Can I Hear Your Face?

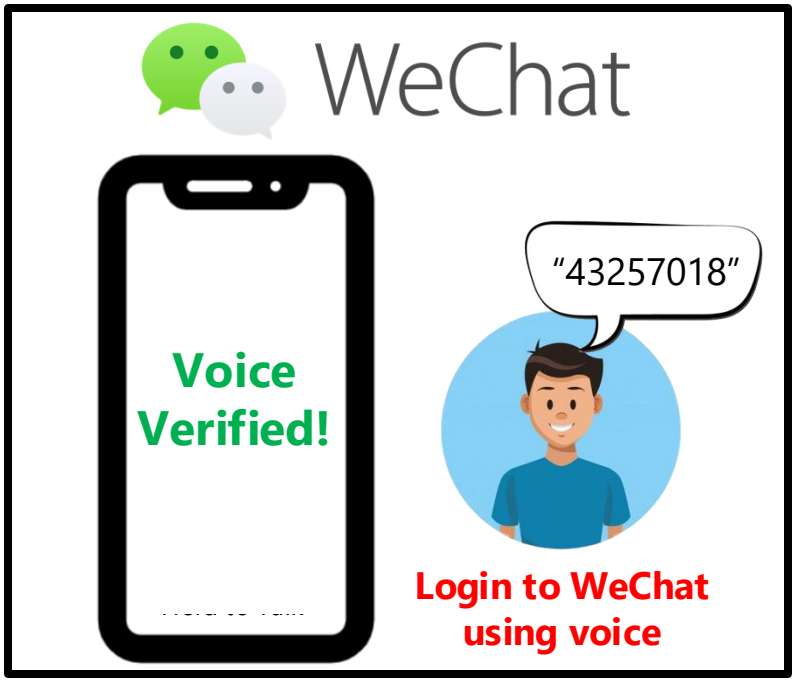
Pervasive Attack on Voice Authentication Systems with a Single Face Image

Nan Jiang, Bangjie Sun, Terence Sim, and Jun Han*

National University of Singapore * KAIST

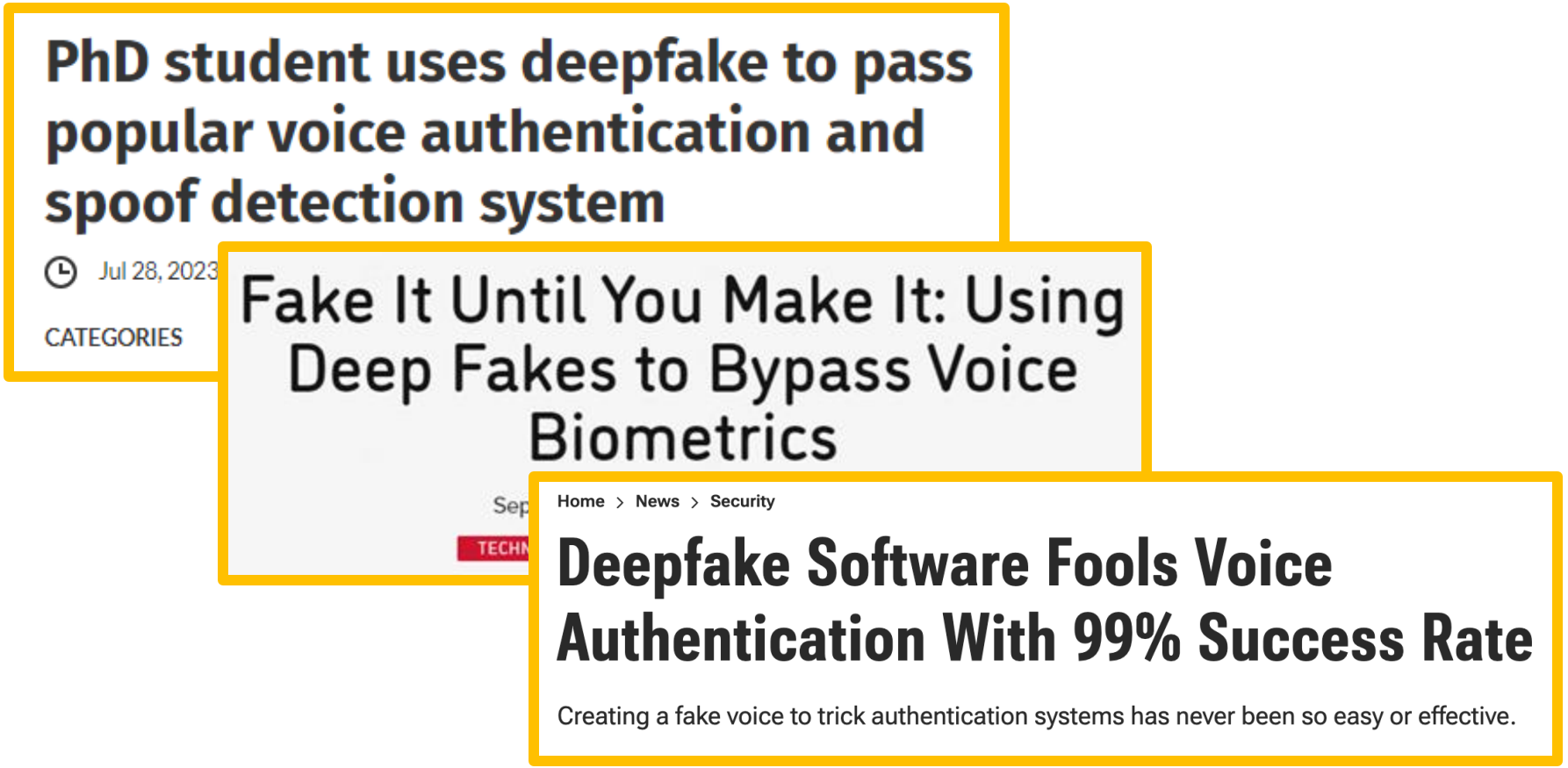
Voice Authentication in Daily Life

Login to Account



Activate Voice Assistant

Voice Deepfake Can Bypass Voice Authentication



Limitation of Voice Deepfake Attack

- Require **high-quality** recording of the victim's voice

(a) Download from the network

Limited range of victims

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Limited range of victims

(b) Secretly record the victim's speech

Poor quality voice recordings

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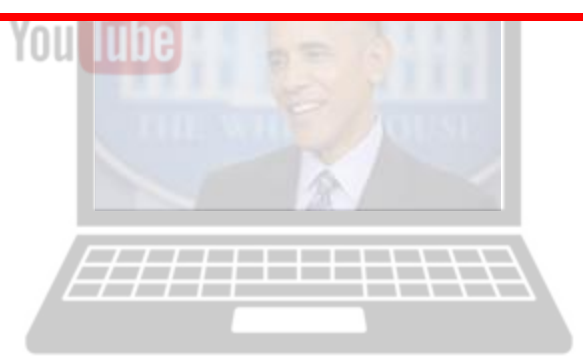


Limited range of victims

(b) Secretly record the victim's

Poor quality voice recordings

How to Overcome this Limitation?

