# Embedded Software Project Report

## ‘Adaptive LED Headlight and Smart Warning System’
## 적응형 LED 헤드라이트와 스마트 경고 시스템

SWIP 9th , Team 2

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HYUNDAI
MOTOR GROUP

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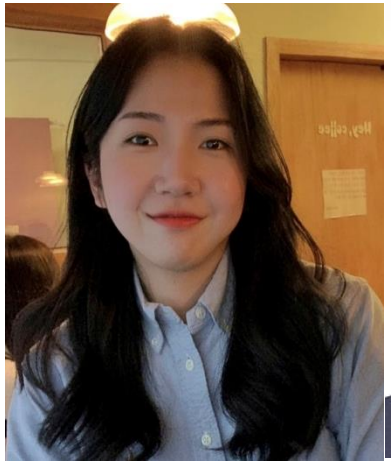
# 1. Introduction - Our Team



Hyerim Lee*

Sewon Jang

Jihoon Kim

Seungho Kim

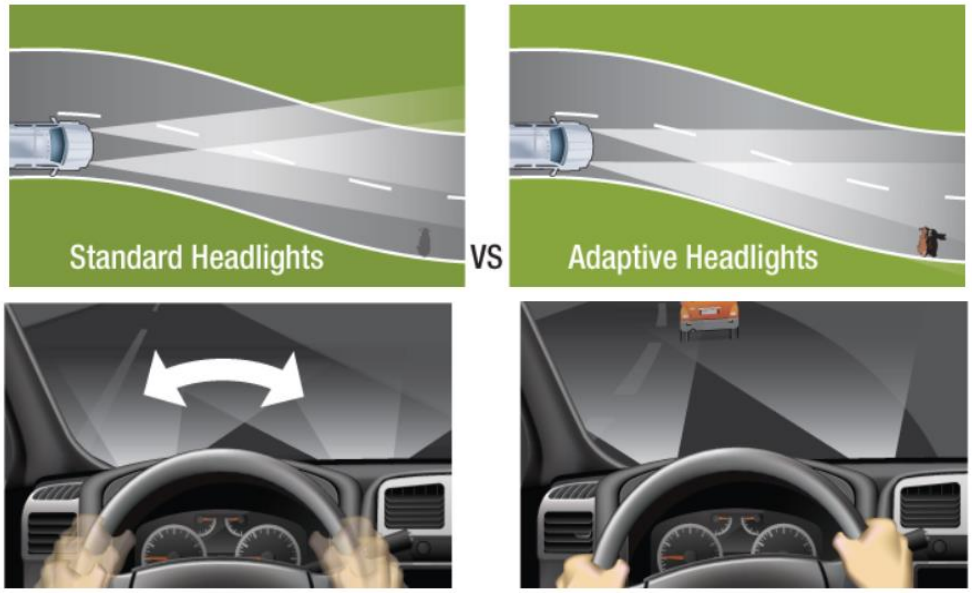
Sangbin Lee

* refers team leader and presenter

# 1. Introduction – Project Goals

**MAVEL**

**MICROCONTROLLER AUTONOMOUS VEHICLE**




Adaptive dimming LED Headlight

1. Steering wheel based
2. Object detection based

Driver Attention Warning (DAW)

1. Traffic Light based Warning (TLW)
2. Forward Collision Warning (FCW)
3. Leading Vehicle Departure Warning (LVDW)

# 2. Proposed System – Functional Specifications [1/3]

Adaptive dimming LED Headlights

1. Steering wheel based (static)
   - It is not in a fixed position at all times.
   - It uses electronic sensors(Rotate potentiometer sensor) that can detect steering angle to illuminate on the direction the car is heading.
   - It doesn't consider objects or vehicles that are illuminated.

2. Object detection based (dynamic)
   - When a vehicle is detected ahead while driving, the illumination angle changes immediately.

# 2. Proposed System – Functional Specifications [2/3]

## Driver Attention Warning (DAW)

1. Traffic Light based Warning (TLW)
   - When traffic light is red, the driver must stop, therefore, *Forward Collision Warning (FCW)* is activated.
   - When the traffic light is green and the driver doesn't press the accelerator pedal, *Leading Vehicle Departure Warning system (LVDW)* is activated.

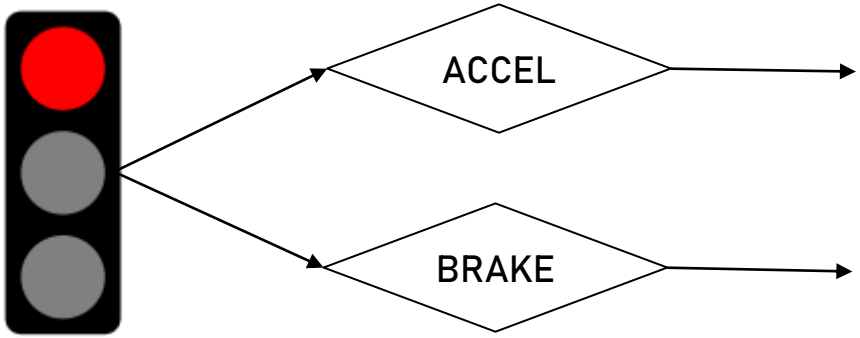
2. Forward Collision Warning (FCW)
   - It scans the road ahead while the driver drives.
   - It warns the driver if the driver is about to crash the car.
   - It alerts the driver with audible warnings, and if the driver doesn't press the brake, it automatically slows down the car.

3. Leading Vehicle Departure Warning (LVDW)
   - It uses the front view camera to detect a front vehicle's departure.
   - It informs the driver with an audible warning.

