



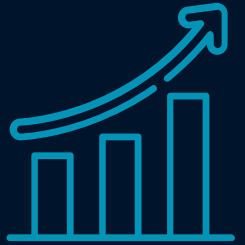
Vision Connectivity



Company at a glance



Est. 2004



Listed 2015
(KOSDAQ)



Revenue : \$354M
Operating Profit : \$20M
(3 Year Average)



CEO
Don Lee



Tech/R&D Center
(Contract Partner)
San Jose, USA

R&D/HQ
Seongnam, Korea

Factory
Phu Tho, Vietnam

Sales Office
Hong Kong

Core Company Competencies

Stable Financial Position

Expanding the scale of investment every year through efficient business operations

Customer-tailored Design Capability

Designing and producing top-quality products that meet customer specifications

Vision Technology

Extensive experience in camera module and 3D sensing technology

Company Milestone

SAMSUNG

- ✓ Samsung Laptop Camera ODM Supply (100% M/S for 7 years)

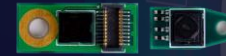


SAMSUNG

- ✓ 2012년, 삼성 휴대폰 진입 2017년, 본격 생산 1세대 광각 셀피 카메라
- 1세대 IR 홍채 및 TOF 얼굴 인식 카메라 공급
- ✓ 2019년, 삼성 플래그십 시리즈 카메라 진입 ('S19 ~ S25' 카메라 탑재)



- ✓ Supplied 3D sensing module to Intel/Sony/Infineon
- ✓ Listed on KOSDAQ



- ✓ Developed Head/Eye Tracking ToF camera module for XR application
- ✓ Started R&D for Hybrid OIS module (Flat Pattern Coil Applied)



✓ NAMUGA founded

2004 2008 2010 2015 2020 2023 2024

- ✓ Started camera module supply to Samsung Mobile
- ✓ NAMUGA's first Time of Flight (ToF) module developed

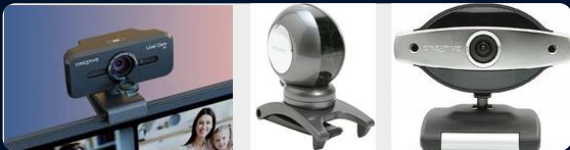


- ✓ Ownership realigned as a DREAMTECH affiliate
- ✓ Expansion of 10 Class manufacturing in Vietnam
- ✓ Developed in-cabin camera module for automotive applications

- ✓ Extensive R&D continue on world's smallest OIS module
- ✓ New projects expand in VX/Mobility /Security/Bio-Medical sectors

- ✓ Creative Webcam ODM Supply (200K~400K/Month)

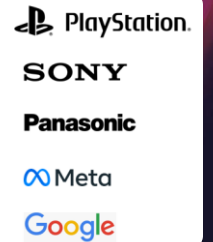
CREATIVE



- ✓ Intel Realsense Stereo Camera ODM Supply (1.2M / 4 years)
- ✓ Expanded 3D cameras market to
- ✓ SONY Robot pet, Samsung Mobile phone & Robot Cleaner



- ✓ Penetrate XR market



NAMUGA Factory in Vietnam

Advanced CM Production Facility in Phu Tho, Vietnam

- Over 99% Yield for MP (RGB Camera)
- 100% On-time Delivery to Customer

Location	Phu Tho, Vietnam (1hr distance from Hanoi Airport)
# of Employee	1,335 (Current)
Established (Yr)	2014
Manufacturing Area	<ul style="list-style-type: none">▪ Lot Area: 57,800m²▪ Facility Area: 38,000m²
Manufacturing Capacity	15 Million modules per month → Factory expansion in 4 months
Size of Plant	<ul style="list-style-type: none">▪ Plant 1 : 8,000m²▪ Plant 2 : 10,000m²▪ Plant 3 : 20,000m²



NAMUGA Factory in Vietnam

NAMUGA is the only Korean company operating overseas 10 Class cleanroom semiconductor facility

- World-class cleanroom facility operation

Cleanroom - 10 Class

Scale : 4,916m²

Process : Front - Packaging / Active align

Cleanroom - 1,000 & 10,000 Class

Scale : 10,550m²

Process : Front - Packaging / End - Test

Cleanroom - 100,000 Class

Scale : 5,337m²

Process : SMT/ End - Test






NAMUGA Factory in Vietnam

(1) SMT Process (100K Class)

Screen Print	SPI	Chip Mounter	Multi Mounter	AOI (Inline)	Reflow	AOI (offline)
						






Maker	Name	Qty	Capa		
			UPH	Month	
JUKI	Mounter	7	3,200	11,000,000	
Koh Young	3D SPI	7	3,500	12,422,000	
Koh Young	3D AOI	6	3,750	13,308,700	
Techwin	10Zone N2 Reflow	6	6,000	18,252,000	
Total				11,000,000	

(2) PKG Process (10 Class)

