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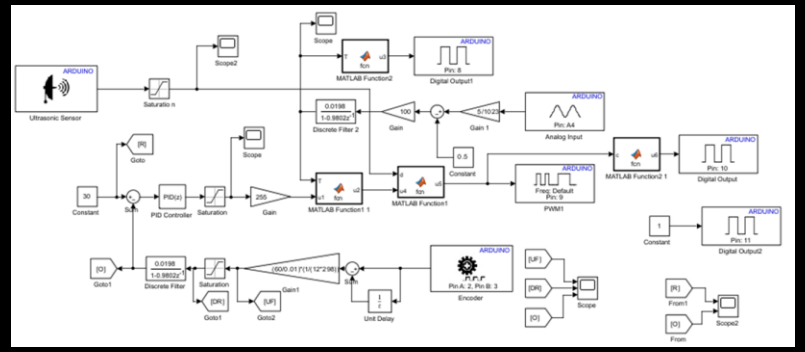
DC Motor Proportional and Integral (PI) and On/Off Speed Control

Key Learning Points

After this Lecture, you will be able to understand the following:

1. Use of the MATLAB function block for applying logic to control systems
2. The use of the MATLAB function block to control the on/off motion of a DC motor due to temperature and obstacles



4.1 Introduction

- On/off control for a DC motor will be designed based on the following:
  i. Temperature control
  ii. Obstacle avoidance
- At this point, you should be well-versed in setting up the control-lab-in-a-box (CLB) for each exercise. Consequently, detailed instructions are not provided here. However, if you need a refresher, please refer to the previous notes.

Control-Lab-in-a-Box (CLB): DC Motor PI Speed Control and Temperature Control

YouTube

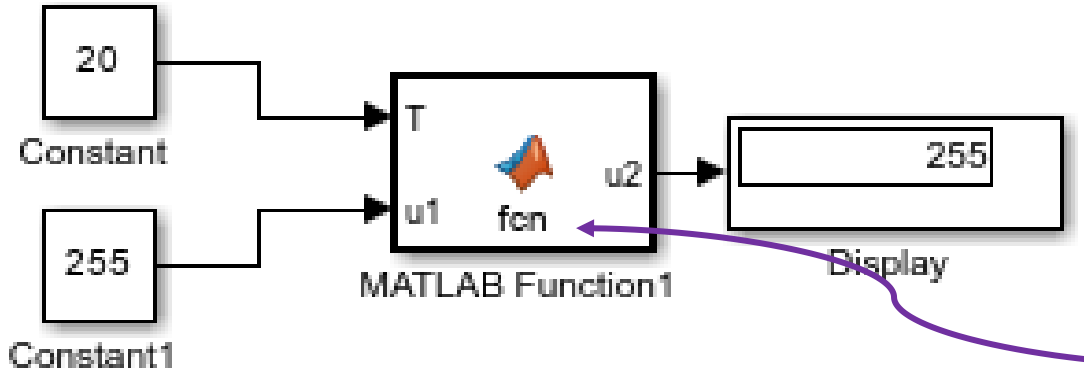
Control-Lab-in-a-Box (CLB): DC Motor PI Speed Control with Obstacle Avoidance

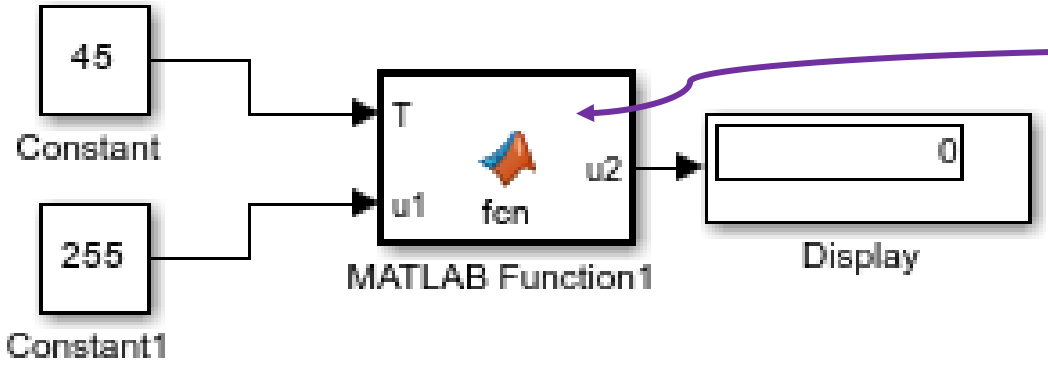
YouTube

4.2 DC Motor Wheel Control (On/Off) due to Temperature

- The MATLAB Function block is used to define the following:
  i. DC motor on when temperature measurement is below 40 degrees Celsius
  ii. DC motor off when temperature measurement is equal or above 40 degrees Celsius

Test the below before implementing this (detailed on the next slide).

