

Embedded Software Project

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# Smart Air Conditioning System

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Jihong Kim, Sunpil Kim, Joohyun Lee  
Woogyung Jung, Seokbum Song

2023 SWIP 1th, Team 1



# 1. Team Introduction



**Sunpil Kim\***  
(Team Leader)



**Jihong Kim**



**Seokbum Song**



**Joohyun Lee**



**Wookyung Jung**



## 2. Project Goals

### Project Goals : Smart Air Conditioning System

- It is difficult for the driver to immediately adjust the amount of air conditioning in a driving situation.
- Therefore, there is a need for a system that **automatically adjusts the amount of air conditioning in the vehicle** for a pleasant and safe driving situation.



#### [ Smart Mode ]

- Automatically adjust the air conditioning volume to adapt to the humidity(Light) in the vehicle.
- Humidity sensor
- Blue led indicating air conditioning volume
- Motor for air conditioning



#### [ Manual Mode ]

- User directly controls air conditioning
- Trigger : Potentiometer
- Blue led indicating air conditioning volume
- Motor for air conditioning



### 3. Project Scenario & System Flow

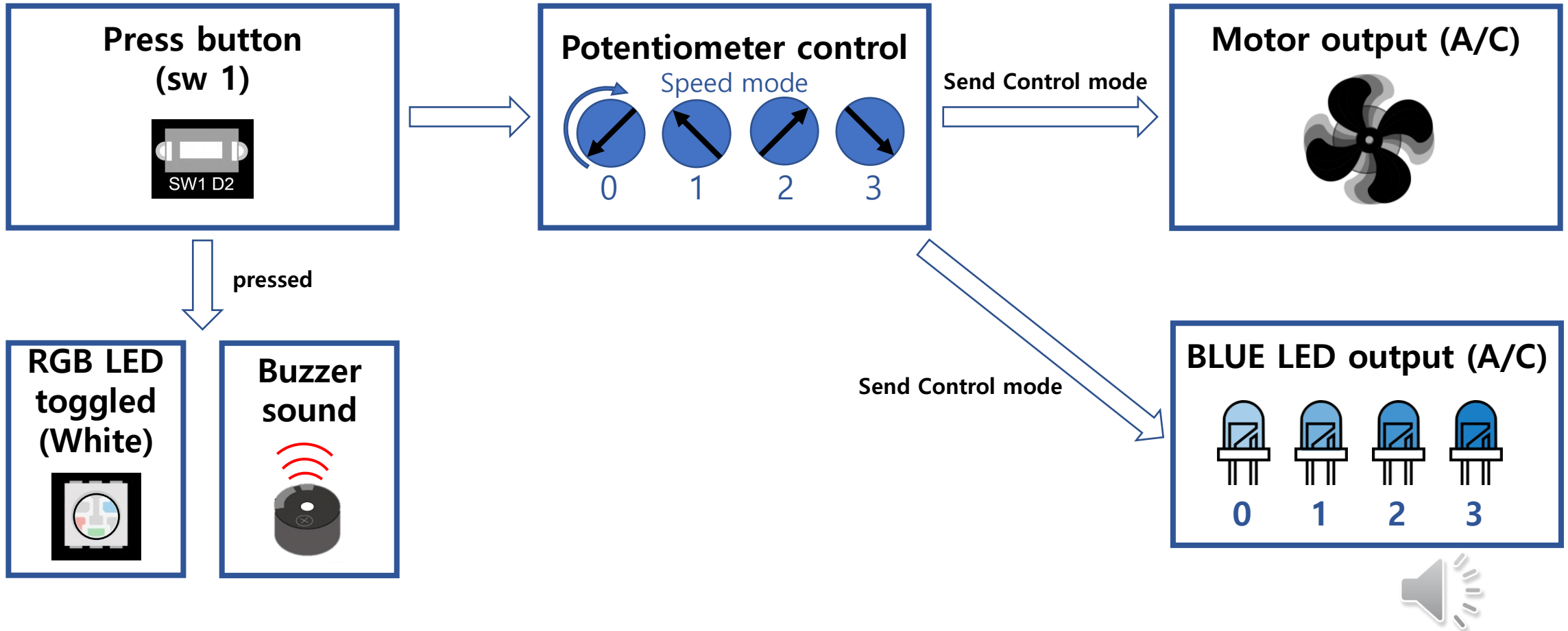
#### Scenario 1 : Manual Mode

1. The user can select a Manual Mode using a switch(DC3)
2. The RGB LED sensor represents the current mode in white & the Buzzer makes a sound
3. The user can set 4 stages(off,1,2,3) using the potentiometer
4. At this point, the Blue LED represents the current air flow from actuator(DC Motor)



