DRIVES

Development and Research on Innovative Vocational Education Skills

SENSOR FUSION EXPERT

SFE.U3.E2 - DATA AND SENSOR FUSION APPLICATIONS, USE CASES AND REAL-LIFE EXAMPLES

Introduction to Sensor Fusion

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LEARNING OBJECTIVES

The student is able to …

SFE.U3.E4.PC1	The student can analyse and understand what sensor fusion applications are.
SFE.U3.E4.PC2	The student recognizes and critically understands the challenging problems surrounding sensor fusion approaches.
SFE.U3.E4.PC3	The student is able to discuss and explain some sensor fusion use cases with focus on autonomous driving.
SFE.U3.E4.PC4	The student is able to explore and interpret real life examples of sensor fusion.

SENSOR FUSION APPLICATIONS

Applications

- The fusion sensor can have many applications and in many areas.
- The applicability of the fusion sensor became more attractive due to the fact that the sensors, due to technological advances, are more accessible both in terms of price and availability in the market.

SENSOR FUSION APPLICATIONS

Onde pode ser utilizado

- Internet of Things
- Automotive and Navigation
- Quadrotors and Drone
- Computer Vision
- Virtual reality / Augmented reality
- Healthcare

SENSOR FUSION APPLICATIONS

IoT – Internet od Things

- **In IoT, Sensor Fusion can be used in:**
  - Real-time data acquisition
  - Helps enable context awareness
  - In the field of industry
  - Building automation
  - One of the simplest examples of the use of sensor fusion in IoT is in the automotive area, where traffic information can be obtained through roadside cameras.

SENSOR FUSION APPLICATIONS

Automotive and Navigation

- **In the automotive sector and navigation, Sensor Fusion can be used in:**
  - Various sensors exist mainly to provide autonomous driving
    - Examples of these sensors are GPS, Lidar and ultrasonic
  - These sensors are used to make a representation of what is in the environment where the car is inserted, to generate data that allow for autonomous driving or other decision-making.

SENSOR FUSION APPLICATIONS

Automotive and Navigation

- **In the automotive sector and navigation, Sensor Fusion can be used in:**
  - Many of them are related to mobile robotics,
    - Path planning
    - Obstacle prevention
    - Make it easy to apply in the real world

SENSOR FUSION APPLICATIONS

Drones / Quadrotores

- **In the drone sector, Sensor Fusion can be used in:**
  - Ensure safe operation and reliable maneuvering
  - Generally the sensors used are the gyroscope, the accelerometer and gps.
  - In Autonomous Flight, especially when there are places that humans cannot reach certain places
  - The cost of implementing the merger is low with satisfactory performance
  - Due to sensor fusion, drones can hover at a fixed location without the need for GPS
  - One of the aspects to be highlighted is to show the reliability of the fusion method

SENSOR FUSION APPLICATIONS

Computer Vision

- **In the computer vision sector, Sensor Fusion can be used in:**
  - Began to try to imitate human vision
  - The fusion sensor began to be used for its fusion to obtain:
    - Medical Images
    - Smart Robots Vision
    - Non-destructive tests
  - In recent years there has been a need to improve the safety of the general public

Augmented Reality and Virtual Reality

- **In the VR/AR sector, Sensor Fusion can be used in:**
  - Head movement tracking
    - As the user changes their head's point of view, it must follow the 3D object
  - Ability to provide stable movements
  - Currently, a weighted filter is used to determine the information to be taken from the different sensors.
  - Predictive tracking methods were included to reduce gyroscope latency at a rate of 30ms.

Healthcare

- **In the healthcare sector, Sensor Fusion can be used in:**
  - Fall detection
  - Monitor the development of motor functions
  - Tracking the mental state of patients using body sensors, trying to classify the state of mind through the fusion of physiological sensor data (heart rate and respiratory rate, carbon dioxide and oxygen level)
  - Currently, existing problems are on the software side, such as measurement reliability and network status to avoid false positives

CHALLENGING PROBLEMS SURROUNDING SENSOR FUSION APPROACHES

Automotive and Navigation

- **Challenges and problems**
  - The sensor fusion process is required at multiple levels to provide a real-time decision.
  - With the appearance of RADAR and LIDAR sensors, the 3D representation of objects is more accurate than the on-board camera.
  - LIDAR sensors can provide a good coverage camp but cannot provide accurate velocity data

CHALLENGING PROBLEMS SURROUNDING SENSOR FUSION APPROACHES

Automotive and Navigation

- **Challenges and problems**
  - A complementary sensor design is required to:
    - Provide a better 3D map;
    - Allow the System to recognize different objects in the environment

CHALLENGING PROBLEMS SURROUNDING SENSOR FUSION APPROACHES

Automotive and Navigation

- Challenges and problems
  - Investigations are currently being carried out to improve the quality of object detection as there are still many cases of false positives and must be reduced and prevented.

CHALLENGING PROBLEMS SURROUNDING SENSOR FUSION APPROACHES

Computer Vision

- **Challenges and problems**
  - A big hurdle is detecting weapons hidden under a person's clothing.
  - Several fusion methods have been developed, examples:
    - Multiple images with different exposures with infrared images
    - Automatic detection of bags in stadiums and museums.

REFERENCIES

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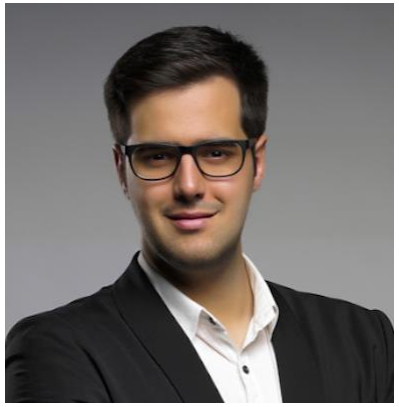
REFERENCE TO AUTHORS



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This Training Material has been certified according to the rules of **ECQA – European Certification and Qualification Association.**

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DRIVES

Development and Research on Innovative Vocational Education Skills

Thank you for your attention

DRIVES project is project under **The Blueprint for Sectoral Cooperation on Skills in Automotive Sector**, as part of New Skills Agenda.

The aim of the Blueprint is **to support an overall sectoral strategy and to develop concrete actions to address short and medium term skills needs.**

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