

2022-23 Ongoing Research

► NEWS Lab

國立臺灣大學

施吉昇

 NEWS^{Lab}
嵌入式系統暨無線網路實驗室

Overview

- ▶ Autonomous Systems
 - ▶ Distributed Vehicle Decision (ADLink)
 - ▶ Vehicle Lane Change Decision
 - ▶ Distributed Real-Time Messaging for V2V and V2X
 - ▶ Autonomous Driving Middleware (Tier IV, JP)
- ▶ Smart Sensors
 - ▶ CIM-Friendly Deep Neural Network Inference and Training
 - ▶ Low-Power Always-On 3D Sensor Using CIM and Structure Light (MediaTek)
 - ▶ Structure Light 3D Reconstruction for Endoscope (QuanTa Computers)



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Autonomous Systems

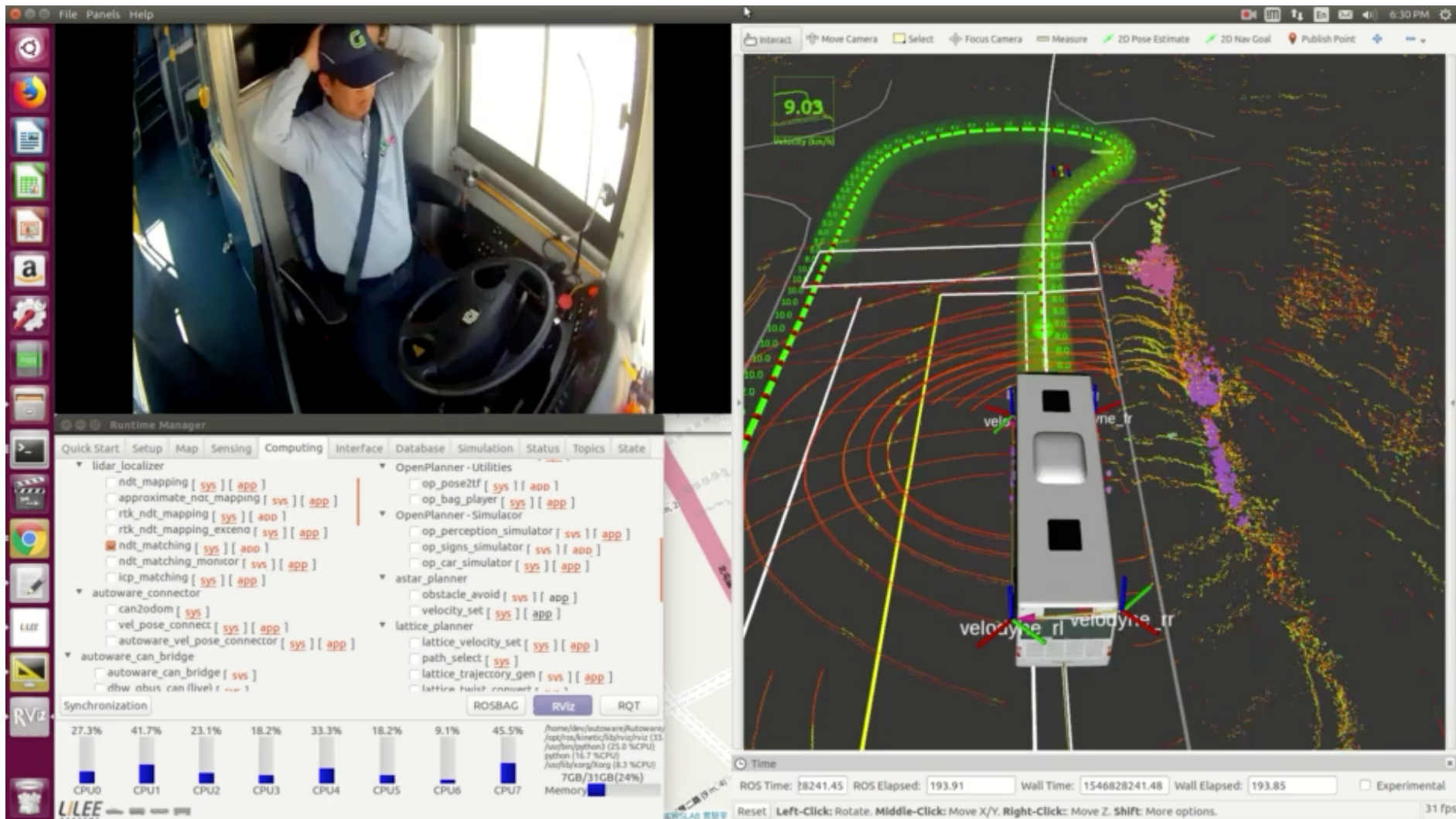
Goals

- ▶ Providing the core technology for autonomous systems.
 - ▶ On the autonomous devices, provide better perception, real-time communication, and consistent coordination with other autonomous devices.
 - ▶ On the infrastructure, provide the out-of-sight perception, localized driving behavior modeling and prediction, and the framework for distributed consensus decision among autonomous devices.

