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NANYANG TECHNOLOGICAL UNIVERSITY

URECA
*Undergraduate Research Experience on CAmpus*

**Category: 4**
**School of Computer Engineering**

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# Creation and Animation of a Talking Head with Lip Sync and Expressions

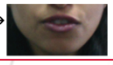
## Introduction and Motivation

A *Talking Head* is an animated model of a human head with synchronized lip movements and expressions. Back in the 1970s, Talking Heads were a major breakthrough in *Human Computer Interaction*. Ever since, they've been used as conversational agents in offline and web-based applications and as a teaching tool to enhance learning in students. Animated talking guides, like the ones used in MS Office demonstate a friendly and effective way to assist inexperienced users.

Though, this topic has already been explored, there are certain *linguistic challenges* which impede the creation of an accurate, realistic and expressive Talking Head. With further advancements, it may be possible to generate *accurate* Talking Heads which can be lipread by the hearing impaired. Moreover, recent research shows that emotionally expressive avatars facilitate learning in people with autism spectrum disorder.

## Phonemes and Visemes

*Phonemes* are the basic distinctive units of speech sound, which are different for every language. *Visemes* are generic facial images that are used to describe a particular sound or phoneme. For example:

Viseme "**f**" →  For Phoneme "**F/V**" in words like "**F**our" (**F** AO R) and "**V**an" (**V** AE N).

## Objectives

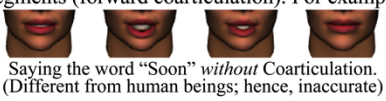
The scope of this project is:

1. To create a custom Talking Head, given a person's photograph and to synchronize the visemes according to the input text.
2. To allow the user to add in expressions as tags into the input text and to produce these expressions in the Talking Head.
3. To solve the *three* challenges described below.

## Challenges

### 1. Problem of Coarticulation

*Coarticulation* refers to the changes in the articulation of a phoneme depending on preceding (backward coarticulation) and upcoming segments (forward coarticulation). For example:

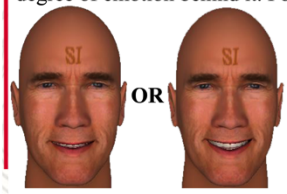


Saying the word "Soon" *without* Coarticulation. (Different from human beings; hence, inaccurate)

Saying the word "Soon" *with* Coarticulation. (Similar to human beings; hence, accurate and what we want to achieve)

### 2. Variation in intensity of emotions

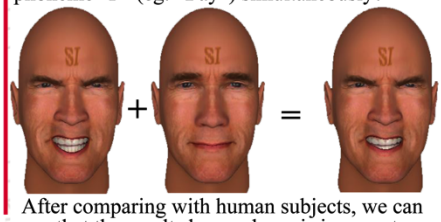
Intensity of emotions greatly affect the facial movements. So, knowing which expression to enact is not enough, we also need to know the degree of emotion behind it. For example:




User's expression is "smile". But, how happy is he? How much should his avatar smile?

### 3. Overlap of expressions and visemes

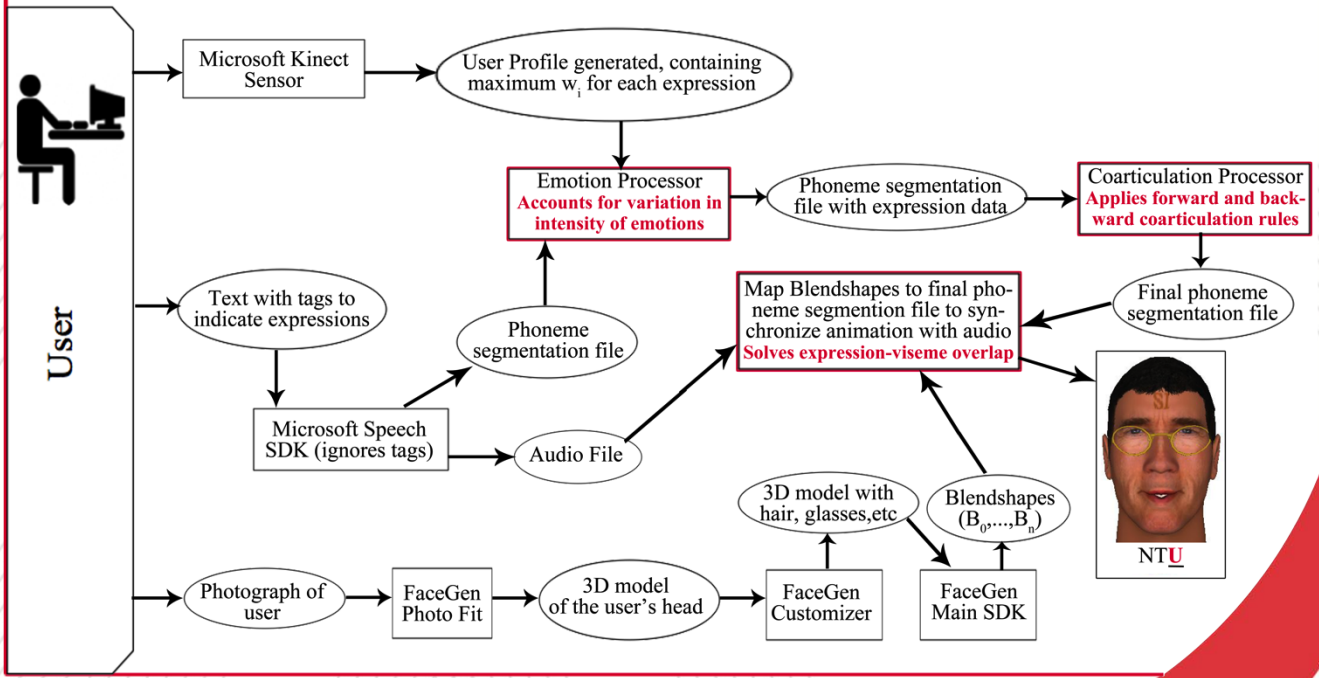
What if you are very angry and pronouncing the phoneme "P" (eg: "**P**ay") simultaneously?



After comparing with human subjects, we can say that the result shown above is incorrect.

## Methodology

For continuous 3D facial animation, we use a blendshape approach. Given a set of n facial expressions or visemes and corresponding polygonal meshes, $B = \{B_0, B_1, B_2, \ldots, B_n\}$ called blendshapes, we can create new expressions by blending different amounts of the original meshes Bi, using: $B_{new} = B_0 + \sum_{i=1} (w_i (B_i - B_0))$, where $w_i$ are arbitrary weights and $B_0$ corresponds to a neutral expression.




**Project Title: Talking Head (Lip Sync) Application**
**Supervisor: A/P Chng Eng Siong**