



Advanced Dashcam Assistance System

Group 2

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Outline

- Introduction
- System Architecture
- Technology
- Global Market Analysis
- Reference

Outline

■ Introduction

■ Motivation

■ Application Scenario

■ System Architecture

■ Technology

■ Global Market Analysis

■ Reference



Motivation

■ Driving Condition

- There are numerous things to pay attention while driving
- Useful Visual Field of View (UFOV) studies in driving ability
- Driver's attention and concentration

■ Target User

- Ordinary drivers with safety consciousness
 - Car rental company
 - Logistics
 - Uber
 - Driving school



Application Scenario

■ Driving Assistance

- Assist ordinary drivers
 - Particularly helpful for new drivers
- Reduce fatigue while driving
 - Prevent from fatigue drivers and drunk drivers

■ Improve the safety of all road users

- Detect drunk driving
- Detect fatigue driving
- Detect distracted driving





Outline

- Introduction
- System Architecture
 - Features
 - System Diagram
 - Data Flow Diagram
 - System Specification
- Technology
- Global Market Analysis
- Conclusion
- Reference

Features – Focus Reminder System

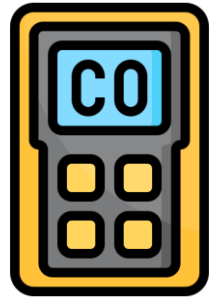
■ Inner system

- A pressure sensor on the steering wheel to prevent fatigue driving
- An alcohol gas detection to prevent drunk driving
- An inner cam and a radar to detect driver and passenger behavior

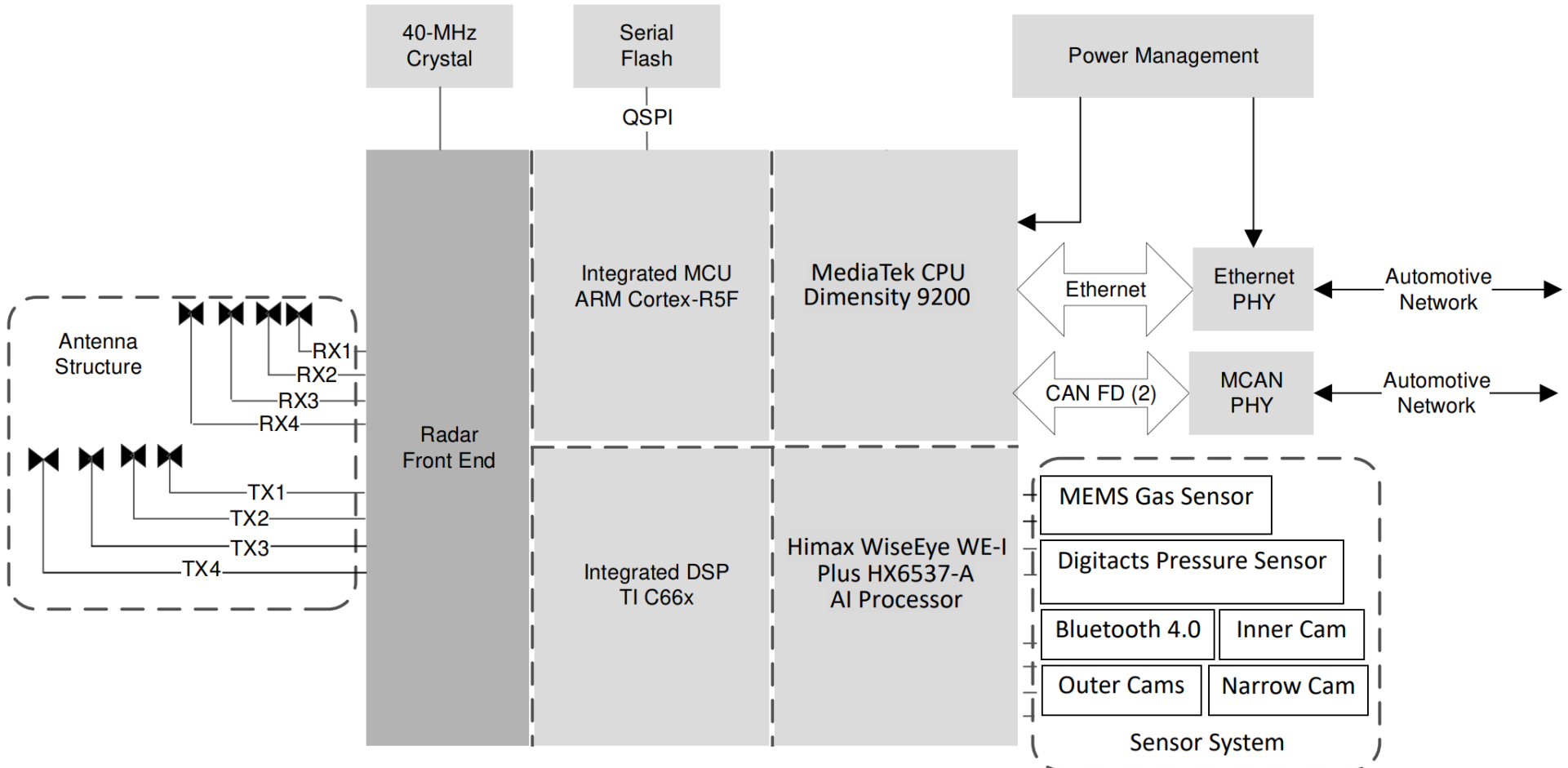
■ Outer system

■ Driving assistance

- Vision for object detection and lane detection
- Radar for object detection that provide range and doppler estimation

