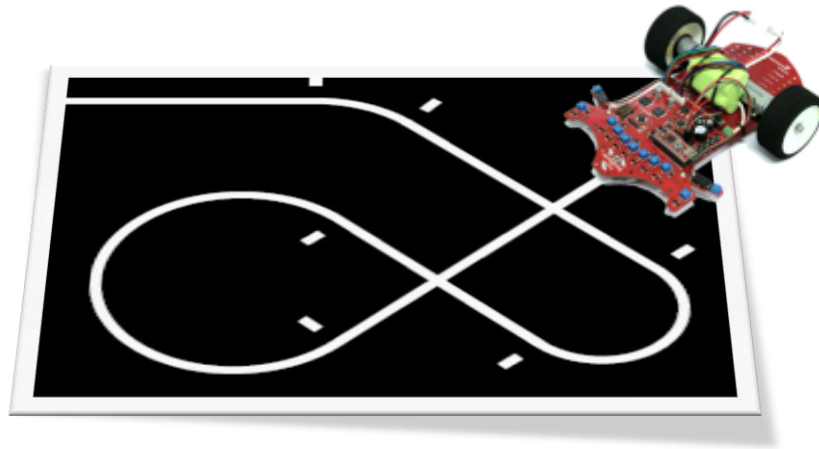


Line Track



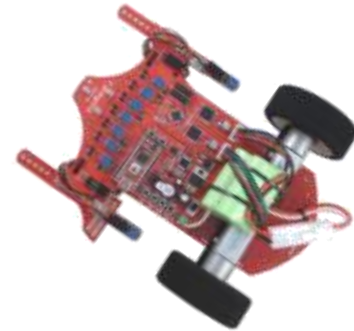
Objective

Use an autonomous race car to complete a line track course. Each race car can try three runs from which the shortest time will be recorded as the best record.




Players can implement their own algorithm and use curve change marks on the course for route memorization to get the best record in the shortest time possible.

Participants

- ❖ School team
- ❖ Individual player
- ❖ Robotic Club teams



Vehicle Requirements

Overall dimension		Height: Less than 8 in, including all electronics Width: less than 10 inches Length: less than 10 inches Weight: no limit
	Wheel Dimension	overall: Less than 4.25" diameter and 2.5" width Axles to axle: less than 14 in 
	Number	Two or four, ball casters is allowed
	Type	Rubber or foam type. The tires cannot be modified to improve traction, (e.g., no studs, nails, sandpaper etc.)
Power		Battery
	Power on/off	For safety, each vehicle must have a single on/off switch and be able to stop when it is off track.
	Motor	DC motor
	Control Method	Autonomous, no remote control is allowed
Processor		Participants can build their own motor control or use the InnoRacer

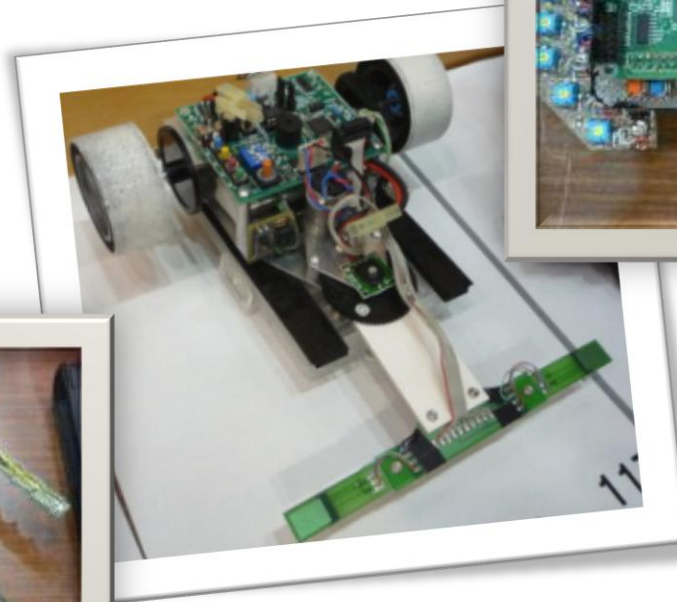
Examples



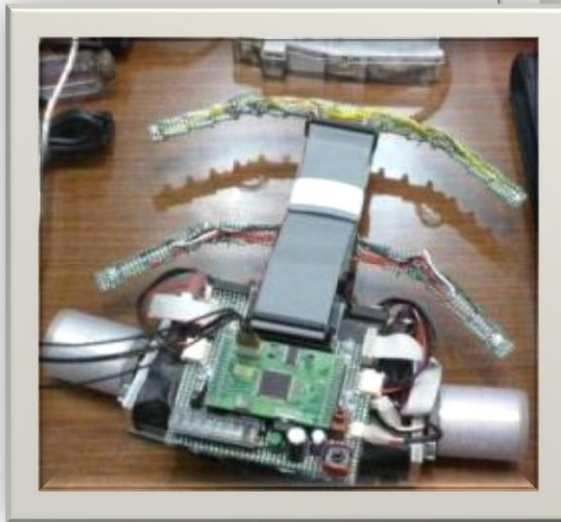
Design your own car.



Overall length might affect the speed.



Choose a good DC Motor.

