

Transportation Gaps and Disability-Related Unemployment: Smarter Cities and Wearables combating Commuting Challenges for the Blind

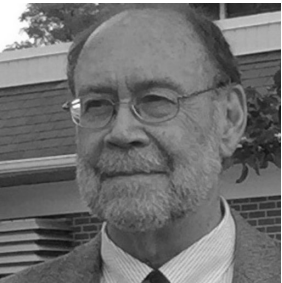
NSF Project_ID: 1952180
John-Ross Rizzo, NYU Langone Health
(SCC-IRG Track 2 , FY2020)

Principal Research Investigators (Name, Institution)

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- William Seiple, PhD; Lighthouse Guild

Community Partners (Name, Institution)

- >10 partners from:
- NYC Department of Transportation (**DOT**)
 - NYC Mayor’s Office for People w/ Disabilities (**MOPD**)
 - NY Metropolitan Transportation Authority (**MTA**)
 - NY Police Department (**NYPD**)
 - My Blind Spot (**MBS**) NPO





NYU

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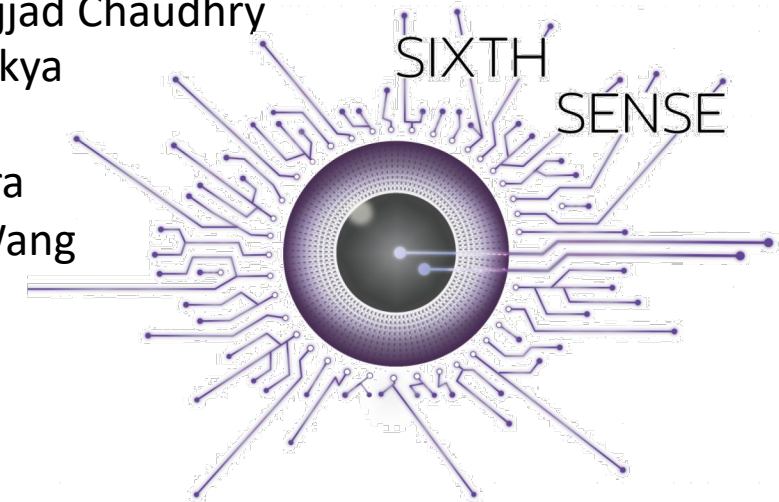
❖ **Team/Students:**

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❖ **Vertically Integrated Projects (VIP) Team members:**

- Joel De Los Santos
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❖ **Consultants:**

- Li-Ta HSU, PhD; The Hong Kong Polytechnic University
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Project Overview

Project Vision

- To develop **VIS⁴ION**, a revolutionary wearable platform that uses backpack-mounted sensors, advanced machine vision, wireless communications, and human-machine interfaces, to afford *'connected' dynamic localization* and *navigation assistance* for the visually impaired in complex urban environments.
- To develop low-barrier frameworks for behavioral investigation in disability studies, guidelines for the design and delivery of navigation-focused wearables, and platforms that enhance economic vitality, safety, security, health and wellbeing, and overall quality of life.

Project Overview

Use-Inspired Research

- The **employment rate** is abysmally **low** for people who are **visually impaired (VI)**.
- Critical employment barriers stem from **commuting challenges** when utilizing public transportation.
- With the help of **MoPD, DoT, NYPD, and MTA**, we are solving commuting challenges faced by the VI, as these urbanites struggle to navigate and negotiate confusing and congested train/subway and bus systems in **NEW YORK CITY**, addressing employment barriers and major safety concerns.