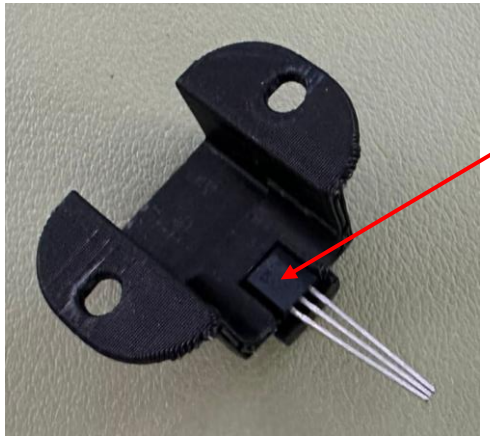





```
function u2 = fcn(T, u1)

if T >= 40;
u2 = 0;
else
T < 40;
u2 = u1;

end
```

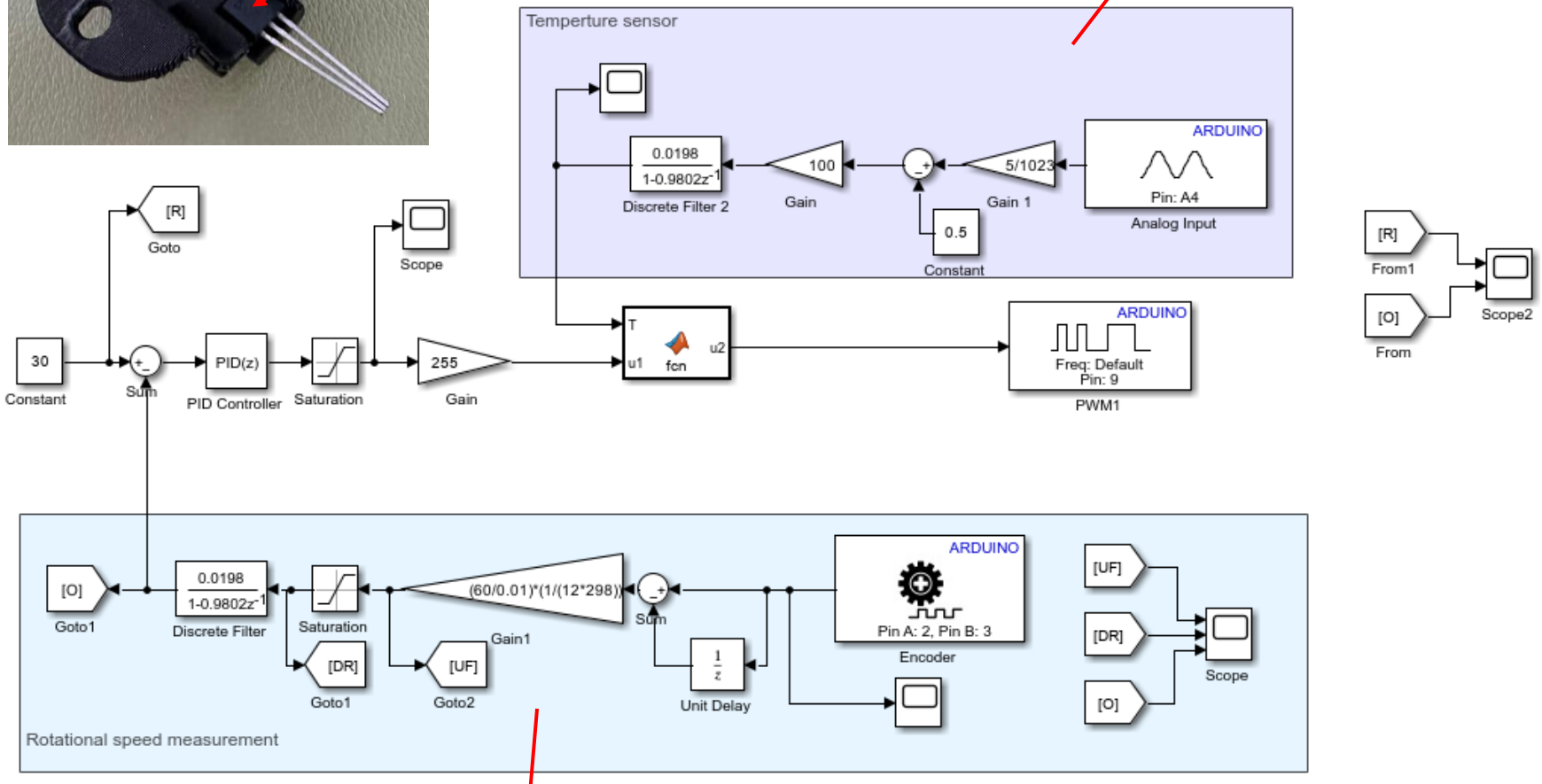
4.2 DC Motor Wheel Control (On/Off) due to Temperature