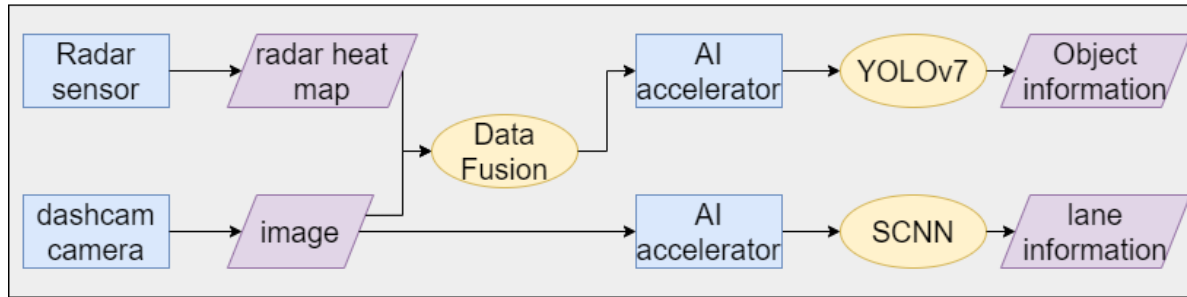


System Diagram

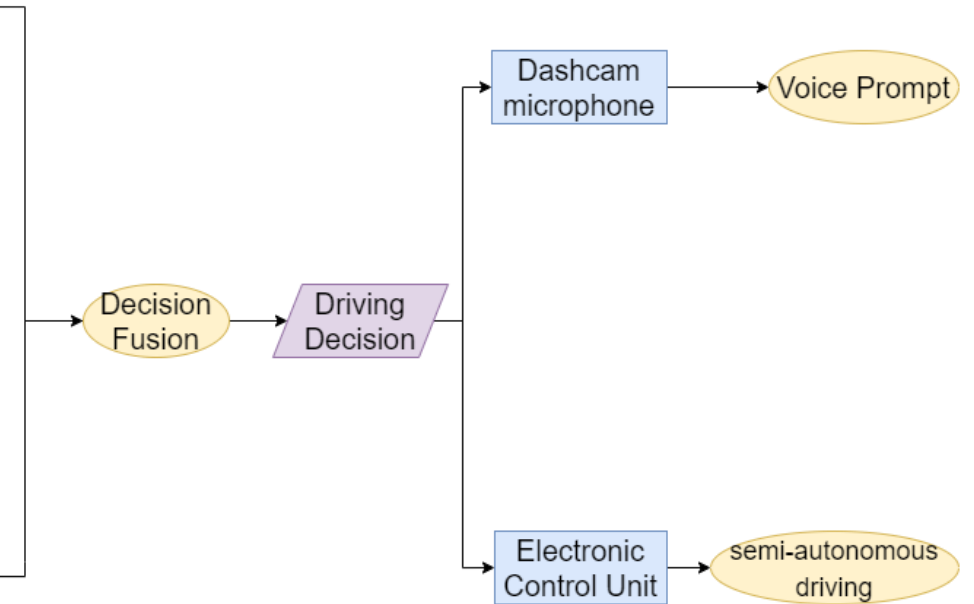
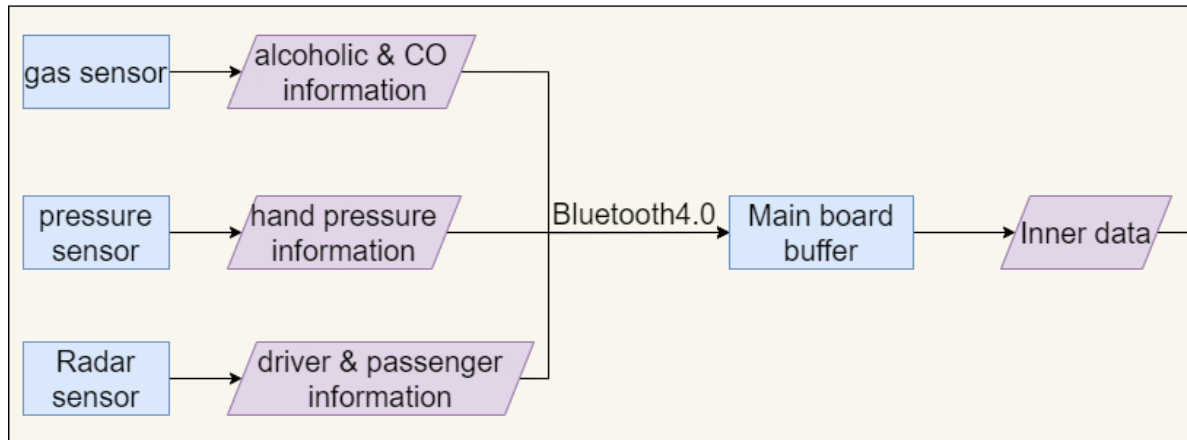


Data Flow Diagram

Outer Sensing



Inner Sensing





System Specification - 1

■ Main Processor

- MediaTek Dimensity 9200

■ Radar Processor

- ARM Cortex-R5F
- TI DSP C66x

■ Camera

- Three 1080p cameras w/ 120 dB of dynamic range: dual-cam 360° vision
- One narrow camera to see far-away objects

■ Storage

- 32 GB built-in storage
- 1TB Samsung 980 NVMe SSD



System Specification - 2

■ Connectivity

■ Cellular Technologies

- FR1: Sub-6GHz
- FR2: mmWave
- LTE, GSM

■ Wi-Fi

■ Bluetooth

■ High-Precision GNSS

- GPS
- BeiDou
- Glonass

■ Nightvision

- IR LEDs for interior night-vision monitoring
- Radar Sensor



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- Introduction
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- Technology
 - Sensor
 - Main Chip
 - Bluetooth Low Energy 4.0
- Global Market Analysis
- Reference



Radar Sensor

■ TI AWR 2944

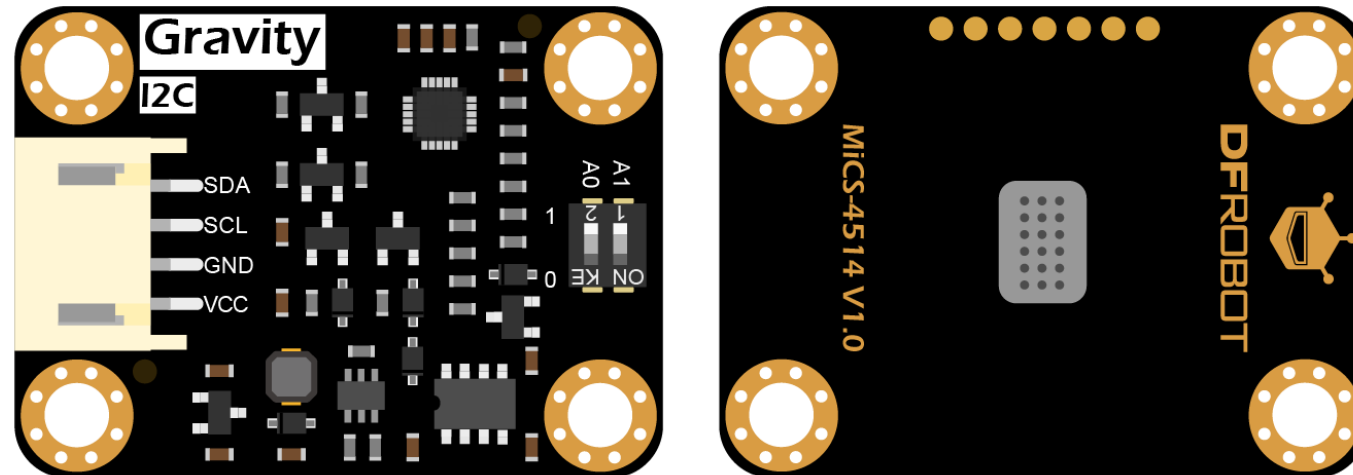
- **76-81 GHz** mmwave radar sensor
- four-transmit four-receive antenna
- On-chip **C66x DSP** core and **ARM Cortex-R5F** controller
- On-chip **hardware accelerator** for FFT