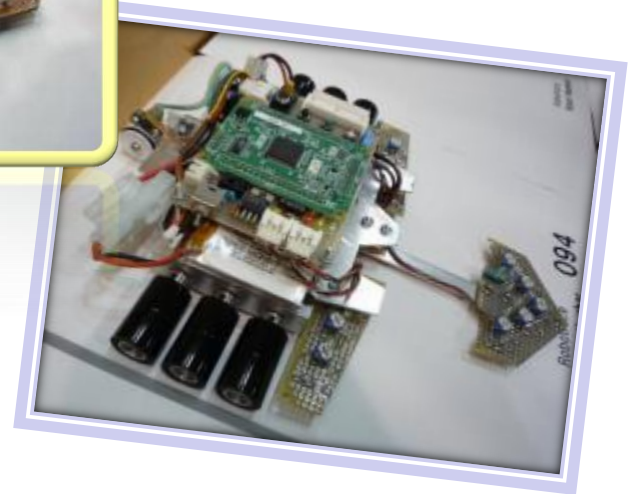
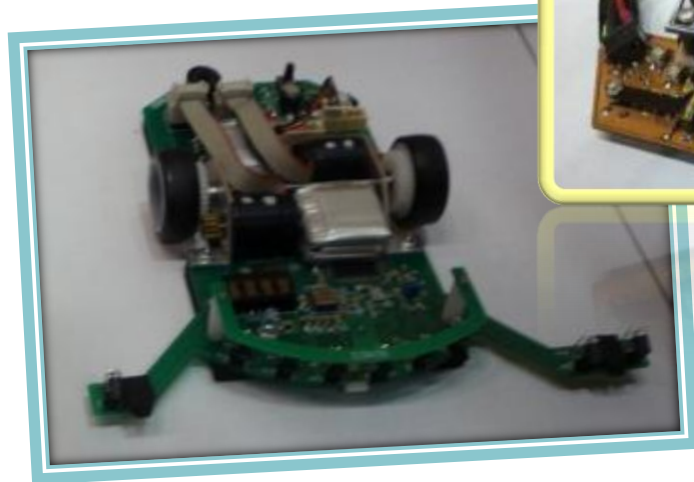
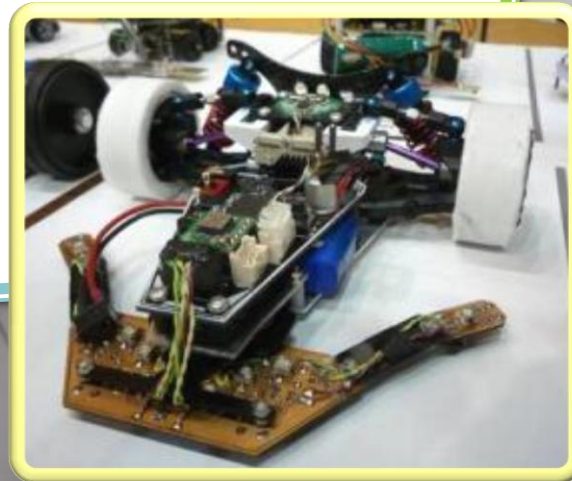
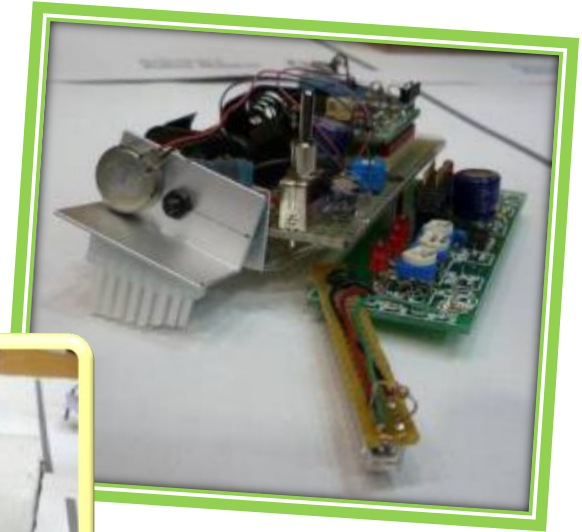


Place the IR sensors wisely.

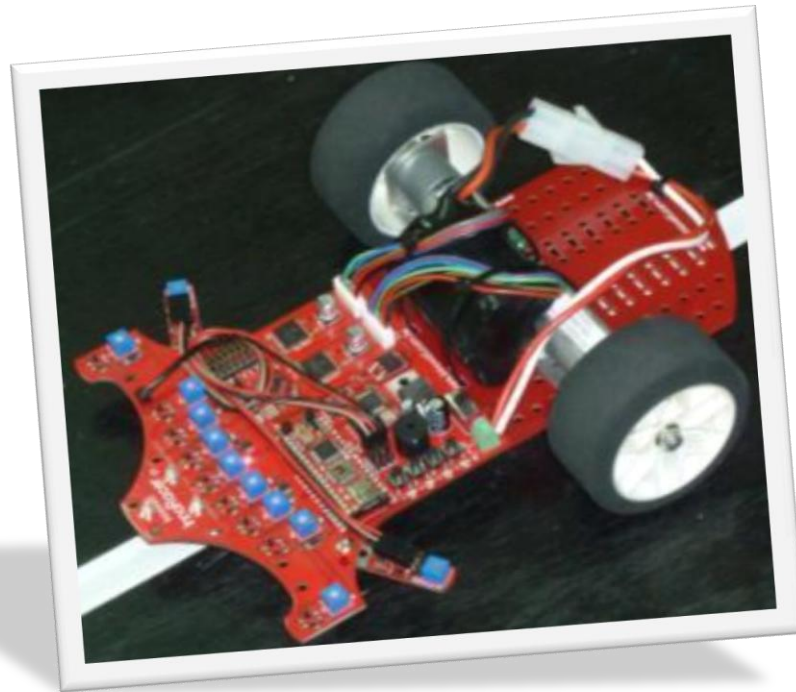
Examples

Less components make the car lighter and run faster.