# 2. Proposed System – Functional Specifications [3/3]

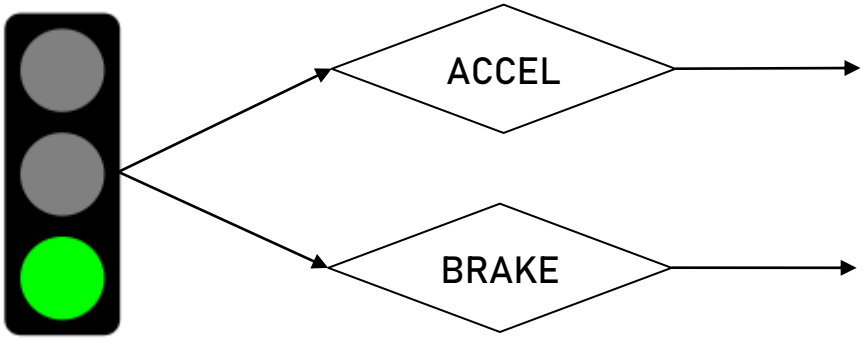
Driver Attention Warning (DAW)

- Traffic Light based Warning (TLW)




Forward Collision Warning (FCW)

Pass




Pass

Leading Vehicle Departure Warning (LVDW)

# 2. Proposed System - Issues

Issues & Characteristics

1. Dual ultrasonic sensor

   -> Find a new port and initialize it

2. Cannot run LED dimming by ultrasonic sensors in parallel

   -> Set SW delay to cover time difference between HW and SW

3. Port collision due to using motor

   -> Use dual MCU board

4. Slow motor interrupt response

   -> Do sampling to reduce switch trigger noises

5. Timer overlap between ultrasonic sensors and RGB LED

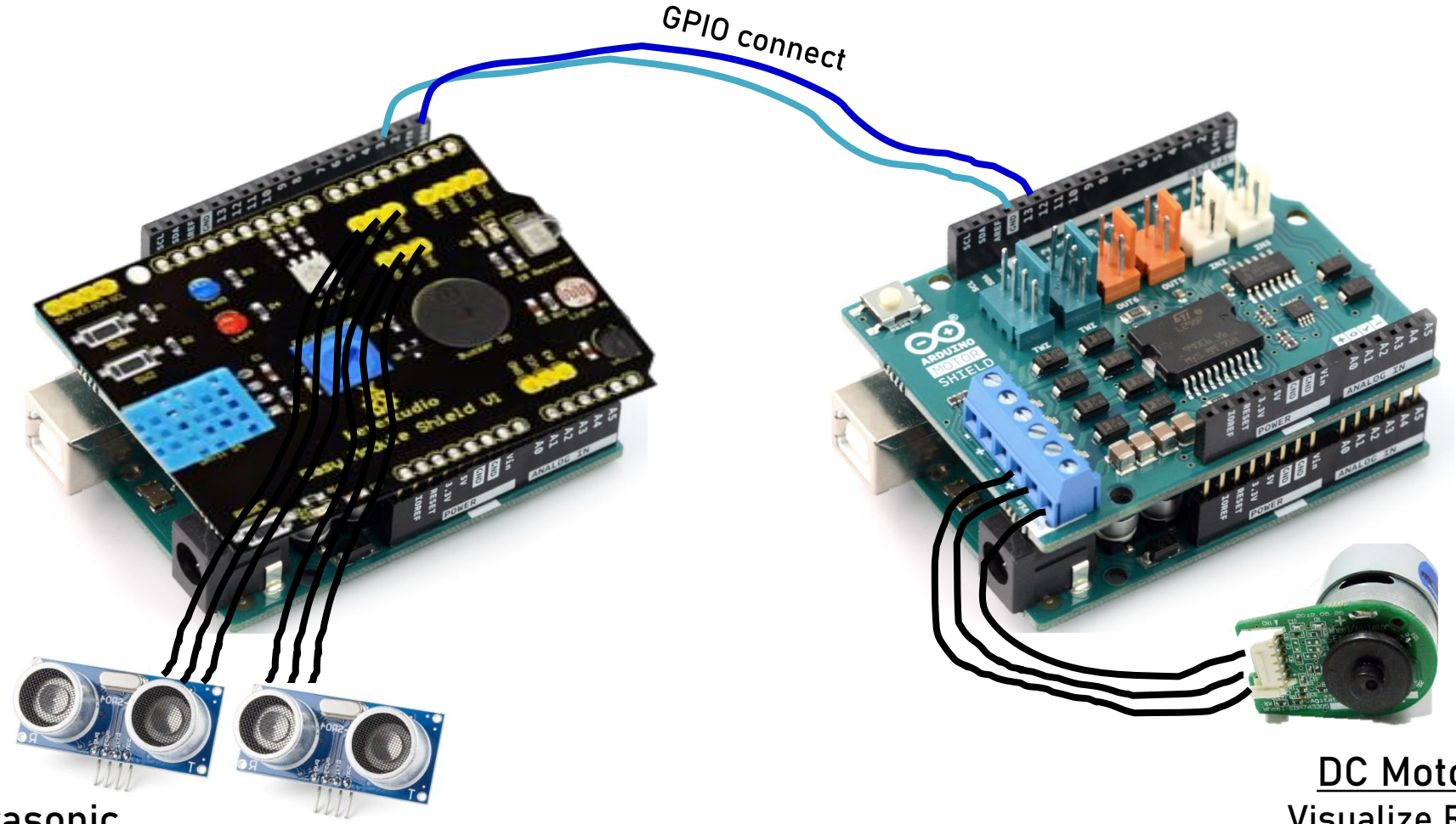
   -> Use triple core

   (CPU 0 : main processing / CPU 1 : RGB LED / CPU 2 : Accel. switch)

# 2. Proposed System – Architecture [1/2]

## Dual MCU

Due to the collision by using a motor!