How About Replacing Voice with Face Images?

- Easier to obtain face images

(a) Download from the network

Wide availability of face images

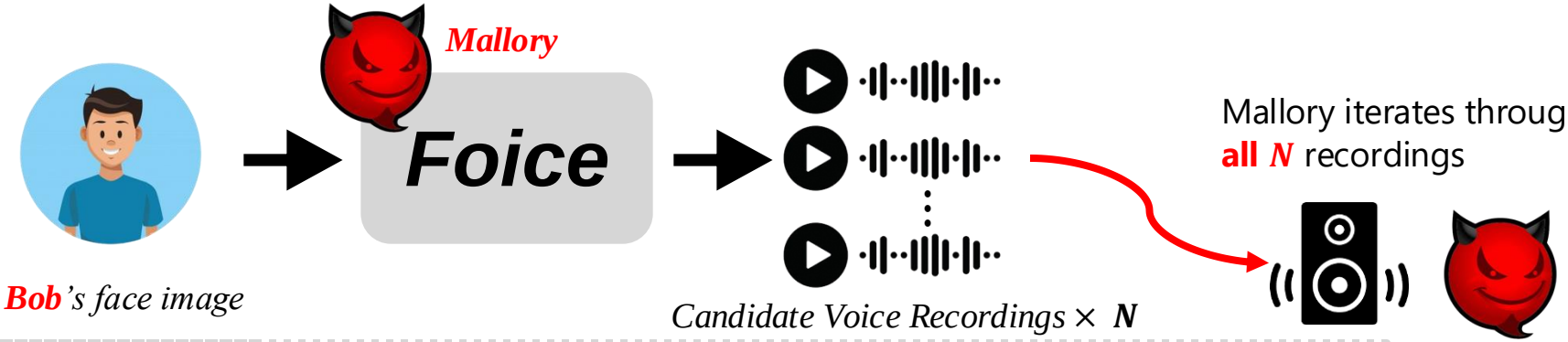
(b) Stealthy photography

Easy capture of clear images

Can we launch a novel attack leveraging only a single image of the victim without requiring voice recordings?

Our Work: *Foice*

- Synthesizes **voice recordings** from a **single face image**



Threat Model

- **Attacker's Goal:** compromise verification
  - **Gain unauthorised access** to the victim's private account
  - **Execute unauthorised commands** on the victim's personal voice assistant

Can You Guess What He Sounds Like?

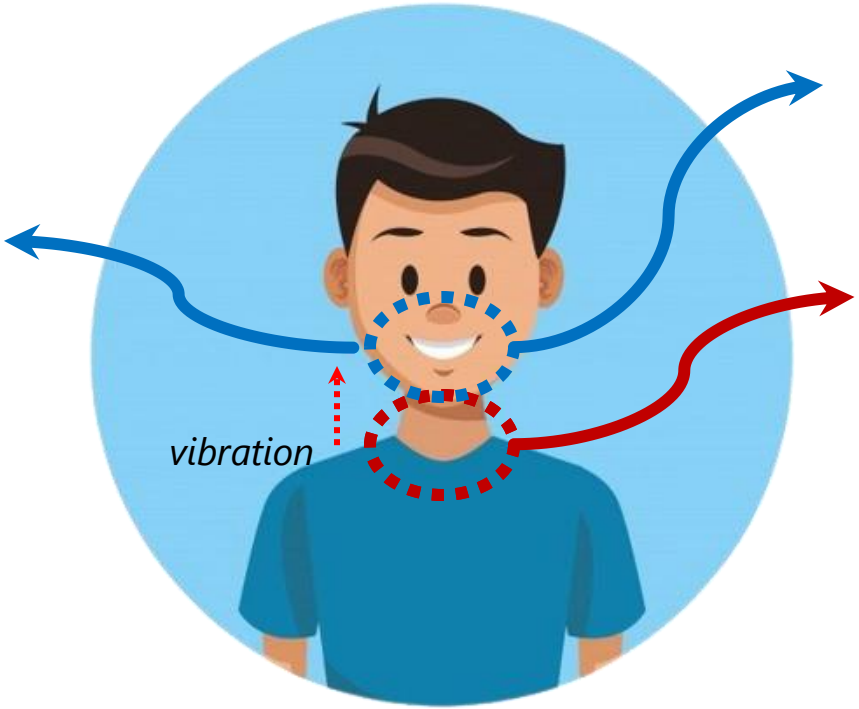
A.

B.

