



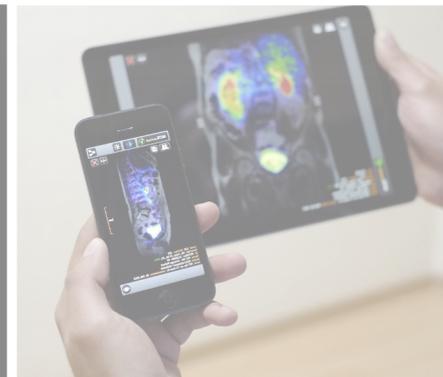
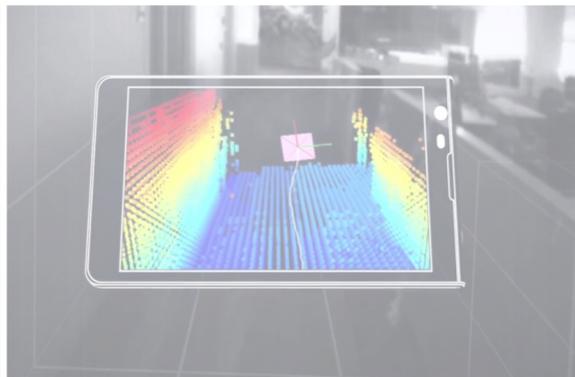
Intelligence Advanced Research Projects Activity (IARPA) Proposers' Day

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

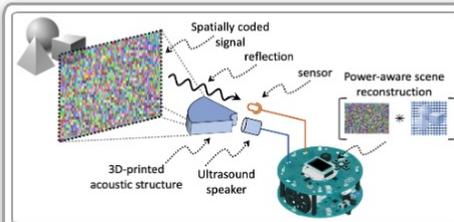
The Networking, Mobile Computing, and Autonomous Sensing Lab



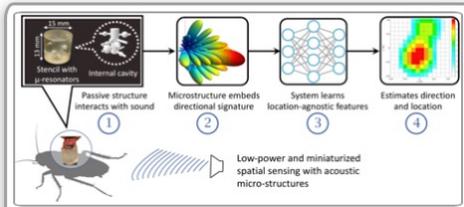
Tidbits

- ★ Project **SPiDR** wins best paper award at MobiSys'22.
- ★ **Nirupam** chairs the intelligent 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.

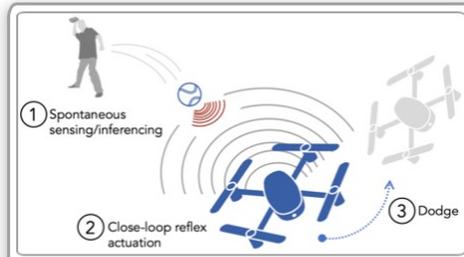
[Awards](#)



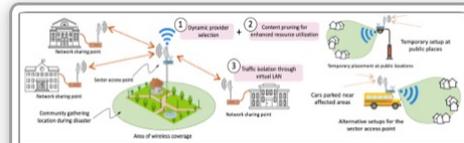
SPiDR: Ultra-low-power acoustic imaging
SPiDR is an ultra-low-power acoustic



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]



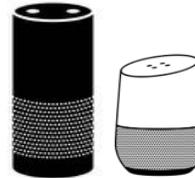
Inaudible sound
[MobiSys 2017]



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.