**Ultrasonic**

Detect objects

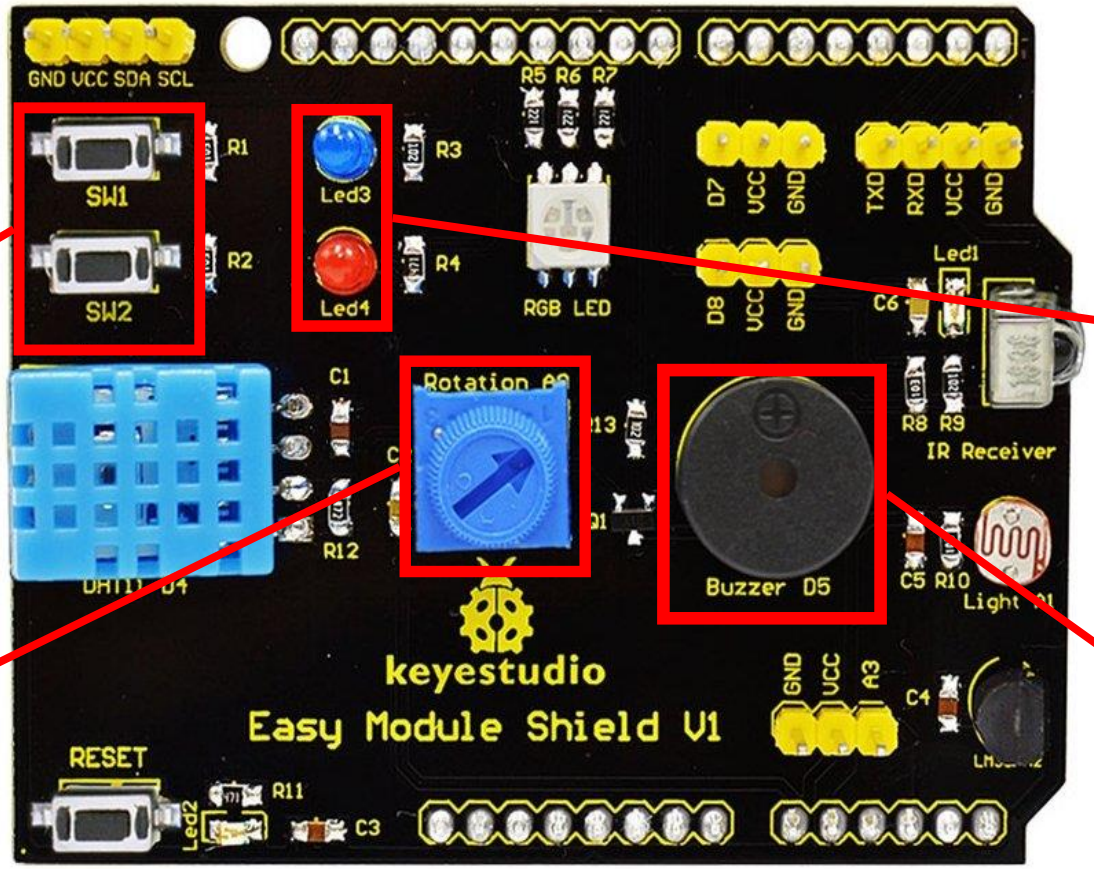
**DC Motor**

Visualize RPM

# 2. Proposed System – Architecture [2/2]

## Dual MCU

Due to the collision by using a motor!




