Advanced Drive Assistance System

(Project proposal structure)

Course: Model-Based Systems Engineering (MOD-E12)

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Submitted to:

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Date of submission:

25.12.2023

Abstract

This document presents an overview of the Drive Assistant System, outlining its components and functionality at a high level. The main goal of this ADAS system is to enhance the overall safety of vehicles, elevate the comfort level for drivers, and minimize the chances of traffic accidents. It's designed to assist drivers throughout their journey, offering vital support in various driving scenarios.

The main purpose of the paper is to give a brief description of the system which can be potentially designed using the APP4MC app and presented on the chosen date by our team after Dr.-Ing. Lukas Krawczyk's approvement.

Introduction

In recent times, the car industry has seen major changes due to new technology. A key development is Advanced Driver Assistance Systems (ADAS). These smart systems are changing how cars work, making them safer and altering the way we drive.

ADAS is a collection of advanced technologies aimed at helping drivers. It includes features like preventing collisions, assisting with parking, managing cruise control automatically, and alerting drivers if they stray from their lane. These systems work in unison to make driving safer and more efficient. [1]

System Components Description

1. **Hardware Components** [2]

Multi-Core Processor: A quad-core processor, with each core capable of running at different frequencies based on the task requirements.

Memory:

RAM: High-speed RAM for fast data processing and temporary data storage.

Flash Memory: For storing firmware and non-volatile data.

Sensors:

Cameras: For capturing real-time video data.

Radar: For detecting objects and calculating distances.

LIDAR: For high-resolution mapping of the vehicle's surroundings.

Communication Interfaces:

CAN Bus: For in-vehicle communication.

Ethernet: For high-speed data transfer.

Actuators: For controlling vehicle functions like braking or steering.

2. **Software Architecture** [3]

Real-Time Operating System (RTOS): To manage task scheduling and resource allocation efficiently.

Software Modules:

Sensor Data Processing: For processing raw data from cameras, radar, and LIDAR.

Object Detection and Classification: To identify and classify objects in the vehicle’s path.

Decision Making: Algorithms for making driving decisions based on processed data.

Actuator Control: For executing actions like braking or steering adjustments.

3. Task Allocation and Core Utilization

Core 1: Dedicated to high-priority tasks like object detection and emergency decision-making.

Core 2 and 3: Handling sensor data processing and classification tasks. These cores can share the load for balancing.

Core 4: Reserved for actuator control and lower-priority tasks, like communication with other vehicle systems.

4. Memory Management

RAM Allocation: Split between cores, with more allocated to cores handling more memory-intensive tasks (like image processing).

Flash Memory: Used for storing long-term data like firmware and ADAS software.

5. Performance Analysis and Optimization with APP4MC

Timing Analysis: Ensuring all tasks meet their real-time requirements.

Load Balancing: Analyzing core utilization and adjusting task allocation for optimal performance.

Data Flow Optimization: Ensuring efficient data transfer between cores, memory, and peripherals.

6. Simulation and Testing (Optional, if we have enough time)

Scenario Testing: Simulating different driving scenarios to test the system's response.

Resource Utilization Analysis: Monitoring CPU and memory usage to identify bottlenecks.

Real-time Performance Validation: Ensuring that the system meets real-time processing requirements.

System Design and Architecture

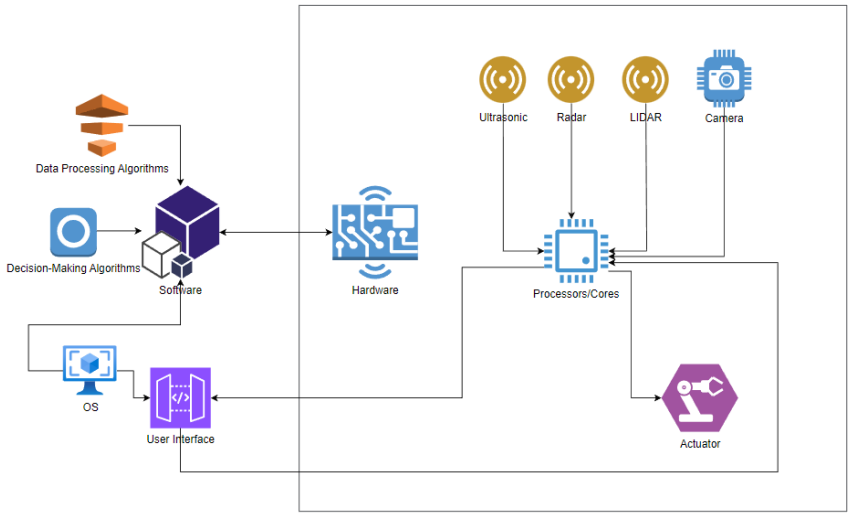

Figure 1. System Workflow

Figure 1 represents a high-level system workflow that will be potentially implemented in the presentation and APP4MC app including runnables, tasks, labels, domains, definitions, and stimuli.

1. **Data Collection**: Sensors continuously gather environmental data.
2. **Data Processing**: The data is sent to the processors, where algorithms interpret it.
3. **Decision Making**: Based on this interpretation, decision-making algorithms determine the appropriate action (like braking or steering).
4. **Action Execution**: The processors send commands to actuators to execute these actions.
5. **Feedback and Display**: The system's status and any necessary alerts are displayed to the driver. The driver's inputs can modify system behavior.

Conclusion

This paper has provides a conceptual overview of an Advanced Driver Assistance System (ADAS), highlighting its software and hardware components. It's important to note that while this paper offers a high-level representation of ADAS. As such, certain aspects of the system may be subject to change as the design evolves. However, the core idea and objectives of the system - to improve road safety, driver comfort, and efficiency - will remain steadfast.

APP4MC offers a valuable platform for modeling and analyzing embedded multi-core systems like ADAS, enabling more efficient resource allocation, task scheduling, and performance optimization. Its capabilities are crucial in ensuring that the system not only meets its design specifications but also adapts to the evolving requirements of modern automotive technology.

References

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[2] A. P. V, "ADAS: Collision Avoidance System on Indian Roads," 10 September 2021. [Online]. Available: https://github.com/AdroitAnandAI/ADAS-Car-using-Raspberry-Pi.

[3] W. contributors, "Advanced driver-assistance system," Wikipedia, The Free Encyclopedia., 25 December 2023. [Online]. Available: https://en.wikipedia.org/w/index.php?title=Advanced_driver-assistance_system&oldid=1189284437.