

## VIRTUAL INFORMATION KIOSK USING AUGMENTED REALITY FOR EASY SHOPPING

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**Abstract:** The interactive information kiosk in shopping malls provides various types of information to the mall visitors. The design of an information kiosk for shopping malls is different from a normal kiosk design as it is necessary to catch the attention of visitors to the shopping mall. The interactive information kiosk is needed in a shopping mall to attract, engage and provide information to the shoppers, visitors and users. This will lead to improve the business, higher product sales, customer satisfaction and the best self service. This paper focus on advanced display system called Virtual Information Kiosk (VIK) follows the novel procedure to obtain the data for the users. The information is generally reached by the authorized person only. Moreover, the approved users only can see the content of the Virtual Kiosk. The user can communicate with Board by free hand using Augmented Reality. The AR Interface is an integrated interface system that links a network of smart devices together, and allows users to communicate with the physical objects using hand gestures. The user wears a smart glass which shows the user interface in an augmented reality view. The hand signals are identified by the smart glass and after recognize the correct hand gesture input, VIK will communicate with the associated smart devices to carry out the designated operations. The Virtual kiosk provides common inter-device operations such as file transfer, printing, zooming and touch screen based operations.

**Keywords:** Augmented Reality, Virtual Board, Information Kiosk, Gesture based kiosk

### 1. Introduction

The technology development in computer industry changing the world every day, the retailers and marketers is using that technology perfectly to promote their products. Moreover, the innovations which can be applied to the retail industry provide the best shopping experience for the customers and at the same time it increases the substantial amount of the product sale for

product owners. Augmented Reality is a blend of the real world and virtual world.

Augmented Reality (AR) is generated from Virtual Reality (VR). However, both technologies are used to create the virtual environment for the users. This virtual environment is designed to interact and manipulate easily in natural or automatic mode by the users.

Both AR and VR transform the shopping experience into the virtual world and it reconstructs the online shopping in different aspect. Mainly, the VR has been used widely in gaming which reflects real world situations of screen scenario for user interaction [Accenture survey Report 2014]. The Augmented Reality has same experience in a more advanced manner by integrating the computer sensory input such as touch, smell, sound etc. with the real time situation. There is no limitation of timing for online shopping. The customers may enter any time at the virtual store and purchase their items and pay the amount in a convenient way.

There is a slight difference between VR and AR. When using VR, the user has the complete experience in a virtual environment, but AR merge the real world with the virtual world. The electronic gadgets like smart phones, tab and wearable devices are providing the easy way to enter into the AR based online shopping [Catalina 2014]. Some examples of AR integrated online shopping tools are Warby Parker-online eyewear shopping, Converse Shoe Sampler – customer can select the perfect shoe from their home and IKEA-tool allows the users to shop online for furniture, sofa and other household items [Retail Perceptions Report 2016].

Augmented Reality for information kiosk that visually sets virtual products into real physical environments for providing better customer interaction [Waghmare Amit et al. 2014]. This trending strategy offers consumers with an opportunity to “try” a product in the home or maybe in a different user environment. The combination of augmented reality with hand gesture experienced made the system work in a much more interactive way. Working with the product requires rotation left or right, navigation over the product by

applying the hand gesture of the consumer .The consumer can see the product from all the directions based on the option made. This will likely cut down the attempts of the customer to use the keyboard operations as a result, creating the advertisement of the product in a much more interactive way.

In this research work, this exciting technology has been used to access the information from the kiosk which is placed in the shopping mall and the user can get all the information about shop location, product sale details and other information about malls. The user interaction with kiosk is done by hand gestures which are predicted by camera configured in the smart glass.

## 2. Related Work

The literature survey has been taken in three aspects such as designing of kiosk, interaction methods and supporting menu.

### 2.1 Information Kiosk System

An interactive kiosk is a computer terminal featuring specialized hardware and software that provides access to information and applications for communication, commerce, entertainment, and education [Waghmare Amit et al. 2014].