2D SLAM for RoboCup SPL



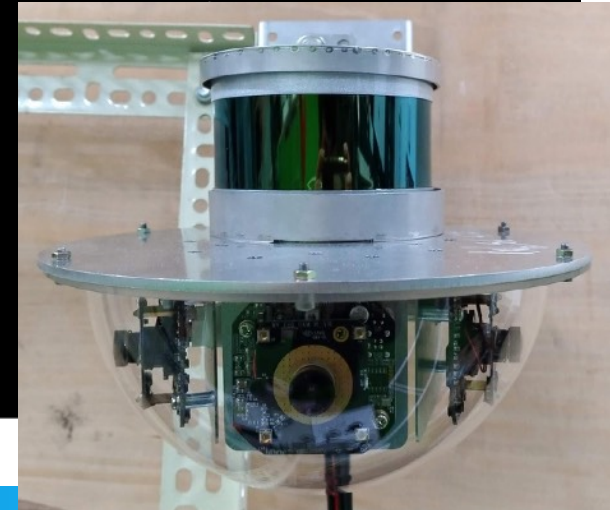
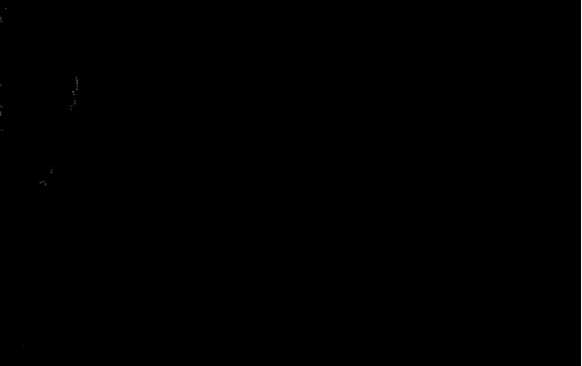
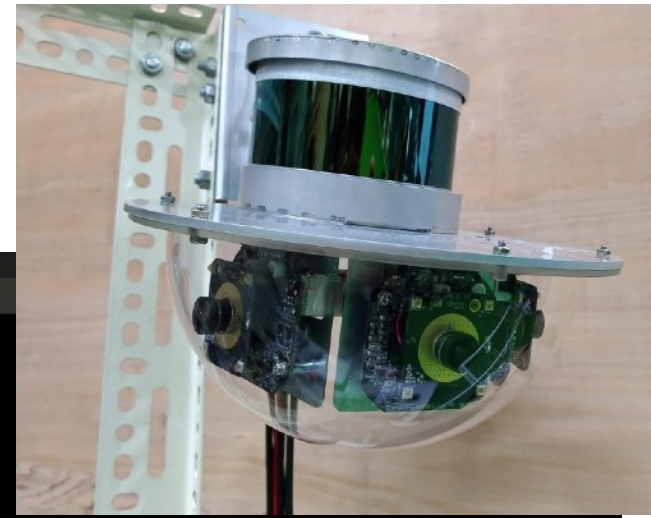
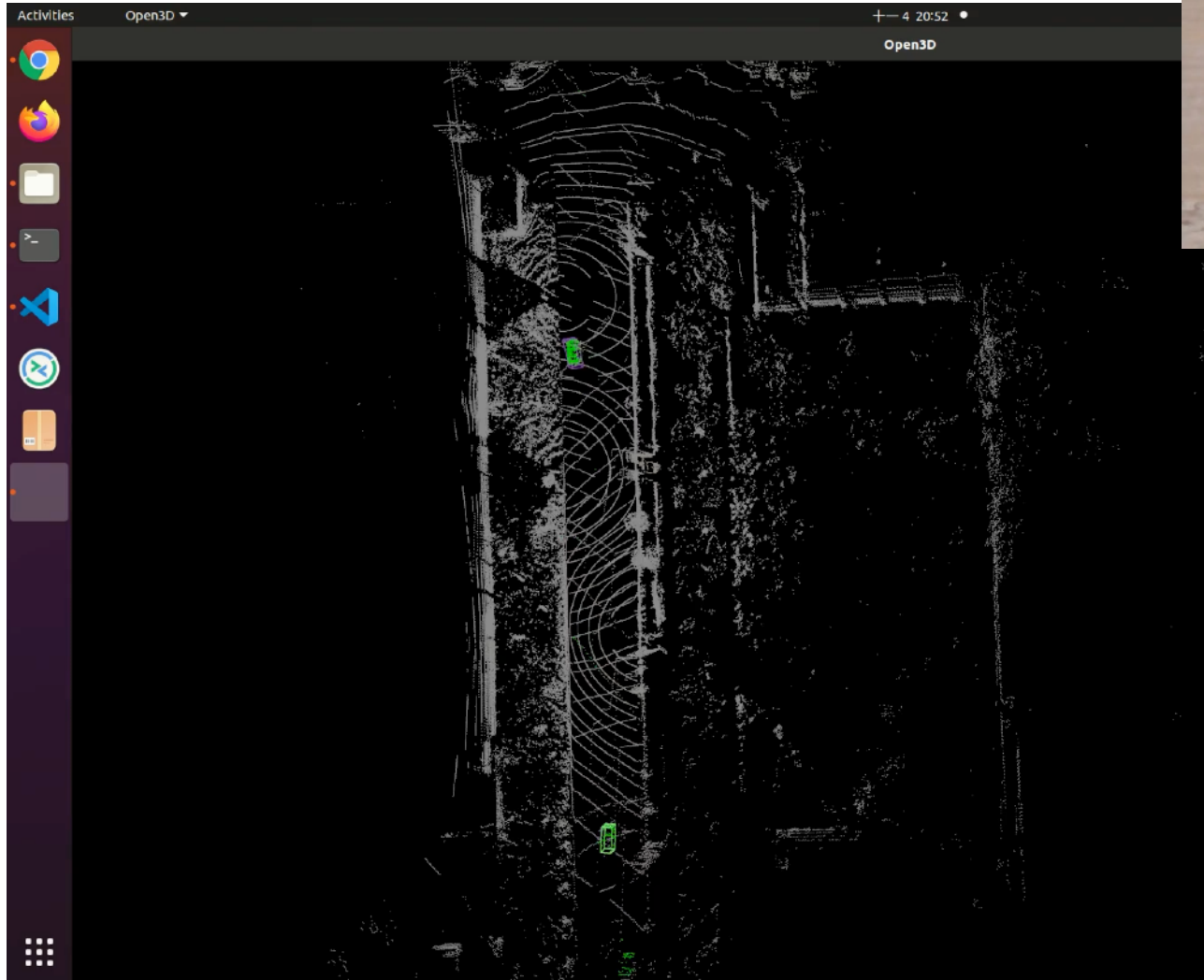
Autonomous Bus