Use good friction tires.



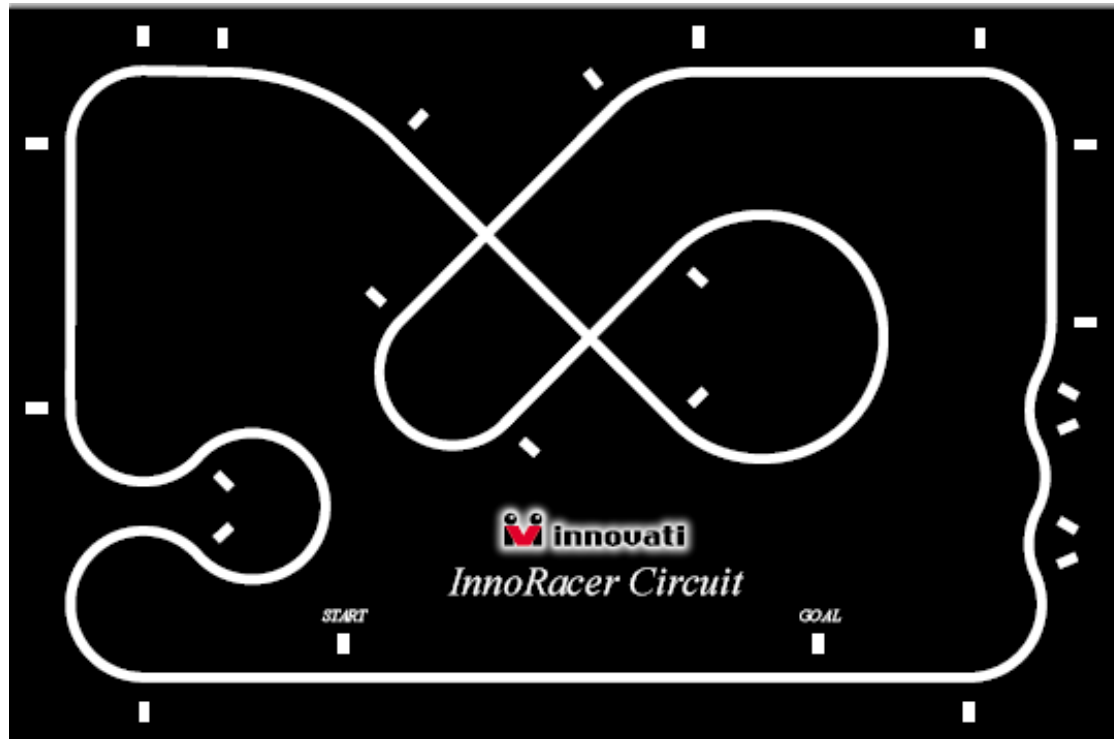
InnoRacer



Ready to run with all parts and
sample codes to help you get started

Practice Track Course

The Practice track course is a pre-printed course on a vinyl surface board marked by 0.75 inch-wide white line on a black background. The dimension of the course is 150 x 230mm. (5.90 x 9.05 inches).



Finding the Start and Goal point

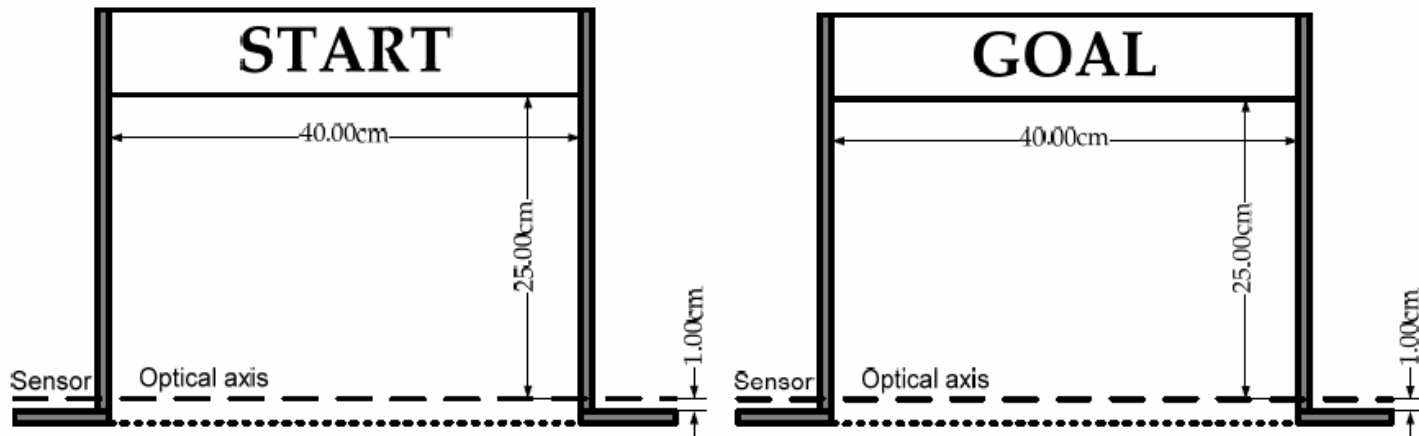
Start and Goal point are indicated by small white mark on the right side of the track.



