VISION BASED ADAS

Leading Company of Vision Based ADAS

INTRODUCTION

2021

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01 VADAS INTRODUCTION

- Company Overview
- Key Members
- Main Products
- Business Model
- Market Value Chain

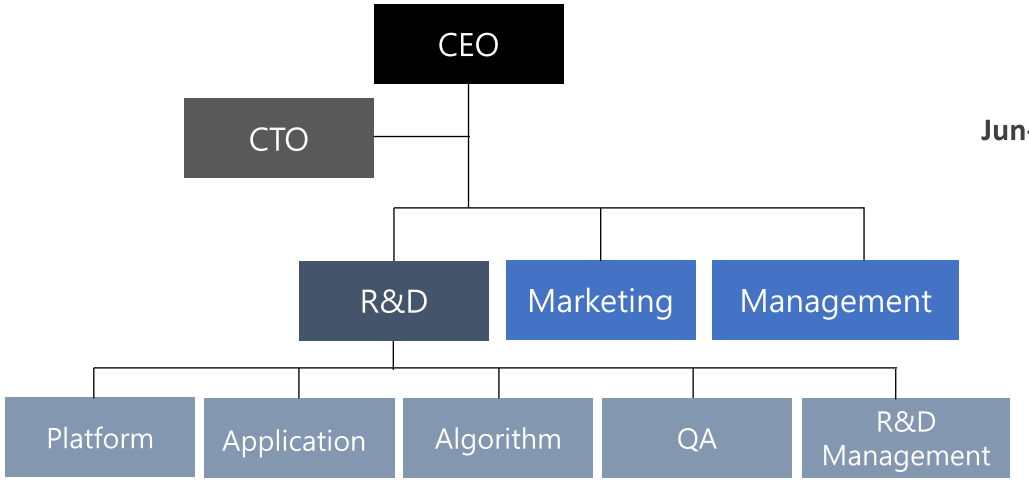
Company Overview

■ Status

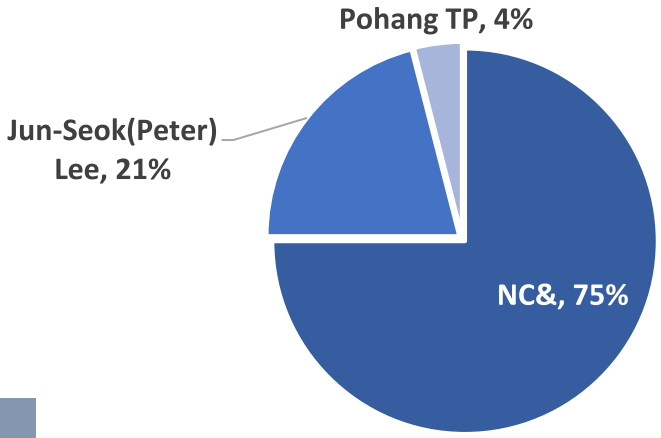
Company	VADAS Co., Ltd
CEO	Jun-Seok(Peter) Lee
Members	26 (as of Oct 2021)
Biz Model	ADAS S/W development and supply

Establishment	July 2010
Capital	1.25 billion (KRW)
Homepage	http://vadas.co.kr/
Address	Pohang Knowledge Industry Center, Buk-gu, Pohang-si, Gyeonsangbuk-do, S.Korea

■ Organization



■ Shareholders



Key Members

■ CEO
Jun-Seok(Peter) Lee

Pohang University of Science & Technology
M.A in Electrical Engineering (1997)
A co-founder of ITX Security Co., Ltd)
(KOSDAQ listed)
Current CEO of VADAS

■ CTO
Byeong-Chan Jeon (Ph.D, PMP)

Pohang University of Science & Technology
Ph.D in Electrical Engineering
- ✓ Real-time image processing & recognition structure design
- ✓ System architecture design
- ✓ H/W & FPGA design
- ✓ Embedded S/W design
- ✓ Project supervisor

Current CTO of VADAS

■ Application Team 1 Leader
In-Tae Na (Ph.D)

Pohang University of Science & Technology
Ph.D in Electrical Engineering
- ✓ Image recognition, video Codec
- ✓ Surround view
- ✓ Embedded S/W

■ Application Team 2 Leader
Woo-Yeol Jeon

Pohang University of Science & Technology
M.A in Electrical Engineering
- ✓ Image recognition
- ✓ Surround view
- ✓ Embedded S/W

■ Algorithm Team Leader
Jeong-Mok Ha (Ph.D)

Pohang University of Science & Technology
Ph.D in Electrical Engineering
- ✓ Camera calibration,
- ✓ Image recognition
- ✓ Surround view
- ✓ Auto parking

Main Products

A leading company of parking ADAS Solution

Experience in Automotive market for 10+ years

SVM(Surround View Monitor)

√ Visualization

Synthesize images taken through **4 cameras** outside of the vehicle (front, rear, right, left) to form a 360°image around the vehicle.