### 3. Proposed System Architecture

Flow Chart (1) – Manual Mode



### 3. Project Scenario & System Architecture

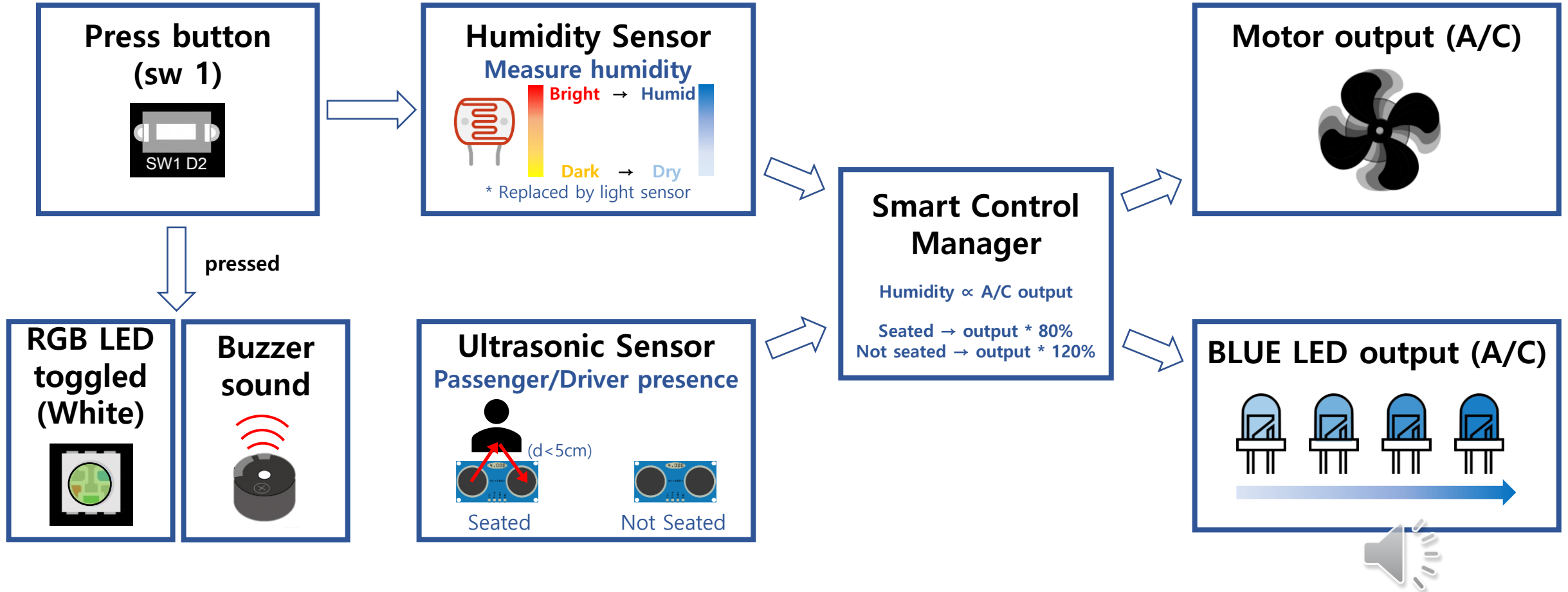
#### Scenario 2 : Smart Mode

1. The user can select a Smart Mode using a switch(DC3)
2. The RGB LED sensor represents the current mode in Green & the Buzzer makes a sound
3. The system analyzes the air quality in the vehicle through a Humidity sensor
4. It is determined whether each seat is occupied or not through an Ultrasonic sensor
5. By combining the two signal information, the system provides the user with optimal air conditioning for each seat