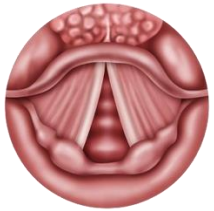
Background: Face and Voice Correlation

- **Facial appearance** affects how human voice sounds like

Vibration here causes **facial** resonance



Narrow space = Bright sound



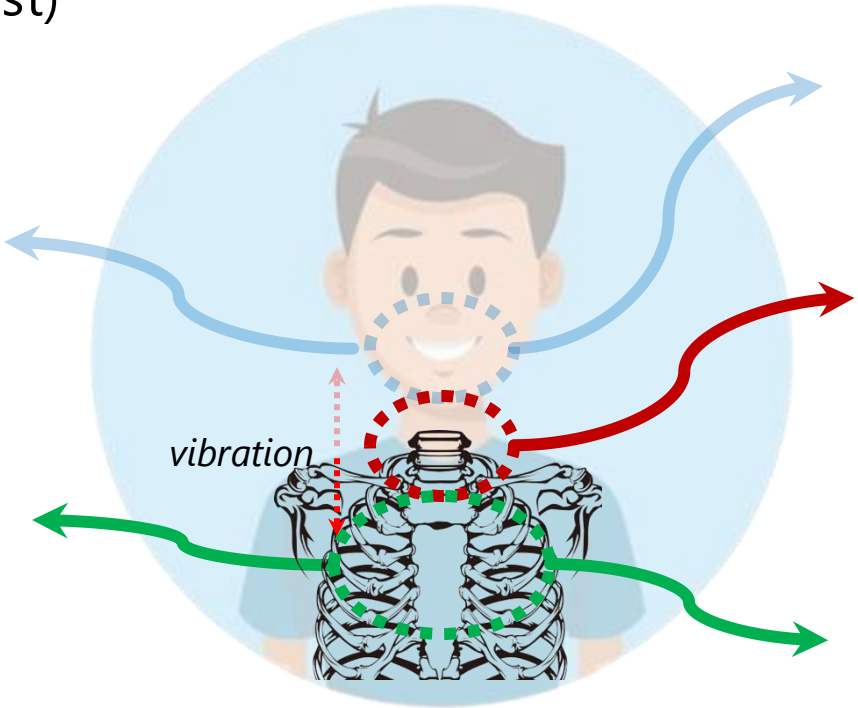
Vocal cords

Background: Face Offers Limited Information

- Human voice is primarily affected by the **inner body structure** (e.g., vocal cords, chest)

Vibration here causes **facial** resonance

Vibration here causes **chest** resonance



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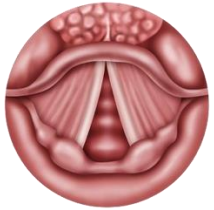


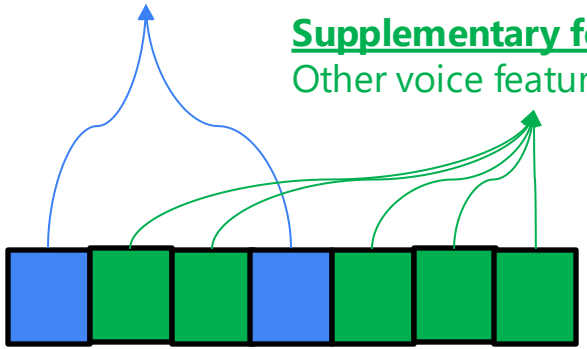
Vocal cords

Wide space = Deep sound

Core Ideas of *Foice*

Face-dependent features:
Voice features related to the face

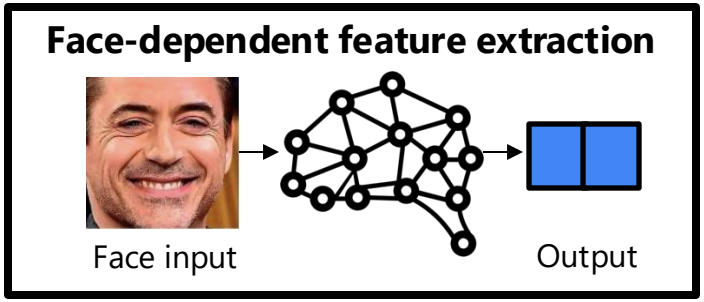
Supplementary features:
Other voice features



Voice features

Our Model

- **Core idea (1)**: **extract** face-dependent features from face image input



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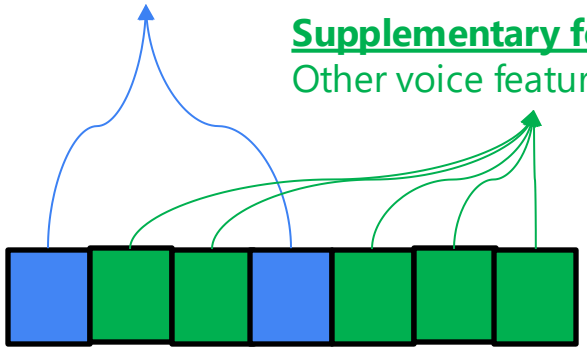

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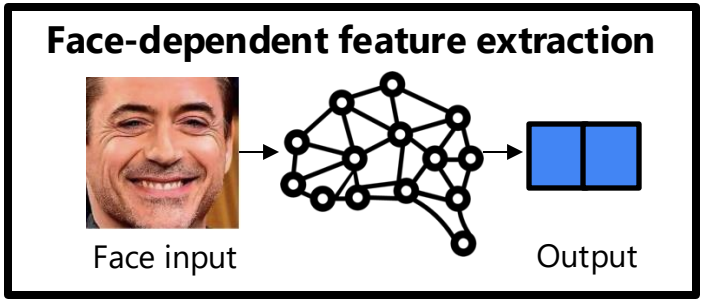
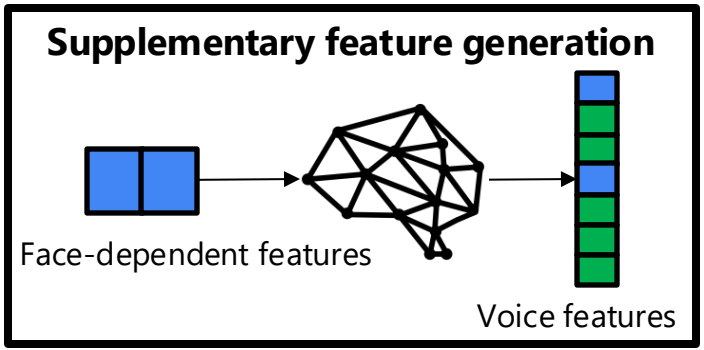


- **Core idea (2): generate** candidate supplementary features



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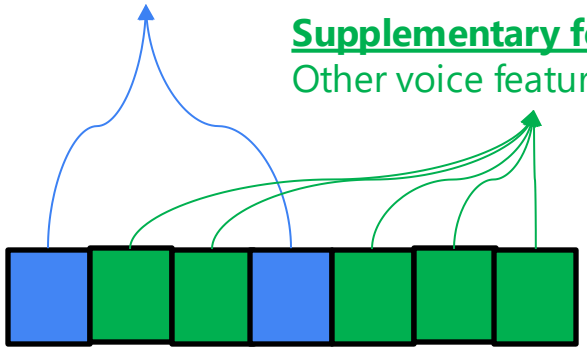