- Simulink diagram is given for the operation of the DC motor wheel control (on/off) due to the ranges in temperature detailed on the previous slide



'Curved' side of the temperature sensor 'sits' within the DC motor bracket

Developed in CLB 3.1

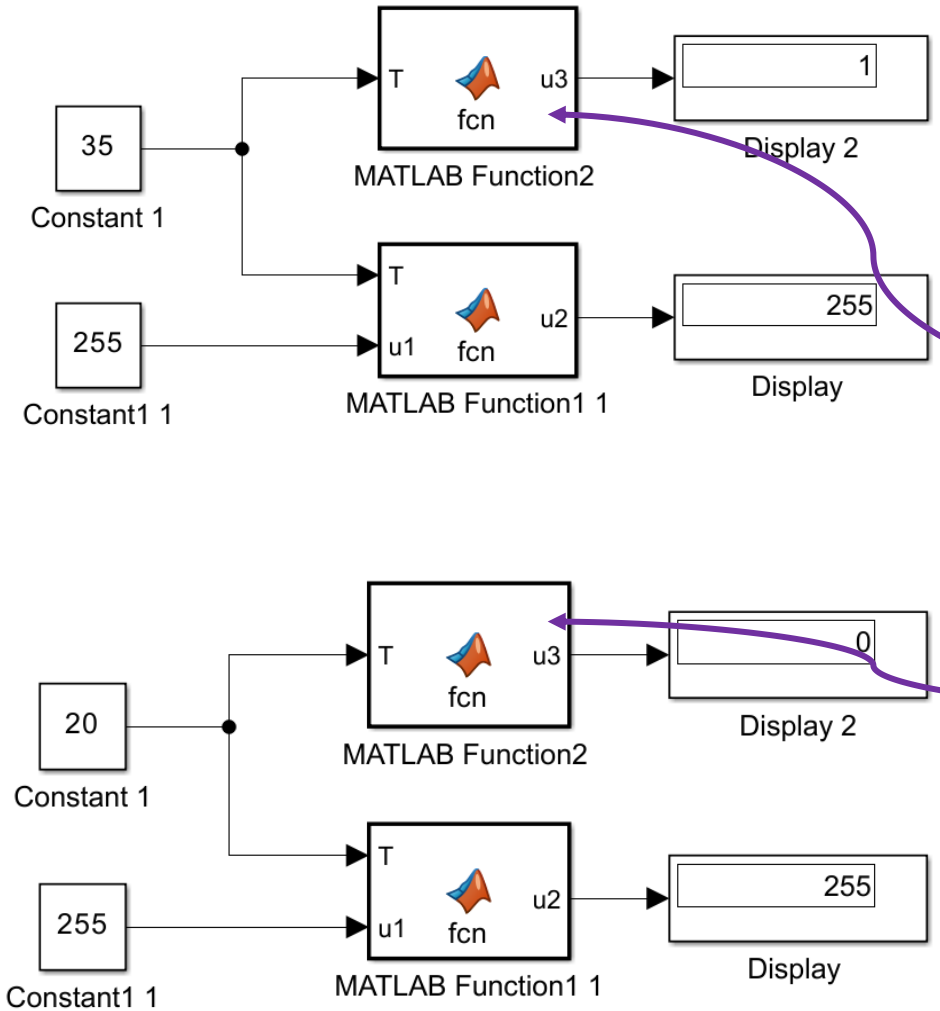


Developed in CLB 3.3 and CLB 4.3

4.3 DC Motor Fan Control (On/Off) due to Temperature

- The MATLAB Function block is used to define the following:
  i. DC motor fan is on when temperature measurement is above or equal to 25 degrees Celsius
  ii. DC motor fan is off when temperature measurement is below 25 degrees Celsius