Number of receivers	4
Number of transmitters	4
ADC sampling rate (Max) (MSPS)	37.5
Interface type	2 CAN-FD, Ethernet, I2C
DSP	C66x DSP 360MHz
Hardware accelerators	Radar hardware accelerator
Rating	Automotive
Operating temperature range (C)	-40 to 140
Power supply solution	LP87745-Q1
Security	Cryptographic acceleration, Device identity/keys, Secure boot, Secure software update, Software IP protection, Trusted execution environment

Gas Sensor

■ Gravity: MEMS Gas Sensor

- Gas concentration sensor from DFRobot
- Support the detection of CO, C₂H₅OH (Alcohol), NO₂, H₂, NH₃, CH₄
- Low power and compatible with Arduino, Raspberry Pi..... using I2C output





Gas Sensor

■ Specification

Operating Voltage (V)	3.3 ~ 5.5 (DC)
Power Dissipation (W)	0.45 (5V)
Output Signal	I2C (0 ~ 3V)
Operating Temperature (°C)	-30 to 85
Operating Humidity	5% ~ 95% RH (No Condensation)
Storage Temperature (°C)	-40 to 85
Lifespan	> 2years (in the air)
Circuit Board Size (mm^2)	27*37
Mounting Hole Size (mm)	Inner Diameter: 3.1 / Outer Diameter: 6

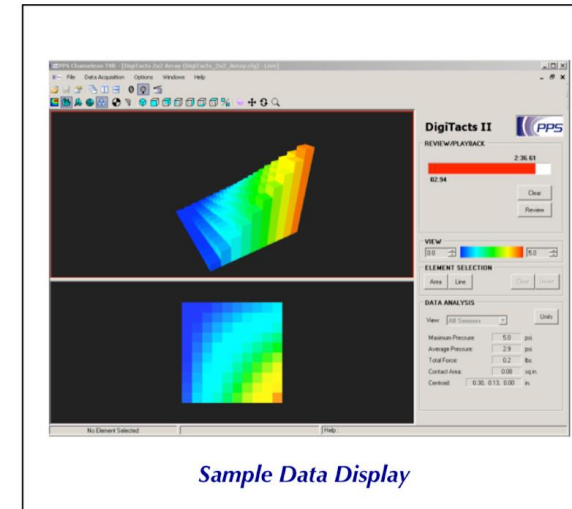
Measuring Range:

- 1 – 1000 (ppm) (Carbon monoxide CO)
- 10 – 500 (ppm) (Ethanol C₂H₅OH)
- 0.05 – 10 (ppm) (Nitrogen dioxide NO₂)
- 1 – 1000 (ppm) (Hydrogen H₂)
- 1 – 500 (ppm) (Ammonia NH₃)
- >1000 (ppm) (Methane CH₄)

Pressure Sensor

■ Digitacts

- High performance embedded tactile sensors from Pressure Profile Systems (PPS)
- Sensitive tactile sensors can be used on almost any geometry surface
- Bluetooth wireless technology and SPI or I2C serial digital output
- Chameleon Visualization Software (Easy to use, high-quality visualization...)





Pressure Sensor

■ Specification

Sensor

Pressure Range (psi)	5, 20, 40
Pressure Sensitivity	0.2%
Linearity	99.7%
Signal to Noise Ratio (SNR)	700
Contact Surface Material	Cloth and Polyimide
Sensor Thickness (mm)	0.5
Cable Length(m)	1.5
Operating Temperature (°C)	-20 to 100

Electronics

Sampling Rate (Hz)	30-100
Computer Interface	Bluetooth
Input Voltage	5V
Input Power	2.5W
ADC Resolution	16 bits
Enclosure Size (cm)	75x40x12.8
Weight (g)	55



Main Chip - SoC

■ CPU

- MediaTek Dimensity 9200

■ Radar Processor

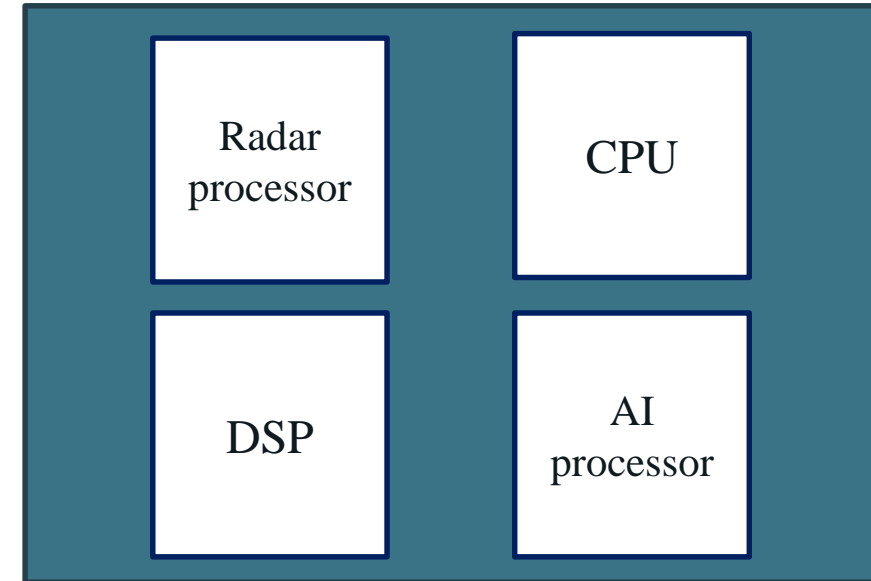
- ARM Cortex-R5F

■ DSP

- TI DSP C66x

■ AI Processor

- Himax WiseEye WE-I Plus HX6537-A



AI Processor

- AI accelerator is a class of specialized hardware accelerator or computer system designed to accelerate machine learning applications.
- We use AI Processor to accelerate
 - YOLOv7 for Object Detection
 - SCNN for Lane Detection