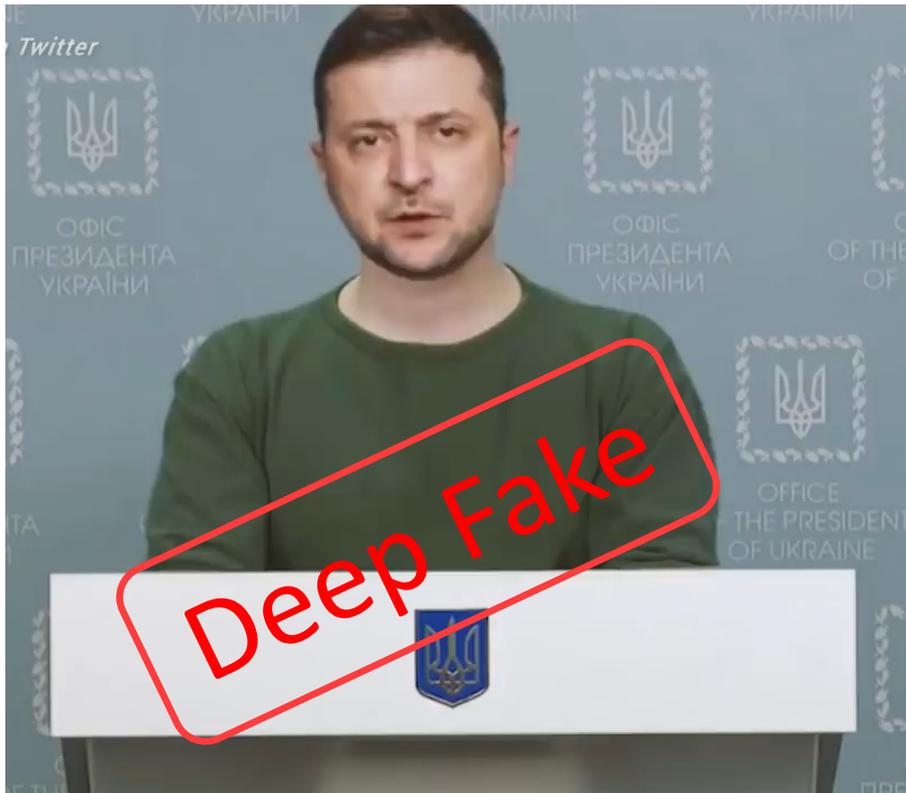


A recent project on speech security

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

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





Ukrainian President Volodymyr calling on his soldiers to lay down weapons



Nixon discussing about the disaster of moon-landing



Fake video of Nancy Pelosi make her to be intoxicated drunk



TalkingFaces

By Synthesys



MegaPortraits: High-Res Deepfakes



DeepSwap



DEEPBRAIN AI

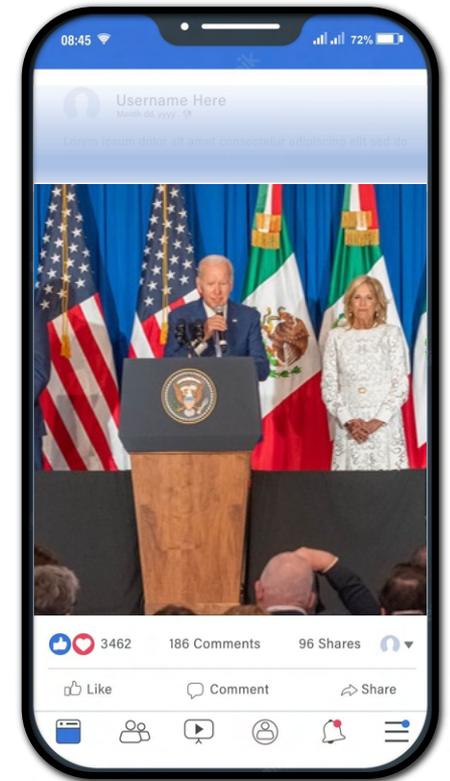
pixble



DeepFaceLab

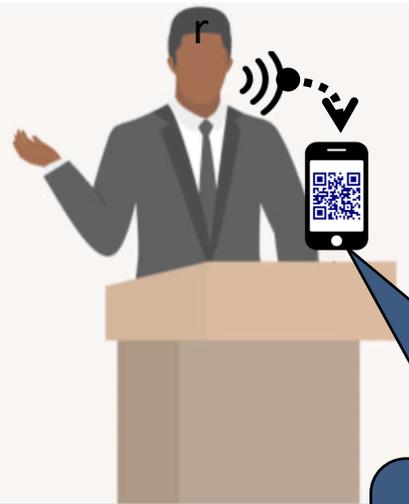


Is it possible to verify live speech when anyone from the audience can record and publish it?

