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CAN-BASED EMERGENCY STOP ALERT AND DRIVER GUIDANCE SYSTEM FOR HIGHWAY SAFETY

Team weCAN

CODERACE 2025

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TOPIC RESEARCH

Problem Context

- Sudden stops on highways (mechanical failure, panic, minor crash) are common and dangerous.
- Existing alerts are manual or delayed, increasing crash risks.
- Most vehicles already broadcast key data via CAN (wheel speed, brake, RPM).

Proposed Solution

- Use CAN + GPS to detect abnormal deceleration and stop in real-time.
- Auto-trigger hazard lights and display guidance via infotainment or V2X.

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TOPIC RESEARCH

Vision & Goals

- Develop a simple, fast, cost-effective and reliable solution using existing CAN infrastructure.
- Provide timely driver alerts (“Activate hazard lights”, “Pull into emergency lane”, “Check engine”)
- Support external alerts (hazard lights, V2X).
- Ensure broad compatibility with most CAN-enabled vehicles, requiring minimal hardware.

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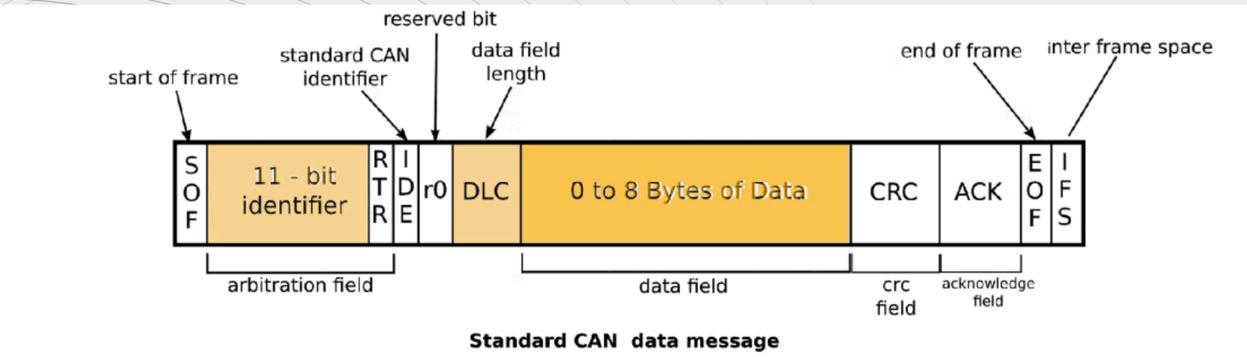
TOPIC RESEARCH
OVERVIEW OF CAN BUS

🧠 What is CAN?

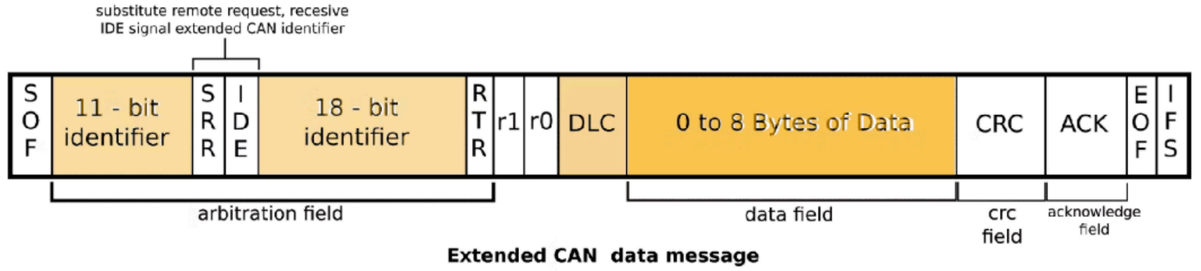
- Developed by Bosch (1983) – now a standard in-vehicle network.
- Enables real-time communication between ECUs (e.g., ABS, Engine, BCM).
- Uses two-wire differential bus (CAN_H & CAN_L) for high noise immunity.