Cleaning	Die Attach	Oven Cure	Wire Bonding	Lens Assy	IR Attach	Housing Attach
						

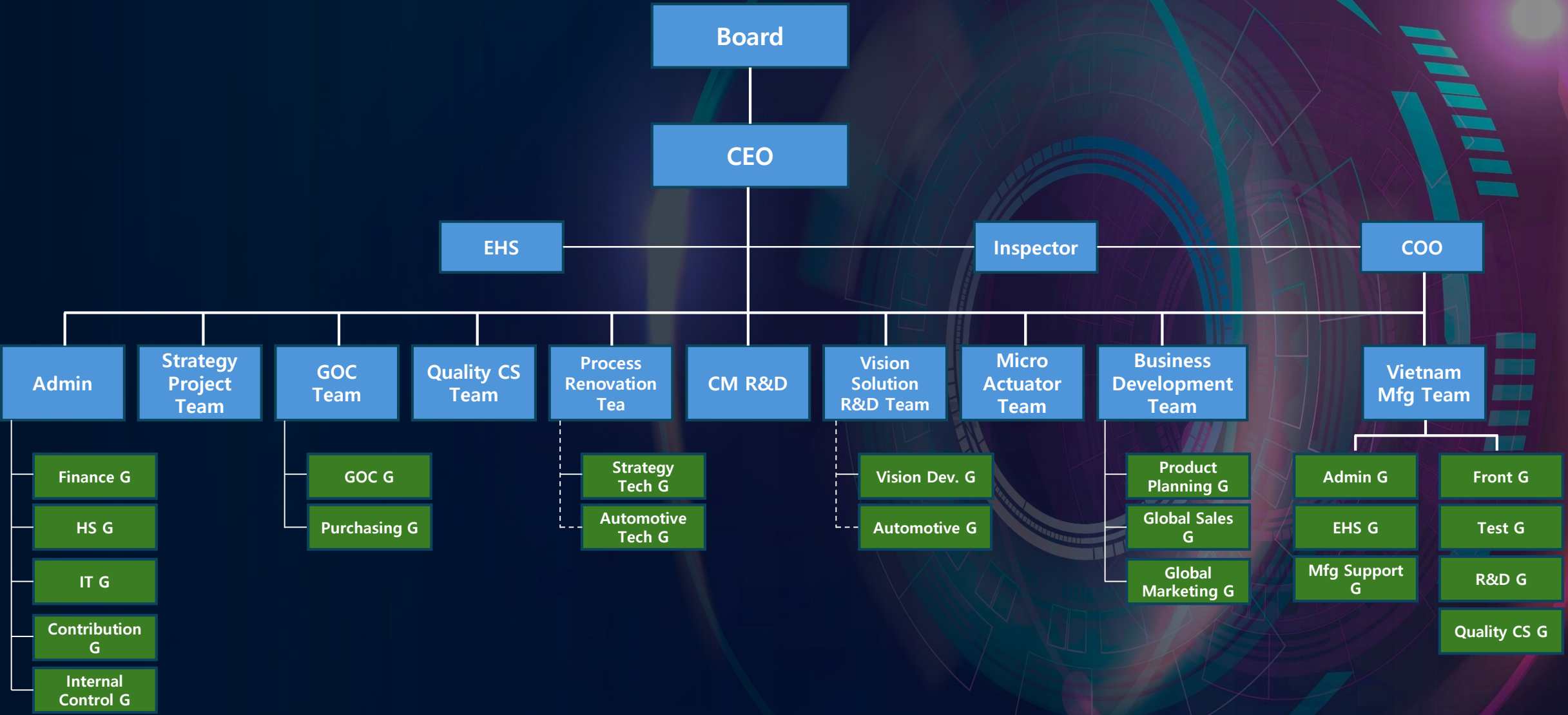
Maker	Name	Qty	Capa		
			UPH	Month	
BESI ESEC	Die Attach	14	2,500	15,500,000	
KNS	Wire Bonder	80	420	16,500,000	
SSP	Housing Attach	16	1,250	15,500,000	
ASM	Active Align	25	450	6,300,000	
Total				15,500,000	

(3) TEST Process (10K Class / 1K Class)

VCM Soldering	Laser Cutting	Function Test	Final Test	EVI	Marking	OQC
						

Fixel	Type	Name	Qty	Capa	
				UPH	Month
Low (8M ↓)	AF	Focus Eye, Matrix	440	-	3,000,000
	FF	Matrix, BB, Manual		-	4,000,000
High (13M ↑)	AF	Matrix, Hyvision		-	4,000,000
	FF	IsMedia, Matrix		-	4,000,000
Total				15,000,000	

Organization



R&D

3D Camera



Team Leader

- 26 years of experience in camera industry (including 13 years of experience in 3D camera)

20 Engineers

- 12 Software Engineers
- 7 Hardware & Mechanical Engineers
- 1 Optical Engineer

Design Ability

- 3in1 Tx for signal efficiency
- ToF Fusion module
 - iToF → sToF → isToF
 - 2D Line Beam Tx
- Retention of Core Design Ability
 - Management of Signal Interference
 - Management of Transmission and View Angle
 - Compact design

IR & RGB Camera



Team Leader

- 26 years of experience in camera industry

30 Engineers

- 6 Software Engineers
- 13 Hardware & Mechanical Engineers
- 3 Optical Engineers
- 5 Process Engineers
- 3 Image Quality Tune Engineers

Design Ability

- Various simulation analysis of lens performance for the best choice for the customer
- Development of LSC and LDC
- Compact design

OIS Actuator



Team Leader

- 18 years of experience in camera industry (specialty in OIS/Actuator)

6 Engineers

- 3 Mechanical Engineers
- 2 Hardware & Software Engineers
- 1 Process Engineer

Design Ability

- Hybrid Type OIS of compact size and simplified assembly process
- Micro-scale actuator design & manufacturing
- CAE-based static/dynamic analysis
- Mechanical structure optimization technique

Mobile Phone Camera Module



Mobile Phone Camera Module

Since 2004



Application for Samsung Mobile Phone

Sensitive High Resolution RGB Module

- 40M AF FOV80D
- 12M UW AF FOV120D
- 50M AF FOV77D
- 108M Bi-Direction AF FOV85D

Multi Camera Module

- Dual : 13M AF + 5M UW & others
- Triple : 48M AF + 8M UW + 5M Bokeh & others

Active Align RGB Module

- 13M FOV79D
- 32M FOV80D

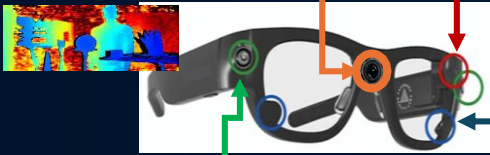
IR Camera Module

- Infrared Recognition Camera

Sensing Camera

Depth Sensing Camera

- TOF Solution
- System in Package
- Spot/Flood Illumination



World View Camera

- Bigger pixel wide view
- Small Foot-print



Hand Tracking Camera

- Global Shutter
- Wide FOV
- Near IR



Eye Tracking Camera

- Chip Scale Sensor Package
- Global Shutter
- Near IR



3 Color images



Standard RGB Sensor

Multispectral images

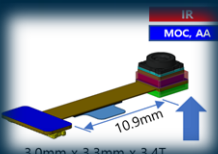
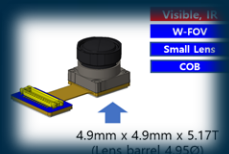
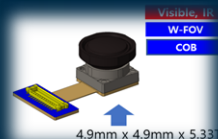
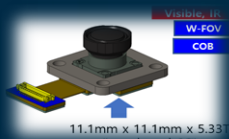