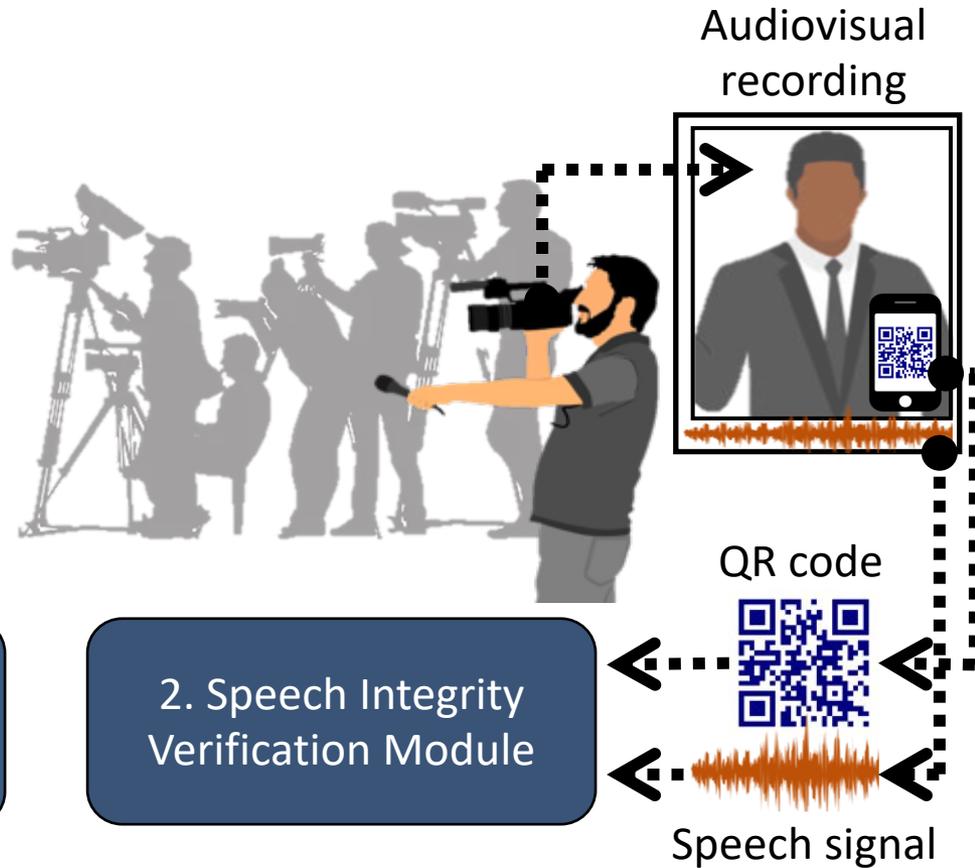


TalkLock

Live
speake



1. Live Speech Signature
Embedding Module



Audiovisual
recording

QR code

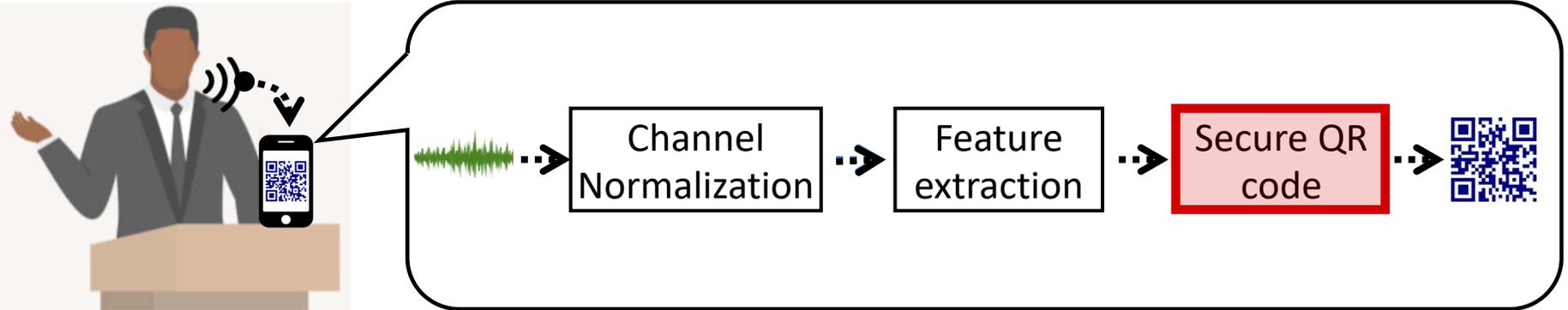
2. Speech Integrity
Verification Module

Speech signal

TalkLock

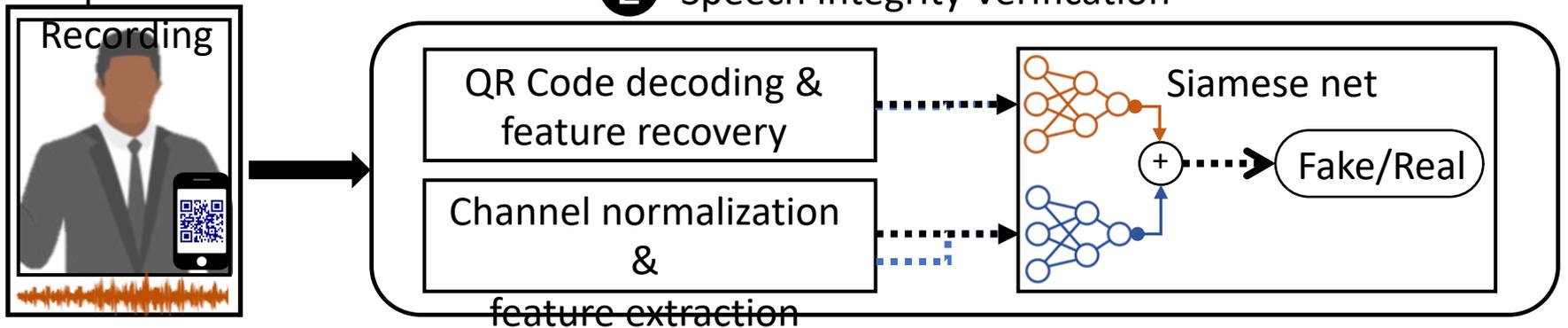
Live speaker

1 Live Speech-Signature Embedding