⚙️ Key Features

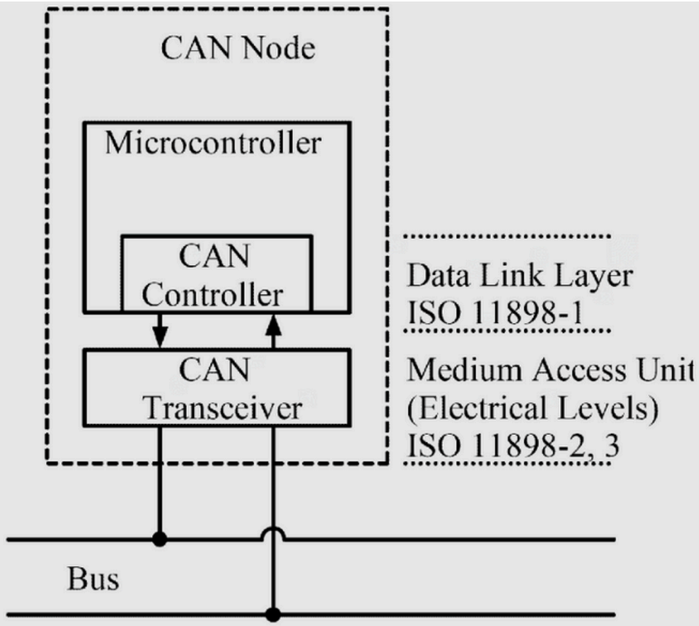
- Message-based, multi-master protocol (no central controller).
- Built-in error detection: CRC, ACK, retransmission.
- Deterministic & real-time — crucial for safety systems.



Standard CAN data message



Extended CAN data message



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SOFTWARE DESIGN

CAN Bus Signals

The system uses wheel speed and GPS data to detect abnormal vehicle movements without requiring additional hardware, making it easy to deploy via the OBD-II port.

Data Processing

The system compares wheel and GPS speeds to detect anomalies like traction loss, using synchronized and filtered data for accuracy.

Decision & Risk Evaluation

The system assesses risk in real time based on detected anomalies and activates emergency mode if signs of driver incapacity persist, while minimizing false alarms through calibrated delays.

Warning & Actuation

When danger is detected, the system activates hazard lights and displays a dashboard warning to alert others and reduce further risk.