**Switch**

SW1 : Brake

SW2 : Accelerator

**Rotate Potentiometer**

Steering wheel

**LED**

Headlight

Blue : Left

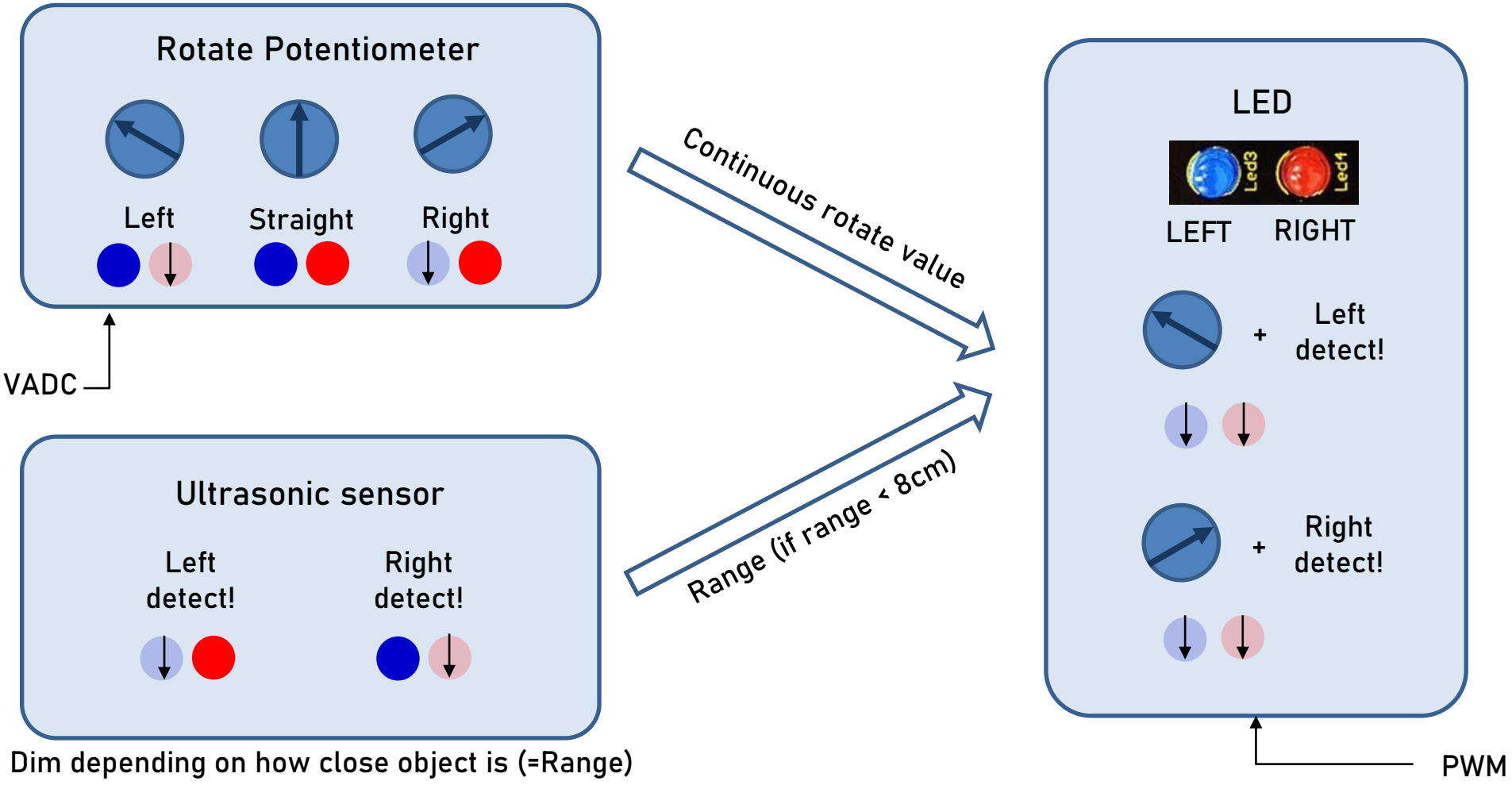
Red : Right

**Buzzer**

Warning

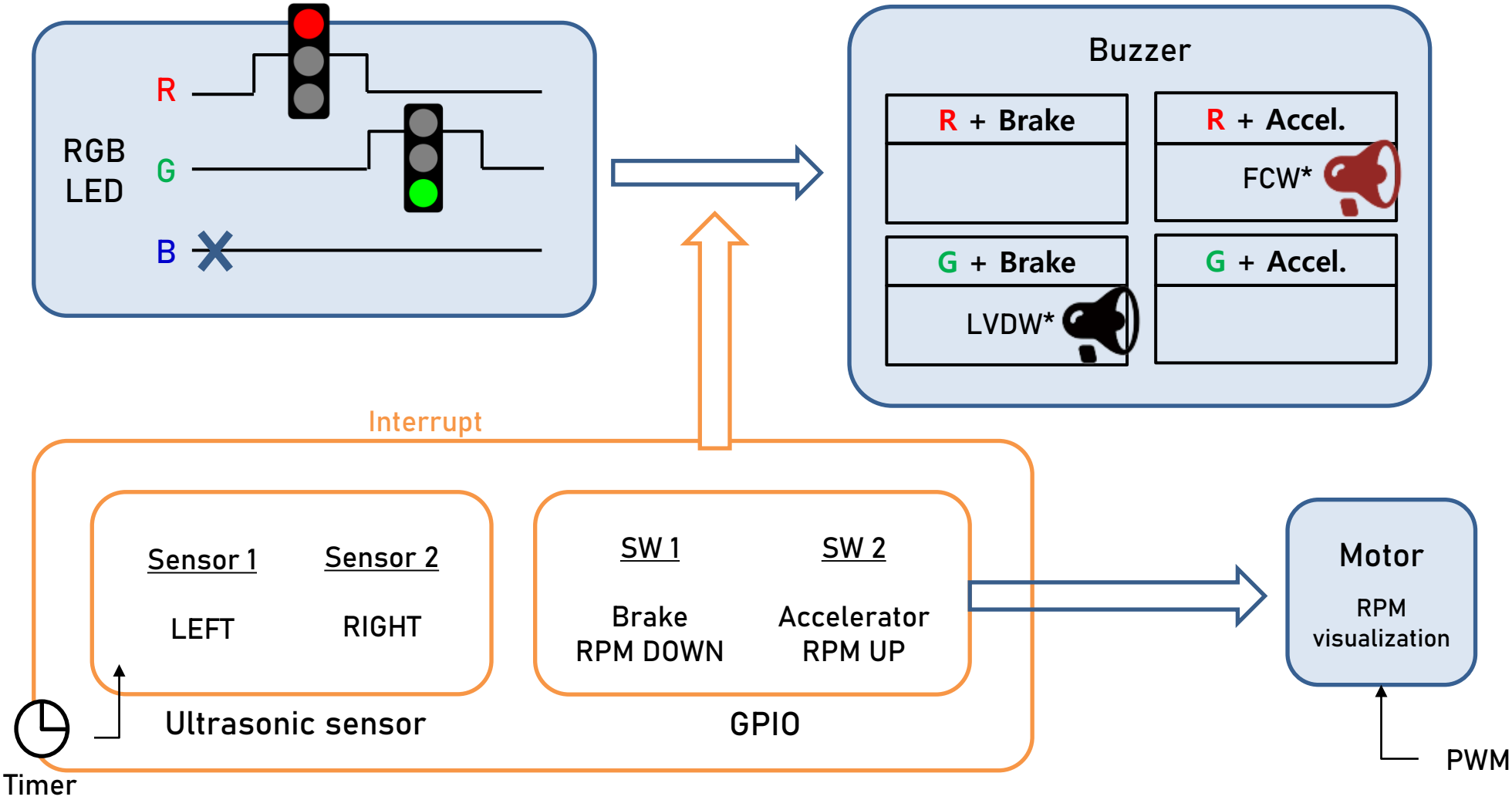
# 2. Proposed System – Flowcharts [1/2]

