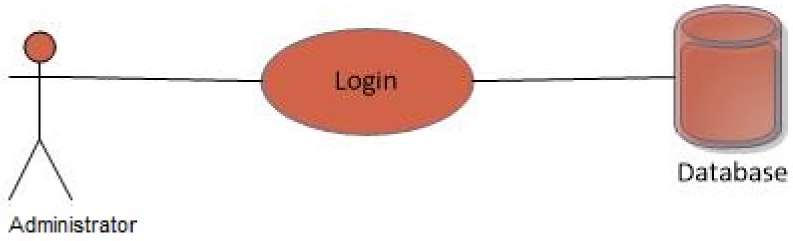
Primary Actor(s): customer, Administrator

Use Cases:

1. Login
2. Manage Database(Add Dress, Update, Delete Dress)
3. Logout
4. Open main menu
5. Search Database
6. Select Category
7. Select Dress
8. Change Size
9. Change color
10. Take Picture.

4.9.1.1 Use Case Description:

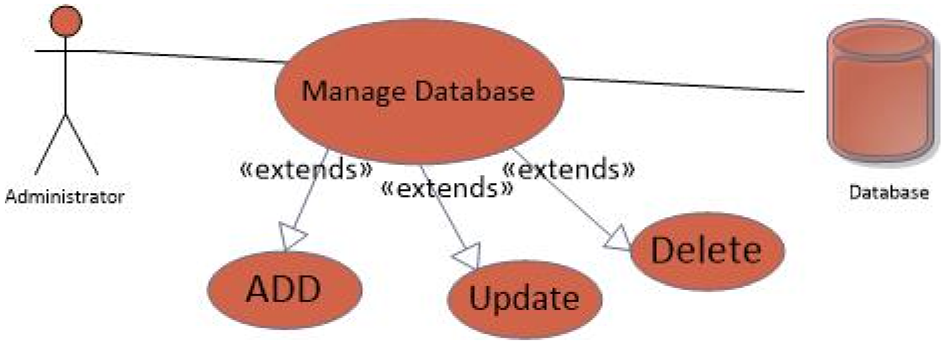
UseCase1



Use Case Name	Login
Primary Actor	Administrator
Secondary Actor	System/Database
Normal Course	• Administrator enters his username • Administrator enters his password • Administrator clicks the login button to enter the application

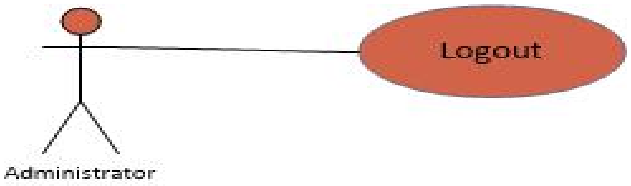
Alternate Course	If the Administrator provides incorrect *username* or *password*, the login fails and the application displays an error message
Pre-Condition	The *username* and *password* of the Administrator must already be registered at the time of coding (default entry in the database)
Post Condition	The Administrator successfully logins to the system
Extends	*N/A*
Include	*N/A*
Assumptions	The Administrator enters correct *username* and *password*

Use Case 2:



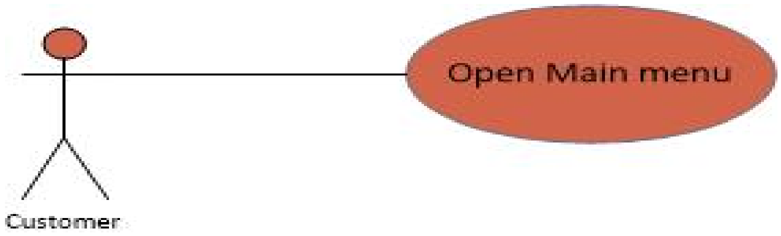
Use Case Name	Manage Database
Primary Actor	Administrator
Secondary Actor	Database
Normal Course	Administrator Add dress to Database by Adding its picture and other attributes. Administrator can update existing record by changing its attributes. Administrator can delete by removing the record from database
Alternate Course	Administrator can select any one of the three option
Pre-Condition	The Administrator must be logged in
Post Condition	Data is retrieved from the database
Extends	Administrator can Add delete or update dresses in database
Include	*N/A*
Assumptions	The Administrator Does not add existing record or delete non existing record.

Use Case 3:



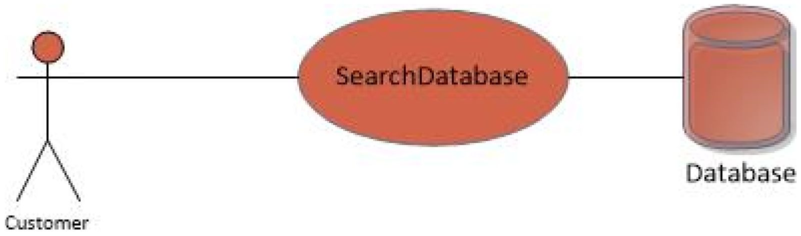
Use Case Name	Logout
Actor	Administrator
Normal Course	Administrator selects the logout option available at different screens and he/she will successfully logout of the system and then application navigates user back to *Login* Screen
Alternate Course	The Administrator cannot logout if the application is busy during database transaction or other processing
Pre-Condition	The Administrator must be logged into the application and that the application should be in idle state
Post Condition	Administrator successfully logs out of the application
Extends	*N/A*
Include	*N/A*
Assumptions	Administrator has performed all required tasks and application is idle

Use Case 4:



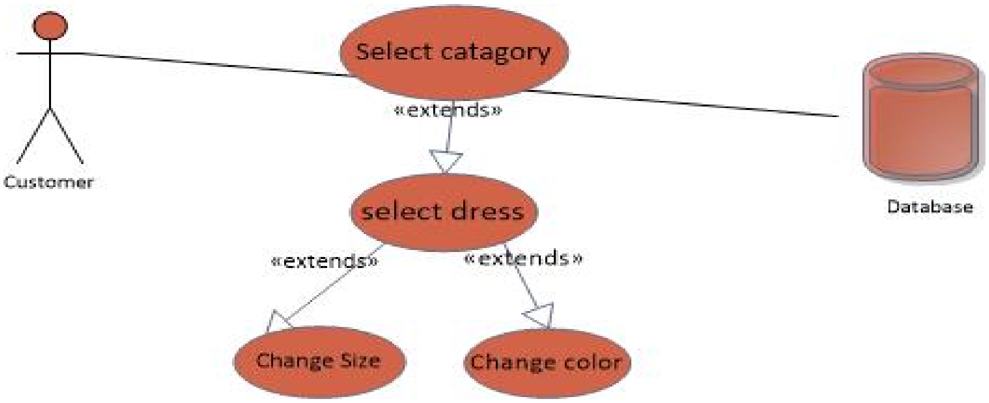
Use Case Name	Open Main Menu
Actor	Customer
Normal Course	Customer Stands Before Screen.
Alternate Course	N/A
Pre-Condition	Application is not busy in database transaction or other processing
Post Condition	Customer successfully opens the main menu
Extends	*N/A*
Include	*N/A*
Assumptions	No one is already using the application.

Use Case 5:



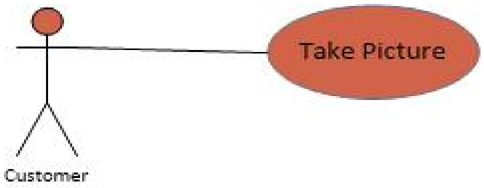
Use Case Name	Search Database
Actor	Customer
Normal Course	Customer Search the required category in the database
Alternate Course	N/A
Pre-Condition	Application is not busy in database transaction or other processing
Post Condition	Customer successfully Search the Database
Extends	*N/A*
Include	*N/A*
Assumptions	No one is already using the application.

Use Case 6:



Use Case Name	Select Category
Primary Actor	Customer
Secondary Actor	Database
Normal Course	Customer will select the category than will select desired Dress. Customer can change size or color of dress if available
Alternate Course	Customer can select any category
Pre-Condition	Application must be correctly working Customer can only select the dress which is available in stock
Post Condition	Dress is selected.
Extends	Customer can change size or color of dress if available
Include	*N/A*
Assumptions	Dress selected is available in stock

Use case 7:



Use Case Name	Take Picture
Actor	Customer
Normal Course	Customer select take picture option
Alternate Course	N/A
Pre-Condition	Application is not busy in database transaction or other processing
Post Condition	Customer successfully get the picture clicked
Extends	*N/A*
Include	*N/A*
Assumptions	No one is already using the application.

4.10Sequence Diagrams:

Sequence diagram of key use cases are as follows

4.10.1**Login**

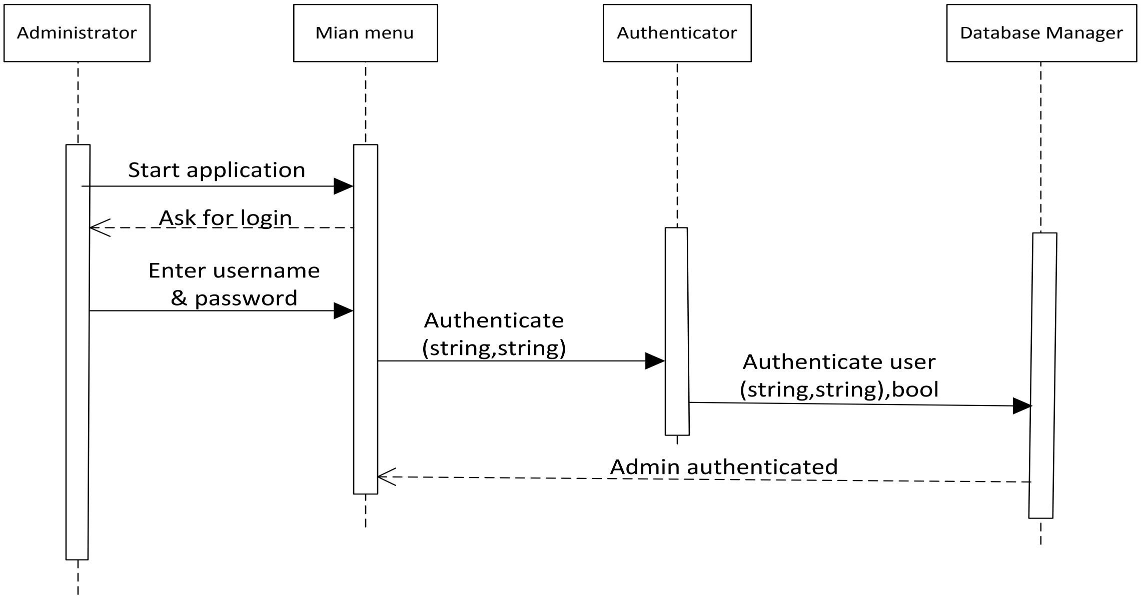


Figure 11Sequence diagram for login

4.10.2Main menu

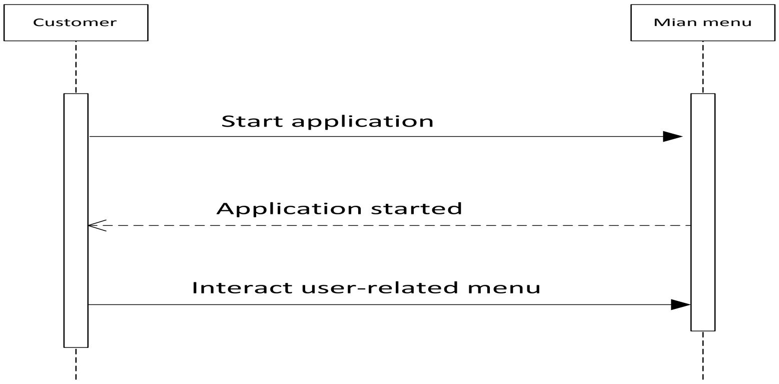


Figure 12 Sequence diagram for accessing main menu

4.10.3**Manage Database:**

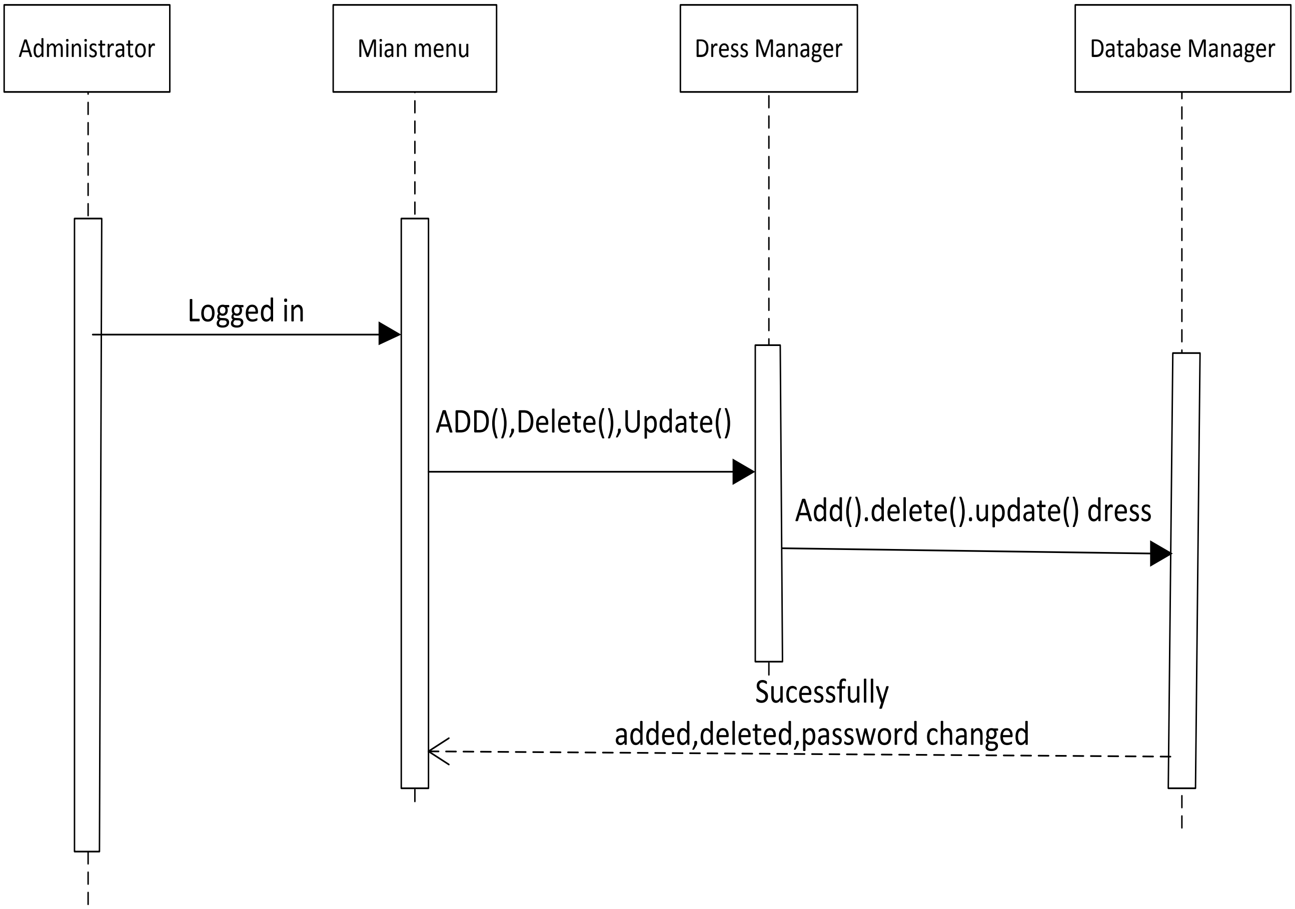


Figure 13 Sequence diagram for manage database

4.10.4**Search Database and Select category:**

Fig 13 shows sequence diagram for two use cases search database and select category

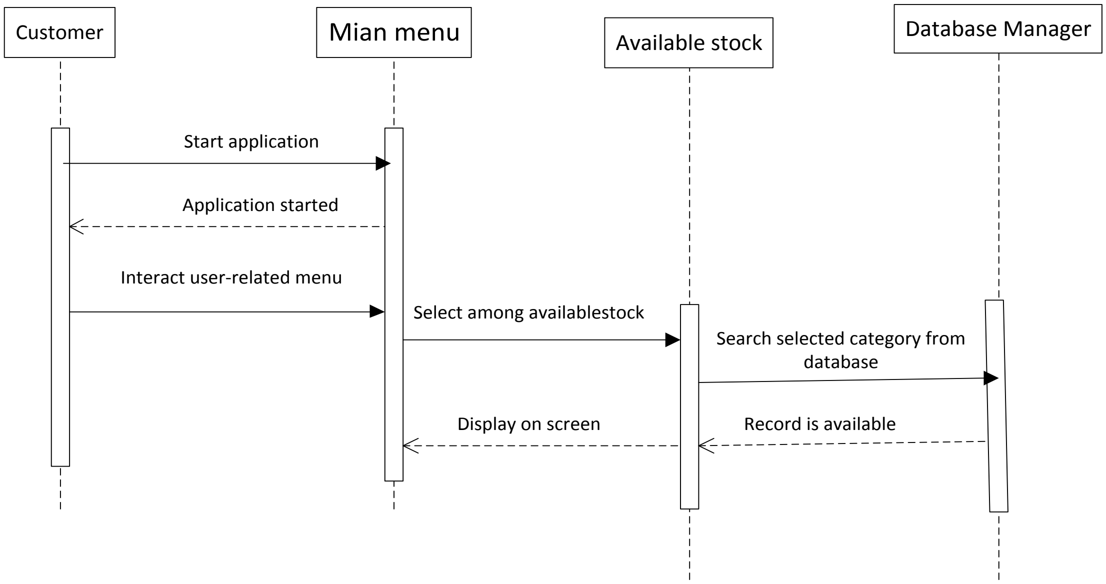


Figure 14Sequence diagram for search Database and select category

4.10.5**Take Picture:**

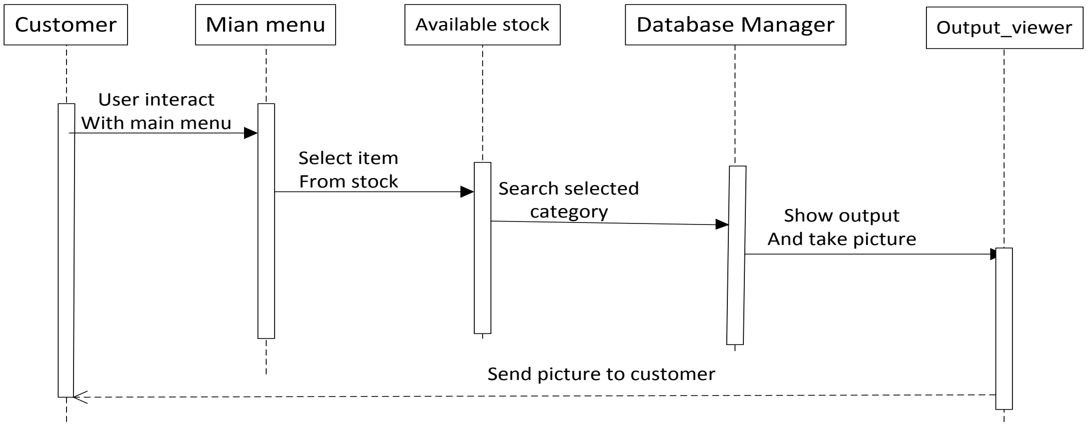


Figure 15Sequence diagram for take picture

4.11Dynamic View:

4.11.1**Activity Diagram:**

In activity diagram, the dynamic view of the system is shown. All the activities are shown concurrently with their respective start and end states.