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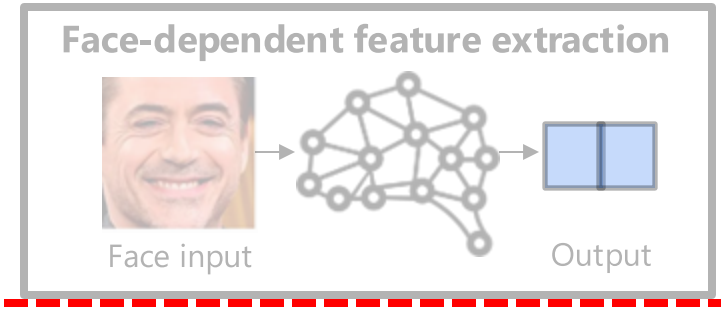

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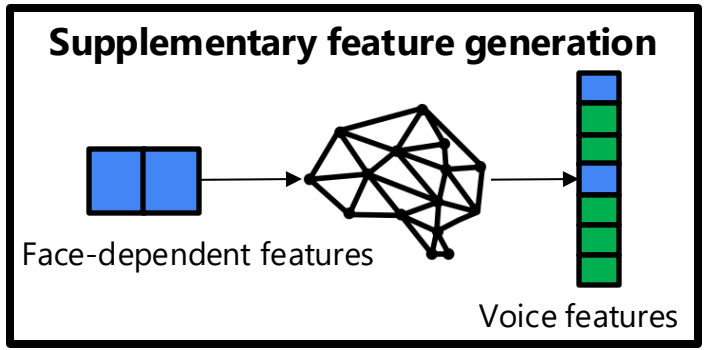
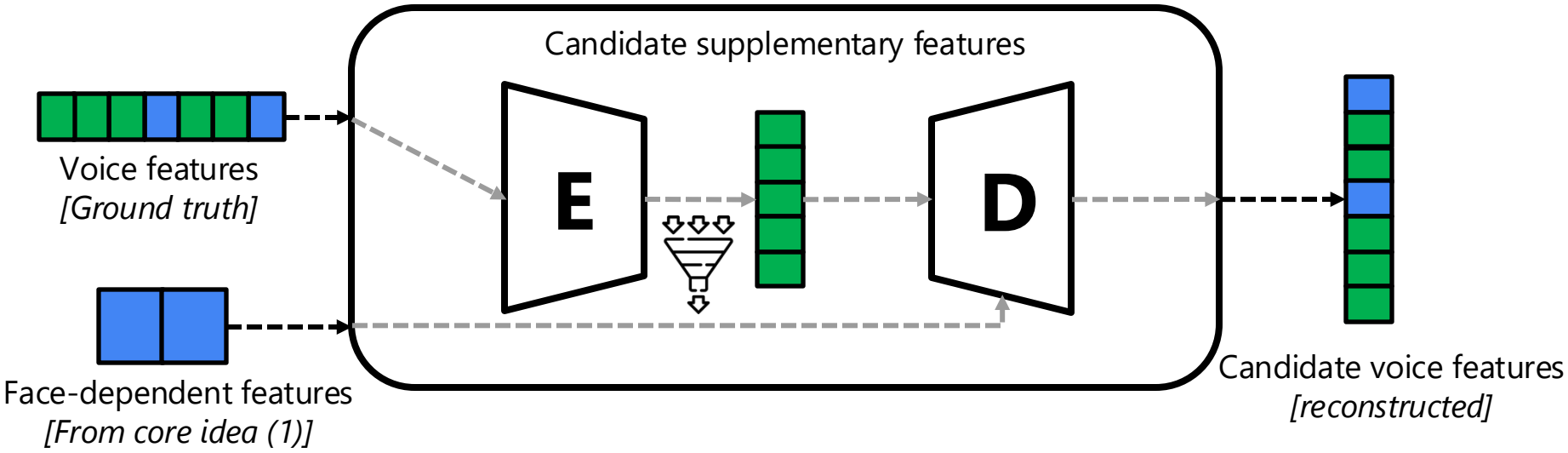


Training: Supplementary Feature Generation

Goal: To generate candidate supplementary features



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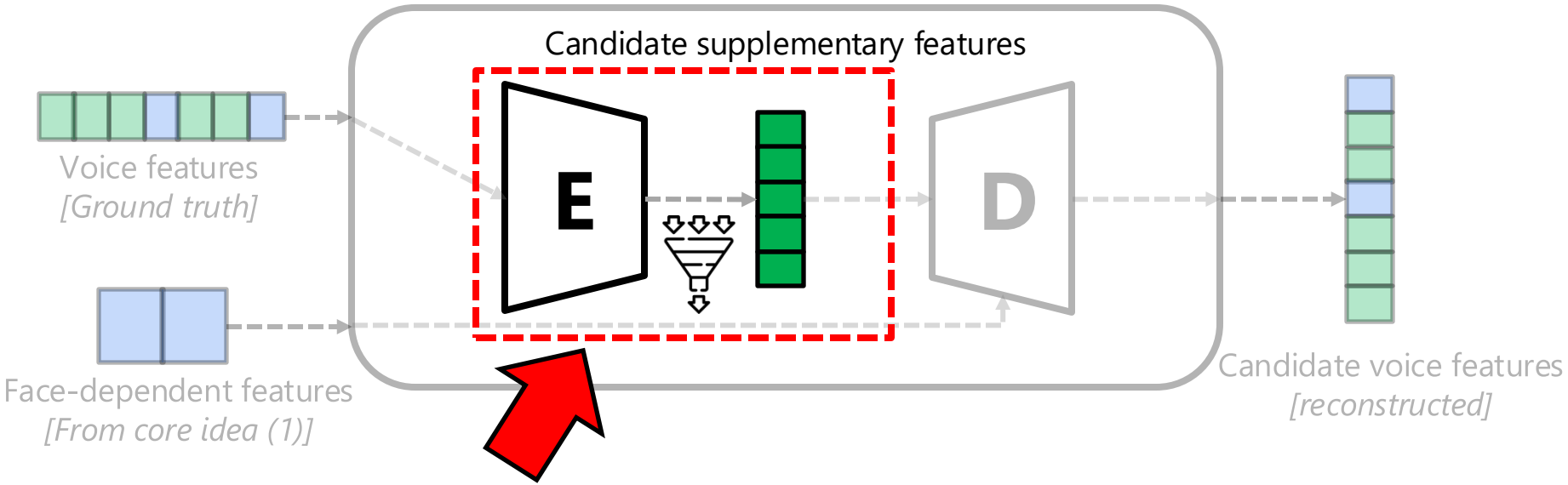

