Visualization of E-wardrobe

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Content

1.Introduction

1.1 Background

"What should I wear?" it is a daily question always be raised when we open the wardrobe facing the tidy or maybe jumbled clothes. Without any aim, most of people rummage around in the wardrobe which truly turn wardrobe into a chose immediately. And probably after 10 times put on and take off, we finally make a decision in a sweat. It seems selecting a cloth has become a aerobic exercise for us. How about we try on cloth in a virtualization way? Without any movement the cloth will be fit on us in a moment, like the magic of Cinderella's fairy godmother. And that is the original idea of e-wardrobe, a magic realized system.

1.2 Overview

Generally, the e-wardrobe system is an interacted platform achieving the interaction between human and computer through web camera. In the e-wardrobe system, the interactive object is cloth and user. The movement of user will finally reflect on cloth. In order to achieve the effect of cloth wearing, cloth should be able to follow the action of user, like translation and rotation, and execute proper adjustment. Hence the e-wardrobe can be divided into two part. One is user tracing, the other one is cloth modification. For the part one, e-wardrobe system should equip the following function in terms of user: the first one is user's movement track. The second is body location. The first function will help the system fix the user omitting the background information. Once the system find user, it will then allocate the shoulder of user. The position of shoulder is the crucial information in e-wardrobe system. The following movement of cloth will be modified according to location of user's shoulder.

In terms of cloth, for the purpose of "put on" affect, it should be a picture or photo with cloth in the right side on it, like the one in online shopping store. The e-wardrobe system should also be able to allocate the position of cloth shoulder for putting it on user.

2. Analyze and Design of Visualization of E-wardrobe

2.1 The Structure of E-wardrobe

E-wardrobe is an interactive system which consist of two part, information read and information processing. The processing part is the dominance of whole system , we will focus on this part. After we obtain the information from web-camera, we can then proceed to judge and respond.

The read part can be categorized into two kinds in terms of information, camera information and cloth information. We obtain the camera information via JMyron library and cloth information through invoking related image function in processing.
The processing part is divided into four steps.

- edge detection
- user center location
- right/left shoulder location
- cloth shearing

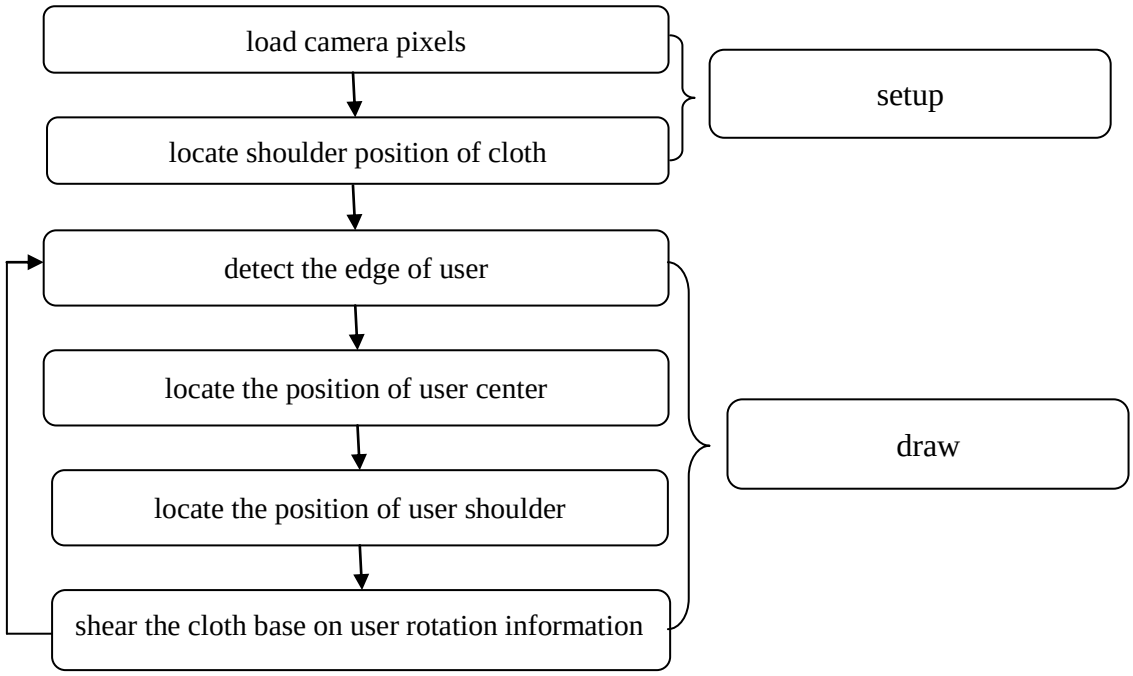

Figure 1: **Structure of E-wardrobe System.**

2.2 The Design of E-wardrobe

2.2.1 Two Detection Method Comparison

In E-wardrobe, the main technique is to locate the shoulder position of user. There are two methods which can accomplish this task, Pattern Match and Edge Detection.