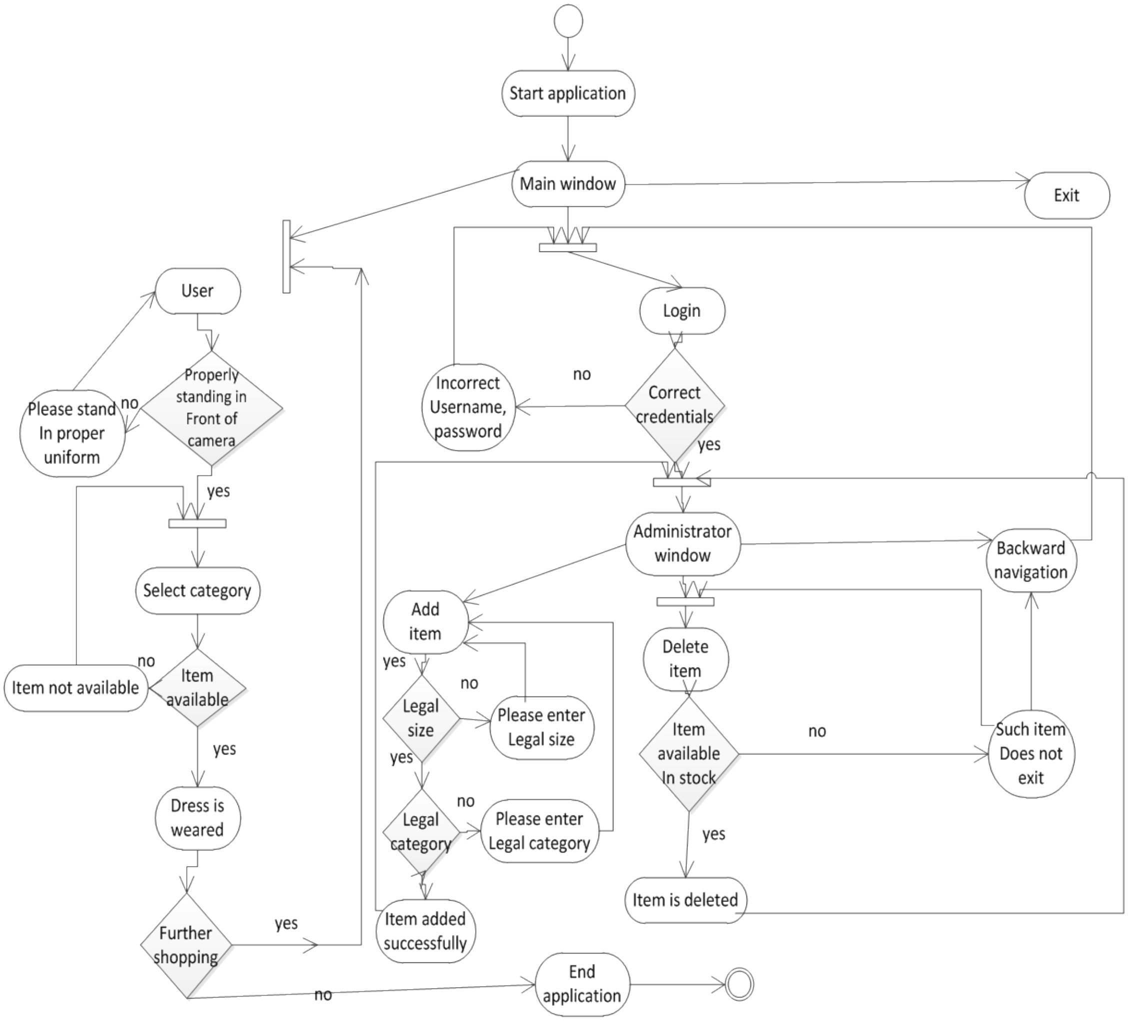


Figure 16 Activity Diagram

4.12Logical View (State transition Diagram):

The State Transitions occurring in the application are shown below:

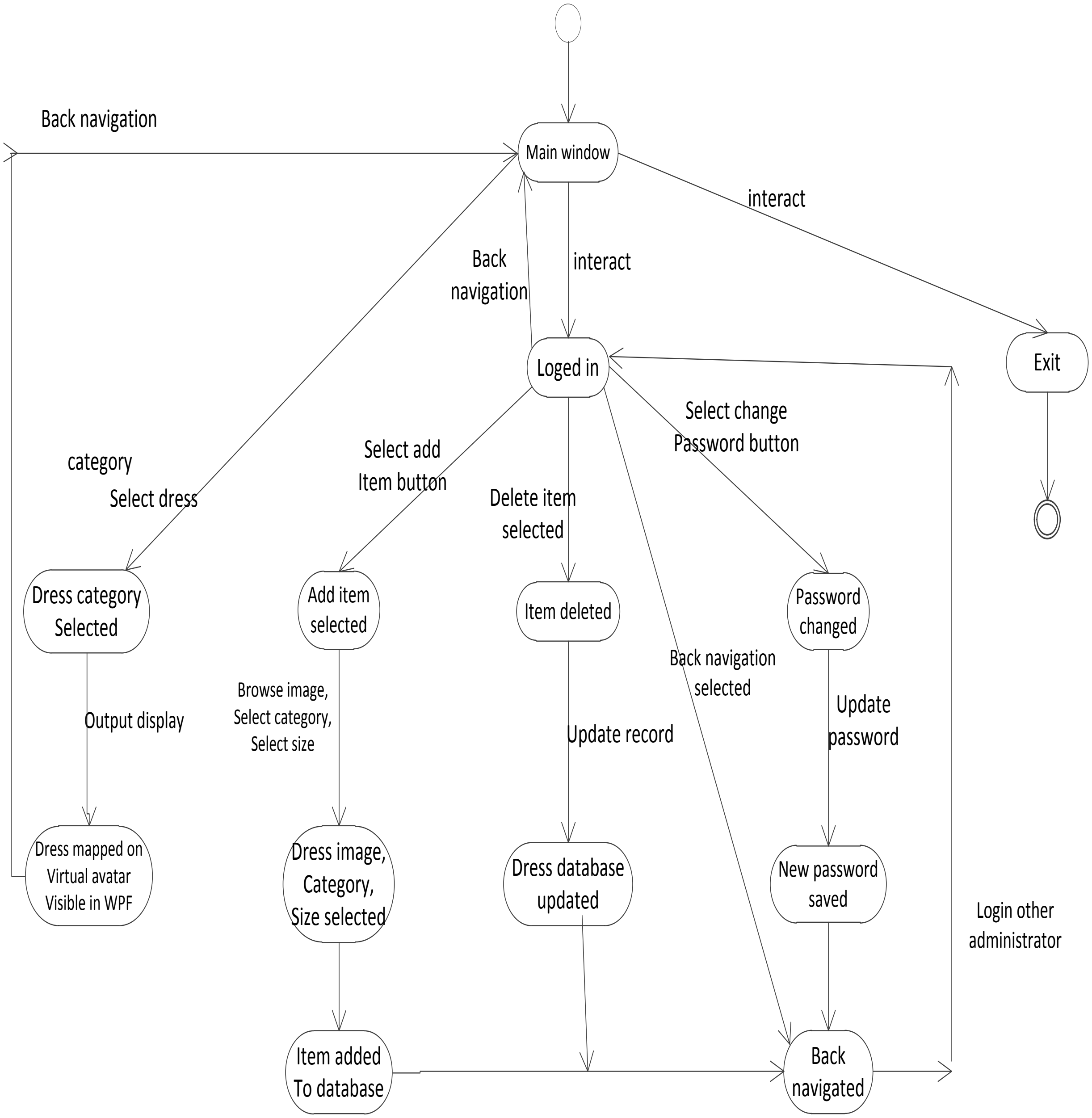


Figure 17State Transition Diagram

4.13Implementation View

4.13.1**(Class Diagram):**

The application comprises of the following classes:

- Main
- Kinect_Sensor
- Authenticator
- Dress_mapping
- Dress_Manager
- Output_viewer
- User
- Administrator

To accommodate the class diagram into the document, it has to be divided into parts. Fig 16 and Fig 17

4.13.1.1 **Class Diagram a:**

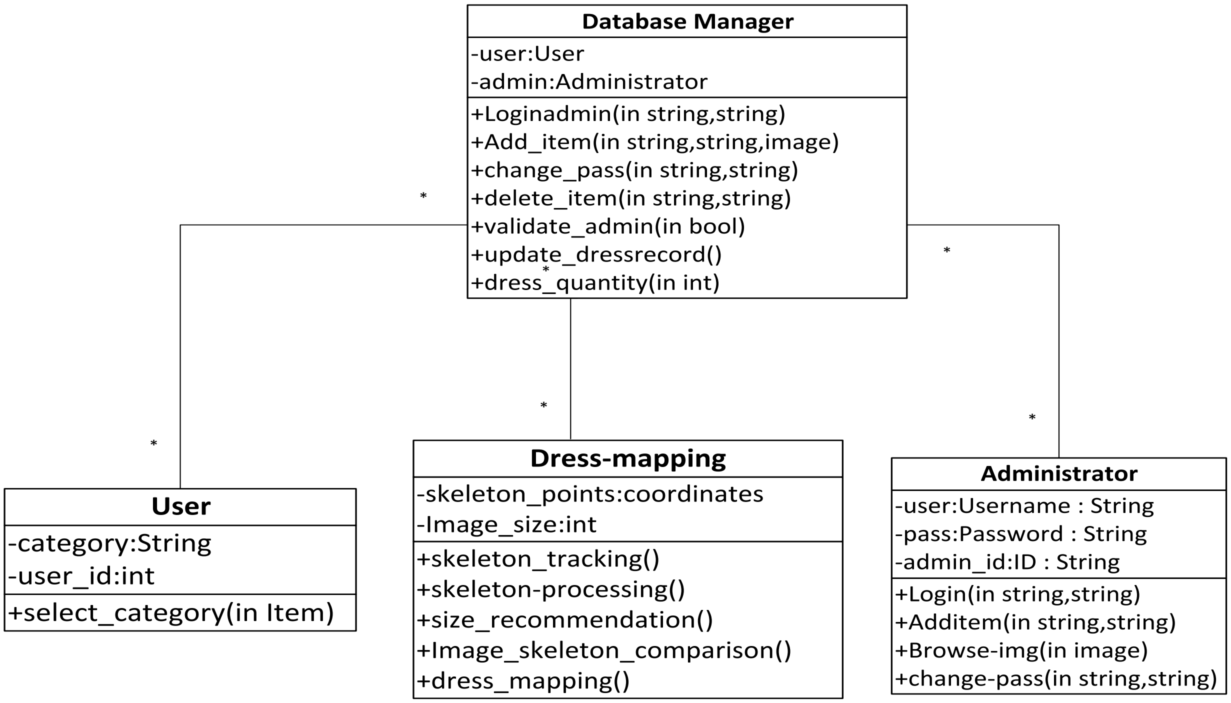


Figure 18Class Diagram (a)

