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Face Morphing and Substitution for Aid of Autistic Children using Augmented Reality

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Abstract

Objectives: This paper aims at easy training of teacher or day care to a child affected by Autism Spectrum Disorder (ASD) using Face Morphing. The augmented reality with the face morphing provides the better solution for this problem. **Method:** The Face identification, Feature extraction based on the way points and morphing are illustrated with the live image. When mapping the pixels of source image on the targeted image, an intermediate image will be generated with image transition. **Findings:** The intermediate image will be tracked back again to the source image, so that over a period of time the targeted image will be the familiar one in the application, which helps the trainer and the child to interact without any sort of difficulty. **Applications:** The system can be automated by introducing the intelligence in face morphing and blending.

Keywords: Augmented Reality, Face Morphing, Local Binary Pattern (LBP), Tracking and Waypoints Substitution (FTAS)

1. Introduction

Autistic children tend to avoid eye contact or any social interaction in some extreme cases[1]. We looked into the new technology of Augmented Reality, with which we wanted to create a system that could aid the autistic child combat his/her fear of social interaction. Our system design had to be simple enough for accessibility to the masses at a low cost and easy to install in a typical school scenario. Since we wanted to remove the communication barrier as fast as possible we choose to target the child's visual interaction with the target person[2]. As we know that autistic children avoid eye contact we chose to use a LCD panel through which the interaction would take place. The motion of the target person would be captured through a webcam. The next step was to substitute the face of the target with that of the parent/guardian, which can be achieved with the help of OpenCV API for face detection. The API would run on a basic computer helping the image received by the webcam to get recognized as a face which will then be substituted with a pre marked input face of the parent/guardian.

2. Existing Work

2.1 Face Detection

Existing strategies for face detection can be categorized in many groups, such as knowledge-based methods, feature invariant approaches, face template matching, and appearance based methods. A face by a set of shape model parameters and matches a query image with flexible appearance models was described[3]. The classifiers

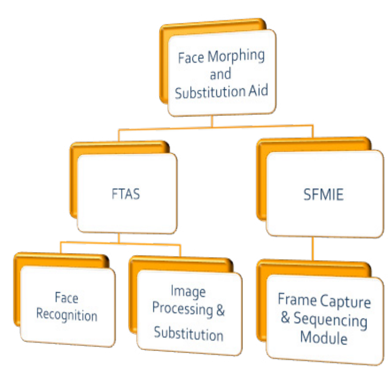

Figure 1. System flow diagram.

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are trained previously and can be loaded by Cascade Classifier class in Open CV. There are many schemes proposed by different authors for face recognition includes systems based on holistic template matching, geometrical local feature based schemes and many hybrid schemes. On implementing any of these FRectechniques, it is advisable to look after two main artifacts such as Illumination problem and Posing problem. Since these problems will result in unsuccessful FRec.

2.2 Face Tracking

For face tracking, it is difficult to obtain various target appearances. Scene conditions and background are the main problems that need to be taken into account. Many methods have been studied and discussed in current literature. Probability estimation method based on intensity normalized color histogram was proposed in the existing system[4]. It calculates prior probability of skin colour, and uses Bayes rule to compute posterior probability of a pixel to check whether it belongs to skin colour of human body. Active Appearance Model (AAM) that gives face shape and texture models in training, and fits them with the search image to locate the target face[5–8]. Feature Morphing gives high level of control to programmer on output results and produce better result[8]. The real time tracking can be accomplished by using tree based, cluster based and prediction based schemes[9]. These schemes are useful when we target a moving object.

2.3 Face Blending

The aim of face blending is to produce a new face that combines features from original face with the target face. In existing literature, there is often a source face and a target face, and authors choose to put the eyes, nose and mouth of the target face on the source face. For simple face blending, Poisson blending technique is a commonly used strategy to reduce artifacts. To generate facial animation and 3D models, the linear image based models are applied on video frames[10]. We cannot use this model since we are focussing on the blending of images for morphing the face.

3. Proposed Work

We are not aware of an AR system specifically aimed at helping autistic children interact with strangers but there is one specific system made to encourage pretend play in autistic children, which proved that a system whose major interaction was through a screen is successful and is used with ease by the child.