ADAS 1

DeepSV™

√ Recognition

Recognize surrounding objects by adopting AI(Deep Learning) technology in SVM Technology

ADAS 2

360Shield™

√ Localization& Maneuvering

SLAM & Path Planning Algorithm added to SVM technology and AI (Deep Learning) Technology

*(*Autonomous Valet Parking Solution)*

ADAS Level3~4

DVRS

√ Recording

- General recording and saving technology
  - ✓Real –time recording and saving while driving
  - ✓Recording status, period, and duration can be set while stopping
- Emergency recording and saving technology
  - ✓When a specific event occurs, the video automatically save the recording file for a certain duration

Business Model

SVM

- ✓ Synthesize 4 channel camera images into a single image

DeepSV™

- ✓ Object Detection (DL) + SVM

360Shield™

- ✓ VSLAM(Mapping) & Maneuvering + Object Detection (DL) + SVM

DVRS

- ✓ Dashcam recording function & all necessary S/W

NRE / Royalty

TIER

MCNEX, Samsung Electronics, Samsung Electro-Mechanics, SL(MP), Longhorn(MP), ALPINE, APTIV, HASCO, IS, FICOSA, HARMAN, VISTEON, WEMARE etc.

OEM

Hyundai & KIA Motors, Geely, BYD, SAIC, FCA, PSA, Ford, GM, DONGFENG, RENAULT, Shanghai VW, Mahindra Suzuki, TATA etc.

BEFORE MARKET

AFTER MARKET

Market Value Chain

OEM

◈ Design & manufacture a complete vehicle

TIER **TIER**

◈ Integrate & supply complete products/modules to OEM needs

- ✓ Manufacturing of ADAS & IVI system
- ✓ Manufacturing embedded system
- ✓ Manufacturing camera/video system

Component Provider **Component Provider** **S/W Provider**

◈ Develop & supply S/W algorithm according to customer needs

- ✓ S/W solution provider
- ✓ System structure consulting

02 MAIN TECHNOLOGY

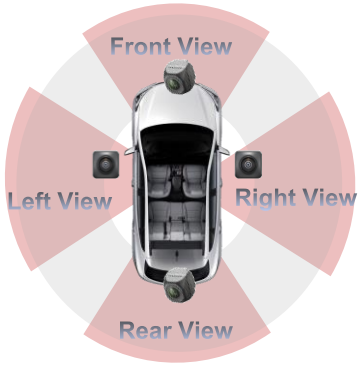
- Product overview
- Surround View Monitor(SVM)
- Deep SV™
- 360Shield™
- DVRS

VISION BASED VADAS

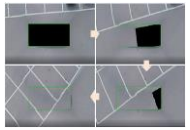
Product overview

- **Surround View** : An algorithm product that helps drivers to grasp 360 degrees around the vehicle at a glance through multi-channel input camera images stitched into a single image.
- **DeepSV™** : An algorithm product that helps to drive safely by strengthening next-generation 3D surround view and deep learning-based recognition function.
- **360SHIELD™** : An algorithm product aims to accomplish the low-speed autonomous driving & parking on a plane ground and multistory by providing safe protection function.
- **DVRS** : A software product that helps to record events in & outside a vehicle through a single or plural wide-angle cameras installed on a vehicle.

SVM



Option

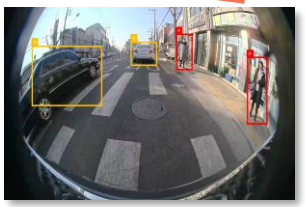


TVC

On-Road calibration

DeepSV™

Deep-Learning BASED

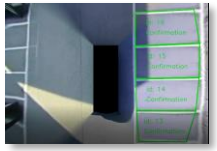


Object Detection
(PD+VD)

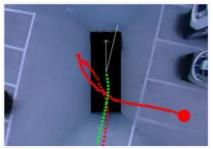
Pedestrian Detection(PD)

Vehicle Detection(VD)

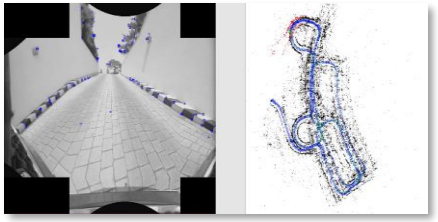
360Shield™



Parking Slot Detection



Vehicle Control

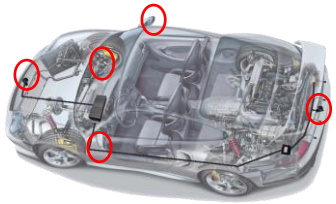


Visual SLAM

Segmentation (Curbstone)

Optical Character Recognition

DVRS



- Cameras installed in & outside of a vehicle
  - ✓One wide-angle camera
  - ✓Plural wide-angle cameras
- Recording and saving technology
  - ✓Real-time recording when driving
  - ✓Impact recording when impact is detected

Surround View Monitor(SVM) – Summary

* **FPC:** Full Pattern Calibration * **SPC:** Simple Pattern Calibration * **ORC:** On Road Calibration

◆ **Summary :** An algorithm product that stitches multi-channel fisheye lens camera images into a single **360 degrees surrounding image** of a vehicle through image processing technology.

