# “Real Baby - Real Family” - VR Entertainment Baby Interaction System

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**Figure 1: (Left) Facial feature data extracted using deep learning, (Middle) Virtual Baby’s face during real time gameplay, (Right) Player wearing the HMD VR headset while holding and bottle feeding the baby agent using HTC VIVE Controller.**

## ABSTRACT

This research, “Real Baby - Real Family” - VR Entertainment Baby Interaction System, is a project aimed at generating virtual baby avatars from any 2D facial images. By pulling specific facial features from photographs, analyzing them, and then merging the obtained data together, the virtual baby avatars whose face closely resembles that of subjects has been successfully created. Furthermore, this experience contains various interactions with physical and virtual baby avatar aimed at provoking thoughts regarding to solving social issue of rapid aging society.

## CCS CONCEPTS

**•Applied computing →Interactive learning environments;**

## KEYWORDS

VR, Baby, Face Generation, Haptic Feedback, Nursing Simulator, Entertainment VR

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## 1 MOTIVATION

VR is a cross point of visual arts and experience. Character and/or avatar must have interactivity in VR. Haptics and force feedbacks are also important channel. If the emotion can be integrated and implemented into a computer generated experience with a rich channels, we can extend a meaning of current virtual reality contents. This project, “Real Baby - Real Family” - VR Entertainment Baby Interaction System, can bring user to a life with a baby which has an audio, visual, and holdable tangible feedback. It may solve declining birthrate by changing relation and understanding of birth by a condenced moment of VR expernence with users’ baby.

## 2 RELATED WORKS

Below are some of the previous researches that deals with child care and/or real time image manipulation. Neuro-Baby [TOSA 1995], Infanoid [IDO et al. 2006], Kismet [KOZIMA 2001], Cog [SCASSELLATI 2001], Babybot [Metta et al. 2001], YOTARO [ONO et al. 2009]. Amongst these researches YOTARO can be considered a work that emulates a realistic baby. YOTARO is a baby robot that can simulate a runny nose and many different emotions. However, because YOTARO’s face is that of an illustration and not a real-life portrait, it looks as if the baby is not related to the subjects. This research generates a baby from portraits of heterosexual or homosexual couples playing it thus subjects get a baby looking just like the subjects. Face2Face [Thies et al. 2016] is another research we look into. It uses monocular facial reenactment in real-time to manipulate the target video into acting out the facial motions of the source. This research deals with real time video manipulation and not still image manipulation however, and it can only manipulate the facial motion and not the age progression of the portraits.

## 3 DESIGN

This VR research realized a virtual family enabling the subjects to communicate with a baby through haptic, visual, and audio feedback while wearing a head-mounted display (HMD). According to our hypothesis, creating a believable baby resembling the subjects will make them more emotionally invested with the experience. Following this theory we created a virtual baby generated from subjects' photos. The most important part of this research; however, is that we constructed a physical baby that can interact with the audience. "Real Baby - Real Family" is unique for allowing subjects to (1) hug and interact with the baby physically, (2) creating a baby looking just like the subjects, (3) contains audio components.

### 3.1 Holdable robot device

In order to hug a baby doll without experiencing discomfort while wearing the HMD, there is a need for high precision position tracking of the doll. However, this is hindered by image recognition ability of an one eyed camera which slows down the position tracking speed. Our proposed method uses multi-point image sensor implemented in the controller of HTC Vive to enable high precision position tracking. This synchronizes the physical and virtual movement of the baby and allows subjects to hug the baby without getting visually disoriented.

### 3.2 Baby Face Generator

Below are three characteristics of our baby face generator: (1) Generating a face fitting the subjects' skin tone, (2) Creating the baby's face from multiple photos, (3) Inverse the age of the subjects to fit that of the baby.

*3.2.1 Average Baby Face Generation.* It determines the skin tone of the baby by averaging the skin tone of the two photographs. This system also morphs the colors and shapes of the faces using OpenCV. Lastly it collects 16 baby face images from each of the following categories using Google Image Search: Japanese, European, and African baby.

*3.2.2 Get Face Landmark Index.* In order to morph the many photographs, it is necessary to obtain the index. In the proposed method, we use the Dlib of open source library, from the results that have been learned by the data set iBUG-300-W, to get the points of each part of the face. As a result of fig.1(Left), the eyes, noses, mouths, eyebrows, feature points, and the 68 points with index composed of contour, are all morphed automatically. Here it can be seen that morphing are concentrated in the mouth and even parts of the face.

*3.2.3 Inverse Age Progression.* Inverse age progression is the process of generating a final image from the averaged age of portraits. This is all done without collapsing baby portraits obtained in Average Baby Face Generation. The implementation uses a Dlib and OpenCV. It obtains feature points performed at Dlib, performs image generation by passing the coordinate data of the feature points OpenCV side. Dlib automatically sorts the feature points obtained and treated them as a landmark. Its index is unchanged in all of the facial images. By setting the contribution ratio with respect to the index number, it is possible to process each selective parts. The color components are produced by Average Baby Face Generation, the present process is a concept that only features the specified parts inherited. If carried out well as deformation of 3D modeling, contour around the chin and other aspects should also be considered. The generated facial image is used by Live2D.

### 3.3 Display of Haptics Synchronized with Voice

When holding the baby robot doll, the baby robot is strengthening the interaction by vibro of Vibro transducer Vp2 (Vp210) which was mounted in the baby doll. This vibro is controlled by voice. Only by passing the band-pass filter using a Fourier transform effective frequency band (5Hz, 200Hz) and extracted as the vibration data onto an output audio can it perform real-time tactile presentation through HMD attendant controller (Vive Controller). However, since it's the only vibrator that is built in the standard Vive controller, we felt it's electric current output which vibrates the baby doll was insufficient after many exhibitions. To fix this problem we mounted the Vp210 onto Vive controller to improve the oscillating capability.

## 4 FUTURE OF REAL BABY

"Real Baby - Real Family" enable many meaningful interactions with baby avatar such as hugging, giving milk, calming down, and causing him/her to burp. Currently the project is being refined according to feedback received during public exhibitions such as the baby behaves differently from an actual baby and inclusion of changing diaper being strongly desired due to the importance it played in raising infants. It is our wish to enable aspiring parents and parents-to-be to experience the joy and essence of caring for a new-born as well as raising the question of nurturing the future generation of humankind, and merging virtual baby with emotional driven interactive scenarios aimed at provoking thoughts of raising a baby may be the solution to rapid aging society nowadays.

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