Object Detection



Lane Detection

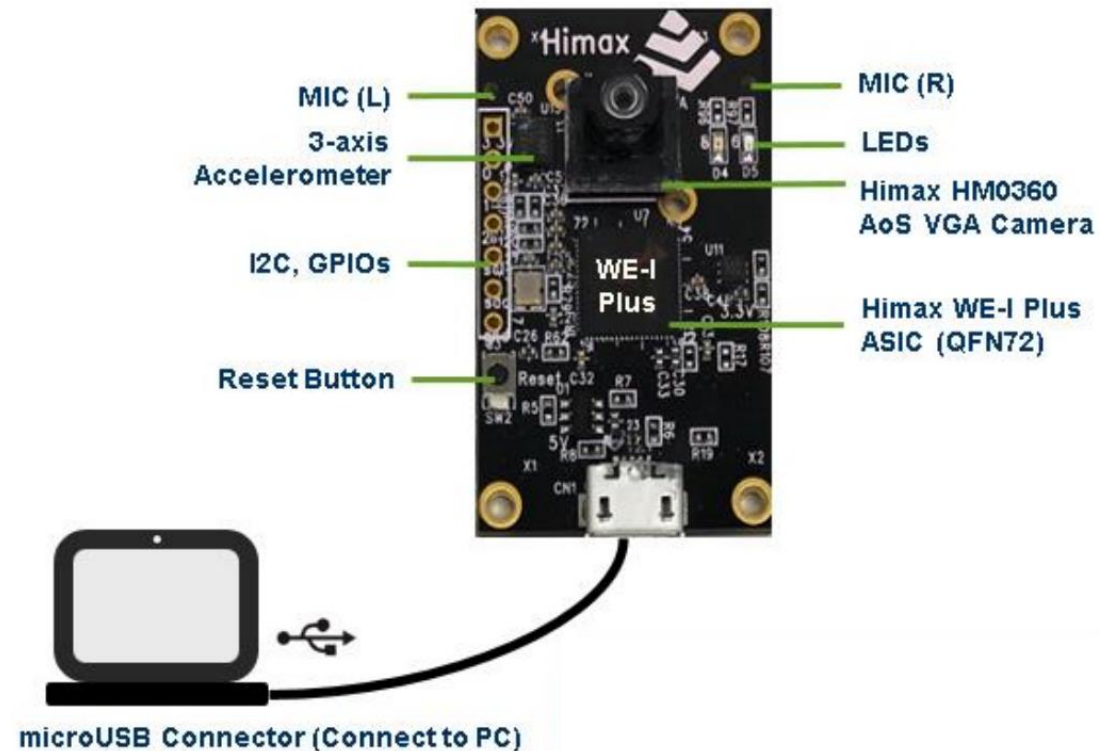
WiseEye WE-I Plus HX6537-A

■ Himax WE-I Plus ASIC

- HX6537-A processor to accelerate NN

■ Feature

- Low power
- Hight Performance
- Support Google TensorFlow Lite



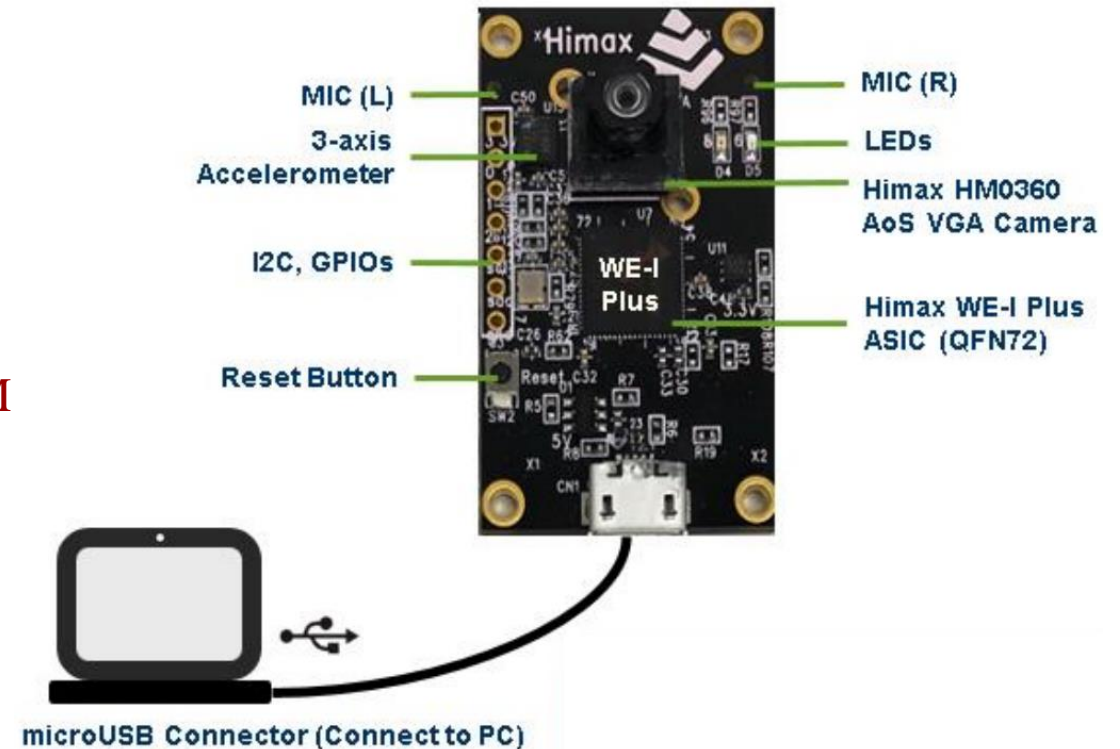
WiseEye WE-I Plus HX6537-A - Specification

■ WE-I Plus ASIC (HX6537-A)