◆ **Purpose :** A solution that provides a help for safe driving by allowing the driver to easily identify the surrounding environment and obstacles when driving or parking.

◆ **Remarks :**

- Fisheye lens with a wide angle is used to view a wide field of view, and an excellent calibration technique is essential to eliminate errors that occur during each image synthesis.
- VADAS provides various types of calibration. FPC technology (most accurate) suitable for B/M, SPC technology (most convenient) suitable for A/M, and ORC technology (high technology) enables automatic calibration when driving. FPC & SPC should be carried out in stationary state, and ORC should be carried out on a dotted road while driving.
- VADAS's calibration technology boasts excellent accuracy, reliability, and flexibility, and holds several relevant patents. (Once carried out a calibration, no need for a separate calibration for *PGL)
- VADAS's SVM has been developed in accordance with various specific feature requirements in multiple operating systems and has abundant development and mass production history.

[SVM related Technology Implementation Video]

1. Real-time View Mode ▶

2. 3D Car Model Animation Effect ▶

3. Transparent Vehicle Chassis (TVC) ▶

Other technologies such as Lens Contamination Detection, Radar Wall, PGL(Parking Guideline), etc. are available.

Surround View Monitor(SVM) – Calibration

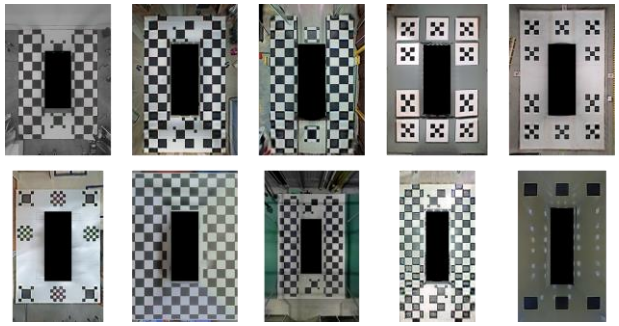
[Calibration Technology Implementation Image & Video]

* **BM:** Before Market * **AM:** After Market

▲FPC (Full Pattern Calibration)

- It is also called In-line Calibration, this calibration method is suitable for Tier 1 and OEM (BM).
  (* Requires a designated calibration site)
- Various types of patterns can be supported (more than 30 types)
- Quick and accurate calibration method that calibrate within 1~3 seconds.
- Since principal point error can be measured, cameras with a lot of principal point error can be supported. (Can support various types of cameras)

1. FPC– Pattern Types



▲SPC (Simple Pattern Calibration)

- It is also called as Smart Calibration, this calibration method is user-friendly method for Tier 1 , dealer, car center, etc. and for AM. (Less restriction for calibration site)
- Easy and convenient calibration method that calibrate within 5 seconds with only four 1.5m size patterns.
- However, since the principal point error cannot be measured, cameras with a lot of principal errors (up to the error within 5 pixel can be supported).

2. SPC ▶

▲ORC (On-Road Calibration)

- A technology that automatically calibrates an image when an installed camera is relocated for various reasons such as minor collision or tire pressure change while driving after the vehicle is released.
- Calibrate within 1 minute by powerful image recognition technology that recognizes dotted lines on both sides of the road while driving.
- A technology developed through collaborative development with domestic company and verified on roads in China.

3. On Road Calibration ▶

DeepSV™ – Summary

* **OD:** Object Detection

◆ **Summary :** An algorithm product that helps the drivers intuitively identify obstacles in the blind spots by combining the SVM with the **recognizing algorithm** using the deep learning.

◆ **Purpose** : Provides a help for safer driving by allowing the driver to be aware of a danger of nearby obstacles (pedestrian, vehicle, bike, or etc.), while parking, or low-speed driving.

◆ **Remarks** :

- Provides safer functions by combining SVM & AI(Deep Learning) technology for the first time in Korea.
- In case of OD, a wide range of obstacles such as various kinds of vehicles (Sedan, SUV, Bus, Truck, etc.), two-wheeled vehicles (motorcycles, bicycles, etc.), pedestrian, stopper, etc., can be detected.

