Qualcomm Innovate in Taiwan Challenge 2021

5G Communication Module of AI base on Quantum Microcomputer in Wireless Vehicular Network

A Good Intention AI Co., Ltd.

Quantum Computer of RD Department

AGAI Bullrun701 Team

http://www.free-powerpoint-templates-design.com

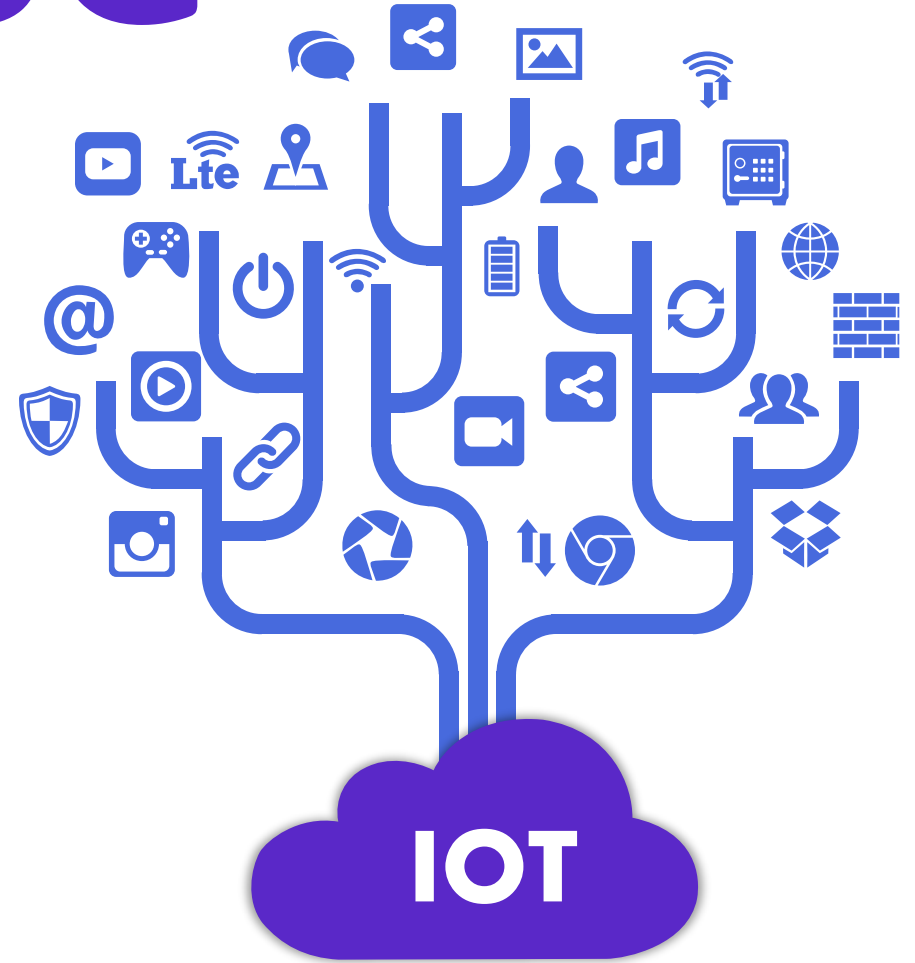How to improve our live with 5G Communication of Network?

Ans

IOT
AI
Wireless Vehicular Network

Vehicular Internet Of Topics

5G AI IoT

- ✓ Prevent collision
- ✓ Locate pedestrian
- ✓ Speed up the localization
- ✓ Improve efficiency of the facility

IOT

What Vehicles can prevent collision and locate pedestrian, even the accident can be reduced and lives can be safer?

