NM500

nepes Neuromorphic Technology Overview

Practical artificial Intelligence Enabler

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Index

INTRO.

1. What is Neuromorphic?

2. NM500

3. Application (Demo)

OUTRO.
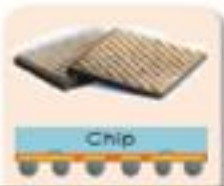
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Business Based on Advanced Semiconductor Packaging

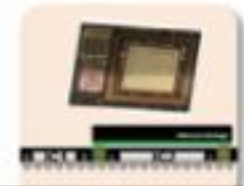**nepes is now expanding its scope of business based on the semiconductor technology.**
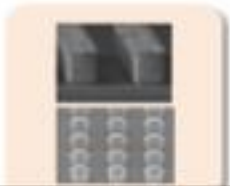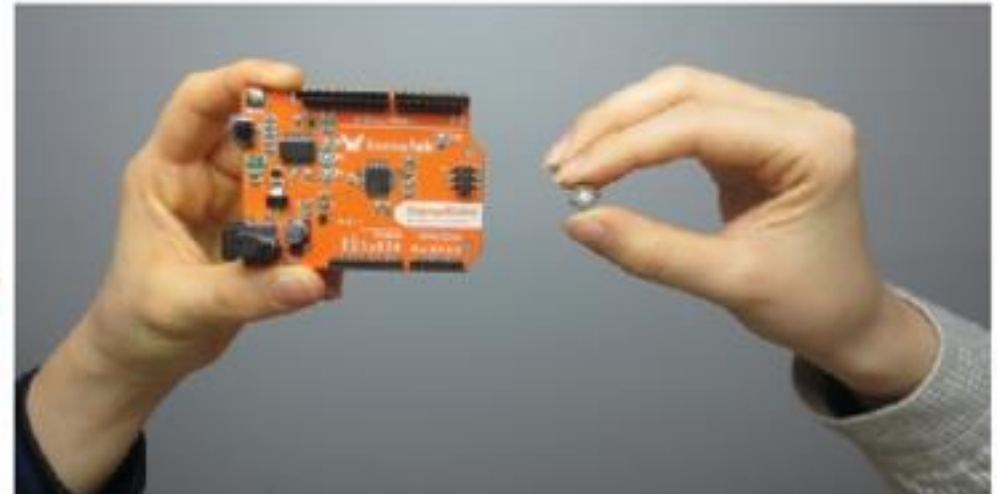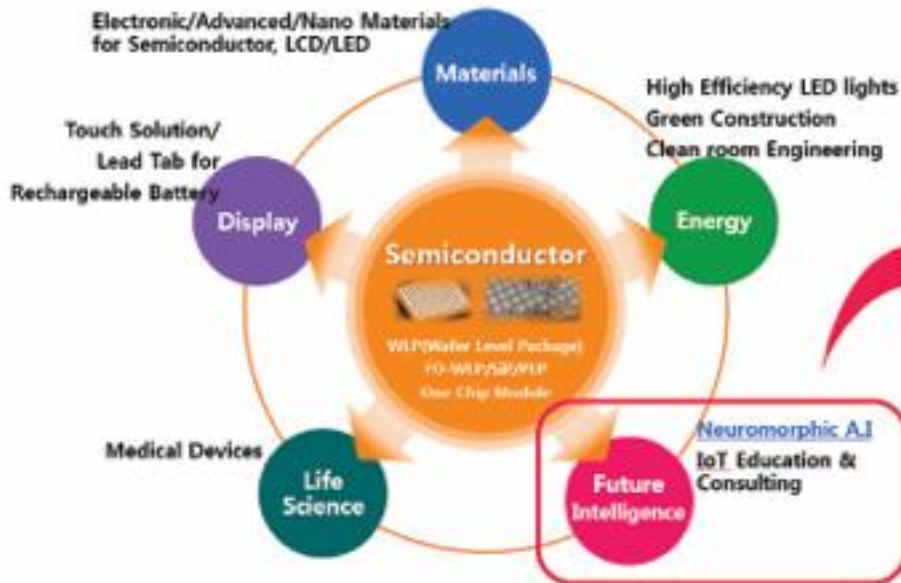