- ARC 32-bit EM9D DSP with FPU
- 400MHz clock frequency
- 2MB SRAM
- 2MB Flash

■ On board

- Himax HM0360 AoS TM ultra-low power VGA CCM
- FTDI USB to SPI/I2C/UART bridge
- LDO power supply (3.3/2.8/1.8/1.2V)
- 3-axis accelerometer
- 1x reset button
- 2x microphones (L/R)
- 2x user LEDs
- microUSB connector





Bluetooth Low Energy 4.0

- Bluetooth Low Energy is a bluetooth protocol, which is created in a low energy consumption mode by Nokia
- Features:
 - **Low power**
 - **Use GATT protocol for various applications**
 - **2.4GHz for bandwidth**

Bluetooth Low Energy 4.0

■ Application

- All of application use the **GATT** profile



Blood Pressure



Navigation

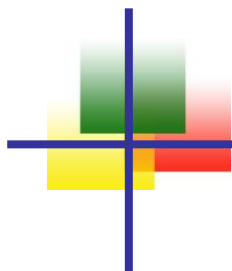


HID connect

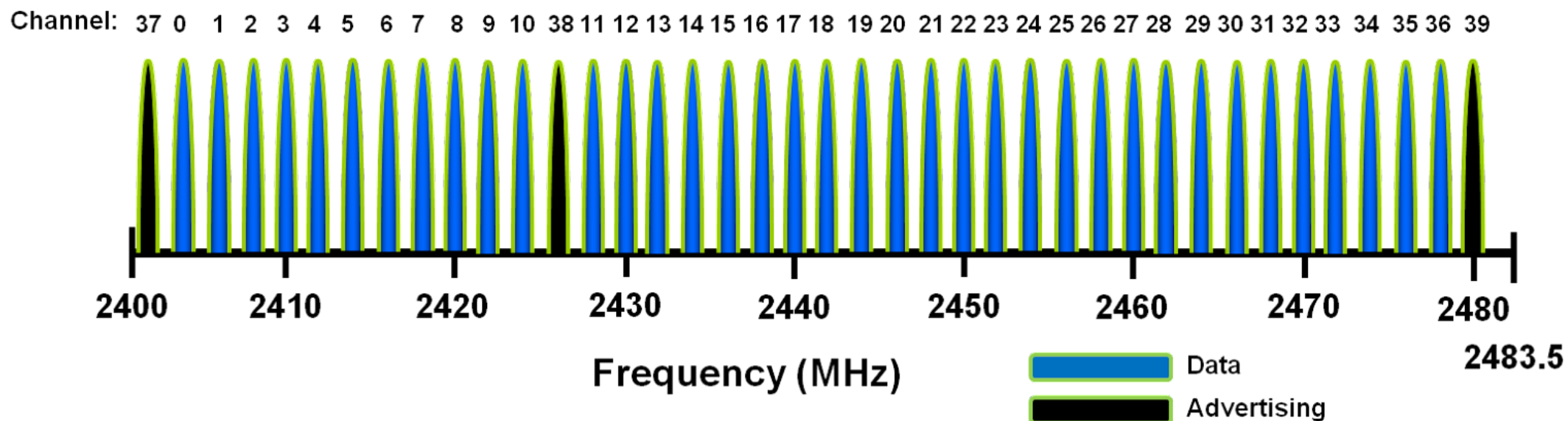


Specification

<i>Specifications</i>	<i>Classic Bluetooth</i>	<i>Bluetooth Low Energy</i>
Range	100 m	Greater than 100 m
Data rate	1–3 Mbps	125 kbitps – 1 Mbps – 2 Mbps
Application throughput	0.7–2.1 Mbps	0.27 Mbps
Active slaves	7	Not defined
Frequency	2.4 GHz	2.4 GHz
Security	56/128-bit	128-bit AES with Counter Mode CBC-MAC
Robustness	Adaptive fast frequency hopping, FEC, fast ACK	24-bit CRC, 32-bit Message Integrity Check
Latency	100 ms	6 ms
Time Lag	100 ms	3 ms
Voice capable	Yes	No
Network topology	Star	Star
Power consumption	1 W	0.01 - 0.50 W
Peak current consumption	less than 30mA	less than 15mA



Bandwidth



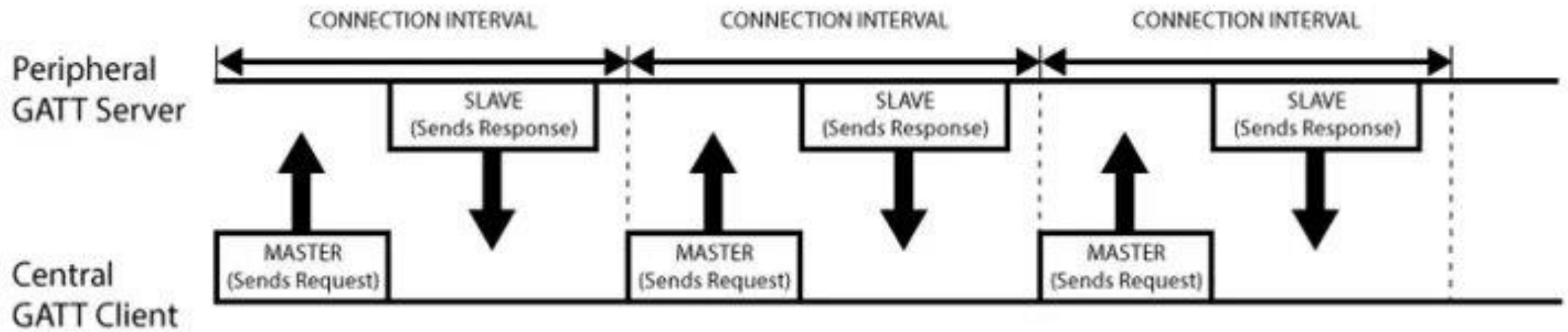
Diviede into 40 channels for each 2 GHz



GATT (Generic Attribute Profile)