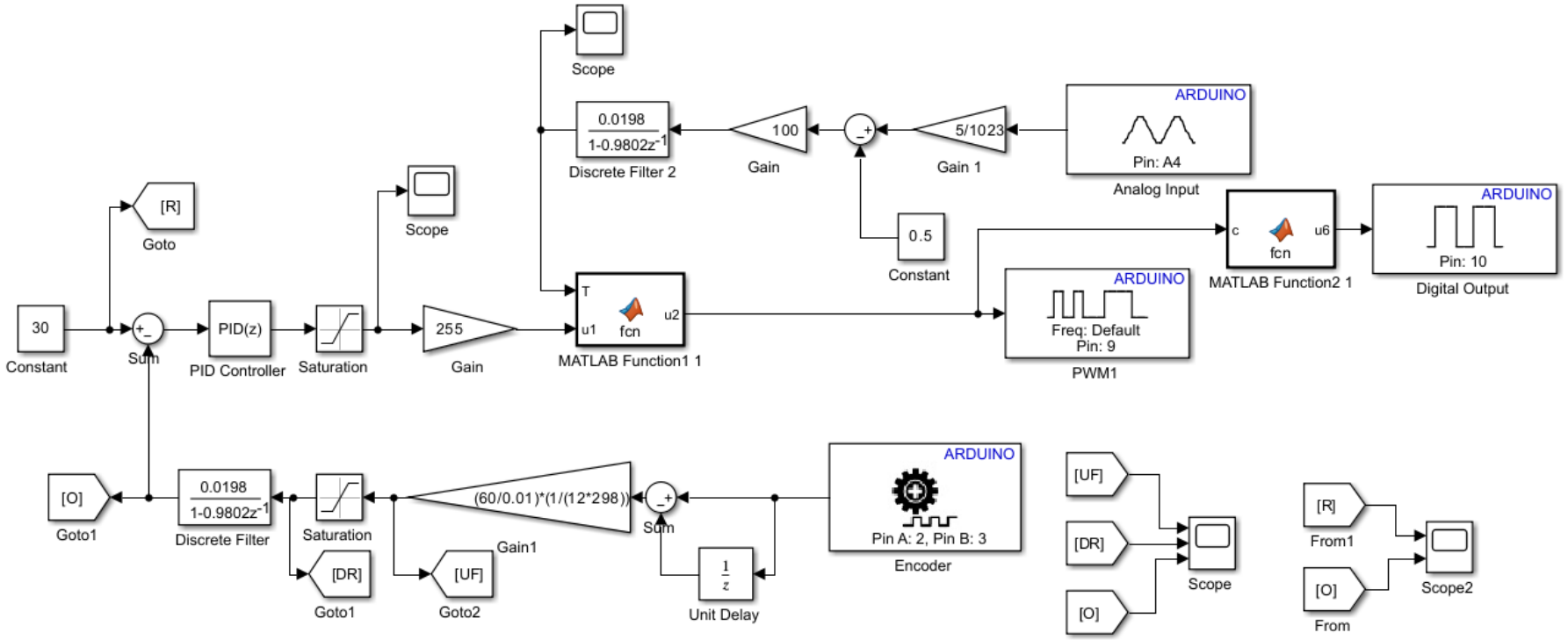
Test the below before implementing this (detailed on the next slide).




```
function u3 = fcn(T)

if T >= 25
u3 = 1;

else
T < 25;
u3 = 0;

end
```

4.3 DC Motor Fan Control (On/Off) due to Temperature

- Simulink diagram is given for the operation of the DC motor wheel control (on/off) and the DC motor with fan due to the ranges in temperature detailed on the previous slide

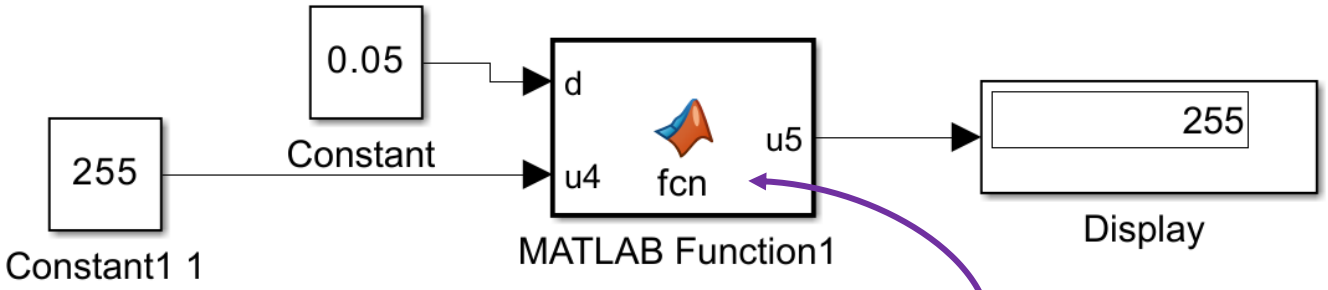


After running the above script, the temperature control will now operate.