Flip-chip Bumping

WLP

Fan-out WLP

System in PKG / Module

Electronic/Advanced/Nano Materials for Semiconductor, LCD/LED

Touch Solution/ Lead Tab for Rechargeable Battery

Materials

Display

Semiconductor
WLP(Wafer Level Package)
FO-WLP/SiP/WLP
One Chip Module

High Efficiency LED lights
Green Construction
Clean room Engineering

Energy

Neuromorphic A.I
IoT Education & Consulting

Medical Devices

Life Science

Future Intelligence
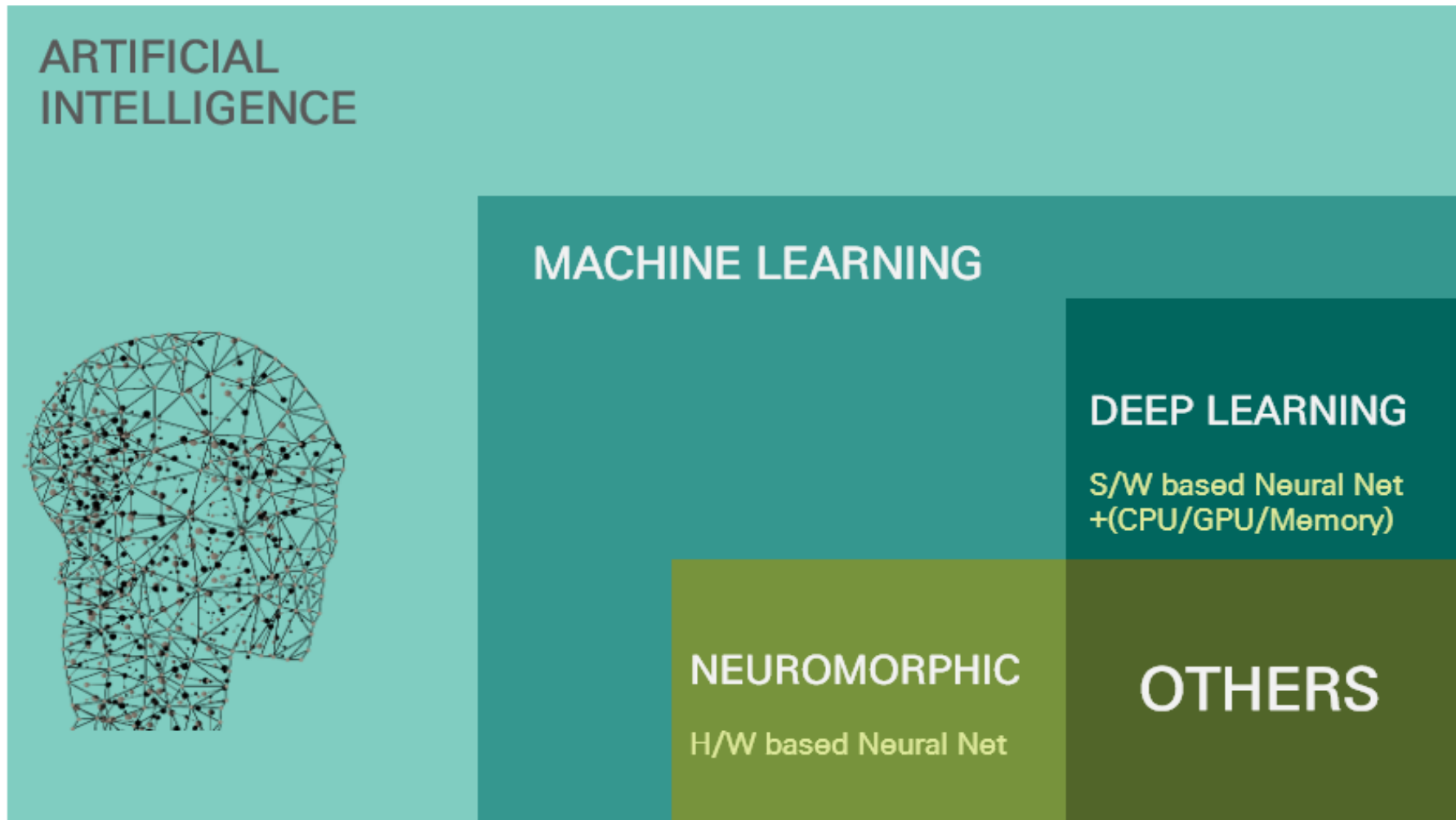
* The meaning of nepes : Eternal Life in Hebrew
* Date of establishment : Dec. 1990
* Number of eymployees : 2,000~ in 2017 ($ 350 million in revenue)

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"**A.I system** is to support human's decision making more precise, quick and correct, based on deep evidences without bias" - IDC, 2017

ARTIFICIAL INTELLIGENCE

MACHINE LEARNING

DEEP LEARNING

S/W based Neural Net +(CPU/GPU/Memory)

NEUROMORPHIC

H/W based Neural Net

OTHERS

Evolution of Artificial Intelligence Hardware

Conventional | 1st Generation | 2nd Generation

CPU → GPU → FPGA → ASIC / ASSP → neuromorphic

(Conventional Computational Power vs AI Computational Power)
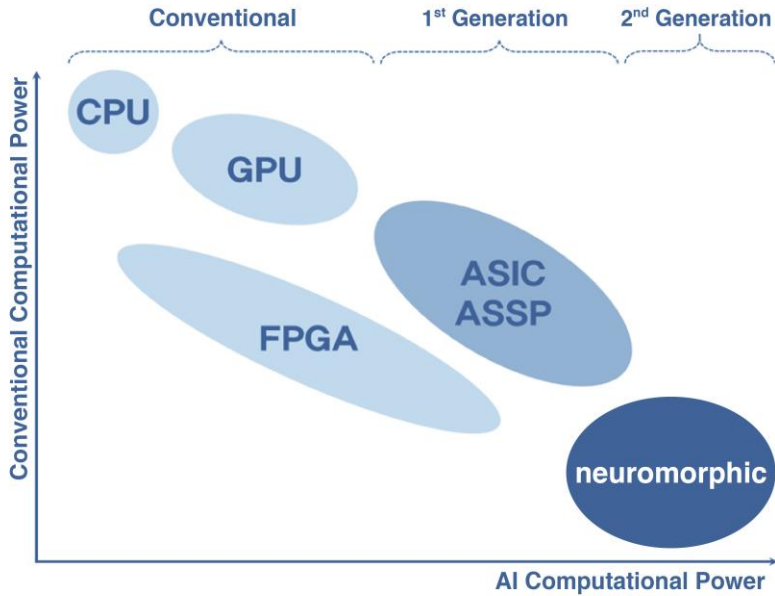
* IBM Truenorth is not commercialized yet.
** Brainchip only sells their IP, not real chip.

- nepes Neuromorphic is the first and only chip you can buy now!