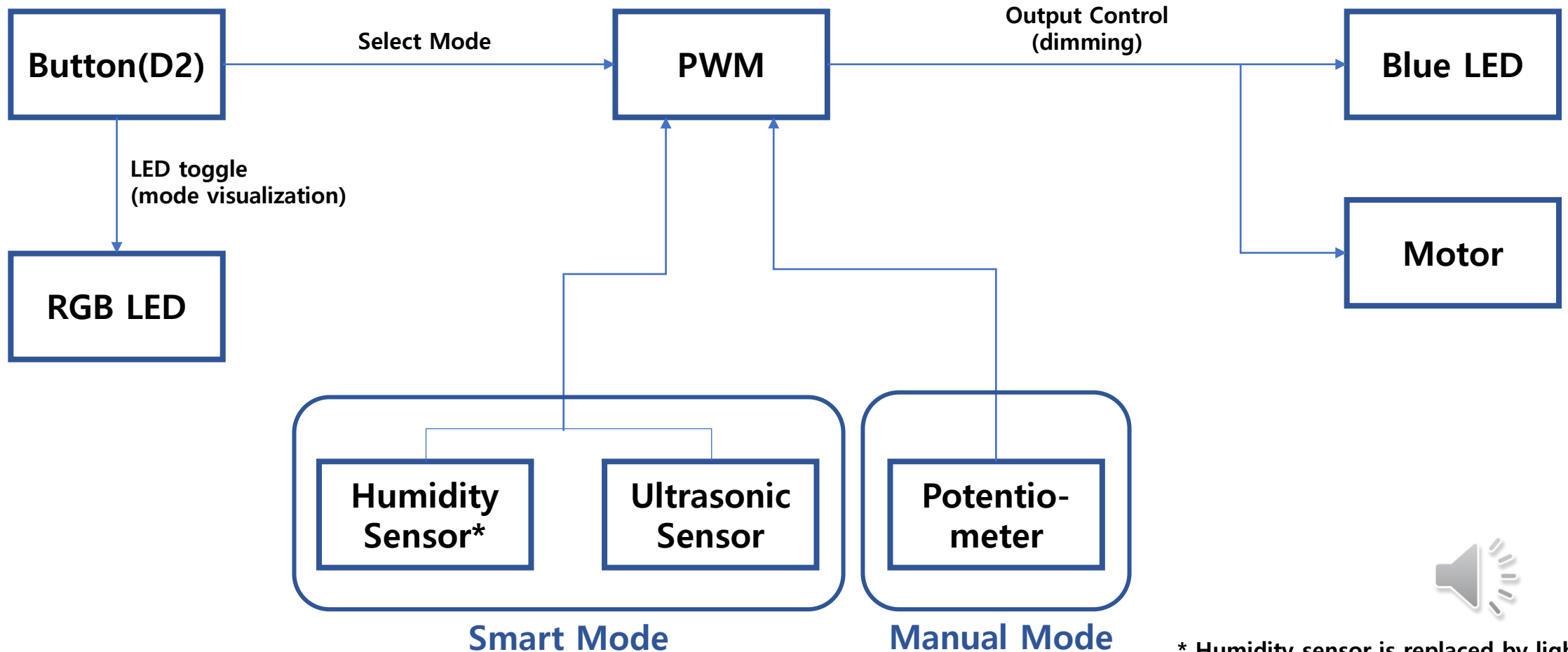
### 3. Project Scenario & System Architecture

