Mini Project
Final Report

<Features in an Aircraft Restroom>

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1. Project Description

<What is the problem statement?>

-Smoking is prohibited in all aircrafts, due to safety reasons. Yet, some smokers continue to smoke as they couldn't help their addiction. Which is why many airlines add a smoke detector in their restroom. However, there are cases where smokers tried to tamper the smoke detector. Hence, to catch the culprit, a tamper detection is built in with the smoke detector.

-A lot of electricity could be consumed when a light is bright for a long time. To prevent that, the light in the restroom conserves energy by remaining dim if it is not occupied

-Restrooms can build up an odour when frequently used. Hence, a ventilation fan and an air freshener are added inside the restroom for a deodorizing environment

- To avoid any unnecessary disturbance to occupier, an 'Occupied' sign is attached outside the restroom, and it will light up once a person locks the door. This is to indicate the other passengers that the restroom is not vacant.

<Briefly state your project working principle clearly>

-Once a person walks in and **locks the door**, the **occupied sign outside the restroom will light up**. In addition to that, there is a **ventilation fan which will start to spin**, and an **air freshener that sprays perfume every 1 second per minute** *(for this project it'll be 1:6 seconds).* And the **dimmed light inside the restroom will shine bright.**

-If the person was a smoker and tries to **smoke a cigar**, the smoke detector will sense it and a **light inside the cabin crew's room will light up**. If the person notices the smoke detector and **tries to break it or cover it,** a loud **buzzer will start to go off**. Even if the smoker takes his hands away from the buzzer and/or tries to clear the smoke away, the **buzzer and the light will not turn off** as the culprit could escape without being noticed. **Both will only turn off once the main switch is offed and on again.**

-Lets say a person straight up tries to **tamper the smoke detector** before even lighting up his cigar, **both the light and buzzer will turn on, and will not off until the main switch is offed.**

-If the main switch is off, all functions are disabled. The main switch also acts as a reset function for both the smoke and tamper detector.

A-Outcome for Door Lock Sensor

A-Outcome for Smoke Detector

A-Outcome for Tamper Detector

A-Outcome for Main Switch

<list the peripherals used>

Switches (x4)

LEDs (x4 and x1 buzzer)

Motor (x1)

Pulse Width Modulator (x1)