Use the right side IR sensor to check the Start and Goal point and store the information in memory.

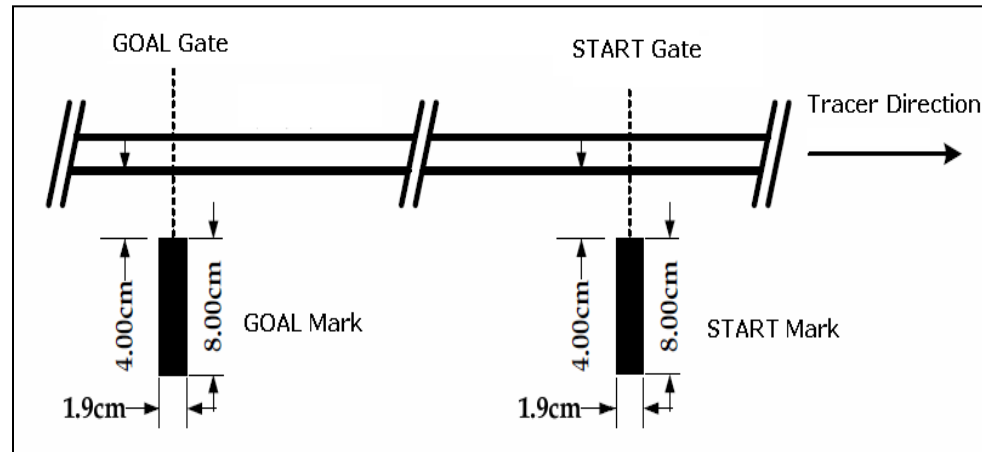
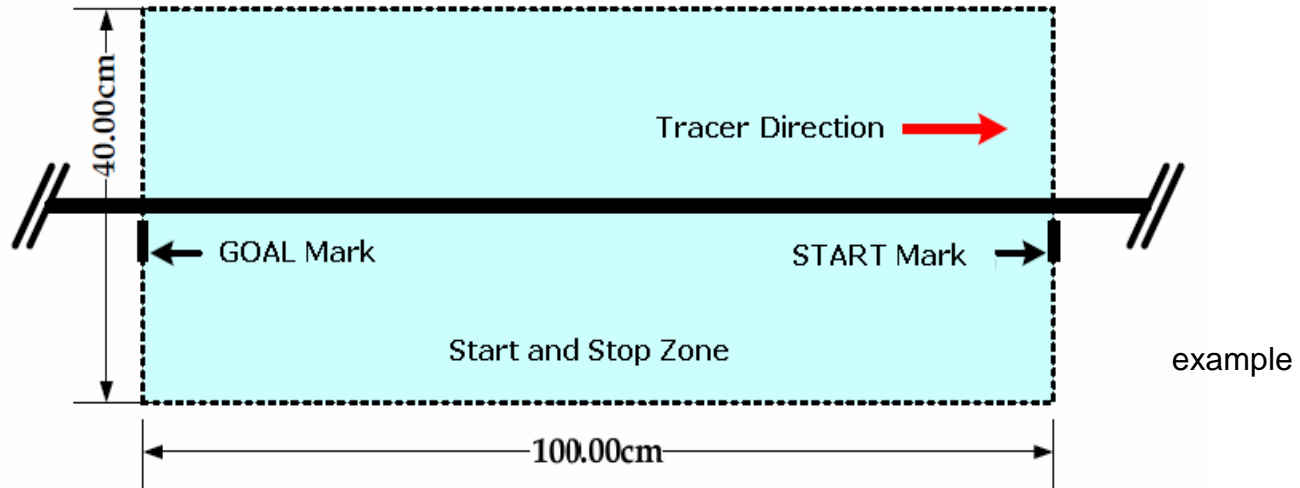
Start and Goal Point

At the beginning of each race, each car will be positioned over the white line between the two posts, from which the participant will turn on the power switch to start the race.



