VR Technology in Self-defined Clothing

Project Plan

September 2016

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Abstract

This project is initiated from a recent shopping phenomenon in Hong Kong's e-commerce market. It is observed that there has been a boom in online sales, especially in the clothing industry, though feedback from the customers about their online shopping experience was quite unfavorable. A great disappointment regarding the actual product they received and its wrong sizing was expressed. Accordingly, smartFit - an iOS mobile application which features precise body measurements and 3D virtual fitting targeting at online clothing purchases - is proposed in this project. By employing some image processing techniques offered in OpenCV library, body measurements can be retrieved from photos inputted from a user. Given the body measurements of the user and a generic 3D human model, an avatar of the user can be constructed. With the application of virtual reality (VR), the user is able to view his or her avatar who has put on clothes according to user's preference in a virtual environment. It is hoped that the mobile application can give online shoppers the confidence in finding their perfect fit and right style so as to revolutionize online shopping experience and enhance customers' satisfaction.

The project plan begins by an introduction presenting the project's motivation, objectives and scope. Background research on existing market solutions is also given. Then, it discusses the methodology of how to develop the mobile application, for example, what kinds of technologies adopted, which development platform is used and what prerequisites are required in deployment. Furthermore, potential obstacles and risks are foreseen. Finally, a detailed schedule and a list of deliverables is provided for reference.

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1. Introduction

1.1 Motivation

Recently, most of the Hong Kong people have been diagnosed as “online shopping fever”. As statistics published by Nielsen in 2016 have shown that over eighty percent of Hong Kong people shopped online and more than fifty percent of customers bought clothing online. [1] However, a growing problem has emerged; many online shoppers were disappointed about the actual product they received and its wrong sizing. [2] Since virtual reality (VR) can give users an illusion of behaving like in the real world, [3] our team decides to utilize this powerful technology to resolve the problem encountered by many online shoppers.

1.2 Literature Review

After an extensive background research, it is discovered that a counterpart named MTailor is an end-to-end mobile ordering application for custom-fit clothing.

MTailor
It is a mobile application that features all-in-one purchasing experience with customized style selection, body measurement, payment and delivery. In particular, the design of its body measurement can be a good reference for us to start with. The procedure of its measuring process is as follows:

1. Set a phone on the floor, leaning against a wall with the screen facing the user
2. Stand approximately 10 feet away from the phone until the body is inside a box on the screen
3. Raise the arms and turn in a circle steadily
4. Input height information for accurate measurement

There is also an instructional video to guide the user throughout the measuring process. [4]

In addition, two existing directions have been identified to deal with only parts of the problem in online shopping.

Standard Sizing Table
Due to a variety of sizing standards adopted by different brands, the sizing tables of two merchandisers are not interchangeable. It turns out that a customer may fit in a size M of one brand but a size S in another brand which unavoidably annoys the customer to purchase the right clothes. As a result, companies ,for example Mytruefit, Clothing Horse and Embodee, suggest to find out a mapping between two sizing tables based on user inputs namely height, weight and name of brand and size of one reference item which a user considers the best fit currently in his or her wardrobe. [5]

Augmented Reality Add-on
Apart from standardizing the sizing tables, some companies ,for example Zugara, Imaginate and FaceCake emphasize on social commerce through a live video sharing to stimulate interaction and build connection when people are shopping. The video can give a hint of fit by embodying an augmented reality add-on which can create an avatar to have a user’s face and try on the clothes that the user has chosen. [5]

1.3 Objectives

After reviewing what the market has offered to the customers, our team has proposed an integrated innovative solution to tackle how a user can get his or her body measurements by himself or herself and how a user can have a 3D-view of himself or herself without actually trying on the clothes. We believe that this first ever idea can bring convenience to online shoppers and uncover the potential customer value hidden in online shopping.

Our goal is to improve online shopping experience and raise customers' satisfaction. Online shoppers no longer purchase the wrong style or unfit clothing and retailers have to suffer a significant number of returns and the associated costs. We attempt to breach the gap between shopping offline and online believing that people can purchase online as if they go to a store with the benefits brought by adopting VR in our mobile application. Besides, they can sit back at home browsing thousands of products with merely a few clicks and enjoy the convenience that efficient delivery contributes to.

1.4 Scope

Even though our team plans to invent a detailed mobile application for online shoppers, we are not able to implement a full set of functions in this one-year project. Therefore, we aim to design a prototype which can demonstrate three important ideas only including body measurement, user profile database and trial of clothing.

Body Measurement
By default, we assume that a user will upload two photos showing the front view and side view of his or her body. The user should keep a distance of 10 feet from the camera when taking the photos. The mobile application will proceed to analyze the photos and get the body measurement automatically.

User Profile Database
The mobile application will generate a user profile which will import the body measurement returned from calculation. The user has to input his or her height and weight to complete the profile. The user profile will also function as a shopping cart to track the user's favorite items and keep a browsing history.

Trial of Clothing
When the user put on a VR headset immersing himself or herself in the virtual world, he or she can see a 3D model of himself or herself standing in the center. By moving the head or walking around the model, the user can view how the clothes look on himself or herself in a 360-degree.