Multispectral Sensor



Sensing Camera Module

Since 2010



TOF Camera Module

- QVGA ~ VGA FOV100D, 0.3m ~ 5m @error 1% ↓
- QVGA ~ VGA FOV120D, 0.3m ~ 5m @error 1% ↓
- Low Latency & Low Power Consumption Voxel Camera
- Eye Safety Class 1

IR Camera

- VGA G/S FOV160D, RGB ~ IR
- VGA G/S FOV150D, RGB ~ IR
- VGA, G/S, FOV106D, IR
- Small Formfactor with Mfg Method

Multi Spectral Camera

- 0.55M 400nm ~ 940nm, 16CH
- Small Formfactor with Mfg Method

Lidar

- Short Range 0.1m ~ 25m (10m@10%)
- Mid Range, ~80m (30m@10%)
- Low Cost & Small Formfactor Lidar

Micro Actuator

Product Line-Up

- Diversified product line-Up on core model
- Ensures compatibility with specific image sensors, lenses and control driver required by customer

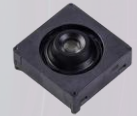
▪ 200MP H-OISA-A1

Image Sensor: 200MP 1/1.4" (~1.0")
Control: Close-Loop (Internal Driver)



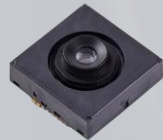
▪ 48(50)MP H-OISA-R1

Image Sensor: 48(~50)MP 1/2.x"
Control: Close-Loop (Internal Driver)



▪ 64MP H-OISA-NX

Image Sensor: 64MP 1/1.7x"
Control: Close-Loop (External Driver)



▪ TX Shutter Actuator for ToF Camera Module

Ultra Low Power Consumption
Compact Size: 5.5X3.6X3.7mm



Micro Actuator

Manufacturing Capability

- **Pilot-Line (Seongnam, Korea)**

Pilot production line set up at Korea HQ with automated processes for R&D activities, process improvements, and prompt response to customers' sample requests & production validation.

- **150K/month production capacity (100 Class)**
- **Dedicated R&D and process engineering team supports and monitors the line**



- **Mass Production Line (Phu Tho, Vietnam)**

OISA & AFA high-volume production line under construction, ready for mass production from Q1. 2025 at the NP1 Vietnam manufacturing complex.

- **≥ 2.5KK/month OISA & AFA production capacity available**
- **Automated main assembly line with 100 Class clean room environment**



Strategic Target Market

VX



Mobility



Vision
Connectivity

Security



Biomedical



Thank You



The background features a complex, abstract design with concentric circles and geometric patterns in shades of teal, purple, and blue. A prominent dark circle is centered in the background. The overall aesthetic is futuristic and technical.

Appendix

IR Module

Model	VF200X	VF203X	VF301W	VF500X	BIR01
Application	Head Tracking	Head Tracking	Head Tracking	Eye Tracking	Automotive (Iris/Facial Recognition)
Sensor	S5K931SX14/GS, 1/9"	S5K931SX14/GS, 1/9"	S5K931SX14/GS, 1/9"	S5K931SX14/GS, 1/9"	PX9210K,1/2.9" AmCBGA
Resolution	640 x 640	640 x 640	640 x 640	640 x 640	1920 x 1080, FHD
IR Filter	Visible / 850	Visible / 850	Visible / 850	850~940	640nm/850nm
Output Interface	MIPI CIS-2	MIPI CIS-2	MIPI CIS-2	MIPI CIS-2	AHD (TVI, CVBS)
Dimension(mm)	11.1(W) x 11.1(L) x 5.3(H)	4.9(W) x 4.9(L) x 5.3(H)	4.9(W) x 4.9(L) x 5.3(H)	3.1(W) x 3.7(L) x 4.2(H)	75(W) x 100(L) x 40(H)
Lens Construction	6P	6P	6P	3P	6P
FOV	160°(D)	160°(D)	150°(D)	106°(D)	160°(D)
Lens TTL(mm)	4.45	4.45	4.29	3.05	18.7
F#	1.8	1.8	1.8	2.0	2.2
Distortion	≤ 14.5%	≤ 14.5%	TV distortion ≤ 15.0%	TV distortion ≤ 1.2%	Optical distortion ≤ 66.1%
IR Illumination	N.A	N.A	N.A	N.A	30° x 12pcs (850nm)
Waterproof	N.A	N.A	N.A	N.A	IP69K
Frame rate	180fps@full 0.41M	180fps@full 0.41M	180fps@full 0.41M	180fps@full 0.41M	30fps@full FHD
Figure	<p>11.1mm x 11.1mm x 5.33T (Lens barrel 6Ø)</p>	<p>4.9mm x 4.9mm x 5.33T (Lens barrel 6Ø)</p>	<p>4.9mm x 4.9mm x 5.17T (Lens barrel 4.95Ø)</p>		
Sample	Available	Available	Available	Jan 2025	Dec 2024