example

Start and Goal Zone



Curves and Cross Roads



Curves with of different degree of difficulty



Smooth winding road

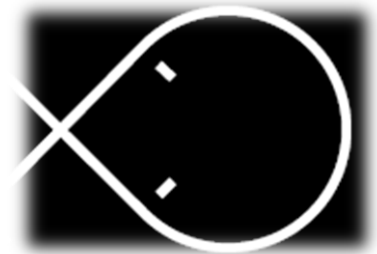


Cross road



Straight road with round corner and turns

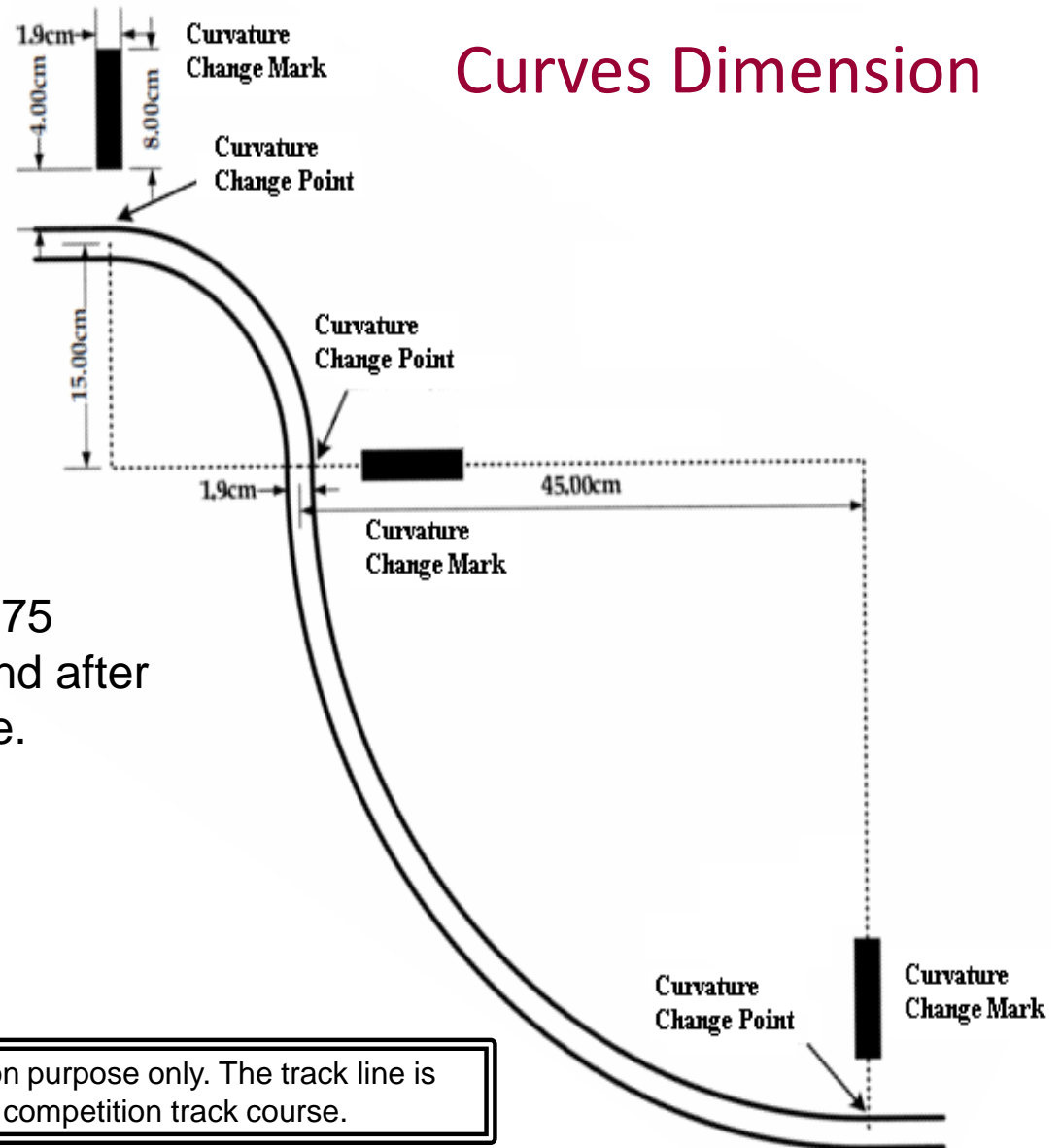
White marks on the left side of the track indicate course change or beginning or end of a section.



Cross road turns to curve

This illustration will help to calculate the acceleration and how to control of the car.

Curves Dimension



Small white marks of 3.15 x 0.75 inches will be placed before and after each section or course change.



Note the illustration is for demonstration purpose only. The track line is black and the marks are while on the competition track course.

