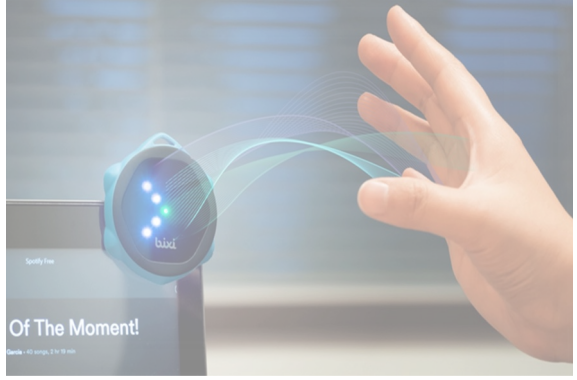
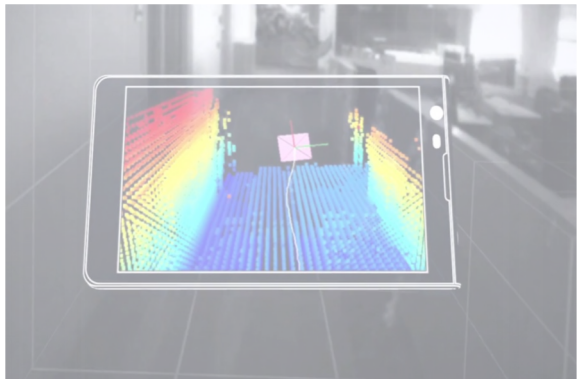


Intelligence Advanced Research Projects Activity (IARPA) Proposers' Day

Nirupam Roy

CS, ECE (affiliate), UMIACS
University of Maryland College Park

IARPA ARTS PROPOSERS' DAY
June 27th, 2023



The Team

Nirupam Roy
Director, Asst. Prof.

Nakul Garg
Ph.D. Student

Yang Bai
Ph.D. Student

Irtaza Shahid
Ph.D. Student

Mahir Jhaveri
UG Student

Full list...

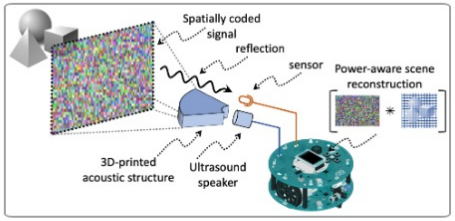
iCoSMoS Lab @ UMD

The Networking, Mobile Computing, and Autonomous Sensing Lab

Tidbits

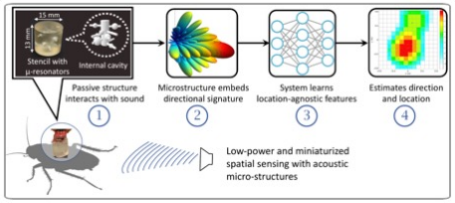
- Project SPiDR wins best pape award at MobiSys'22.
- Nirupam chairs the intelligen acoustics session at MobiSys.
- Project Owlet wins best demo award at MobiSys'21.
- Yang receives N2Women fellowship 2021.
- Mahir gets the departmental honors in Computer Science, UMD.
- Nakul and Irtaza are selected for UMD CS research fellowship
- LidarPhone wins best poster runner-up award at SenSys'20.

Awards



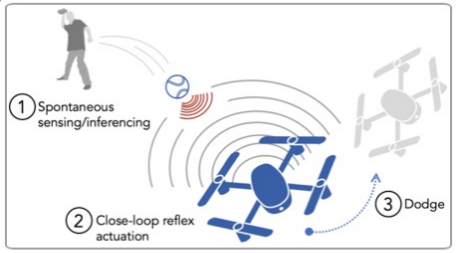
SPiDR: Ultra-low-power acoustic imaging

SPiDR is an ultra-low-power acoustic

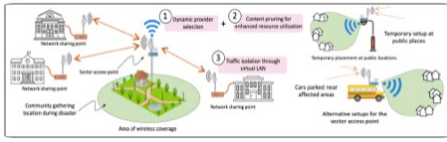


Owlet: Low-power and miniaturized spatial sensing

Owlet is a low-power and miniaturized system for measuring



Low-power situational awareness for small drones



Disaster resilience through wireless infrastructure

Urban greenspaces are untapped assets in infrastructure improvement and disaster

Making and Breaking Acoustic IoT

Acoustic perception
[HotMobile 2020]

Noise cancellation
[SigComm 2018]

Inaudible sound
[MobiSys 2017]

Vibratory communication
[NSDI 2016]
[NSDI 2015]

Acoustic spying
[NDSS 2014]

Inaudible attacks
[NSDI 2018]

Eavesdropping with vibrations
[MobiSys 2016]

H/W fingerprinting
[NDSS 2014]

Inaudible Voice Attack on Alexa

The New York Times

Alexa and Siri Can Hear This Hidden Command. You Can't.

Researchers can now send secret audio instructions undetectable to the human ear to Apple's Siri, Amazon's Alexa and Google's Assistant.