LiDAR-Based Tracking

Sponsored by THI and NTU



Toward Coordination and Collaboration

Real-Time Tracking
for Road Users

RSU

V₃

V₂

V₁

R₇

R₃

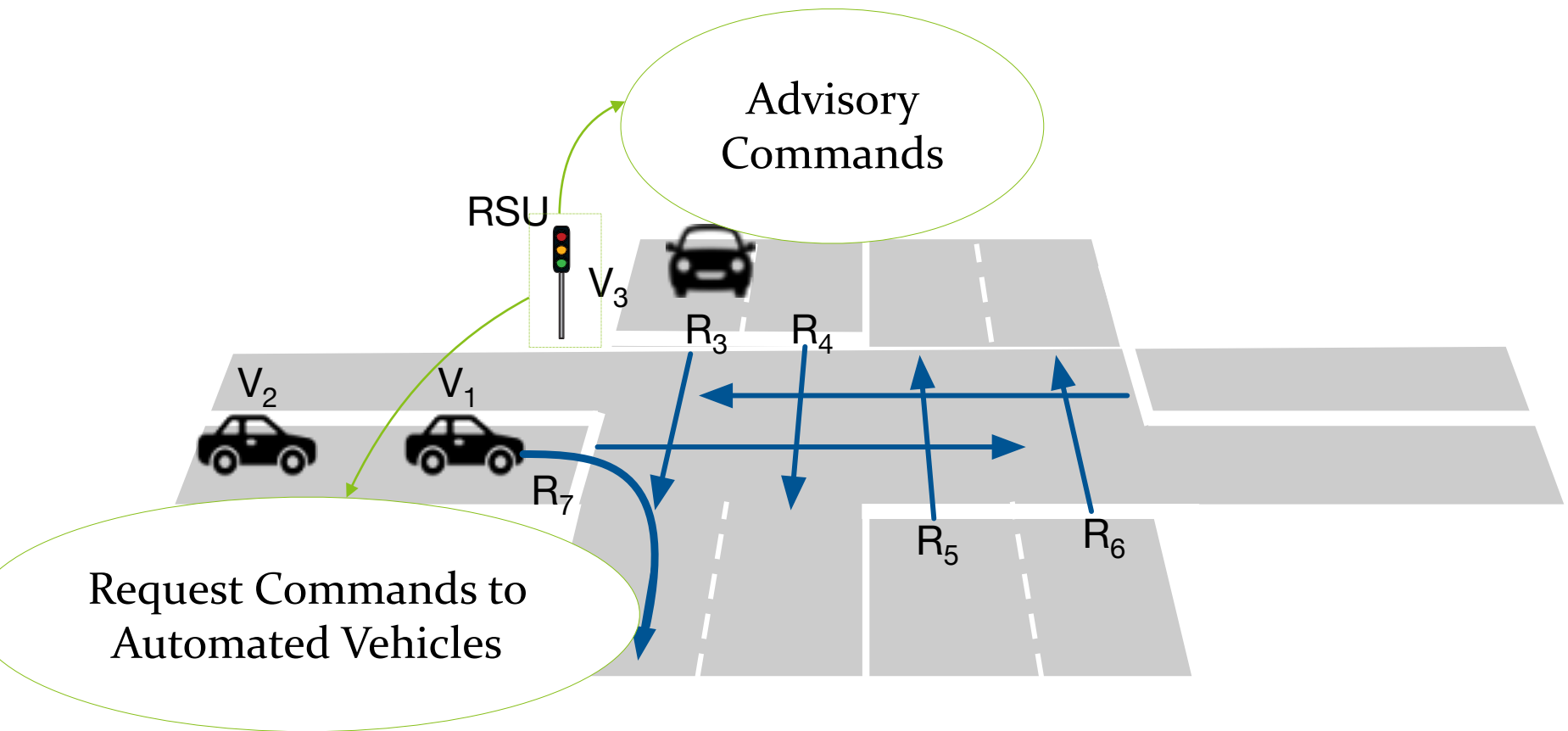
R₄

R₅

R₆

Route Plan for
Autonomous Vehicles

Toward Coordination and Collaboration

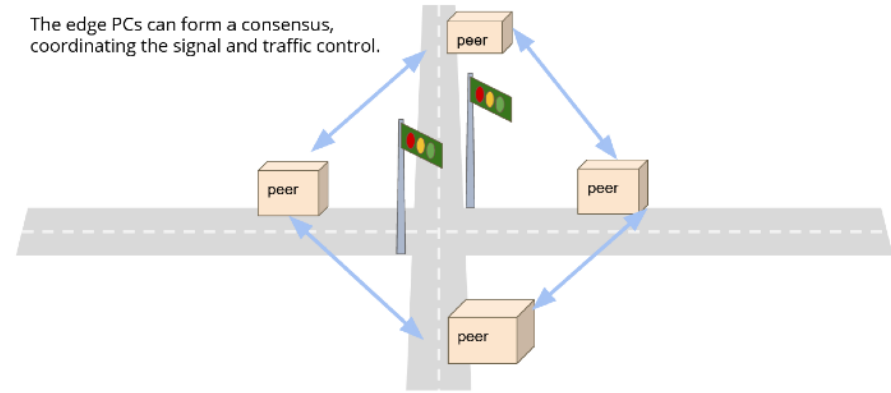


Distributed Consensus as Virtual Traffic Signals Sponsored by ADLink

- ▶ Goal: optimize the intersection use subject to safety requirements without traffic lights
- ▶ Methods:
 - ▶ Allow the vehicles to negotiate with each other and find the optimal decision to cross the intersection
 - ▶ Road Side Unit will serve as the observer, gateway and decision logger.
- ▶ Challenges:
 - ▶ The number of vehicles dynamically change.
 - ▶ The decision has hard deadline constraint.

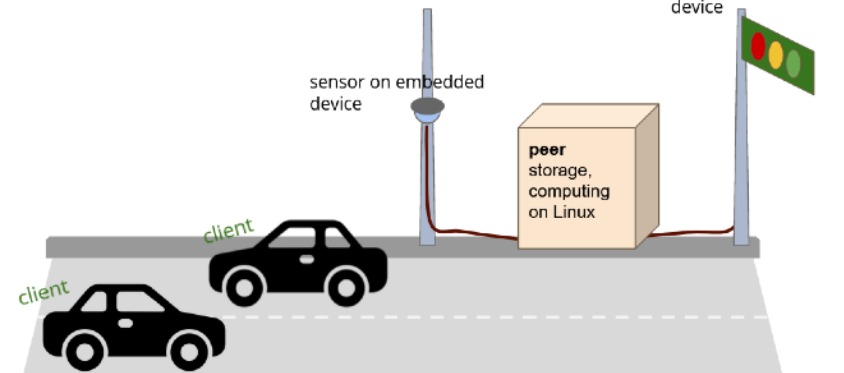
Coordinating Roadside Devices

The edge PCs can form a consensus, coordinating the signal and traffic control.