01 Sensor + GPS
Prevent Collision

02 AI + Computer Vision
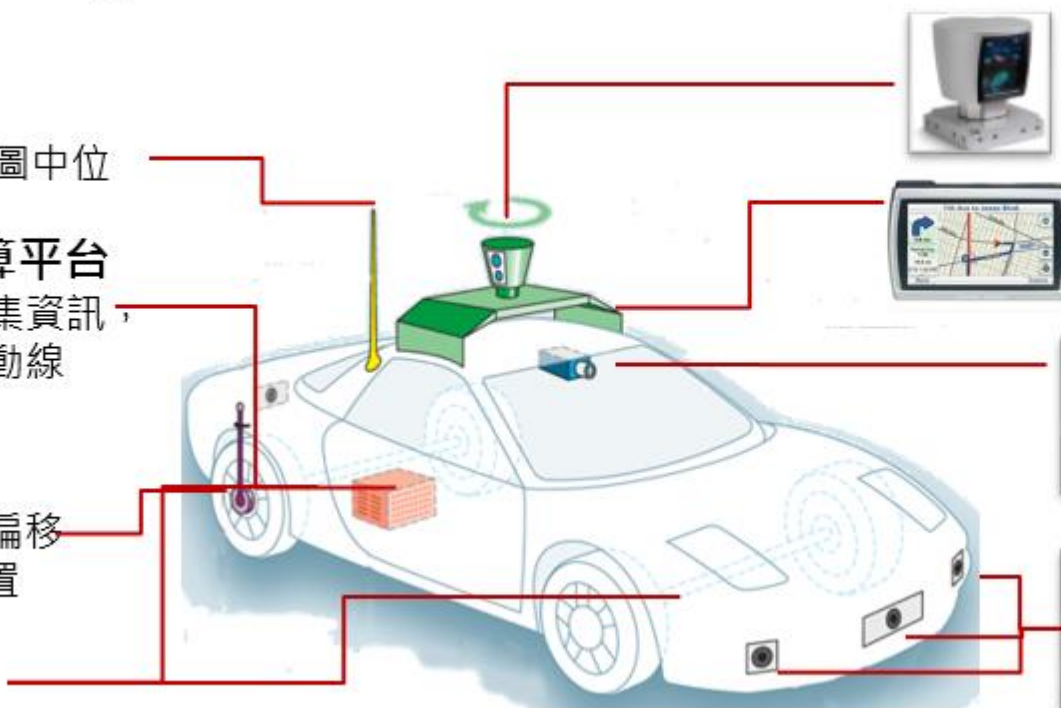**Locate Pedestrian**

03 Edge Computing
Accident Reduced

https://www.automan.tw/news/newsContent.aspx?id=2725

序號❺~❽：執行「決策與控制」程序

序號❶~❹：執行「感測」程序

❺ GPS接收器
辨識車輛於地圖中位置

❻ 電腦資料運算平台
透過感應器蒐集資訊，決定車輛行進動線

❼ 定位感測器
監控車輛是否偏移GPS地圖中位置
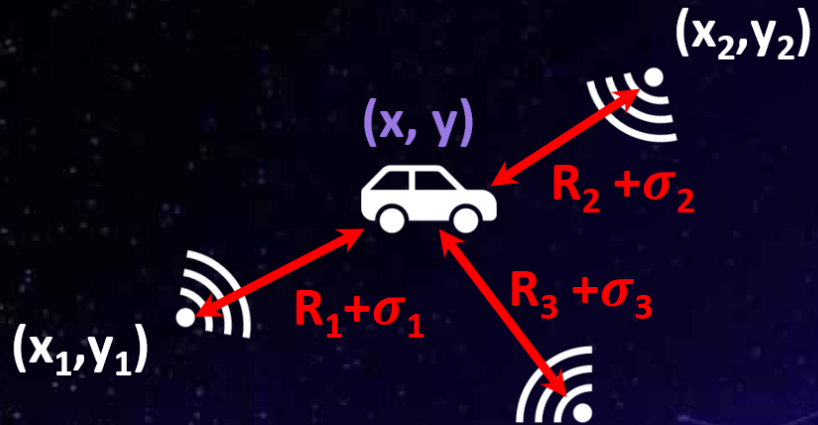
❽ 電子線控
(X-by-wire)

❶ 光達
360度旋轉，掃描周遭200公尺環境並繪成3D

❷ 慣體動作感測器
因應GPS訊號微弱時，提供航位推算功能

❸ 攝影機
負責判讀交通號誌，並偵測移動障礙物

❹ 毫米波雷達
判斷車輛遠距離物體位置與距離

What can be solved or support by Quantum Computing?

Quantum Algorithm can support computing Vehicle Localization

(x_2, y_2)

(x, y)

$R_2 + \sigma_2$

$R_1 + \sigma_1$

$R_3 + \sigma_3$

(x_1, y_1)

$$\min \left| \sum_{i \in I} (x_i - x)^2 + (y_i - y)^2 - (R_i^2 + \sigma_i) \right|$$

Car's position = (x, y)
Sensor's position = (x_i, y_i)
Sensor's noise = σ_i
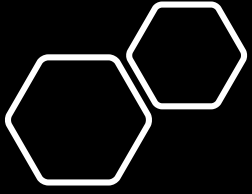
Problem Type

Optimization problem

Method

Quantum approximate Optimization Algorithm

Quantum Advantage

Solve NP problem in Classical Computer

Speedup your Computing Time

Guerreschi, G.G., Matsuura, A.Y. QAOA for Max-Cut requires hundreds of qubits for quantum speed-up. *Sci Rep* **9**, 6903 (2019). https://doi.org/10.1038/s41598-019-43176-9

Quadratic Problem

$$\min \left| \sum_{i \in I} (x_i - x)^2 + (y_i - y)^2 - (R_i^2 + \sigma_i) \right|$$

QAOA

- hybrid quantum-classical variational algorithm
- designed to tackle combinatorial optimization problems