Country	Category	Company	Cloud Computing GPU	Cloud Computing FPGA	Cloud Computing ASIC	Cloud Computing Neuromorphic	Edge Computing 1-Chip	Standalone GPU	Standalone FPGA	Standalone ASIC	Standalone Neuromorphic
U.S.A	Semiconductor	intel		○	△	△					◉
		NVIDIA	◉					◉			
		AMD	○								
		XILINX		◉							
		QUALCOMM				○					
	IT	Google	◉							○	
		Microsoft								○	
		amazon.com								△	
		IBM									◉ *
		Apple					◉				
		Hewlett Packard				△					
	etc.	TESLA								△	
		cerebras	△								
	Start-up	Wave Computing			○						
		MYTHIC								△	
		thinci								△	
		groq			△						
		KNUEDGE				○					
		NOVUMIND			○					○	
		brainchip									○ **
		adapteva			△					△	
		TERADEEP		△							
		gyrfalcon technology								○	
China	Company	HISILICON					○				
		Cambricon								◉	
		Horizon Robotics								○	
		DEEPHi			○					○	
		BITMAIN			○						
		Think Force			△						
		Unisound								△	
		intellifusion								○	
	School	清華大學 (칭화대)								△	
		中國科學院 (과학원)								△	
Korea	Company	삼성전자					○				△
		nepes									○
		NEXELL			△						
		ETRI								○	
	School	서울대학교									△
		KAIST								△	

◉ : A market leader   ○ : A market chaser   △ : Product under development
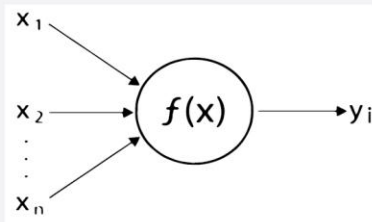
Source : IITP, 2018

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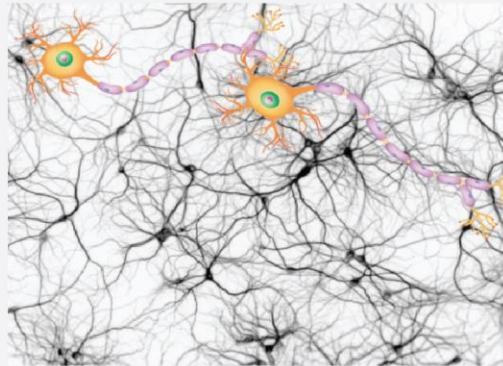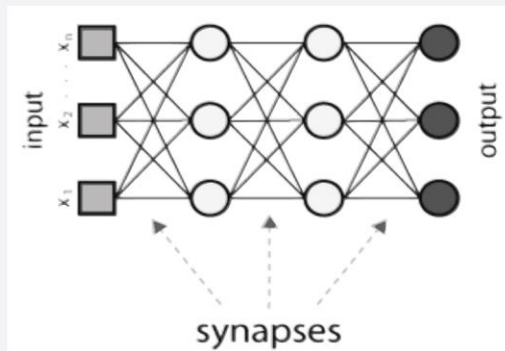Inspiration from biology to design hardware models of neural and sensory systems.

Neuron
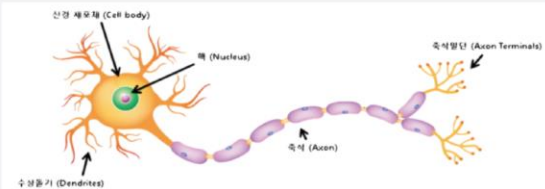
**Perceptron**

Neural Network

Artificial Neural Network

(Neuromorphic Chip)

(Von Neumann Computing)

NM500

- Cloud computing is a great solution for the current AI era.
  - Higher cost of computing power for faster (increased cost)
  - More fast & stable network connections (increased security issues)

- If the sensor is intelligent coupled and learn and judge information directly
  - Real Time Processing under milliseconds & Low network traffic in the workplace .(Small embedded AI)
  - Performs AI functions independently of the network & user-specific application.(Free from security issues)
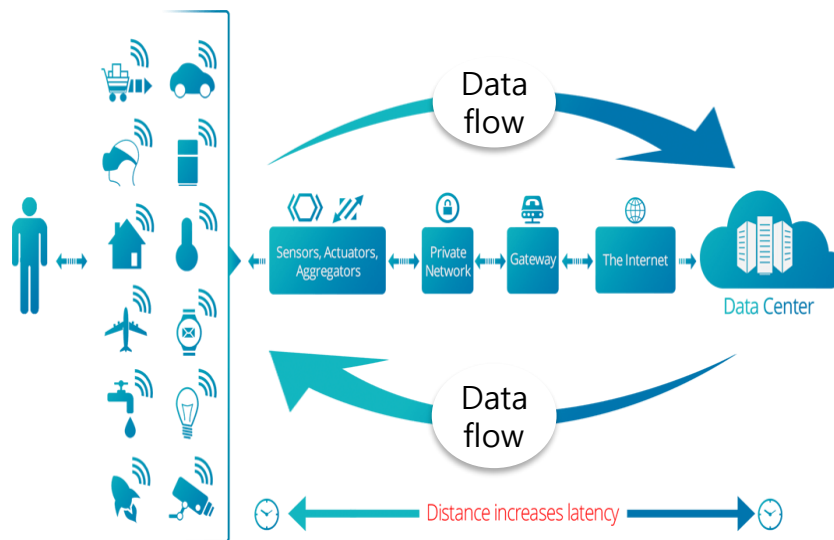
Server/Cloud
- Training
- Execution/Inference
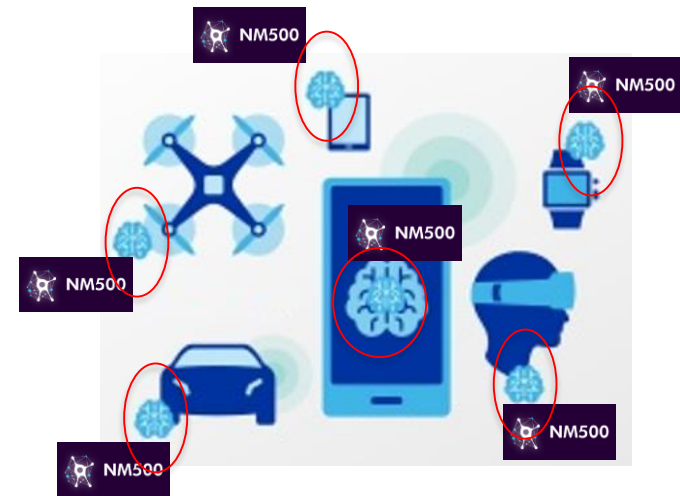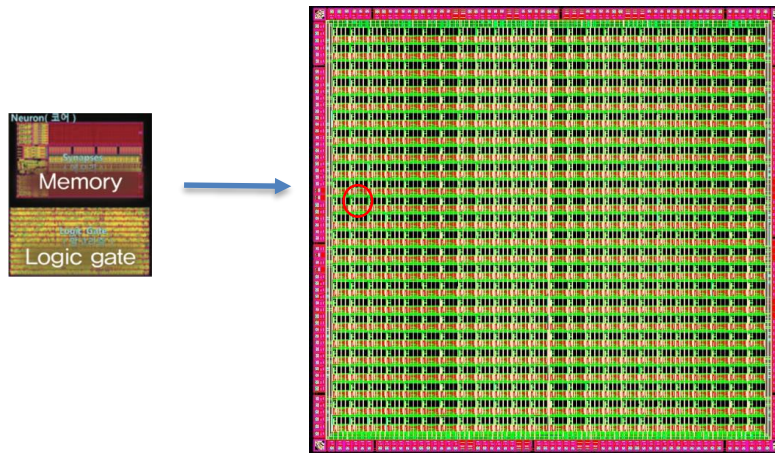
Devices
- Execution/Inference
- Training (On the fly)