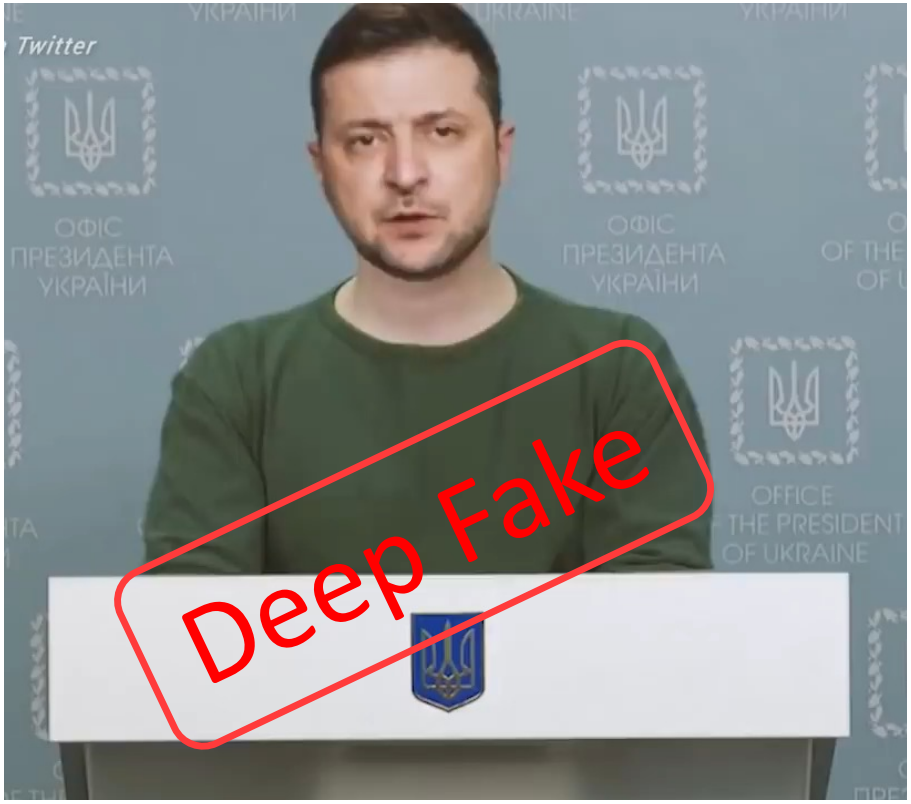
A recent project on speech security

"Is this my president speaking?" Tamper-proofing Speech in Live Recordings

Irtaza Shahid, Nirupam Roy
University of Maryland, College Park
{irtaza,niruroy}@umd.edu