- NP-hard problem

- Can be mapping into QAOA (Quantum Approximate Optimization Algorithm)

arXiv:1812.01041v2
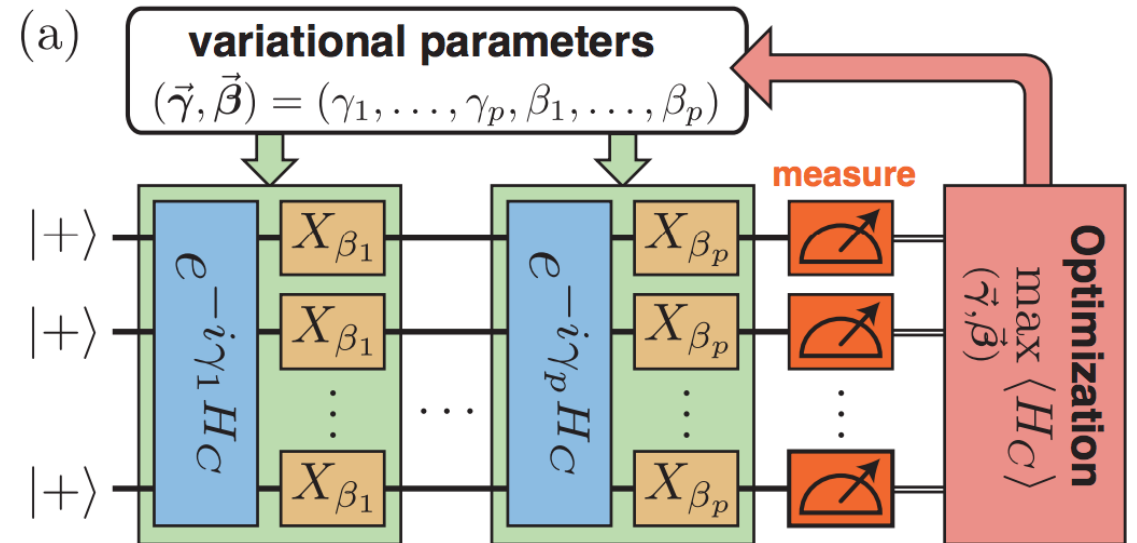
- How does we Integration 5G Communication of Wireless Vehicular Network & Quantum Computing to IOT Application scenarios?

- How does we create this 5G Communication of Network Product?

How to Integration
5G Communication
and
Quantum Computing?

➢ We only need to using Evaluation Board and 5G Chip and antenna, building an Communication Module.

➢ We should install quantum computer SDK on Microcomputer Chip.

➢ Combine this Communication Module and Microcomputer Chip to a Sensor Device

Our Idea Production
5G Quantum Microcomputer Sensor

5G Chip

All antennas can be customized as required

5G

Qualcomm snapdragon

Evaluation Board

5G Antennas

arm

Arm® NEOVERSE™ SoC
DAWN Ares Platform

TSMC 7FF
T8H014.00 W01 019 (TT)
4618   0018

Qiskit

Quantum SDK

11

Picture source by google Image Search

Final Creation
5G Quantum Microcomputer Sensor
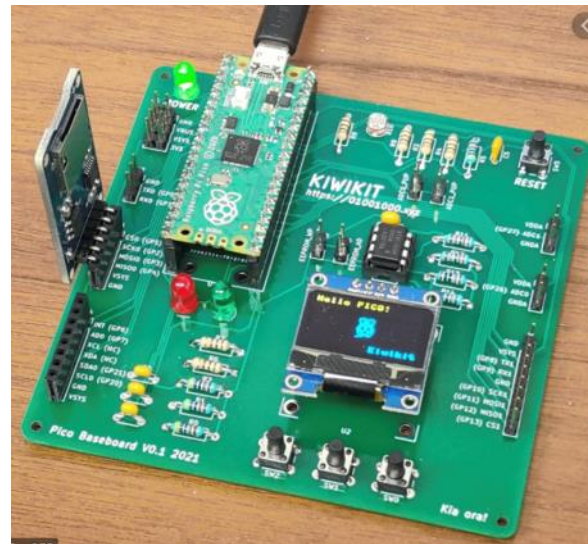
How does we create this 5G Communication of Network Product?