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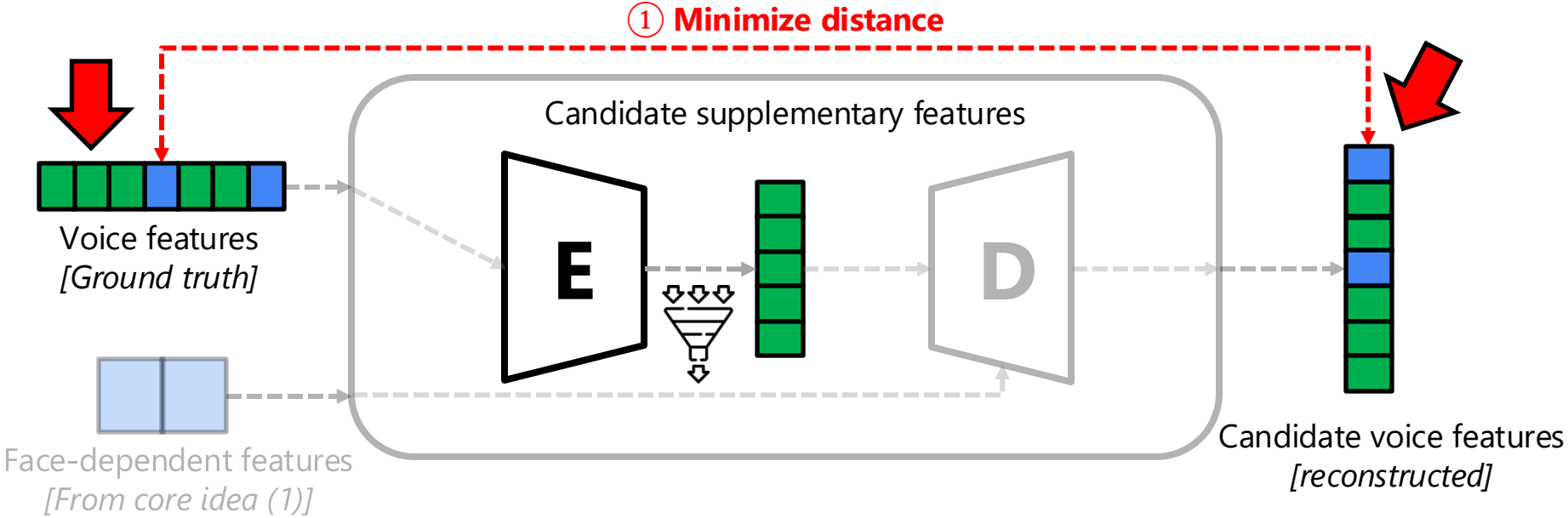

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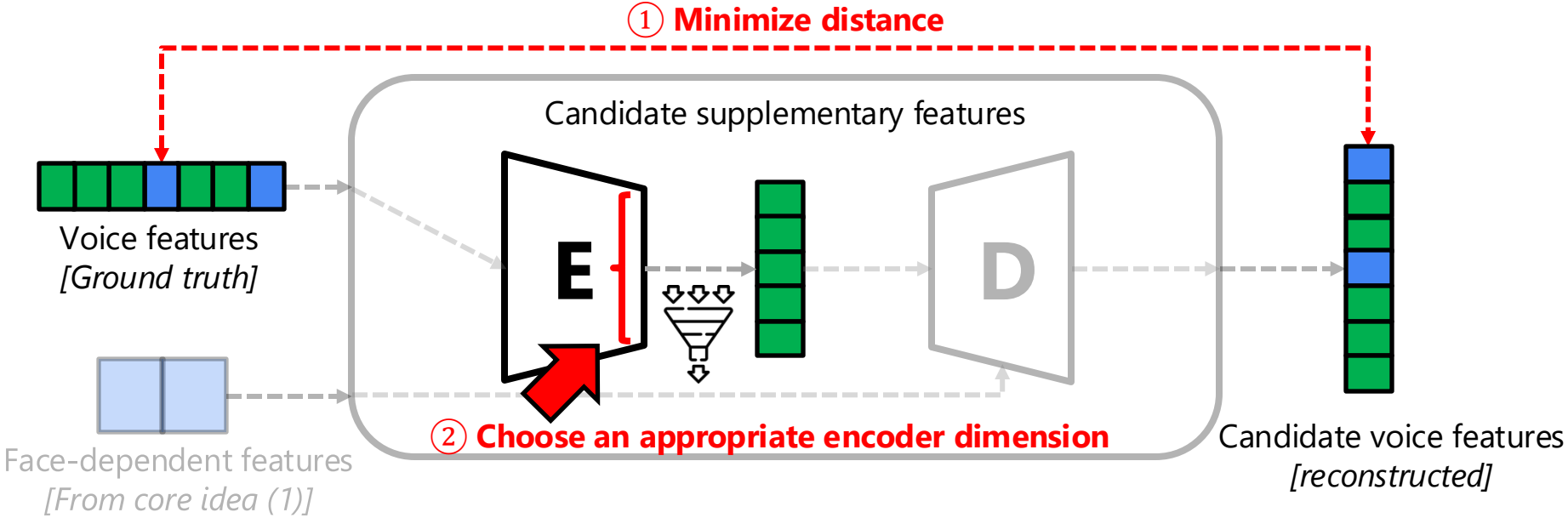

