UP Competitive Robotics Club

Workshop 2: Intro to Competitive Robotics

Slides by:
Pio Mendoza and Alfred Abanto

UP CRC

ABOUT US

UP CRC

Pursue competitive robotics

Introducing and popularizing competitive robotics to universities and schools in the Philippines

Host robotics tournaments

Pushing for people to get creative and be better at robotics

Develop robotics-based solutions

Helping communities and localities through robotics research

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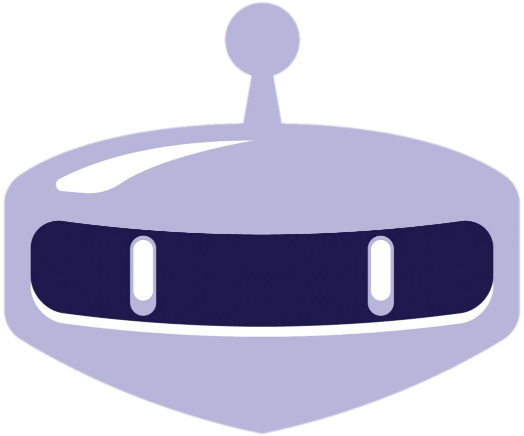
Speaker



Alfred Jason Abanto

- UP CRC Chief Executive Officer
- Synergy: Revolutionary Robotics 2019 – Head
- Synergy: Revolutionary Robotics 2018 – Head
- Revolutionary Robotics workshop speaker 2019
- Revolutionary Robotics workshop speaker 2018
- Dagitab 2019: Day 4 – Guest speaker
- Smartfox Data solutions Inc. - Developer

ABOUT US

Round table discussion ft.

Ian Palabasan
Chief of Tournament Operations

Uyayi Rigoroso
Chief Finance

Marion Uy
Research and Development member

First UP team to compete in Revolutionary Robotics. They are founding members and have extensive exposure to competitive robotics before UP CRC.

Questions

Go to menti.com and type in the code 4016 8090

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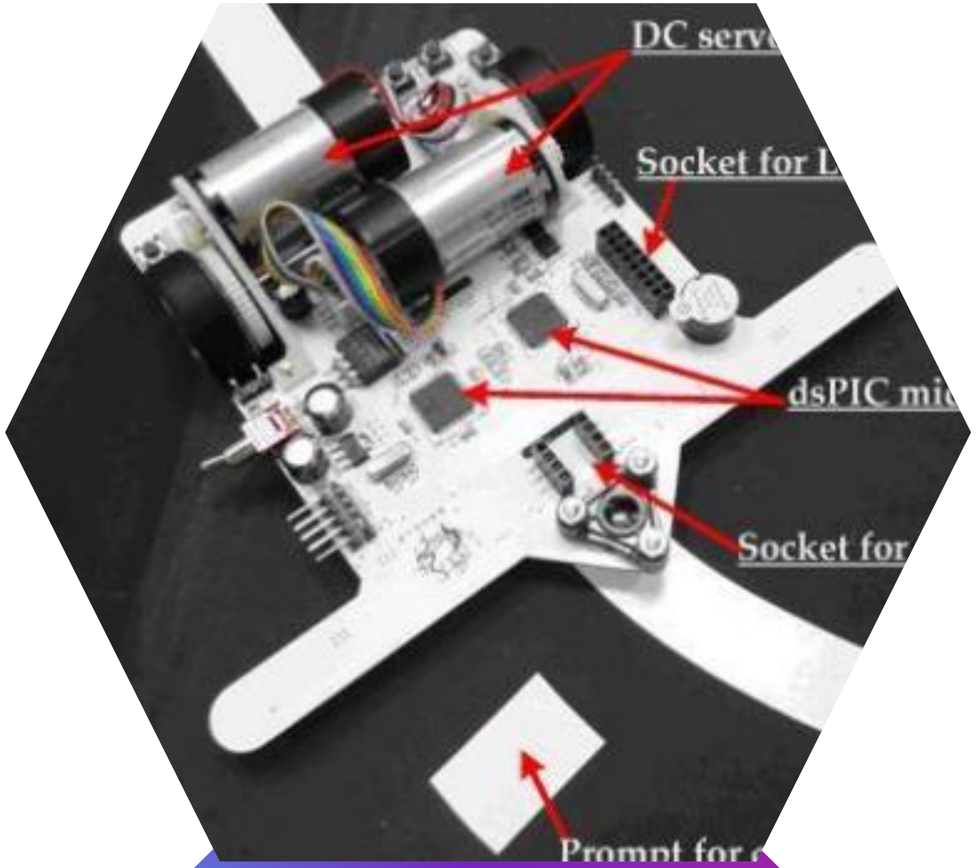
Building a maze solving robot