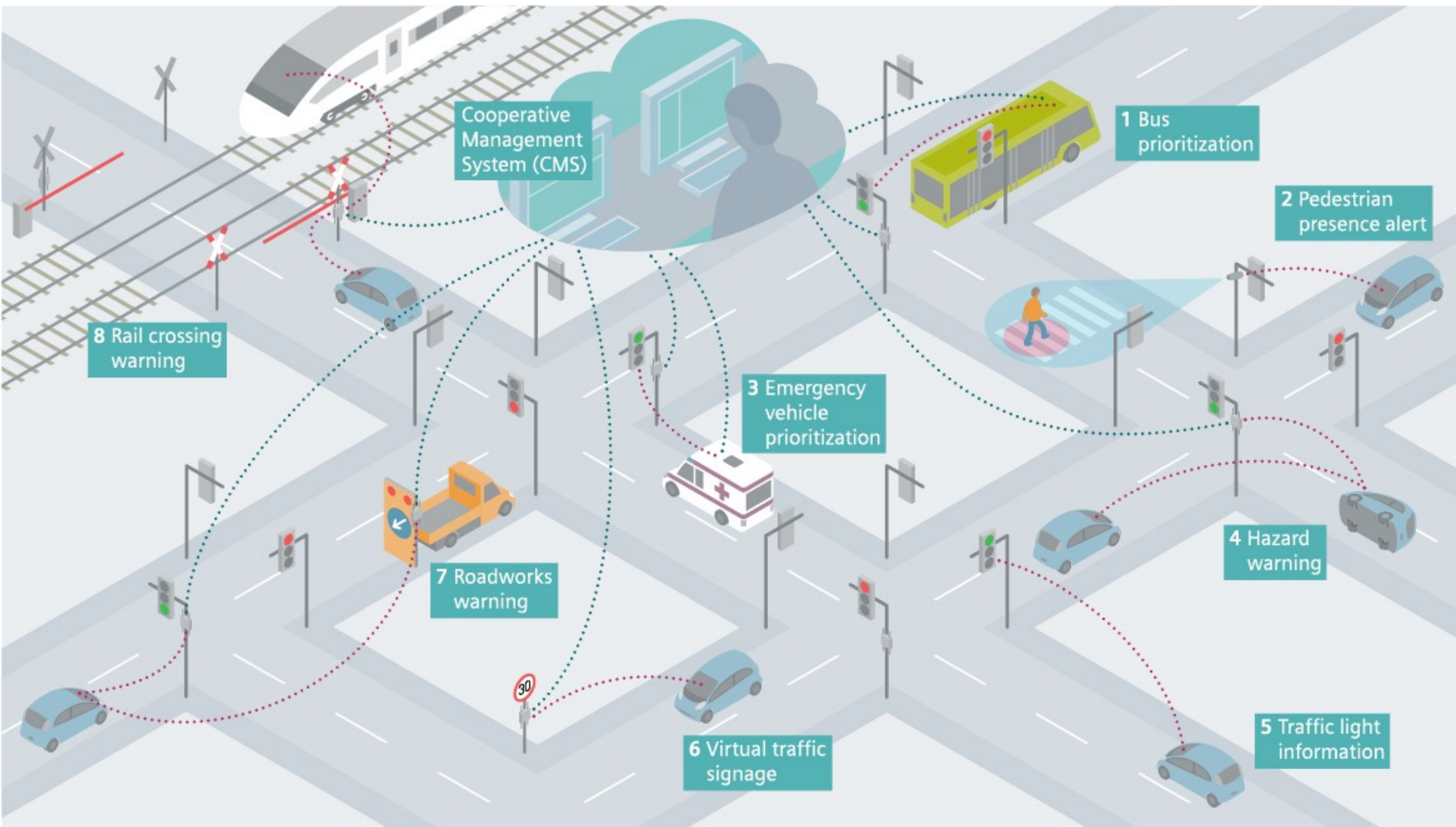


The Traffic Scenario

signals on embedded
device



Coordinated and Collaborated Smart Transportation



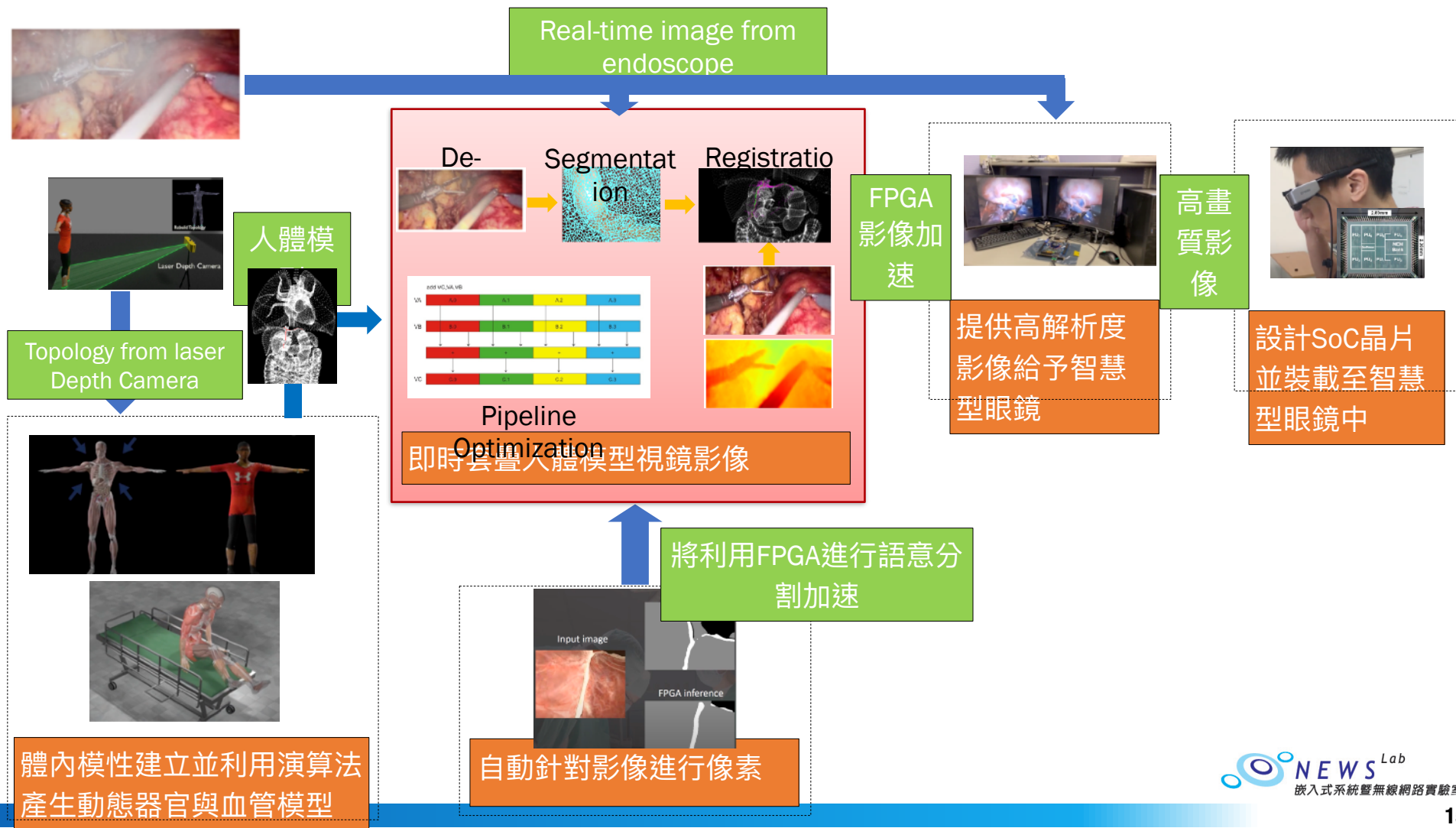
<https://www.yunextraffic.com/global/en/portfolio/traffic-management/connected-mobility-solutions/vehicle2x-communication>

Sponsorships

- ▶ This researches are sponsored by following agencies and entities:
 - ▶ Ministry of Science and Technology
 - ▶ ADLink Inc.
 - ▶ ARM
 - ▶ Tier 4 Inc. (Japan)
 - ▶ Autoware Foundation
 - ▶ National Taiwan University