There are different types of kiosk information system are available for public usage. These kiosks are placed in various locations such as railway stations, bank, Academic institution, shopping malls to access the information. The first widely available public kiosks where the bank ATMs already in 1970's . There has been a recent trend to concentrate on multimodal interfaces for a kiosk [Cassell et al. 2002; Johnston and Bangalore 2004]. Mobile devices with localization support have been studied for local services [Albert Huang et al. 2005].

Some of the kiosk which is used in the public places is Touch Screen Information Kiosk. Telecoms, Multimedia Kiosk, Interactive Kiosk and Retail Kiosk. Each kiosk system has been designed with unique functions. The information kiosk can be supported for marketing as a display system and it is configured with touch screen, camera, biometric reader and RFID. Interactive Kiosk is designed with remote management software to monitor the activities of kiosk in remote locations and avoid annoying crashes. Generally, the requirement and needs of shopper and visitor are varied which makes it difficult to deal with the individual queries. In such places, the interactive kiosk can fill the gap between customer and service provider and it make

sure that users and customers can get the best services and information.

Retail Kiosk is facilitated by self-scan and self-check-out terminals where the customer can check prices, pack the product and pay. These kiosks are designed with information terminals to advise and recommend customers on particular products based as per their preferences. Further, these self-service kiosks can increase profits by cutting down on staff costs. Along with helping in decreasing waiting times for customers, these fully satisfy the customers with their ability to serve them quickly and easily.

This research work focus on extending an information kiosk [Waghmare Amit et al. 2014] with Augmentation Reality features. This allows the customers to access the information like product details, price and availability of the virtual interface which is projected in front of the AR glass. These details can be accessed by gesture operation such as pinch, unpinch, zoom and drop.It permits the customer to transfer the information from kiosk to their personal electronic gadgets.

### 2.2 Mode of Interaction

To provide the effective and user-friendly interface, the free hand interaction has been investigated [Ni et al. 2011] .The standard interfaces such as mouse and keyboard can't apply for free hand interaction. In the investigative work of [Hurst et al. 2013;Ni et al. 2011] digital gloves and fiducial markers has been used for freehand interaction . Other work includes Microsoft Kinect. This work presented the free hand interaction driven by hand poses and motions of the hands and fingers [Guimbretiere et al. 2012] .But, this approach has many drawbacks such as the hand gloves are limited to some set of users and make the tiredness for the users. The usage of fiducial markers and sensors needed to appropriate set-up and calibrations. Image Processing technology was used to produce the free hand interaction to identify and realize hand gestures which is well suited and produced better results in public places [Ren and Neill 2013] .Since the mobile devices are becoming powerful, these types of techniques are ensuring for mobile phones as built-in cameras may be used without make use of more devices or sensors.

### 2.3 Augmented Reality Supported Menu

Typically, the menus are being used in the user interface for providing the simple way access for the users. Augmented reality based menu designing is not a simple process. It needs to be projected in the three dimensional

view. The ring menu [Liang and M. Green 1994] and the tile menu [Rahman et al.2009] was built to perform the operation on the three dimensional space. All these non-traditional menus have been made to support mid-air operations.

Usually, the traditional input devices like mouse and keyboard has been disposed to reduce the disturbance in Augmented Reality application. Another device such as pen was used for manipulating the menu. Studier tube [Zalavari .Z and M. Gervautz 1997] is the best example of that in which pen is used for menu selection on the tablet. However, still the tablet and pen are needed in this approach. Additionally, some devices such as fiducial markers [Poupyrev et al. 2002] and fingers were used to access the menu. The digital gloves equipped with motion sensors to detect the motion like wrist tilt and multiple pinch gesture [Ni et al. 2011] .