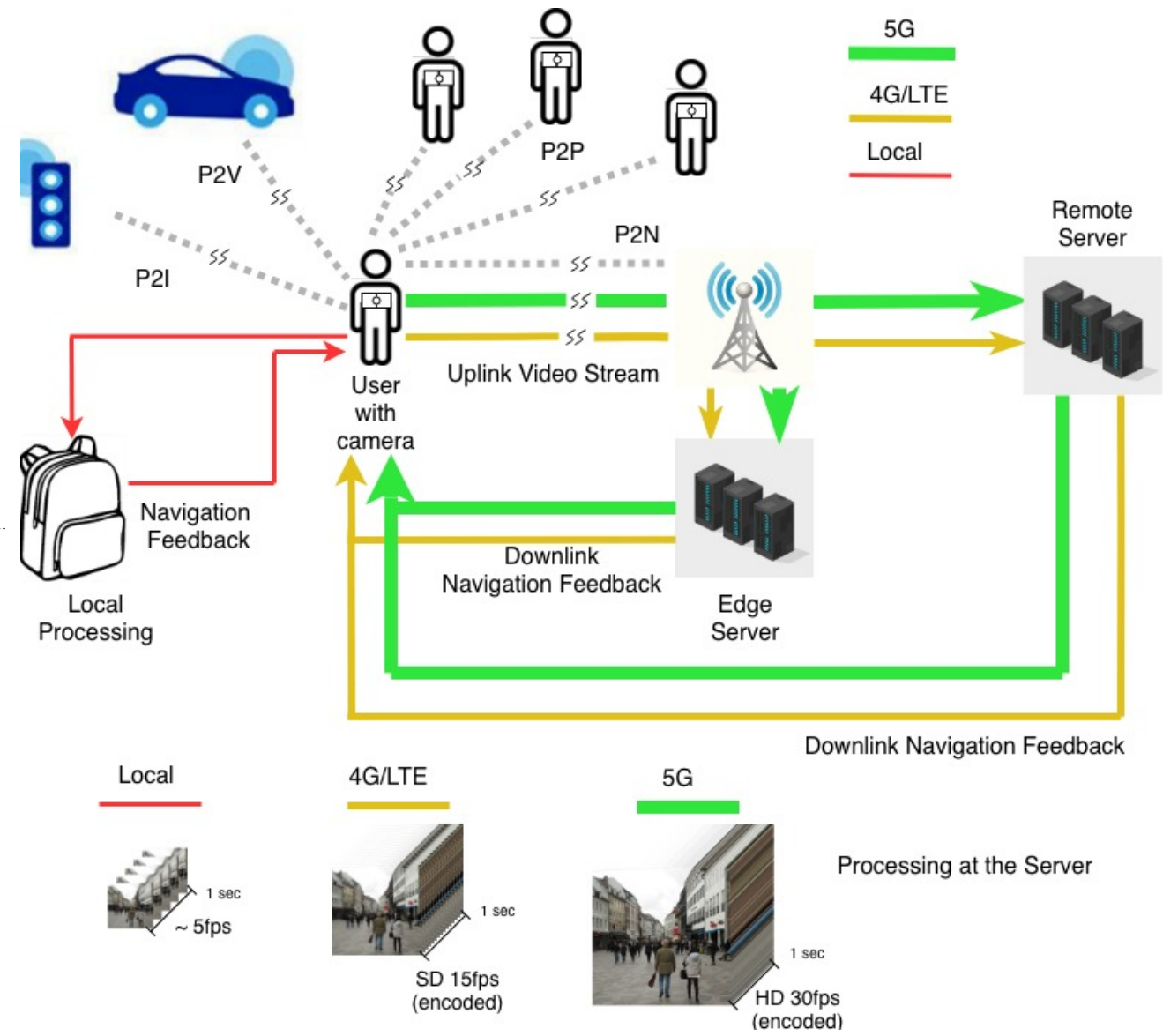
