Augmented Reality Based Self-Treatment Using Acupressure

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Abstract—Acupressure is an ancient Asian method of relieving pain and curing diseases. This paper presents our work on customized Augmented Reality Based Self-Treatment Using Acupressure (ARBASTUA) that uniquely uses facial symmetry to model acupressure points personalized for users' faces and displays the information using augmented reality. We also bridge the gap in presenting this useful information to users in a user-friendly manner. With the increase in use of smart-phones, a lot of health tips apps have been released. Most of these apps are text based, and provide health related information in text form which is not very user friendly. This information can be better presented in a novel way by using augmented reality.

Index Terms—Acupressure, Golden Ratio, Face Detection, Face Symmetry, Augmented Reality, Chinese medicine

I. INTRODUCTION

This paper presents our novel work on Augmented Reality Based Self-Treatment Using Acupressure (ARBASTUA). Acupressure is a technique developed by the Chinese to relieve pain and cure different diseases by applying finger pressure at specific points on the human body. It is widely used and studied by people all around the world in fields as advanced as treatment for Traumatic Brain Injury [9], as well as Sleep quality and cognitive function of older adults [10]. In today's information age, information about acupressure is readily available on the world wide web in text form. Many apps have also been developed to provide such information. However, these apps are limited in that they present the information in the form of text or pictures. This is not very user-friendly. We have come up with the idea of developing a desktop application which uses augmented reality to provide customized knowledge about acupressure to its users. The users can then use this information to relieve their pain or to work on curing their diseases themselves.

Augmented reality is a technology that overlays digital information on objects or places in the real world for the purpose of enhancing the user experience [11]. It is already being used to enhance user experience in a number of fields. Its roots can be traced back to the work carried out by Professor Tom Caudell in the 1990s. What started out as a way to improve the manufacturing process at Boeing turned into a way to improve the gaming experience and now to enhance user experience in a variety of fields.

Our work is the first of its kind as it uses the golden ratio [1] of face symmetry to model Acupressure points on the user's face

Fig. 1. Trisection of Face, as originallydescribed by Vitruvius [7]
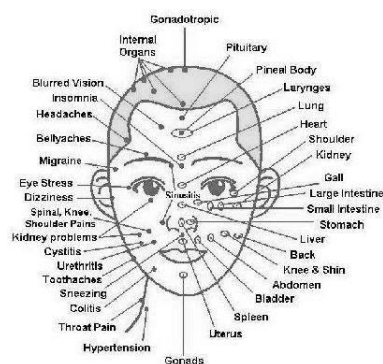

Fig. 2. Acupressure points modeled on sketch of human face

instead of using a generalized face and depicting Acupressure points on it. Moreover, it combines Augmented Reality with the modeled Acupressure points, thus making it even more unique. Thirdly, it enables the users to conduct self-treatment of diseases without the aid of a practitioner.

In this section, we have introduced the domains of Acupressure, face detection, and augmented reality which have not been used in conjunction with one another before our work. In section II we review the work already done in modeling and providing Acupressure points information to users. In section III, we present our solution for personalizing the Acupressure points modeled and presented to users based on their face symmetry rather than using generalized Acupressure points

TABLE I
HEADACHE PRESSURE POINTS

Region	Points
Forehead Region	Third Eye point
	Bright Light
Temple Region	Hairline Curve
	Valley Lead
	Celestial Hub
	Floating White
	Head Portal Yin
Face Region	Welcome Fragrance

TABLE II
PRESSURE POINTS FOR DIFFERENT EYE DISEASES

Region	Points	Diseases
Forehead Region	Yang Bai Point	Eye pain, glaucoma, night blindness
Temple Region	Tai Yang Point	Eye pain, photophobia, improve visual acuity
Face Region	Si Bai Point	Relieves dry eyes, aging vision, removes eye bags
	Bi Tong Point	Refractive errors
	Yin Tang Point	Relax eye strain, improve eye sight
	Zan Zhu Point	Relieves red and painful eyes, teary tears, foggy vision
	Yu Yao Point	Eye problems related to worry, excessive study and mental strain
	Tong Zi Liao Point	eye fatigue and wrinkles, blood circulation to the eye
	Cheng Gi Point	Pink eye, nearsightedness and optic atrophy
	Jing Ming Point	Glaucoma, hysteria with vision loss and early stage cataracts

information using sketches. Section IV discusses the results of our work. In Section V, we conclude our paper and mention the directions that can be worked on to improve on our work.