4.13.1.2 **Class Diagram b:**

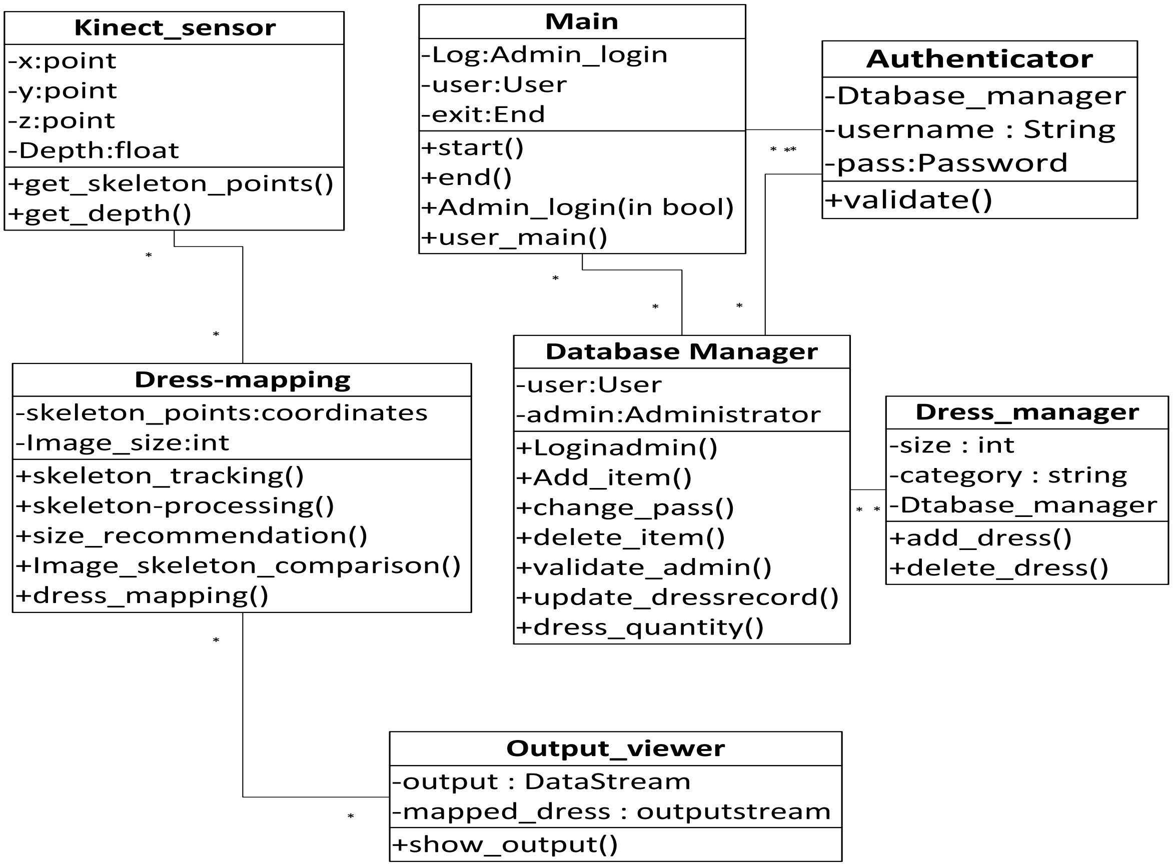


Figure 19Class Diagram (b)

4.13.2**System Classes Description:**

Classes	Description
Main	The main class is dealing with Kinect sensor, authenticator and database manager and these classes have further relationship with the other classes. It is basically acting as a bridge
Kinect_sensor	Kinect sensor class is dealing with all the activities related to the getting skeleton points, user motions in live video and tracking the user body and hand.
Authenticator	Authenticator class is authenticating the access of administrator to make changes in garments database. It authenticates the administrator by username and password then allows to make modifications in database.
Dress_mapping	This class deals with the mapping of the dress on user body by using the skeleton points.
Dress_Manager	This class deals with loading the available dress to the WPF list to show it on the display to have user choice.
Database_manager	This class deals with all the activities of making modifications to database like to add, delete item.
Output_viewer	Output viewer class is for showing the output of user after wearing the dress on to the LED

4.14User Interface Design

The application includes the following screens

Main screen contains 2 selecting mode options i.e. User mode and Admin mode

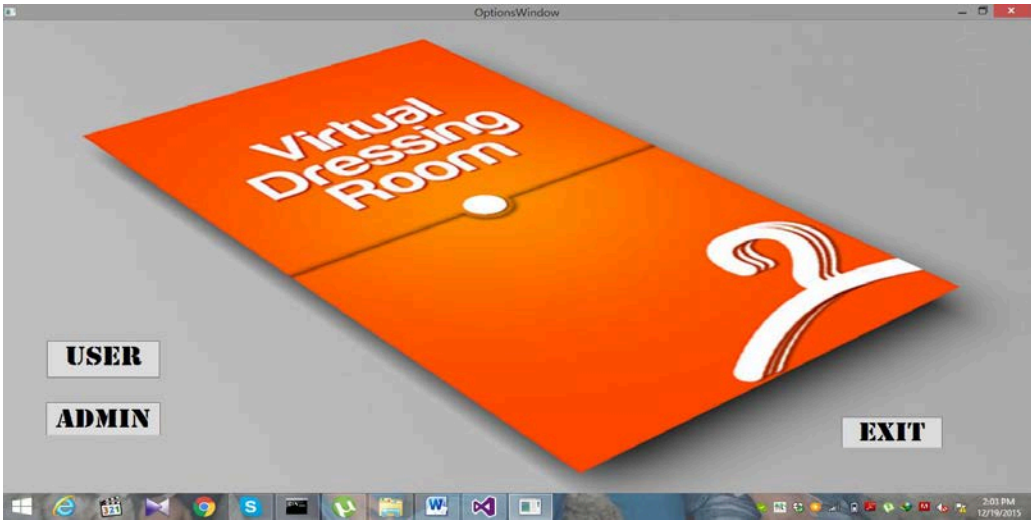


Figure 20Main menu

Admin can login by providing user name and password

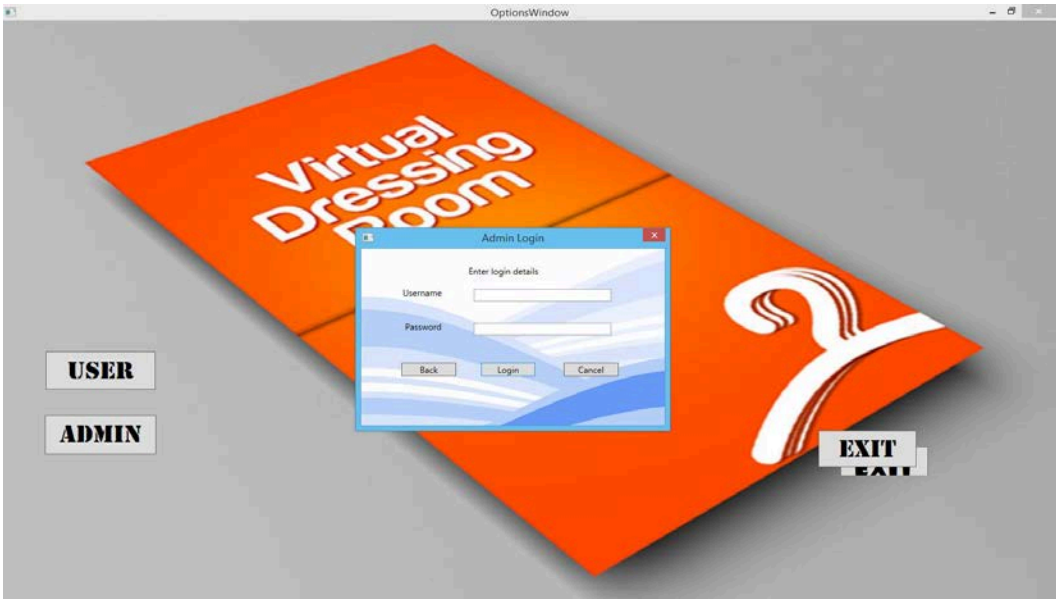


Figure 21 Login

After a successful login, the main screen shows up, from which admin can either add or delete the items.