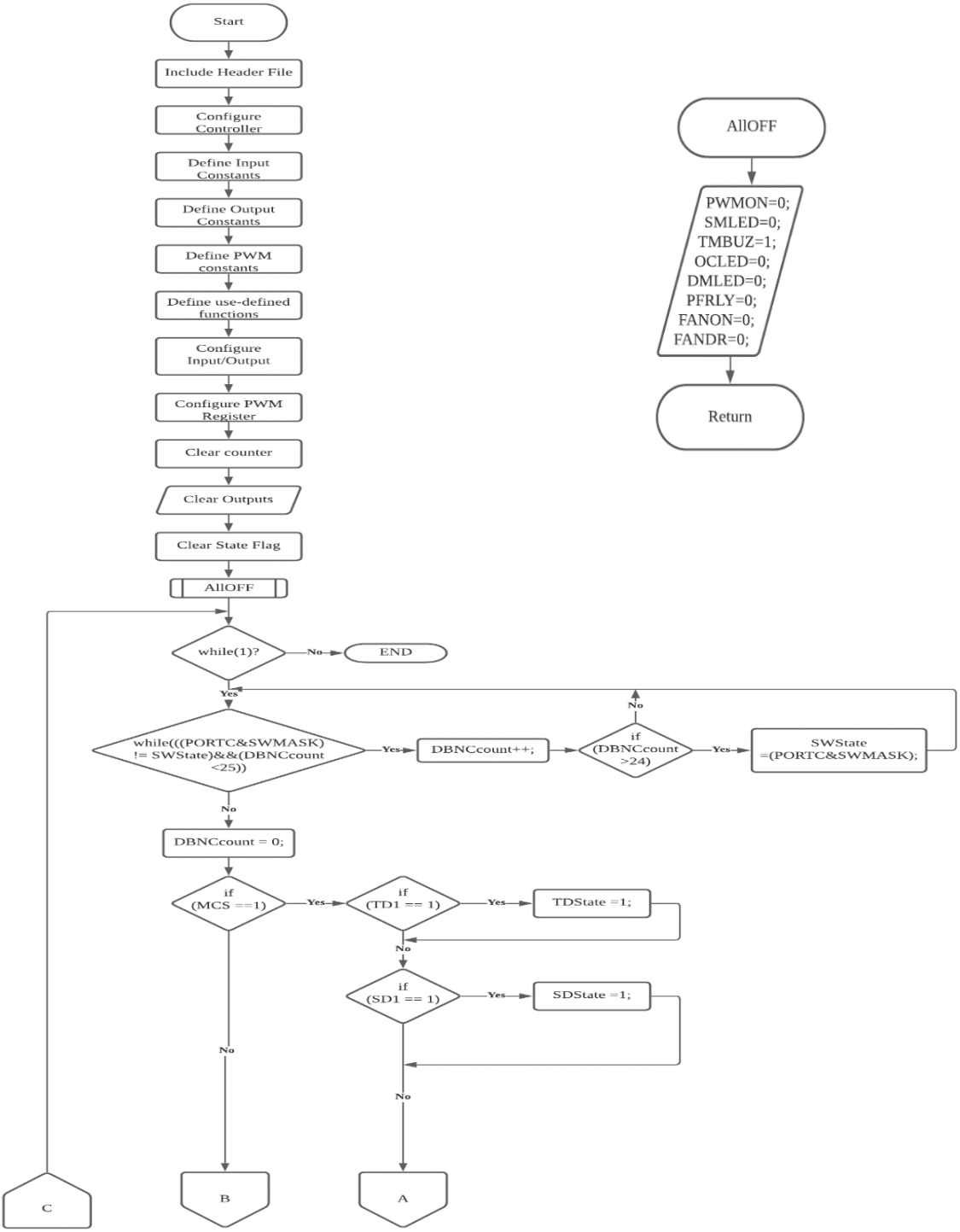
2. Truth Table

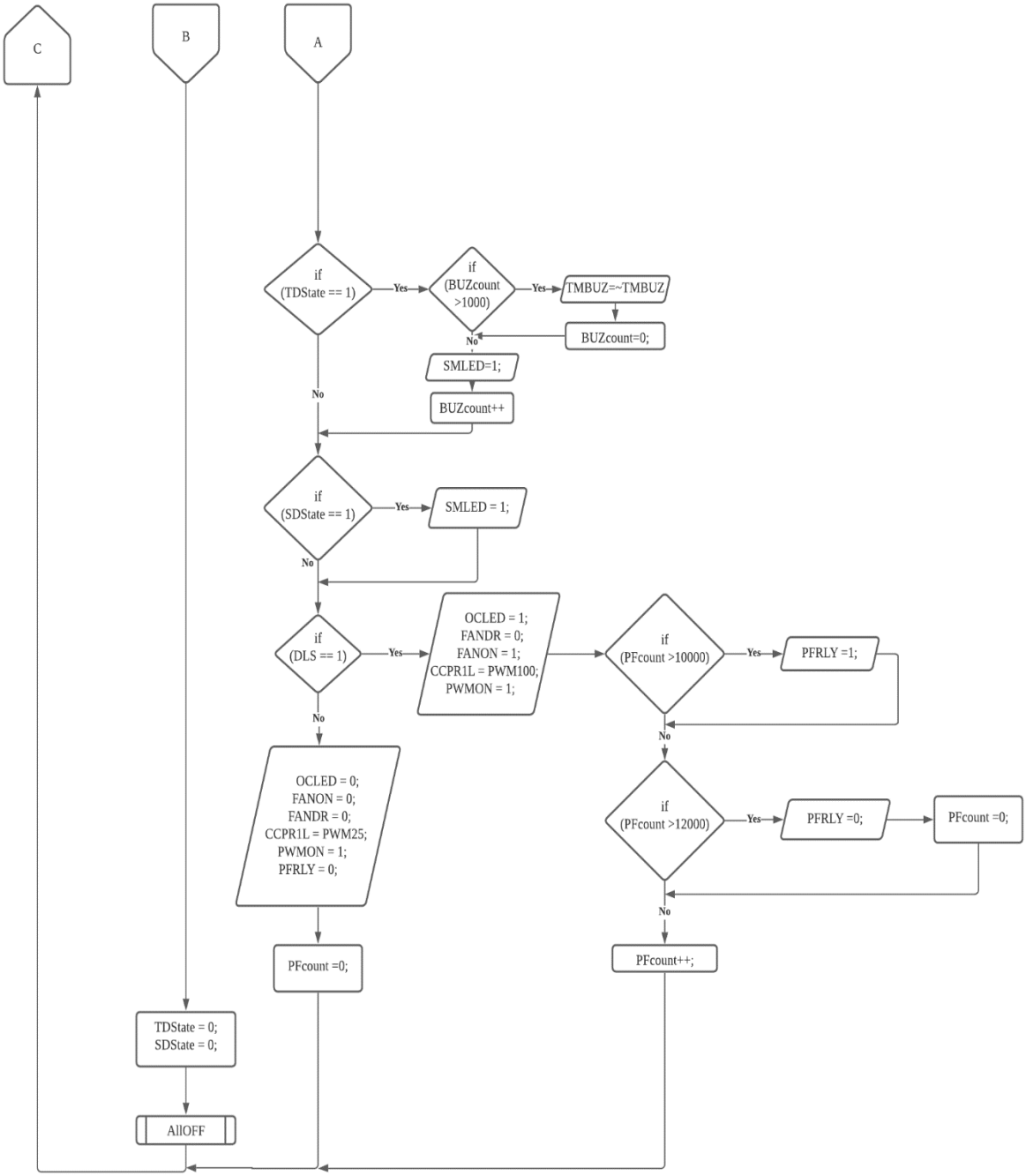
Inputs				**outputs**					
Smoke Detector 1 (S1)	*Tamper Sensor 1 (S2)*	*Door Sensor (S6)*	*Main Switch(S7)*	*Smoke Detection Led (L1)*	*Tamper Detection (Buzzer in the MCU)*	*Light inside restroom (L3)*	*Air Freshener (L4)*	*Occupied sign Led (L5)*	*Ventilation Fan (motor)*
X	X	X	1	OFF	OFF	OFF	OFF	OFF	OFF
0	0	X	0	OFF	OFF	As per S3	As per S3	As per S3	As per S3
X	1	X	0	ON	ON/OFF every 0.5sec	As per S3	As per S3	As per S3	As per S3
1	0	X	0	ON	OFF	As per S3	As per S3	As per S3	As per S3
1	1	X	0	ON	ON/OFF every 0.5sec	As per S3	As per S3	As per S3	As per S3
X	X	0	0	As per S1/S2	As per S1/S2	50%	OFF	OFF	OFF
X	X	1	0	As per S1/S2	As per S1/S2	100%	Every min, On for 1sec	ON	ON