[DeepSV™ Technology Implementation Video from 2019]

DeepSV™

Apply deep learning-based object recognition technology specialized in fisheye camera image

H/W Evaluation Environment

- ✓ TDA2x SoC (from TI) platform
- ✓ Using 4x HD LVDS cameras
- ✓ Running both Surround view @30fps and CNN-based detector @30fps
- ✓ Targets including vehicles, pedestrians and bicycles

Deep Learning – SoC Porting History

* **PD:** Pedestrian Detection * **VD:** Vehicle Detection * **PSD:** Parking Slot Detection * **LD:** Lane Detection * **TLD:** Traffic Light Detection

Vendor	SoC	Time	Development Object
Samsung	Exynos 8890	2018.3Q~4Q	DeepSV (PD/VD) / GPU-based
TI	TDA2	2019.2Q~3Q	DeepSV (PD/VD)
TI	TDA4	2020.3Q~4Q	DeepSV (PD/VD/PSD)
nVidia	Jetson Xavier	2020.3Q~4Q	Object Detection (PD/VD)
AllWinner	V535	2020.4Q ~ 2021.1Q	Object Detection (PD/VD)
Rockchip	RK1126	2020.4Q~2021.1Q	Object Detection (PD/VD/LD)
Coral	TPU	2021.1Q~4Q	Object Detection (PD/VD)
Nextchip	Apache4	2021.2Q~3Q	Face Detection (for Thermometer)
SigmaStar	SAV837	2021.2Q~2022.1Q	Object Detection (PD/VD/LD/TLD)

360Shield™ – Summary 1

***PSD:** Parking Slot Detection ***SEG:** Segmentation ***VSLAM:** Visual SLAM

◆ **Summary :** An algorithm product that enables the vehicle to recognize its location in real-time and to find a parking lot on its own only with camera images that strengthened by DeepSV™.

◆ **Purpose :** Without driver's intervention and advance infrastructure environment, real-time location identification and environmental map are created only with camera images to help a vehicle to park safely on its own.

◆ **Remarks :**

- Integrated solution that includes recognition function (PSD, SEG), localization (VSLAM), and maneuvering (Path Planning) etc. which are strengthened in DeepSV™.
- Through application of four technologies such as visualization, recognition, localization, and maneuvering, even without a driver, the vehicle recognizes the surrounding environment by itself and conducts autonomous parking.
- Cost saving method by enabling safe parking only with camera images without driver's intervention and advance infrastructure environment (communication infra) in the parking lot.
- In case of PSD, it is possible to detect various types of parking spaces belonging to a straight line, diagonal line, one column line, sloping etc. according to customer's specific requests.
- SEG application scope is limited to curbstone.

[360Shield™ System forming 4 Essential Technologies]

APA

Technology development

AVP

Visualization	Recognition	Localization	Maneuvering
2D/ 3D Surround View 2D/3D Synthesized Viewing	**Deep Learning** Object(Pedestrian etc.) Detection	**VSLAM(Map Building)** Short distance obstacle mapping	**Path Planning** Autonomous Driving
✓Real-time Calibration ✓Recognition function linkage	✓Parking Slot Detection (PSD) ✓Optical Character Recognition (OCR)	✓ Long distance & ground /underground mapping	✓ Create driving path based on the overall map ✓ Emergency braking for an obstacle

360Shield™ – Summary 2

[360Shield™ Technology summary]

SVM & Deep Learning

+ Enhanced S/W

Features

- Sensor Fusion Capability (Camera, USS or Radar)
- AI & Visual SLAM
- Multistory AVP will be available

Surround View
Calibration
3D geometry

Visual SLAM
Feature extraction
Reconstruction

Visualization
Localization

360Shield™

Recognition
Maneuvering

Deep Learning
Detection
Segmentation

Path planning & tracking
Optimal path
Feedback control

Environment

Parking

- Plane Ground
- Multistory
- Available only when parking slot is marked

H/W Spec

H/W

- 4 Fisheye cameras
- TDA4 or higher performance

APA
(Automatic Parking Assist)

Memory Parking

AVP
(Autonomous Valet Parking)

360Shield™ – AVP Roadmap

2019.4Q

AVP Basic

Short Distance(<15m)

- Plane ground
- Surround view + PD, VD
- Parking Slot Detection (PSD)
- Multi-platforms:
  IMX6 + Jetson + Laptop(i5) + Ethernet cameras

2021.4Q * Underdevelopment

AVP Plane

Long Distance (<approx.900m²)

- AVP Plane Feature
- **Mapping by VSLAM**
- **Call back function**
- **Single platform:**
  TDA4VM or higher performance