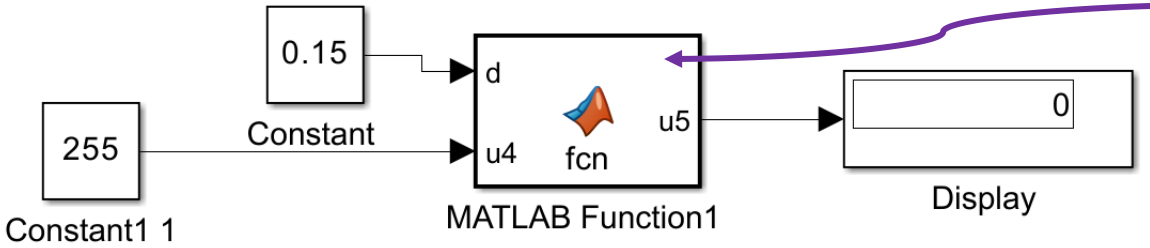
4.4 DC Motor Fan Control (On/Off) due to Obstacle

- The MATLAB Function block is used to define the following:
  i. DC motor on when distance measurement is above or equal to 0.1 meters
  ii. DC motor off when distance measurement is below 0.1 meters

Test the below before implementing this (detailed on the next slide).



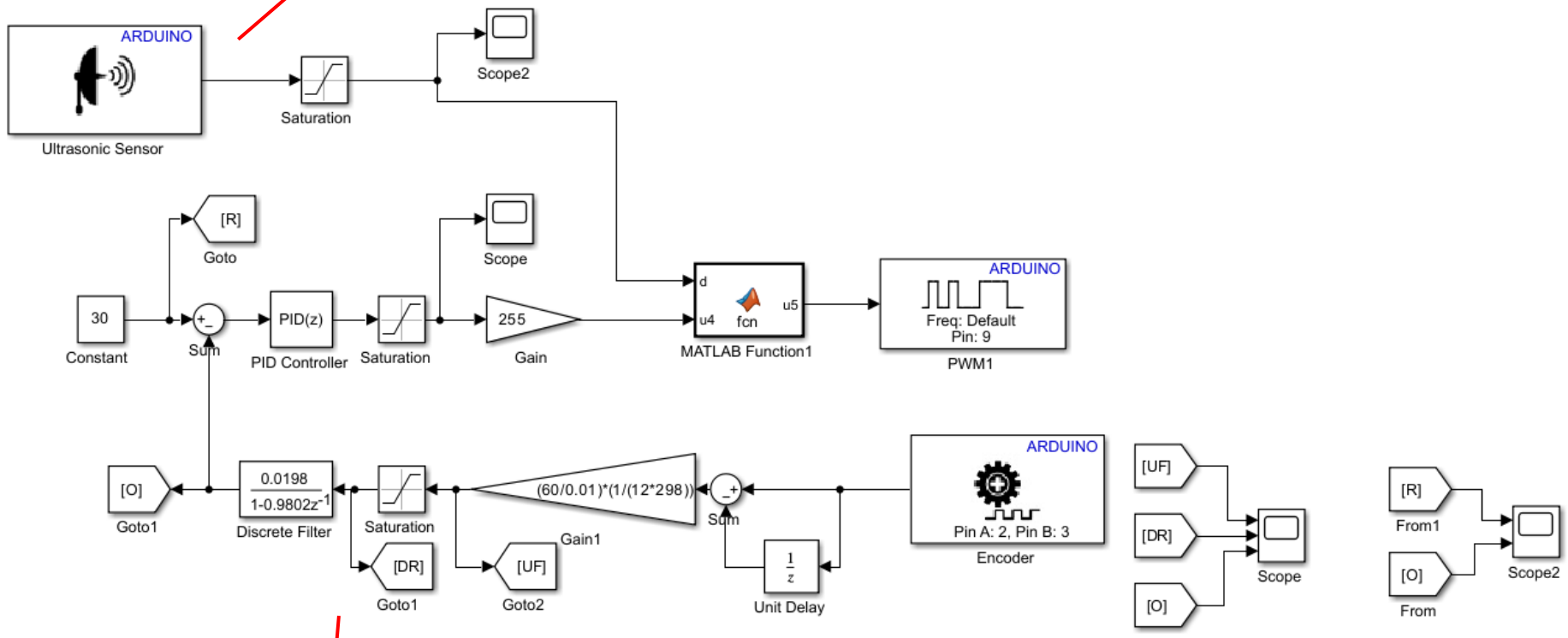

```
function u5 = fcn(d, u4)

if d >= 0.1;
u5 = u4;
else
d < 0.1;
u5 = 0;

end
```