- **Pattern Match:**

The basic idea of Pattern match is to scan the search area finding the most similar pattern compared to reference image. In E-wardrobe system we focus on the location of user shoulder. The reference shoulder image is retrieved once the user click his/her shoulder on screen. Since the system fix position through pixel comparison between current scan region and reference pattern when user is moving, the requirement to the background is much strict. If the user move to a place where behind background is different to the one in reference image, which would change the entire pattern even though the shoulder shape is unchanged, the system would fail to find the shoulder in this case. Another drawback of Pattern Match is that it fails to locate the shoulder when user rotates. The rotation will change the shape of shoulder lead another failure location. As a result, we abandon the method of Pattern match.

- **Edge Detection:**

Edge Detection focus on moving object location. It doesn't concern a certain pattern but the changing pixels between two successive frames. In order to obtain such information, we need to store the data of previous frame. Edge Detection weaken the restriction of background for no reference image needing. Here we locate shoulder through finding the peculiarity of shoulder edge among the data we got. Due to the attribute of Edge Detection, it is able to fix shoulder position even though user rotates. Another advantage of Edge Detection is the lax requirement for search area background. In Pattern Match, the background color should and must be same. Whereas in Edge Detection, we do not need to keep such condition, but the uniform color background would provide better performance. In the following chapter we will discuss Edge Detection in detail.

2.2.2 Edge Data Retrieving

User will rotate or move when using E-wardrobe system. Base on this, we are able to locate the user position by detecting the changing pixel between current and previous frame. Through comparison, we can point out the first and last changing pixel in each row. The (first, last) pixel set in whole image then shape the outline of user. We can see the final result in figure 1.

However due to the low quality of web camera, the system still can detect pixel change even though the user doesn't move. Therefore, we need to filter the data select the changing caused by user. This step can achieved by simply add a threshold, given the pixel change is under small scale when user stand still.

Another problem need to tackle is the continuity. E-wardrobe system can only compare the present and last frame. When user pause for a moment and continue moving, the system would fail to make a comparison between the frame before halt and present one, instead, it will see the proceeding moving as a first frame since the last frame has no edge information. We figure out the problem through recovering the data if the number of changing pixels is less than the threshold.