Flow Chart (2) – Smart Mode



## 4. Proposed System Architecture

### System Architecture



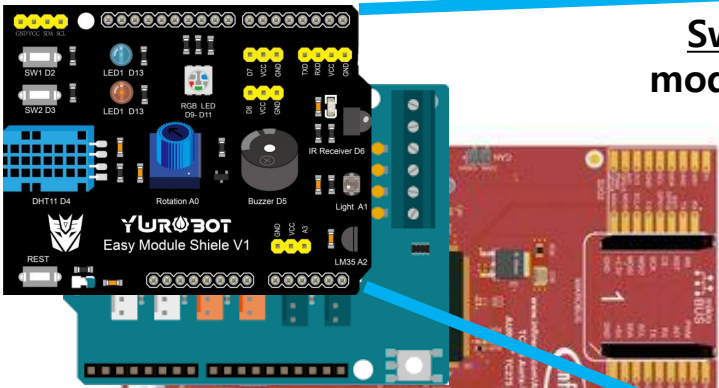
\* Humidity sensor is replaced by light sensor



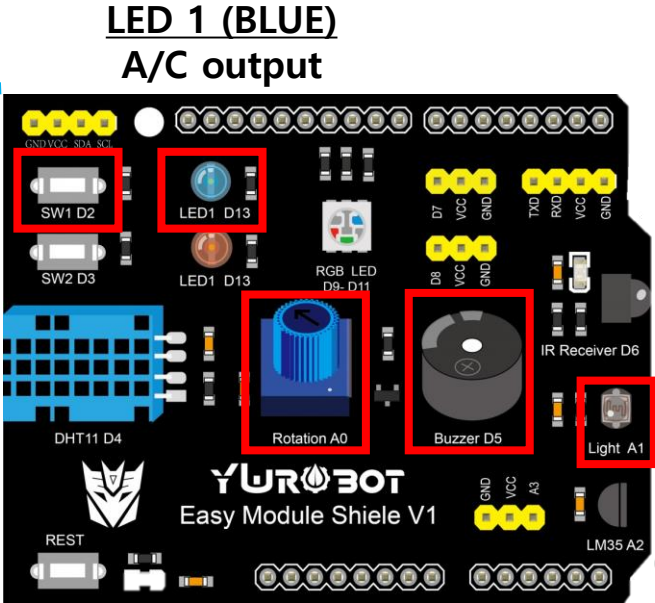
# 4. Proposed System Architecture

## Hardware Architecture

Master Board



Switch 1  
mode switch

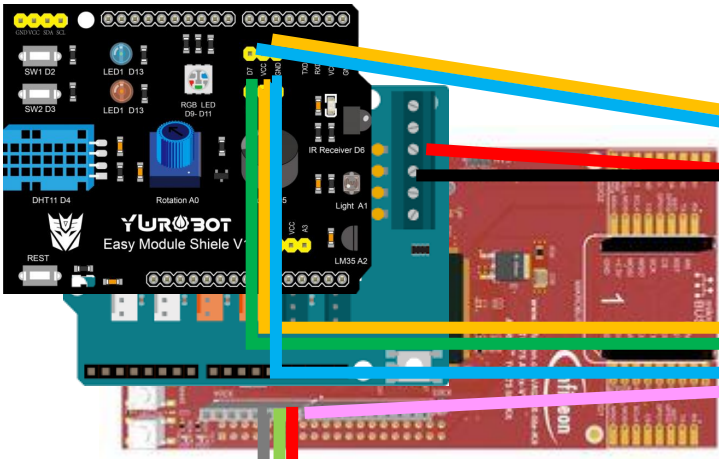


Potentiometer  
manual input

Buzzer  
Mode switch alert  
System Error Warning

Light Sensor  
humidity input  
(alternative to humidity  
sensor)