2022.3Q

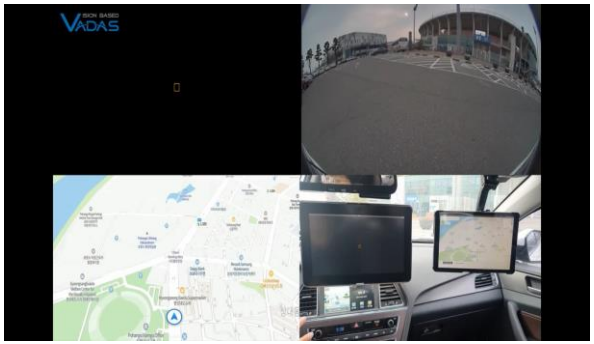
AVP Multistory

Multistory

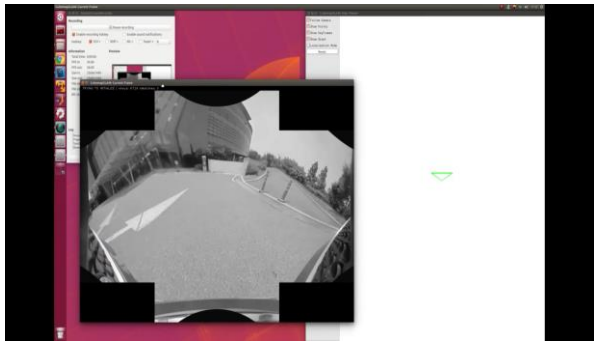
- AVP Plane Feature
- **Character(Sign) Recognition**
- **Path Decision Making**
- Single platform:
  Apache 6, Orin, etc.

[AVP Technology Implementation Features & Videos]

- ✓ Within 15m(plane ground), conducts autonomous parking to the parking space
- ✓ Brake when there is an obstacle that is found through 360° object recognition around the vehicle



- ✓ Within 900m²(plane ground), creates a map of the surrounding environment and conducts autonomous parking
- ✓ Recognize road space that can be driven through SEG



- ✓ Creates a map of the surrounding environment and conducts autonomous parking through recognizing multistory
- ✓ Automatic path setting and added character recognition function

360Shield™ – AVP Feature

	2019.4Q **AVP Basic**	2021.4Q **AVP Plane**	2022.3Q **AVP Multistory**
Visualization	• **2D/3D Surround view** : in-line, on-road calibration	• **2D/3D Surround view** : seamless 3D objects	• **2D/3D Surround view** : seamless 3D objects
Recognition	• **Object detection (DL)** : pedestrians, vehicles, bicycles • **Parking slot (CV)** : a few slot shapes	• **Object detection (DL)** : pedestrians, vehicles, bicycles • **Parking slot (DL)** : a few slot shapes • **Segmentation (DL)** : curb, drivable free space	• **Object detection (DL)** : pedestrians, vehicles, bicycles • **Parking slot (DL)** : a few slot shapes • **Segmentation (DL)** : curb, drivable free space • **Character recognition (DL)** : Korean and English signs
Localization	• **Not applied**	• **Visual SLAM** : indirect method : dedicated for fisheye image	• **Visual SLAM** : speed optimization : providing a practical calibration
Maneuvering	• **Parking lot navigation** : simple straight movement only • **Parking control** : optimal path planning : tracking by visual information	• **Parking lot navigation** : AD considering dead-end in the lot • **Parking control** : optimal path planning : tracking by visual information	

360Shield™ – Memory Parking

◆ **Summary:** Memory Parking is an algorithm product that is introducing new functions of APA as a practical approach to AVP.

◆ **Purpose:** Without driver's intervention, a vehicle conducts automatic parking in a designated parking space on its own.

◆ **Special Note:**

- Memory Parking Basic (MP Basic) is a technology that remembers the memory saved parking space and remotely conducts automatic parking without a driver.
- MP system works within the environmental range of saved data values for the driver to automatically park the vehicle in specific parking space.
- When a vehicle arrives at the memory saved parking space, the system automatically starts and repeats the parking process in short distance scenario.
- In the long-distance scenario, MP function can work only when VSLAM is added.
- Currently, Memory Parking Advanced and AVP Plane technologies that allow a vehicle to conduct automatic parking in a place from 150 meters away without a driver are being under development. (2021.4Q)

MP (Memory Parking) Basic : Two Components

①Memory Mode Driver √

✓ Saves the starting point when parking for the first time.