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ALGORITHM DEVELOPMENT

- Flowchart Design
- Logic Design
- Test Case Demonstrations

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FLOWCHART DESIGN

Input Signals

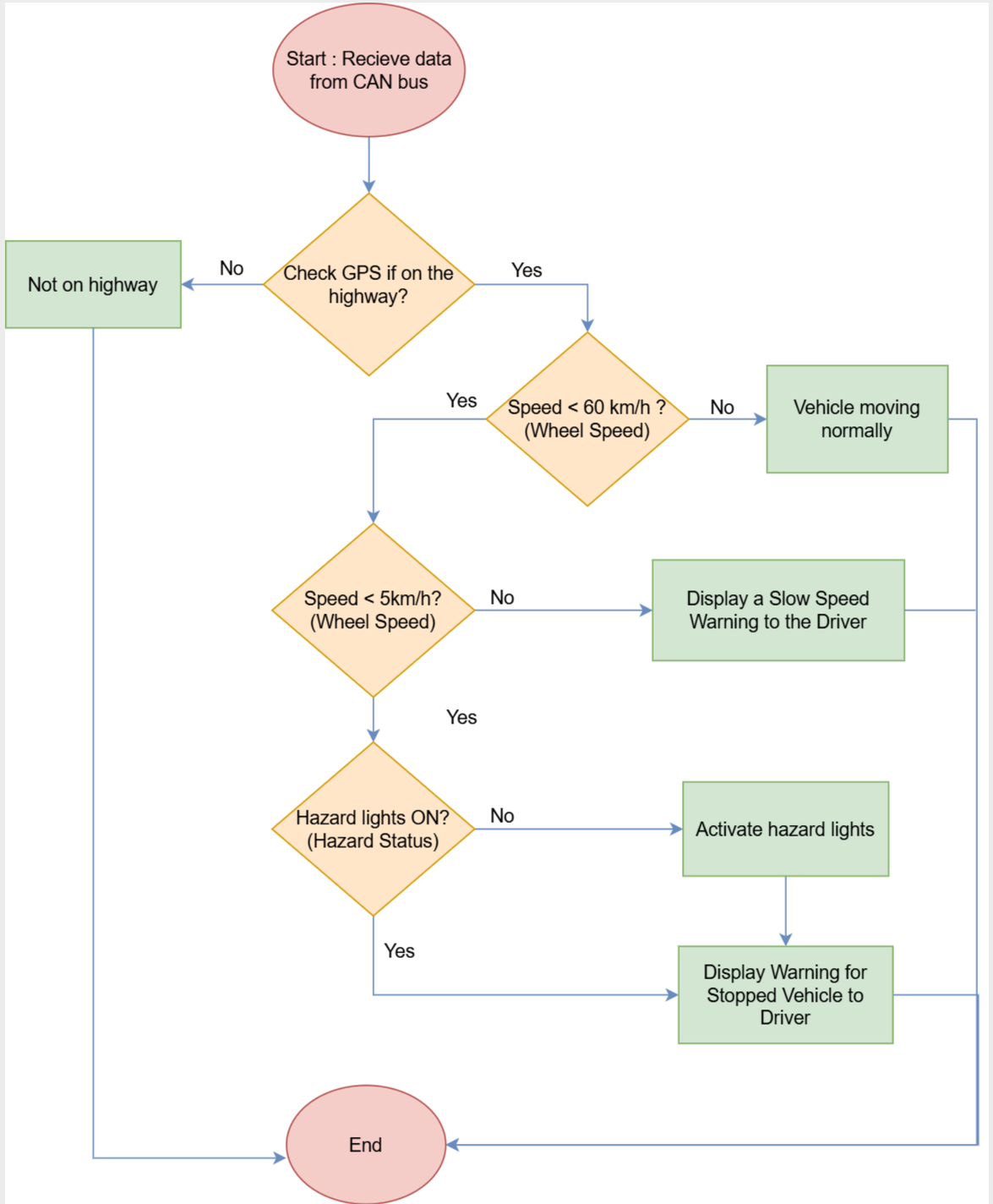
Check GPS

Check Speed

Check Stopped

Check Hazard

Output Warning



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LOGIC DESIGN

Input Signals

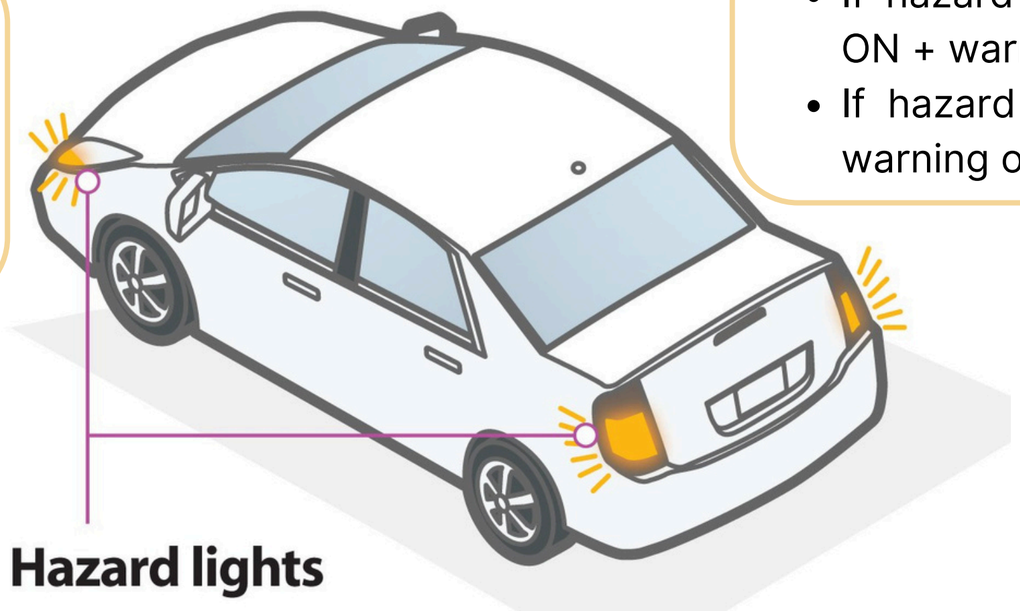
Receives real-time data every **5 seconds** from CAN and GPS (Wheel Speed, Hazard Status, GPS, ...)