3. Port Assignment Diagram / Wiring Diagram

Category	Port Number	Allocation	Remarks
PORT C	0	S0	Smoke Detector
	1	S1	Tamper Detector
	2	L5	PWM LED
	6	S6	Door Lock Sensor
	7	S7	Main Switch
PORT D	0	L0	Smoke LED
	1	BUZZER	Buzzer
	2	L3	Occupied
	3	L4	Air Freshener
	6	MR	Ventilation Fan
	7	MF	Ventilation Fan

4. Flowchart


Start
Include Header File
Configure Controller
Define Input Constants
Define Output Constants
Define PWM constants
Define use-defined functions
Configure Input/Output
Configure PWM Register
Clear counter
Clear Outputs
Clear State Flag
AllOFF
while(1)?
No
END
Yes
while(((PORTC&SWMASK) != SWState)&&(DBNCcount <25))
Yes
DBNCcount++;
if (DBNCcount >24)
Yes
SWState =(PORTC&SWMASK);
No
No
DBNCcount = 0;
if (MCS ==1)
Yes
if (TD1 == 1)
Yes
TDState =1;
No
if (SD1 == 1)
Yes
SDState =1;
No
No
C
B
A
AllOFF
PWMON=0;
SMLED=0;
TMBUZ=1;
OCLED=0;
DMLED=0;
PFRLY=0;
FANON=0;
FANDR=0;
Return


C
B
A
if (TDState == 1)
Yes
if (BUZcount >1000)
Yes
TMBUZ=~TMBUZ
BUZcount=0;
No
SMLED=1;
BUZcount++
No
if (SDState == 1)
Yes
SMLED = 1;
No
if (DLS == 1)
Yes
OCLED = 1;
FANDR = 0;
FANON = 1;
CCPR1L = PWM100;
PWMON = 1;
if (PFcount >10000)
Yes
PFRLY =1;
No
if (PFcount >12000)
Yes
PFRLY =0;
PFcount =0;
No
PFcount++;
No
OCLED = 0;
FANON = 0;
FANDR = 0;
CCPR1L = PWM25;
PWMON = 1;
PFRLY = 0;
PFcount =0;
TDState = 0;
SDState = 0;
AllOFF