✓ Saves the moving path from the starting point until the parking point

②Parking Mode Driver X

✓ Refers to the starting point from the memory mode

✓ Only by pressing a button from the starting point, conducts automatic parking until the parking point

MP Basic vs. MP Advanced

MP Basic	MP Advanced
Memory mode (Driver √) + Parking mode (Driver X)	MP basic + Long Distance Driving
• Surround view + PD, VD • **Rerouting function on Parking Mode** • Parking slot < 15M ahead • Single platform: TDA4VM + LVDS cameras	• **Self-drivable distance < 150M** • **Supporting multistory parking starting from entrance** • **Call back function** • Single platform: TDA4VM or Similar
Short Distance	Long Distance

DVRS – Summary

***DVRS:** Digital Video Recording System ***BM:** Before Market ***AM**: After Market

◆ **Summary :** DVRS is a software product that is similar to the dashcam by being installed on a vehicle to perform continuous recording or impact recording during driving and pausing.

◆ **Purpose :** To be able to check for any error or accident through continuous recording or impact recording according to the driver's settings when driving or pausing.

◆ **Remarks :**

- The only company in Korea that owns the BM & AM dashcam development record.
- Abundant experience in research & development of dashcam SW over the past 10 years.
- Achieved advanced development & mass production development records with numerous OEMs/Tiers of BM & AM.
- According to the customer's specific needs develop detailed recording functions (continuous recording, impact recording, manual recording, etc.) respectively corresponding to the driving mode and parking mode.

High-Reliability SW Framework

- ✓ Video Recording, File Saving, GUI integrated SW
- ✓ Design based on automotive SW quality process
- ✓ Applicable to static and dynamic verification

Vehicle internal system interface

- ✓ Supports BM navigator (AVNT) linkage
- ✓ Supports transmission of LVDS & ethernet video
- ✓ Supports self-diagnosis through CAN linkage

Support video recording mode

- ✓ Supports camera resolution for front QHD & rear FHD
- ✓ Supports H.264, H.265 recording & container
- ✓ Supports time-lapse recording function

Quick booting & low-power SW design

- ✓ Starts video recording within 5 seconds after power on
- ✓ Applies low-power Sleep Mode when parking recording
- ✓ Supports DVRS dedicated battery management module linkage

Applies Hyundai-Kia Motor's quality development method ▶ Satisfies automotive development quality standard (A-SPICE, AEC-Q100)

03 COMMERCIALIZATION STRATEGY

- Competitiveness (1) (2) (3)
- Competitors
- Business Strategy
- Development History
- Business Outlook

VISION BASED VADAS

Competitiveness (1)

ASPICE

- S/W development & response experience targeting BM
- High-reliable S/W development capability targeting BM
- Certified ASPICE level 2 in 2016 & level 3 in 2018

CERTIFICATE OF ASSESSMENT

VADAS

AUTOMOTIVE SPICE® v 3.0 CL 3

Patent

- Guaranteed intellectual property rights through patents.
- A total of 36 domestic and overseas patents related to 2D SVM, 3D SVM, Calibration are applied.
- Of these, the number of registrations was 20 in Korea & 3 overseas , a total of 23.

Network

- Closer customer management is possible as a group company
- Expect synergy effect with parent company NC& (black box) and Nextchip (BM, ISP, ADAS SoC)

Competitiveness (2)

The only S/W solution supplier in Korea that has all the major autonomous parking technology elements

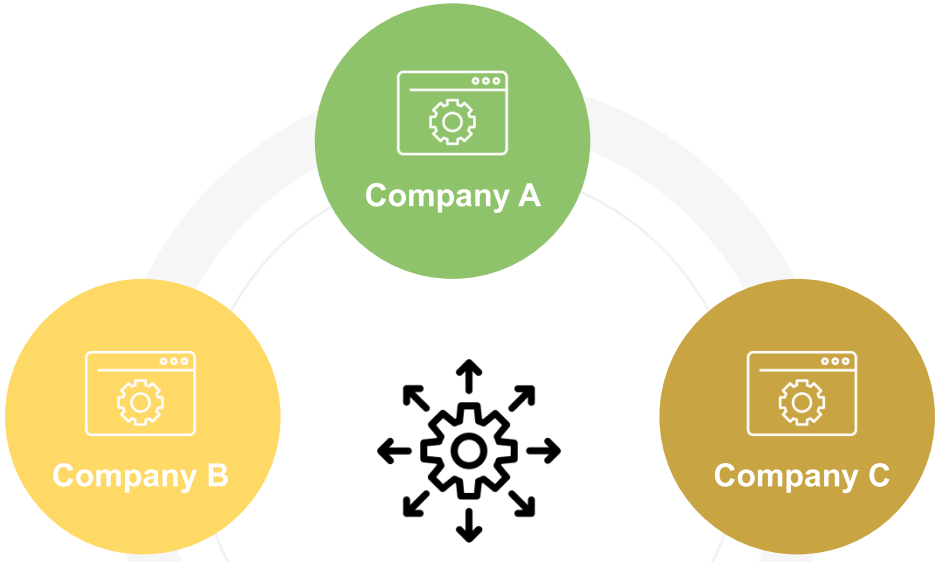
The only company in Korea that achieve the BM & AM dashcam (blackbox) development record

Posses IP technology through abundant mass production experience, systemized global development process, and technology infrastructure as a group company etc.