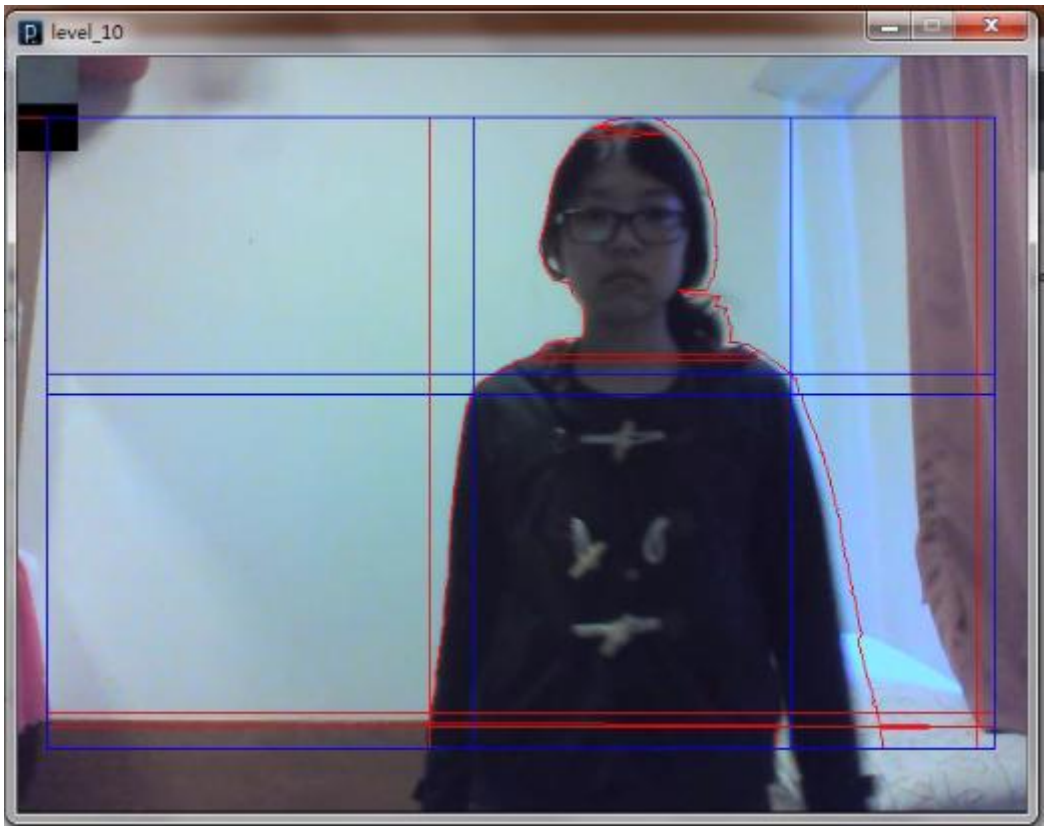

Figure 2: **User Edge.** The red line around user is the user edge detected by system

2.2.2 User Center Location

User center is a significant indication for user rotation. The first condition we define the rotation in E-wardrobe system is the position alteration of user center is no more than 10 pixels. The user center then requires to maintain same when user rotate. We calculate the center base on the fact that the head change the least when rotate shoulder. Using the head edge data we can then calculate the center of user. Here we add another threshold in order to keep the center unchanged when user rotate.

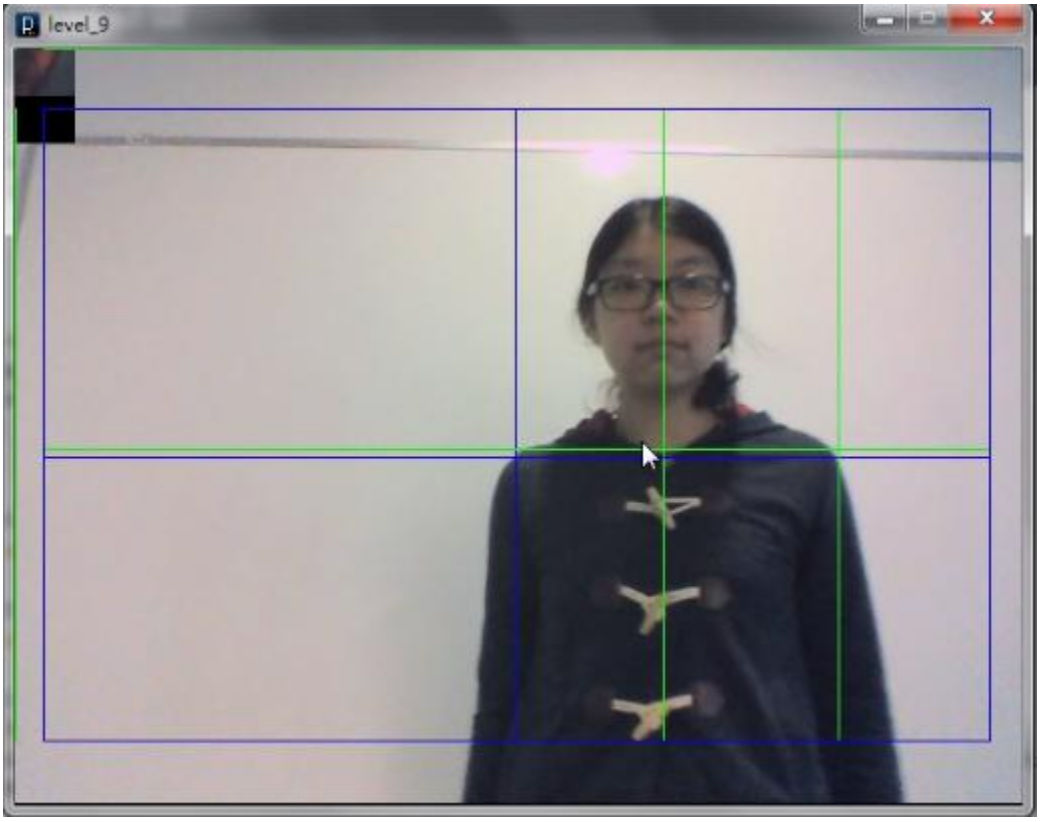

Figure 3: **User Centre**. The green line located in the middle of user denote the center of user.