### 3. System Design

The Virtual Information kiosk is an augmented reality application which requires users to work with wearable equipment such as smart glass [Haugstvedt et al.2012; Heun et al. 2013; Schmalstieg et al. 2007]. The Smart glasses are configured with cameras, processors, network functionality which enables it to show augmented views to the users. All of these features are usually necessary for the VIK system. Since the user is wearing the smart glass, the camera will capture the scene of the adjacent physical environment. The camera recognizes the smart devices in the environment as well as keeps track of their locations according to the details on the corresponding markers. The camera on the smart glass also understands the user hand gestures which allow the user to communicate with objects by freehand manner. The smart glass also provides users with an augmented reality view, which overlays information and interface neatly over the real world.

Designing a VIK takes the consideration of the following:

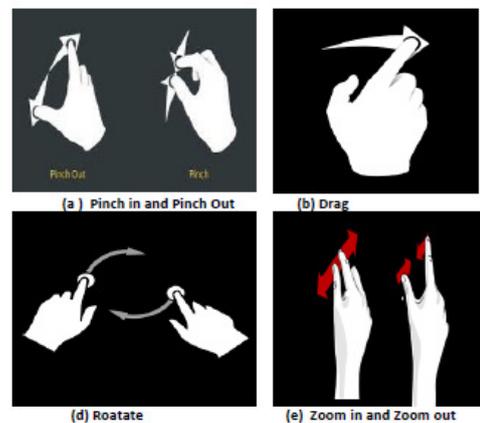
- (i) Physical affordance, which can be accessed from the user's electronic devices.
- (ii) To introduce the free-hand working of virtual interface to access the product contents of Kiosk for the customers.
- (iii) To provide the efficient way of communication path for the end users to link the virtual interface and the physical objects.

The Interactive Virtual Information Kiosk (VIK) can be used in two different modes. The modes of operation are,

**1) Virtual mode:** When the VIK is in virtual mode, which means the user wears the AR glass and attempts to

access the contents of kiosk through Augmented Reality. It allows the user to access the contents of the notice board using hand gesture. The VIK uses several types of hand gestures to provide the multiple freehand interactions, which are used for various file transfer operations by the user. Figure 1. Shows the Types of hand gestures which are supported interacting with the interface.

**2) Non Virtual Mode:** The VIK will be acting as an electronic notice board. In this context, the viewer or user is connected to the E-notice board through internet, and checks for updated notices and also has the privilege to download the updated notice. All the notices are stored in and retrieved from the database.



**Figure 1.** The supported hand gesture for VIK

The following are the various operations which can be recognized from shape of the position of the hands [Zhanpeng Huang et al.2016].

**Pick Operation:** A Pinch gesture is interpreted as pick operation. The select operation needs to be carried out on a menu item, otherwise it will be invalid.

**Drop Operation:** An un-pinch gesture plays the role of dropping the picked item. A pick operation needs to always end with a drop operation.

**Drag Operation:** This operation is recognized by combined operation of pick and direction. The selected item is attached and move together with directional gesture when simple drag operation is carried out in the event of file transferring. Every drag interaction ends at any time when a drop operation performs.

**Rotate Operation:** A pair of pinch operation gestures moves in X and Y direction in that order on screen space. This kind of interaction is used to find the relative distance between them which will be useful to

find the rotation angle. The Rotation operation is used for menu implementation. The menu provides various options to perform on the interface. The Rotation operation ends whenever either or both pinch gestures end.

**Zoom:** The zoom operation is activated when a combination of two drag operations carried out on the same item. The relative movement of drag operation is used to increase and decrease the item size. The zoom operation ends at the event of one of or both drag operation terminated.

#### 4. Prototype Development

The system Implementation needs technologies from the aspects of object tracking and hand gesture identification [Zhanpeng Huang 2016]. The physical marker-based approach can be used for physical object tracking. A pair of distinct strategies which includes the double-threshold algorithm is attempted together with assessed for pinch gesture detection.