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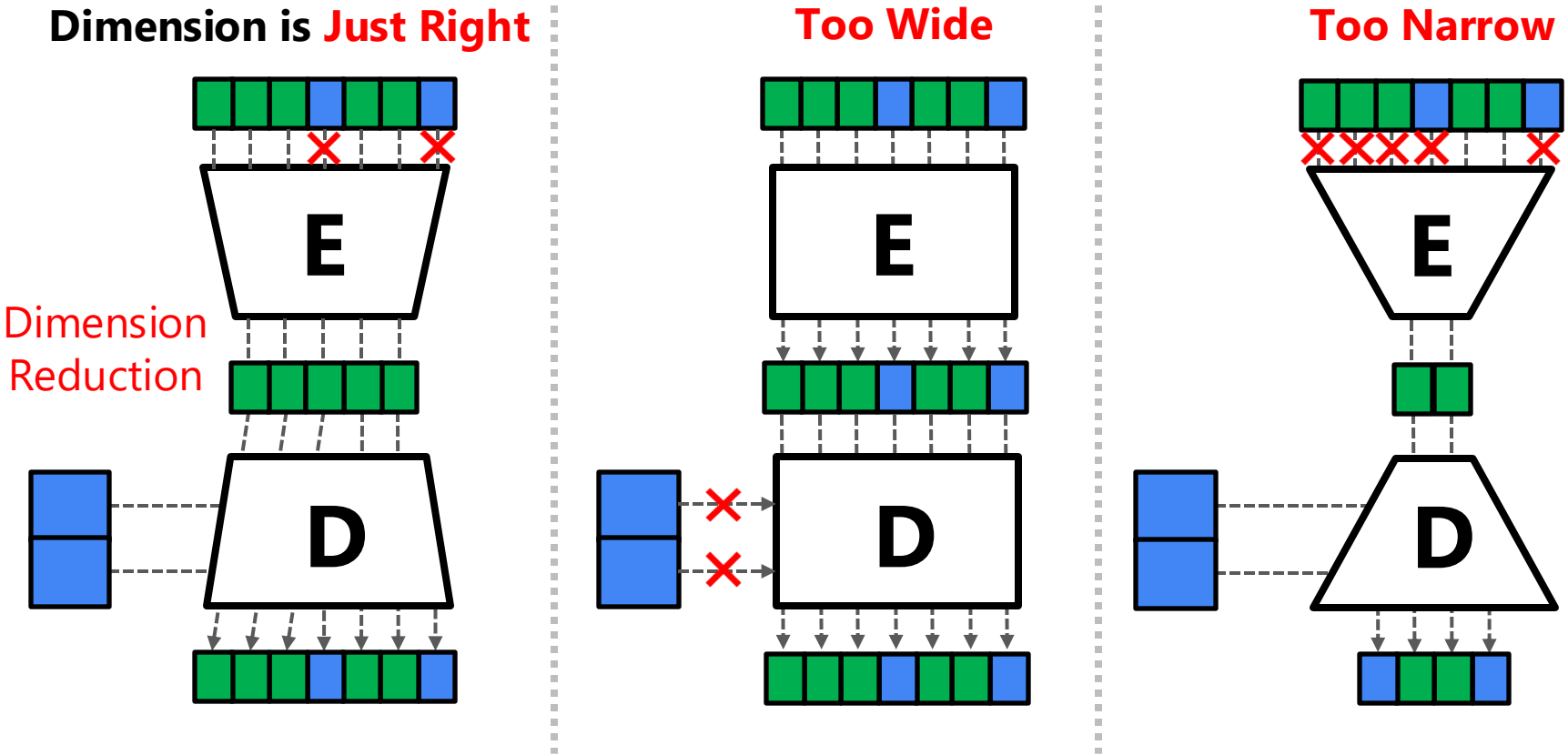

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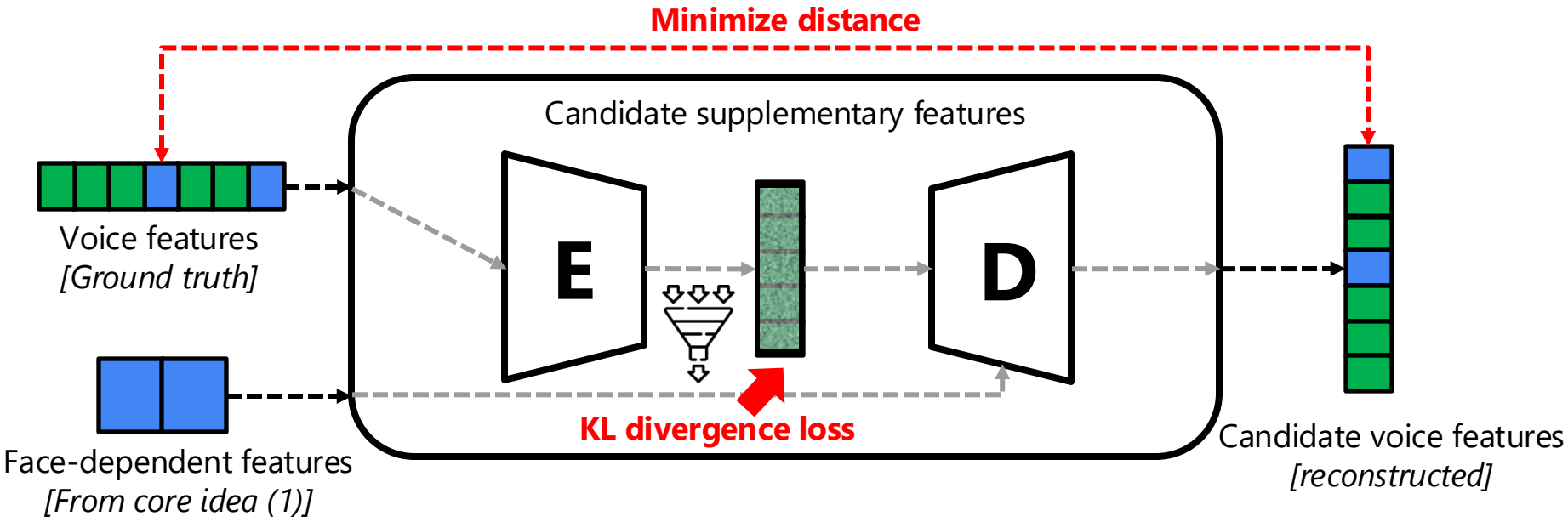
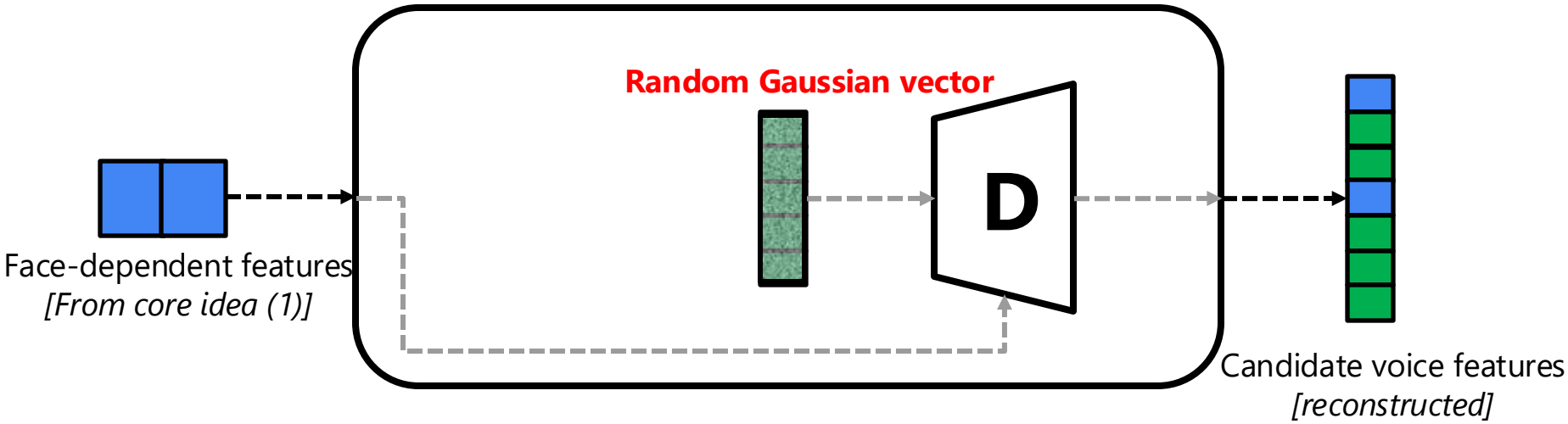