3D TOF Module

Model	Titan100	Titan120	Pinocchio
Application	XR, Mobility	XR, Mobility	XR, Mobility
Sensor	Samsung LSI/S5K63DSX, 1/6.3" QVGA	Samsung LSI/S5K63DSX, 1/6.3" QVGA	Infineon /IRS2975C, 1/6" HQVGA
Tx VCSEL	Lumentum / Qianmu, dual junction	Lumentum / Qianmu, dual junction	AMS, single junction
Tx Power	Ave 0.31A / Peak 3.8A	Ave 0.31A / Peak 3.8A	Ave 0.17A / Peak 1.5A
Distance range	0.3~7.5m(dual), 0.3~3m(single)	0.3~7.5m(dual), 0.3~3m(single)	0.3~4.0m
Depth accuracy	±1%	±1%	±2%
Rx FOV	85°(H), 69°(V), 100°(D)	100°(H), 81°(V), 120°(D)	57.4°(H), 44.6°(V), 70.1°(D)
Dimension(mm)	9.9(W) x 14.8(L) x 6.3(H)	9.9(W) x 14.8(L) x 6.3(H)	10.0(W) x 16.0(L) x 4.1(H)
Modulation freq.	100/30MHz(dual), 50MHz(single)	100/30MHz(dual), 50MHz(single)	50/6080MHz(dual)
FPS	30/60	30/60	30/60
Lens F#/distortion	1.3 / <3%	1.4 / <10%	1.1 / <3%
interface	MIPI CSI-2 1Lane	MIPI CSI-2 1lane	MIPI CSI-2 2lane
Figure			
Application	    	  	   

Wearable Glass
Space tracking,
Object detection

Robot
Slam & object
recognition for
vacuum
cleaner

Portable projector
Auto key scan,
focus

Homecare Robot
Object avoidance

Core Technology For 3D Sensing

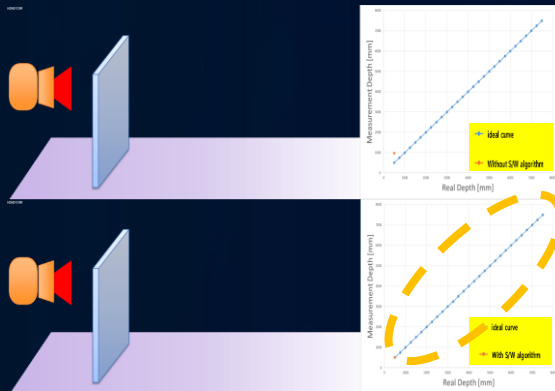
Key Part(Sensor)

- Strategic partnership with major 3D sensor vendor (∴ experience of high volume mass production)



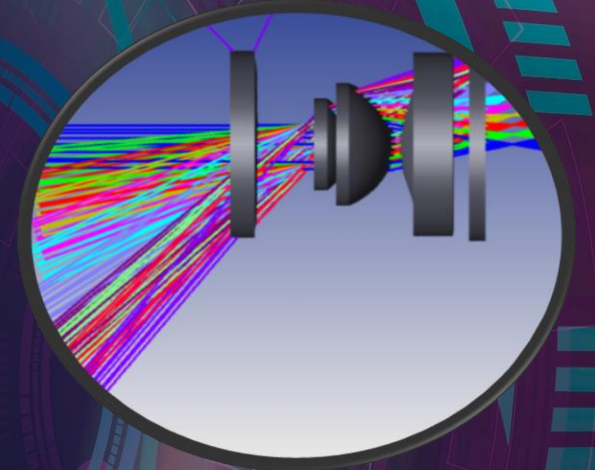
Data Processing

- S/W management technology
 - Raw data processing
 - Temperature compensation
 - Intrinsic compensation(Lens parameter)
 - Noise removal filters by software
 - Custom-developed IPs to optimize 3D data



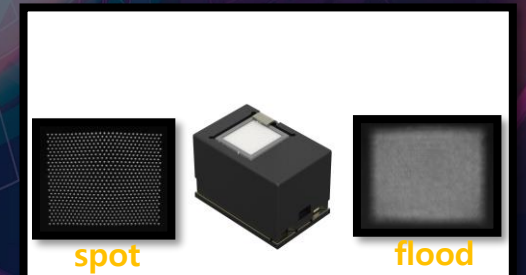
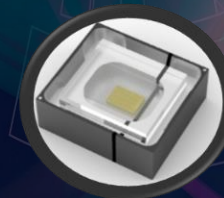
Dedicated 3D Optical Lens

- Customized ToF lens : FOV, F No, RI and E.T.C
- Slim lens design for compact module



Tx illumination(Projector)

- Specific package for VCSEL projector
- Customized optic design of diffuser & spot DOE
- Dual mode(switching) for spot and flood light



Beam Steering for LiDAR

Control Light ✗

Mechanical beam steering
Poor cost, size, reliability
or
No beam steering (flash)
Poor performance



LCM Beam steering ✓

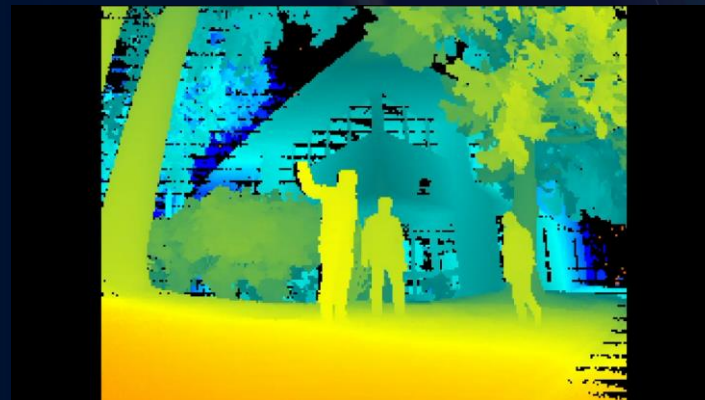
Semiconductor based
Digital, solid-state beam steering
Software-defined performance
Low cost and size
High reliability



Programmable optical semiconductors made up of microscopic structures that capture and steer light at the subwavelength scale without any moving part