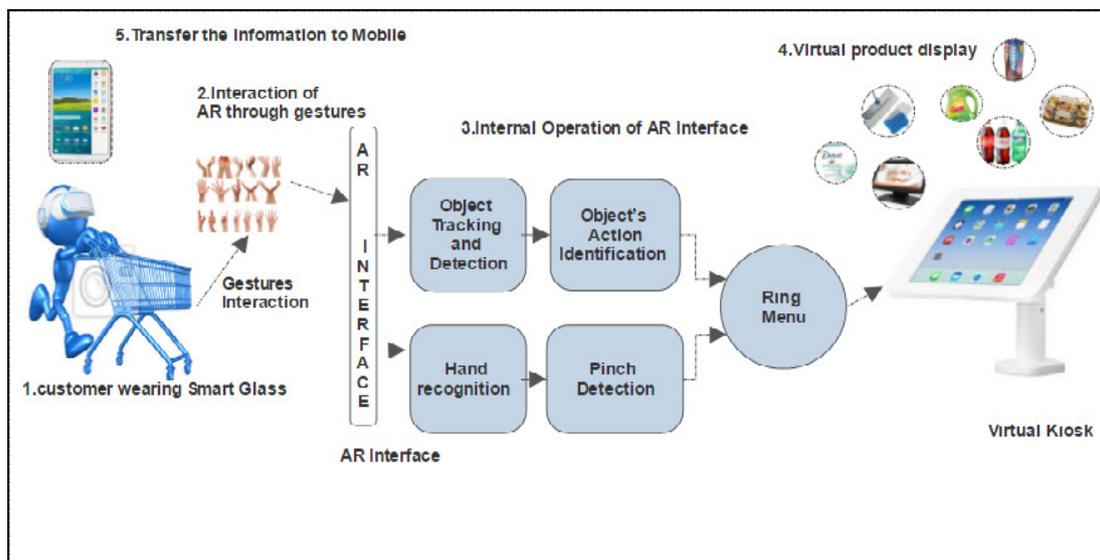


Figure 2. System Architecture of Virtual Information Kiosk System

The system architecture of VIK is shown in Fig. 2. The camera configured with AR Glass takes live videos of the scenarios around users, which are streamed for image analysis of object tracking and hand recognition. The QR code which is pasted on the objects is used to extract object information of IP addresses and object's type. This can be used for recognizing the physical objects and to provide the network communication among the electronic devices which are placed in the surrounding place. The camera which is used in the virtual interface is updated periodically as per the real camera pose to make 3D menus from corresponding viewpoint and creating virtual menus associate with surfaces of physical objects. In this scenario, the menus are designed using the AR overlays and video stream, and then displayed on AR Glass display prism. Hand gestures are taken out of a video stream using a modified inexpensive technique according to the method [Wilson, D 2006]. The contours are then filtered, making

use of double thresholds to find out pinch gestures. Users have the ability to communicate with physical objects by way of virtual menus using pinch gestures, which are usually interpreted as socket to carry out communication between physical objects via underlying network.

#### 4.1 Marker design

The physical markers have used to act as the unique tags to the objects. The information which is used to identify the objects is object type, location of the network and some addition information about objects. This kind of information is hidden in the marker. Using this valuable information the user can interact with the objects. The users can share the files with other users easily.

All the devices are linked to the printed physical marker and it uses the QR code to encode the information which hides in the marker [Baur et al.2012]. Generally,

the size of the marker in the minimum range of 5 X 5 cm which can be identified by the AR glass from the acceptable distance. The reliability of distance gets increased when bigger size of markers used. Actually, the marker is the printed paper placed on the device. This can be viewed on in the smart phone screen after setting up the VIK application. The VIK recognize the embedded information of marker and based upon that it overlay the information to the passengers in the AR interface. The place and position of the markers also used to find out the alignment and coordinates of the virtual overlay.

#### 4.2. Menu Design

The AR supported menus are designed with attributes of depth, rotation and position. The following specifications have been taken into consideration in designing the menu.

**Placement:** In this specific context, the object-referenced placement has been used to assign the menus to the physical objects [Brudy F. 2013]. The visual markers are affixed to the physical objects. It achieves the goal of designing the system to split the centralized interface into a specific interface for the users.