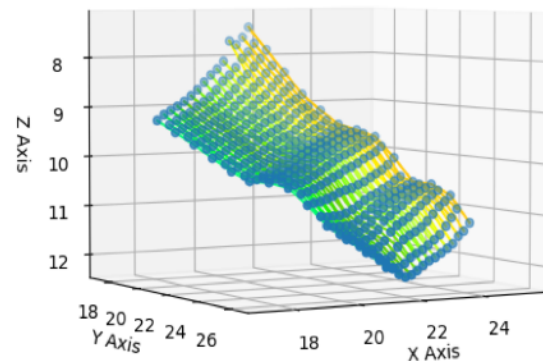
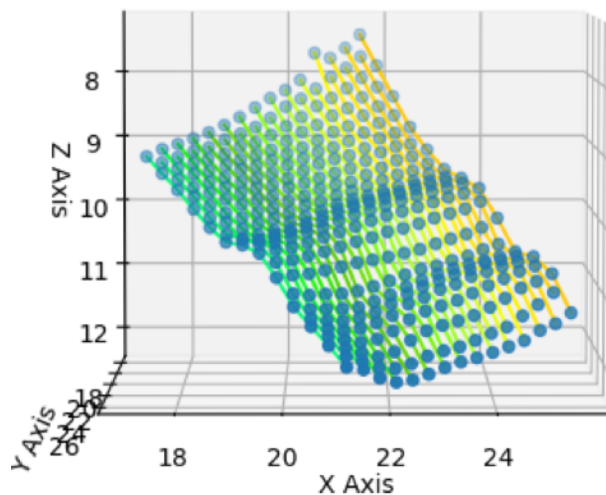
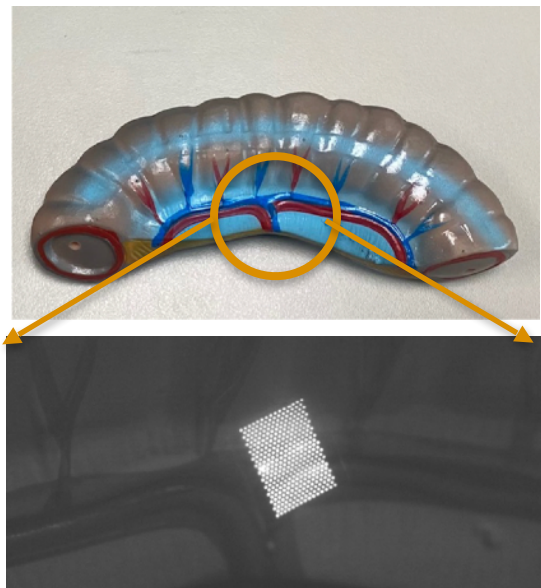
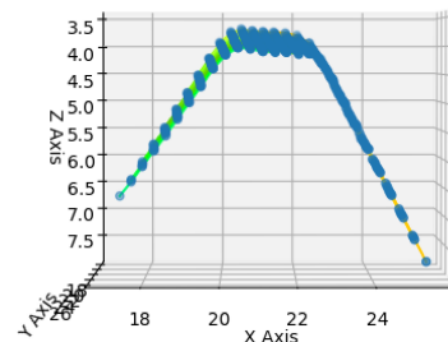
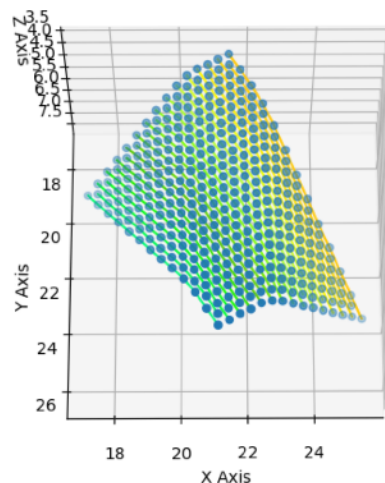