Highway Check

- If GPS ≠ highway → end.
- If GPS= highway → continue.

Check Speed

- Speed > 60 km/h → Vehicle operates normally
- 5 km/h < Speed < 60 km/h → Vehicle runs at low speed
- Speed < 5 km/h → Vehicle stopped



Hazard Light

- If hazard **OFF** → system turns ON + warning to driver
- If hazard already **ON** → show warning only

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WARNING

Slow speed warning : *“Your vehicle is moving below the regulated speed of 60 km/h. If you are experiencing an issue, please, turn on the hazard lights and move to the emergency lane.’*

Stop warning : *“Hazard lights have been activated. Your car has stopped unexpectedly. Please remain calm and contact traffic police for assistance.’*

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TEST CASE DEMONSTRATIONS

01

Tire Burst

Sudden Stop on Highway

02

Traffic Jam

Slow Movement on Highway

03

Traffic Light

No Stopping on Highway

Test Case 1: Tire Burst – Sudden Stop on Highway

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Input signal

GPS

Speed drops quickly below 5 km/h (Wheels Speed)

The vehicle becomes unstable (Yaw Rate Sensor)

Hazard lights are OFF (Hazard Status)

Algorithm

Check GPS = true → on highway

Speed < 60 km/h → Continue monitoring

Speed < 5 km/h → Car is classified as stopped

Hazard lights = OFF

Output

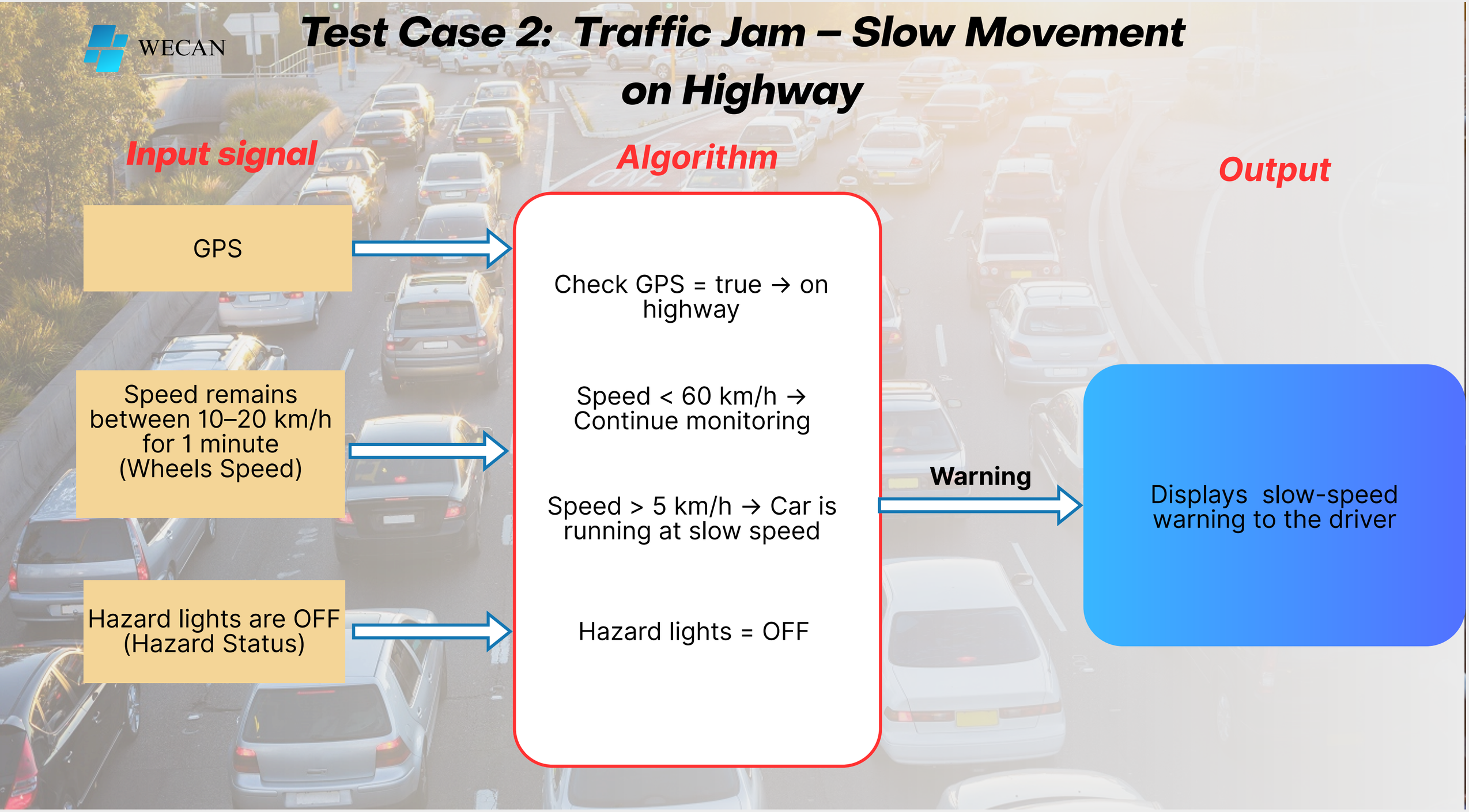
Driver support

System automatically activates the hazard warning lights

Warning

Displays a stop warning to the driver

Test Case 2: Traffic Jam – Slow Movement on Highway



Input signal

GPS

Speed remains between 10–20 km/h for 1 minute (Wheels Speed)

Hazard lights are OFF (Hazard Status)