Sub Board



DC Motor  
A/C output



Ultrasonic Sensor  
passenger/driver  
presence input

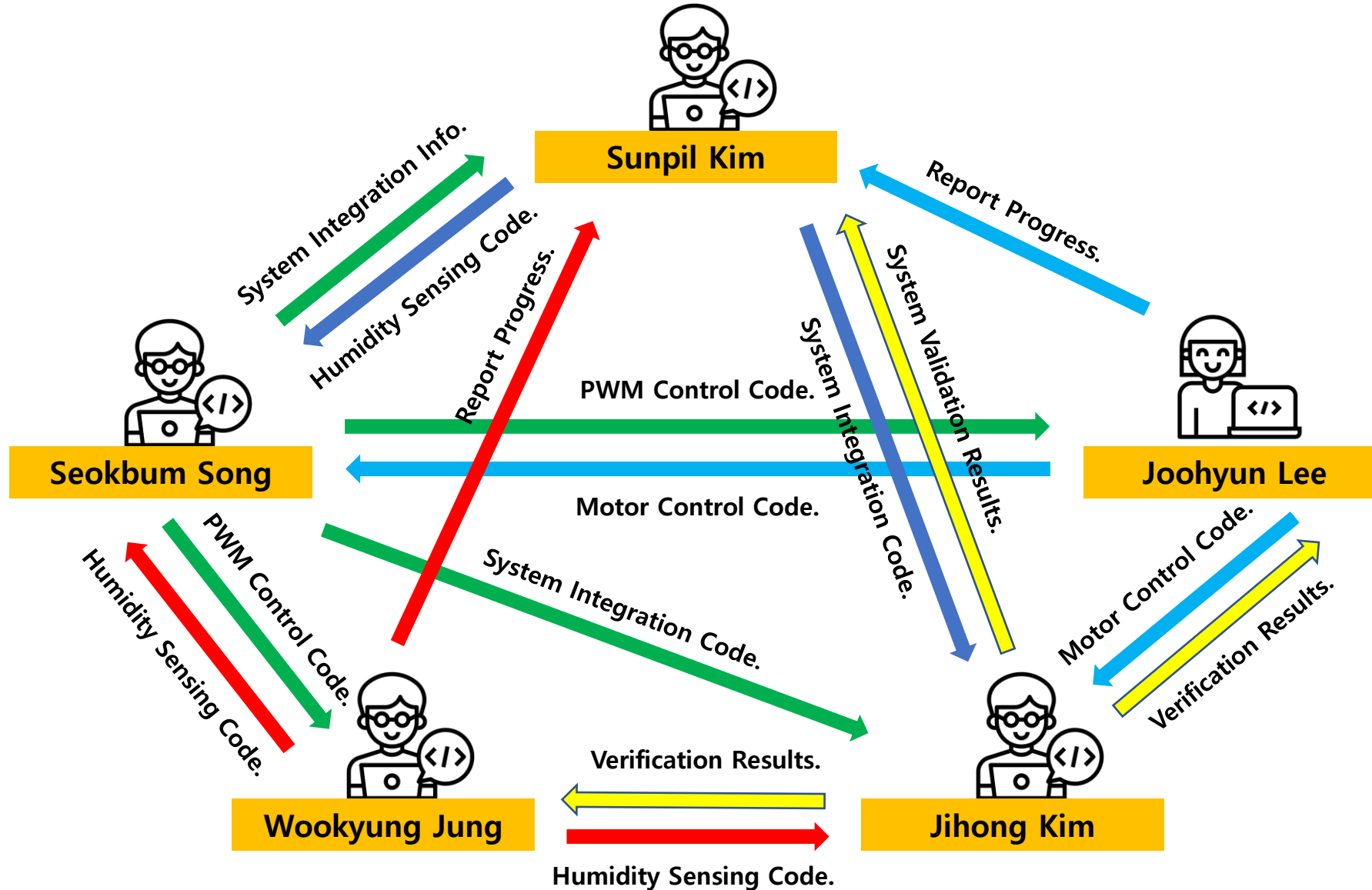


# 5. Project Roll Distribution

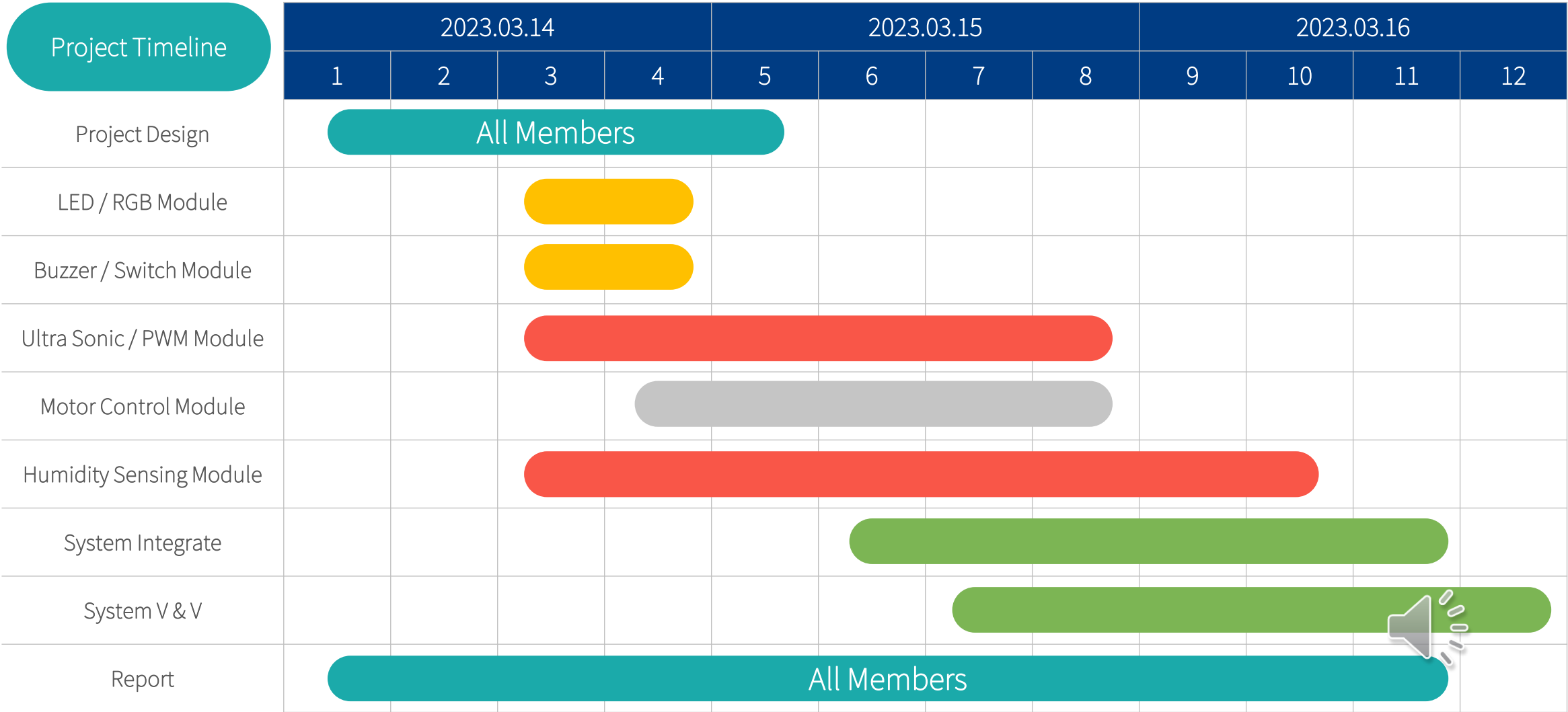
Name	Work								
	Main Roll	Design		Development		Validation		Document	
Sunpil Kim	Project Management	Ultra Sonic Humidity	20%	Humidity	10%	Module Test	10%	Overall	40%
Jihong Kim	System Validation & Verification	Ultra Sonic Motor Buzzer	20%	Sensing Module Development	22.5%	System Test	30%	UML Diagram	15%
Joohyun Lee	Module Development	LED Motor PWM	20%	Sensing Module Development	22.5%	Module Test	20%	Video	15%
Seokbum Song	System Integration	PWM Switch LED	20%	Control Module Development	22.5%	System Test	20%	Figure	15%
Wookyung Jung	Module Development	RGB LED & Humidity	20%	Sensing Module Development	22.5%	System Test	20%	Specification	15%