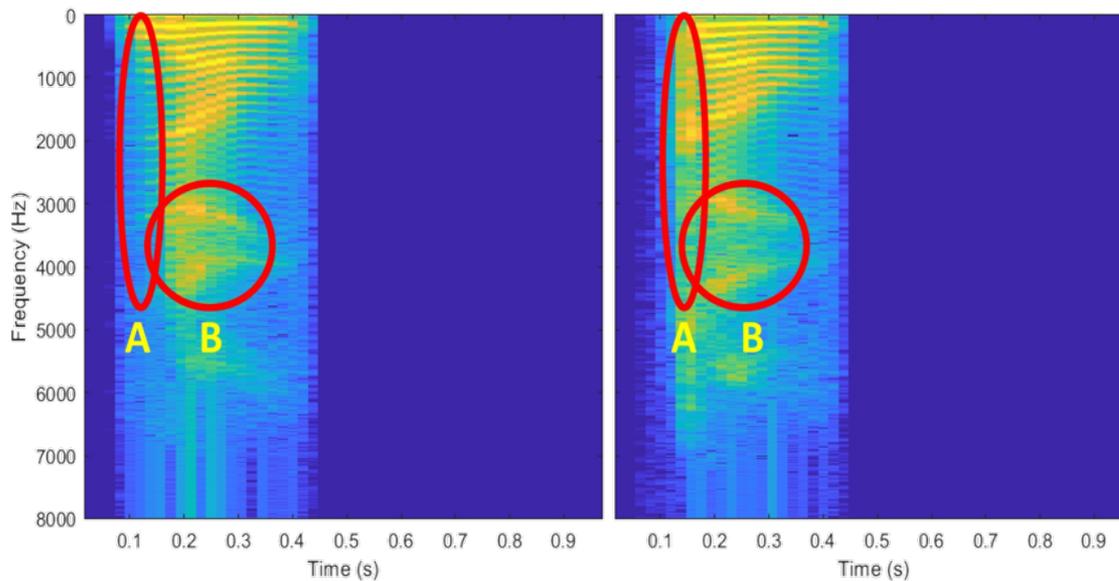


Speech

2 Speech Integrity Verification

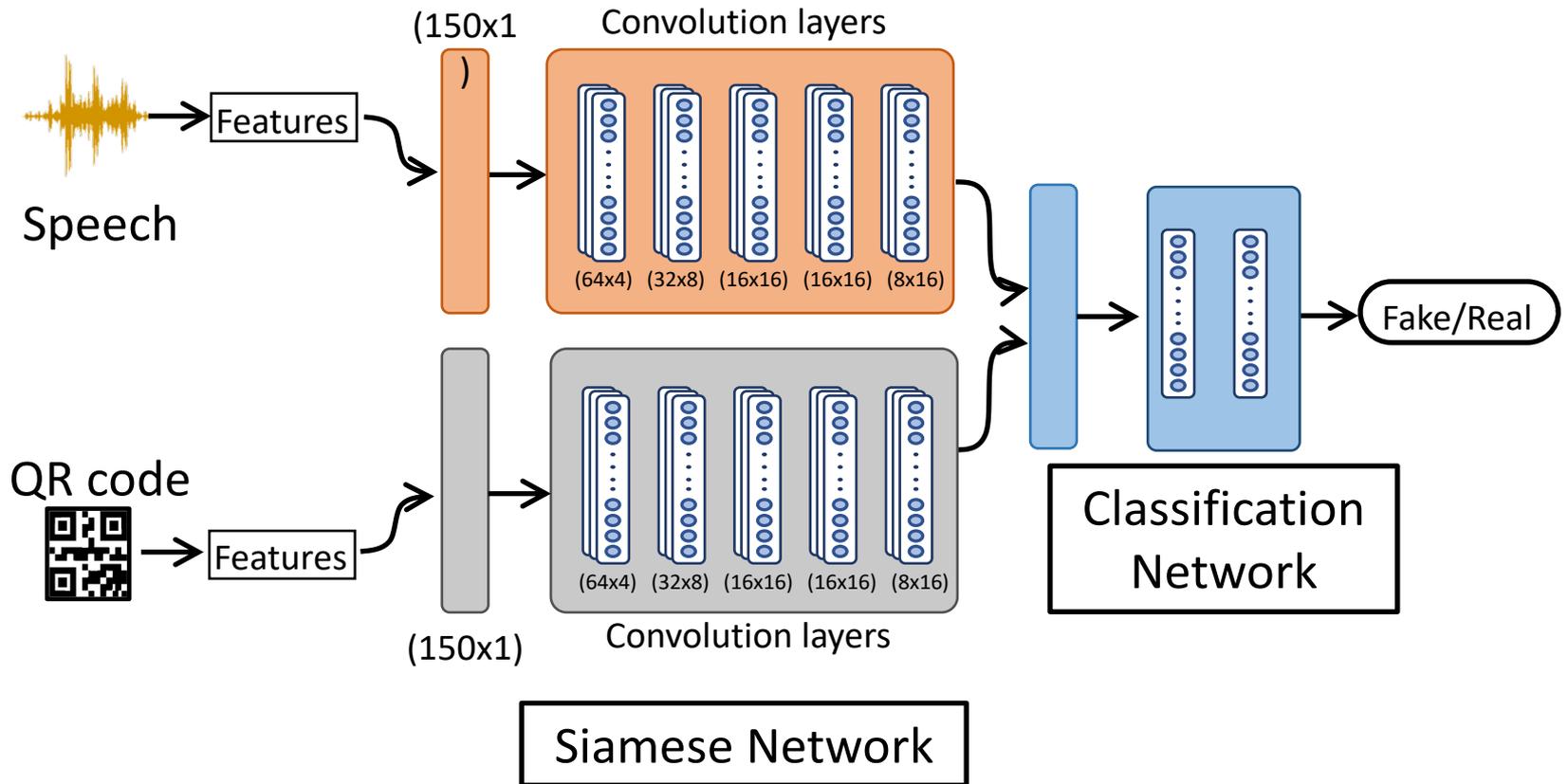


Feature Extraction



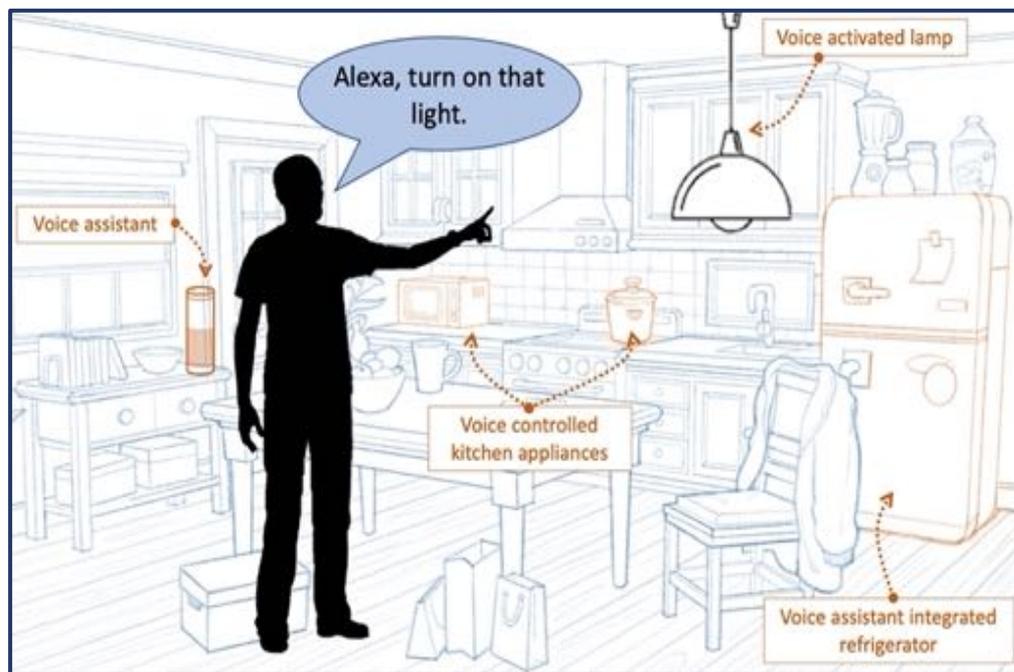
- Time-Energy Modulation:
 - Captures the distribution of energy across time.
- Time-Frequency Convolutional:
 - Captures the distribution of energy across harmonics.