5. Source Code

```
#include<p18f4520.h>

#pragma config OSC=INTIO67          //set external High-Speed(HS) oscillation
#pragma config LVP=OFF              //disable the Watchdog feature of the MCU
#pragma config WDT=OFF              //disable Low Voltage programming (LVP)
#pragma config PBADEN=OFF           //Port B Analogue to Digital (AD) module is OFF

//Input definitions
#define SD1 PORTCbits.RC0           // Define Smoke Detector 1 as Port B bit 0
#define TD1 PORTCbits.RC1           // Define Tamper Detector 1 as Port B bit 1
#define DLS PORTCbits.RC6           // Define Door Lock Detector 1 as Port B bit 6
#define MCS PORTCbits.RC7           // Define Main Control Switch 1 as Port B bit 7
#define SWMASK 0b11000011           // Mask only Switch connected bits

//Output definitions
#define SMLED PORTDbits.RD0                 // Smoke Detect LED
#define TMBUZ PORTDbits.RD1                 // Tamper detect Buzzer
#define OCLED PORTDbits.RD2                 // Occupied sign LED
#define PFRLY PORTDbits.RD3                 // Perfume Relay
#define FANON PORTDbits.RD6                 // Fan Motor ON (MR)
#define FANDR PORTDbits.RD7                 // Fan Motor Direction (MF)
#define DMLED PORTCbits.RC2                  // Define PWM output at Port C bit 2

#define PWMON T2CONbits.TMR2ON              //Enable PWM by enabling Timer 2
#define PWM25  0b00100111                   //PWM duty cycle register value for 25% = PR2 = 4.992msec
#define PWM100 0b10011100                   //PWM duty cycle register value for 100% =4*PR2= 9.984msec
```

```
void AllOFF(void)
{
        PWMON = 0;      // Disable PWM
        SMLED = 0;      // Smoke Detect LED OFF
        TMBUZ = 1;      // Tamper detect Buzzer OFF
        OCLED = 0;      // Occupy LED OFF
        DMLED = 0;      // Dimmer LED OFF
        PFRLY = 0;      // Perfume Relay OFF
        FANON = 0;      // FAN Motor OFF
        FANDR = 0;      // FAN motor Default direction
}


void main()
{
 char DBNCcount;            //debounce count
 char SWState;              //Main control switch state
 char TDState;              // Tamper Detect state
 char SDState;              // Smoke Detect state
 long int BUZcount;         // Define Buzzer counter
 long int PFcount;          // Define Perfume Counter

 TRISC = SWMASK;            // Configure Port C bit <7:6> and <1:0> as input other are outputs
 TRISD = 0x00;              // Configure Port D as output

 BUZcount = 0;                  //Initialize Buzzer counter
 PFcount =0;                    //Initialize Perfume counter
 SWState = 0;                   //Initialize Switch state
 TDState = 0;                   //Initialize Tamper Detect state
 SDState = 0;                   //Initialize Smoke Detect State
 PORTD = 0;                     //Ensure all outputs are in OFF state
 PORTC = 0;                     //Clear Port C

 OSCCON = 0b01000000;       //Internal Oscillator frequency = 1MHz, bit<6:4>=100
 T2CON = 0b00000110;        //Timer2 is ON (bit2 = 1), TMR2 presale = 16(bit 1=1, bit 0=0)
 PR2 = 156;                 //PWM Period = [(PR2) + 1] * 4 * TOSC *(TMR2 Prescale Value) for Tosc= (1/1M)sec,
                            //PWM period = [156+1] * 4 * (1/1M) * (16) = 10.048msec
 CCP1CON = 0b00001100;      //CCP1M<3:0> 1100 = PWM mode, P1C active-high, duty cycle reg <1:0> = 00
```

```
CCPR1L = PWM25;          //PWM Duty Cycle = (CCPR1L:CCP1CON<5:4>) * TOSC * (TMR2 Prescale Value)
                         //PWM Duty Cycle = (0b0100111000=312)(1/1M)(16) = 4.992msec or 50% Duty cycle
AllOFF();


    while (1)                    //infinity loop
    {
        while (((PORTC&SWMASK) != SWState)&&(DBNCcount <25))  //De-bounce Port C
        {
            DBNCcount ++;
            if (DBNCcount >24)                          //if Port C stable for 10 counts
            {
                SWState =(PORTC&SWMASK);          //Port C value updated in SWState
            }
        }
        DBNCcount = 0;                          //De-bounce counter reset

        if (MCS ==1)                                                //Main control Switch state ON
        {
            if (TD1 == 1)                          //if Tamper detect ON
            {
            TDState =1;                                             //setTamper detect state is active
            }

            if (SD1 == 1)              //if Smoke detector is ON
            {
                SDState =1;                  //Smoke detect state is active
            }
            if (TDState == 1)            //Tamper detector state ON
            {
                if (BUZcount >1000)  //check buzzer counter reached approximately 0.5 sec for 4MHz osc freq
                {
                    TMBUZ = ~TMBUZ;    //Toggle Buzzer
                    BUZcount =0;         //reset Buzzer conter
                }
                SMLED = 1;           //smoke detector ON
                BUZcount++;          //increment Buzzer counter
            }
```

```
        if (SDState == 1)           //if Smoke detector state is OFF
        {
                SMLED = 1;          //smoke detector ON
        }
        if (DLS == 1)                       //Door Lock Sensor ON
        {
                OCLED = 1;                  //Occupied sign LED on
                FANDR = 0;                  // FAN motor direction set to forward rotation. (MF)

                FANON = 1;                  // FAN Motor ON (MR)
                CCPR1L = PWM100;            //set PWM duty cycle register for 100% Duty cycle
                PWMON = 1;                  //Enable PWM

                if (PFcount >10000)         //check Perfume counter reached approximately 1min
                {
                        PFRLY =1;           //Turn ON perfume
                }
                if (PFcount >12000)         //check perfume counter reached 1min 1sec
                {
                        PFRLY =0;           //Turn OFF perfume
                        PFcount =0;         //reset Buzzer counter
                }
                PFcount++;                  //increment Perfume counter
        }
        else                        //Door Lock Sensor Switch OFF
        {
                OCLED = 0;          //Occupied sign LED off
                FANON = 0;          //FAN Motor OFF (MR)
                FANDR = 0;          //FAN motor Default direction (MF)
                CCPR1L = PWM25;     //PWM duty cycle register for 25% Duty cycle
                PWMON = 1;          //Enable PWM
                PFRLY = 0;          //Perfume Relay OFF
                PFcount =0;         //Reset Perfume counter

        }
}
else    //Main control Switch state OFF
{
        TDState = 0;                //Initialize Tamper Detect state
```

```
                    SDState = 0;            //Initialize Smoke Detect State
                    AllOFF();               //Ensure all outputs are in OFF state
                }
            }
}
```