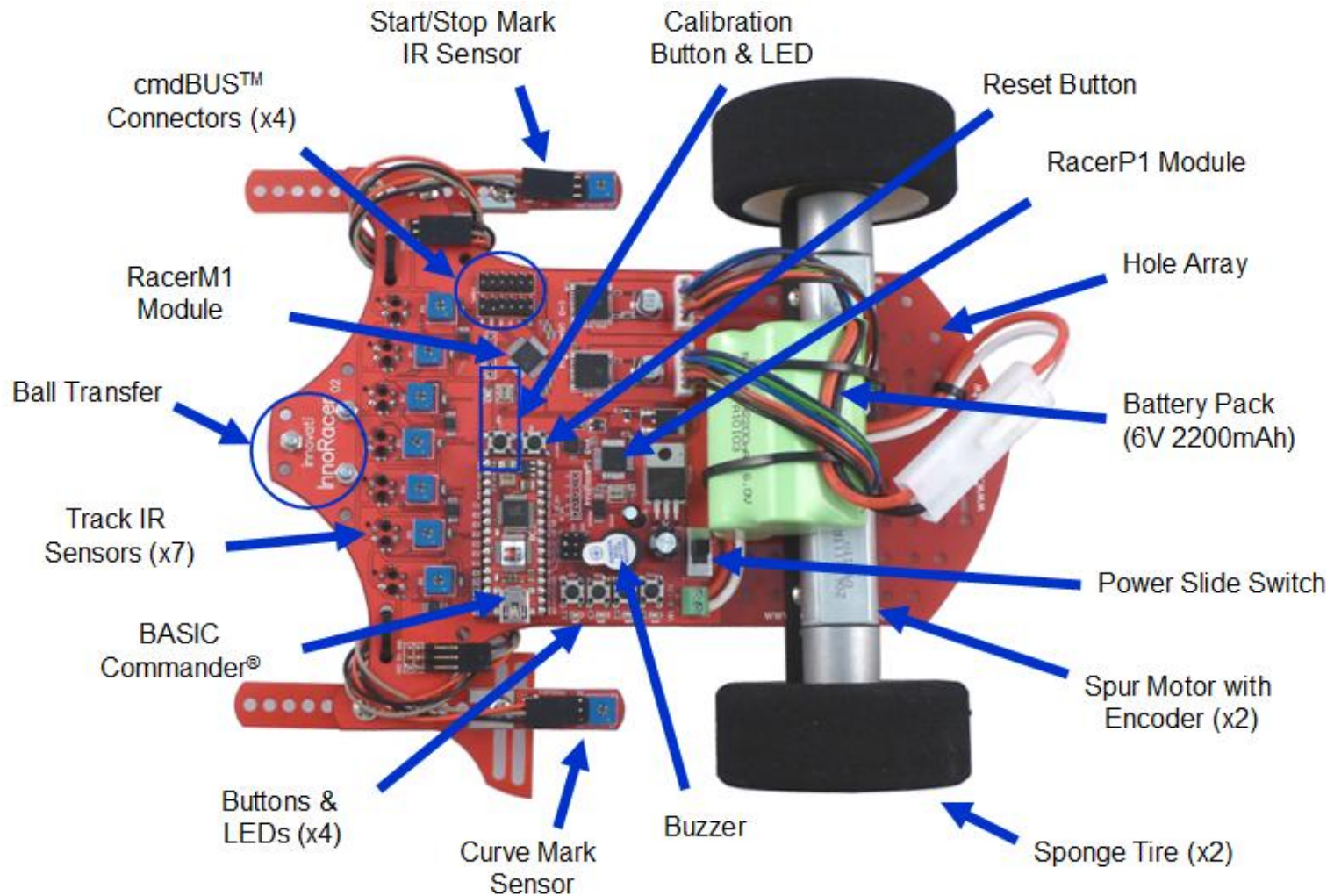
InnoRacer Features



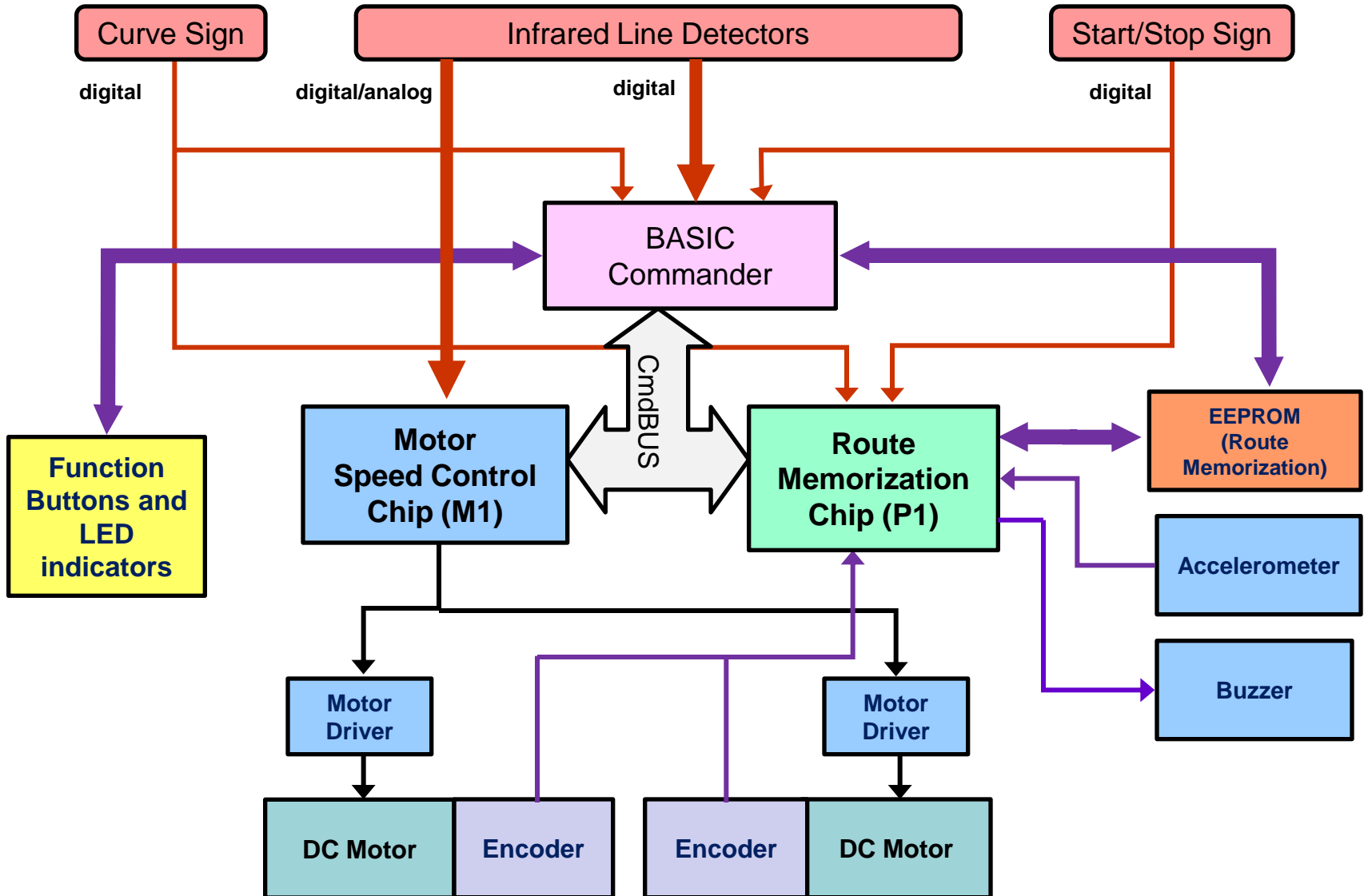
- BC2 As Core Controller
- Cmdbus interfacing
- USB for downloading & debugging
- InnoBAISIC programming language
- 7 fixed infrared sensors for track detection.
- Digital & Analog PID control
- Route memorization
- Motor tachometer and over current protection
- Accelerometer (G-Sensor) for curve sensing
- Reset button to restart the program.
- Variable resistors to change the infrared detection sensitivity in digital mode