4.4 DC Motor Fan Control (On/Off) due to Obstacle

- Simulink diagram is given for the operation of the DC motor wheel control (on/off) and the due to the ranges in distance measurements detailed on the previous slide

Developed in CLB 3.2



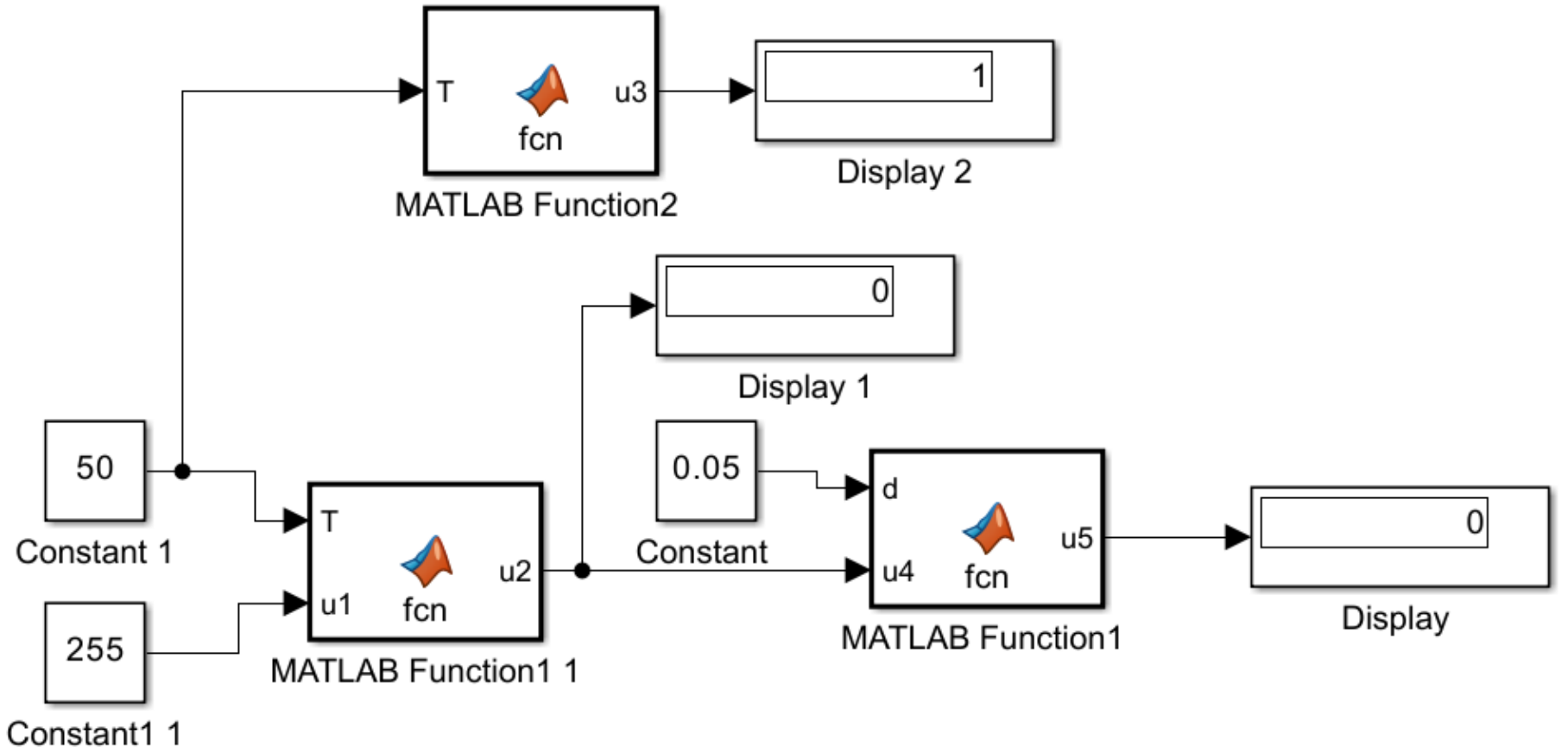
Developed in CLB 3.3 and CLB 4.3

After running the above script, the obstacle avoidance will now operat.