Adaptive dimming LED Headlights



# 2. Proposed System – Flowcharts [2/2]

## Driver Attention Warning (DAW) System

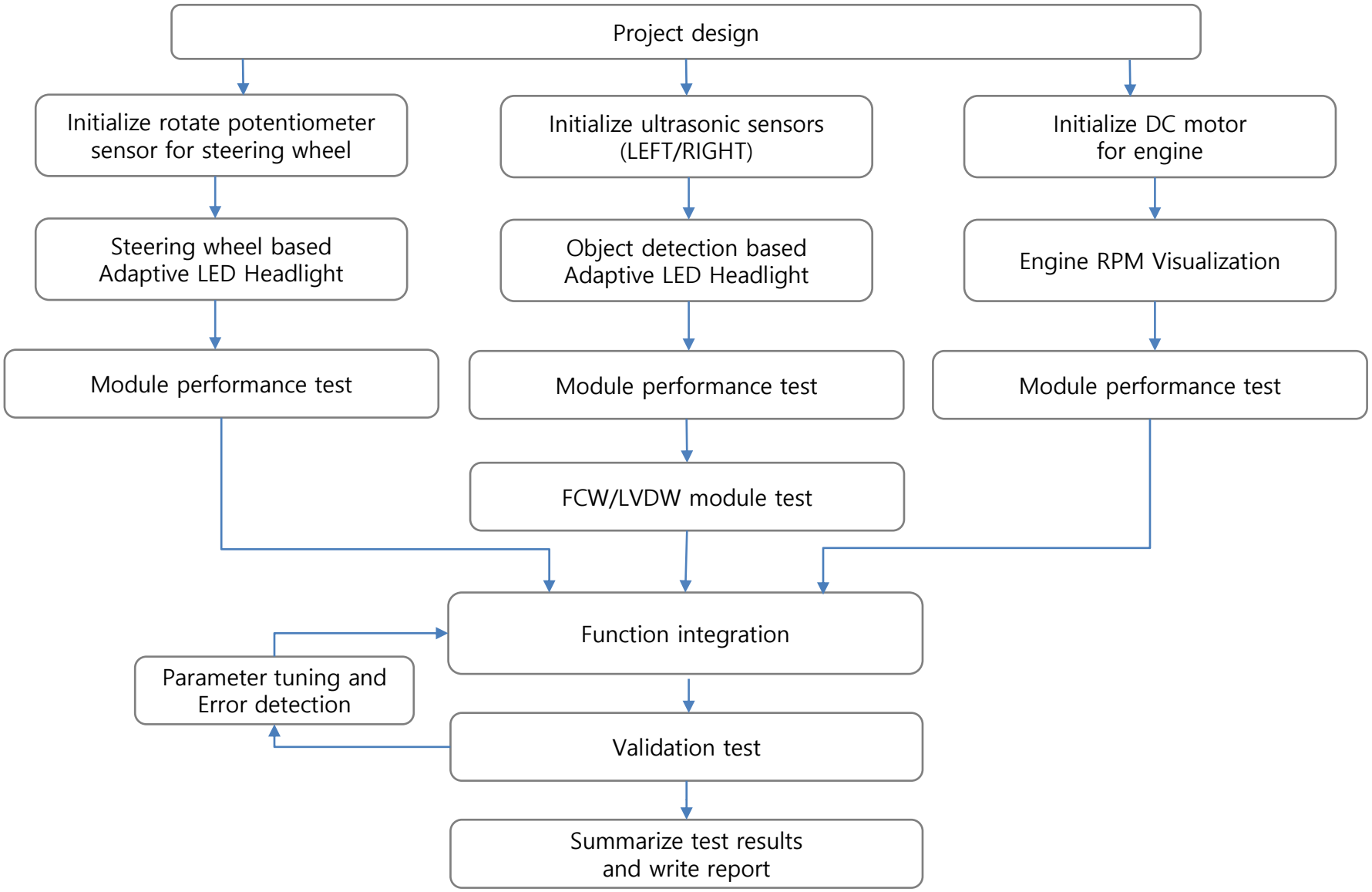



* FCW : Front Collision Warning, LVDW : Lead Vehicle Departure Warning

# 2. Proposed System – Project Distribution

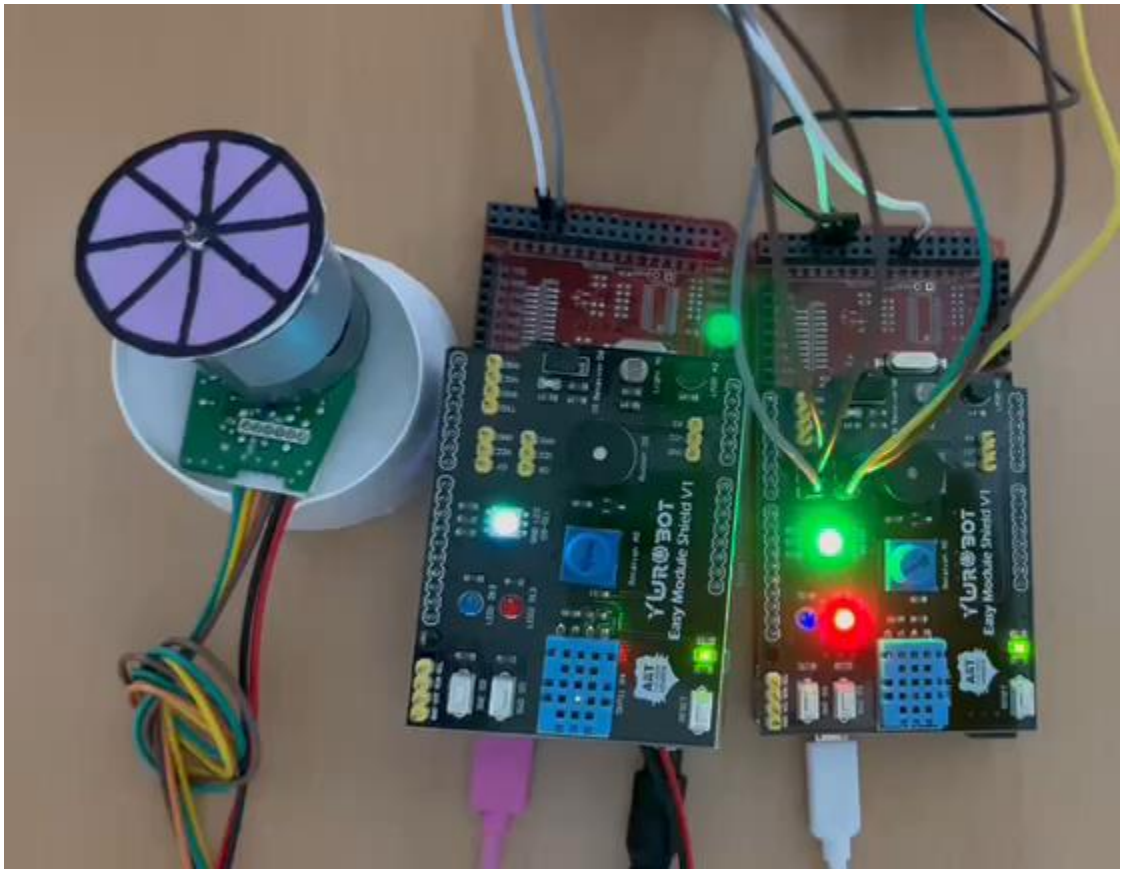
| Name | Work | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Design | | Coding | | Validation | | Document | |
| Seungho Kim | Ultra sonic | 10% | Ultra sonic | 25% | Ultra sonic | 25% | Flowchart | 15% |
| Jihoon Kim | Overall | 40% | initializati on | 5% | Testcase | 5% | Figure | 10% |
| Sangbin Lee | Motor | 20% | Motor | 25% | Motor | 25% | Flowchart | 10% |
| Hyerim Lee | Steering Wheel | 10% | LED | 20% | LED | 20% | PPT | 55% |
| Sewon Jang | Traffic Light | 20% | Buzzer | 25% | Buzzer | 25% | Flowchart | 10% |