6. Problems Encountered and Solutions

<What are the problems you faced during this mini project implementation?>

-Debounce Error

-Smoke detector LED and buzzer won't turn off once the main switch is turned OFF and ON again. *(logical error)*

-Code for PWM wasn't working.

<what methods have your considered?>

-Google the errors and search for the possible solutions

-Read the book to see if I missed out anything

<how did you resolve them?>

-I added a code to prevent debounce error

-I tried to alter my code after some research

-I researched more on PWM and managed to understand execute it on my code

7. Conclusion

<What are your thoughts of this Mini project?>

-I've gained a lot more confidence in programing compared to last time. While this project was stressful, the satisfaction of completion was priceless.

<What have you learnt from this Mini project implementation?>

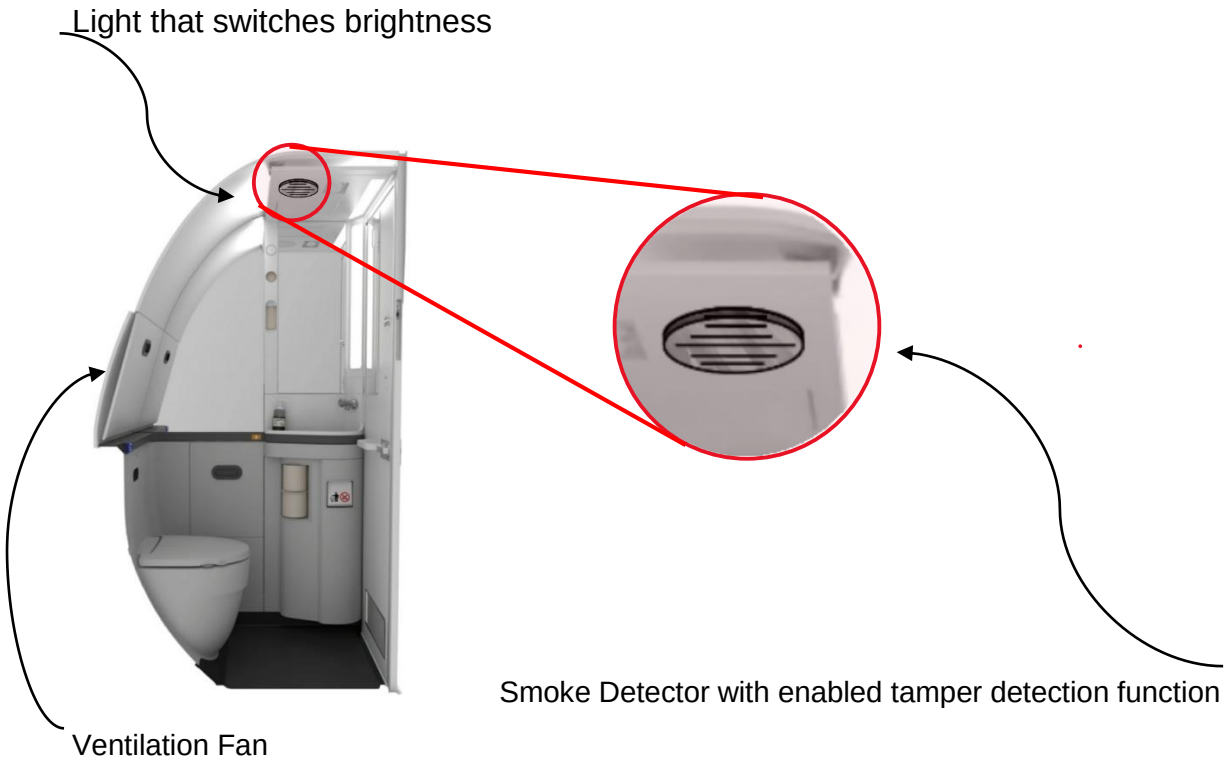
-I've learned about PWM, Motor and the Buzzer
-I've learned that it may seem hard at first, but as long as I don't give up or choose an easier route, I will be well pleased with the final result.