Uniform Scan



Advantages

High Performance



Scalable Performance
5-300m max range with same architecture



Ultra wide FoV
Up to 180°



Software defined performance
Multiple virtual lidar sensors via API



Robust operation in sunlight
Up to 100 klux



High point cloud quality
No point jitter
Low multi-path and low blooming



No angle calibration required
No variation over temp or time

Mass Deployable



Radically low-cost system
>5x lower vs. mechanical or addressable VCSEL

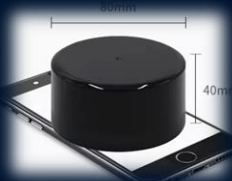







Ultra-small size
>5x lighter vs. mechanical



High reliability
Immune to mechanical wear, shock and vibration

Beam Steering for LiDAR

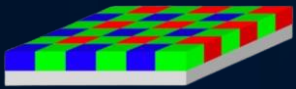
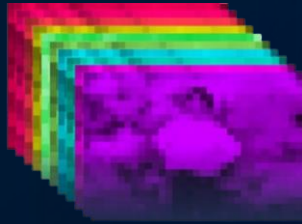
Items	Short Range		Mid Range	
	Conventional Lidar (2D)	Namuga M30 (3D)	Conventional Lidar (3D)	Namuga M4x (3D)
Sample DEMO	-	Available	-	Dec. 2024'
Price	\$450 ~ \$900	↓↓	\$1,620 ~ \$4,000	↓↓↓↓
Application	Robot	Robot, Automatic door	Automotive	Automotive, CCTV
		Specification		
2D/3D	2D	3D (Solid State)	3D (Solid State)	3D (Solid State)
Rx	iTOF	iTOF	SPAD	SPAD
FOV (H/V/D)	360°	120° x 90°	180°(H) x 40°(V)	100° x 70° (SONY SPAD) 120° x 90° (ADAPS SPAD)
FOV control	-	Real time by S/W (Programable)	-	Real time by S/W (Programable)
Range	10m@10%	0.1m ~ 25m (10m@10%)	100m (45m@10%)	80m (30m@10%)
Power Consumption	10W	8W	15W	TBD
Dimension	80mm x 40mm 	55 x 35 x 25 mm 	116 x 90 x 76mm 	55 x 35 x 25 mm 
Application	Indoor Robot 		Truck, Security, Passengers Car 	

Multispectral Module Solution

3 Color images



Multispectral images



Standard RGB Sensor



Multispectral Sensor

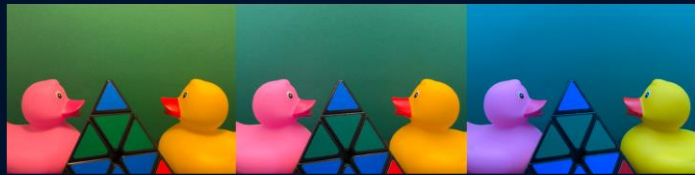
Warm white
Flourescent



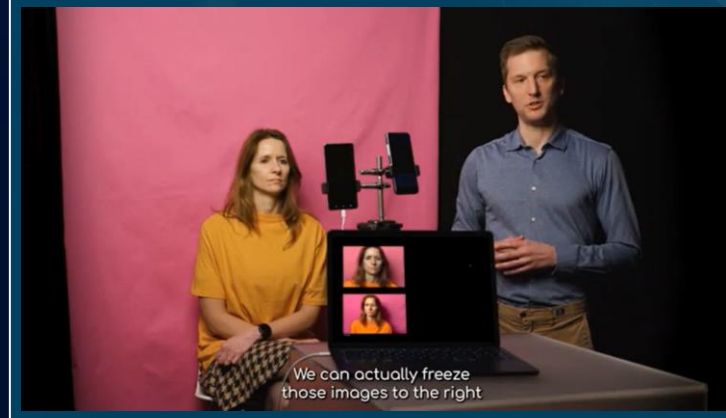
Warm white
LED



Cold white
LED



Model	S1
Sensor	Spectricity SP4072M
Resolution	864*648
Wavelength(nm)	400~850
Dimension(mm)	7.0*7.0*7.0(H)
FOV	81°(D)
TTL(mm)	6.45
RI	>50%
F#	2.0
Distortion	TV distortion ≤ 5%



Applications



Auto White Balance

True color photography
Color matching (e-commerce)
Accurate object rendering (AR)



Skin Analysis

Skin biomarkers
for health monitoring
Remote cosmetics



Face Authentication

Anti-spoofing

"i" maker phone

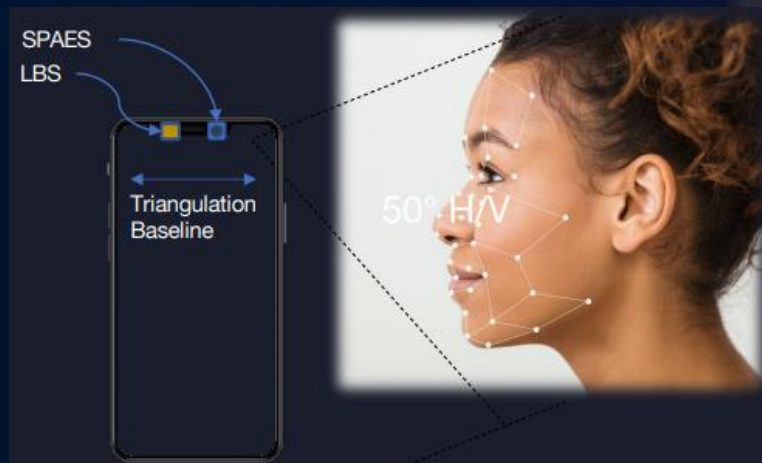
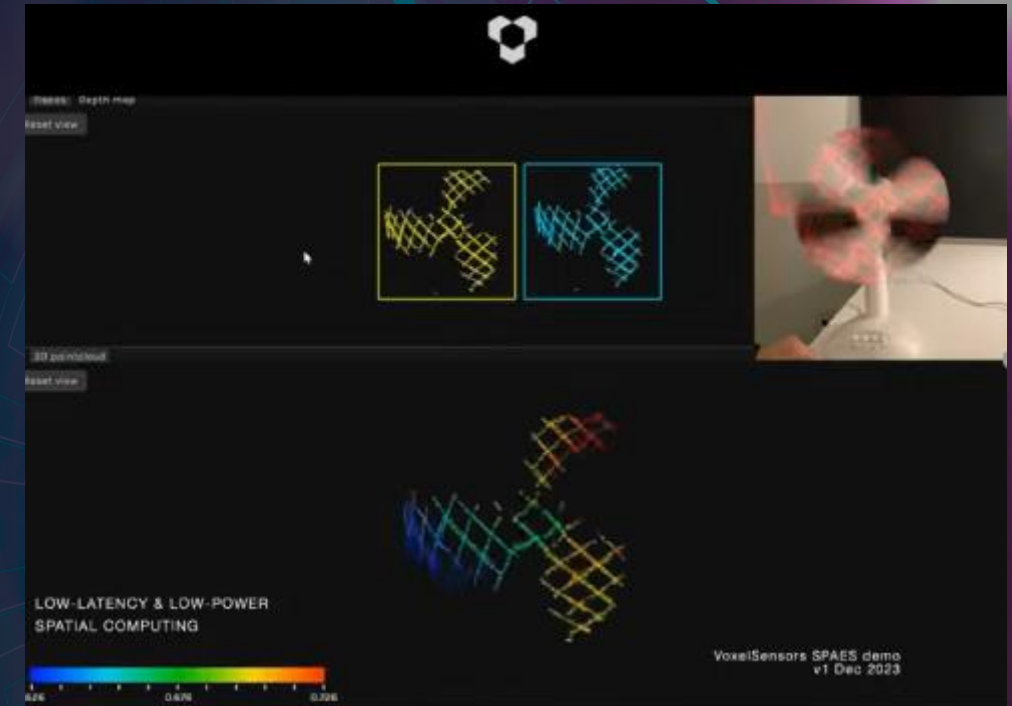
Multispectral
Solution