Algorithm

Check GPS = true → on highway

Speed < 60 km/h → Continue monitoring

Speed > 5 km/h → Car is running at slow speed

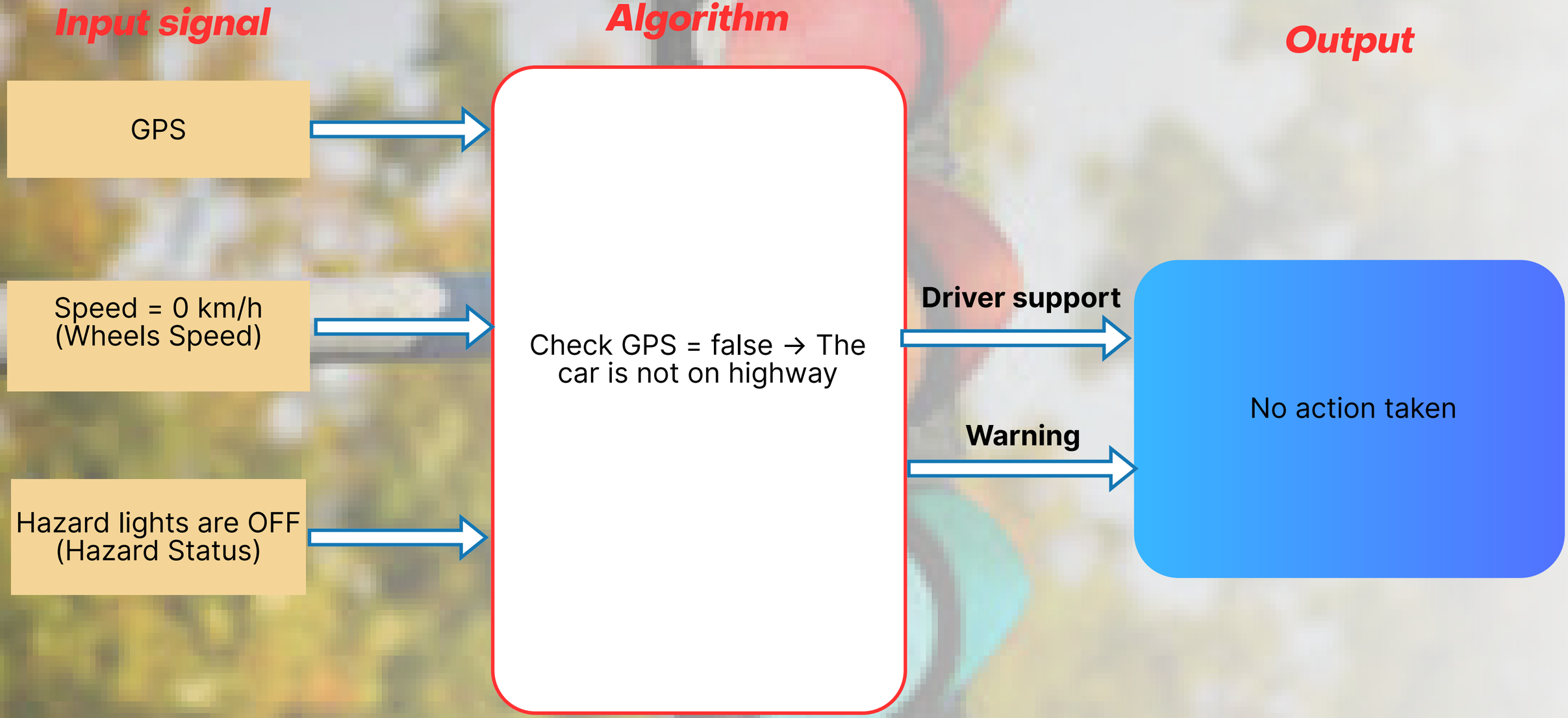
Hazard lights = OFF

Warning

Output

Displays slow-speed warning to the driver

Test Case 3: Traffic Light - No Stopping on Highway



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CURRENT SYSTEMS

Mercedes-Benz Active Emergency Stop Assist

Pros:

- Multi-sensor ADAS integration
- Coordinated safety actions
- Field-tested on EU highways

Cons:

- High hardware cost
- Only on premium models
- Needs good road conditions
- No third-party upgrades

KIA's Driver Attention Warning (DAW) & Lane Following Assist (LFA)

Pros:

- Low-cost integration
- Available on mid-range models
- Simple visual/audio alerts

Cons:

- Limited driver behavior analysis
- Still needs camera and lane sensors
- No independent emergency stop logic
- Relies on visible lane markings

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WHAT'S NEW IN OUR SYSTEM ?

Hardware-Free Deployment

A hardware-free solution using CAN bus data via the OBD-II port, easily deployable across all vehicle types and markets.

Privacy-Respecting Behavior Monitoring

Instead of monitoring the driver, the system analyzes vehicle behavior to detect risk, preserving privacy and working without cameras.

Optimized for Markets like Vietnam

Works without lane markings or map data, ensuring reliability in Vietnam's real-world conditions.

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WORK PACKAGE BREAKDOWN

Phase 1 – Design and Analysis