2. Methodology

2.1 Software Development Approach

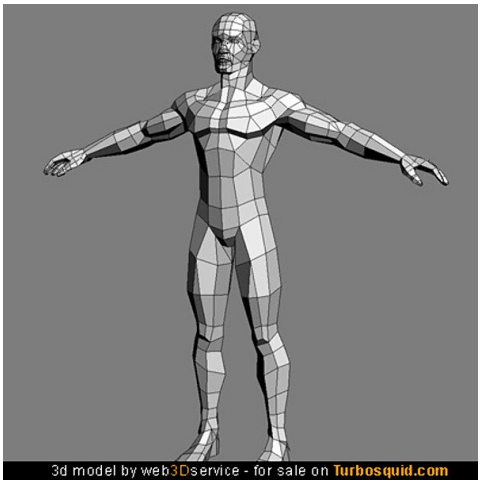
The mobile application development will be carried out in two stages which are divided by its functionalities so that a functional deliverable can be released at each stage to gather users' feedback for subsequent improvements.

Stage One

Our team will embark on the project by constructing a customized generic 3D human model with adjustable size of different body parts. After that, we will proceed photos inputted from a user to detect the location of different body parts. Then, precise calculations will be performed to get the body measurements. Meanwhile, user profile will be designed.

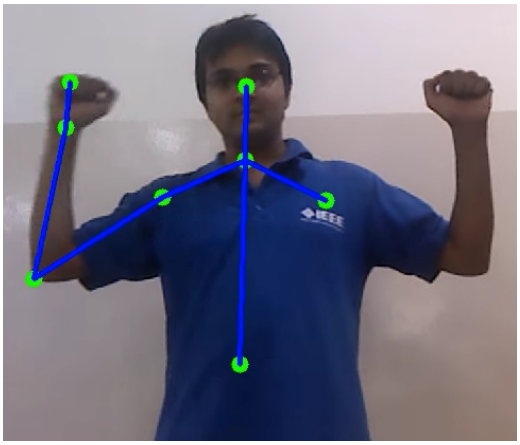
- 3D Model Construction

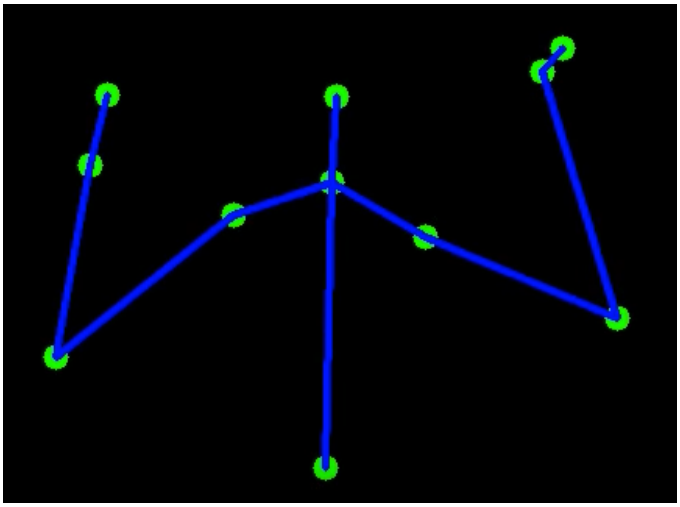
We will try to search for a 3D human model that is available on the market. If not, we will construct a 3D model by ourselves. The 3D model needs to be able to identify different body parts and have the corresponding parameters. In other words, the 3D model can be adjusted to create an avatar of a user given some input parameters.



- Human Joints Detection

It is planned to implement by OpenCV library which includes all the functions related to computer vision. [6]





- Body Measurements

Suggestions on what and how to measure different body parts are given by specialists. Our team decide to adopt the suggestions and follow the industrial standard in measurements. [7] After recognizing different parts of the body, OpenCV library is used to track the displacement of human joints in the photos so as to get the body measurements.

Bust	Measure around fullest part
Waist	Measure around the fullest part
Low Hips	You can find your low hip 20cm below your waistline
Inside Leg	Measure from top of inside leg at crotch to ankle bone
Chest	Measure around the fullest part, place the tape close under the arms and make sure the tape is flat across the back

- User Profile Database

A MySQL database server is set up to store information about the customers and the clothing. After the completion of body measurement, a user profile is uploaded to the server. In the meantime, all available clothing items are loaded from the server. There are three tables defined in the server and the corresponding data structures are as below:

Table 1

Customer ID	Name	Gender	Height (cm)	Weight (kg)	Bust (cm)	Waist (cm)	Low Hips (cm)	Inside Leg (cm)	Chest (cm)
1	Ann	F	170	60	95	73	97	80	85
2	Peter	M	185	65	100	75	99	93	103