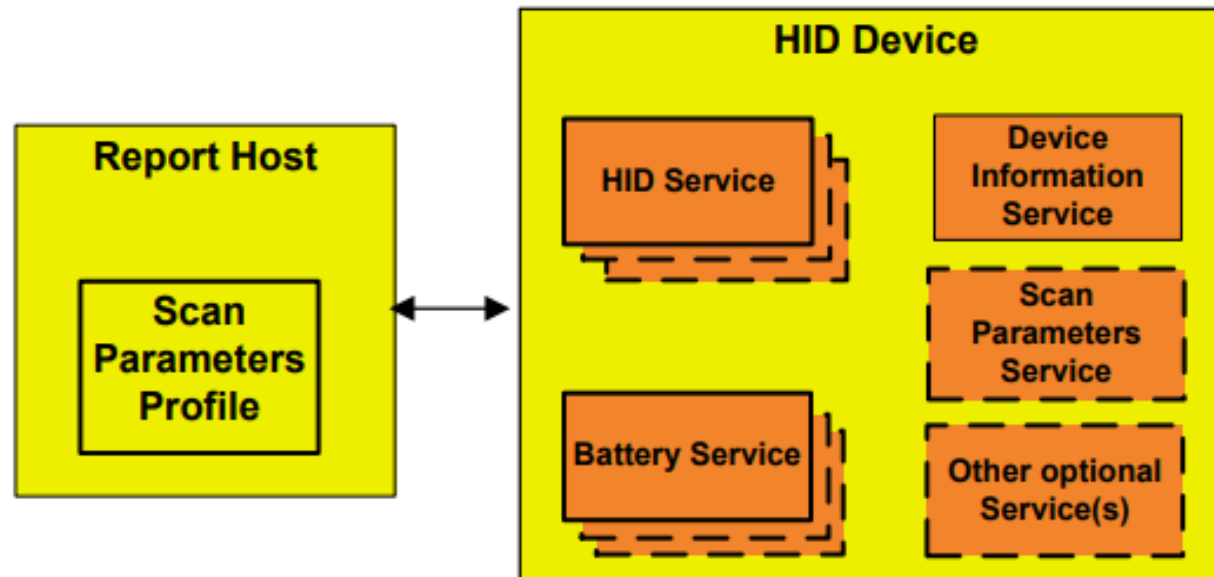
- Two mayor characteristics
 - **GATT Server**
 - **GATT Client**
- Framework of GATT: ATT protocol (Attribute protocol)
 - Define the reationship between GATT Server and GATT Client
 - Request the data of APK and attriute during the connection
 - Bound the same type of servie into one service

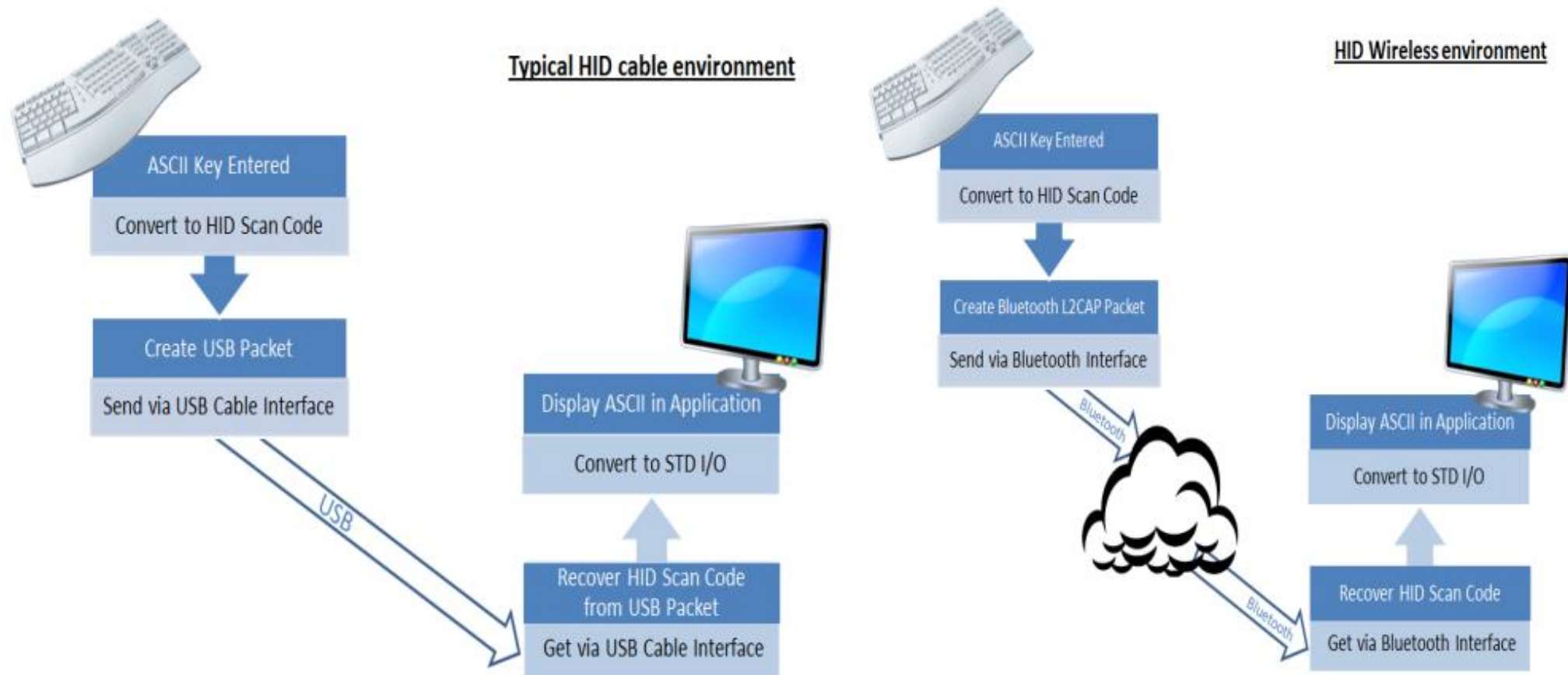
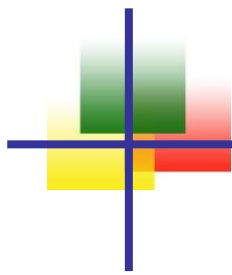
Connection of GATT



HID (Human Interface Devices)

- Used to connect peripheral device on this report
 - One of GATT profile
- Provides the wireless connection with longer usage time
 - Wireless mouse, wireless keyboard...





The type of HID device, such as a keyboard, mouse, or joystick, is defined by the HID descriptor in the raw HID report.