2.2.3 Shoulder Location

Locating the position of user's shoulder is the key part in E-wardrobe system. We locate the shoulder position according to the slope which characterize the shape of shoulder in some degree. Nevertheless, the simple slope calculation may fail to find the shoulder position. The edge data in first step mix with a lot of abnormal data for the low quality of web camera. For this reason, we should establish a mechanism to deal with the abnormal data. The whole procedure can be divided into 3 steps.

- Finding the first normal data
- abandon the abnormal data
- Finding the data with the shoulder slope feature

Because the first edge data is seen as a standard for the shoulder finding procedure, we need to make sure it is not a abnormal data, otherwise it will lead the searching failure. However the abnormal data could appear at the beginning of entire edge data, in that case, we should find the first normal data initially.

Once we find the first normal data we can than start to look for the shoulder location. But, again, we will face the abnormal data which exists everywhere within the whole edge data. For solving this problem E-wardrobe system abandon the unusual data only process the normal data in locating the shoulder.

The slope feature obtained from the fact that the slope of people arm is much more steep than the one around shoulder. Whereby the principle above, by calculating the slope along user edge, we can finally find the shoulder.

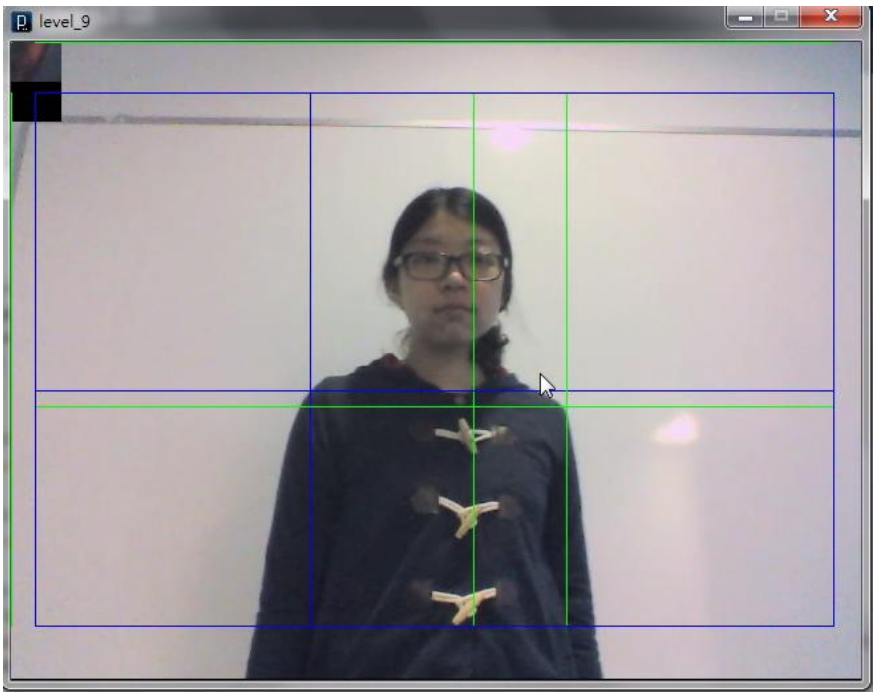

Figure 4: **Shoulder Location.** The intersection of blue horizontal and perpendicular line denote the left shoulder of user. Same as the green line.

2.2.4 Cloth Shoulder Location

In order to put the cloth on user, we need to determine its shoulder. The shoulder location is much like user shoulder location. But without considering the abnormal data, the processing is much more easy. We still use the slope to find shoulder, edge data here is retrieved by comparison the background color with cloth color finding the first pixel has the maximum distinction in each row. Once we find shoulder, we can then match the cloth shoulder with user shoulder to put the cloth on. The cloth size is also need to adjust according to the length of user shoulder.