Image source : https://www.vapor.io/
Current IoT infographic

Sourced :Qualcomm
Modified : nepes

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◆ NM500`s Neuron = Reactive logic to learn and recognize + Memory

- **Reactive logic** : Modeled on biological brains – designed to process (or classify) sensory data such as images and sound and respond to changes in that data in ways not specifically programmed

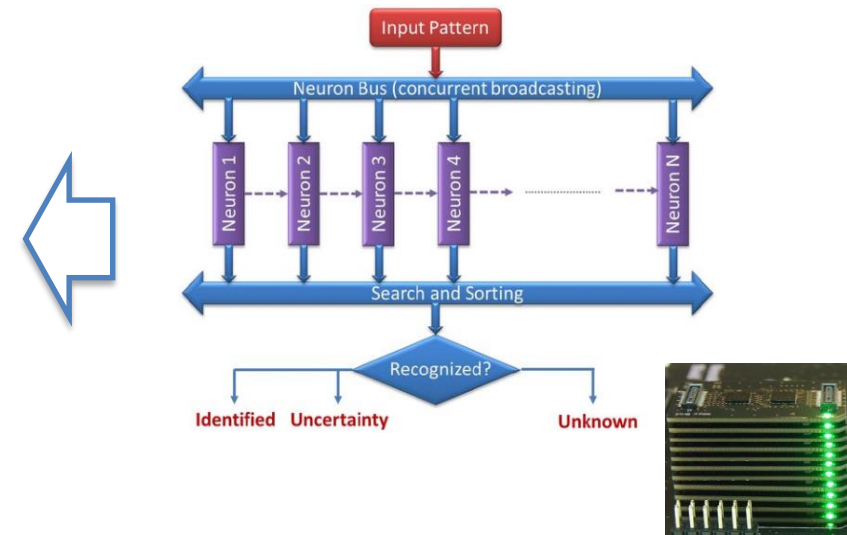- **Memory** : Store the processed result data or the vector data to be processed

Non-linear Classifier : RBF(RCE) , KNN
- Neuron : A component with **memory storage**
+ reactive logic to **learn and recognize**