Smart Sensors: Low-Power r Always-On Real-Time 3D Sensing



現有成果 – 以 VCSEL (15 x 25) 為光源

Resolution is 17 μ m at 20cm

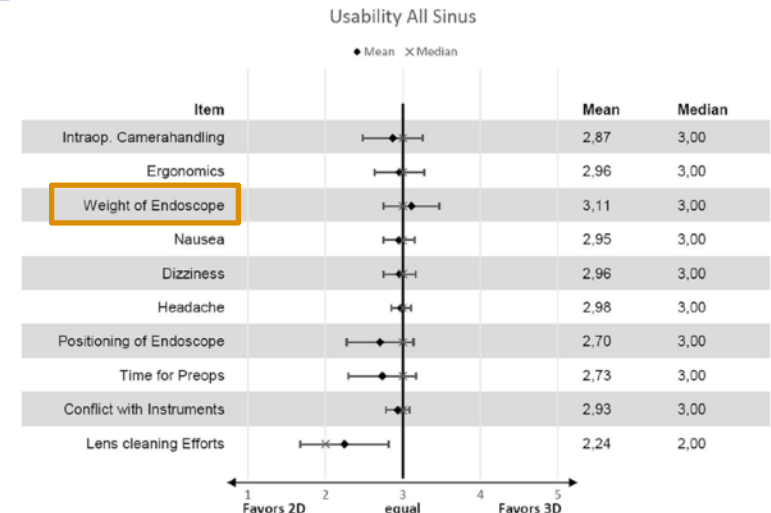
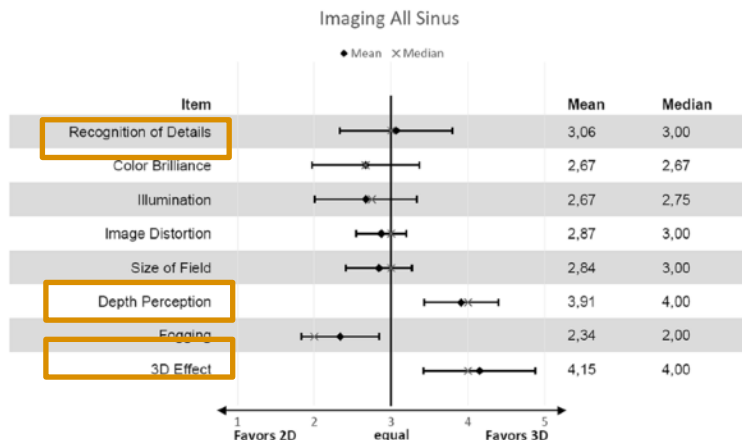
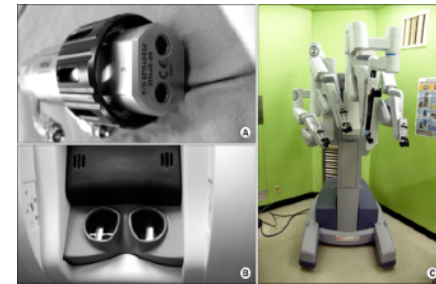
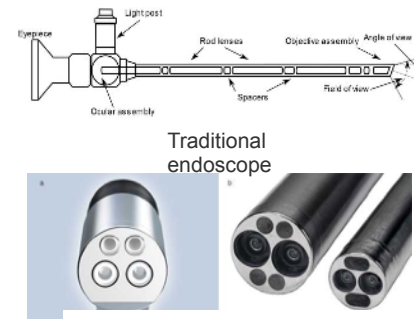


From 2D to 3D Endoscope

- ▶ The visualization of a 3-dimensional surgical field has the theoretical advantage to provide the surgeon with more realistic information about the anatomy of the surgical field which may be beneficial for surgical control and may even reduce complications.

▶ Current Products:

- Da Vinci XI
- Image1 S by KARL STORZ
- Olympus 3D Imaging Solutions



The mean duration for surgery (per sinus) was 7.75 min (SD 4.38) for 2D and 8.06 min. (SD 5.76) for 3D without statistical significance ($P = 0.334$).

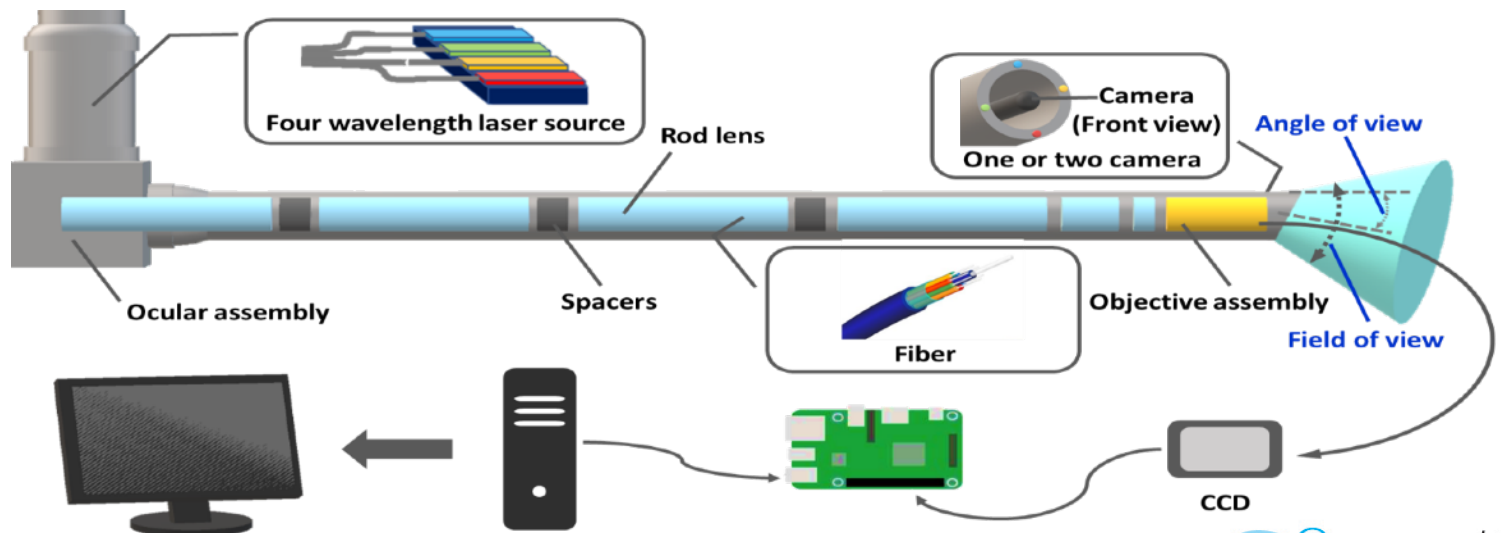
<https://onlinelibrary.wiley.com/doi/10.1111/coa.13494>