4.5 DC Motor Fan Control (On/Off) due to Obstacle and Temperature

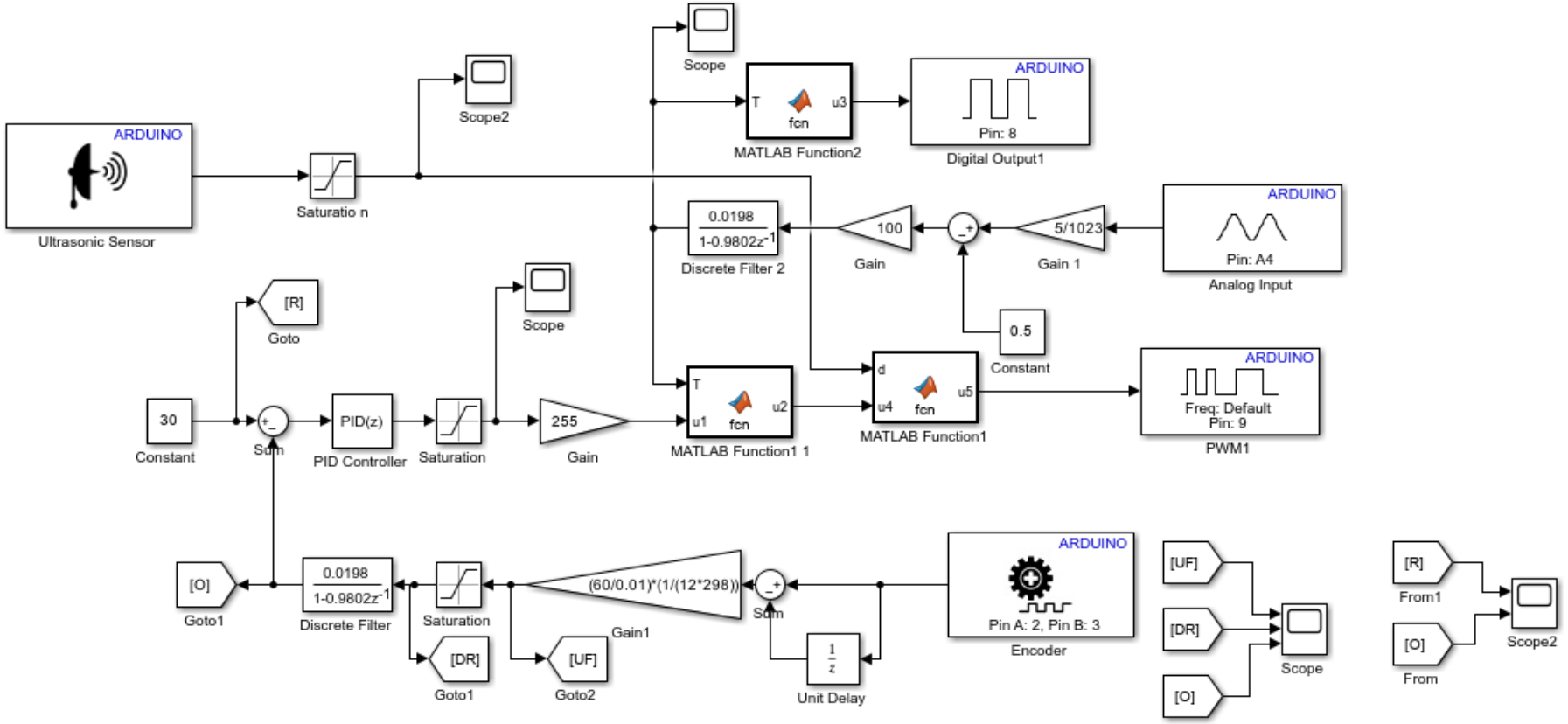
- All three of the MATLAB Function blocks are combined here

Test the below before implementing this (detailed on the next slide).