Microcontroller

- Small footprint
- Convenient to use

Geared Motors

- Low current draw
- High torque



Sensors

- Easy to source
- Low-cost

Drivers and power circuits

- Low-cost
- Easy to source

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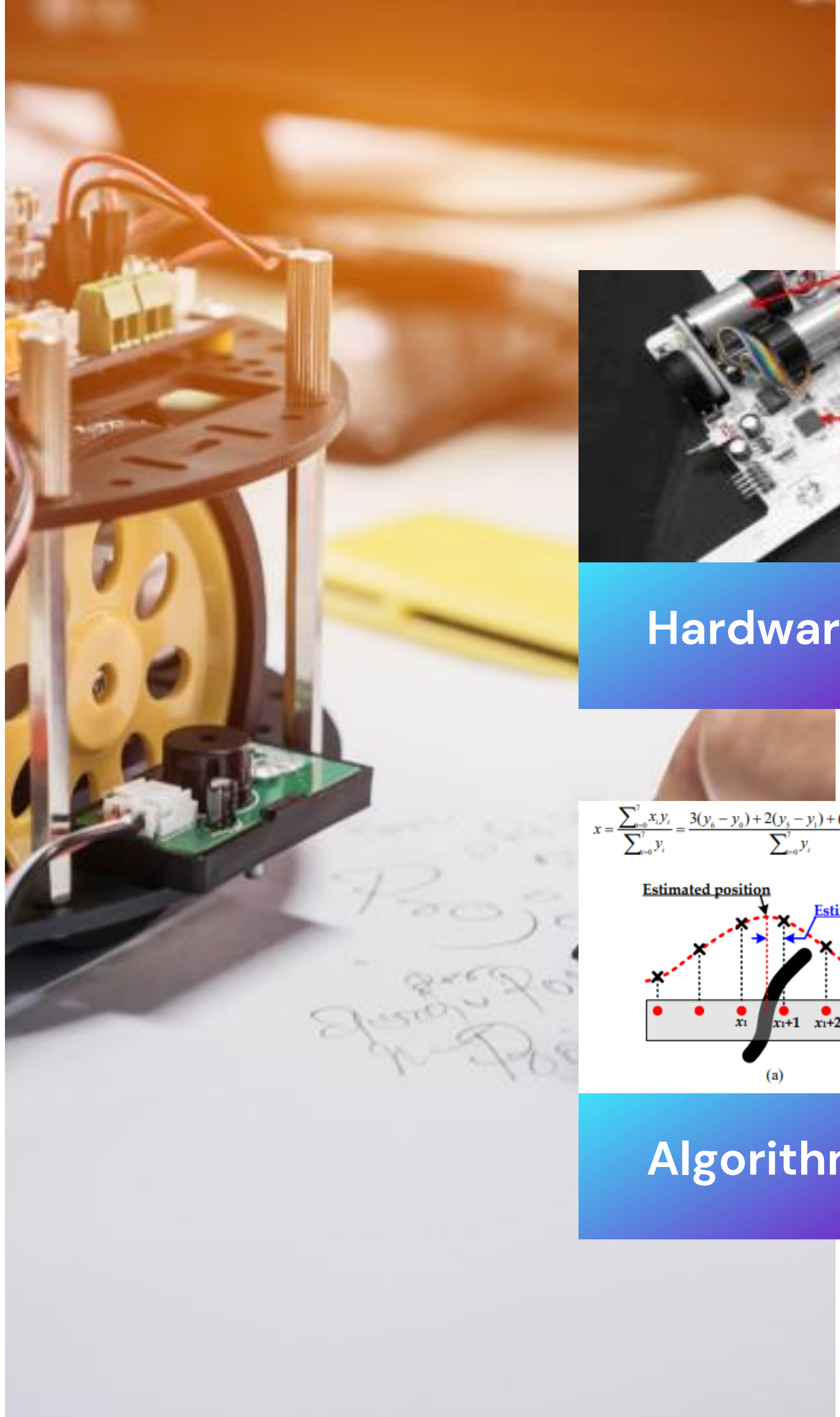
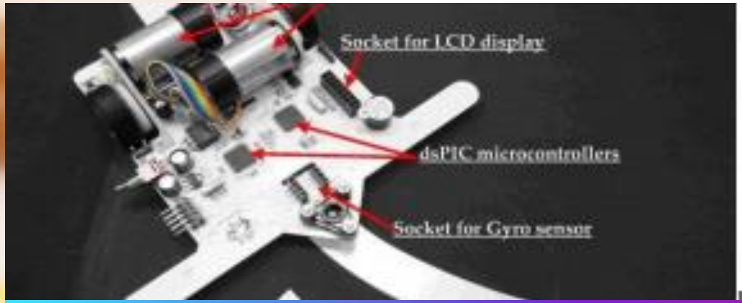
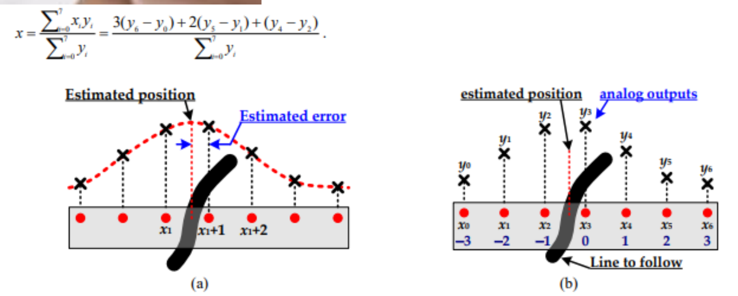
A good start – research

- **An intelligent line-following robot project for introductory robot courses by:** Juing-Huei Su, Chyi-Shyong Lee, Hsin-Hsiung Huang, Sheng-Hsiung Chuang & Chih-Yuan Lin Lunghwa University of Science and Technology Taoyuan County, Taiwan





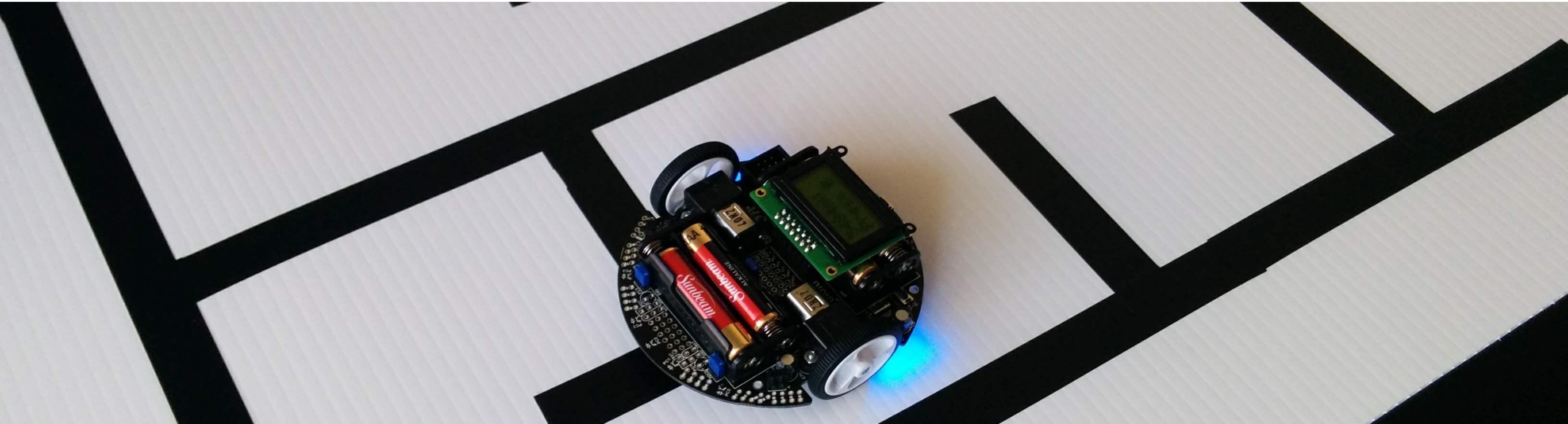
Hardware Description



Algorithms and Maths

Why line maze solving?