1. Finding a sample of 5G Communication Module
2. Fallowing this sample to Copy-DIY our Microcomputer
3. Install Qiskit and our Quantum Code on Microcomputer

Finding a sample
5G Communication Module

AGAI Sensor Device

Copy-DIY our Microcomputer

All antennas can be customized as required

5G Chip(communication+AI)

Embedded

5G Antennas

Evaluation Board

Embedded

5G

Qualcomm snapdragon

arm NEOVERSE™ SoC DAWN Ares Platform
TSMC 7FF
T8H014.00 W01 019 (TT)
4618 0018

15

Picture source by google Image Search

Install Qiskit on Microcomputer

https://medium.com/qiskit/rasqberry-quantum-computing-is-the-coolest-project-for-raspberry-pi-3f64bec5a133

Evaluation Board

Install our Quantum Code on Microcomputer

burn code

Evaluation Board

Quantum Approximate Optimization Algorithm

$$\min \left| \sum_{i \in I} (x_i - x)^2 + (y_i - y)^2 - (R_i^2 + \sigma_i) \right|$$

17

Quantum Programming

Final DEMO
5G Quantum Microcomputer Sensor
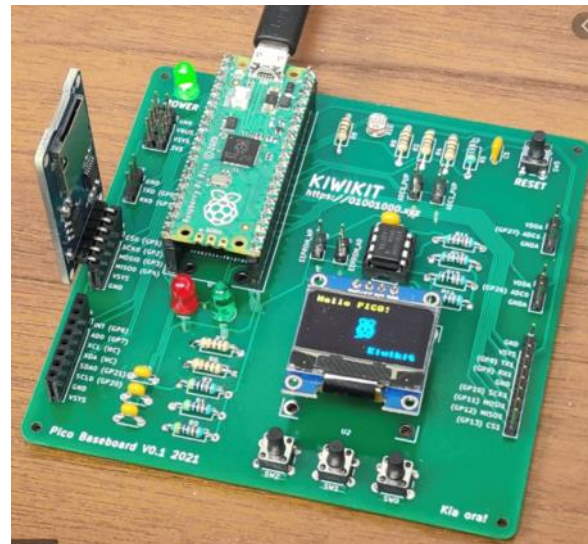
Future work
5G Quantum Microcomputer Sensor deploy

https://www.automan.tw/news/newsContent.aspx?id=2725
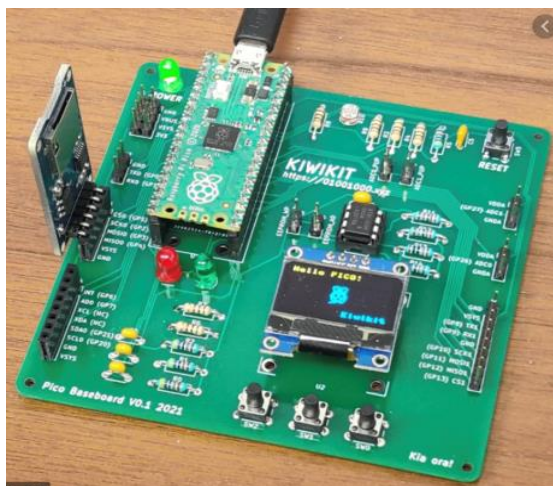
01 Sensor + GPS

02 AI + Computer Vision

03 Edge Computing

序號❺～❽：執行「決策與控制」程序

序號❶～❹：執行「感測」程序

❺ GPS接收器
辨識車輛於地圖中位置

❻ 電腦資料運算平台
透過感應器蒐集資訊，決定車輛行進動線

❼ 定位感測器
監控車輛是否偏移GPS地圖中位置

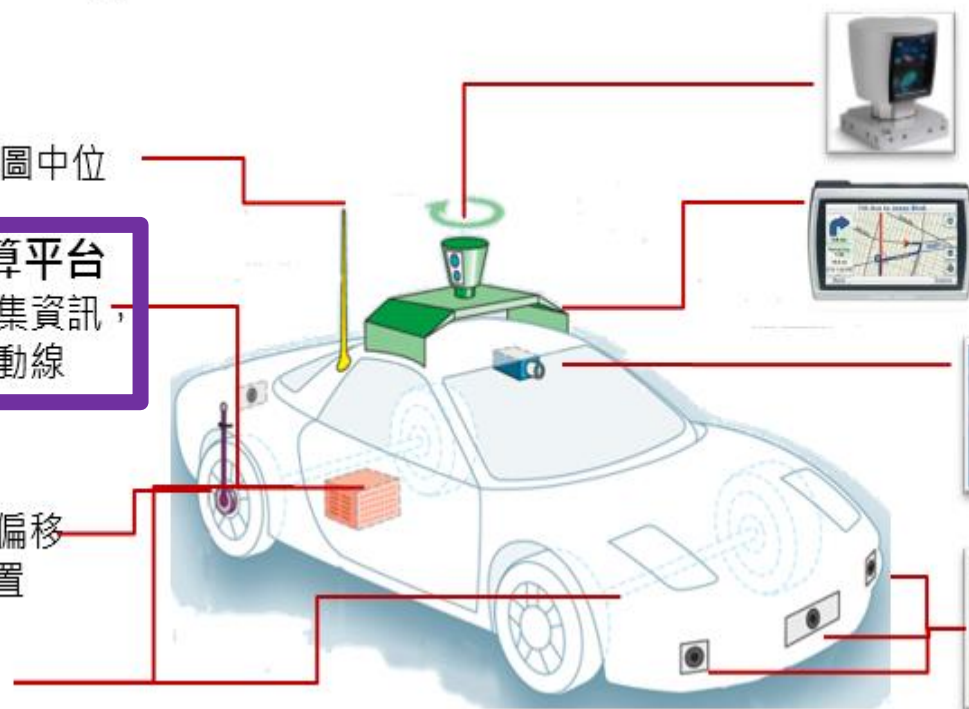❽ 電子線控
(X-by-wire)