UNIVERSITY OF MARYLAND

iCoSMoS
Intelligent • Connected • Secure • Mobile • Systems



Ukrainian President Volodymyr calling on his soldiers to lay down weapons

Nixon discussing about the disaster of moon-landing

Fake video of Nancy Pelosy make her to be intoxicated drunk

TalkingFaces
By Synthesys

MegaPortraits: High-Res Deepfakes

DeepSwap

DEEPBRAIN AI

pixble

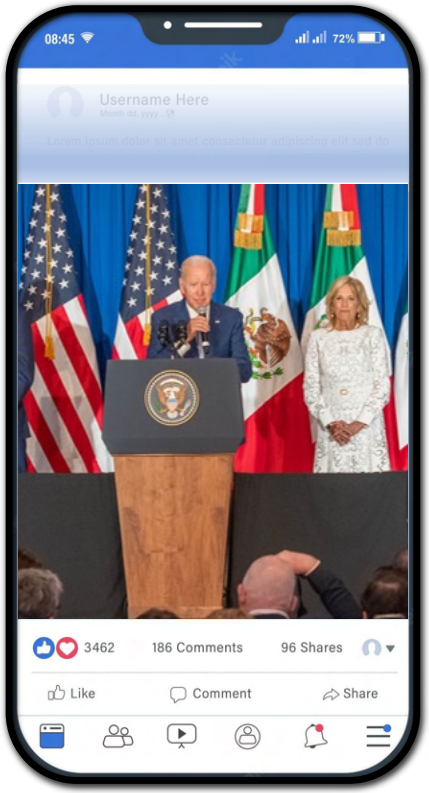
Facemagic

DeepFaceLab

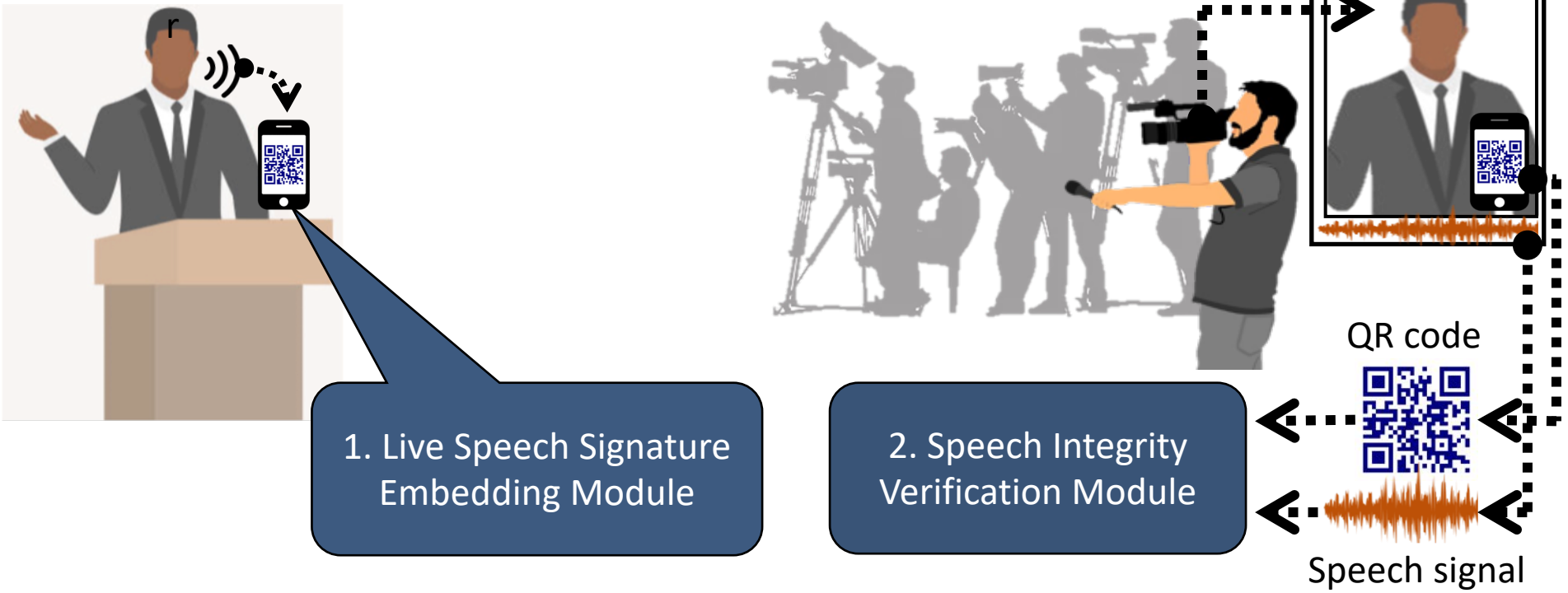
DEEPFAKES WEB

Hoodem

Is it possible to verify live speech when anyone from the audience can record and publish it?



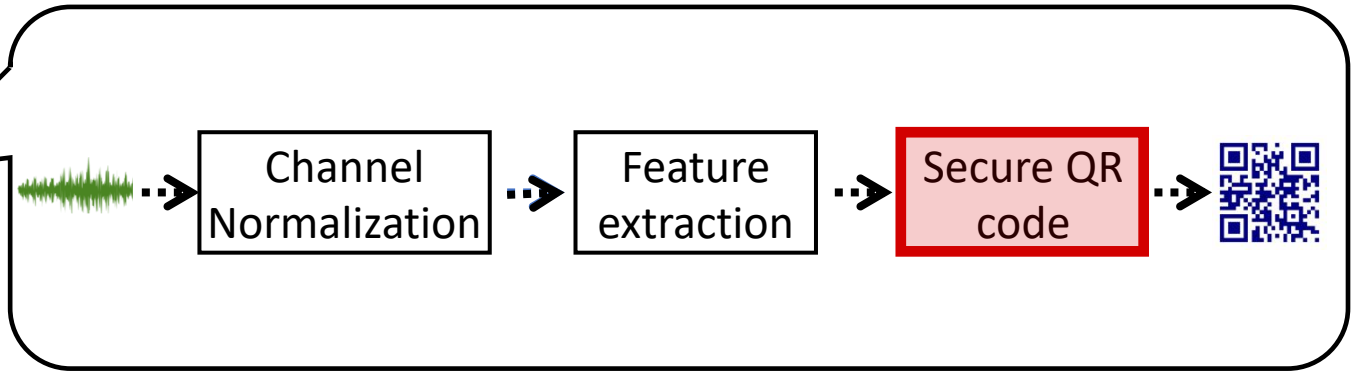
TalkLock


Live
speake
r
Audiovisual
recording
QR code
Speech signal
1. Live Speech Signature Embedding Module
2. Speech Integrity Verification Module

