ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 4, Issue 9, September 2015

Virtual Wardrobe and Fitting Station for Apparel Sales using Real-Time Image Processing

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Abstract: The e-Commerce boom has greatly changed the process through which a consumer purchases goods and services. The driving force behind this shift from brick and mortar stores is the sheer convenience of procuring items online. However, consumers are unable to really discern their own appearance in the clothing available from images on a website and are hence hesitant towards such purchases. This paper and its implementation is an attempt to offer a resolution to this issue and provide the consumer with the ability to "visualize" themselves wearing garments as they would in a store mirror. With the use of Computer Vision techniques, it is possible to achieve a real-time implementation of the project.

Keywords: Image Processing, Augmented Reality, Computer Vision, Object Recognition, Open CV.

I. INTRODUCTION

From the advent of the very first system of online retail in 1979 by Michael Aldrich [1], the Internet has provided an excellent framework for the sale of items. In recent years, there has been an exponential increase in the number of purchases from e-Commerce websites which has brought substantial investment to such ventures. E-Commerce has in turn improved the warehousing industry, wherein optimum stacking of products is the need in contrast with the need for proper presentation, as in a store.

E-Commerce portals have, however, thus far been unable to compete with brick and mortar stores with respect to the consumer's ability to perceive their appearance wearing the products from a catalogue, given the absence of a physical medium on such an online portal. Given the premium attributed to physical space, brick and mortar stores too, face related issues, such as being able to display only a limited catalogue of stocks at a time.

Augmented Reality aims to enhance details of real-world surroundings. We are able to view an overlay of images by replacing real world objects with a model design. All this is done while keeping other background details unchanged. Such techniques are employed to virtually 'fit out' a user, thus enabling the user to view one's appearance as if actually trying on simulated items of clothing.
The implementation is based in Python and Open CV to provide a portable and an open-source application.

II. PROPOSED WORK

Fig. 1 is a representation of the system. The consumer enters the camera's angle of view wearing stock clothing. An image of the user is captured. It is filtered for noise.
The image is then thresholded to exclude the background. Next, the object boundaries and its orientation are calculated. The selected garment image is then sized and oriented accordingly and is overlaid on the user's clothing. Additional information about the garment may also be provided.

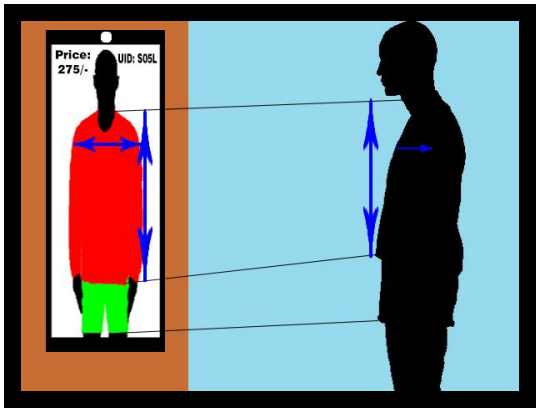

Fig.1. System Representation

The user then has the option to scroll between all available garments in the entire catalogue. The basic block diagram of the system is as shown in Fig.2 below.

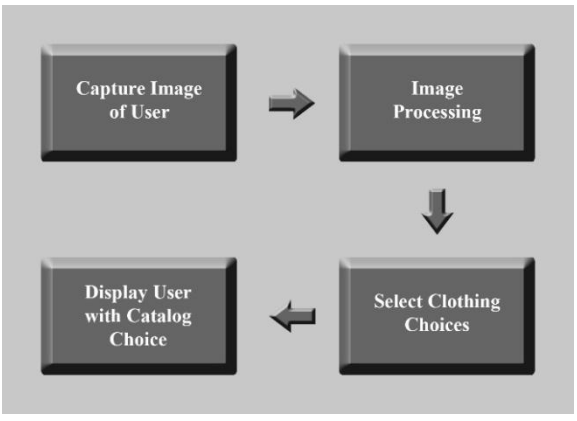

Fig.2. System Framework

III. METHODOLOGY

A. Camera

A standard USB Camera was utilized having a 640x480 pixel resolution at 20 Frames per Second (FPS).

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The FPS must be at least 15 to keep with the Real-Time constraint. The camera is placed at a distance of about 2.5 meters (for an individual of a height of 1.8 meters) from the location where the user is expected to be standing in order to contain the user in the frame as shown in Fig 3.

Fig.3. Image of the user is captured

B. Image Processing

Image Processing is performed using the Python programming language with the help of the Open CV library and it's supporting Numpy Library that is optimized for matrix operations.

Initially, the image is converted from the BGR (Blue Green Red) format that is it captured in, into HSV (Hue, Saturation, and Value). This separates the brightness of the image from its color, making thresholding simpler.

The image is then thresholded using the specified values of the stock clothing. Any existing noise not contained by the main body of the stock clothing is filtered out to remove background. The resulting binary image is shown in Fig. 4

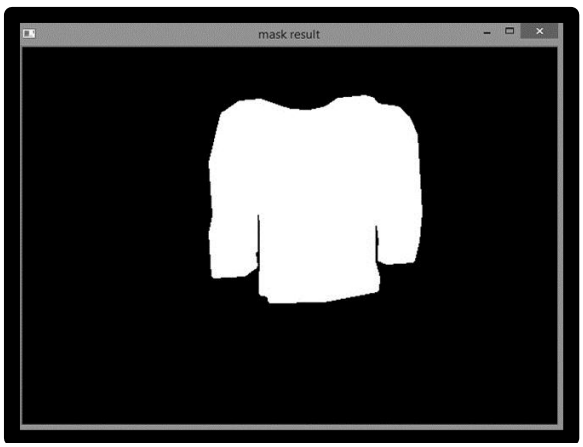

Fig.4. Image Post Thresholding

The image that remains is then checked for contours. This represents the detected stock clothing. Its location, size and orientation are calculated. These are then used to alter the catalogue garment image as shown in Fig. 5.