**Orientation:** Menu alignment is required to provide, the easier view to read the options .The alignment of the menu is performed by marker which is tagged on the surface of the objects[Dachselt R. and A. Hubner.2007].

**Triggering:** According to the active state of the corresponding object in the menu may be able to be seen or unseen. The user can see the menu only in the in the status of the visual marker of the physical object appears in the user's view. Whenever the user applies the pinch operation on the file icon the menu item is triggered and the capture zone is turned on if menu icon is put in the capture zone.

#### 4.3 Object tracking

The object tracking consists of in identifying objects and also analyzing spatial relationships between objects and users. The marker-based baseline has been applied to do this work, which may be normally more precisely and also a suitable method for image distortion and illumination variation [Heun et al. 2013;Neumann et al. 1999]. In this system, the QR codes are being used as fiducial markers to encode added information as object features for physical objects. The fiducial markers are the markers which can be placed on the field of view of the imaging system. The object information which includes IP address and object type is encoded in QR code in advance using the QRcode tool

#### 4.4 Hand Gesture Recognition

This approach follows Wilson's vision-based technique to recognize single as well as two-hand pinching gestures, with various enhancements in our technique [Wilson. D. 2006]. The first and foremost process is for identifying the hand gestures from the background image and it is done by segmenting and connected component techniques of computer vision. Generally, the background image is darker than foregrounds and the system needs the foreground image such as hand gestures. So, the foreground hand gestures are extracted from the background for further processing. The hand skin color is used as the reference color while extracting the images. Contour of hand images is extracted based on the size of the contour. The incorrect contours are filtered according to the size bounds which are specified previously. The bounds ranges are recognized by the acceptance and elimination curve. Any inner contour exceeds the specified bound value are eliminated.

While identification of hand gestures, the space between the thumb and index fingers, decides the type of the operation and it plays the main role in recognizing the pinch gesture, but this method will fail in the condition of whole background space is occupied by the other fingers. The system will not work in the case of hole is unseen to the cameras. For example, sometime thumb and index fingers will be in the position of horizontal.

The real time contour method is used for gesture recognition process. It provides accurate results for most of the cases and it can't recognize the gesture while the background is complicated.

In general, the pinch gestures are determined by the posture of the thumb and index fingers touching with each other and it has a hole between the fingers as shown in the figure 4 .a .Here, OpenCV software has been used for separating the unnecessary gestures other than pinch and also eliminate the interruptions.

The entire workflow of the logic is shown in Figure 3.

**Pre-sampling:** As per the strategy used in [Andresen .S 2013.], the user's skin color of hand has been taken into consideration for pre-sample in order to remove the background. The HSV method is used for skin recognition.

Initially, all the RGB color space frames, which are obtained from the camera image, are converted into HSV color. In this stage, the users' hand's skin color is collected by the camera for sampling. Usually multiple sampling is obtained for each user.

**Processing Stage:** At this stage, the noise has been eliminated using Gaussian Blur Algorithm. Following

that, the hand color, shape has been taken out based on the sample colors in addition to color radius to generate the exact hand shape. Finally, to eliminate the irrelevant colors the medium blur is implemented on the combined shape. In the next stage, contours of hand color sections are extracted based on the threshold value. The threshold value is decided according to the distance between arm length and camera. The convex polygonal features are extracted from the contours to differentiate the pinch and non-pinch gestures. Usually, the ratio for pinch gesture is lower than 2.2 and non pinch gestures are higher than 2.2.

### 5. Evaluation and Experimentation

There are three experiments have been designed to assess the method from a different perspective. Different level of participants was asked to carry out the experiments in the devices owned by the users. The task completion time and also failed trials in offline and online were calculated and compared. A technology acceptance model (TAM) [Haugstvedt et al. 2012] was one of the main assessment and it followed to assess user practical experience.