Proposed Design

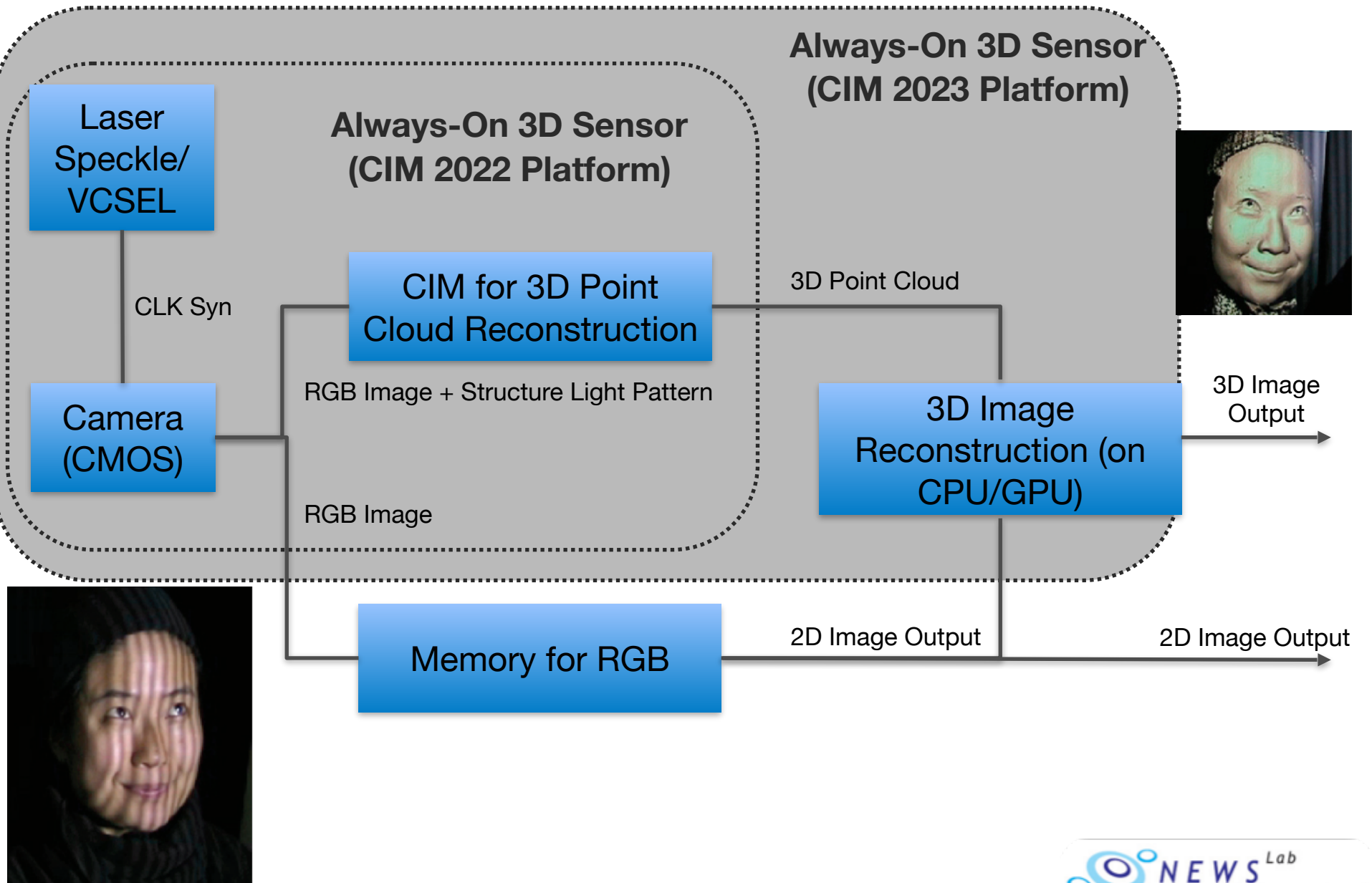
To better fit the light sources and camera into tube of endoscopes, we propose to

- (1) use fiber to carry the light of different wavelengths and
- (2) add space mask to create structure patterns

to create structure patterns on surface. Given our current approaches, we can analyze the images to estimate the depth of the surface or create three-dimension mash of the image.



Architecture of Smart Sensors



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 - ▶ MediaTek Inc.
 - ▶ QuanTa Computer
 - ▶ National Taiwan University

Lab Activities

- ▶ Social Events:
 - ▶ Spring event: Outdoor (Camping, hiking, air gun shooting, etc.)
 - ▶ Fall Event: BBQ (indoor or outdoor)
 - ▶ Yearly event: banquet
- ▶ Meeting:
 - ▶ Weekly group meeting for all members
 - ▶ Weekly Project meeting for member in each individual project
 - ▶ Individual meeting for senior students (30 minutes biweekly)
- ▶ Current members:
 - ▶ PhD: 2
 - ▶ Master: 14
 - ▶ Full-time engineer: 1
 - ▶ Full-time Assistant: 1
- ▶ Lab location: 442 and B04

Opportunities

- ▶ Intern Opportunities:
 - ▶ ADLink, MediaTek, and others
- ▶ International Exchange Opportunities:
 - ▶ NAR Lab (Canada)
 - ▶ University of Tokyo (Japan)
 - ▶ Université Paris-Saclay (France)

Next Actions

- ▶ Send me an email before 5PM Friday, including:
 - ▶ One topic you are interested in.
 - ▶ NTU exam grade report
 - ▶ Grade report from your current or latest degree
- ▶ 1st round will be replied before Monday, including admitted and waiting list.