# 2. Proposed System – Project Timeline Flowchart



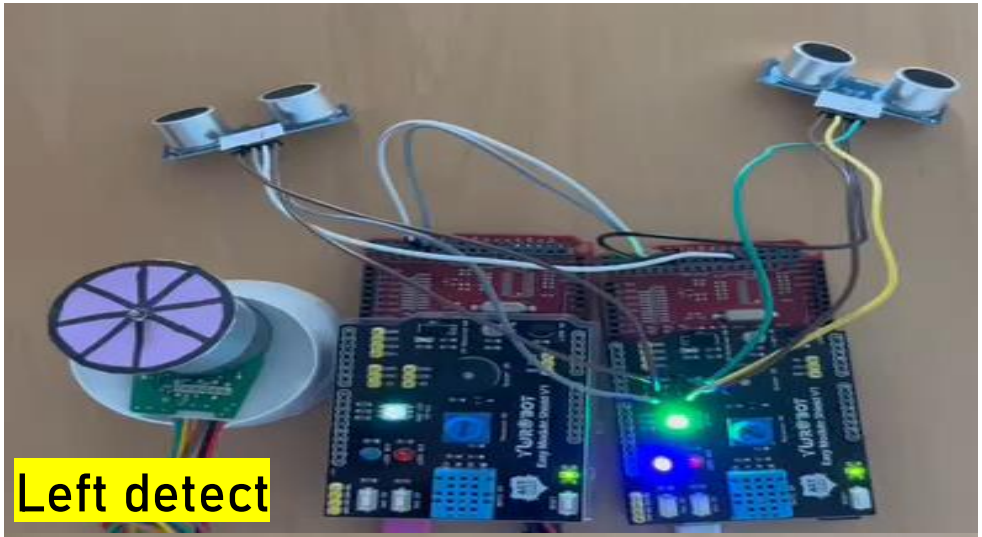
# 3. Results – Testcase #1

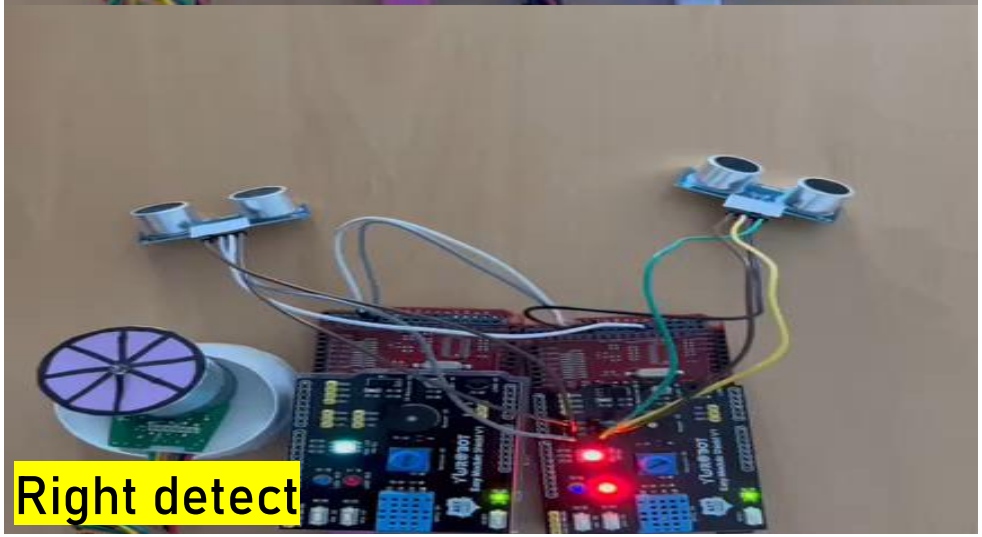
Steering wheel based Adaptive Headlight



# 3. Results – Testcase #2

Object detection based Adaptive Headlight



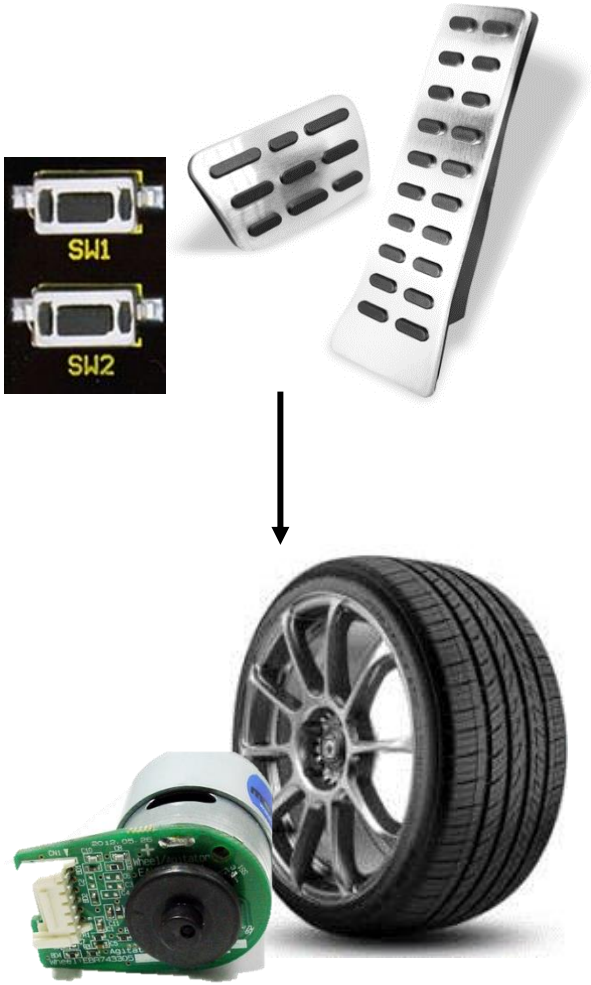



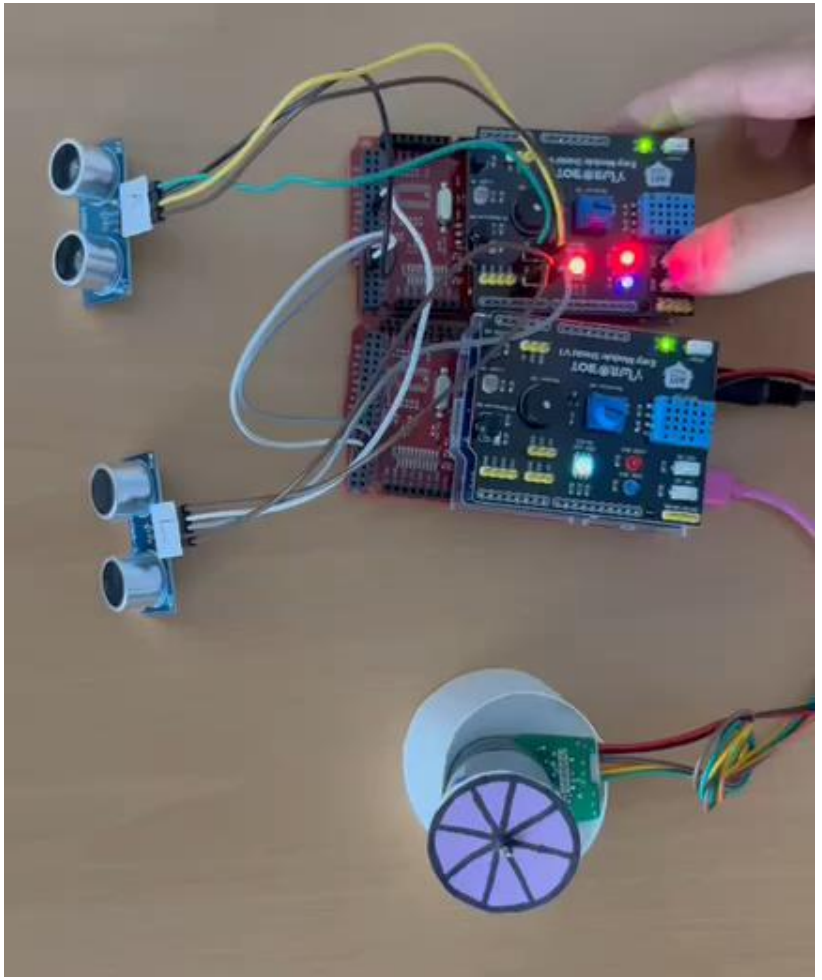