Hardwired parallel Architecture
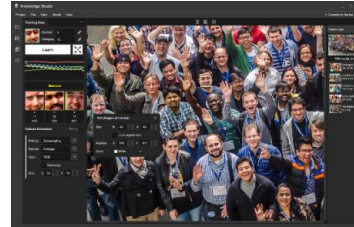

- Small(4.5mm²) & low power (0.15W)
- Ready to Industry level &
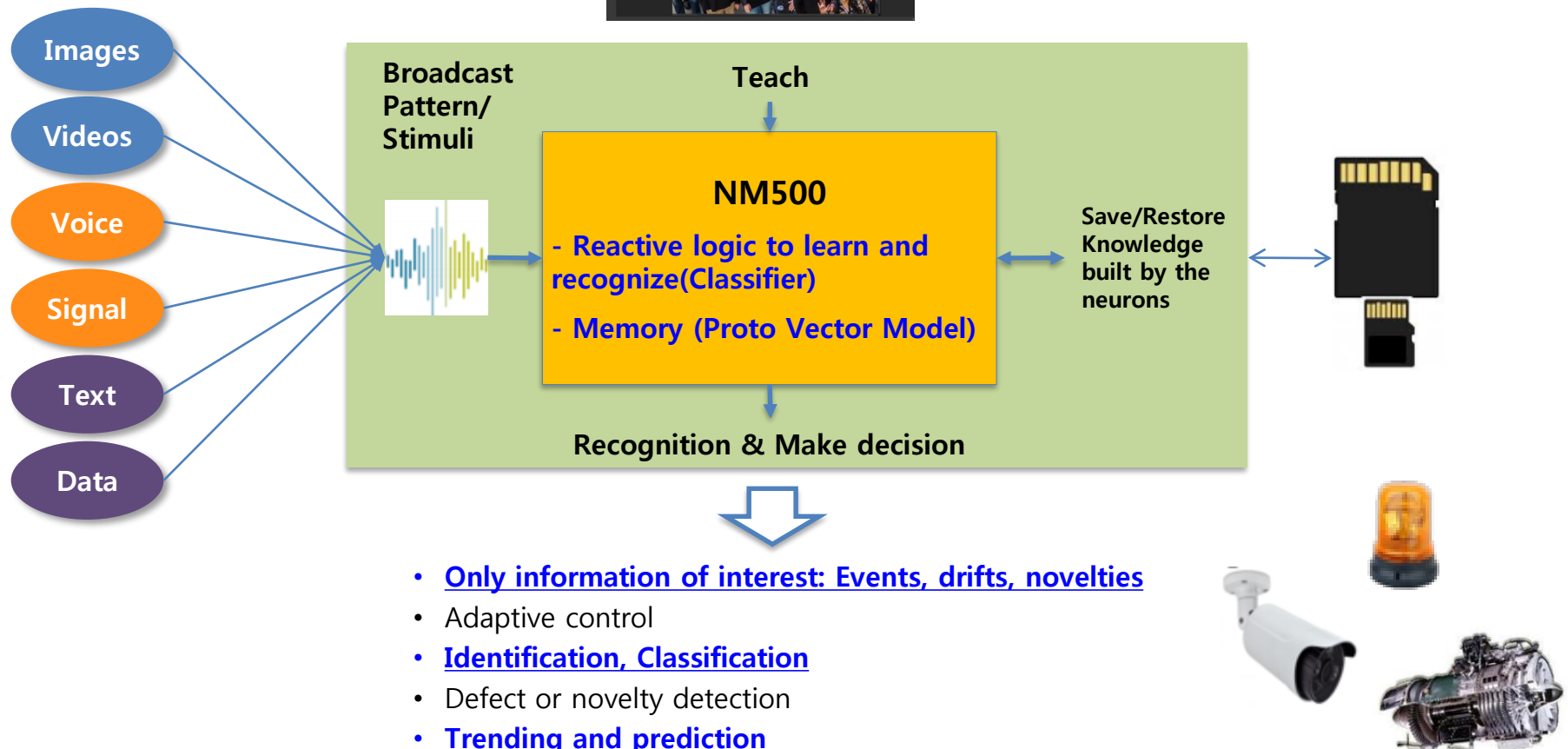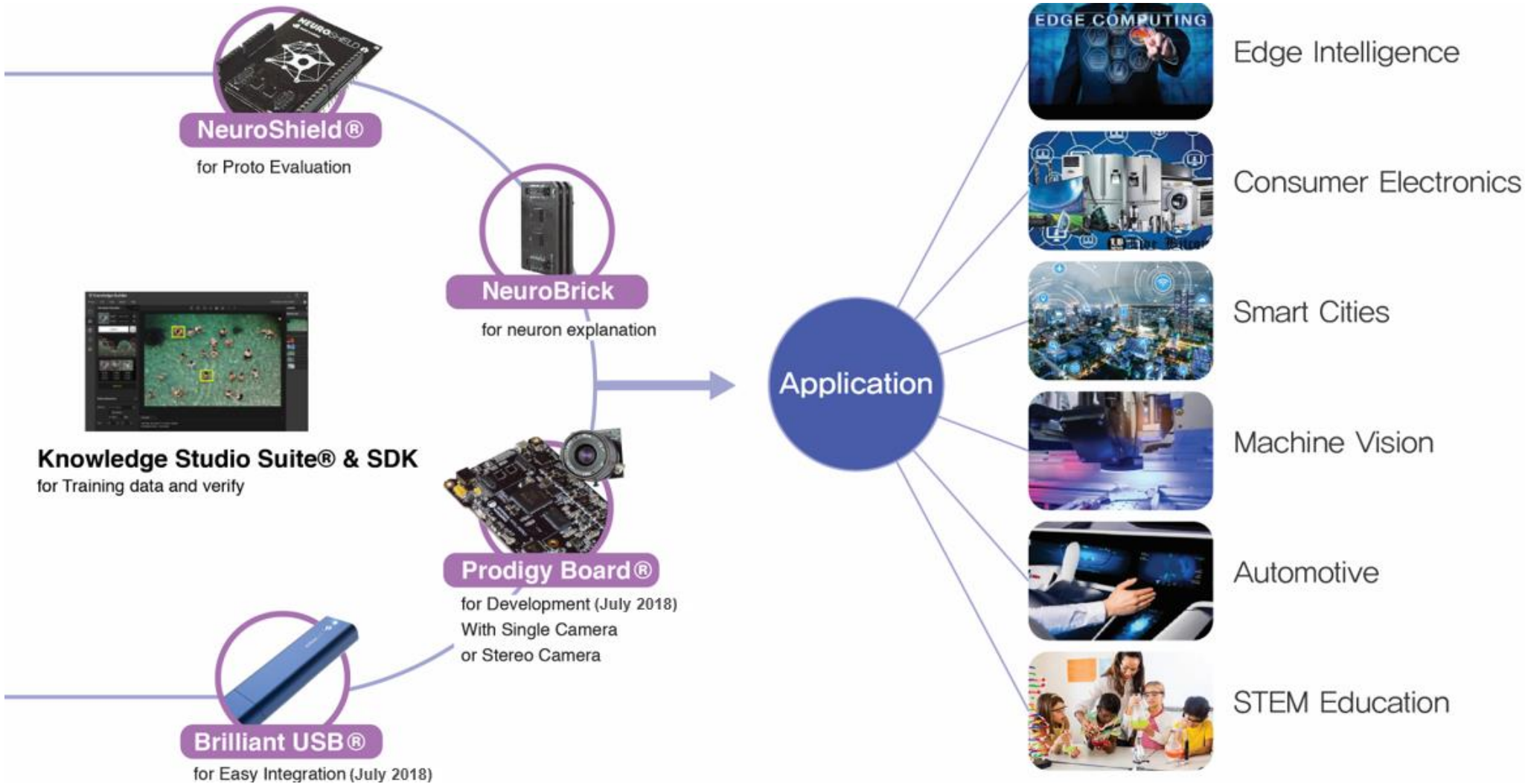 Automotive level(Device Level) Reliability

- Deterministic High Speed latency (µsecs regardless of the size of the network)
- Easy expandable neuron Quantity.