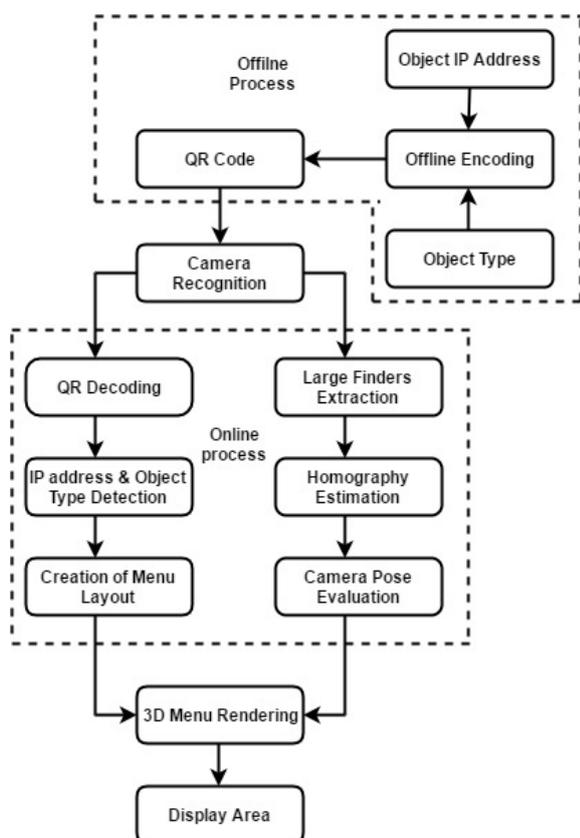


Figure 3. Workflow of Hand Gesture Recognition

To perform the experiment, the participants were equipped with AR glass and mobile or Tab. The messaging software Skype 4 and share tool Dropbox 5 have been installed initially into the system for transferring as well as sharing document. Many accounts have been created earlier to use the software. Printers and electronic gadgets which are attached with the kiosk system were running in order that participants could not have to login or turn on devices.

Ex1: The initial task is to copy the product contents or information from Virtual kiosk System to Mobile or other electronic gadgets. First, the participants needed to copy specified contents from the Kiosk in manual operation like to take picture by mobile camera. Afterwards, the customers were asked to use the VIK. In this context, participants were required to carry out pick, drag, and drop operations with their hands to transfer the file from VIK to the electronic gadgets. To access the various items which are folded into the menu, the rotate operation also needed.

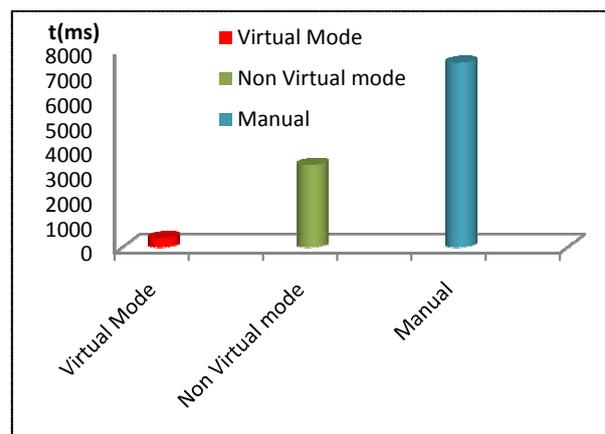


Figure 4. Comparison of task completion time of VIK with traditional methods.

Ex2: In the following task, the copying contents from non virtual mode of VIK to Mobile are taking into consideration. The participants were asked to transfer the contents from VIK to mobile using Bluetooth or wifi options.

Ex3: Detection rate and failure rate of gesture identification are taken into consideration for the third task. Here, a shape of the hand plays the major role in gesture recognition. The shape of the hand section is extracted while copying the content from VIK. The biggest one is the outer contour (i.e shape of the hand) of

the hand section as illustrated in Figure 4. Mostly it is in dark color. Any inner contour refers an inner hole appeared when we fold the fingers in the hand section. General illumination along with other non-pinch gestures may additionally generate the inner contours and it is shown in Fig 4.e and f.