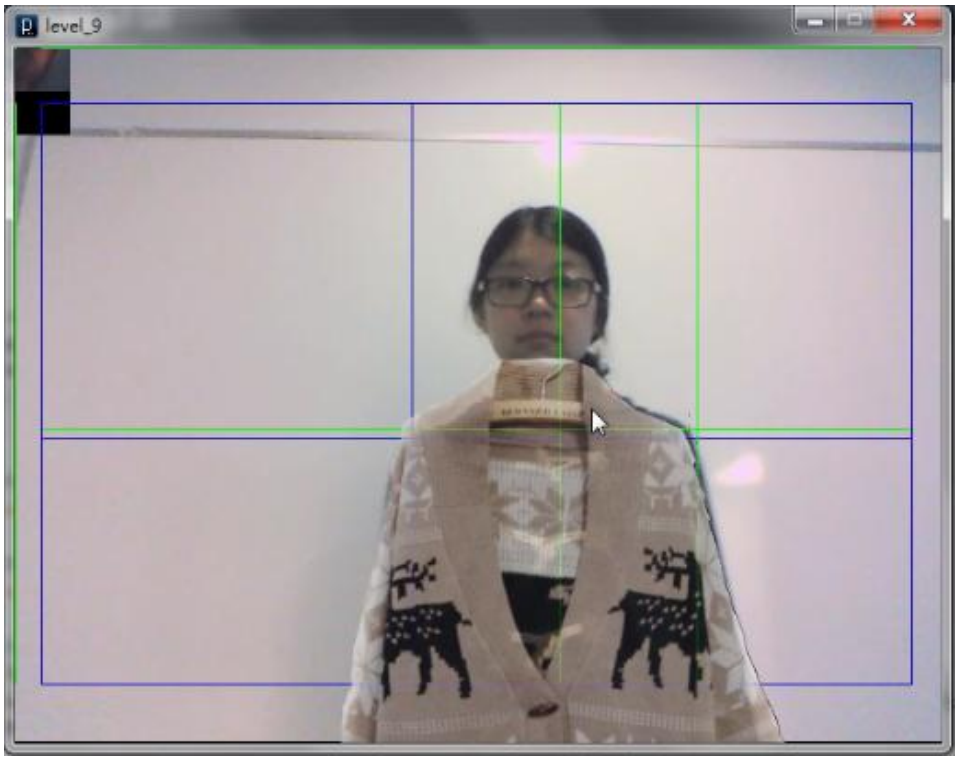

Figure 5: **Cloth Shoulder Location**. The system find cloth shoulder math it on the shoulder of user.

2.2.5 Cloth Shearing

The cloth shearing is aiming to adjust the shape of cloth when user rotate. Because the e-wardrobe is base on the 2D, the shearing is enough to satisfy the affect of cloth rotation. The key issue in this part is to determine the direction user rotate. We solve the problem with the help of user center. When user rotate to either direction the length between this direction and user center will decrease, the other side length will increase inversely. Base on that, we can make sure which direction user rotates. And calculate the angle according to the standard length obtained when user doesn't rotate.