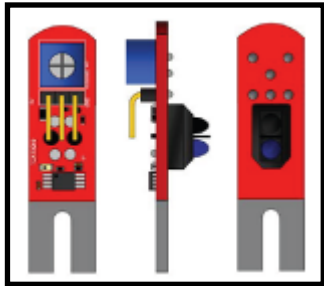
InnoRacer Parts



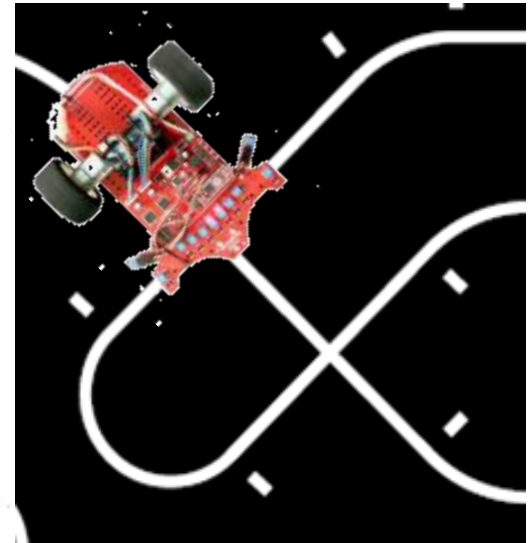
Control Diagram



7 Reflective IR sensors



Use the front row IR sensors to detect the cross road or curve change.

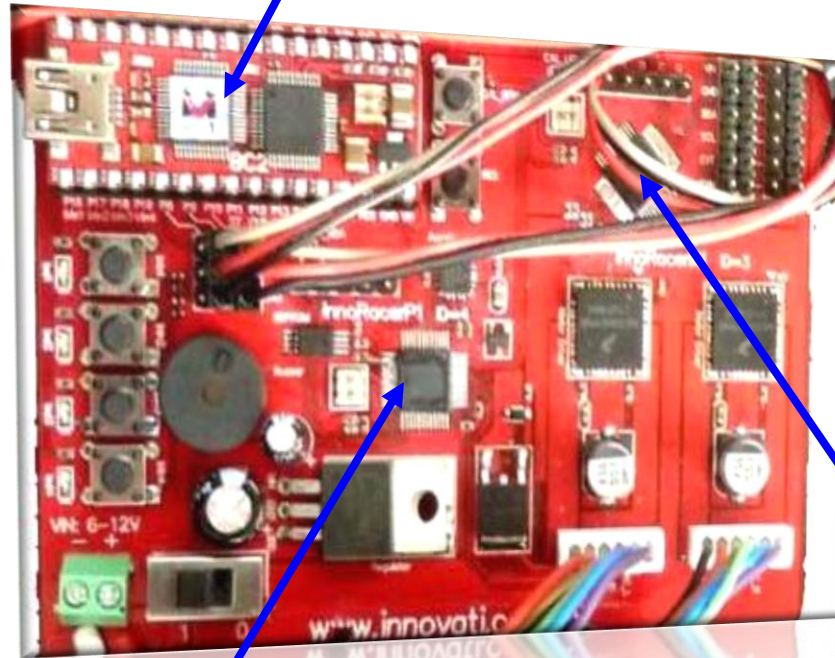


Use the side IR sensors to detect the Start and Goal point.