❶ 光達
360度旋轉，掃描周遭200公尺環境並繪成3D

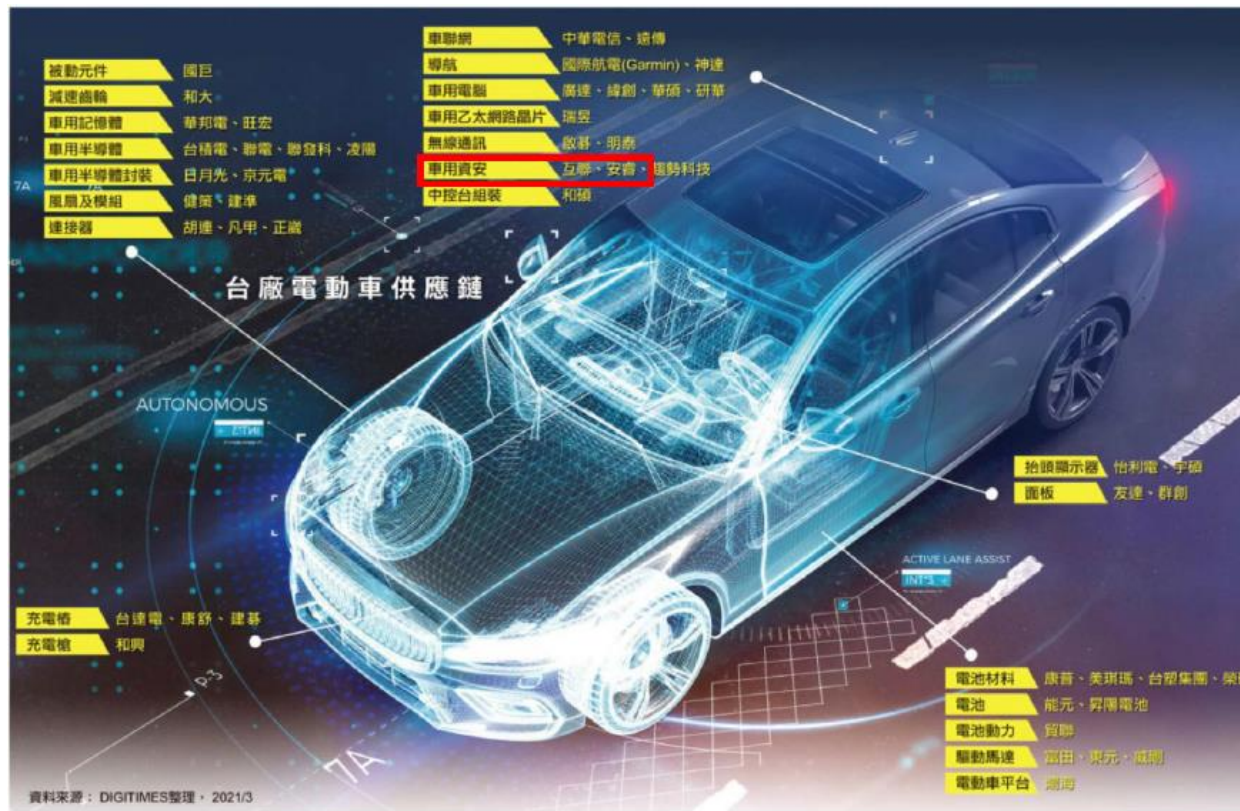❷ 慣曡動作感測器
因應GPS訊號微弱時，提供航位推算功能