Speech Integrity Verification



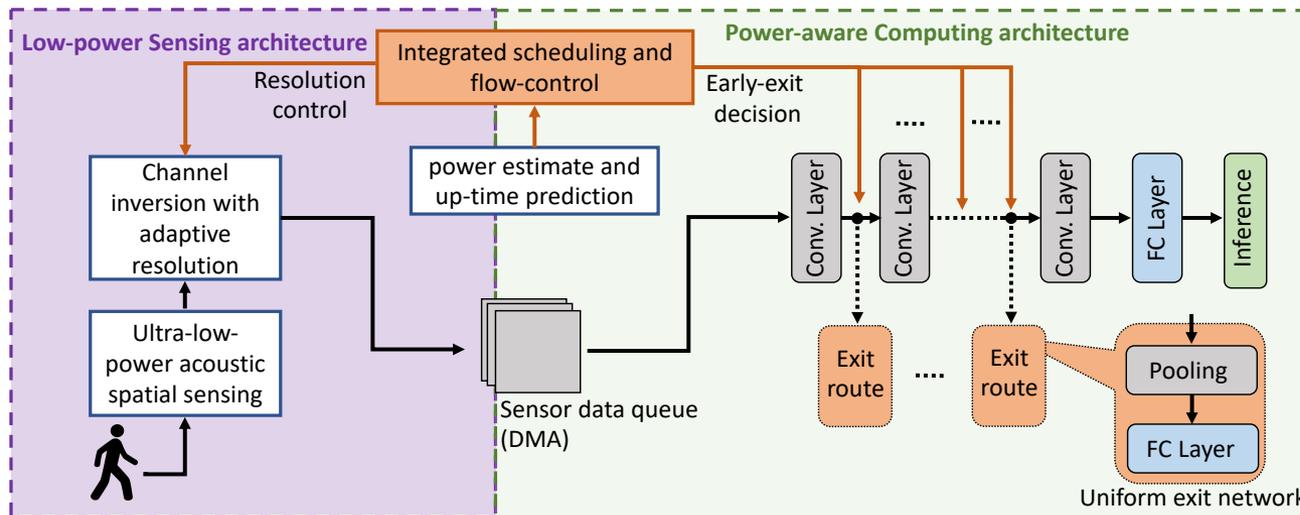
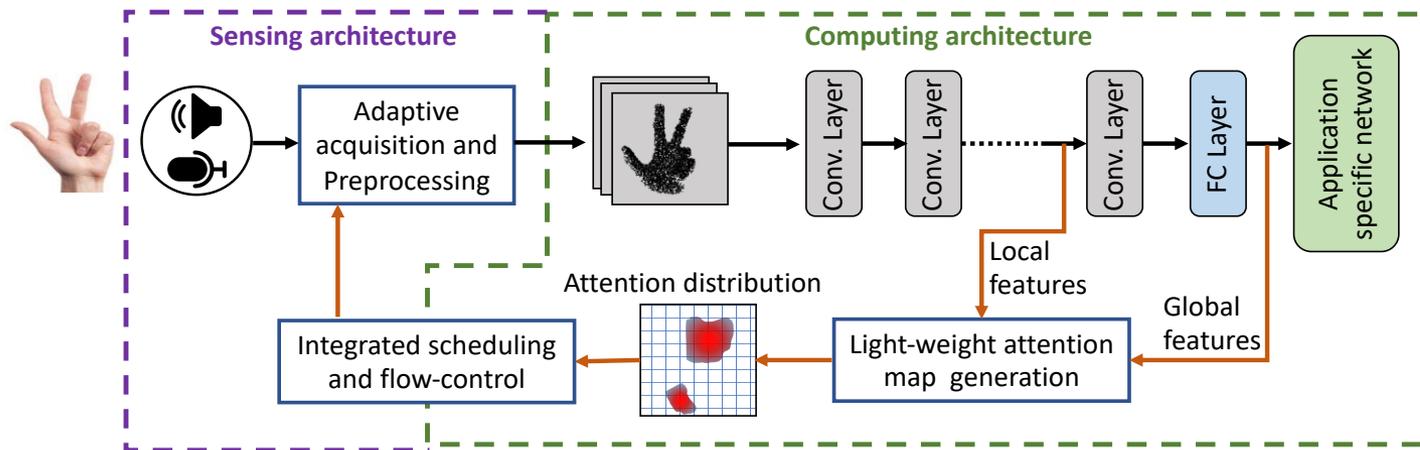
Relevant current research