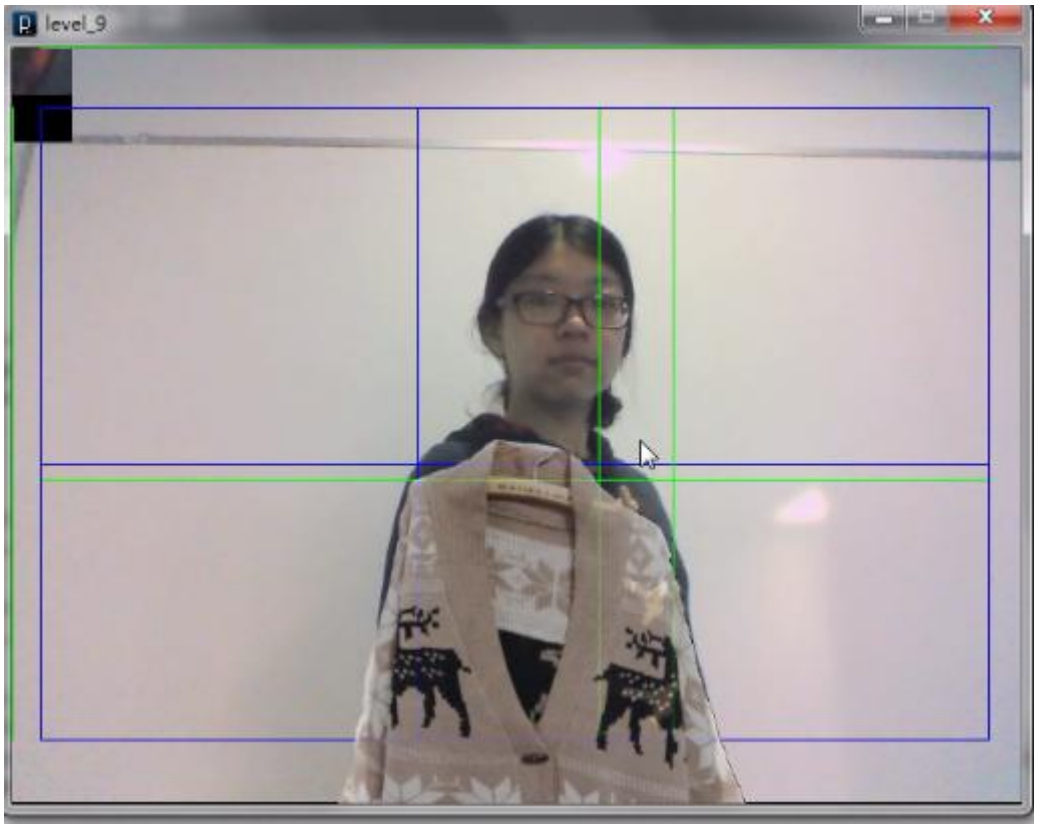

Figure 6: **Cloth Shearing**. Cloth shear when user rotate.