❸ 攝影機
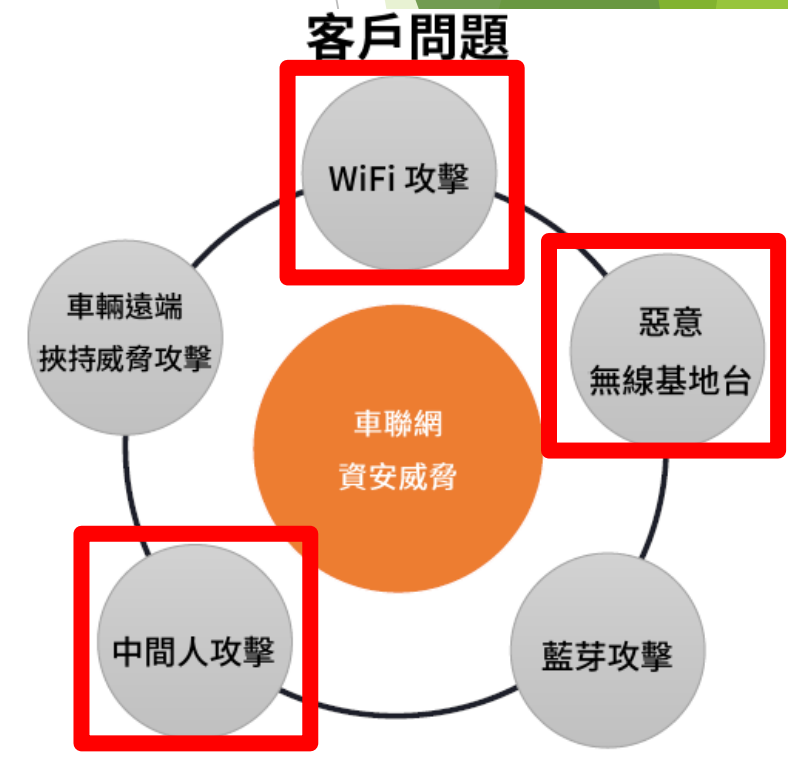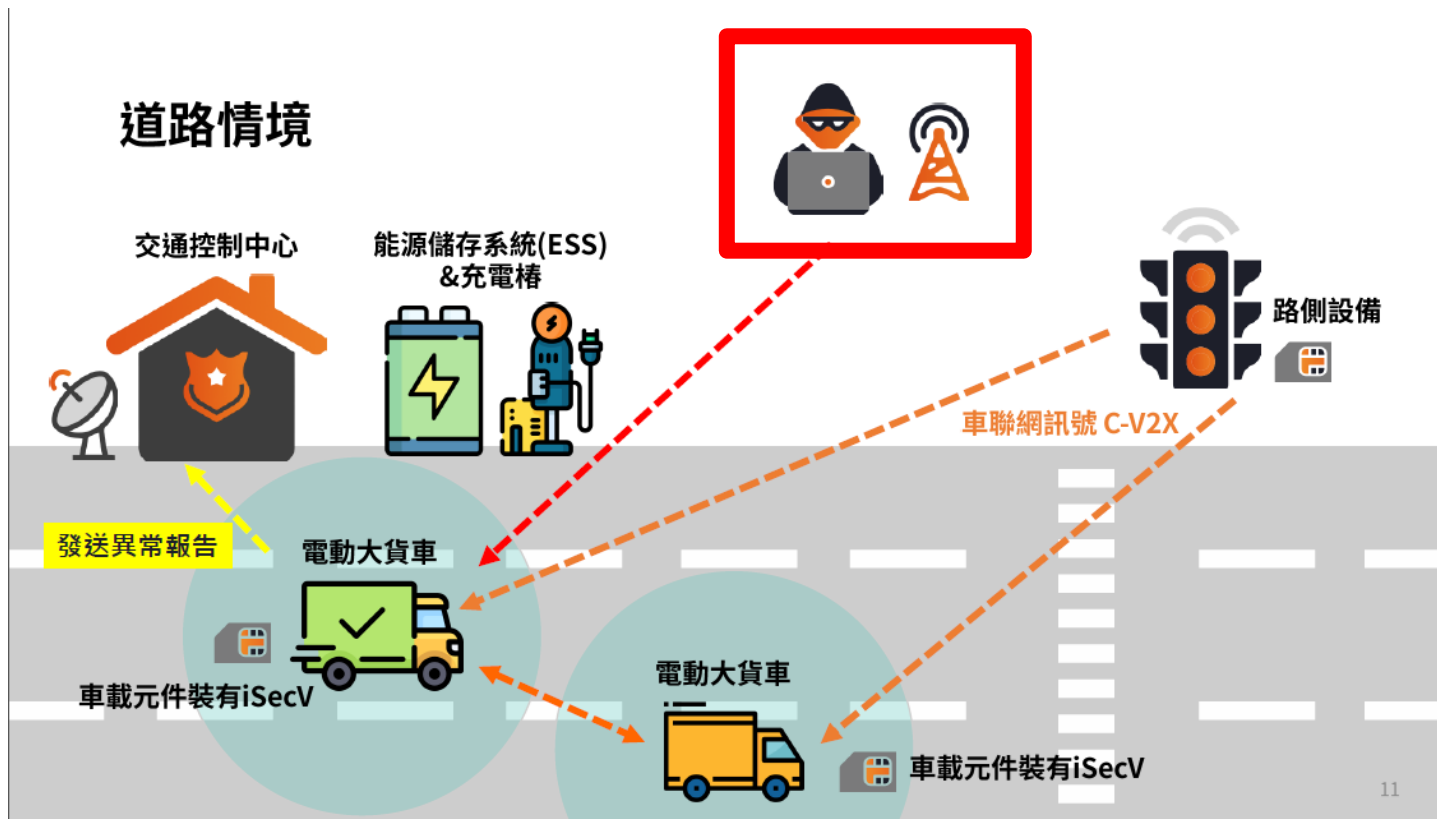負責判讀交通號誌，並偵測移動障礙物