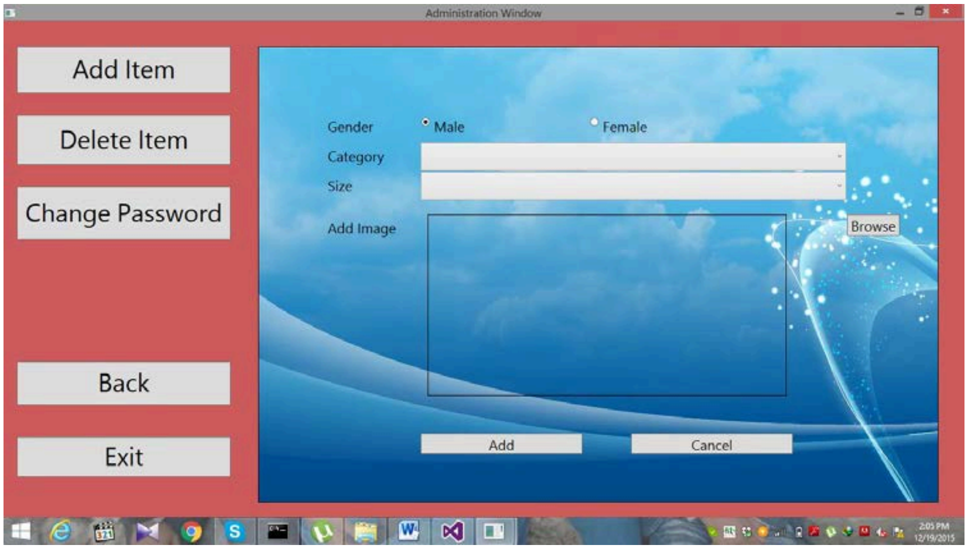


Figure 22 Add item

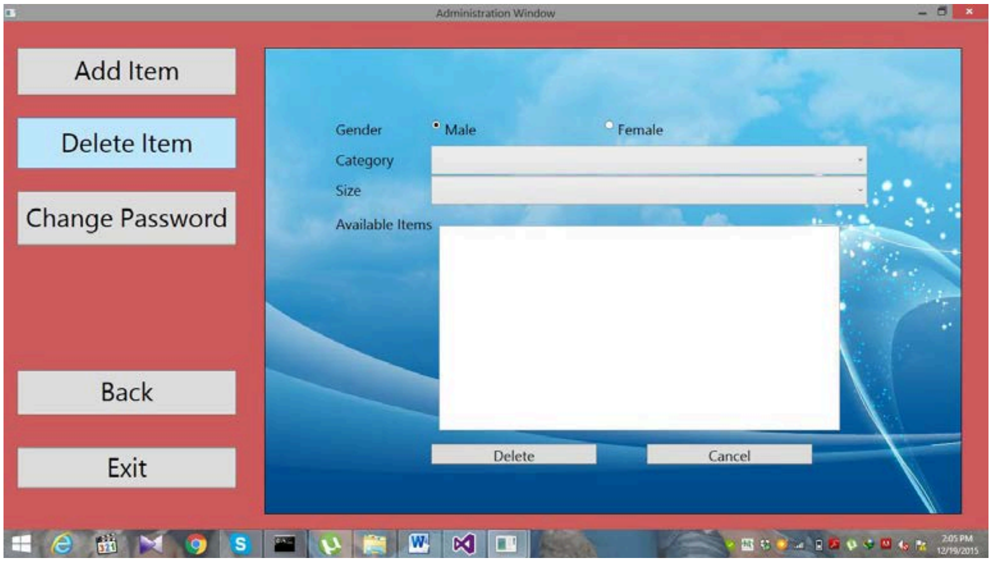


Figure 23 Delete Item

Admin can change password

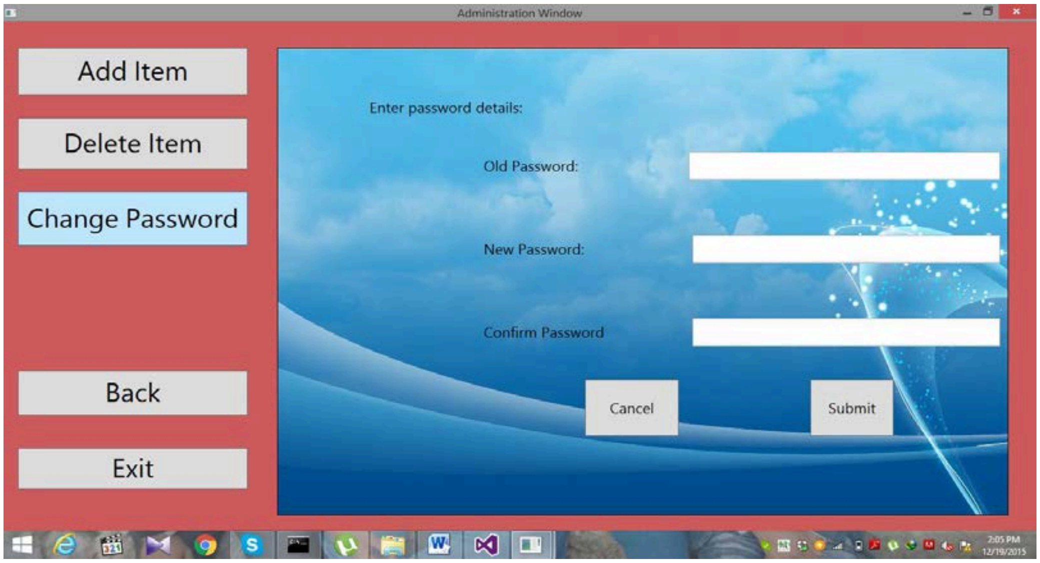


Figure 24 Change Password

If one select user option this screen will appear

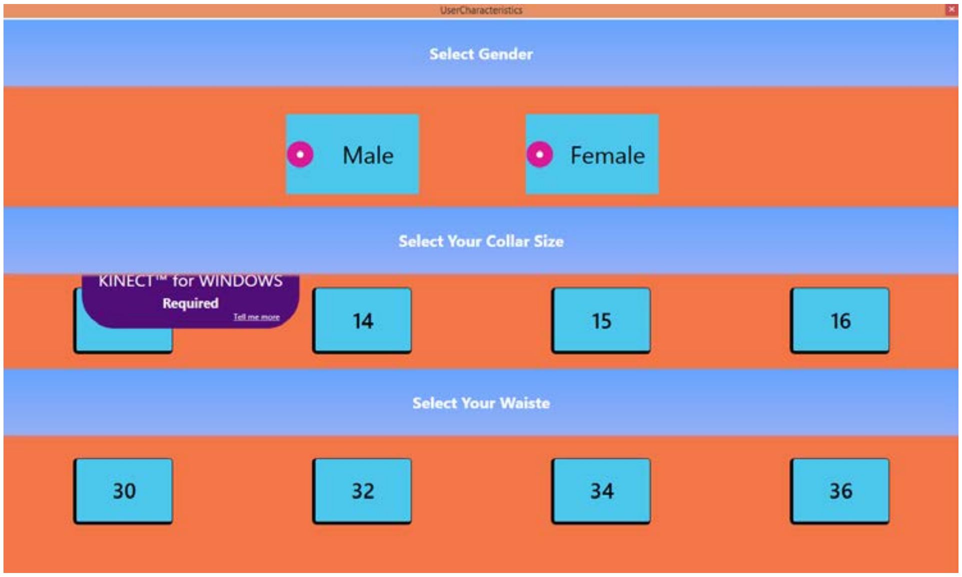


Figure 25 User's characteristics

From this screen Customer can put in his characteristics.

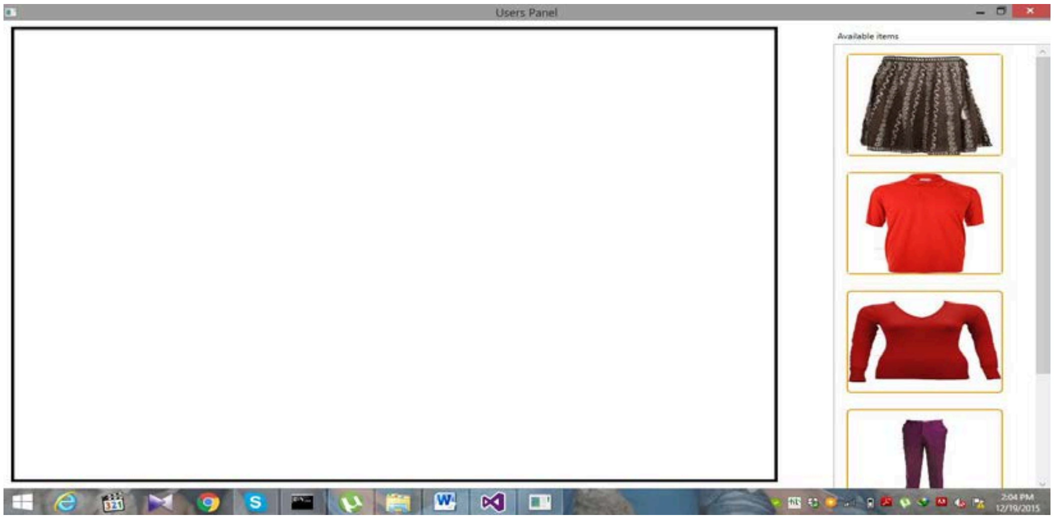


Figure 26 Customer's screen

Customer can see him/her self on the screen’s central video pane. He/she can select the dress from the side bar. This set up a UI environment that appears much more pleasant to the user, and also make the navigation through application quicker.

CHAPTER:5

SYSTEM IMPLEMENTATION

5 System Implementation:

5.1 Overview:

Implementation Languages:

The whole application is implemented in C#, Windows Presentation Foundation (WPF) and SQL Server.

Kinect SDK Used:

The kinect SDK 1.0 and kinect sample browser is used in the application.

API's:

WPF Viewers:

The WPFViewers API is used in the application which consists of the core libraries WPFSensorChooser, WPFColorViewer and WPFSkeletonViewer.

- **WPFSensorChooser** is used to track the user who is standing in front of the kinect and all the processing related to get the skeleton points are done by using this library.
- **WPFColorViewer** is used to get the video stream of the environment in which the system is deployed and the video of customer is taken by using this library.
- **WPFSkeletonViewer** is used to get the skeleton image of user body to detect that the system is getting the customer skeleton and to also check that there are no more than 1 skeletons detecting by kinect. This library gives all the acknowledgement related to user skeleton image.

KinectExplorer:

This API is used to integrate the kinect device with Visual studio C# environment. This API is used for configuration of Kinect with Visual studio.

CodingForFun:

CodingForFun API is used to get the depth data of the skeleton points of the body and its extension methods are used for the scaling of the joints of body.

KinectExplorer is used to integrate the kinect device with visual studio after that WPFViewers API is used to get all the actions of live video streaming, skeleton points getting and skeleton viewing. Once the skeleton data is acquired then it is used to detect that which collar size and pent waist is suitable for this customer and it adjusts the dress according to that information and extract the garments from garments database. The body part of the shirt image is implemented on the spine of the body and all the movements of customer are catered my rendering the image which is done with the help of the angle of spine with the neck of user. This image rendering is done in WPF. The shoulder parts of the shirt image is mapped on the shoulder joints of customer. These different parts of the shirt are kept in coordination with the help of relative motion equations which are evaluated with the angle made between the elbows and shoulder the user. The user can bent 35^{o} angle on left side and 35^{o} degree on the right side. The image will be automatically rendered according to this angle. After that a final result will be displayed on the screen.