The line maze solver robot will help you develop skills in a well rounded way. From teaching you control systems to using interrupts and shortest path algorithms. We use a line maze instead of a walled maze since we want the competition to be accessible and easy to conduct. The line maze solving competition is also a popular competition in other countries such as Japan and India so the scene is still quite large



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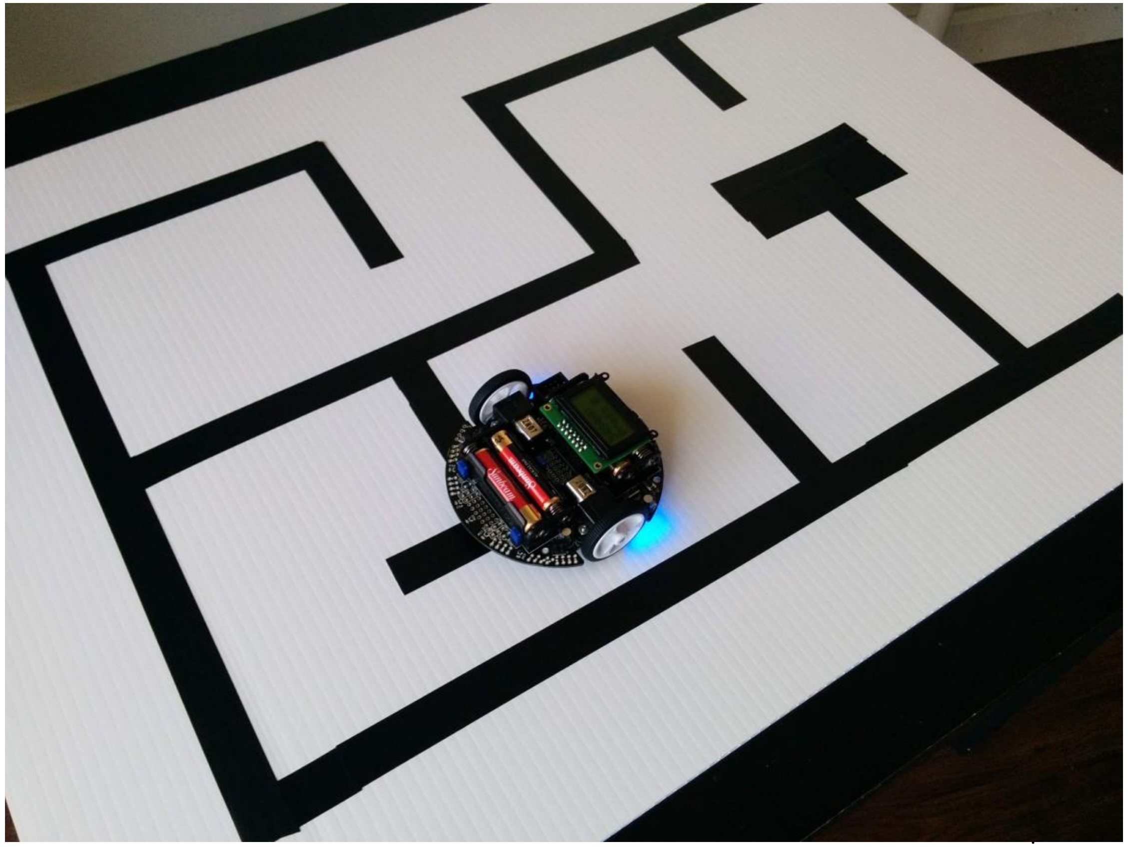
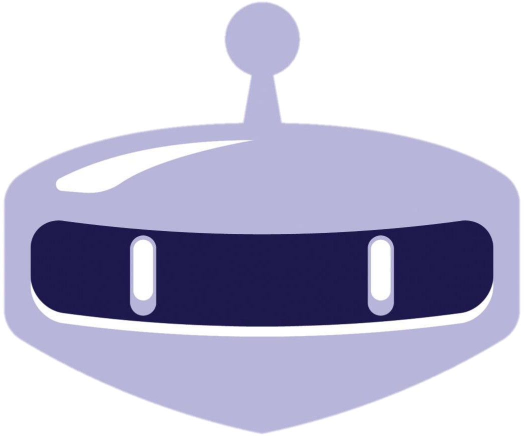


Some info about the task at hand

Sensors



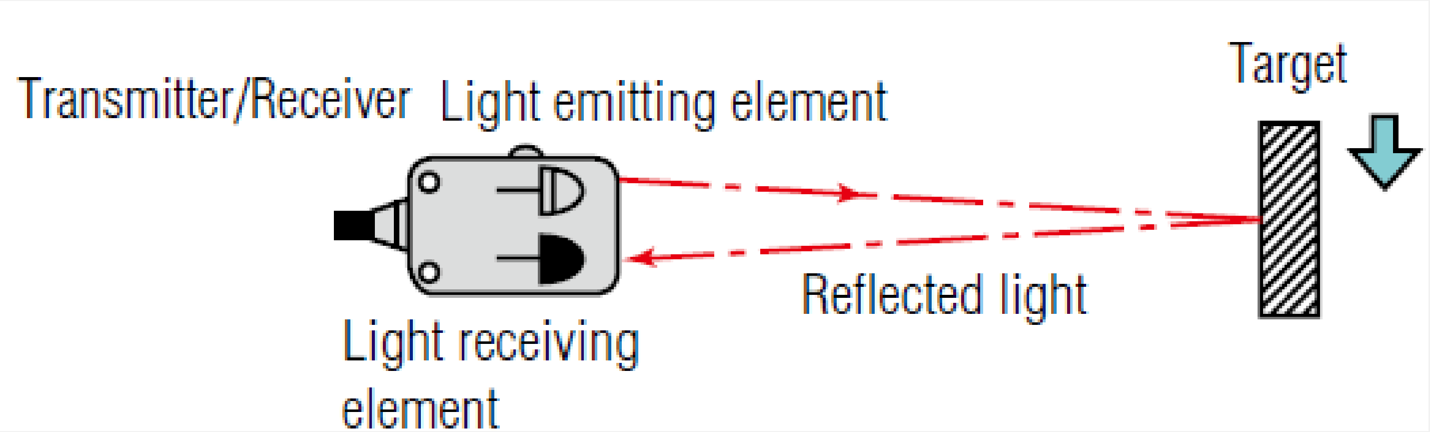
Used in many application in industry

From proximity sensing to rotary encoding and to color recognition, the humble optical sensor is used everywhere and so learning to use it is a good investment of your time.