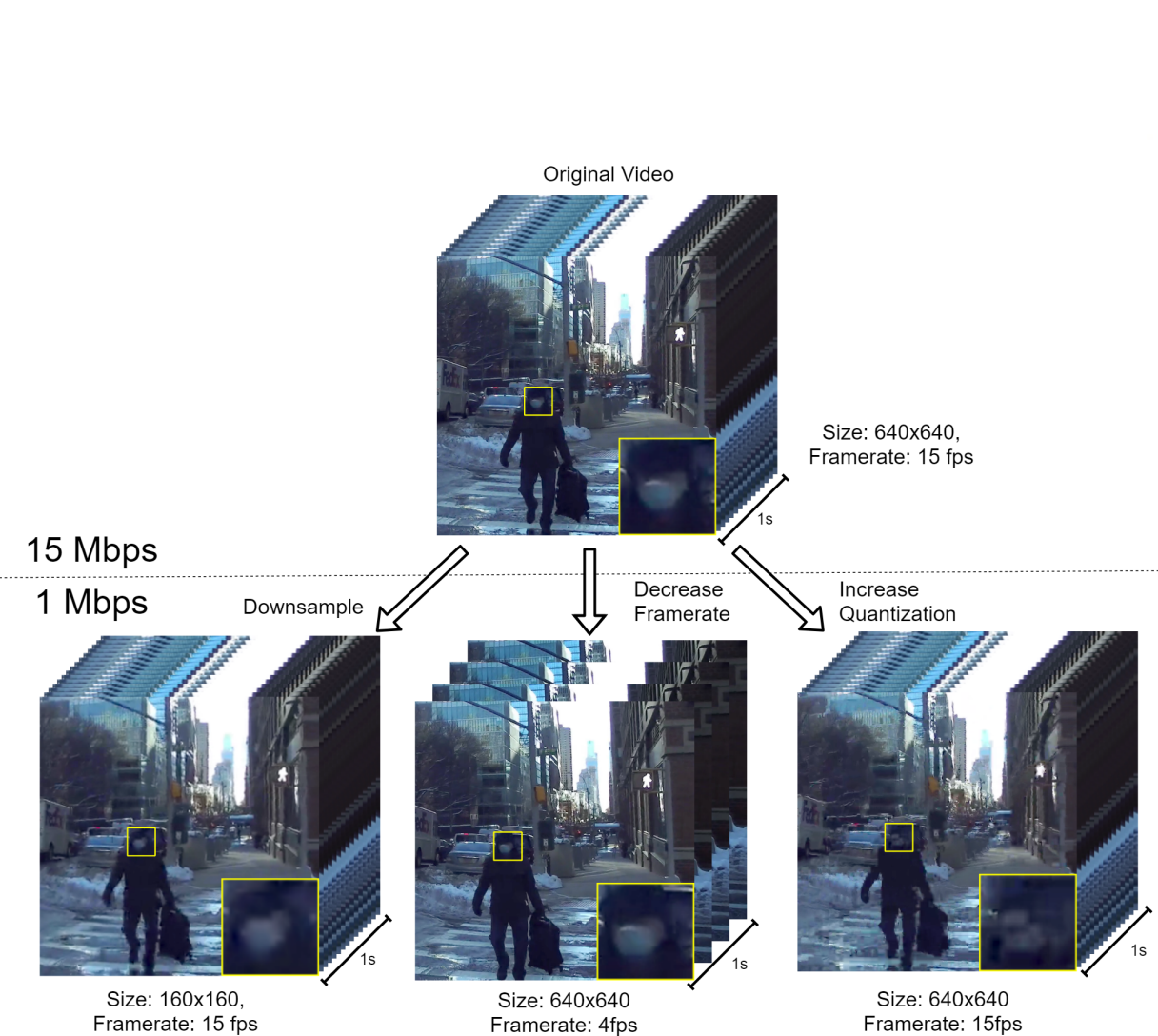