TalkLock

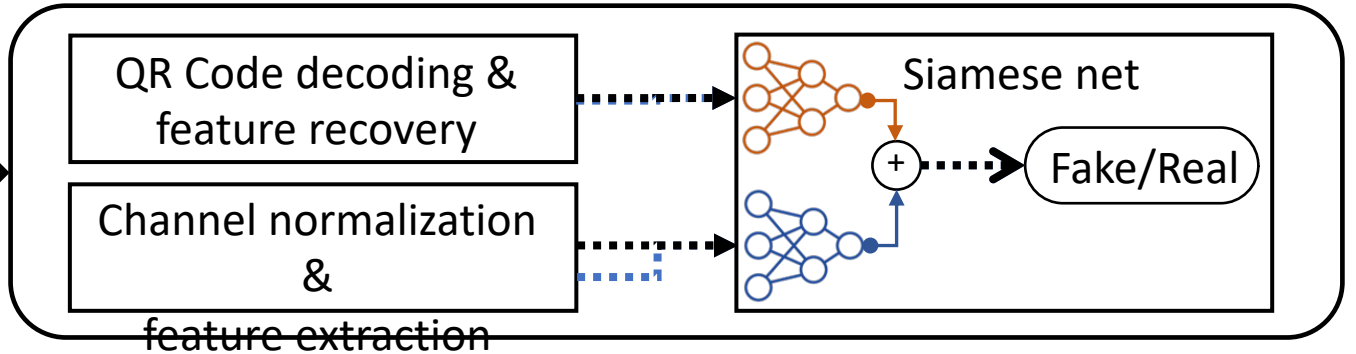
Live speaker

1 Live Speech-Signature Embedding

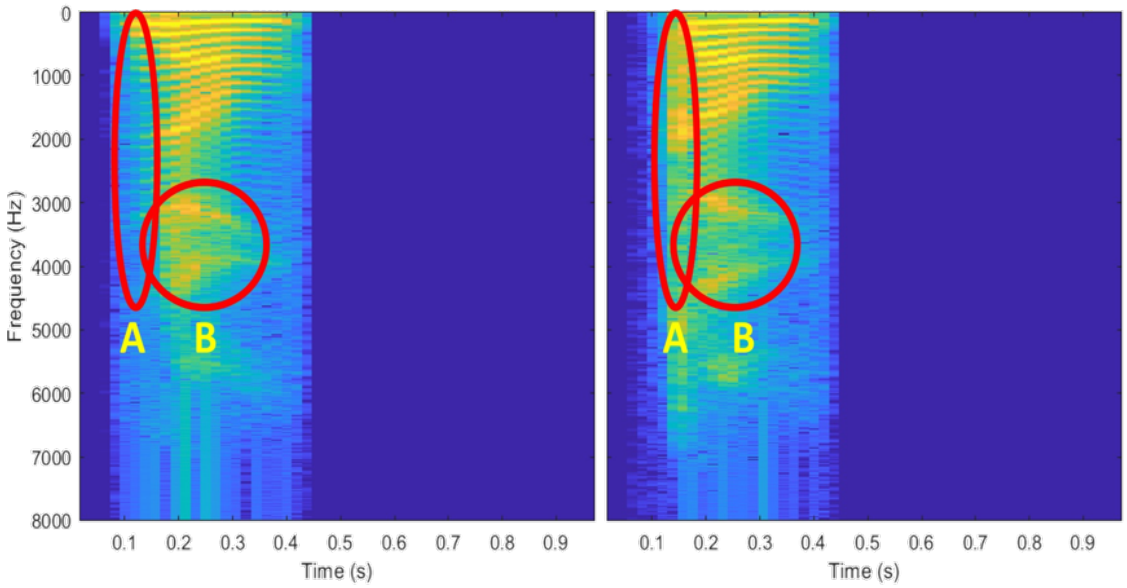


Speech Recording

2 Speech Integrity Verification

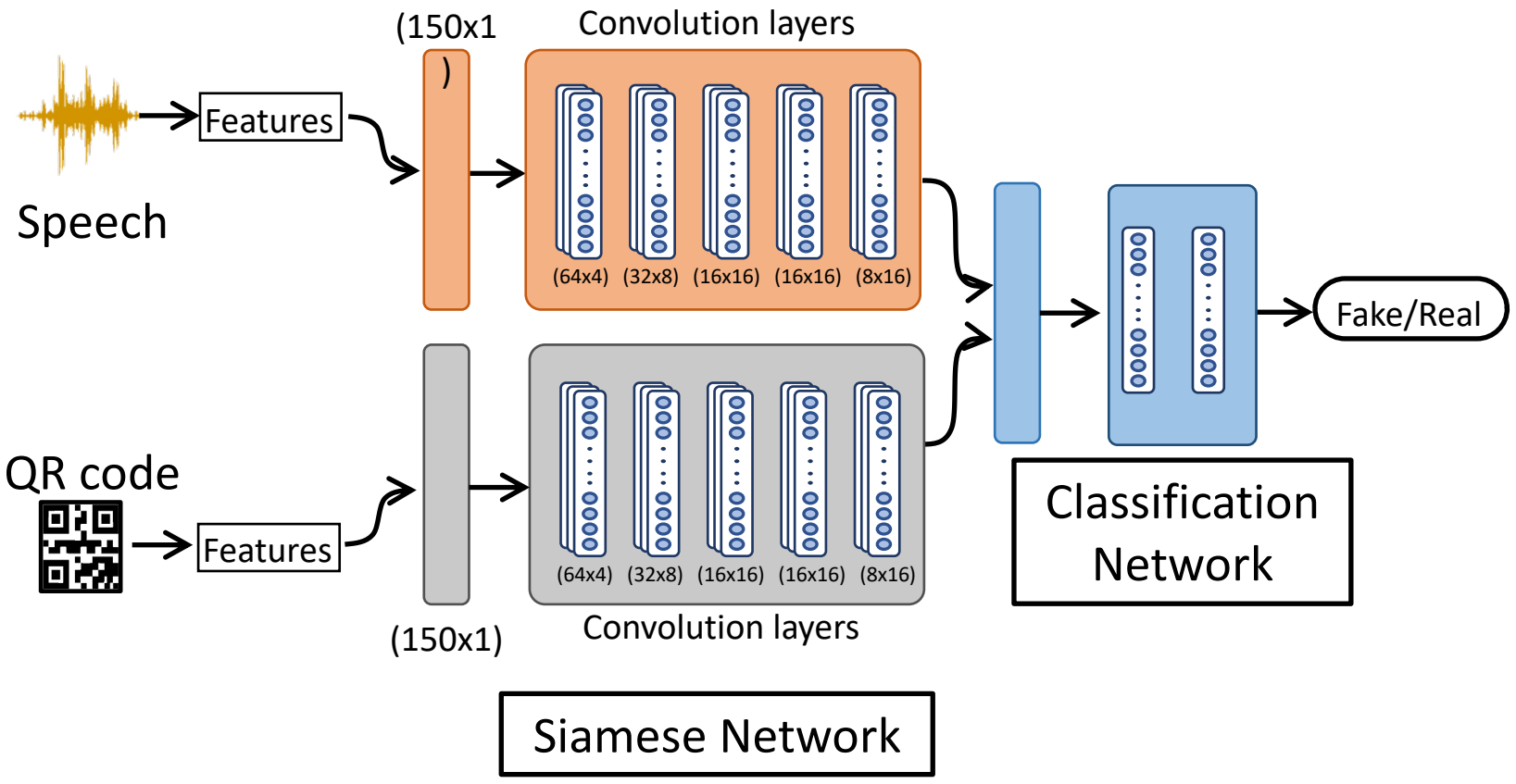