❹ 毫米波雷達
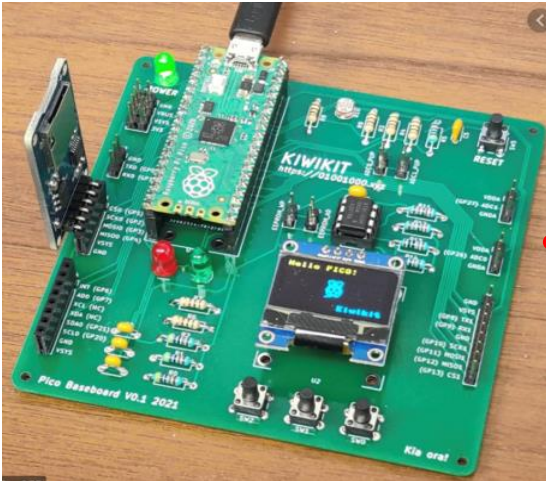判斷車輛遠距離物體位置與距離

Future work
Wireless Vehicular Network Security on 5G

Wireless Vehicular Network Security Scenarios on 5G

Our Cooperative manufacturer can used 5G Quantum Microcomputer Sensor deploy on Their 5G Security Solution Consultant
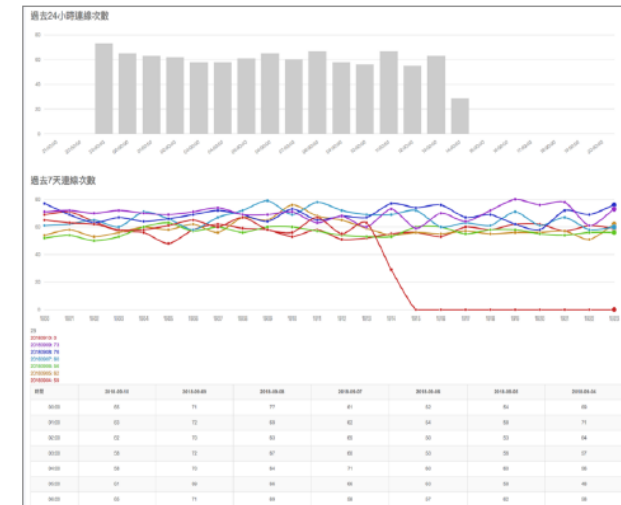

車聯網場域 資安對策

透過軟硬整合，有效達成資安防護

• 硬體-感測器

i SecMaster
ARCRAN INC.

• 軟體-監控平台

應用於多元化領域: 4G路由器、
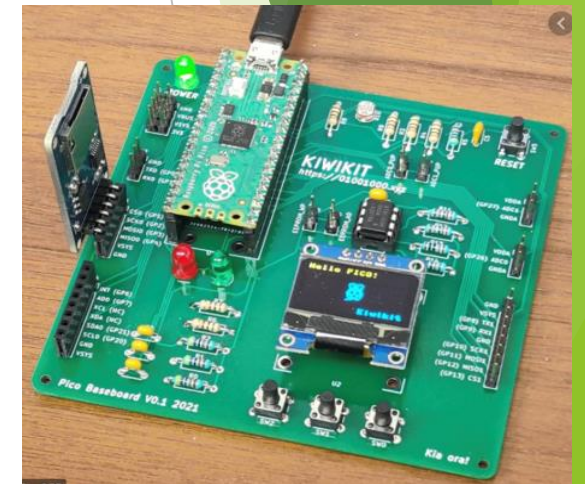網路影像監視器、Kiosk、
智慧裝置；Open SDK

ArcRan Inc.