Posses domestic BM/AM dashcam history *▶ Secures technology infrastructure capabilities as a group company*	*Supplies four key technologies for autonomous parking* *▶Visualization, Recognition, Localization, Maneuvering*	*Posses an abundant history of advanced development/ MP* *▶Collaborated with major customers in BM & AM*	*Posses ASPICE level #3* *▶ SW reliability certification*
▪ **BM Advanced development** - Development history with YuraCorporation(HKMC向) & Samsung Electronics (Renualts向) etc. ▪ **AM Mass Production development** - Mass Production history with FineDigital(Domestic) & SanDisc(Asia/Pacific) ▪ **Technology infrastructure capabilities within a group company** - [Parent Company]NC&: Occupy 30% of domestic black box - [Brother Company]Nextchip: Posses ISP & Ethernet AVB for BM	▪ **Surround View Monitoring(SVM)** - Wide-angle camera processing technology ▪ **Deep Learning** - Object recognition technology on the sides, rear, front of the vehicle ▪ **VSLAM** - Nearby environment map generation technology ▪ **Path Planning & Tracking** - Optimal parking movement path planning, tracking, and controlling technology	▪ **Performance of advanced development** - Performed advanced development PJT with major tier/OEM in domestic and overseas. - Applied SVM, Deep Learning technologies. ▪ **Performance of mass production development** - Performed mass production development PJT with major tier/OEM in domestic and overseas. - Applied SVM, Deep Learning technologies.	▪ **ASPICE** - Certified ASPICE level 2 in 2016 & level 3 in 2018 - Posses the ability to develop high-reliable S/W - Posses global process for mass production projects ▪ **Registered a numerous patents** Every year professional personnel applies a lot of patents in the field of image recognition and processing - Registered some patents related with 2D SVM, 3D SVM, Calibration, in Korea and abroad.

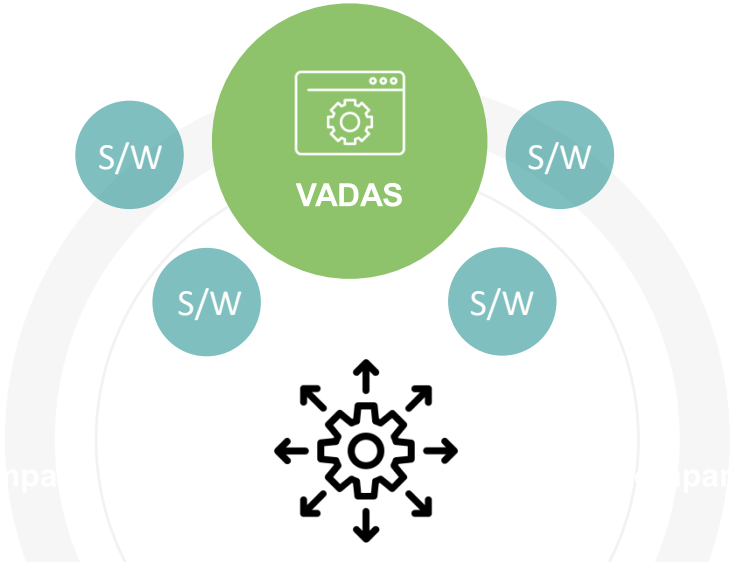
Competitiveness (3)

1 stop supply of all elemental technologies required for autonomous driving ▶ Save time & cost required for the system composition



▲ Verification time/cost

▲ Unstable S/W compatibility



Reduce verification time/cost through S/W supplier unification

Competitors

Superior performance compared to competitors in all major element technologies of autonomous parking

Comparison of selecting top suppliers in the market by technology▶ VADAS' competitive advantage in autonomous parking S/W configuration

1) Fisheye image recognition technology for parking is not mature
2) Deep learning is based on the previous machine learning technology
3) Using pre-production map-based spatial search technology

	Technology	Contents	VADAS	L(Korea)	S(Korea)	C(USA)	M(China)	A(Germany)
360Shield™ / DeepSV™	SVM	Fisheye camera-based calibration technology 3D SVM source technology	○ (Unrivaled in Korea)	△	X	○ (Best)	X	X
	Deep Learning	Fisheye image-based deep learning technology Object recognition and extraction function Target tracking function	○ (Unrivaled in Korea)	X	△ 1)	△ 2)	○ (Best)	X
	VSLAM	Fisheye image-based SLAM technology Real-time mapping and localization technology	○ (Unrivaled in Korea)	X	X	X	△ 3)	○ (Best)
	Maneuvering	Driving path forming technology Maneuvering technology	△	X	X	X	○	X