Feature Extraction



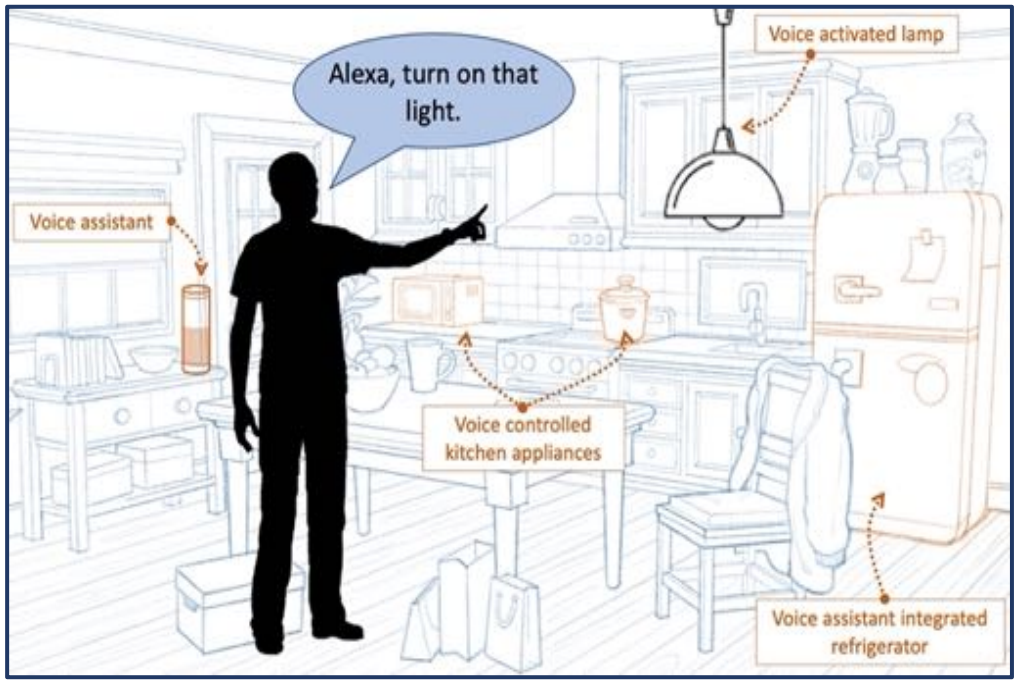
- Time-Energy Modulation:
  - Captures the distribution of energy across time.
- Time-Frequency Convolutional:
  - Captures the distribution of energy across harmonics.