II. RELATED WORK

In this section, we shall review the work on the use of the golden ratio [1, 2] of the human face as well as the work currently available on Acupressure points to cure specific diseases. A lot of work has been carried out on the proportions and golden ratio of the human face in terms of perception of beauty. A recurring theme in this work is the so-called golden number $\phi = Phi \approx 1.618$ [8]. The basis of the golden ratio is that the proportions of the human face naturally follow the golden number. The first step in using this golden rule is dividing the height of the face, i.e. the distance from the hairline to the chin point into three equal sections from the hairline to the glabella point, the glabella point to the nasal root point and the nasal root point to the chin point. This division is referred to as Trisection [2, 7]. This concept was first described in Vitruvius [7]. We use this concept of Trisection of the human face in our work with some modifications.

Currently, the information about Acupressure points is presented to users in text/picture form on websites or in apps. There are currently no apps that detect the face of the user from captured images and then model the Acupressure points on to the detected face.

The apps currently available for Acupressure or Acupuncture information are Acupressure Point Tips [3], AcuGraph [4] and Acupressure: Heal Yourself [6] on Android platform. Acupressure: Heal Yourself app is also available on iTunes. All these apps provide information to their users about Acupressure points but these are all in the form of text/pictures. Moreover, it is generalized information depicted on sketches of human faces rather than information tailored to the user's face proportions.

Acupressure Point Tips is an android application which gives information about Acupressure points. Different diseases have been mentioned in the application and their respective Acupressure points along with a visual description are available. This app shows the information about acupressure points, reflexology points, hand acupressure, leg acupressure and neck acupressure. However, this application does not get the image of the patient for self-treatment. Thus, the acupressure points are generalized. The treatment is depicted in text form so it is difficult for the patients to understand it properly.

AcuGraph provides detailed information about disease behavior to the Acupuncture practitioner using the app. It helps the user identify precise issues, select the most effective actions and determine the control of acupuncture with objective proof. This application is used only by practitioners. Patients cannot use it on their own; practitioner guidance is needed.

Acupressure: Heal Yourself is an app that provides complete offline information about acupressure points for different diseases using textual and pictorial format. It does not model the acupressure points according to the face of the user. Hence, the acupressure points are not customized, but generalized.

III. METHODOLOGY

A. Design

Our proposed work ARBASTUA has three stages in the order explained below: Face Detection, Acupressure Points Modeling, and Acupressure tips using Augmented Reality. These stages are conducted using Haar Cascade Classifiers [5], Golden Ratio [2] of human face, and Augmented Reality. The first step before these three stages, is of disease selection where the user selects the disease which he wants to cure.

1) Face Detection: The first step in modeling acupressure points according to the user's face is Face detection of the user from an image. This Face Detection of the user is carried out using Haar-like features described by Viola and Jones in [5] by using the Viola-Jones detection framework where they are implemented as Haar Cascade Classifiers for fast face detection. Haar-Classifier encodes the existence of oriented contrasts between regions in the image. A set of these features can be used to encode the contrasts exhibited by an object. The detection technique is based on the idea of the wavelet template that defines the shape of an object in terms of a subset of the wavelet coefficients of the image. A Haar-like component considers neighboring rectangular regions at a particular area in a recognition window. In

Fig. 3. Detection of Eyes and Nose in ARBASTUA

Haar-cascade, the system is provided with several numbers of positive images (like faces of different persons at different backgrounds) and negative images (images that are not faces but can be anything else like chair, table, wall, etc.), and the feature selection is done along with the classifier training using Adaboost and Integral images [5]. Adaboost improves the speed of feature detection.

Haar Cascade Classifiers were chosen because of their ability for fast face detection while maintaining accuracy. This makes our process fast and thus our application has a good response time.

Once the face has been detected, a rectangular box is shown around the face, eye and nose as this is our Region of Interest. The next step is Acupressure Points Modeling.

2) Acupressure Points Modeling: The next step in AR-BASTUA is to model the Acupressure points on the user's face against the disease selected by the user. Face symmetry and proportions are considered while modeling exact pressure points on the face. This is done using the golden ratio of face symmetry [2]. The face is divided into three sections (Trisection). The position of the Acupressure points relevant to the disease selected by the user are then calculated for the face of the user by modeling the position of that Acupressure point (as on a sketch of a human face). This is done using the relative distance of the Acupressure point from other points of interest on the users face by calculating the proportions within these three sections.