Business Strategy

*BM: Before Market *AM: After Market

Securing an unrivaled position in the autonomous parking field

▶ Creating value at the level of Mobile Eye in the autonomous driving market (Vision Processing)

Expansion of market position & securing sales through phased commercialization of autonomous parking technology

Product	Target Market	Strategy Summary	Partner Company
SVM	Domestic ADAS-PRK 2nd generation BM, AM in China and BM in Europe	▲ **Performed SVM Advanced & MP development PJT** with major tier 1 in Korea and overseas. ▲ Through the history of SVM mass production over the past decade, **we have secured the stability & technology skill of S/W.**	Samsung Electronics, Samsung Electro-Mechanics, MCNEX, SL, HARMAN, FICOSA, LONGHORN, IS, ALPINE, HASCO, APTIV, WEMAER etc.
DeepSV™		▲ Secure stable revenue **by developing S/W customized for customer's system.** ▲ Seek additional collaboration opportunities through **VADAS IP technology sales**	
360Shield™	Domestic ADAS-PRK next generation BM in Korea, China, & Europe	▲ **Promote the domestic development of the next generation of ADAS-PRK.** ▲ Expand actual sales **by performing the mass production development of AVP and Memory Parking in Korea and overseas.**	Samsung Electronics, POSCO, MCNEX, Hyundai Mobis, LONGHORN, IS etc.
DVRS	Domestic DVRS 2nd generation BM in Korea	▲ **Collaborate on the advanced development for 2nd generation of DVRS** with domestic major customers ▲ In the future, **secure a bridgehead for mass production development** through the history of advanced development	MCNEX, Hyundai Mobis

Development History

■ Main development history

Section	Company	Product	OEM
Advanced	H(Domestic)	2012-2013	Camera based rear pedestrian recognition
	F(Spain)	2013-2015	TSR Algorithm development
	Y(Domestic)	2014-	2D Surround View Development
	V(Germany)	2015-2016	Advanced development of BM black box (targeting HKMC)
	S(Domestic)	2015-2016	Head Unit Embedded 2D SVM
		2018	2019 CES Exynos Platform SVM+Recognition function support
	S(Domestic)	2021	Exynos V9 3D SVM Development
MP	S(Domestic)	2012-2013	SVM MP Development
	A(Japan)	2015-2016	4 channel HD class 3D support SVM Development
	L(China)	2016-	MP & Initiation of Analog AVM
	L(Domestic)	2017-2015	Completed On-Road Calibration development for China
	X(China)	2019	Completed development for 4 channel 3D AVM commercial truck
	C(China)	2021	Completed development for 4 channel 3D AVM commercial bus

■ Current project status

Section	Company	Contents
SVM +DeepSV	X(China)	Discussing to deliver commercial vehicles (Company F & Q)
	W(China)	Developing a product for After Market in China
	C(China)	Completed development for commercial bus in China
	H(Germany)	Discussing advanced development PJT
	M(Domestic)	SVM&DVRS MP deliver project for company H in domestic
	S(domestic)	Developing 2.9MP camera SVM
	S(domestic)	Discussing the DeepSV development
360˚ Shield	L(China)	Camera, ultrasonic sensor fusion advanced project TBD Developing deep learning recognition function
	P(domestic)	Developing locomotive autonomous driving project for the first time in Korea
	M(domestic)	Joint Development for parking support system that targets company H in domestic
	I(China)	Developing a product that targets the Before Market in China

Business Outlook

01 Surround view which is specialized for parking, combined with recognition technology

Next generation surround view technology that can identify any dangerous situation while parking through recognition of pedestrian and vehicle

Based on the surround view technology skill, it secures the foundation to expand the autonomous parking business in Korea and abroad.

02 As the front leading company in the autonomous parking field our Upside Potential

Achieved all four core elemental technologies needed for autonomous parking such as Visualization, Recognition, Localization, and Maneuvering

Planning to stand up as First Mover which leads the autonomous parking market through phased commercializing the autonomous parking core technologies.

03 High growth potential in the parking assistance system and autonomous parking market

Global parking assistance system is expected to grow at an annual average of 5.6%, and the global autonomous parking market is expected to grow at an annual average of 10.5%.

Continuous sales growth potential in the companies targeting the Chinese market by the growth of Asia-Pacific and Chinese parking industries.

04 Expecting a high operating margin along with full-fledged sales from 2022

Since the DeepSV™ product started to be on sale from 2021, continuous external growth is expected after 2022 when 360 SHIELD™ product plan to be on the market.

VADAS

THANK YOU

VISION BASED VADAS