Speech Integrity Verification



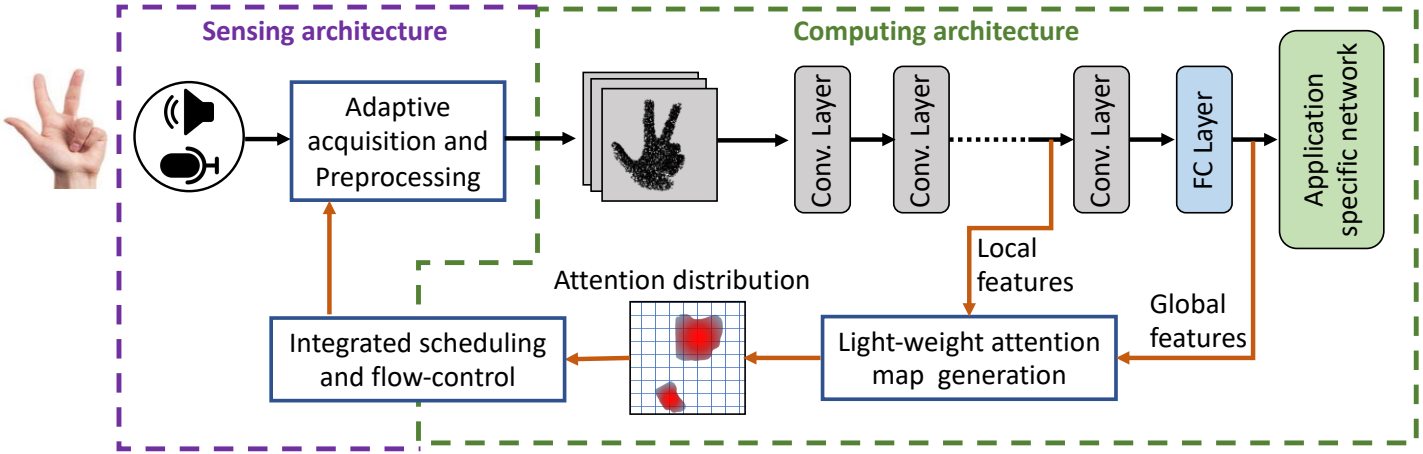
Relevant current research

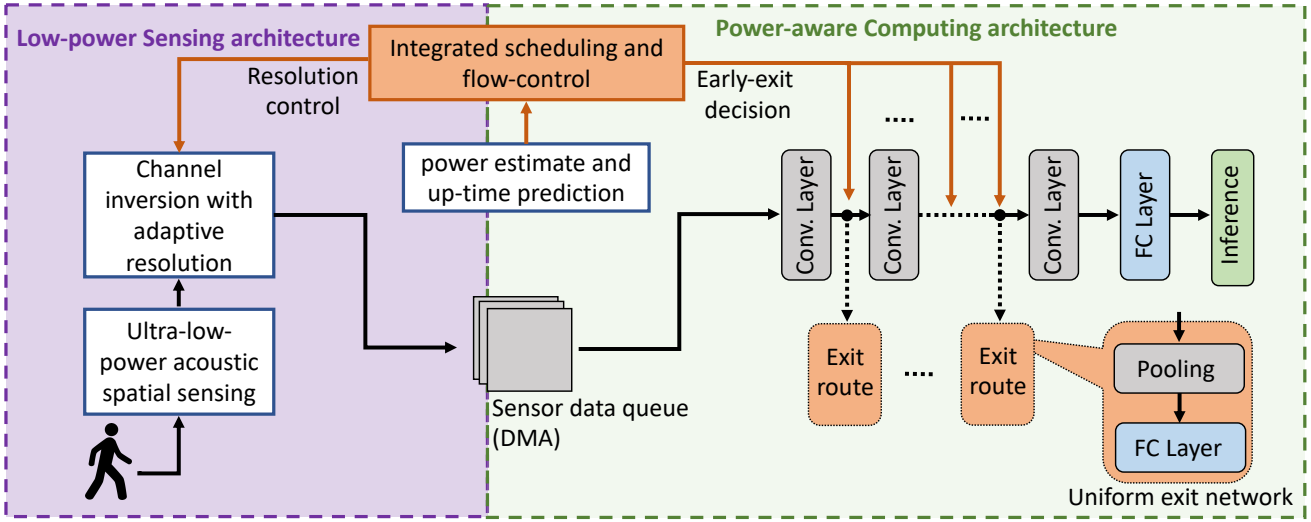
1 Physical context in conversation with voice assistants
(Funding: Meta/Facebook Research Award)



Relevant current research

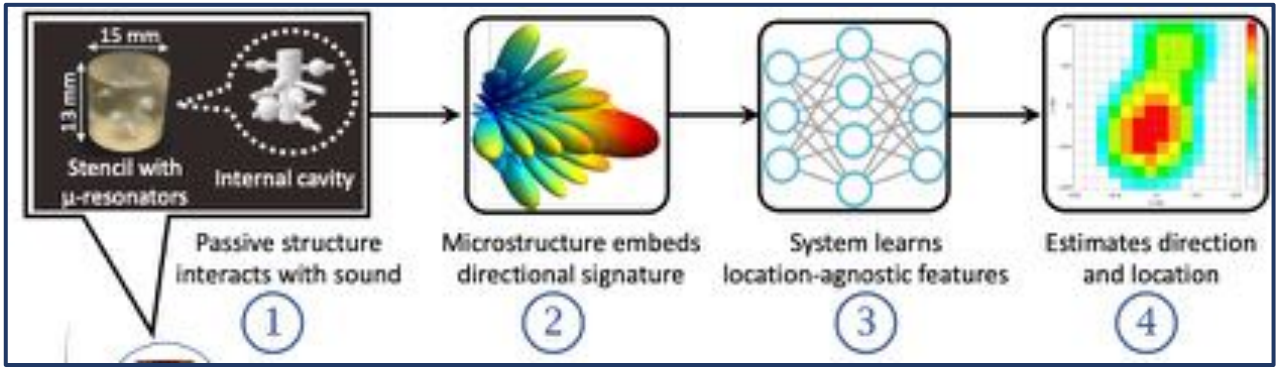
② Acoustic ambient computing
(Funding: NSF CAREER Award)