NM500

- Live video
- Images, movie files
- Voltage, Torque, Sound, Vibration
- Temperature (human, ambient)
- Biosensors

Knowledge Studio
-Show & Tell ecosystem

Images

Videos

Voice

Signal

Text

Data

Broadcast Pattern/ Stimuli

Teach

NM500

- Reactive logic to learn and recognize(Classifier)

- Memory (Proto Vector Model)

Save/Restore Knowledge built by the neurons

Recognition & Make decision
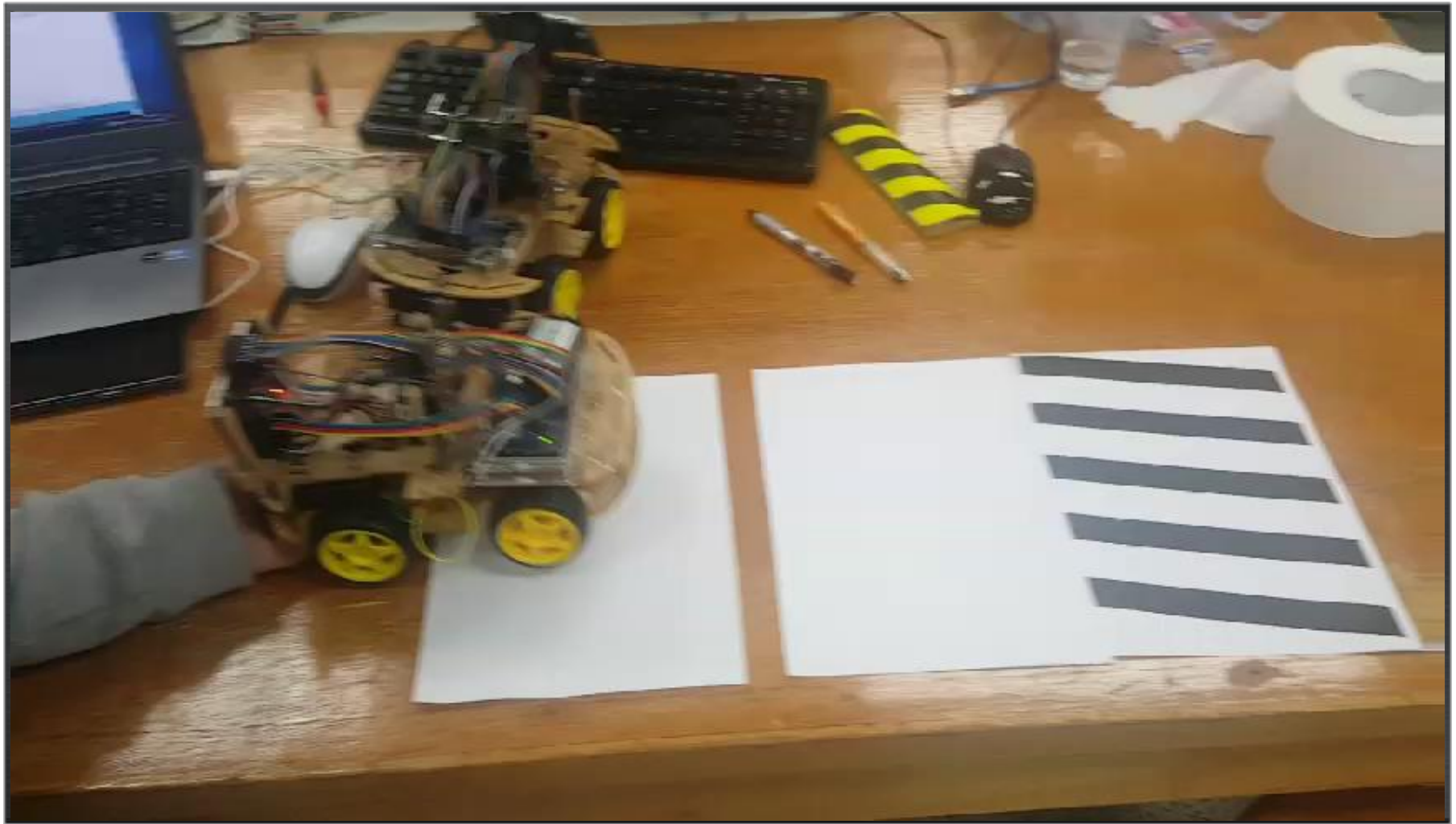
- **Only information of interest: Events, drifts, novelties**
- Adaptive control
- **Identification, Classification**
- Defect or novelty detection
- **Trending and prediction**

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NM500을 활용한 COF ILB Flying Chip 검출

- P&T장비팀 -

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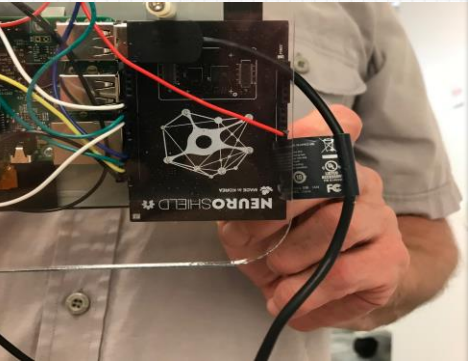
AgTech Hackathorn in Hawaii, Winner!

NM500 is using to inspect Kahuai coffee.

https://www.oceanit.com/news/oceanit-uses-ai-chip-innovation-to-win-hawaiis-first-annual-agathon

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Real Time Face Recognition

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Smart Door Lock with NM500

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ПЕРМЬ

Unsupervised Learning and Novelty Detection

*Brilliant*USB NEURO

Start A.I. Development in 30 Seconds!