4.5 DC Motor Fan Control (On/Off) due to Obstacle and Temperature

- Simulink diagram is given for the operation of the DC motor wheel control (on/off) and DC motor fan (on/off) due to the ranges in distance measurements and temperature measurements detailed on the previous slide

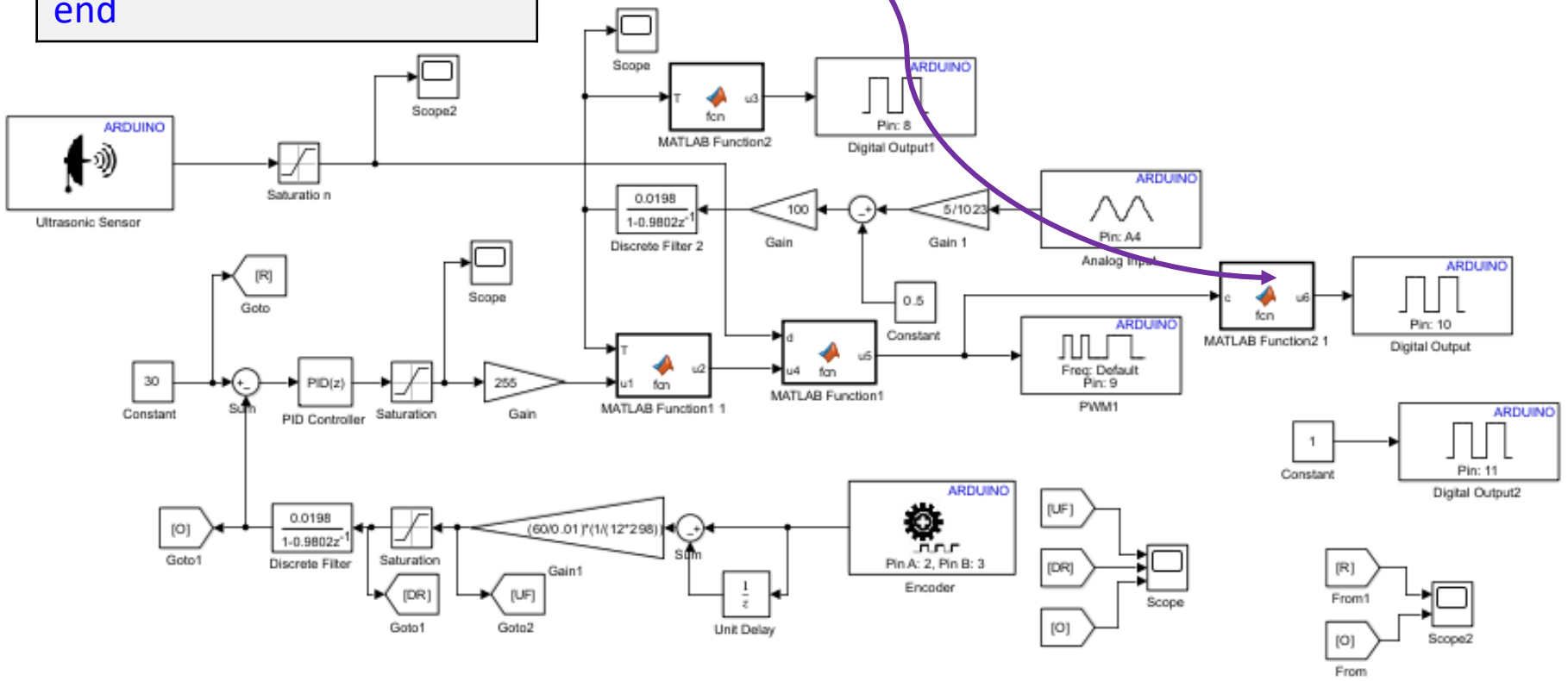


After running the above script, the temperature control and obstacle avoidance will now operate.

4.6 LED Lights

- LED lights are added with the following function:
  i. Red (or blue) on when conditions are 'broken', i.e., obstacle within 0.1 meters and temperature above 40 degrees Celsius

```
function u6 = fcn(c)
if c == 0;
u6 = 1;
else
c > 0;
u6 = 0;

end
```



After running the above script, the temperature control and obstacle avoidance will now operate with the LED lights.

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DC Motor Proportional and Integral (PI) and On/Off Speed Control

4.7 Summary

1. Details of the MATLAB function block for applying logic to control systems have been given
2. The use of the MATLAB function block to control the on/off motion of a DC motor due to temperature and obstacles have been detailed