Simple to use and understand

The physics of this sensor will not hinder you from using it with minimal circuitry. A simple voltage divider circuit is enough to be able to get data out of them

Sensors-Reflective



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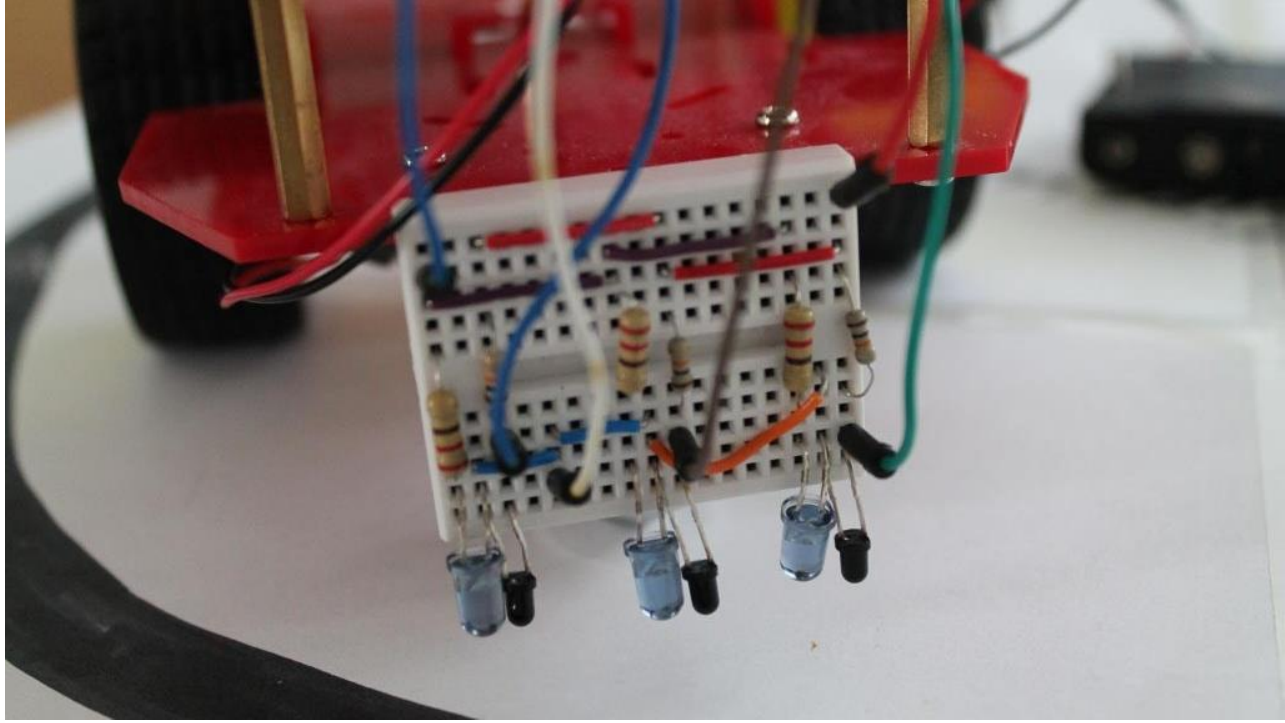
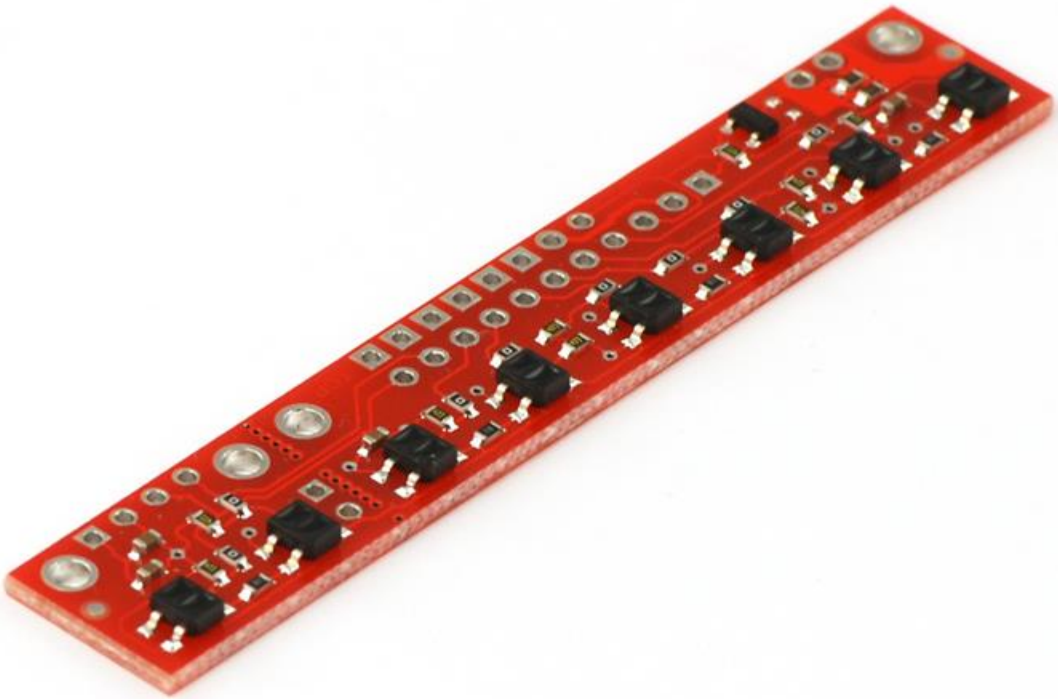
Modules vs DIY

And why it matters to you





Line sensor modules are usually expensive since they have other components such as resistors costs labor to assemble. This is why **DIY** sensor arrays are encouraged. This also give you freedom on how to shape your robot.