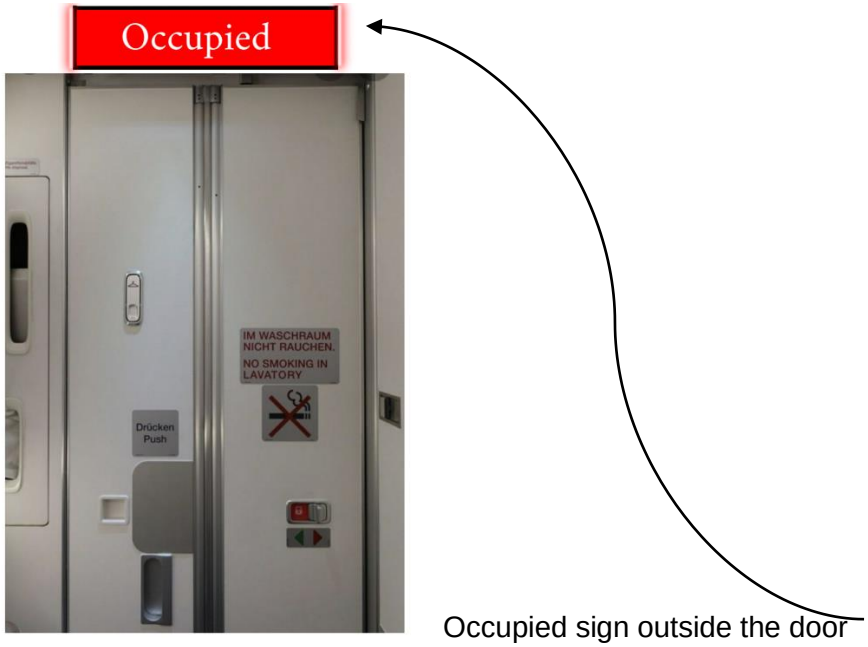
<who would you like to thank?>

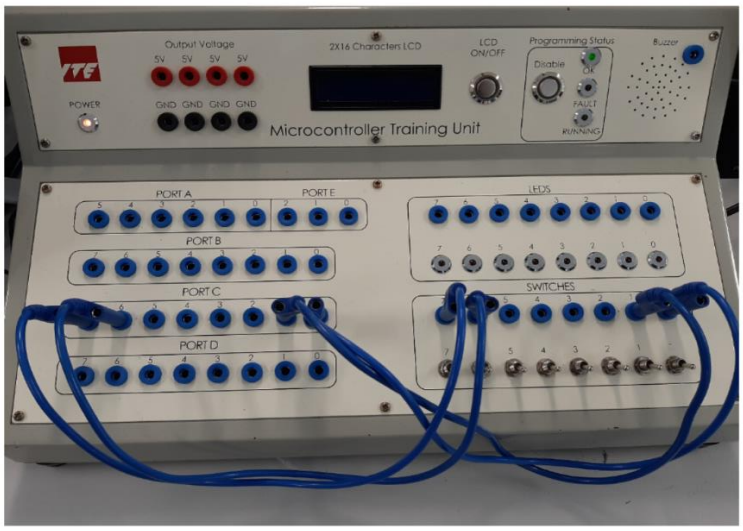
-Firstly, I'd like to thank my father as he helped me realize there was a way to solve the debounce error.
-Secondly, I'd like to thank my friends for supporting when I felt stressed

-Lastly, I'd like to thank the teachers in charge of creating this exciting and informative project.