9

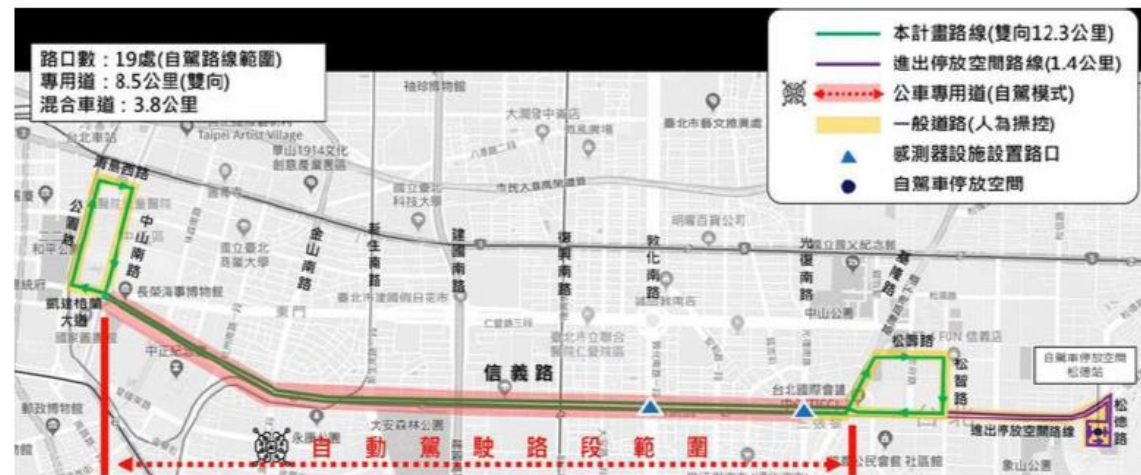# 5G Quantum Microcomputer Sensor has Expansion Module

功能

- 支援訊號種類:
  - ➢ 藍芽
  - ➢ 802.11a, b, g, n, ac, ax
  - ➢ 短距無線通訊DSRC(802.11p) , 蜂巢式車聯網 C-V2X, etc.
- 為自駕車通訊系統提供資安威脅預防系統 (情境包含: 車間通訊V2V, 車與路側設備/基礎設施互聯V2I, 車與雲端互聯V2C,車與行人互聯 V2P, etc.)

We can Application on 5G Wireless Vehicular Network Security Market
with Our Cooperative manufacturer

[案例]
台北信義區
自駕巴士

- 臺灣智慧駕駛與北市政府合作，於信義區公車專用道進行自駕巴士試煉
- 試煉路線全長共12.3公里，包含雙向公車專用道及混合車道，途經19個路口
- 互聯安睿提供iSecV車聯網資安威脅偵測器，於測試期間進行即時數據收集、資安防護
- 本案證實iSecV可於實際道路應用，維護乘客安全及公共交通安全，避免因系統漏洞、駭客攻擊等資安威脅，使自駕巴士無法正常行駛，造成人員傷亡、財物損失

路口數：19處(自駕路線範圍)
專用道：8.5公里(雙向)
混合車道：3.8公里

本計畫路線(雙向12.3公里)
進出停放空間路線(1.4公里)
公車專用道(自駕模式)
一般道路(人為操控)
感測器設施設置路口
自駕車停放空間

自 動 駕 駛 路 段 範 圍

12

24

We can Application on 5G Wireless Vehicular Network Security Market
with Our Cooperative manufacturer

[案例]
桃園虎頭山
創新園區

- 虎頭山創新園區為首座結合「車聯智駕中心」與「資安物聯網中心」的測試研發基地，提供智慧駕駛及自駕車研發環境及測試場域，園區面積4.7公頃
- 互聯安睿受邀進駐該園區，為智慧駕駛廠商提供專業資安輔導，進行資安防護系統建置與實際場域試煉，有效提升智慧駕駛之創新服務能量，為整體產業鏈加值

13

Conclusions

➢ **We Integration 5G Communication of Wireless Vehicular Network and Quantum Computing to IOT Application scenarios.**

➢ **Final We create a 5G Communication of Network Product by Copy-DIY**

➢ **IN the future, we deploy to Wireless Vehicular Network Security on 5G with our Cooperative manufacturer.**
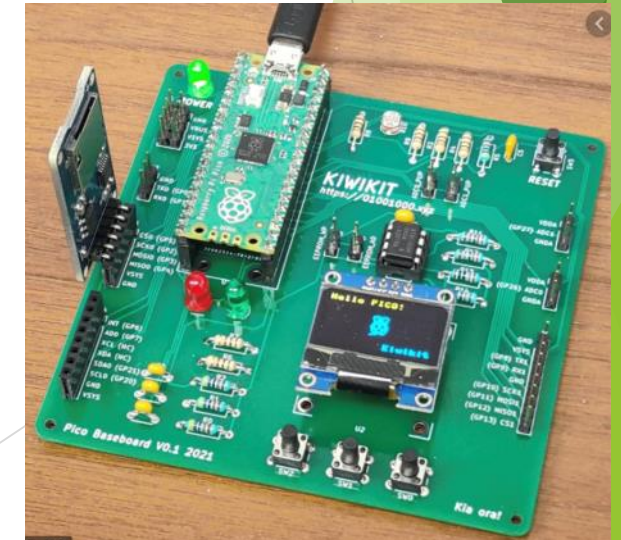
Thank you
for your attention!

We are AGAI Bullrun701 Team