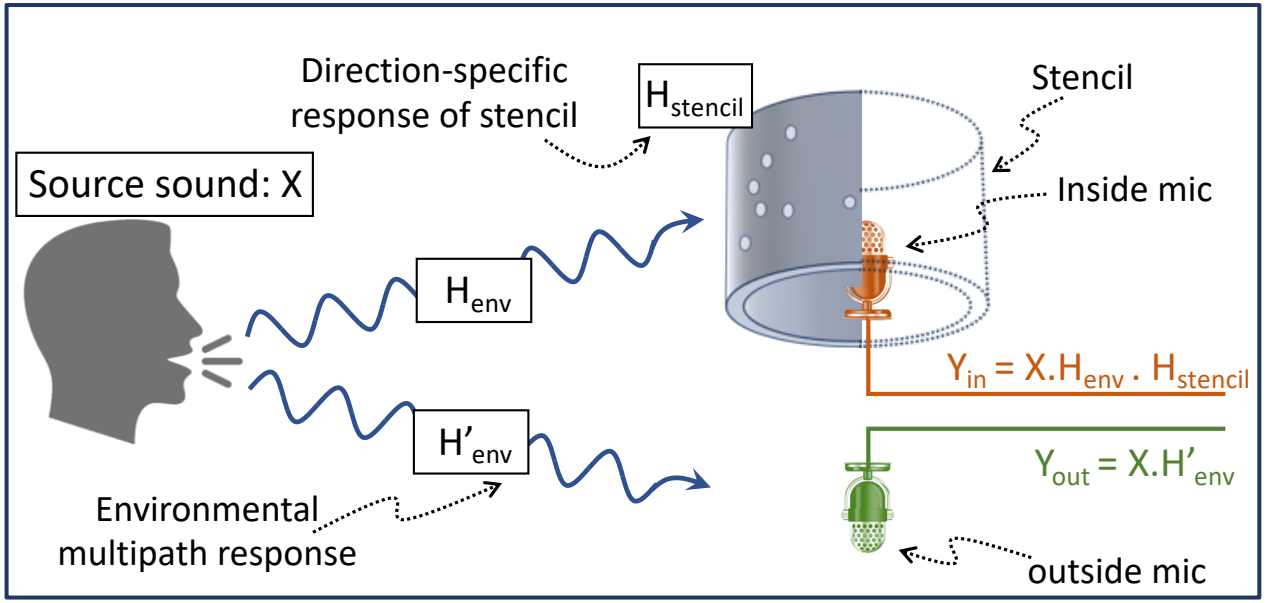


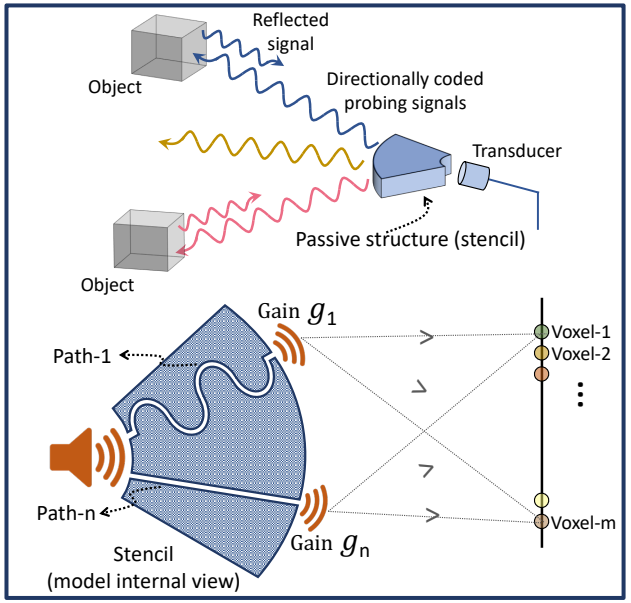


Relevant current research

③ Software-defined acoustic sensing
(Funding: Agreement with a leading defense product developer)



