Person-vehicle collision prevention with embedded Artificial Intelligence

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Yumain Sensing & Predictive AI

Smart Cameras based on Embedded AI

Yumain team skills

- Signal and image processing
- Artificial intelligence
- Processor design
- FPGA & GPU implementation
- HW boards design
- Real time recognition applications

Input data and visual, signal and acoustic information is collected through sensors. This knowledge is used for the Yumain Decision which interacts with the data collection system.

Target Markets

30 % transport, 70% Industry 4.0

The transport applications include predictive maintenance related to the safety of railway networks, and counting systems for buses and tramways.

Applications in the field of Industry 4.0 include the protection of goods and people (peripheral machine protection, risk of collision detection machine/pedestrian) and surface inspection and quality control.

Yumain Technology Concept

- Simple Tasks with Human Brain vs Von Neuman Computer (like PC):
    - Calculate in less than one second (398387.86 x 498.07=?)
    - But recognize in less than one second an image of the Eiffel tower
- Artificial vision model proposal: Deep Learning + Spike Neurons
    - Arithmetic calculations used in image filtering for example:
        → Von Neuman (or Harvard) architectures
    - Object recognition from natural images:
        → Neuro-inspired human intelligence
- Deep Neural Network (DNN) + Spike Neural Network (SNN) implemented on embedded systems
    - Algorithm To Architecture Adequacy Methodology

Deep Neural Network (DNN)

- ImageNet classification (Hinton's team, hired by Google)
    - 1.2 million high resolution images, 1,000 different classes
    - Top-5 17% error rate (huge improvement)
- Facebook's 'DeepFace' Program (labs head: Y. LeCun)

- 4 million images, 4,000 identities
- 97.25% accuracy, vs. 97.53% human performance

DNN: State-of-the-Art in Recognition

Database	Number of images	Number of classes	Best Score
MNIST Handwritten digitals	60,000 + 10,000	10	99.79% [3]
GTSRB Traffic sign	~ 50,000	43	99.46% [4]
CIFAR-10 Airplane, automobile, bird, cat, deer, dog, frog, horse, ship, truck	50,000 + 10,000	10	91.2% [5]
Caltech-101	~50,000	101	86.5% [6]
ImageNet	~1,000,000	1,000	Top-5 83% [1]
DeepFace	~4,000,000	4,000	97.25% [2]

Deep Learning based on ConvNets (CNNs)

Deep = number of layers >> 1

E.C.S – Edge Computing Sensor, Embedded Smart Sensor

ECS is a solution that can be installed in hazardous areas, consisting of fixed sensors with embedded artificial intelligence (Edge-Computing). These smart sensors detect and analyse risk situations in real time. The combination of image processing and artificial intelligence can drastically reduce detection failures and false positives.

Applications covered by YUMAIN SIL 2 certification

Certificate of compliance in accordance with IEC 61508 N* 175362 / 2022A issued by INERIS

- Detection of persons in a hazardous area
- Detection of people and devices in a dangerous area

Application Yumain – Collision

Prevention of collisions between pedestrians and forklifts in real time

The main reasons that motivate company managers to install this type of solution:

- Ensure the protection of human beings in the company's environment
- Securing the site and interacting in hazardous areas
- Improve employee behaviour through risk awareness

Application Yumain – Peripheral Machine Protection

Image 1: The Yumain sensor monitors an area in a machine hall in which workers are allowed to move (green) or are not allowed to move (red). The sensor registers when workers step in the restricted area and gives a signal or stops the machine.