BrilliantUSB® is an easy to use Artificial Intelligence evaluation and development tool. Thanks to the NeuroMem H/W Artificial Intelligence technology, it has compact USB memory type form factor easily inserted into the standard USB port of your PC/Labtop to develop A.I. enabled application instantly. No need to learn complicated algorithm programming such as C++ or Python, it uses graphical user interface software called 'Knowledge Studio' which is as easy as using powerpoint or photo editing S/W.

BrilliantUSB® features 500 ~ 2,000 neuron engines to cover requirements from DIY hobbyists to those serious application developers. Each neuron engine can learn and classify from images, videos, signals and text from saved data or capture and learn live data from other standard USB peripherals such as USB Cameras, Mics, Kinects and etc. No cloud, no training server is necessary.
Training and Inferencing is seamlessly done inside the same BrilliantUSB® in real-time at the field you are using your A.I. application.
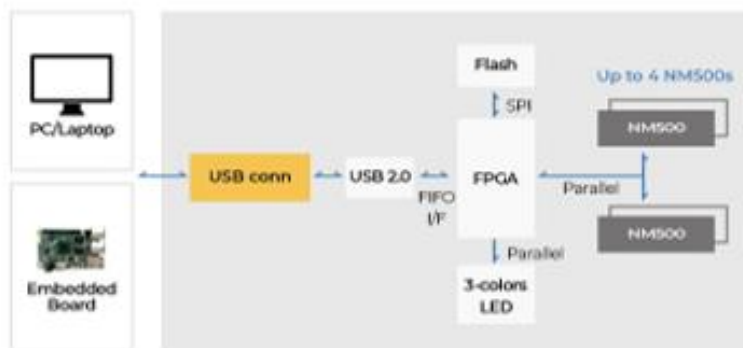
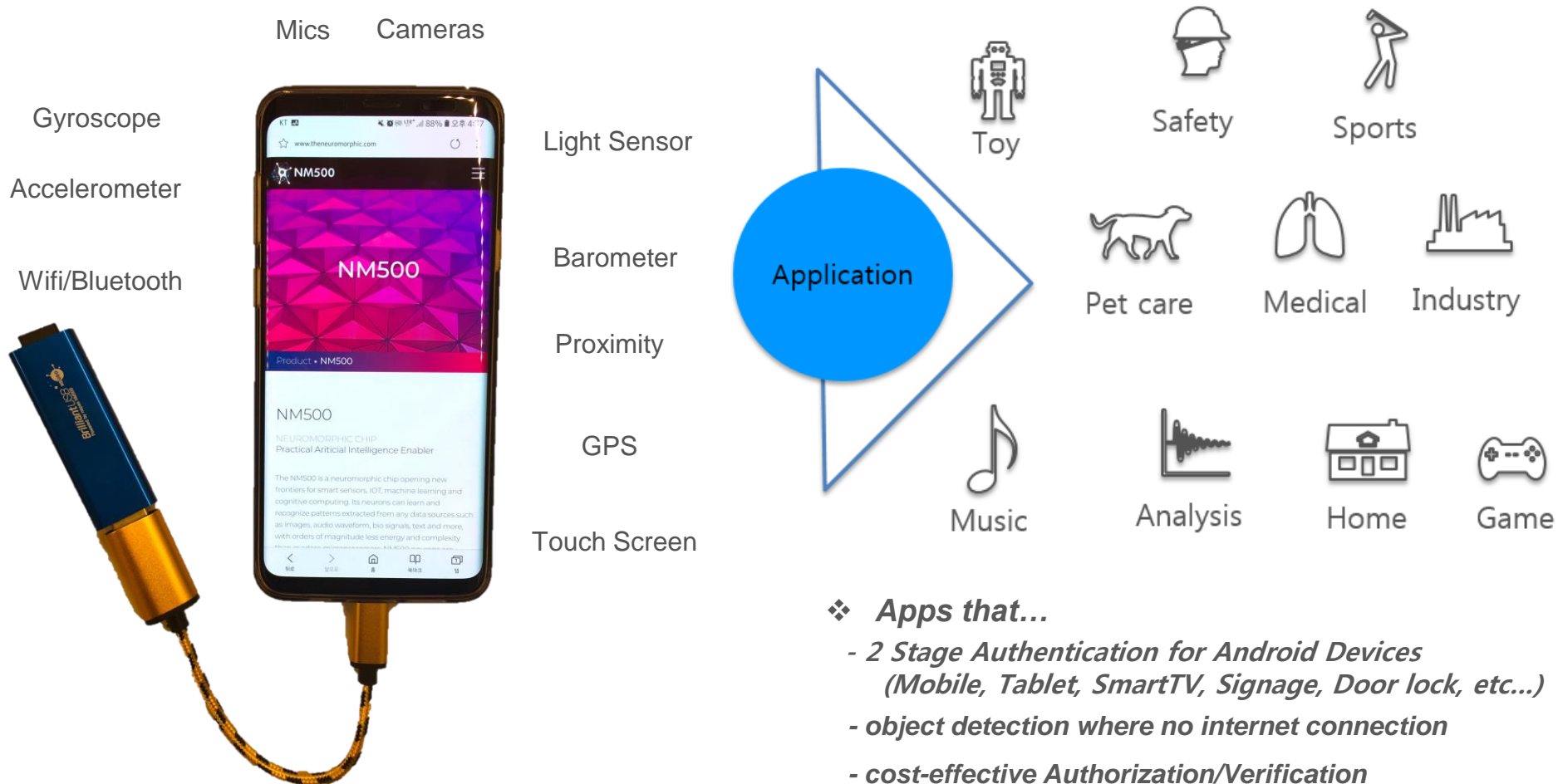[BrilliantUSB® Specification]