Multispectral Module Solution

Comparison	Conventional Hyperspectral	Conventional Multispectral	Namuga Multispectral	Remark
Maker	Specim, HySpex, Corning, CHNSpec, XIMEA	Spectral Devices, CHNSpec	Namuga	
Price	\$5,000 ~ \$40,000		↓↓↓↓↓	Price ↓
Wavelength (nm)	400 ~ 1000, 930 ~ 2500	580 ~ 820, 1125 ~ 1640	400 ~ 850	
Size (XYZ)	150 x 120 x 70mm	28 x 28 x 47mm / 55 x 55 x 82mm	8 x 8 x 5mm	Size ↓
Sensor	IMEC 2/3" CMV2K-LS150	AMS CMV4000 (1"), 5.5um pixel	Spectricity 1/5", 1.12um pixel	
Pixel resolution	1024, 1920x1920	256x256 / 512x512 2048 x 5 lines	860x680	
Frame rate	120 ~ 700fps	37 ~ 178fps	30fps	
Spectral Channel	186 ~ 360	4 ~ 16	16	
Spectral Resolution (FWHM)	2 ~ 15nm	25 nm / 25-45 nm	15nm	
Power consumption	4W ~ 15W	4W	<160mW	Power consumption ↓
Image Sensor Structure				
Camera Design				
Application	<p>Satellite</p> <p>Smart Farm</p> <p>Agriculture</p> <p>Biomedical Blood Pressure</p>		<p>Color Enhancement</p> <p>Melanin Detection</p>	

Hybrid 3D sensor (ToF & Structured Light)

Mobile	SPAES			dToF (Apple)	dToF (ST)	iToF (Sony)	MLdepth
Depth Range	2.5cm – 10m			20cm – 4m	5cm – 10m	Short Throw	0.25 - 4 m (clipped)
Tolerable ambient conditions	100klux			100klux (3m)	“strong ambient”	10klux	20 klux
Behavior to edges	Super sharp					Reasonably sharp (yet flying pixels)	Smoothing out / blending edges
Baseline	4cm			N/A	N/A	N/A	N/A
DFoV	80deg			70deg	70deg	80deg	90deg
Spatial Resolution	2k	80k QVGA	300k VGA	1k	2.4k	VGA	30 k
FrameRate (fps)	30	90	15	15	30	45	10
Depth Noise (1 sigma)	1cm @ 1m			1%			7%
Power	5mW	125mW	50mW	300mW	300mW	400mW	280-400mW
Imaging Resolution	500k passive				2.4k active	VGA active	30k