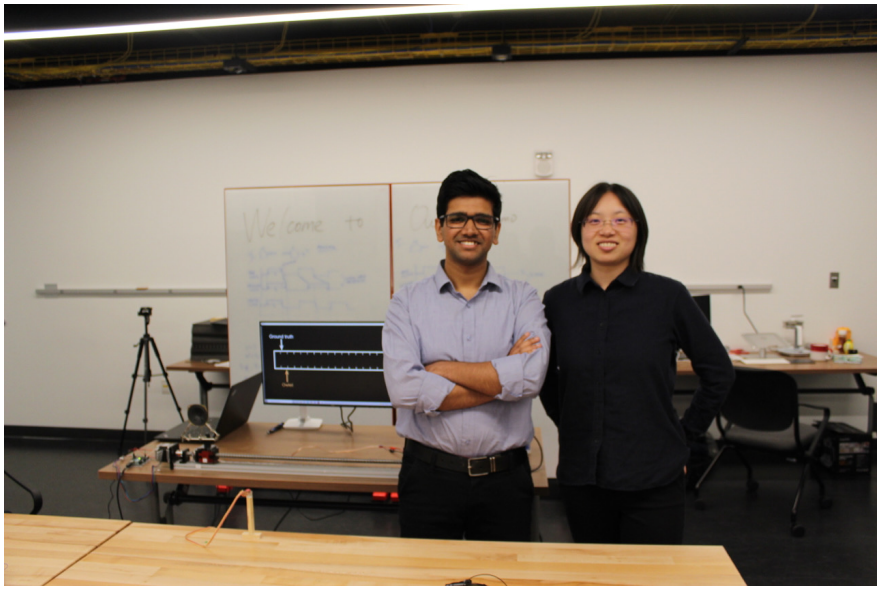


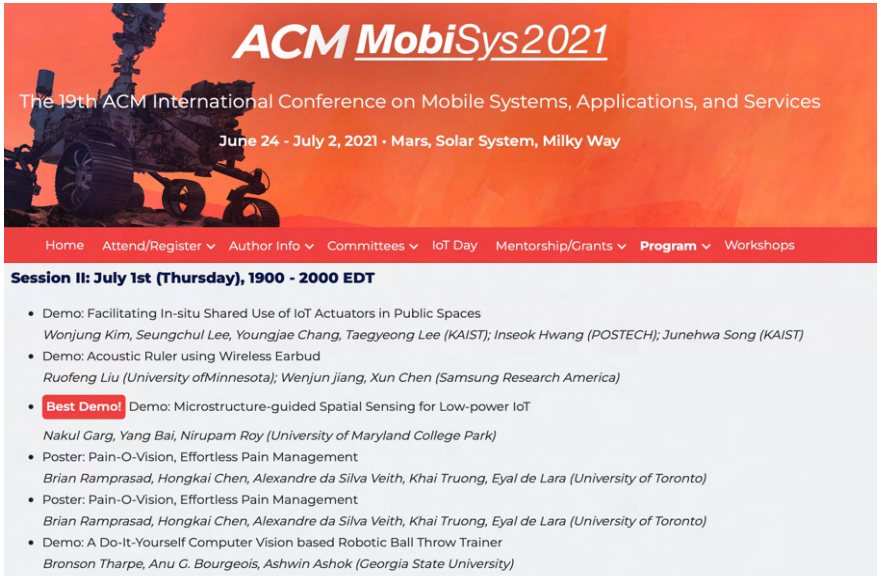


Best Demo Award 2021

MOBILE COMPUTING & COMMUNICATIONS REVIEW Volume 25, Issue 2 • June 2021

GetMobile





Best Paper Award 2022

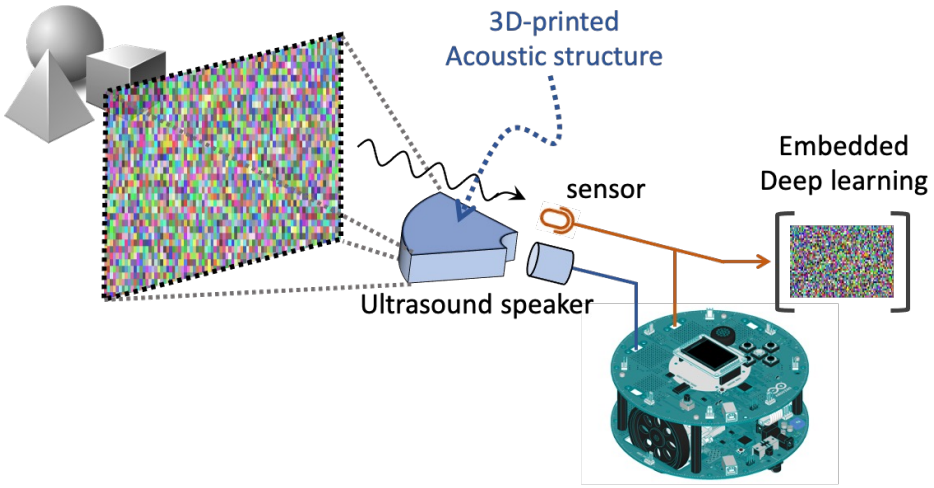
SPiDR: Ultra-low-power Acoustic Spatial Sensing for Micro-robot Navigation

Yang Bai‡
yangbai8@umd.edu
University of Maryland College Park

Nakul Garg‡
nakul22@umd.edu
University of Maryland College Park

Nirupam Roy
niruroy@umd.edu
University of Maryland College Park

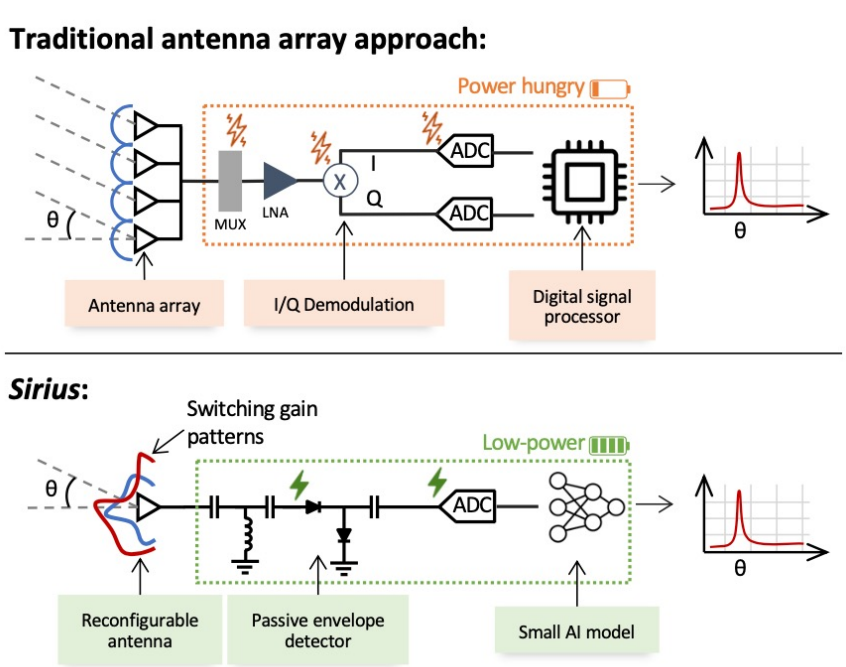
(‡ Co-primary Student Authors)



Best Poster Award 2023

Poster: Ultra-low-power Angle-of-Arrival Estimation Using a Single Antenna

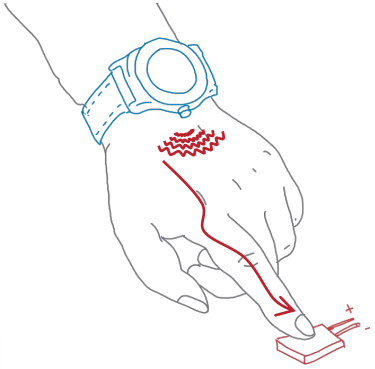
Nakul Garg, Nirupam Roy
{nakul22, niruroy}@umd.edu
University of Maryland, College Park

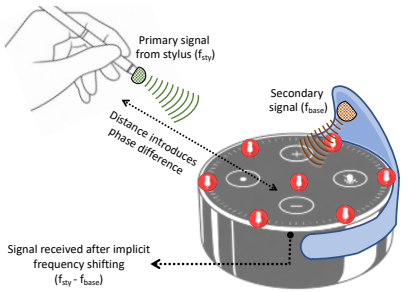


Signal Processing
Communication
Learning

Sensing
Networking
Embedded Systems

MIT Technology Review · curiosity · POPULAR SCIENCE · TechCrunch · engadget





Voice Interfaces

SenSys 20,
NSDI 18,
MobiSys 17 (Best Paper)

Wearables

NSDI 16,
NSDI 15

Security/Safety

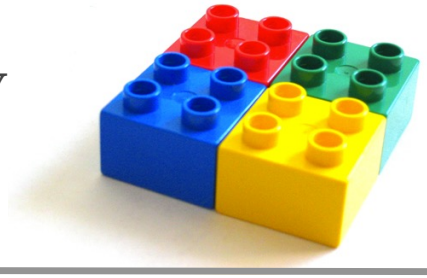
HotMobile, 20
MobiSys 16,
NDSS 14

Ubiquitous Acoustics

MobiSys 22 (Best Paper)
MobiSys 21,
MobiSys 20

Acoustic Communication and sensing

Vibratory modem



Low-power sensing

Localization

Intelligent • Connected • Secure • Mobile • Systems

Website: *http://icosmos.cs.umd.edu*

Email: *niruroy@umd.edu*

UNIVERSITY OF MARYLAND