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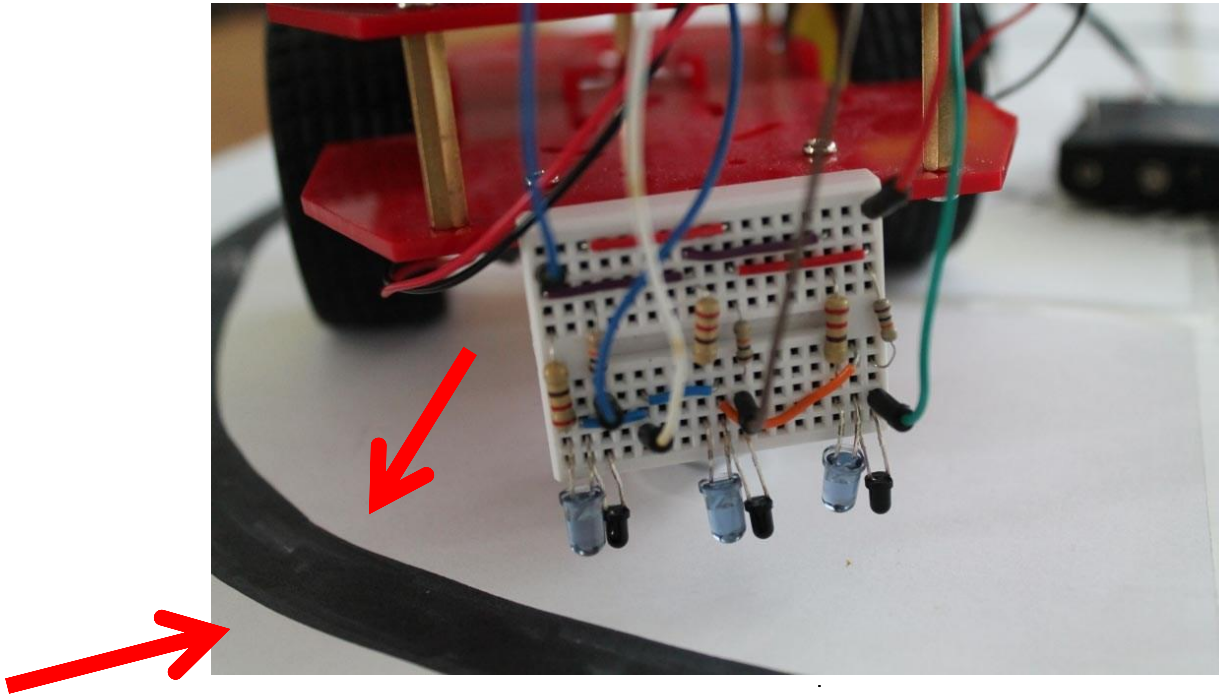
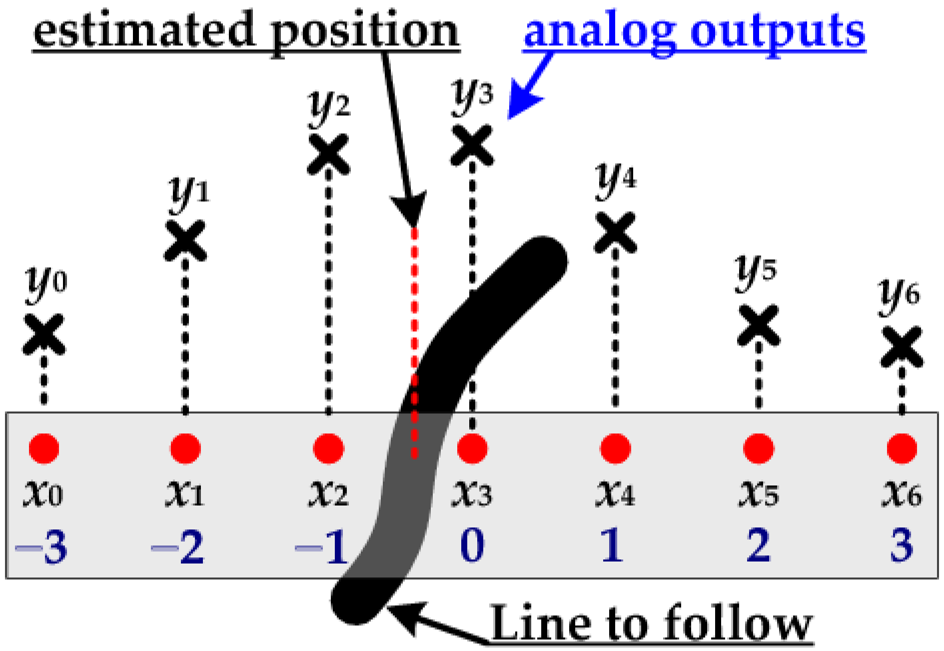
Light sensors cool.

How many sensors do I need?





Depending on how thicc the line is and your control system

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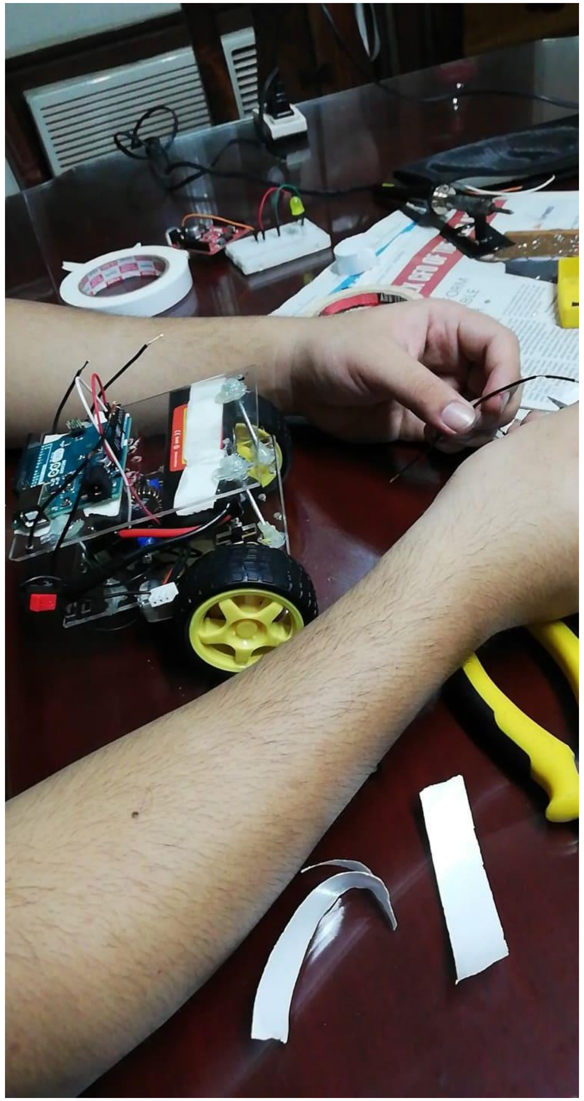

Before shopping for your module.