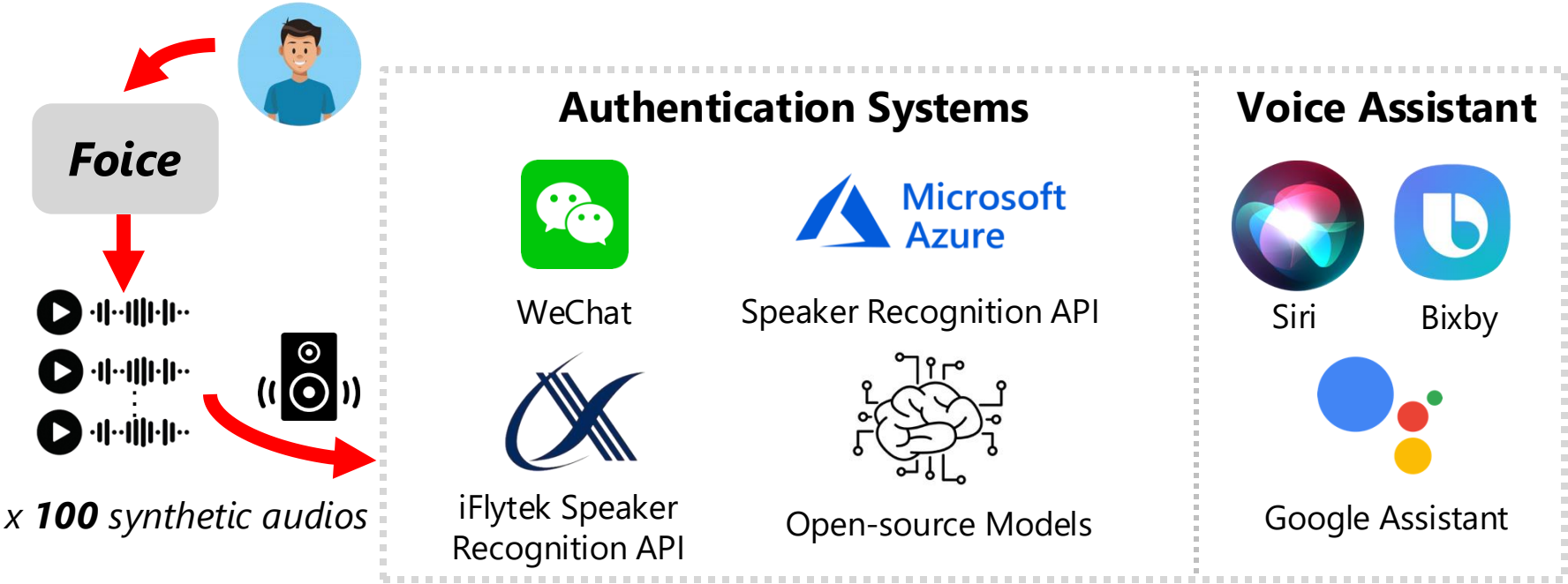
Supplementary Feature Generation

Testing Phase



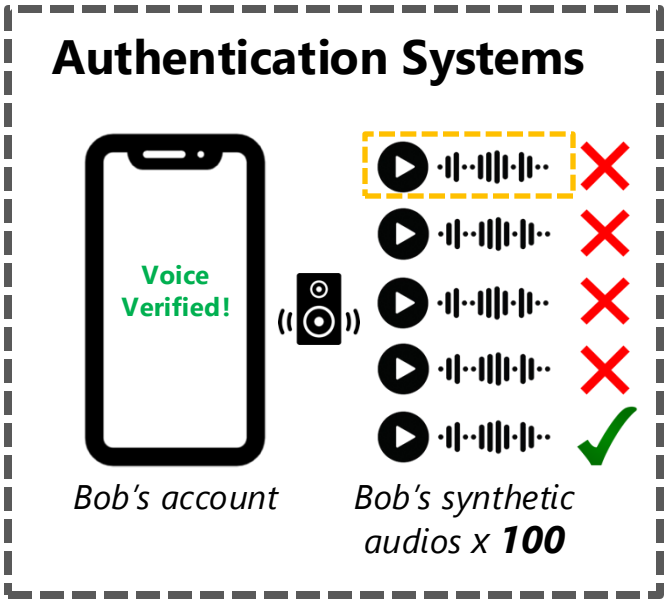
Evaluation Setup

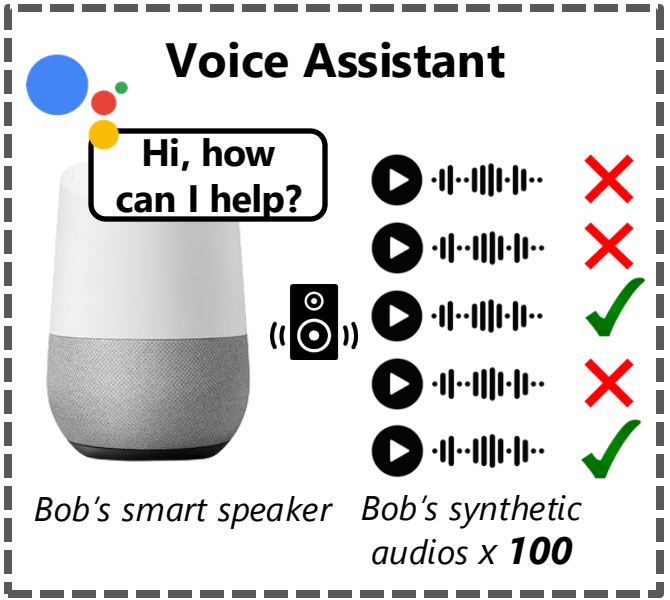
- Evaluate *Foice* with **authentication systems** and **voice assistants**
  - **100** candidate synthetic audios for each subject in the test dataset