5.2 Main flow:

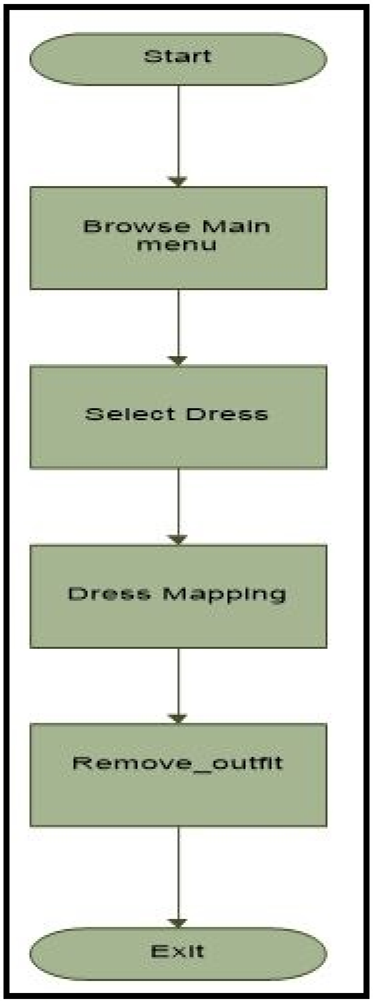


Figure 27Main flow

5.3 Pseudocodesfor components:

5.3.1 For Administrator

```
if Login is Successful

begin

        Show Welcome_Message

        Show Add_Item_Button

        Show Delete_Item_Button

        Show Change_Password_Button

       Show Back_Button

    Show_Exit_Button

End

else

    print ‘Invalid Username/Password’
```

5.3.2 For Kinect sensor

```
begin

    Start_Sensor

    Track_Skeleton(Full body)

end
```

5.3.3 For analyze gestures

```
ifKinect_Sensor is Running
begin
    Get hand location from Kinect_Sensor
    Convert location to point
    Get depth from Kinect_Sensor
    Convert depth to float
    Analyze depth
    Analyze location
end
else
    print ‘No Kinect Sensor Found’
```

5.3.4 For Body Skeleton Tracking

```
ifKinect_Sensor is Running
begin
    Get body joints location  fromKinect_Sensor
    Convert body joints location to body skeleton point
    Get depth from Kinect_Sensor
    Convert depth to float
    Analyze depth
    Analyze location
end
else
    print ‘No Kinect Sensor Found’
```

5.3.5 **For Add Item**

```
if Administrator is log in successfully
begin
    admin selects add item option
    Select category of dress from male and female
    Select size of dress
    Browse the image of dress
    IF image is browsed successfully THEN show it in the image frame
    Else ‘please browse the image of dress to be added’
    Select Add_Button
end
else
    print ‘Admin do not have the privileges to add item’
```

5.3.6 For Delete Item

```
if Admin is logged in successfully
begin
                Select the category of item to delete
                Select size of item to delete
                Select the image from record list
        If the category, size and image exist in record Then delete item
        Print ‘one item is deleted successfully’
        else’ Such image does not exist’
end
else
        print ‘Do not have privileges to delete item
```

5.3.7 For Change Password

```
If Admin is logged in successfully
begin
        Enter old password
        Enter new password
        Confirm new password
        If old password is correct and new password is equal to confirm password
       Then change the password
        Print ‘password is changed successfully’
Else ‘please enter correct old password or enter same password in new and
confirm password fields’
end

Else
Print ‘Do not have privileges to change password’
```

5.3.8 **For User**

```
ifKinect_Sensor is Running
begin
    Select User_button
    Select the available item
    IF the quantity of selected item is greater than zero in stock then map that dress item to user body
    If dress is properly mapped to user body and user likes it then update the display of available items by excluding that dress item
    Item_quantity = item_quantity - 1
else 'such dress size is not available in stock'

else 'such dress is not available in stock'
end

else
    Print 'No Kinect Sensor Found or no user is recognized'
```

CHAPTER:6

ANALYSIS AND EVALUATION

6 ANALYSIS AND EVALUATION

6.1 Unit Testing:

Interface

Test case name	**Interface for general user**
Test Case Number	1
Description	Testing Main Menu for User Button
Testing Technique used	Dynamic testing, Interface Testing using black box testing technique
Preconditions	Application should be open
Input values	Hand gesture
Valid inputs	Hand gesture taken through Kinect or mouse click
Steps	Select the User button from the user type menu by Placing your hand on User Button for 3 second
Expected output	User menu should open
Actual output	User menu opens
Status	Pass

Test case name	**Admin login**

Test case name	**Interface for Admin**
Test Case Number	2
Description	Testing Main Menu for admin Button
Testing Technique used	Dynamic testing, Interface Testing using black box testing technique
Preconditions	Application should be open
Input values	Hand gesture
Valid inputs	Hand gesture taken through Kinect or mouse click
Steps	Select the Admin button from the user type menu by Placing your hand on Admin Button for 3 second
Expected output	Admin login menu should open
Actual output	Admin login menu opens
Status	Pass

<table>
<tr><td>Test Case Number</td><td colspan="3">3</td></tr>
<tr><td>Description</td><td colspan="3">Testing User Type Menu for admin login</td></tr>
<tr><td>Testing Technique used</td><td colspan="3">Manual testing, Interface Testing using black box testing technique, Condition Coverage testing</td></tr>
<tr><td>Preconditions</td><td colspan="3">Admin should have selected the admin button
Database should be connected to authenticate the username and password</td></tr>
<tr><td>Input values</td><td>correct username and wrong password</td><td>Wrong username and wrong password</td><td>correct username and wrong password or wrong username and correct password</td></tr>
<tr><td>Valid inputs</td><td colspan="3">Valid characters for username and password and hand gesture taken through Kinect</td></tr>
<tr><td>Steps</td><td colspan="3">Type user name in USER NAME text field and password in PASSEORD text field
Place your hand on User Button for 3 second</td></tr>
<tr><td>Expected output</td><td>Admin should be authenticated and admin menu should open</td><td>Not Logged in</td><td>Not Logged in</td></tr>
<tr><td>Actual output</td><td>System authenticates admin and admin menu opens</td><td>Not Logged In</td><td>Not Logged In</td></tr>
<tr><td>Status</td><td>Pass</td><td>Pass</td><td>Pass</td></tr>
</table>

Test case name	**Add Item**	
Test Case Number	4	
Description	Testing Add items in database	
Testing Technique used	Dynamic testing, Interface Testing using black box testing technique	
Preconditions	Admin menu should be opened Database should be connected	
Input values	Enter the required information	required information not entered
Valid inputs	Hand gesture taken through Kinect or mouse click	
Steps	Place your hand Add item button from admin menu for 3second , browse the dress image and add image in database	
Expected output	Dress should be added in database	Dress should not be added in database
Actual output	Dress added in database	Dress not added in database
Status	Pass	Pass

Test case name	**Delete Item**
Test Case Number	5
Description	Testing Delete items from database
Testing Technique used	Dynamic testing, Interface Testing using black box testing technique
Preconditions	Admin menu should be opened

	Database should be connected
Input values	Hand gesture
Valid inputs	Hand gesture taken through Kinect or mouse click
Steps	Place your hand on delete item from admin menu for 3 second browse the dress image from database Place your hand on delete button for 3 second
Expected output	Dress should be deleted from the database
Actual output	Dress deleted from database
Status	Pass

Test case name	**Change password**
Test Case Number	6
Description	Testing change password button of admin menu
Testing Technique used	Dynamic testing, Interface Testing using black box testing technique
Preconditions	Admin menu should be open Database should be connected

Input values	Hand gesture, keyboard characters
Valid inputs	Hand gesture taken through Kinect or mouse click, valid characters
Steps	Click on Change password button from admin menu, type old password and then new password
Expected output	Password should be changed updated in database
Actual output	Password changed and updated in database
Status	Pass

Test case name	**User panel**
Test Case Number	7
Description	Testing user panel for browsing
Testing Technique used	Dynamic testing, Manual Testing ,Interface Testing using black box testing technique
Preconditions	User menu should be opened Database should be connected
Input values	Click on desired dress from available items panel
Valid inputs	Hand gesture taken through Kinect or mouse click
Steps	Browse the Available items Select the desired dress from the panel
Expected output	Dress should be selected and mapped
Actual output	Dress selected and mapped
Status	Pass

Database

Test case name	**Database connection**
Test Case Number	8
Description	Testing database connection
Testing Technique used	Manual testing
Preconditions	Admin Menu should be open
Input values	Hand gesture
Valid inputs	Hand gesture taken through Kinect or mouse click
Steps	Place your hand on database connection from Admin menu for 3 second
Expected output	Database should be connected
Actual output	Database connects
Status	Pass

Test case name	**Kinect connection**
Test Case Number	10
Description	Testing whether Kinect is connected or not
Testing Technique used	Black box testing
Preconditions	Application should be open
Input values	Connect to the Kinect from main menu

Valid inputs	Mouse click
Steps	Click on Connect to Kinect from main menu
Expected output	Kinect should be connected
Actual output	Kinect connects
Status	Pass

Test case name	**User detection**
Test Case Number	11
Description	Testing whether user is detected or not
Testing Technique used	Manual testing, black box testing
Preconditions	Application should be opened Kinect should be connected
Input values	Video frames ,Skeleton points of user, depth data from Kinect
Valid inputs	Information from Kinect
Steps	User must stand in front of Kinect at the distance of 2 meters
Expected output	User should be detected and skeleton points should be taken.
Actual output	User detected and skeleton data received.

Status	Pass

Test case name	**Dress mapping**
Test Case Number	12
Description	Testing whether Dress is mapped or not i.e. dress moves along with the user
Testing Technique used	White box testing
Preconditions	Application should be opened Kinect should be connected User menu should be opened User must stand in front of Kinect at the distance of 2 meters Proper light
Input values	Video frames ,Skeleton points of user, depth data from Kinect
Valid inputs	Information from Kinect
Steps	User select the desired dress from the user panel
Expected output	Dress should be mapped
Actual output	Dress mapped on the user
Status	Pass

Test case name	**Dress meshing**
Test Case Number	13

Description	Test whether the dress adjust itself according to the varying measurements of users
Testing Technique used	White box testing
Preconditions	Kinect should be connected Application should be opened User must stand with in the distance of approximately 2 meters Proper Light User menu should be opened
Input values	Video frames ,Skeleton points of user, depth data from Kinect
Valid inputs	Information from Kinect
Steps	User selects the dress from menu
Expected output	Dress should adjust itself according to the measurements of the user
Actual output	Dress adjusts itself according to the measurements of the user
Status	Pass

6.2 Integration Testing:

This application consists of five modules which are Application UI, Kinect Sensor, Process Data, Analyze Gestures and Data Control. These modules are integrated by using top down integration technique. Top down integration testing is an incremental integration testing technique which begins by testing the top level module and progressively adds in lower level module one by one. Top Down integration can be performed and tested in breadth first or depth first manner. Modules which are mentioned above are implemented as follows:

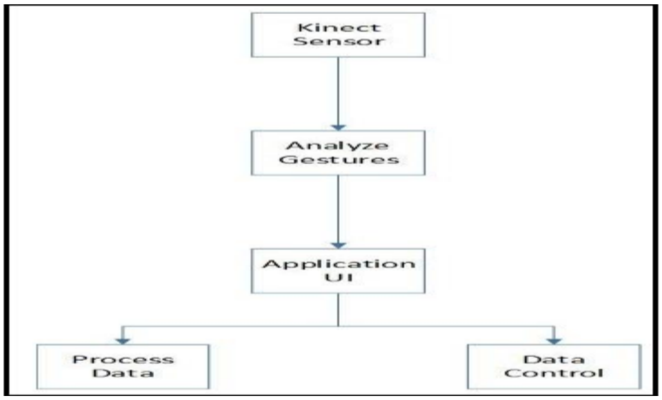


Figure 28Top-Down Integration Testing

First of all, we enable the Kinect sensor by using the software development kit 1.0 provided by Microsoft which is covered in ‘Kinect Sensor’ module and then we checked the inputs of Kinect which is covered in ‘Analyze Gestures’ module. After implementing these modules we developed the user interface that is ‘Application UI’ module and finally integrated ‘Process Data’ and ‘Data Control’ modules after that. We carried out black box tests after implementing every module, and the results were successful after every phase so no white box tests were required.