• Hạnh: Topic research on CAN, active safety systems, and hardware.

• Huy: Responsible for system architecture, flowcharting, and technical design documentation.

• Huấn: Develops algorithm logic for emergency stop detection.

Phase 2 – Implementation

• Hạnh: Implements code for input signal processing (CAN, GPS).

• Huấn: Develops the core logic for emergency detection and response.

• Huy: Implements output control, including hazard light activation and display alerts.

Phase 3 – Testing and Finalization

• Hạnh: Designs test scenarios and builds test cases.

• Huấn: Runs system tests and handles debugging and issue resolution.

• Huy: Finalizes system integration into the Bosch-provided model, ensures stable end-to-end operation.

Phase	Deliverable / Milestone	Deadline
Phase 1: Design and Analysis	- Complete topic research (CAN basics, safety trends) - Design system flowchart and data flow - Define input/output hardware specifications - Draft technical design document - Initial algorithm logic design	**[30/6/2025]**
Phase 2: Implementation	- Parse CAN/GPS data and detect abnormal stop - Implement signal logic and hazard response - Handle output actions (hazard light, display alert)	**[17/7/2025]**
Phase 3: Testing and Finalization	- Build test scenarios and test cases - Debug and validate system behavior - Compile technical report and prepare presentation - Finalizes system integration into the Bosch-provided model, ensures stable end-to-end operation.	**[21/7/2025]**

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THANKS FOR YOUR ATTENTION!