Table I describes the Acupressure points for Headaches as well as the facial regions they fall in. Table II describes which acupressure points are found in which facial region as well as the Eye diseases that can be treated using those acupressure points.

Table III shows the relevant Acupressure points in different Quinque-sections for different Head and Eye diseases.

We have used the golden ratio of human face in a slightly modified way by utilizing the trisection of the human face (as originally described first by Vitruvius, see Figure 1) and modeling Acupressure points using the face proportions of different regions. After the face has been detected in the previous step, the face is divided into three sections. The information about the location of the Acupressure points, for the disease selected by the user, as found on the sketch of a human face is then used to model those Acupressure points on to the face of the user.

Figure 2 shows Acupressure points modeled on the sketch of a human face. Figure 3 shows the Acupressure points being modeled by ARBASTUA after face detection.

3) Augmented Reality: After the Acupressure Points have been modeled in the previous module, the system will depict the Acupressure points relevant to the selected disease using Augmented Reality animation tips. These animation tips are shown on the calculated acupressure points.

IV. RESULTS

ARBASTUA is the first work of its kind. Firstly, it models the Acupressure points according to a user's face, thus customizing the Acupressure point modeling instead of using generalized points.

Secondly, it uses Augmented Reality, rather than text/pictures, to depict the information about these Acupressure points to

TABLE III
ACUPRESSURE POINTS FOR HEAD AND EYE DISEASES IN QUINQUE-SECTIONS

Region	Point	Diseases/Functioning
Quinque-section 1, 5	Si Zhu Kong Point	Migraine, Eye problem
	Tong Zi Liao Point	Improve blood circulation to the eye, reduce eye fatigue and reduce wrinkles
	Tai Yang Point	Helps with Migraine, eyepain, photophobia and improves visual acuity
Quinque-section 2, 4	Yu Yao Point	Eye problems related to worry, excessive study and mental strain
	Qui Hou Point	Moistens and clears the eyes
	Cheng Gi Point	Alleviate conjunctivitis, nearsightedness, and optic atrophy
Quinque-section 3	Zan Zhu Point	Relieves red and painful eyes, teary tears, headaches, foggy vision
	Jing Ming Point	Helpful in dealing with myopia, night blindness, glaucoma, vision loss, and early stage cataracts
	Yin Tang Point	Relax eye strain, headaches.

TABLE IV
FEATURES COMPARISON OF ARBASTUA WITH EXISTING APPS

	Acupressure Point Tips	Acupressure: Heal Yourself	ARBASTUA
Platform	Android	Android	Desktop
Information Presentation Format	Text/Picture	Text/Picture	Augmented Reality
Face Detection	No	No	Yes
Acupressure Point Modeling	Generic	Generic	Customized
Ease of applying Acupressure Points according to users face	No	No	Yes

the user.

Thirdly, this combination of Face Detection, Acupressure point modeling, and Augmented Reality does not exist previously. Thus, ARBASTUA cannot be quantitatively compared with other work. However, it can be qualitatively compared with other apps.

Table IV shows the comparison of ARBASTUA with other apps. ARBASTUA is a desktop application whereas "Acupressure Point Tips" and "Acupressure: Heal Yourself" are both android applications. As can be seen from the table, both "Acupressure Point Tips" and "Acupressure: Heal Yourself" provide information about Acupressure points through text and generic pictures, whereas ARBASTUA provides this information through Augmented Reality. Moreover, the apps "Acupressure Point Tips" and "Acupressure: Heal Yourself" do not use the user's facial proportions to calculate Acupressure points specific to the user. On the other hand, ARBASTUA

uses the user's picture, taken by a camera, to calculate accurate Accupressure that are customized according to the user's face.

Thus, as shown by Table IV, ARBASTUA is qualitatively better than its predecessors due to the unique combination of the three features mentioned above.

V. CONCLUSION

ARBASTUA is a novel concept in that it uses augmented reality for presenting customized, usable knowledge about an ancient medicinal technique to its users and enables self-treatment by patients to cure headaches and eye diseases.

ARBASTUA primarily focuses on two diseases, Headache and Eye related diseases. It can be enhanced by including the ability to provide tips for more diseases. Moreover, the extended app should include enhanced features to provide more comprehensive knowledge to the users.

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