Fig.5. Catalogue Shirt image overlaid on User's Shirt Left: Overlay Disabled, Right: Overlay Enabled (Keyboard for User Input)

C. GUI Display

The Graphical User Interface (GUI) is set up so that the user receives maximum information about their selected garment such as the price, Unique Identification number (UID) and the selected size which they may modify. This adds to the user experience providing additional information about the product akin to a store tag. If a particular selection catches the user's fancy, they merely have to make a note of the UID and request the corresponding product.Fig. 6 show the system's GUI.

Fig.6. GUI Display

D. Sizing and Orientation

A fiducial system of objects placed as a size reference can be used to size the garment according to international standards.

Also, the users may then select other sizes based on their body type for the best fit.

Special care is taken here to ensure that the orientation of the user is matched in the display of the garment.

This is done by matching the orientation of the catalogue image to the stock clothing. The user may also not be standing perfectly straight, which would otherwise cause a misalignment of the garment image. This shift must be corrected for to allow an angle of tilt as shown in Fig. 7.

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Fig.7. No distortion of overlay if the user tilts. Left: User standing vertically, Right: User tilting

However, this creates another issue if the image is also sized up as in Fig. 8.

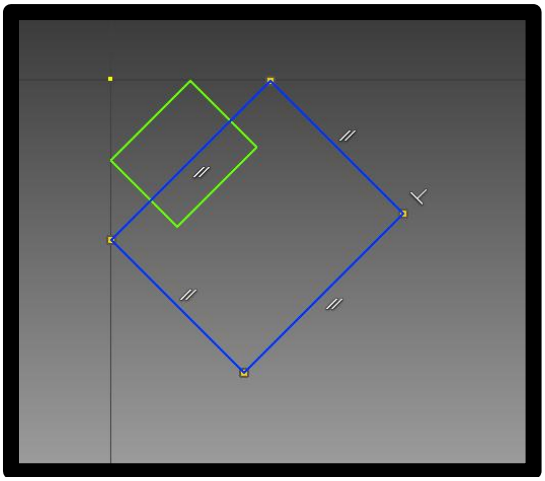

Fig.8. Sizing and Rotation causes an image shift. Green: Input Image, Blue: Resized Image

The garment is overlaid on top of the stock clothing and as such is in within its contours. If the catalogue image is sized up; it extends beyond the boundaries of the contour equally, disturbing the top of the image.

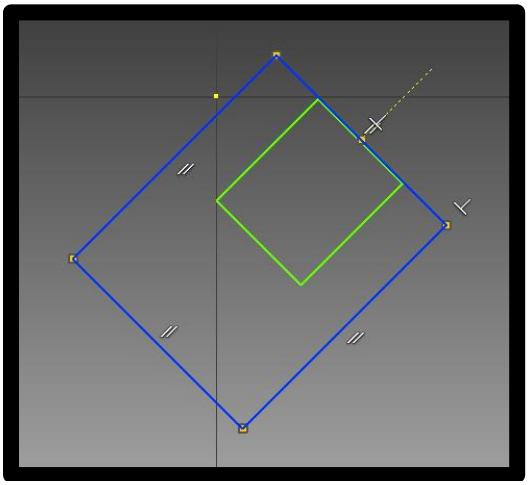

Fig.9. Corrections are made for proper overlay. Green: Input Image, Blue: Resized and Shifted Image

We need to shift the image so that the neckline, in the example of a shirt, is matched. These issues are solved as shown in Fig. 9 by matrix operations akin to shifting of origin.

IV. WORKING

The user distances themselves so that their entire frame is visible in the display. Then the catalogue display is enabled by the user. The camera captures the image of the user. The garment is selected as per the user's choice. Alternatively, the garment at the beginning of the catalogue (the default) is selected and the corresponding image is imported. This image is then altered as per the contour and combined with the initial original image. The resulting image is then displayed.

The entire process takes less than 60 milliseconds to fit within the scheme of Augmented Reality.

The user can then switch between the different choices in the catalogue. Users also have the ability to switch between different garments types, for example, Trousers as shown in Fig. 10.

Fig.10. Other Garment Types (Trousers)

V. FUTURE SCOPE AND APPLICATIONS

In the future, other types of apparel such as caps and jewelry could be included into the system. A 3D model of the catalogue garment would allow for a user to view the entire surface area. This would be paired with a system that identifies the rotation of the user's body. Scrolling of clothing could be done entirely by hand gestures.

A home user could also model their own wardrobe and use the system to decide on an outfit. The system would fit into an enclosed space such as a walk-in wardrobe requiring dimensions of about 2.5x1x1.8 meters.

VI. RESULT

The implementation of the Virtual Wardrobe and Fitting Station for Clothing Sales using Real-Time Image Processing was successfully carried out. The system has the capabilities to model upper and lower body garments, as well as hats. It runs smoothly and provides an excellent user experience.

DOI 10.17148/IJARCCE.2015.4979

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 4, Issue 9, September 2015

VII. CONCLUSION

Using the Virtual Wardrobe and Fitting Station, a user could go through an entire catalogue in minutes as opposed to having to constantly change between outfits to view their appearance.

A large number of products can be displayed with a limited space requirement, and the user has the ability to browse through an entire catalogue in a minimum time.

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BIOGRAPHY

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