# 3. Results – Testcase #3

Adaptive LED headlight system

# 3. Results – Testcase #4

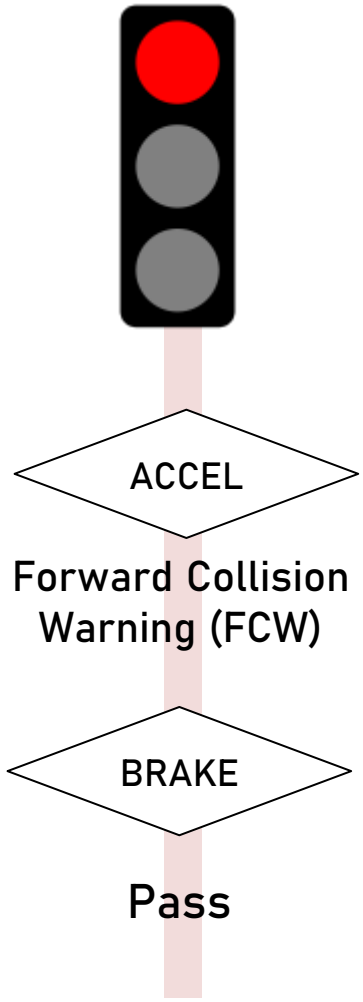
Engine RPM visualization using Motor

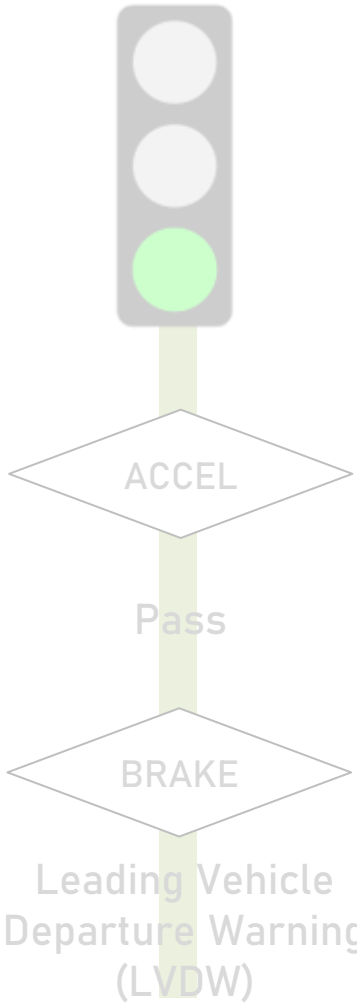


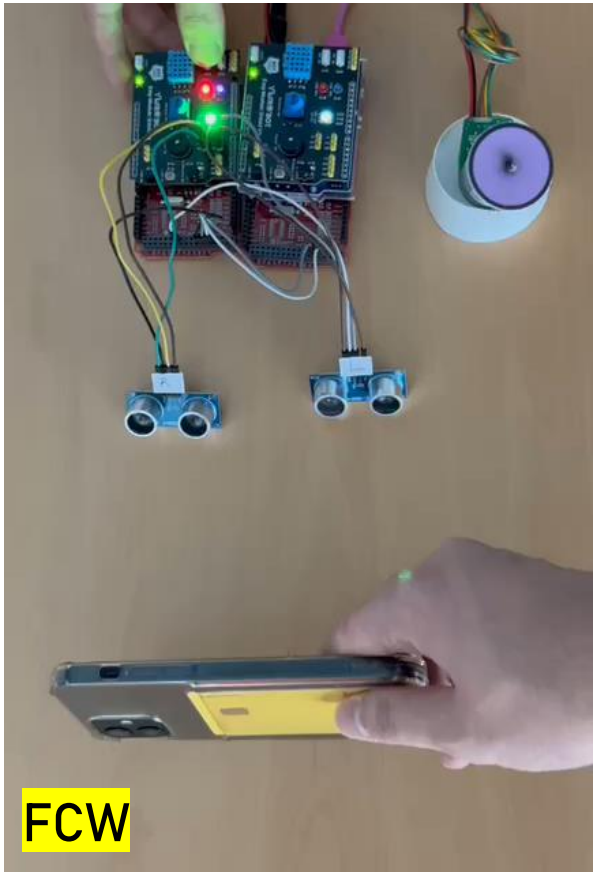



# 3. Results – Testcase #5

## Driver Attention Warning (DAW) System

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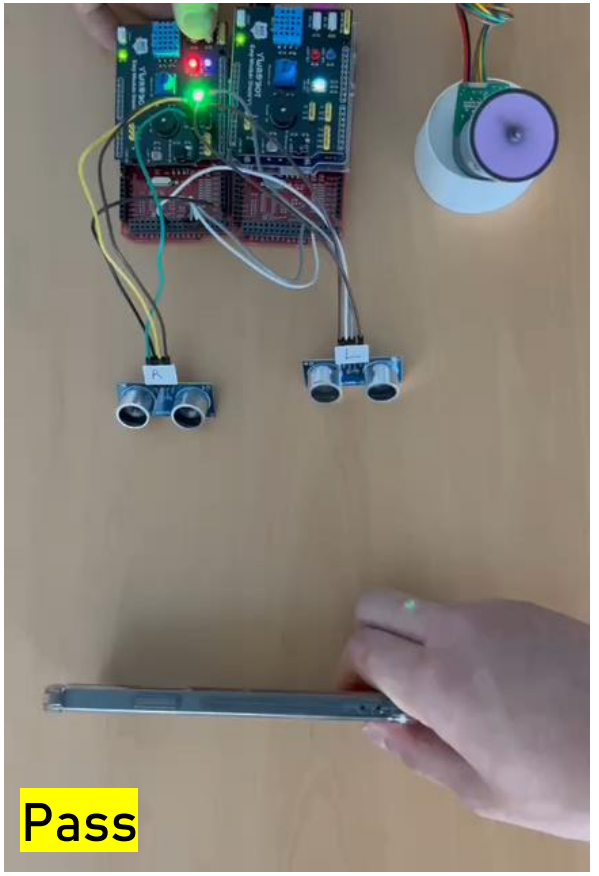