6.3 System Testing:

The System Test for VDR system will verify that the developments to system have been implemented as described in the System Requirements and Design Specifications documents.

6.4 General Functionality Testing:

Test scenarios will be established based on the systems requirements and design Specifications documents

6.5 Performance Testing:

Performance testing will verify that the following screens and functions satisfy the performance targets. We have performed all the required tasks necessary to check the proper functioning of the system. The first login screen appears and user (Admin) can enter his username and password. After entering the credentials a screen shows up, from which admin add or delete a dress. The Admin successfully adds a new Dress from

"Add new Item" button by filling the required fields. Admin successfully delete a dress from "Delete Item" button. Similarly From main screen customer can enter the User screen from User button. Customer successfully selects the dress and dress is mapped on his/her body. After carrying out the test we have concluded that all of the system features satisfy the performance targets and therefore the application is functioning properly.

CHAPTER:7

FUTURE WORK

7 Future Work:

VDR is not based on any previous systems neither it’s an extension of any other applications at any level. But it can be evolved into a bigger and more complex system with more features and functionality. Beginner Kinect developers can also reuse some of the modules of the system. The practical usage of the system can be increased by adding 3 Dimensional mapping of Dress.

The application can also be enhanced to further include more features like accessories mapping, picture sharing according to customer’s consent.

8 Conclusion

Shopping for dressing is common activity of our routine. The motivation of project is to provide an application that will assists the shoppers in trying out different dresses without waiting for the trying/fitting room. Because Instore trying rooms are time consuming and they have security issues as well. Therefore the importance of having a **virtual dressing room** has its ownbenefit to consider. This is, in fact, a new kind of technique that helps buyers try on a variety of clothes by positioning them on their body to appreciate the fitting, color, style and other things associated with consecrating the buyer.

Therefore we Proposed Kinect Based application using which Customers will be able to see themselves in a particular dress without physically trying it. In our project we used Kinect sensor to Track skeletal scan and distance of the customer from the sensor. It takes input from the customer which they will provide in form of hand gestures and movements. The customer easily tries the dress virtually. Moreover a complete database System for dresses has been maintained.

This, without any hesitation, is one of the best and innovative techniques used to make one's shopping a very good and contented experience to go for.

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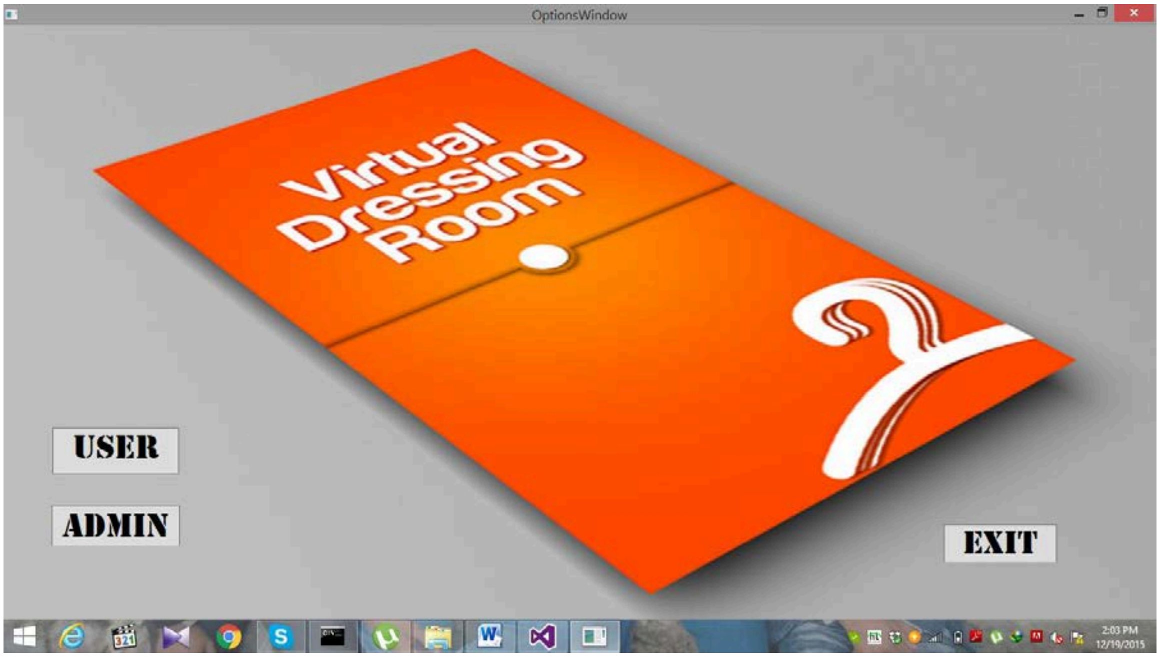
Appendix-I

User Manual:

1. Overview: This application ‘VDR’ is made for two types of users which are admin and customers. VDR enables the admin to add, delete and update dresses which customers can view on themselves virtually. This user manual will guide how to perform the user related tasks mentioned above.

2. Main screen:

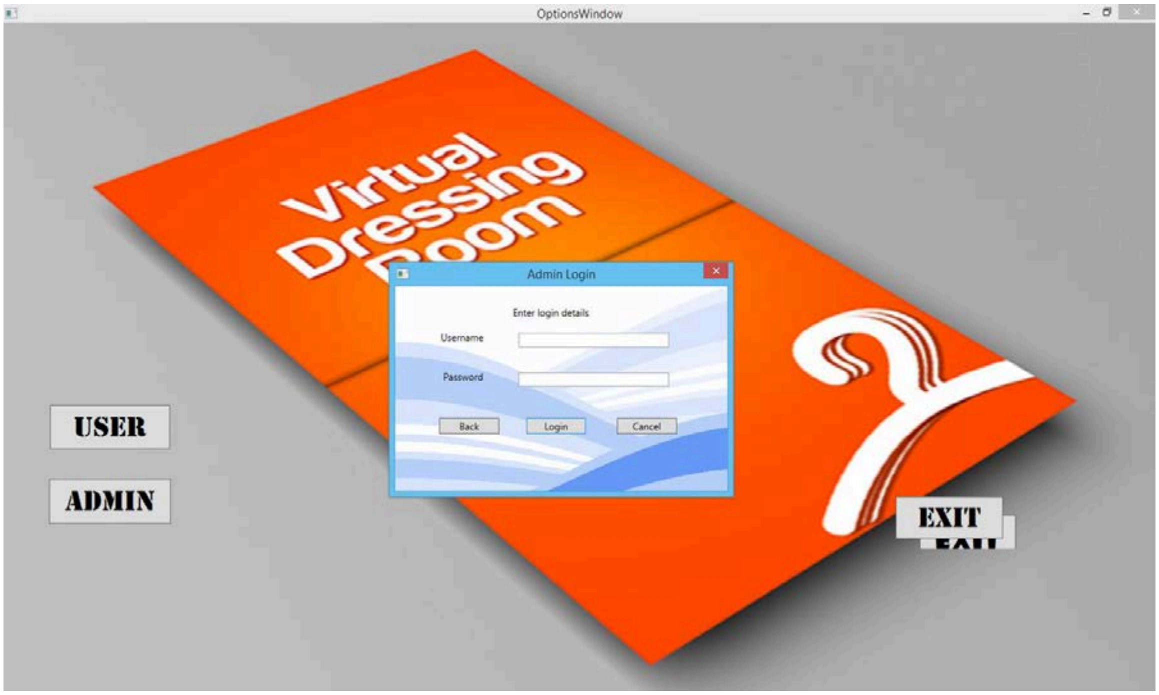
The main screen is as follows:



User can select the desired mode from this main screen by clicking on user or admin button. If user select admin mode Login window will appear

3. Login:

Login screen of the application is displayed below:



User can perform the following activities on this screen:

1. Enter Password by typing in the password text field.

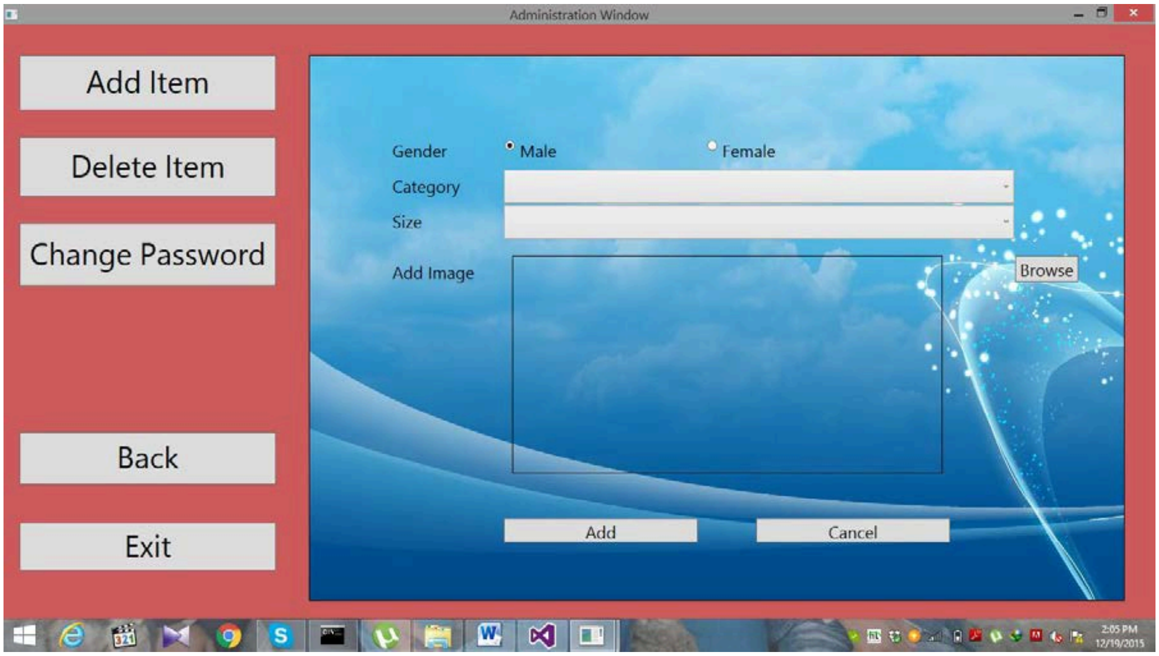
2. Press login for logging into the application.