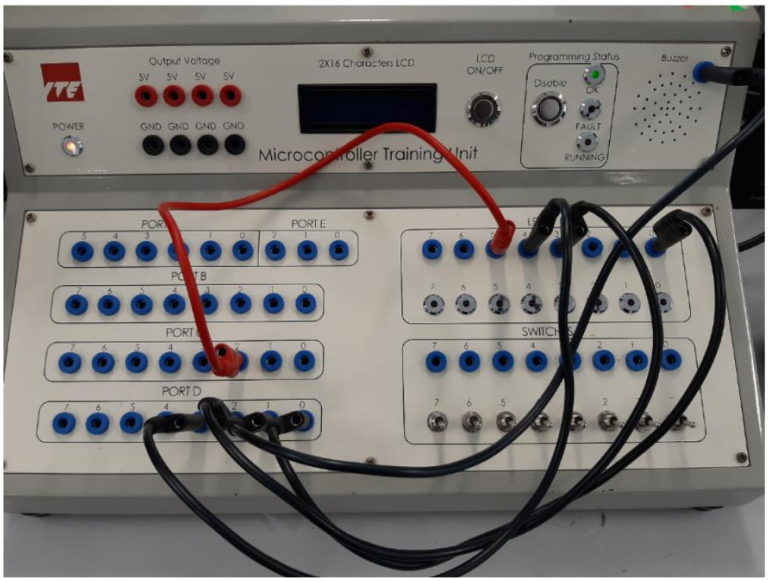
Annex A


Light that switches brightness
Smoke Detector with enabled tamper detection function
Ventilation Fan

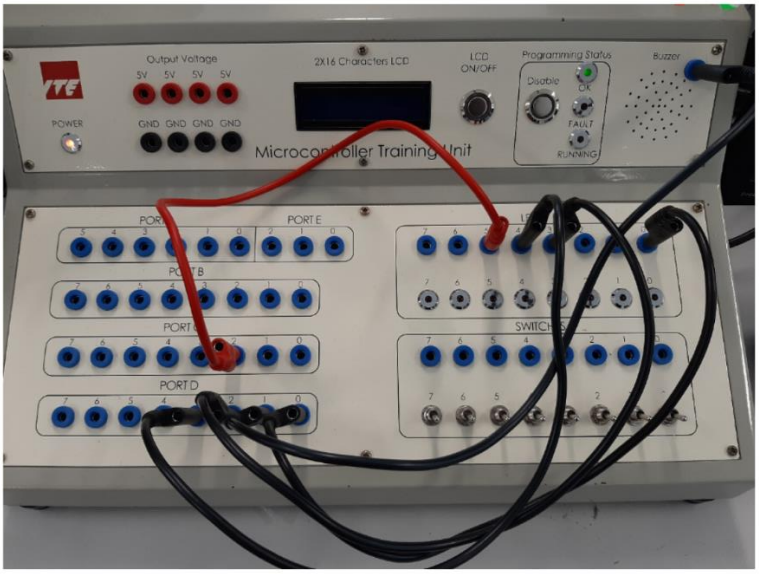

Occupied
IM WASCHRAUM NICHT RAUCHEN.
NO SMOKING IN LAVATORY
Drücken
Push
Occupied sign outside the door