Fundamental Research Contributions

- The proposed research will enhance engineering and scientific knowledge and training while chipping away at a notorious social problem for the visually impaired and disabled at large: **unemployment**.
- Progress will foster advances in:
 - computer vision,
 - machine learning,
 - video compression,
 - wireless transmission,
 - human factors,
 - spatial positioning, and
 - understanding VI behavior
- The advances will lead to platform features that augment situational awareness for our advanced wearables, creating new frontiers for immersive assistive technologies.

Project Update

Advances → Video Coding and Wireless Communications for Computational offloading



Project Evolution

- By repeatedly documenting **commutes** from Lighthouse Guild (central hub for visually impaired services) to transportation access points, we have quantified the **number and diversity of obstacles** that impede efficient navigation.
- We have constructed an **inventory** of objects that have predictable locations in the environment (**Figure A**) and those that are unpredictable (**Figure B**).
- We learned that mapping predictable objects and providing information about their location and respective prompts to optimize negotiation is only a **first step** to developing an effective navigation tool.
- Moreover, we learned that persons with vision loss devote a great deal of attention to navigation, *minimal cognitive reserve* is available to react to unexpected challenges. These findings will guide system design.

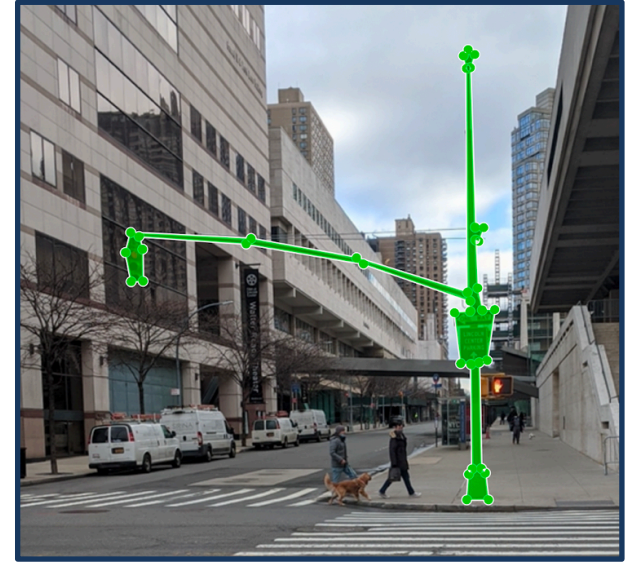


Figure A

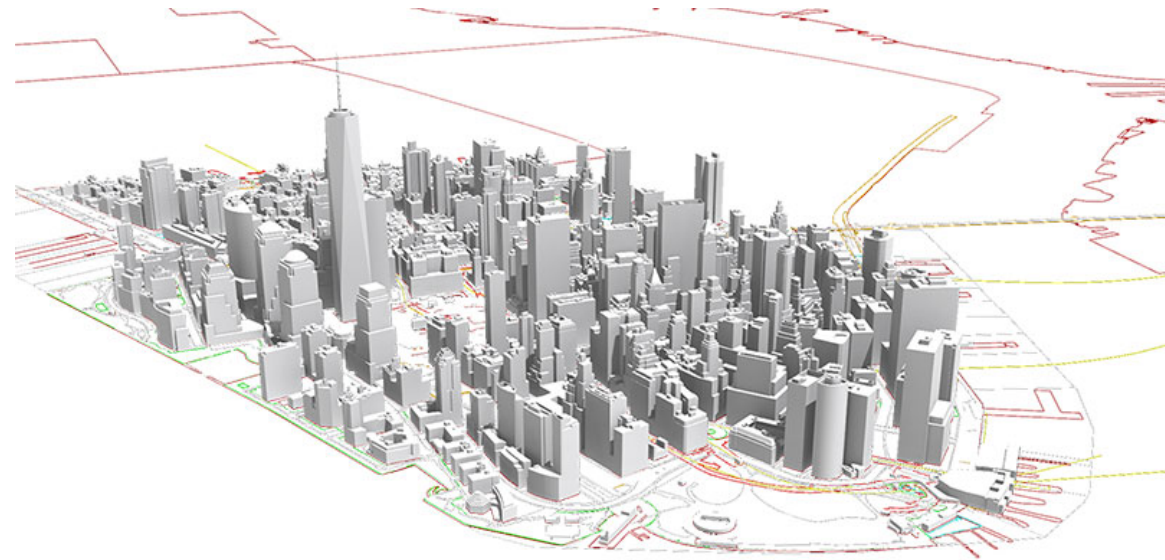


Figure B



Anticipated outcomes & success measures - 1

- **PRODUCT:** 3DMA GNSS algorithm (localization)
- **Outcomes:**
 - Generation of **skymasks** across the city (satellite visibility plots) based on NYC publicly-available 3D building models
 - Development of a **real-time 3DMA GNSS prototype**



- **Success Measures:**
 - Transform 3D building models to standard format (skymask)
 - Complete data acquisition in selected urban scenarios (urban canyons), with both static and dynamic experiments
 - Implement existing 3DMA GNSS algorithm with open-source GNSS tools → validate performance

Anticipated outcomes & success measures - 2

➤ **PRODUCT:** Network Connectivity Genie Policy

➤ **Outcomes:**

- Report specifying requirements and an initial evaluation for 5G connectivity
- Prototype 5G connection between a base station and **VIS⁴ION** in the lab

➤ **Success Measures:**

- Develop wireless network simulation in realistic environments
- Integrate **VIS⁴ION** in the COSMOS (5G) testbed

➤ **PRODUCT:** Video Coding to Computer Vision for Commuting

➤ **Outcomes:**

- Log specifying objects pertinent to dynamic navigation
- Report specifying image resolutions and bitrates required to accurately detect objects of interest at specified distances
- Object detection models that are optimized for compressed videos at varying resolutions and bit rates

➤ **Success Measures:**

- Collect an expanded video dataset for commuting
- Review dataset with experts in O&M and behavioral ecology to determine object pertinence
- Create an annotated dataset that includes bounding boxes and distances for each pertinent object
- Test and refine models that work across resolutions and bit rates, and evaluate the achievable detection accuracy at different resolutions and bit rates

Thank You



NYC Mayor's Office for
People with Disabilities

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ALLIANCE

Lighthouse
Guild

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TANDON
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NEW YORK CITY

C2 SMART
CONNECTED CITIES WITH
SMART TRANSPORTATION

NIH

tactile
NAVIGATION TOOLS



MTA

INTERDIGITAL

NYU WIRELESS



-Rusk Senior Leadership
-Tandon Senior Leadership/Eng. Teams
-Sponsors and Gracious

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