3. Enter username by typing in the username text field.

4. Close the application.

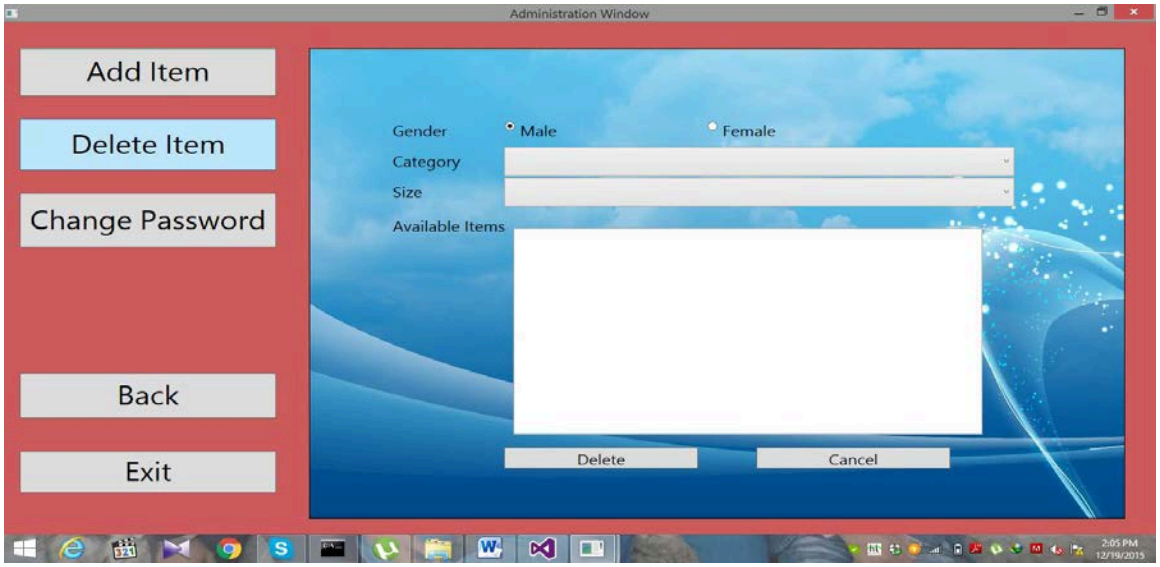
For logging into the next screen of the application, the username and password should both be correct.

4. Add Dress:



Admin can add new dress by clicking on “Add Item” button.

5.Delete Dress:

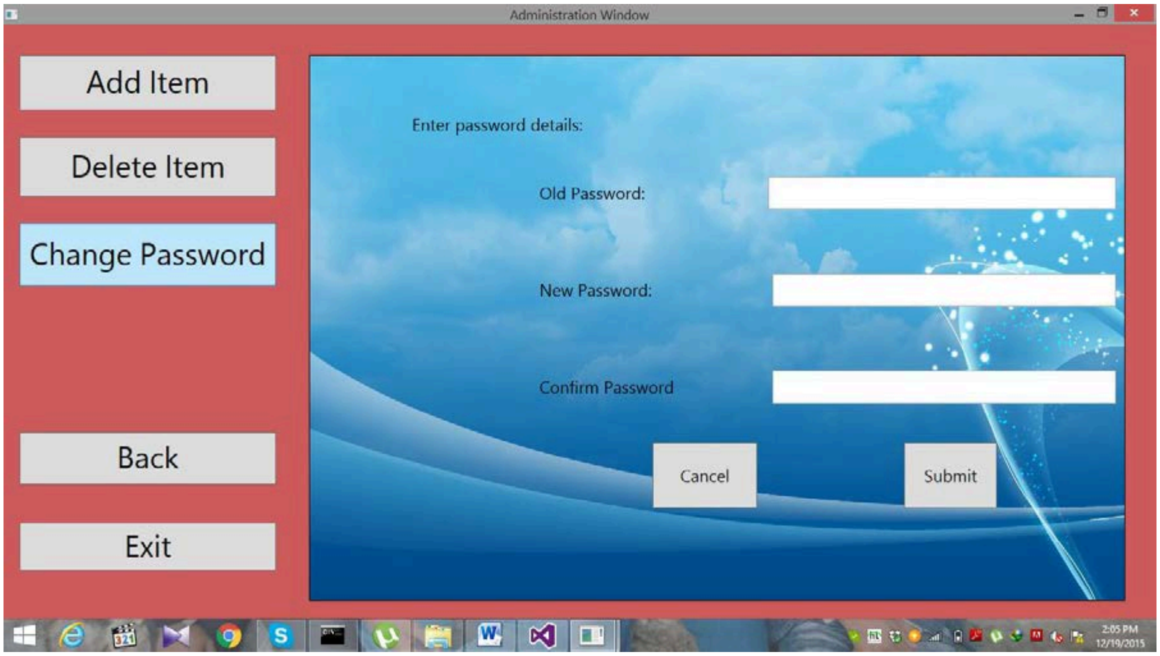


Gender ● Male ○ Female

Admin can delete dress by clicking on “Delete Item” button.

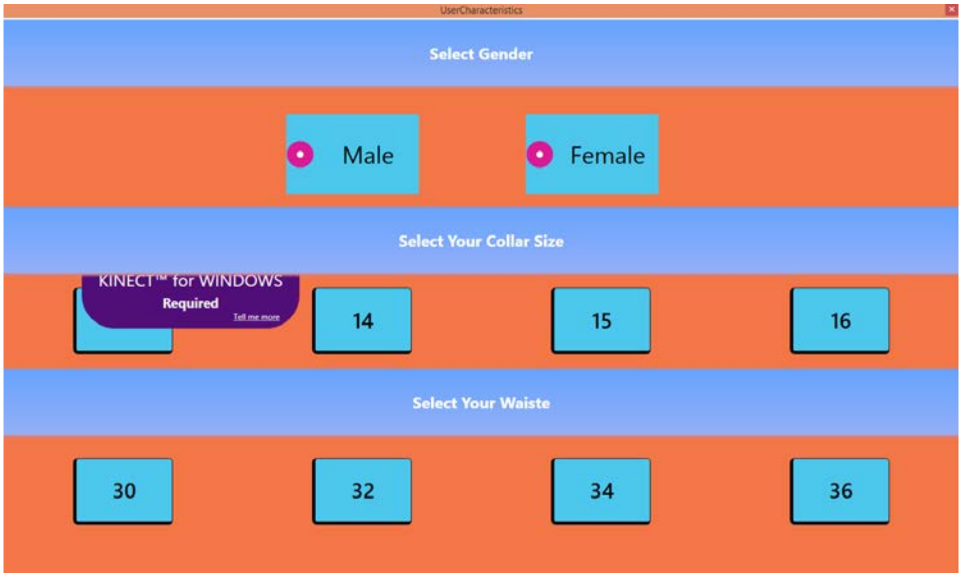
6. Change Password:

Admin can change his login credential by clicking on “change Password” button.



7. Search Dress:

If one select user option this screen will appear

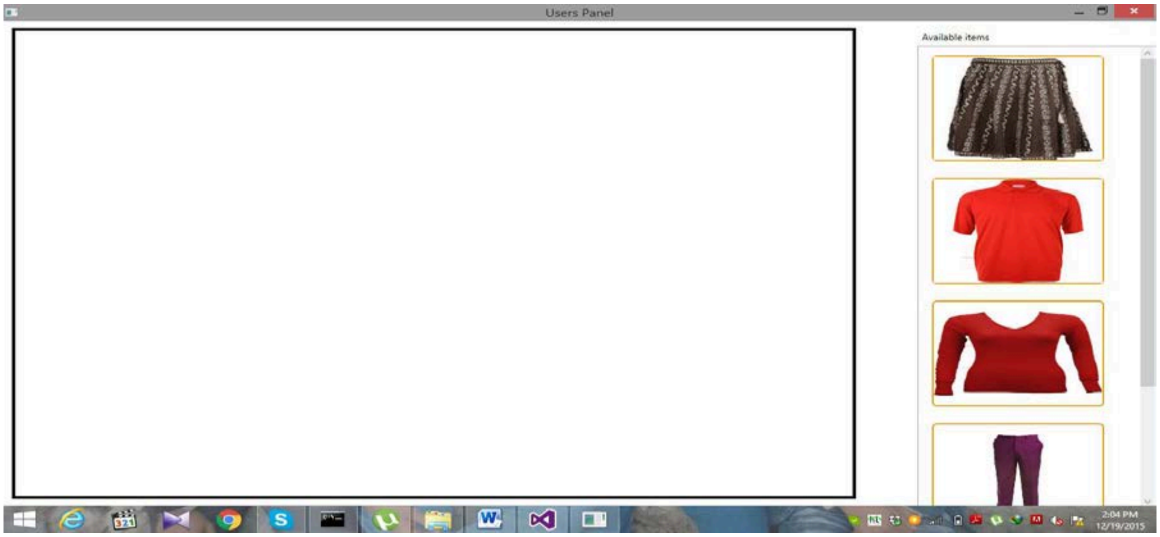


8. User Panel:

From this screen Customer can put in his characteristics.

Customer can select the desired dress from this menu screen

Customer can see the output on the video pane in the center.


Users Panel
Available items
2:04 PM
12/19/2015