# 5. Project Roll Distribution



# 6. Project Timeline



# 7. Project Management

Cpu0_Main.c	230315 Intergration
Cpu1_Main.c	230315 add CPU1
Cpu2_Main.c	230315 Intergration
submodule.h	230315 Intergration
submodule_button.c	230315 Intergration
submodule_buzzer.c	230315 Intergration
submodule_ccu60.c	230315 add CPU1
submodule_eru.c	230315 Intergration
submodule_gtm.c	230315 Intergration
submodule_init.c	230315 add CPU1
submodule_led.c	230315 Intergration
submodule_mode.c	230315 Intergration
submodule_motor.c	230315 Intergration
submodule_vadc.c	230315 Intergration

```
1  /*
2      File Name   : submodule_buzzer.h
3      Author      : SWIP 1th - Team 1
4      Date        : 2023.03.15
5  */
6
7  #include "Ifx_Types.h"
8  #include "IfxCpu.h"
9  #include "IfxScuWdt.h"
10
11 #include "submodule.h"
12
13 /*
14     Function Name : initButton
15     Author        : SWIP 1th - Team 1
16     Date          : 2023.03.15
17     input         : void
18     output        : void
19     Description    : Set Button
20 */
21 void initButton(void)
22 {
23     // P02_IOCR0.U &= ~(0x1F << PC1_BIT_LSB_IDX);    // reset P02_IOCR0 PC1
24     // P02_IOCR0.U |= 0x02 << PC1_BIT_LSB_IDX;        // set P02.1 general input (pull-up connected)
25
26     P02_IOCR0.U &= ~(0x1F << PC0_BIT_LSB_IDX);    // reset P02_IOCR0 PC0
27     P02_IOCR0.U |= 0x02 << PC0_BIT_LSB_IDX;        // set P02.0 general input (pull-up connected)
28 }
```

# 7. Project Management

☐ 3 Open   ✓ 2 Closed

☐ 스마트 모드에서의 연속 값 입력을 위해 한개의 통신 포트 필요  
#5 opened 32 minutes ago by SunnyProj

☐ 조도 센서 / 가변 저항 센서 레지스터 충돌  
#4 opened 33 minutes ago by SunnyProj

☐ 포트 겹침 현상으로 인한 이슈  
#3 opened yesterday by SunnyProj

☐ DC 모터 및 RGB LED 채널 겹침 현상 발생 외 1  
#2 by SunnyProj was closed 31 minutes ago

☐ 1st commit  
#1 by wkjungswip was merged 2 days ago

SunnyProj commented yesterday Collaborator

1. DC 모터 및 RGB LED 채널 겹침 현상  
-> D9 채널 변경 요청

2. DC 모터 및 스위치 채널 겹침 현상  
-> D3 채널 겹침으로 변경 요청

wkjungswip commented yesterday Collaborator

1. DC 모터 및 RGB LED 채널 겹침 현상  
-> 문의 필요

2. DC 모터 및 스위치 채널 겹침 현상  
-> D3(SW2)에서 D2(SW1)로 변경

SunnyProj commented 1 hour ago Collaborator Author

1. DC 모터 및 RGB LED 채널 겹침 현상

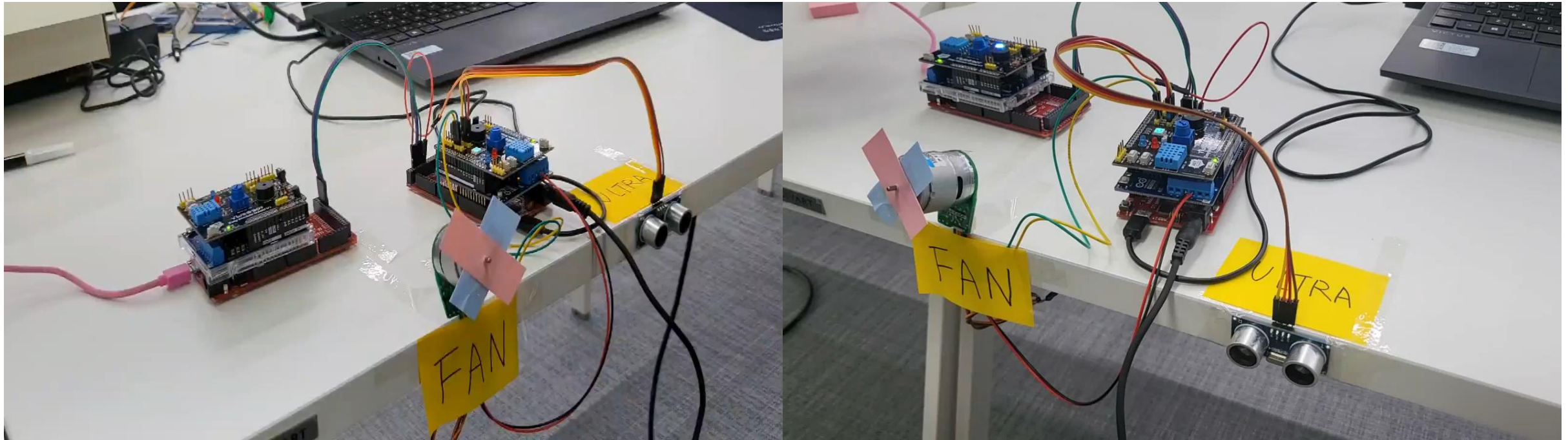
2. DC 모터 및 스위치 채널 겹침 현상  
-> D3(SW2)에서 D2(SW1)로 변경