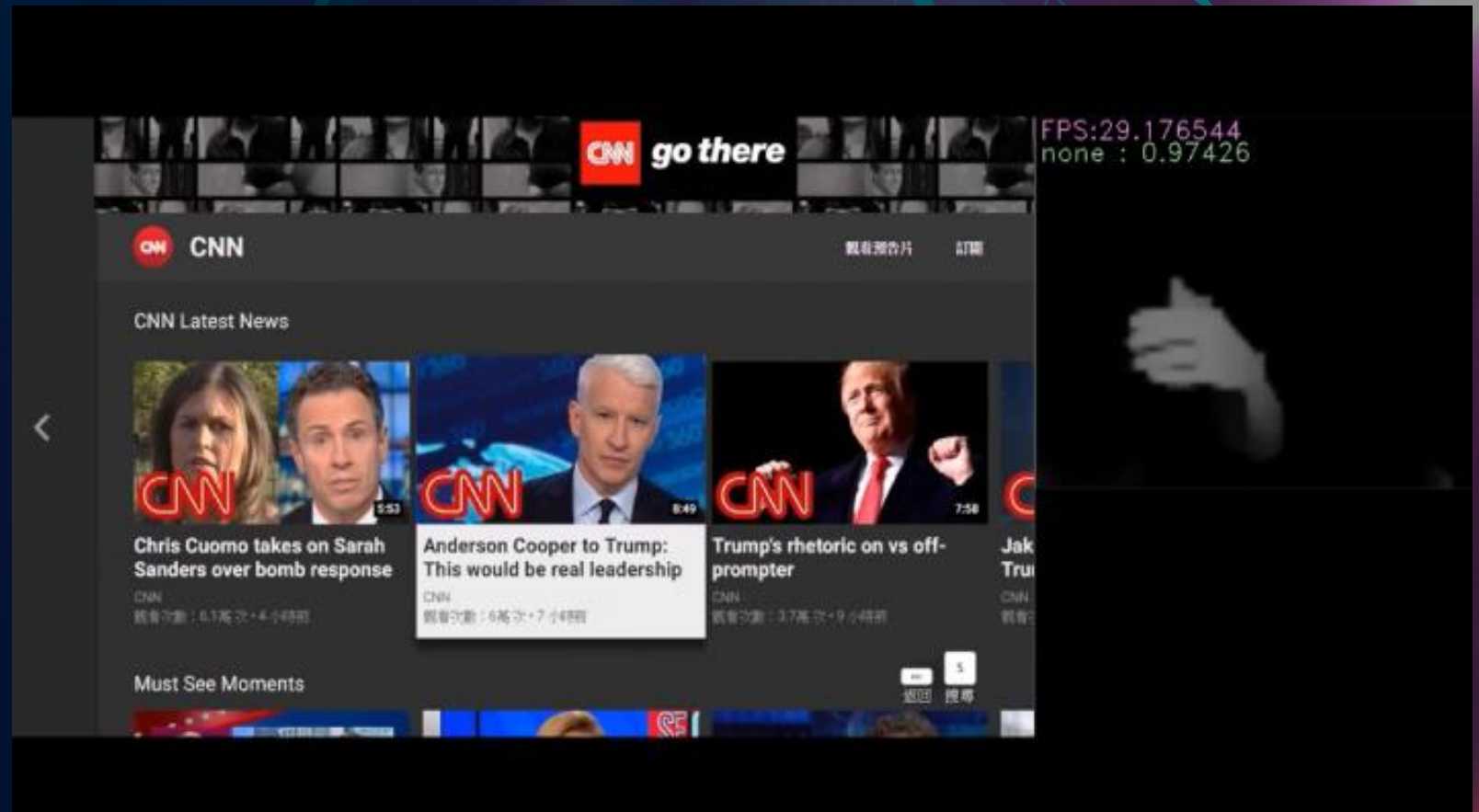
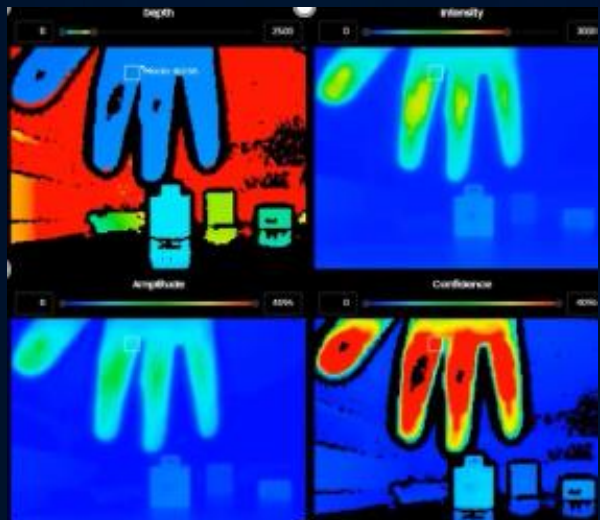
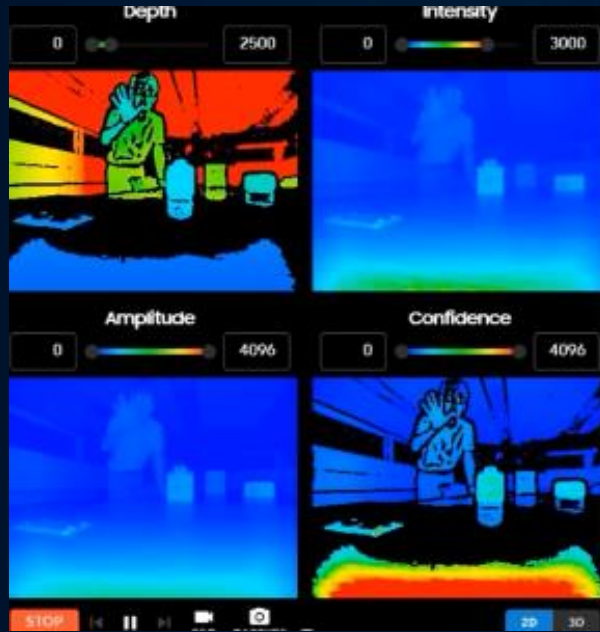


- ✓ Low power consumption (Tx & Rx)
- ✓ Low latency
- ✓ Low computation
- ✓ Face recognition

*SPAES : Single Photon Active Event Sensor

Motion Gesture & Touchless Interface Solution

by 3D ToF Module



* Gesture Algorithm by LIPS

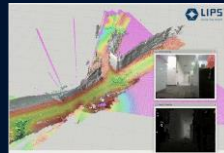
- ✓ ToF camera based solution with wide-FOV and long-range
- ✓ Pre-defined motion gestures
- ✓ Support additional motion gesture development upon request

NAMUGA's Mobility Solution for Automotive

Pedestrian Detection

LIPSAMR Perception DevKit

LIPSAMR Perception DevKit includes a collection of hardware-accelerated software packages for visual AI, tailored for Autonomous Vehicle to perceive, localize, and operate robustly in unstructured environments



Driver Monitoring

Driver Fatigue Detection Solution

Detect and authenticate if the driver is the registered driver of the vehicle so the vehicle can start and set the car preferences accordingly.



-> [Link to demo video](#)

Motion Control

Motion Gesture & Touchless Interface Solution

LIPSense Motion Gesture recognizes hand gestures while LIPSense touchless interface detects a person's fingertips to control onboard infotainment applications



-> [Link to demo video](#)

Automotive Camera Solution

SVM, RVM (Surround, Rear View Monitor)

- Park assist for Front / Rear / Left / Right wide FOV camera

MFC (Multi Function Camera)

- Front camera for Advanced Driver Assistance System
- LDWS, LKAS, HBA, TSR, FCW, AEB, PD, VD, BSD

CMS (Camera Monitor System)

- Rear Side Camera
- Blind Spot Monitor and Detection

DVRS (Drive Video Record System)