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



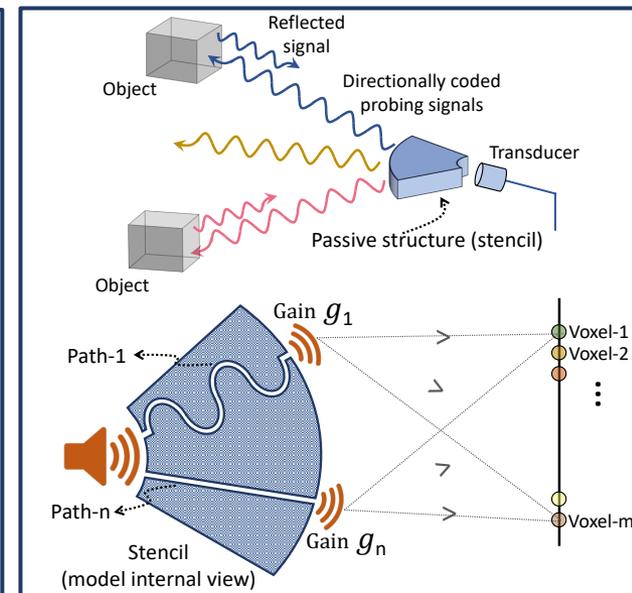
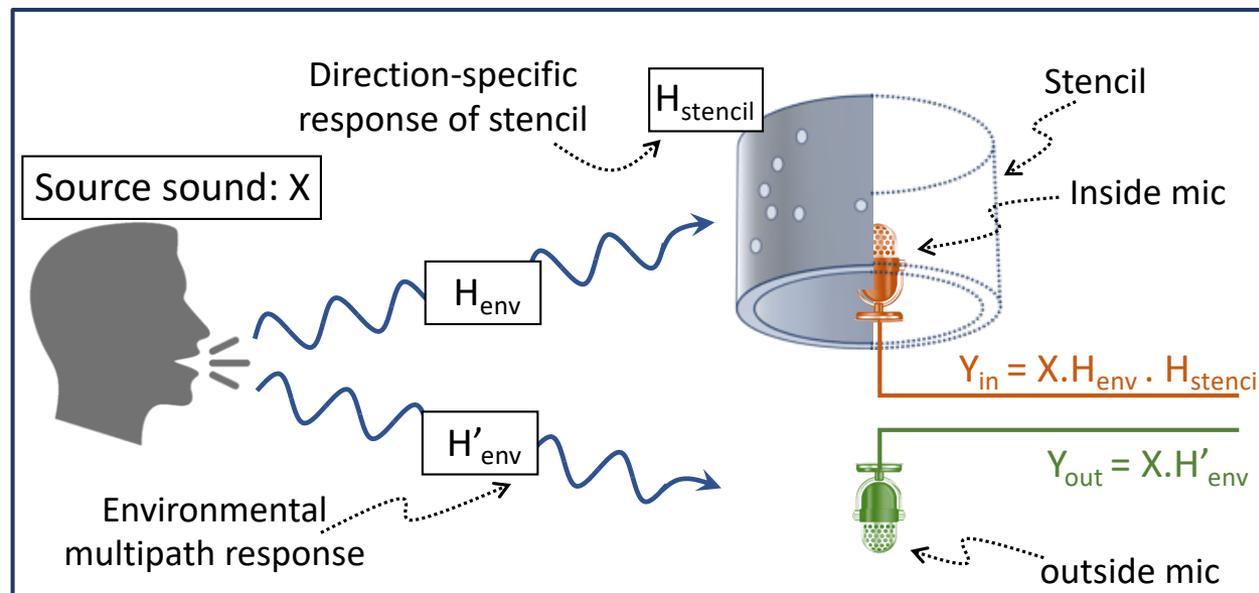
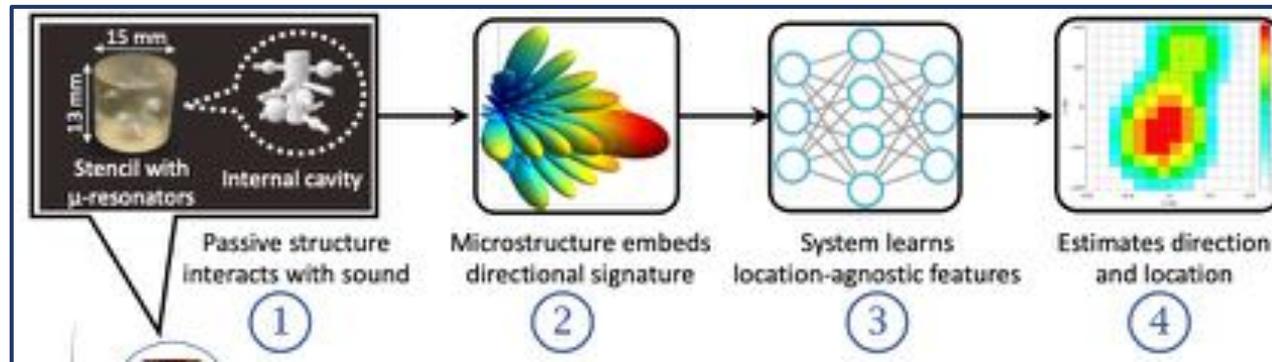
Relevant current research