+ NM500 chip (576 neurons) up to 4 NM500s (2,304 neurons)
+ USB2.0 support
+ XO3 FPGA for interconnection
+ On-flash memory for saving user knowledge data
+ 3-colors LED indicator
+ @48Mhz(FPGA),@35Mhz(NM500) <150mW

+ OS platforms | Windows
Mac OSX
Linux
Android

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Face Recognition with NM500

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NM500

Mics   Cameras

Gyroscope

Light Sensor

Accelerometer

Barometer

Wifi/Bluetooth

Proximity

GPS

Touch Screen

Application

Toy   Safety   Sports

Pet care   Medical   Industry
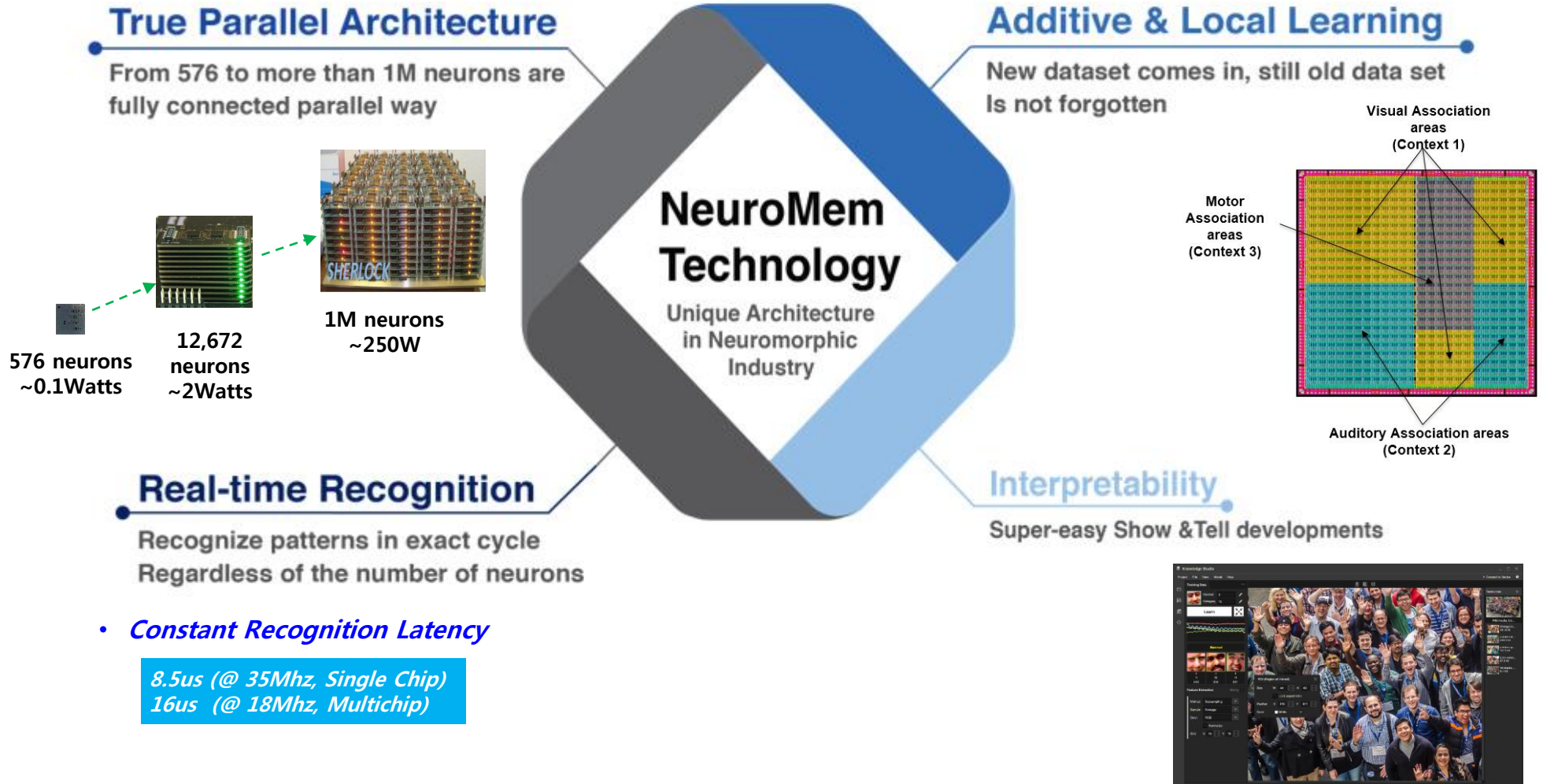
Music   Analysis   Home   Game

❖ *Apps that…*

- *2 Stage Authentication for Android Devices*
  (Mobile, Tablet, SmartTV, Signage, Door lock, etc...)

- *object detection where no internet connection*

- *cost-effective Authorization/Verification*

- *Field data training device*

- *Education*

- *Imagination is the limit…*

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The NeuroMem technology is a crucial enabler for cognitive computing and artificial intelligence.

True Parallel Architecture
From 576 to more than 1M neurons are fully connected parallel way

576 neurons ~0.1Watts

12,672 neurons ~2Watts

1M neurons ~250W

Additive & Local Learning
New dataset comes in, still old data set Is not forgotten

Visual Association areas (Context 1)

Motor Association areas (Context 3)

Auditory Association areas (Context 2)

NeuroMem Technology
Unique Architecture in Neuromorphic Industry

Real-time Recognition
Recognize patterns in exact cycle Regardless of the number of neurons

Interpretability
Super-easy Show &Tell developments

- *Constant Recognition Latency*

8.5us (@ 35Mhz, Single Chip)
16us (@ 18Mhz, Multichip)

www.theneuromorphic.com

Artificial Intelligence PRODUCTS **with NM500**

https://github.com/nepes-ai

NM500 is a *direction* and not a *destination*!

Thanks!

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