2.3 Flow Chart

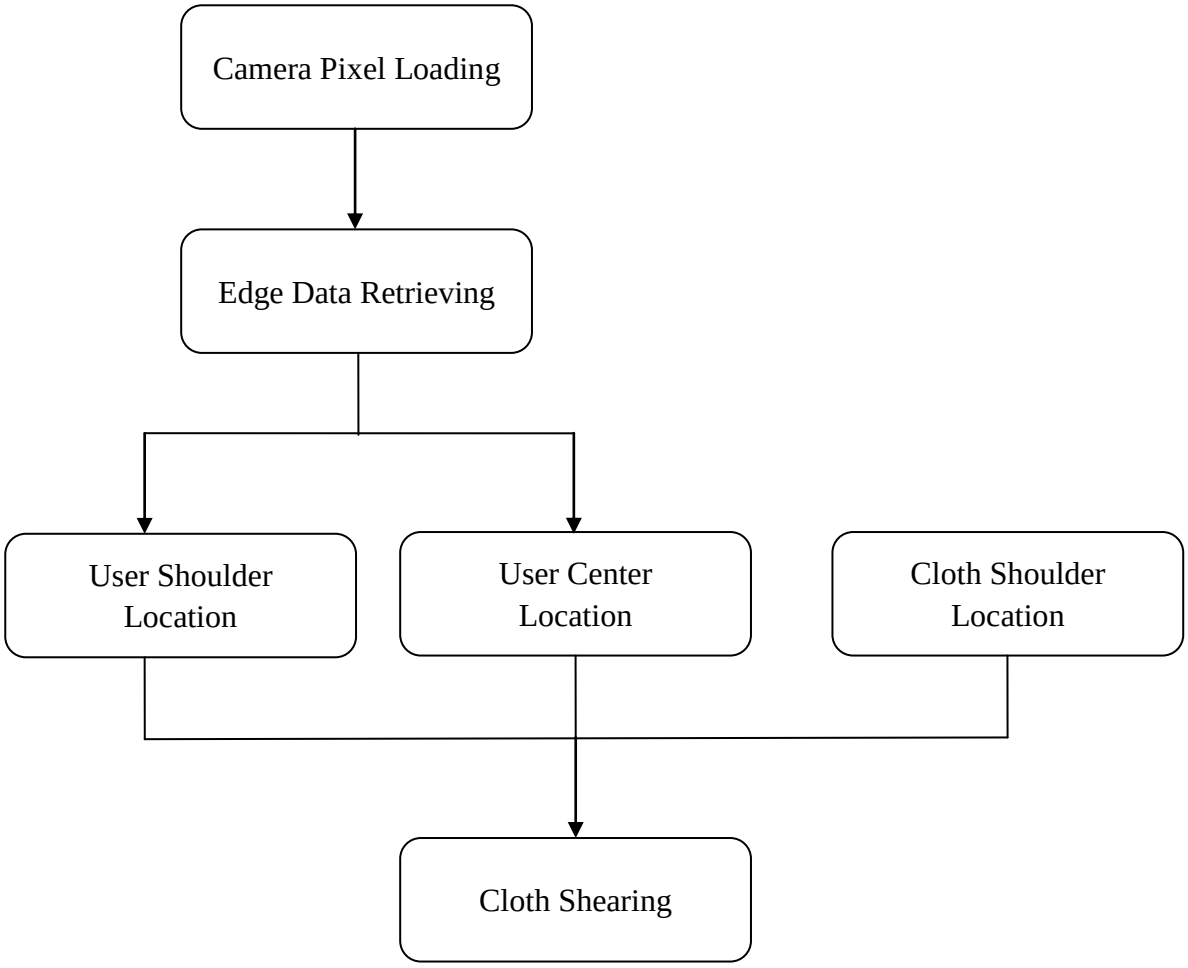

Figure 7: **Flow Chat of E-wardrobe System.**

3 Software and Hardware Requirements

The following is the requirement for E-wardrobe system.

3.1 Hardware

The E-wardrobe system has a lax requirements for the hardware. The only restrict requirement is that user's computer need to install a web camera.

3.2 Software

Software requirements include the following:

Development platform: Processing
Language: JAVA
External library: JMyron

4.Conclusion

E-wardrobe system focus on the body track technique. In our system we focus on tracking the shoulder position. Overall, the tracking can be implemented through two ways. One is to compare the pixel in whole search area finding the area has the minimum difference with the reference shoulder area. The other is to detect the user edge and search the connect point between arm and shoulder on it. However, when use the two way separately, the performance of system is not so good. For the pixel searching only can precisely determine the shoulder position when user translate, similarity, the edge searching can successfully locate the shoulder position when user rotate the body. Hence, we combine the two way together in order to get an higher accuracy system. For the cloth put on part, the main problem is also to determine the position of shoulder. The subsequent operation will be executed according to the shoulder information.

In conclusion, the e-wardrobe system realized the interaction within user and cloth through camera. User can enjoy the virtualization way to put on cloth without any practical action. Like look in the mirror, the user can rotate and move to see the effect of cloth on body.

6.Appendix

6.1 Meeting Minutes

Minutes of 1st Meeting

Date: 09/30/2011

Time: 11:30 a.m

Place: Rm.3512

Attending: Prof. Rossiter, Xu Chang

Absent: None

Recorder: Xu Chang

1. Approval of Minutes
Since this is the first meeting, there is no approval of minutes of previous meeting.

2. Report on Progress
Since this is the first meeting, there is no progress to be reported.

3. Discussion Items and Things To Do
• Project idea
• Development platform for E-wardrobe

4. Meeting Adjournment
The meeting was adjourned at 12:00 a.m.

Minutes of 2nd Meeting

Date: 07/10/2011

Time: 11:20 a.m

Place: Rm.3512

Attending: Prof. Rossiter, Xu Chang

Absent: None

Recorder: Xu Chang

1. Approval of Minutes
The minutes of the last meeting were approved without amendment.

2. Report on Progress
Xu Chang using the default pattern detection program achieved a square rotation.

3. Discussion Items and Things To Do
•Modification the pattern program enhance its efficiency
•Locating the search area on user only
•increase the scan region to get precise location.

4. Meeting Adjournment
The meeting was adjourned at11:45 a.m.

Minutes of 3rd Meeting

Date: 21/10/2011

Time: 11:00 a.m

Place: Rm.3512

Attending: Prof. Rossiter, Xu Chang

Absent: None

Recorder: Xu Chang

1. Approval of Minutes
The minutes of the last meeting were approved without amendment.

2. Report on Progress
Xu Chang achieved shoulder location by using Pattern Match method with higher efficiency by limiting the searching area on user only.

3. Discussion Items and Things To Do
•The way to enhance accuracy by calculating the moving vector
•Add cloth in system

4. Meeting Adjournment
The meeting was adjourned at11:20 a.m.

Minutes of 4th Meeting

Date: 02/12/2011

Time: 11:00 a.m

Place: Rm.3512

Attending: Prof. Rossiter, Xu Chang

Absent: None

Recorder: Xu Chang

1. Approval of Minutes
The minutes of the last meeting were approved without amendment.

2. Report on Progress
Xu Chang abandon the Pattern Match Method, using the Edge Detection achieved shoulder location with higher efficiency and accuracy.
Adding function key in system, user can put on or take off cloth by pressing Up and Down respectively.

3. Discussion Thing To Do
•Finish the report
•Record a vedio

4. Meeting Adjournment
The meeting was adjourned at11:20 a.m.