Development of Automated Vehicles in Taiwan

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Current Demonstration in Taiwan

Shuttle buses from France have been being demonstrated for public transportation
Automated Vehicles by Taiwanese industry

Taiwan’s Auto industry has be integrating local institutes, companies and international companies to develop it’s own automated vehicles

Institute: ITRI/ARTC…

Perception
Positioning
Decision making
Driving Control

Whetron/nVIDIA
KingwayTek
HAITEC/nVIDIA
Advanced Micro Electronics

local and foreign companies
The basis of Taiwan’s automated vehicles

Mature ADAS (perception) solutions in Taiwan, but only for driver warning;

ADAS: Advanced Driver Assistance Systems
Taiwan’s Eco-system

Taiwan as a company: highly integrated from Technology to Market

- **Technology**: Institute
  - Electrified powertrain
  - Automotive electronics
  - Lightweight body

- **Product**: Company

- **Integration**: Platform

- **Market**: Region
  - Taiwan
  - China
  - International
Members of TARC

- Organized and supervised by the DoIT, MOEA
- Integrating 4 local research institutes and HAITEC to work coherently

工业技術研究院
Industrial Technology Research
Mechanical & Systems Research Laboratories
Materials & Chemical Laboratories Institute (ITRI)
http://www.itri.org.tw

車輛研究測試中心
Automotive Research & Testing Center (ARTC)
http://www.artc.org.tw

金屬工業發展中心
Metal Industries Research & Development Center (MIRDC)
http://www.mirdc.org.tw

中山科學院
Chung-Shan Institute of Science & Technology (CSIST)
http://www.csistdup.org.tw

華創車電公司
Hua-Chuang Automobile Information Technical Center Co (HAITEC)
http://www.haitec.com.tw

http://www.ev.org.tw/Home/index
ITRI’s Vehicle Platform

Gen 1
Electric Vehicle

Gen 2
Self-driving Car

Gen 3
AI Car

2017 Pre-production by a local OEM

2018 Site Testing in ITRI Campus

2019 Site Testing around Hsinchu High speed train station

Presented by Jensen Huang in 2016
Gen2 Self-driving Car
Demonstration of the automated vehicle -1

Camera

GPS

Lidar
Gen2 Self-driving Car

Demonstration of the automated vehicle -2
Gen-3 AI Self-driving Car

To replace traditional obstacle tracking from numerical data, it is a necessity of using visual depth learning on intuitive traffic scene understanding.

Automated driving functionality

- **Vehicle Behavior**
  - Maneuvers
  - Prediction
  - Goals
  - Classification

- **Vehicle Tracking**
  - Position
  - Filtering
  - Dynamics
  - Data Association

- **Vehicle Detection**
  - Appearance
  - Motion
  - Shape
  - Disparity

Driving environment

- **Urban road**
  - Highway: 80~110km/h
  - Traffic jam: <15km/h
- **Urban road**
  - 15~80km/h
Gen-3 AI Self-driving Car

R&D Eco-system of ITRI’s AI Automated Vehicle

- Traffic Scenario Database
- Multi-lens Cameras
- Real Driving Scene

- DL Modeling & Computing Center
- DL Perception Processor
- Automated Vehicle

- Sensed Data
- Traffic Scene Video
- V2I
- V2V

- Driving Teaching
- Advanced Driving Simulator
- DL model

- Deep Learning (DL) Cloud System
- DL Driving Controller
- nVIDIA PX2
- On-Board Driving Control Systems
Deep Learning Improves Quality of Object Detection

• Only front vehicle on the same lane could be precisely detected!
  • Recognition Rate: 93%

• Easy to precisely detect multiple vehicles at the same time!
  • Recognition Rate: 98%
Gen-3 AI Self-driving Car
Prediction of Car Accidents with deep-learning techniques

Behavior

Detection

Box attention
high

low

Focus on the box weight > 0.4

Threshold

Probability
Gen-3 AI Self-driving Car

End-to-end driving with Deep-learning Techniques, nVIDIA PX2 based
Integration Platform

• Systematic
• Flexible
Systematic R&D on EVs

Demonstration: ITRI’s virtual vehicle technologies
Systematic Integration

Vehicle to Component; Simulation to Verification

Simulation

Vehicle in the Loop (ViL)
All are models

Model in the Loop (MiL)

All are models

ARTC

ISO 26262
Model-based
C code

Verification

Vehicle in the Loop (ViL)

All are hardware

Hardware in the Loop (HiL)

Some hardware, some software

ARTC

Vehicle to Component; Simulation to Verification

Manufacturing

Component

System

Vehicle

Component
Flexible Integration

Autonomous Driving System

Sensor
- Camera
- Lidar
- DGPS
- IMU
- Ultrasonic
- Radar

Algorithm
- Sensor Fusion
- Decision Center
- Detect Net
- Pilot Net

Motion Control
- Lane Following
- Auto Emergency Braking
- Adaptive Cruise Control
- Auto Parking

Vehicle
- E-Throttle
- EPS
- Braking

Key Components

MIL
- MONO Camera: R Color Left
  V: 160 x 320
  10 fps

HIL

VIL

Virtual Model
Real Hardware
Example 1: Virtual EVs and systems
Example 2: Virtual Site
Example 3

- Auto Braking and Turning Verification: Controller in the loop

Virtual Simulation Model (PreScan)

System

Vehicle

Sensor

Intersection left turn with oncoming vehicle in front of building 58

Virtual Vehicle Platform (CPEV)

ibeo LUX Lidar (4-layer)

Steer, Brake, Throttle Commands

Vehicle Position, State, Sensor Data, Path Check Point

Controller Model (Simulink)

MicroAutobox

Controller in the loop
Example 4

- Auto Parking Verification: **Controller in the loop**

**Virtual Simulation Model (PreScan)**

**System**

**Vehicle**

**Sensor**

Automatic parking to certain parking space in front of building 58

**Virtual Vehicle Platform (CPEV)**

Camera

Steer, Brake, Throttle Commands

Vehicle Position, State, Sensor Data, Path Check Point

**Controller Model (Simulink)**

**MicroAutobox**

Steer, Brake, Throttle Commands

Vehicle Position, State, Sensor Data, Path Check Point

**Controller in the loop**
Example 5

Testing System for

• Steering
• Brake
Example 6: Deep Learning Platform

**Data Training**

CNN model:
Object detection: SVM, Faster R-CNN, YOLO
Classify: Lenet, Alexnet, Caffenet, DriveNET
Datasets: Pascal + MSCOCO + KITTI+

**Data Mining & Labeling**

Label Tool: Vatics
Labeled: >1,000k images
Object type: Pedestrian, Bike, Motorcycle, Vehicle, Bus, Truck

**Data Server - 144 TB**

**Ground Truth**

**Data Capture**

10GB/day

**Electronically Integrated SW Porting**

TX1, DrivePX2

**Training Server - NVidia DGX-1**
ITRI could Serve as Virtual Tier 1

To bridge OEMs and Tier 2 suppliers during R&D phase

Current

R&D Value-chain

Market Supply-chain

OEM

Supplier

OEM

Virtual Tier 1

Supplier

OEM

Tier 1

Supplier
Welcome to Join our Platform to development your Automated Vehicles and Systems