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

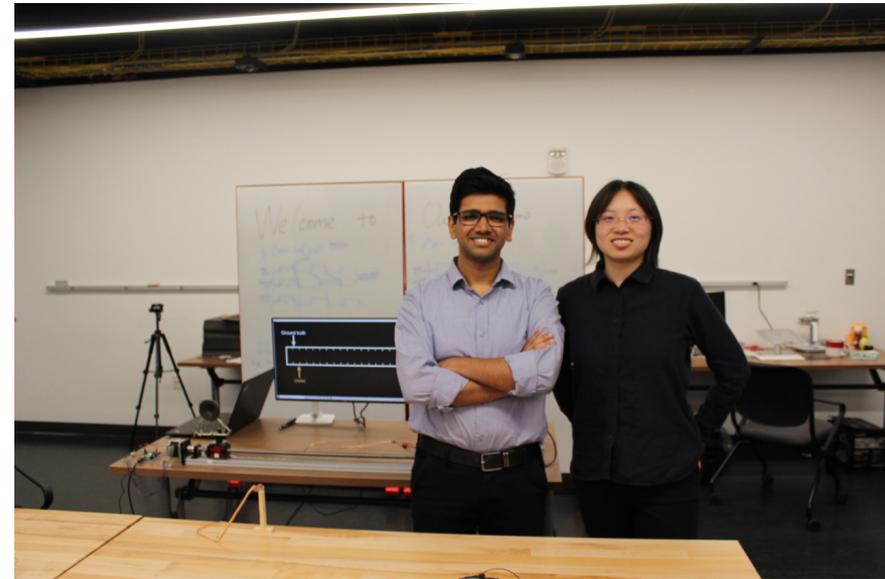


Owlet: Insect-Scale Spatial Sensing With 3D-Printed Acoustic Structures

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A PUBLICATION
OF ACM SIGMOBILE



ACM MobiSys2021

The 19th ACM International Conference on Mobile Systems, Applications, and Services

June 24 - July 2, 2021 • Mars, Solar System, Milky Way

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Session II: July 1st (Thursday), 1900 - 2000 EDT

- Demo: Facilitating In-situ Shared Use of IoT Actuators in Public Spaces
Wonjung Kim, Seungchul Lee, Youngjae Chang, Taegyeong Lee (KAIST); Inseok Hwang (POSTECH); Junehwa Song (KAIST)
- Demo: Acoustic Ruler using Wireless Earbud
Ruofeng Liu (University of Minnesota); Wenjun Jiang, Xun Chen (Samsung Research America)
- **Best Demo!** Demo: Microstructure-guided Spatial Sensing for Low-power IoT
Nakul Garg, Yang Bai, Nirupam Roy (University of Maryland College Park)
- Poster: Pain-O-Vision, Effortless Pain Management
Brian Ramprasad, Hongkai Chen, Alexandre da Silva Veith, Khai Truong, Eyal de Lara (University of Toronto)
- Poster: Pain-O-Vision, Effortless Pain Management
Brian Ramprasad, Hongkai Chen, Alexandre da Silva Veith, Khai Truong, Eyal de Lara (University of Toronto)
- Demo: A Do-It-Yourself Computer Vision based Robotic Ball Throw Trainer
Bronson Tharpe, Anu G. Bourgeois, Ashwin Ashok (Georgia State University)

Best Paper Award 2022

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

Yang Bai[‡]

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University of Maryland College Park

Nakul Garg[‡]

nakul22@umd.edu

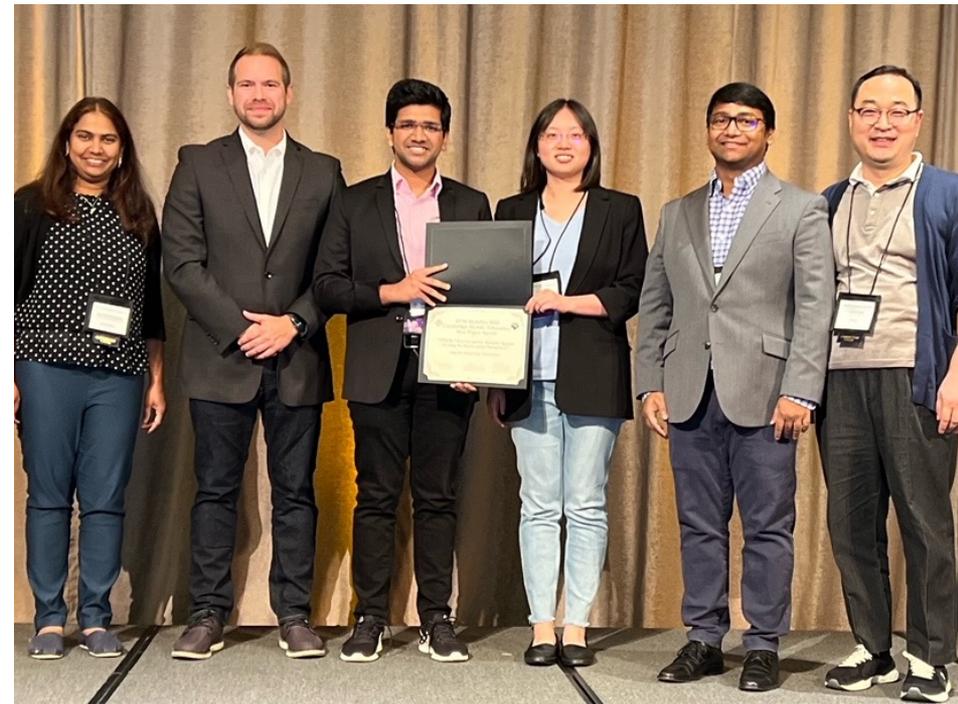
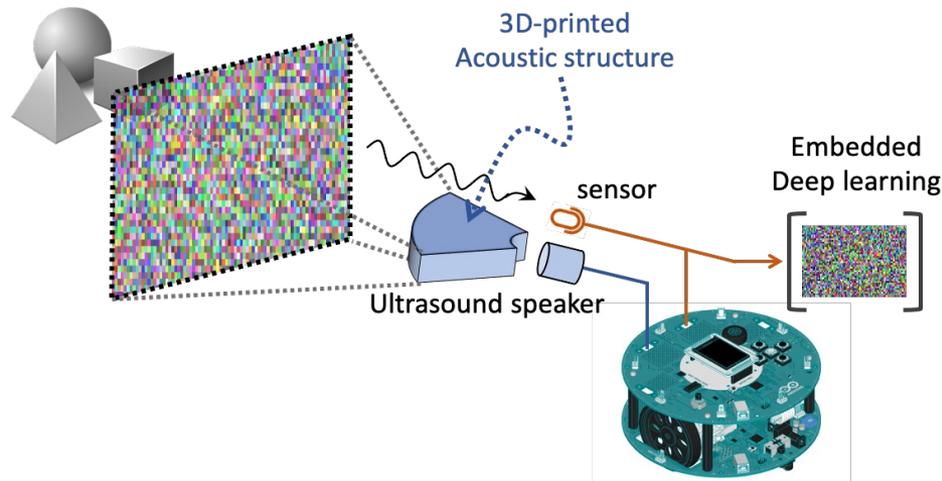
University of Maryland College Park