Evaluation Setup

- For each subject, a successful attack is defined as:





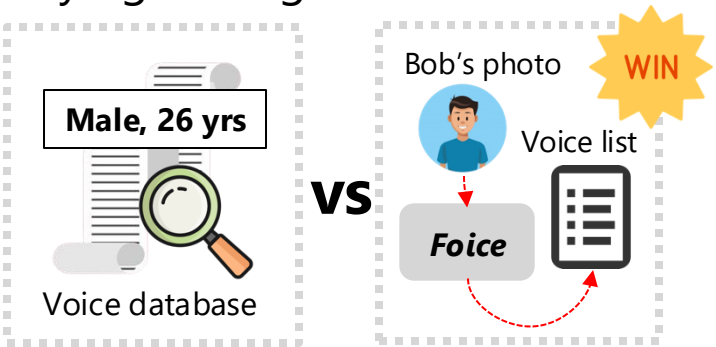
Summary of Results

- **All** tested systems vulnerable to *Foice* attack

- **Comparable** attack performance to voice deepfake attack

- Attack success rate improved by **more than three times** when combing face and voice

- *Foice* outperforming attacks using only age and gender information



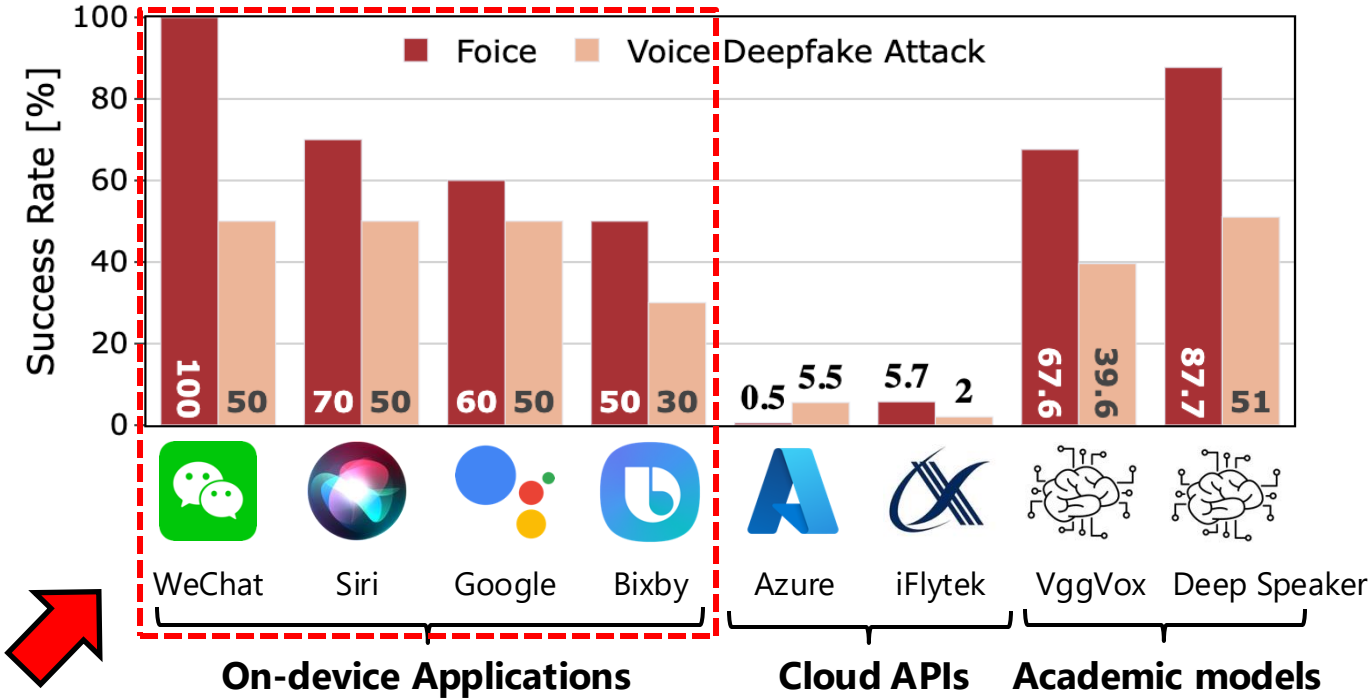
- *Foice* **robust** to various types of image conditions

Occlusion

Resolution

Main Result

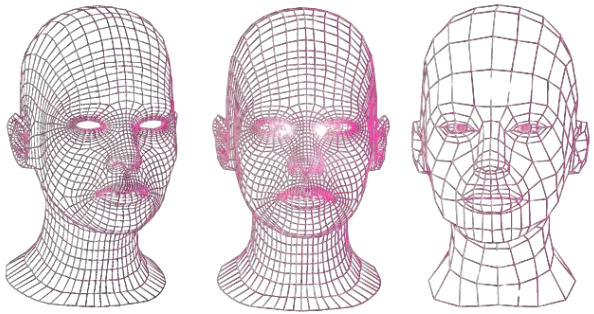
- Achieves **comparable** attack performance to the state-of-the-art voice deepfake attack



Discussion

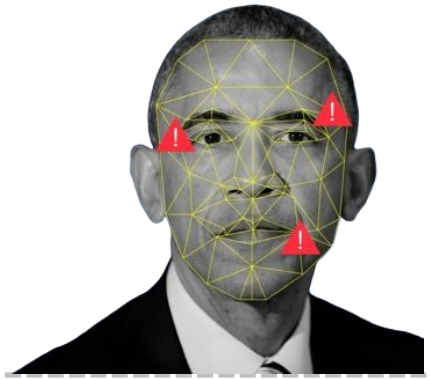
① Improving *Foice*

- **Dynamic** face provides more details on the facial bone structure
- Optimize model structure



② Countermeasures

- Deepfake detection and liveness detection
- Lack of adoption in real-world systems



Conclusion

- Synthesize **voice** recordings using a single **face** image
- Highlight the need to protect voice verification against deepfake attacks