## 6. Results and Discussion

The above Fig 4. Compares the participants' task completion time using VIK(virtual mode) system and other traditional techniques like content transfer via USB devices and Skype, content share through Dropbox and using other networking features. The time expense of VIK is significantly a lot less than other traditional methods in every task. Particularly, it is taken 360ms(Red bar) for move the contents which is nearly 4 to 7 times much faster respectively when compared with transferring on Skype (Green bar, Non Virtual mode =3317ms) and USB flash copy. The manual transfer will be done through observing the content manually or photo image taken by mobile. It is taken 7442 ms for processing manually in Ex1.

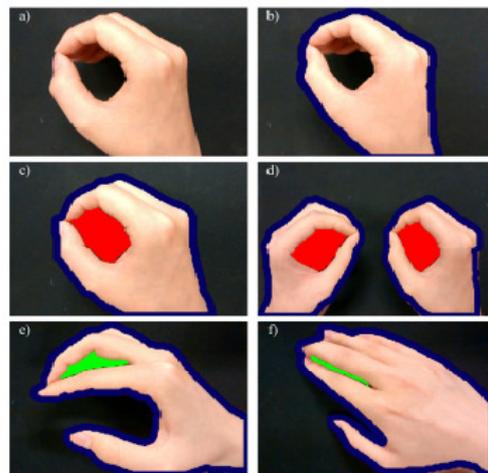
Generally, copying the content from one device to another device involves plugging in, plugging out and copying contents between devices and mobiles and needed some physical actions of users. But, in the context of VIK, It simplifies the manipulations without direct physical touch and provides the fast secure accessing technique. When the printer is connected with the VIK virtual mode, the VIK takes 380ms for print the document. It saves the time spending for doing the operations by clicking \print..." menu item and choosing specified printer from the printer list needed by traditional method(10242ms). It was clear that a few participants to complete the task when by selecting a printer from the configuration panel. In that case, the VIK takes 307 ms and the traditional manual operation takes 8735ms.It can also be more effective in document sharing in comparison with Dropbox sharing (Manual=13502ms, VIK=1127ms), as it would not require verifying target user's Dropbox account, that may be normally not the same as the target computer's account.

Almost all pinch gestures identification will pass when the threshold is small and the recognition accuracy decreases when the threshold goes up. A lower bound 0.6 and upper bound value 0.8 has been set to achieve over 85% accuracy of both pinch gesture detection and non-pinch gesture removal. The approach will work in both one and two-hand pinch gesture identification as shown in Figure 4. Actually, it is very difficult to remove other non-pinch gestures. Figure 4.shows two gestures with

holes in unusual position of the hands, but they are removed by this approach by comparing with the lower bound threshold values. In practice, the larger upper bound consists of the result set of smaller upper bound and it can be applicable to uncheck the upper bound .However, size of pinch hole may vary by person and it the main constrain in this context.

## 7. Conclusion

Thus, Virtual Information Kiosk provides a decentralized user interface system for manipulation between the physical and digital worlds. User interface and communication are carefully designed to manage free-hand user experience. This technique is evaluated for both aspects of technological and user experience. By communicating with objects at a high-level of physical affordance instead of fundamental electronic counterparts, this approach supports users carry out operations in much comfort as well as a natural way. It has been shown to be helpful for simple and frequently-performed manipulations with associated digital devices in closed environments.



**Figure 5.** The pinch gesture detection. a) a typical pinch gesture; b) outer contour of hand is extracted; c) and d): red closed regions are recognized as pinch holes; e) and f): green closed regions are eliminated as non-pinch holes.

In our experiments, it was clear a lot of failures were occurring due to hand gesture detection. The color-based method is selected to relieve computational cost, but it is not correct enough in backgrounds with similar

color of hand skin. In future we decided to incorporate depth and visual cameras to enhance the accuracy. Another problem is the limitation of weak computational capability and minimal power capacity of AR Glass. The approach has been verified to improve both real-time performance and runtime sustainability. This AR integrated kiosk can be extended to support the complete shopping like selecting the product and billing through AR Interface as future work.

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