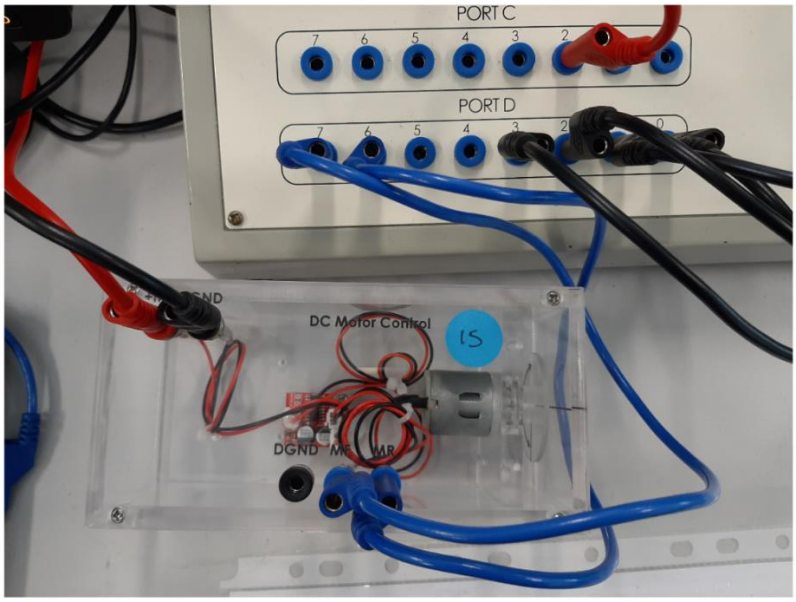
Inputs



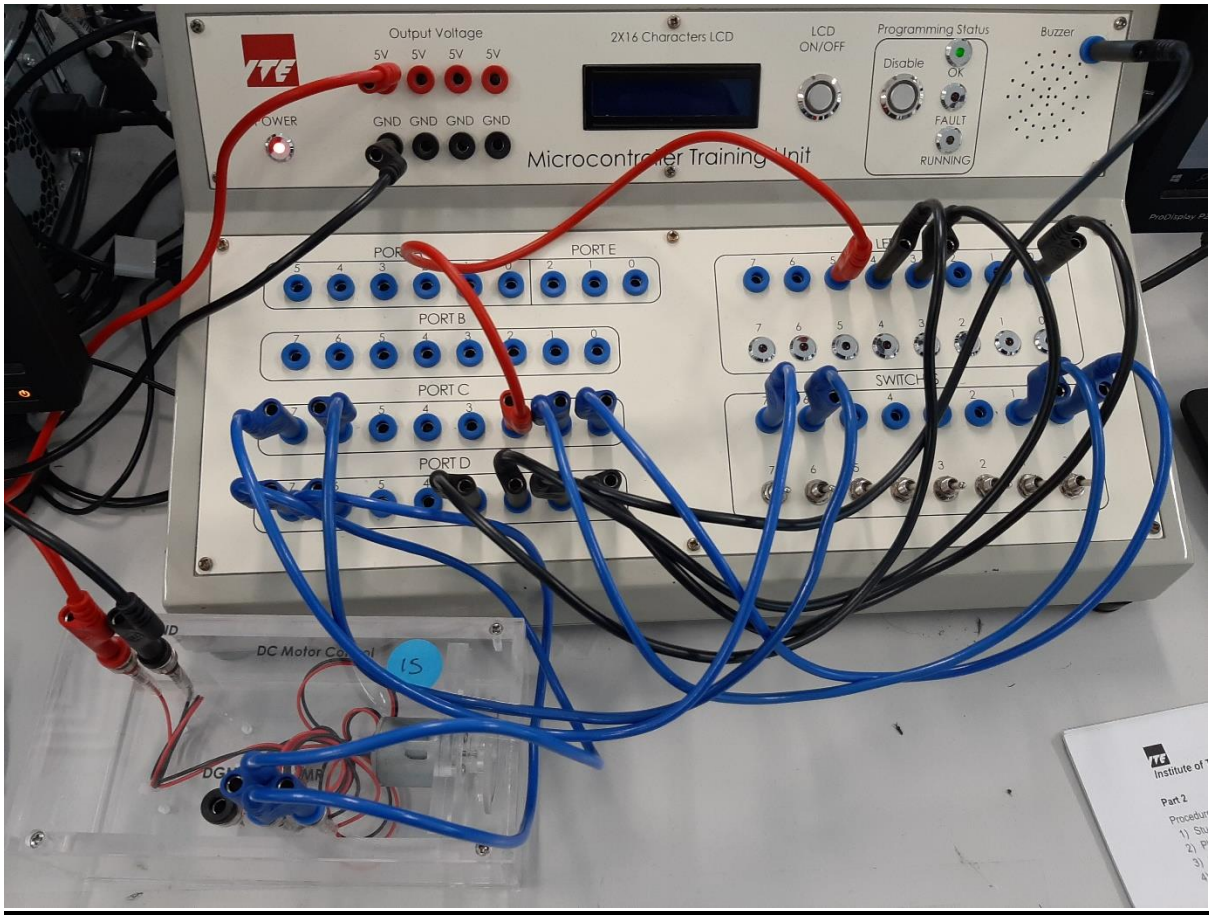
PWM Outputs



PWM Outputs



Motor


Output Voltage
5V 5V 5V 5V
GND GND GND GND
2X16 Characters LCD
LCD ON/OFF
Programming Status
Disable
OK
FAULT
RUNNING
Buzzer
PORT E
PORT B
PORT C
PORT D
SWITCH

The End