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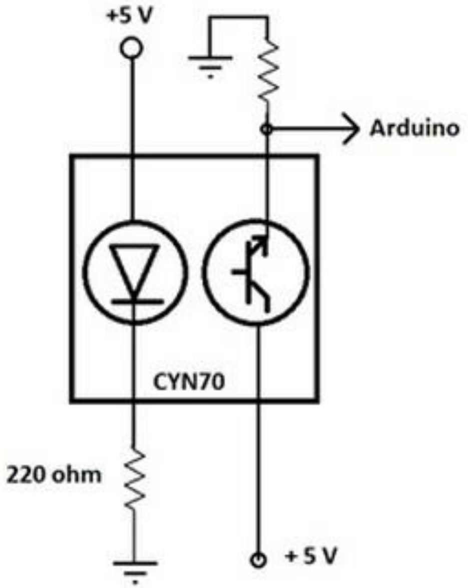
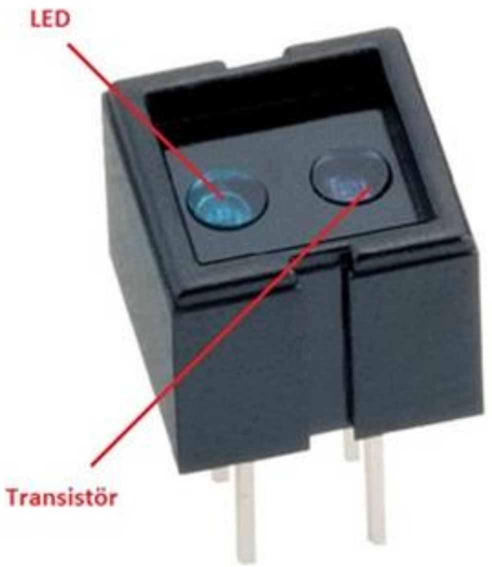
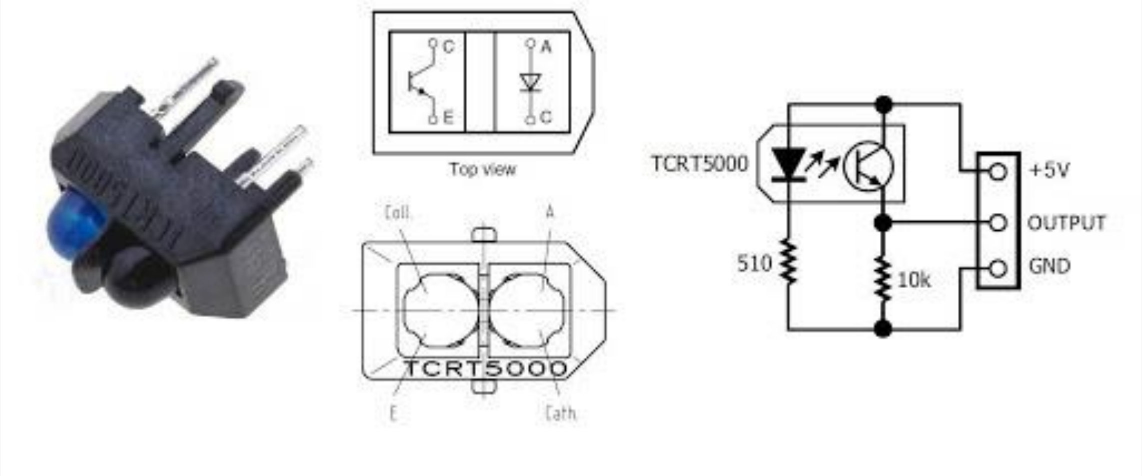
CNY70 and TCRT5000

Old reliable







CNY70 and the **TCRT5000** are optical transistors and are most easily used in a voltage divider configuration since it they only require 2 additional resistors.

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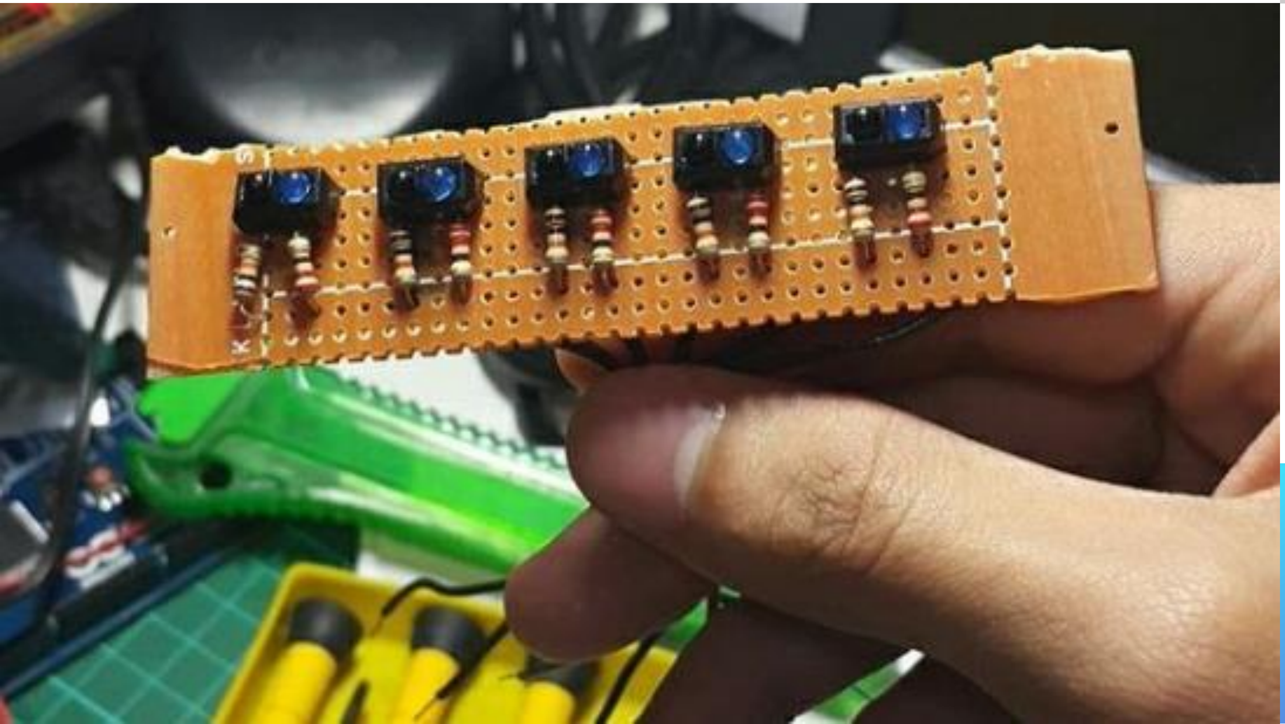
DIY works well but..

Black magic

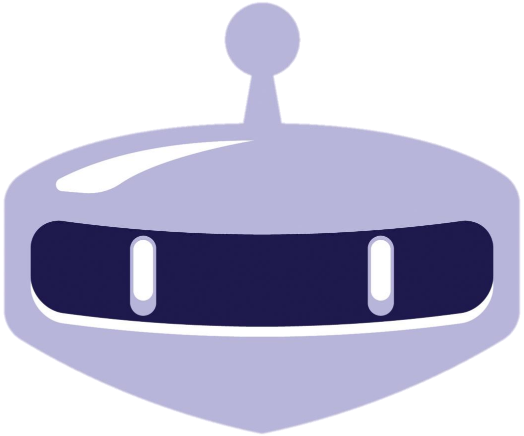


One of the limitations of using a DIY sensor module, which uses **voltage dividers,** is that **you're limited by the number of analog pins you can perform analogRead() on.**

Analog voltage gud

What do you with the data?