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- Global Market Analysis
 - SWOT Analysis
 - Porter's 5 Forces Analysis
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Global Market Analysis

■ Market Forecast

- ADAS market was valued at **\$23.44 billion** in 2021
- It is expected to reach a value of **\$75.27 billion** by 2030
 - Therefore, it has an extraordinary compound annual growth rate (CAGR) of 13.83%

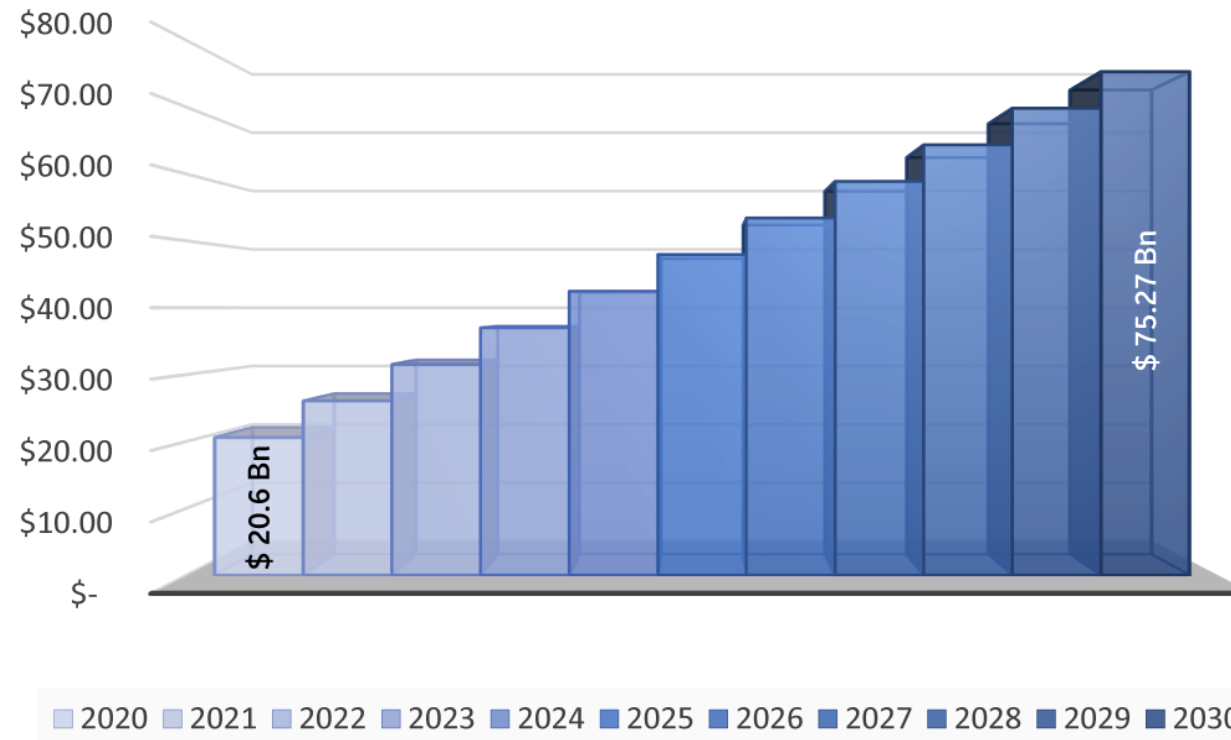
■ Two key factors of the market growth

- The **increase in disposable income levels** among consumers
 - According to a study by the US Bureau of Economic Analysis
- The **stricter enforcement of transportation regulations** by authorities around the world
 - In 2020, the US Congress requires the use of Lane departure warning system (LDWS) and automatic emergency braking (AEB) in commercial trucks

Global Market Analysis

Global Advanced Driver Assistance System Market (2020-2030)

Market forecast to grow at a CAGR of 13.83%





SWOT Analysis

- 1. Don't need to buy entire self-driving cars
- 2. Cheaper
- 3. Easy to install

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- 1. Weaker self-driving function
- 2. Smaller market share

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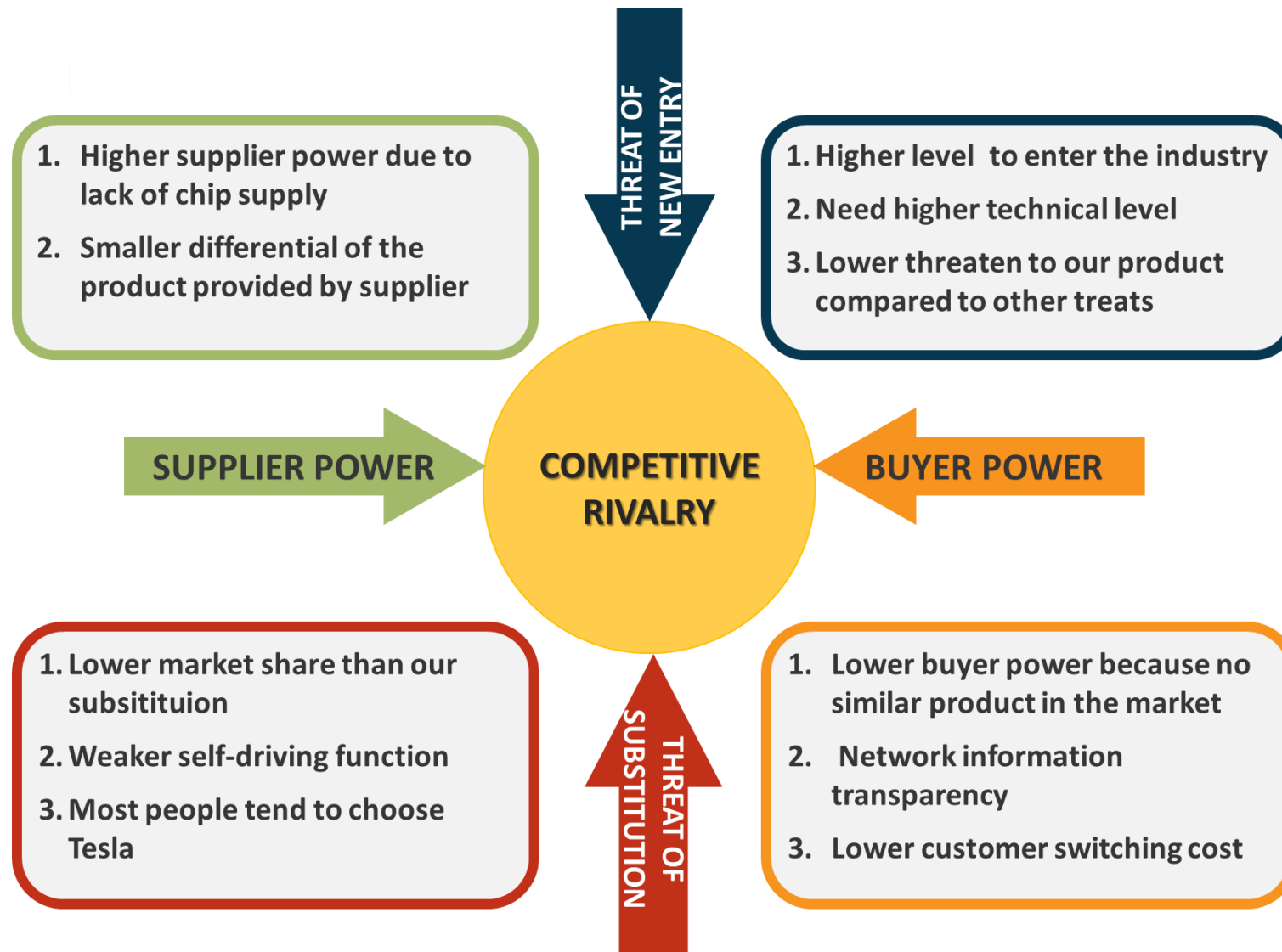
- 1. Improve of driving safety awareness
- 2. Better SOC process technology
- 3. Higher resolution of Radar