4. System Description

The system will consist of a basic computer capable of running a webpage which uses augmented reality to give them an illusion of interacting with a known entity i.e. their parent/guardian. The system will not only help them get over the fear of interacting with the stranger/teacher but also give them a smooth transition period to start the interaction with the stranger/teacher without getting dependant on the system for all future encounters.

5. System Design

The system will consist of two major modules: Figure 1.

1. Face Tracking and Substitution
2. Segmented Face Morphing and Image Extraction

6. Face Tracking and Substitution

This module will deal with Face Recognition (FRec) of the live video received from the webcam into the system which is running the OpenCV API. The face gets marked with waypoints to highlight the major features of the face as shown in Figure 2. The Fiducial points based on the local binary pattern of an image is fixed and then the vertical and horizontal distances are extracted from the face[11]. But FRec module adds more fiducial points than the local binary pattern providing for any face in the image, so that the accuracy during blending will be improved. The second major role of this module is image substitution which is done by marking waypoints as done in the FRec part and combining it with the input image of the parent/guardian which is done with the help of an image coordinate extractor Figure 3. These coordinates are then fed into the OpenCV code in the desired format to achieve accurate face substitution Figure 4. There are numerous applications of FRec varies from formatted static photographs to unformatted dynamically active videos. This paper achieves the Frec in real time camera record and tracks the local points for substitution. There are wide range of technical difficulties includes image process, analysis a, understanding of image features and pattern recognition.

Figure 2. FRec through webcam.

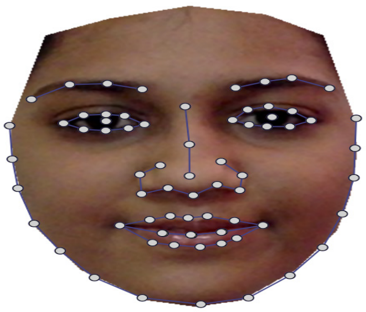

Figure 3. Input image mapping.

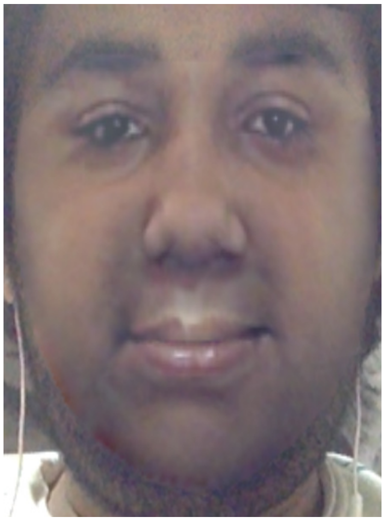

Figure 4. Output on target.

7. Segmented Face Morphing and Image Extraction

This module will be used to remove the dependency of the teacher/stranger to use this system to interact with the child. This module helps the child get used to the stranger by morphing the parent/guardian's image to the target face over a period of time. The module works by segmentation of the input images into smaller fractions which then tend towards the target over a period of time (as suggested by the teacher) to make the transformation phase comfortable for the child Figure 5.

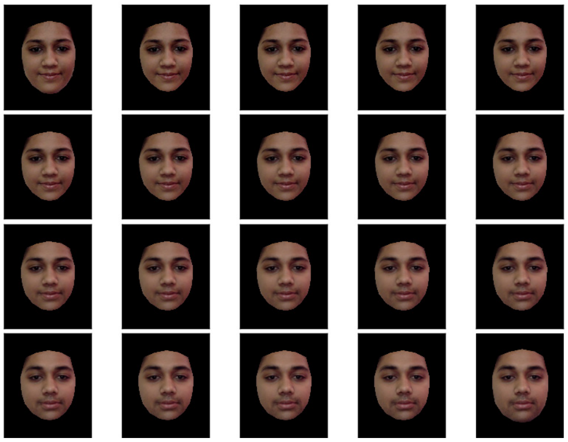

Figure 5. Transition of face from original to target face.

8. Study Limitations and Future Work

Our team has collaborated with three schools specializing in treating autistic children and we will then implement this system this system starting from September 2016. The results will then be recorded by comparing the time of interactions between the child and the stranger with and without the system.

9. Conclusion

The ASD affected can be trained well without any difficulty both academically and personally with the aid of FTAS. The system on practice provides the user more comfort and enables the imaginative capability to the child. The system can be improved by considering the artifact, when more than one human face is recognized during face tracking. Also further research and work can be done to include face recognition in the background and confirm their ability to realize and mirror human expressions using artificial intelligence.

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