Control Systems (peek)



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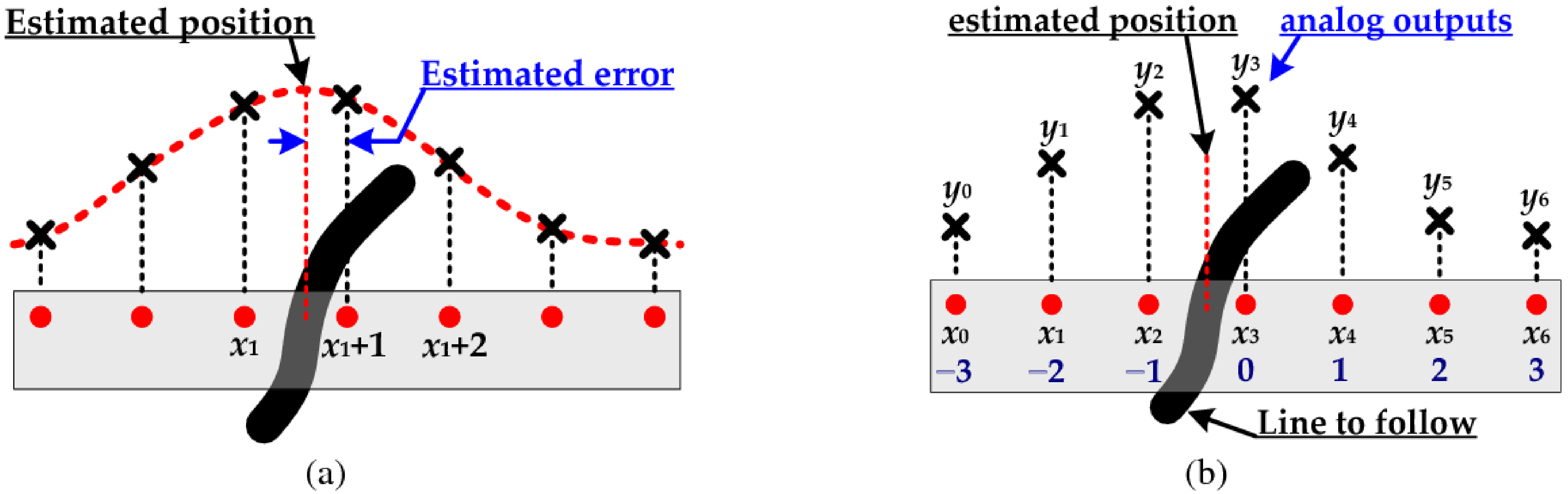
$$x = \frac{\sum_{i=0}^{7} x_i y_i}{\sum_{i=0}^{7} y_i} = \frac{3(y_6 - y_0) + 2(y_5 - y_1) + (y_4 - y_2)}{\sum_{i=0}^{7} y_i}.$$



You find the error

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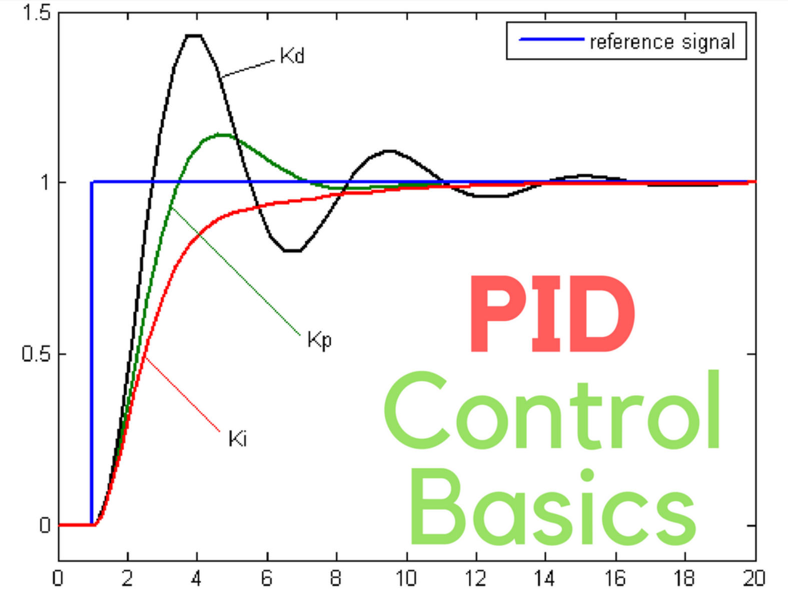
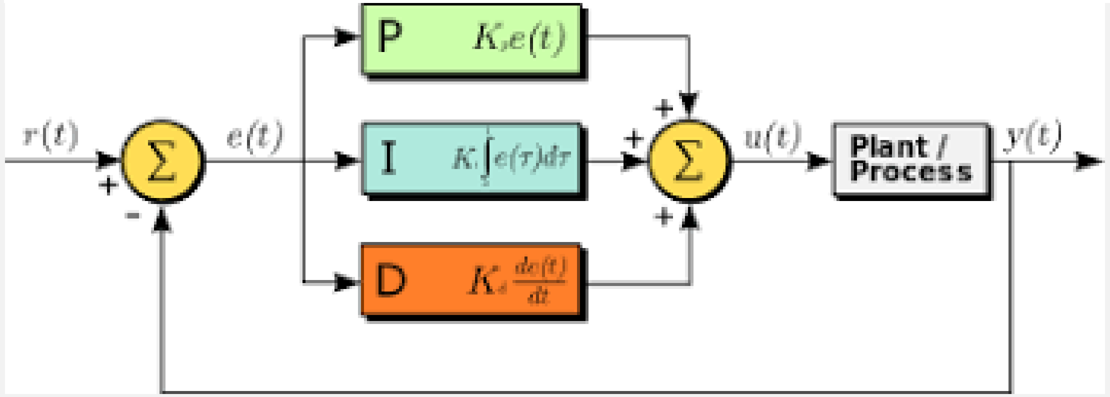
PID to minimize error

Black magic



$$u(t) = K_\mathrm{p} e(t) + K_\mathrm{i} \int_0^t e(t')\,dt' + K_\mathrm{d} \frac{de(t)}{dt},$$



PID is the industry's go to control system. To understand it completely you need to know some calculus and control systems engineering. **HOWEVER, beginners are capable of using it without understanding the math completely. It just takes some patience and quite a bit of trial and error**

Voltage make motor go brr

I’m a beginner, how do I this PID magic?