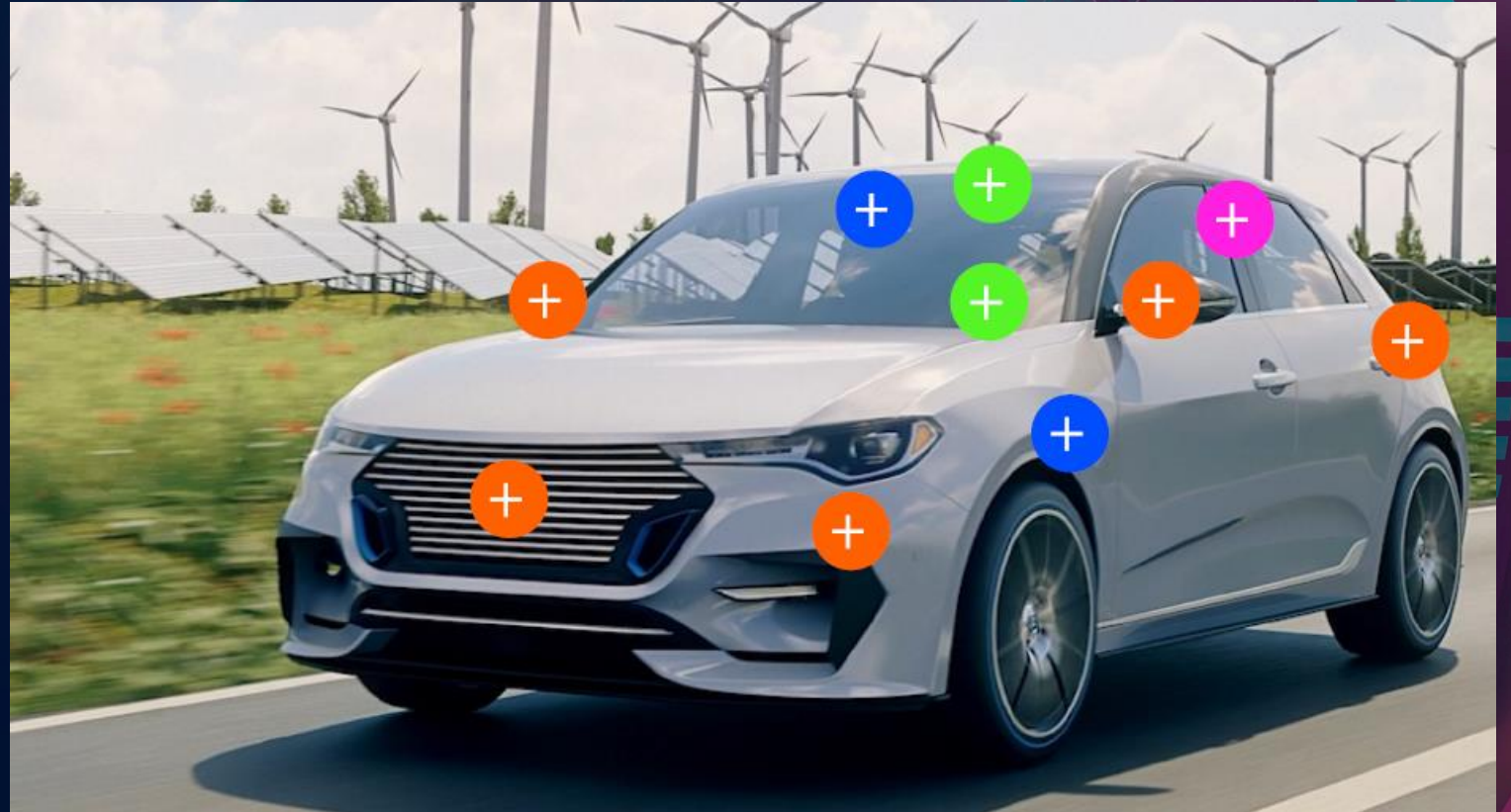
- Front, Rear Camera
- Recording(Constant, Event)

In-Cabin (DMS, OMS)

- Driver Monitor Camera
- Occupant Monitor Camera

Face Recognition

- Unlocked Car door
- Article Surveillance



NAMUGA's Security Solution for Security

Recognition

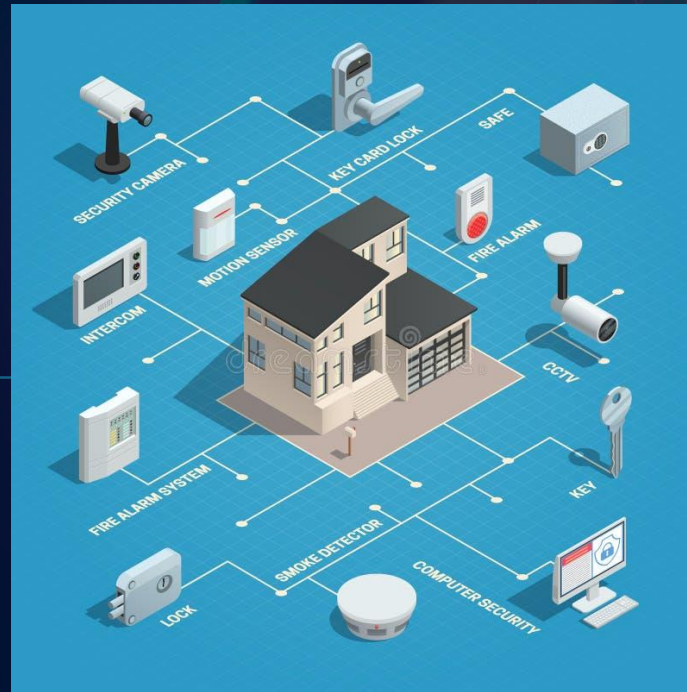
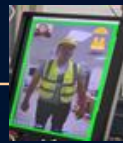
Facial Recognition Solution

Allows only authorized people to gain access to a specific site



Clothes/Equipment Recognition

Allows only authorized people with designated equipment to gain access to a specific site



Safety

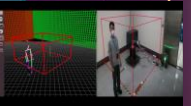
People Counting Solution

Detect number of people entering / leaving the construction sites and ensure clearance during off hours



3D Virtual Fence Solution

Safeguard construction zones and secure facilities by detecting human intrusions



Security Robots

Automotive Mobile Robot Solution for Security

3D sensing for VSLAM, collision avoidance & pedestrian detection