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T

- 1. LiDAR-based ADAS system
- 2. Tesla

Porter's 5 Forces Analysis





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Reference

- [1] Gershon, Pnina, et al. "Distracted driving, visual inattention, and crash risk among teenage drivers." *American journal of preventive medicine* 56.4 (2019): 494-500.
- [2] Ball, Karlene K., Virginia G. Wadley, and Jerri D. Edwards. "Advances in technology used to assess and retrain older drivers." *Gerontechnology* (2002).
- [3] Tzortzi, Anna, et al. "Driving behavior that limits concentration: A nationwide survey in Greece." *International journal of environmental research and public health* 18.8 (2021): 4104.
- [4] https://www.himax.com.tw/wp-content/uploads/2020/06/Himax-Launches-WiseEye-WE-I-Plus-HX6537-A-to-Support-AI-Deep-Learning-with-TensorFlow-Lite-for-Microcontroller_-final.pdf
- [5] https://cdn.sparkfun.com/assets/1/b/b/2/1/WE-I_Plus_EVB_Technical_Document_v03.pdf
- [6] Redmon, Joseph, et al. "You only look once: Unified, real-time object detection." *Proceedings of the IEEE conference on computer vision and pattern recognition*. 2016.
- [7] Wang, Chien-Yao, Alexey Bochkovskiy, and Hong-Yuan Mark Liao. "YOLOv7: Trainable bag-of-freebies sets new state-of-the-art for real-time object detectors." *arXiv preprint arXiv:2207.02696* (2022).
- [8] Pan, Xingang, et al. "Spatial as deep: Spatial cnn for traffic scene understanding." *Proceedings of the AAAI Conference on Artificial Intelligence*. Vol. 32. No. 1. 2018.
- [9] <https://chih-sheng-huang821.medium.com/%E6%A9%9F%E5%99%A8-%E6%B7%B1%E5%BA%A6%E5%AD%B8%E7%BF%92-%E7%89%A9%E4%BB%B6%E5%81%B5%E6%B8%AC-non-maximum-suppression-nms-aa70c45adffa>
- [10] <https://www.globenewswire.com/en/news-release/2022/07/20/2482868/0/en/Advanced-Driver-Assistance-Systems-ADAS-Market-Worth-USD-75-27-Billion-by-2030-With-a-CAGR-of-13-83.html>



Reference

- [11] <https://www.dfrobot.com/product-2417.html>
- [12] <https://img.dfrobot.com.cn/wiki/5b973267c87e6f19943ab3ad/ec7dd3a55ba1d58fcbd5830ee08c0e7f.pdf>
- [13] <https://img.dfrobot.com.cn/wiki/5b973267c87e6f19943ab3ad/b5b08fe2ea631f0becdfa0c15db88c4a.pdf>
- [14] <https://pressureprofile.com/sensors/digitacts>
- [15] https://cdn2.hubspot.net/hubfs/5361756/Spec%20Sheets/Spec%20Sheet_DigiTacts%20System.pdf?_hstc=57482165.7b47cad7ed79f0c6c059ea4d87fe50ad.1672817794233.1672817794233.1672820140562.2&_hssc=57482165.1.1672938130050&_hsfp=2977007349&hsCtaTracking=4427830a-a50d-4af1-b425-660de65748d0%7Cd684d85b-195b-4d34-a900-a1b2273652b7
- [16] <https://hackmd.io/@ShenTengTu/SkPltNmiE?type=view>
- [17] <https://medium.com/@nalydadad/%E6%A6%82%E8%BF%B0-gatt-%E8%97%8D%E8%8A%BD%E5%82%B3%E8%BC%B8-9fa218ce6022>
- [18] <https://ithelp.ithome.com.tw/articles/10224000>
- [19] <https://www.ti.com.cn/cn/lit/an/swra715/swra715.pdf?ts=1656944702493>
- [20] <https://www.2cm.com.tw/2cm/zh-tw/market/B1C12F26DAD442478C0CACF162E9D44D>
- [21] https://www.researchgate.net/figure/3-Comparison-of-Classic-Bluetooth-and-Bluetooth-Low-Energy-BLE-46_tbl3_341913410
- [22] <https://microchipdeveloper.com/wireless:ble-phy-layer>
- [23] <https://wifivitae.com/2020/05/01/ble-overview/>
- [24] <https://cdn.sparkfun.com/datasheets/Wireless/Bluetooth/RN-HID-User-Guide-v1.0r.pdf>
- [25] TI AWR 2944 EVM. Available online: <https://www.ti.com/tool/AWR2944EVM> (accessed on 08 January 2023)
- [26] TI AWR 2944 Spec. Available online: <https://www.ti.com/product/AWR2944> (accessed on 08 January 2023)
- [27] MediaTek Dimensity 9200 Spec. Available online: <https://www.mediatek.com/products/smartphones-2/mediatek-dimensity-9200> (accessed on 08 January 2023)



Thanks