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Sample Code

Black magic

```
    error = pos-10;
    P = error;
    D = error - old_error;
    I += P;
    old_error = error;

    PID_val = P*Kp + I*Ki + D*Kd;
```

```
void PID_steer(int PID_val) {
  // Calculating the effective motor speed:
  float Lspeed = init_speed + PID_val;
  float Rspeed = init_speed - PID_val;

  // The motor speed should not exceed the max PWM value
  Lspeed = constrain(Lspeed, 0, 100);
  Rspeed = constrain(Rspeed, 0, 100);

  analogWrite(L_speed_pin, Lspeed); //Left Motor Speed
  analogWrite(R_speed_pin, Rspeed); //Right Motor Speed
  //following lines of code are to make the bot move forward

  digitalWrite(L_forward, HIGH);
  digitalWrite(L_backward, LOW);
  digitalWrite(R_forward , HIGH);
  digitalWrite(R_backward, LOW);
}
```

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Voltage make motor go brr

But how EXACTLY do you build and use the sensors?

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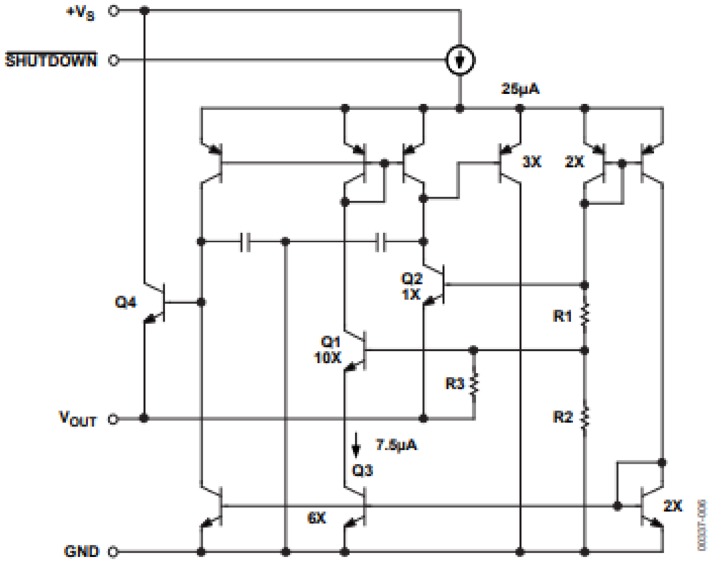
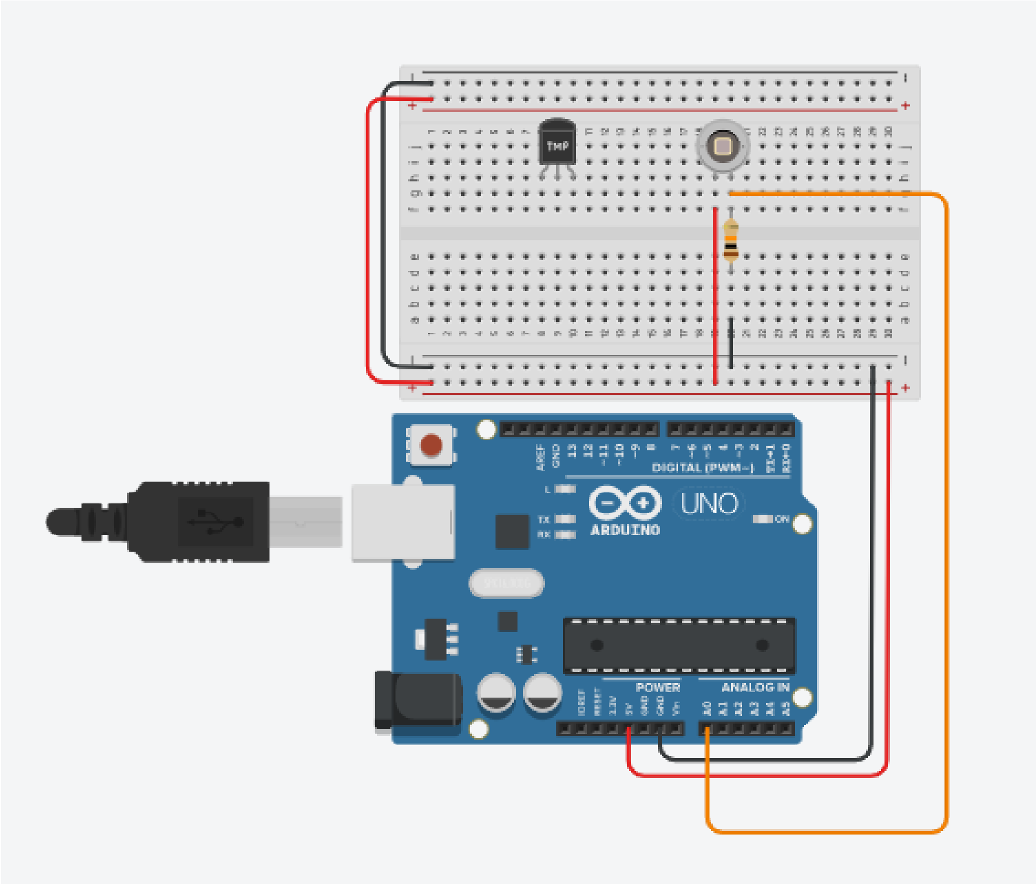


Figure 22. Temperature Sensor Simplified Equivalent Circuit

Table 4. TMP35/TMP36/TMP37 Output Characteristics

Sensor	Offset Voltage (V)	Output Voltage Scaling (mV/°C)	Output Voltage at 25°C (mV)
TMP35	0	10	250
TMP36	0.5	10	750
TMP37	0	20	500



you’ll find out in our hands-on activity

Q&A

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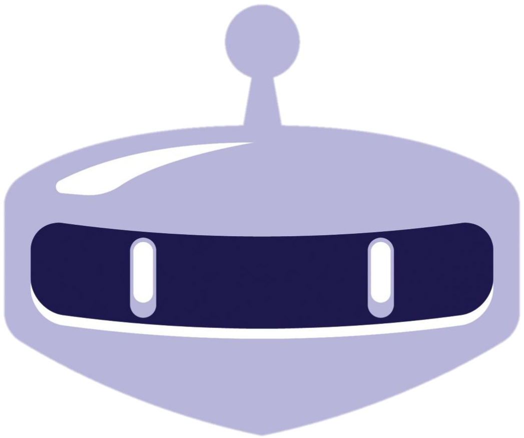
Closing Remarks



Thank You

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