Table 2

Customer ID	Item ID
1	1
1	2

Table 3

Item ID	Brand	Type	Size	Color	Bust (cm)	Waist (cm)	Low Hips (cm)	Inside Leg (cm)	Chest (cm)
1	abc	Dress	S	Black	83	65	88.5	/	/
2	abc	Dress	M	Black	93	75	98.5	/	/
3	abc	Dress	L	Black	103	85	108.5	/	/
4	xyz	Shirt	M	White	/	/	/	/	96-101
5	xyz	Shirt	L	White	/	/	/	/	101-106

Stage Two

- Trial of Clothing

A garment can be embedded to the 3D model by mapping different joints of the garment to the respective joint of the model which is a function provided in OpenCV library. Consequently, the user can get an immediate picture once he or she put on the garment. [8]

Future Prospects

- Online Order and Delivery

A user can place an order of the items saved in the shopping cart of his or her user profile. The mobile application will direct the user to payment system provided by some outside financial institutions. After the transaction is completed, the mobile application will notify individual retailers to ship the items to the user's home. Meanwhile, shipping information is available in user profile. The delivery will be traced by real-time tracking mechanism.

- Customized Search Engine

The mobile application has provided every user a platform to search for his or her favorite clothing from a vast database. However, our team thinks a step further what if the search engine is smart enough to look for a desired item efficiently according to the user preference and purchasing pattern. A well-designed searching algorithm should be introduced by applying the concepts and techniques in machine learning. All the clothes are then given a priority to showcase in the online

shop. With the help of the algorithm, the mobile application can now act as a salesperson to give personalized clothing recommendations to the user.

2.2 Development Platform

The mobile application will be developed under Unity which is a cross-platform game engine developed by Unity Technologies. [9] Our team will deploy to an iOS application written in Objective-C since our team has past experience working as a Apple developer. [10] Furthermore, graphics engine platform and Google Cardboard SDK for unity will be extensively used throughout the development because there are rich resources in the libraries and online tutorials can be found easily.

2.3 Deployment Consideration

Internet connectivity of the mobile phone is required. To display the 3D model in VR environment, Google Cardboard is also needed.

2.4 Technical Difficulties

Accuracy of the Body Measurements

- Biased from User Inputs

Although our team expect the body measurements can be as accurate as an experienced tailor, the performance of the system depends greatly on the quality of two photos inputted from a user.

- Absolute Error Occurred in Calculations

After the mobile application can recognize the location of different parts of the body in a photo, an algorithm is designated to perform the mathematical calculations.

2.5 Risks and Mitigation Strategies

Restricted Access Posed By Industrial Partners

Since the project is industrial-based partnering with the outside business corporations, our team is restricted to access corporations' highly confidential information. Even though permissions are granted to access some non-disclosure documents, concerns about the proper handling of such files should be raised to prevent any leakage in any circumstances. Thus, we should always behave in a professional manner and follow the industrial-standard code of conduct and business ethics.

3. Schedule and Deliverables

Date	Week	Submission Date	Deliverables	Description
September 2016	1	N/A	N/A	• Gather user requirements from the representatives of the industrial partners
	2			• Brainstorm the functionalities provided in the mobile application • Research existing market solutions • Acquire knowledge about available technologies that will be used in the mobile application
	3			• Draft project plan • Create project web page
	4			• Finalize project plan • Upload project web page to HKUCS server
October 2016	1	2 October 2016	Project Plan Project Web Page	• Search for or construct a generic 3D human model
	2	N/A	N/A	• Amend the 3D model to an adjustable one with given inputs
	3			• Study the use of OpenCV for detecting different body parts
	4			• Prepare materials (e.g. photos or videos) for test cases
November 2016	1	N/A	N/A	• Study the use of displacement tracking for body measurements • Determine what measurements to be collected
	2			• Write a program for getting body measurements
	3			• Optimize the body measurements program
	4			• Set up a database server • Design database architecture and tables • Draft user interface of the mobile application
December 2016	1	N/A	N/A	• Program user interface of the mobile application • Write sql queries in the database server
	2			• Code the body measurements part in the mobile application
	3			
	4			• Deploy the mobile application • Draft PowerPoint slides • Prepare scripts for the presentation
January 2017	1	N/A	N/A	• Rehearse for the presentation
	2	9-13 January 2017	Presentation PowerPoint	• Finalize the mobile application • Rehearse for the presentation
	3	N/A	N/A	• Draft interim report • Optimize the mobile application

	4	22 January 2017	Preliminary Implementation	• Perform system test on the mobile application • Study the use of VR for constructing a virtual fitting room
			Interim Report	
February 2017	1-2	N/A	N/A	• Finalize functionalities (body measurement and user profile) offered in stage one • Prepare materials (e.g. VR headset, clothes) for test cases
	3-4			• Construct the virtual environment
March 2017	1-4			• Perform unit test on virtual fitting room
April 2017	1			• Draft final report • Draft PowerPoint slides • Prepare scripts for the presentation • Perform system test on the mobile application
	2			• Optimize the mobile application
	3	16 April 2017	Finalized Tested Implementation	• Rehearse for the presentation
			Final Report	
		18-21 April 2017	PowerPoint	
	4	N/A	N/A	• Design project display board
May 2017	1	2 May 2017	Project Display Board	• Showcase the mobile application to the public

4. References

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