--> 해결 완료 했습니다. 이슈 닫겠습니다.

SunnyProj closed this as completed 1 hour ago

## 8. Results

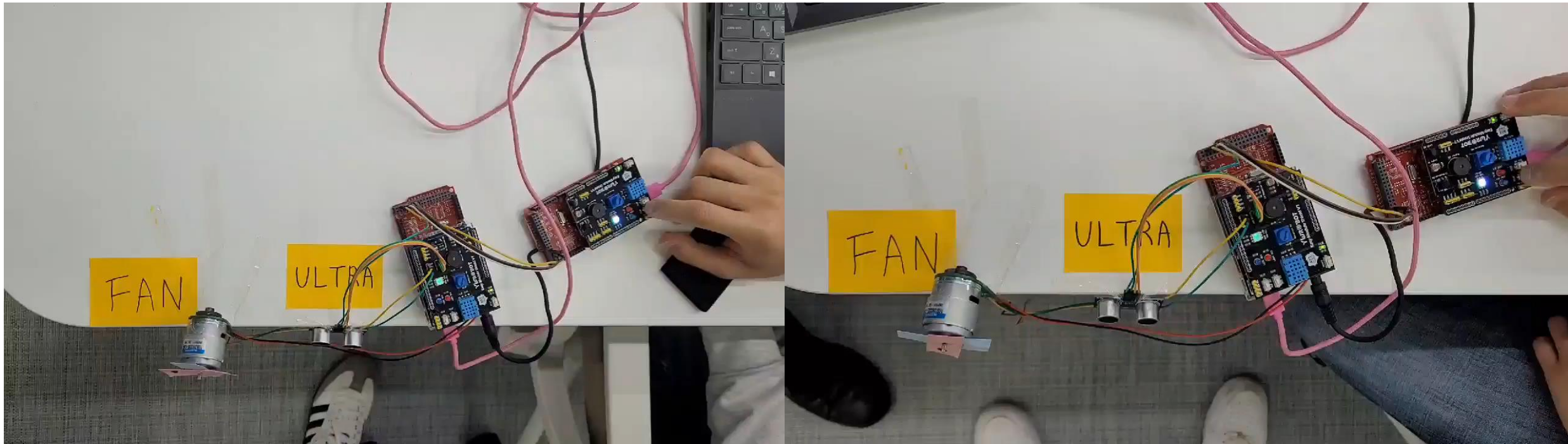
### Scenario 1 : Manual Mode





## 8. Results

### Scenario 2 : Smart Mode





# 9. Conclusion

## Summary : Smart Air Conditioning System

### 1. Smart Mode

- Automatic A/C control based on humidity
- Seat-specific control while maintaining total A/C output volume

### 2. Manual Mode

- Manual A/C control based on potentiometer input

### 3. System Error Warning

- Buzzer sound to notify user when system error occurs

## Future Works

1. Dual Motor Control to wholly implement seat-specific control
2. Operate humidity sensor to make use of humidity data for output control
3. Implement adaptive control logic for output value



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**Thank you.**

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