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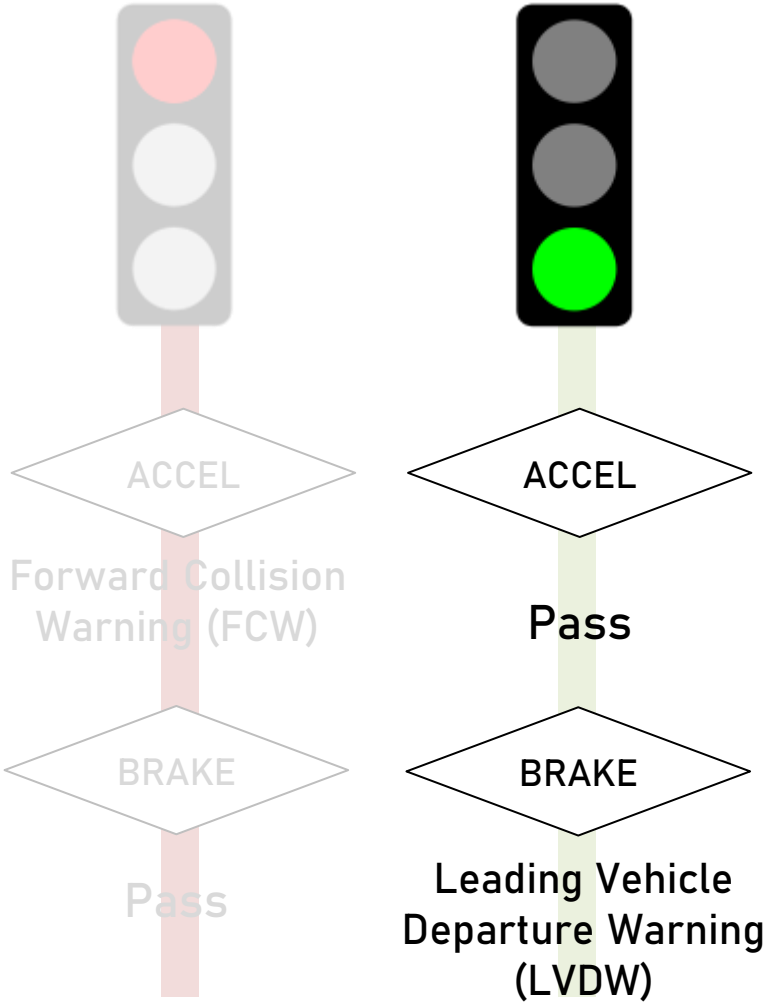
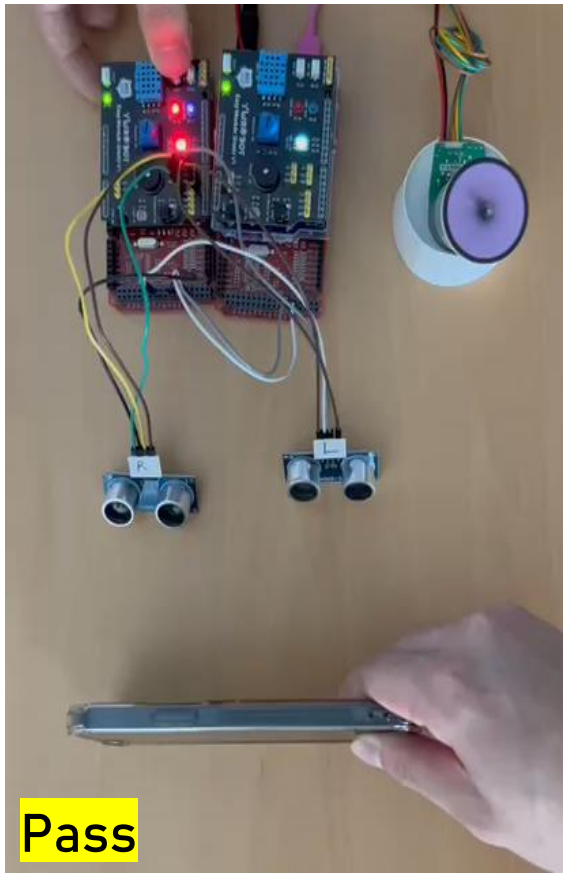
# 3. Results – Testcase #5

## Driver Attention Warning (DAW) System

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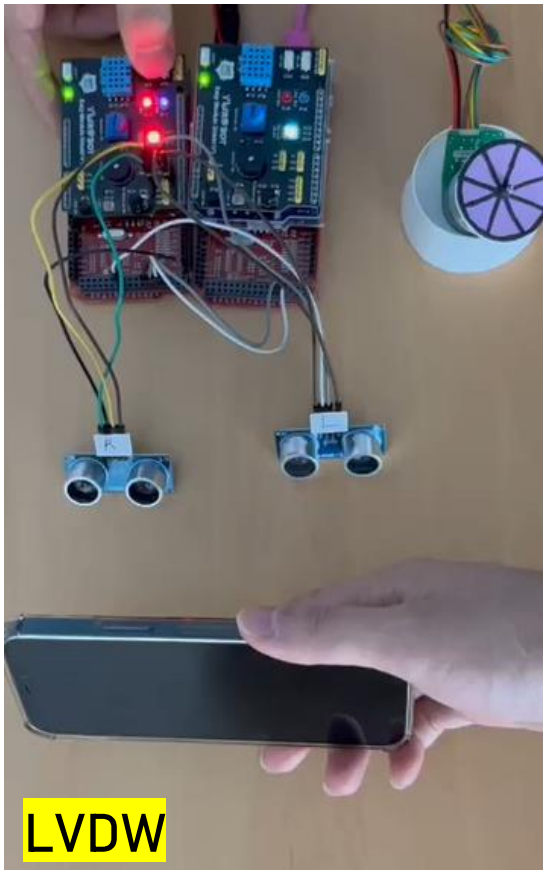


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# 4. Conclusion

◆ Summary

1. Adaptive LED headlight
   - Dim LED based on the distance between vehicle to object
   - Quite inaccurate performance due to the bad ultrasonic sensor resolution (0.3cm)

2. Smart Warning System
   - Use dual ultrasonic sensors for left and right side of view
   - Use DC motor for visualizing engine RPM
   - Warn using a buzzer with respect to the traffic light

3. Use dual ultrasonic sensors, MCU board, and triple core

◆ Future works

- Adaptive warning threshold with respect to the vehicle speed
- Continuous RPM increasement
- Implement in a MCU board using communication

# References


1. https://mycardoeswhat.org/safety-features/adaptive-headlights/
2. https://post.naver.com/viewer/postView.nhn?volumeNo=26929476&memberNo=1313972
3. https://post.naver.com/viewer/postView.nhn?volumeNo=28079982&memberNo=46073699
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5. https://heycar.co.uk/blog/types-of-headlights

# Thank you!