Nirupam Roy

niruroy@umd.edu

University of Maryland College Park

([‡] Co-primary Student Authors)

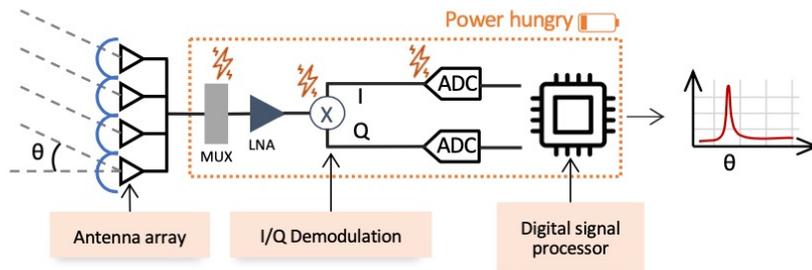


Best Poster Award 2023

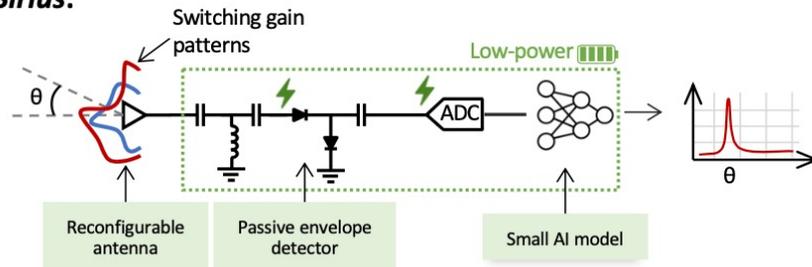
Poster: Ultra-low-power Angle-of-Arrival Estimation Using a Single Antenna

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

Traditional antenna array approach:

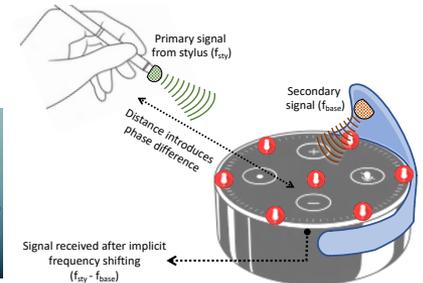
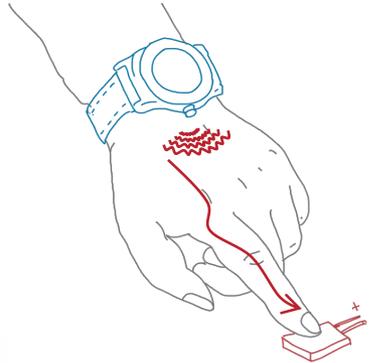


Sirius:



Signal Processing
Communication
Learning

Sensing
Networking
Embedded Systems



Voice Interfaces

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

Wearables

NSDI 16,
NSDI 15

Security/Safety

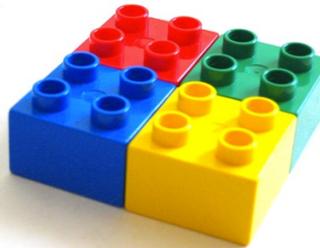
HotMobile, 20
MobiSys 16,
NDSS 14

Ubiquitous Acoustics

MobiSys 22 (Best Paper)
MobiSys 21,
MobiSys 20

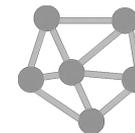
Acoustic
Communication
and sensing

Vibratory
modem



Low-power
sensing

Localization





Intelligent • Connected • Secure • Mobile • Systems

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