Controllers

BC32

Main Controller



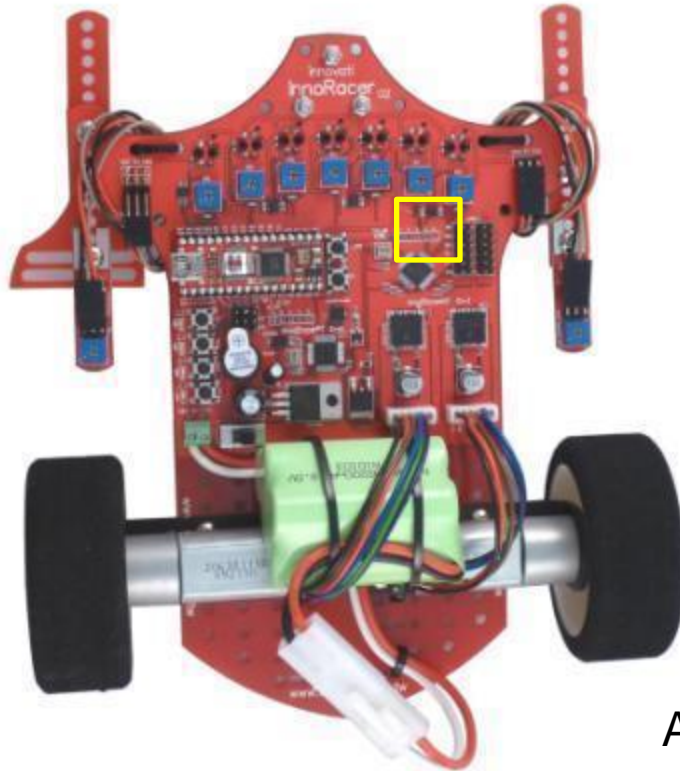
RacerP1

For route memorization

RacerM1

For speed control

Motor Driving Control



RacerM1 module

Control two DC motors with 1024 steps of speed.

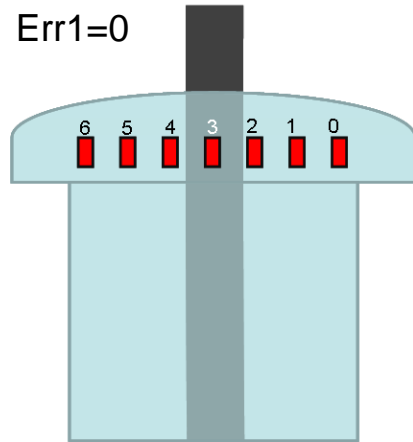
Built-in PID control feature for better track following capability.

Use PD control to adjust the speed of both wheels to reduce the error to minimum area.

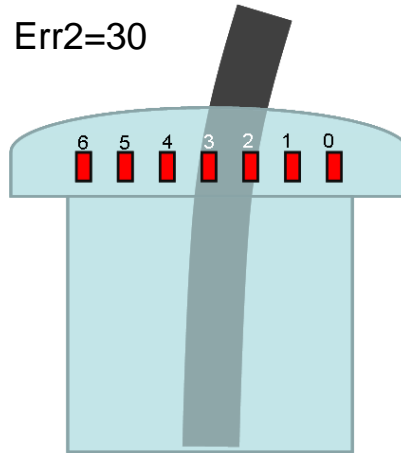
Advanced IR Analog Feedback Control

Proportional-Derivative (PD) Control

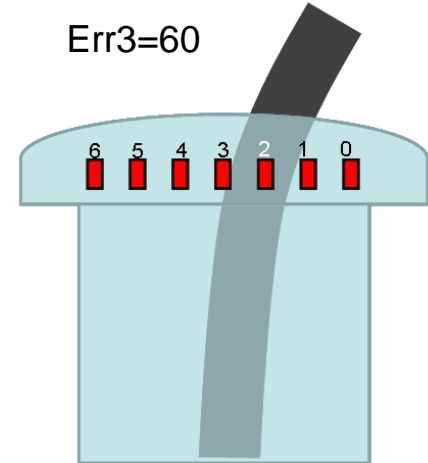
Err1=0



Err2=30



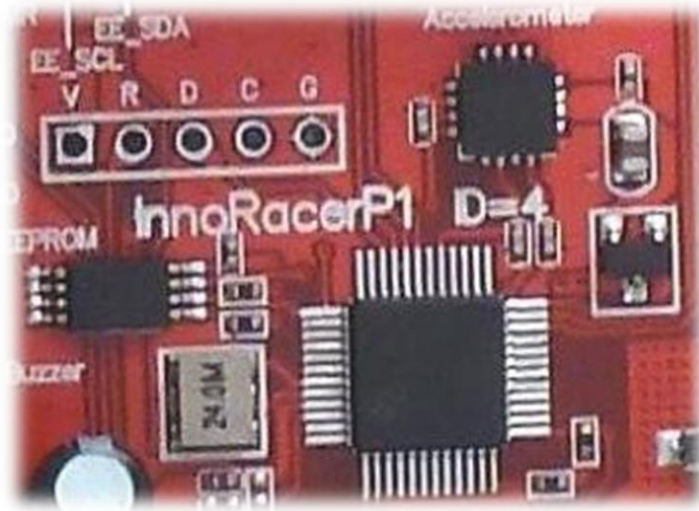
Err3=60



Examples

- The speed of left and right wheels is adjusted in proportion to the amount of Error.
- The speed of left and right wheels is also adjusted in proportion to the change rate of Error.

Information Management



RacerP1 module

Record up to 256 entries of track section information.

Tachometer feedback gives absolute control over position and speed.

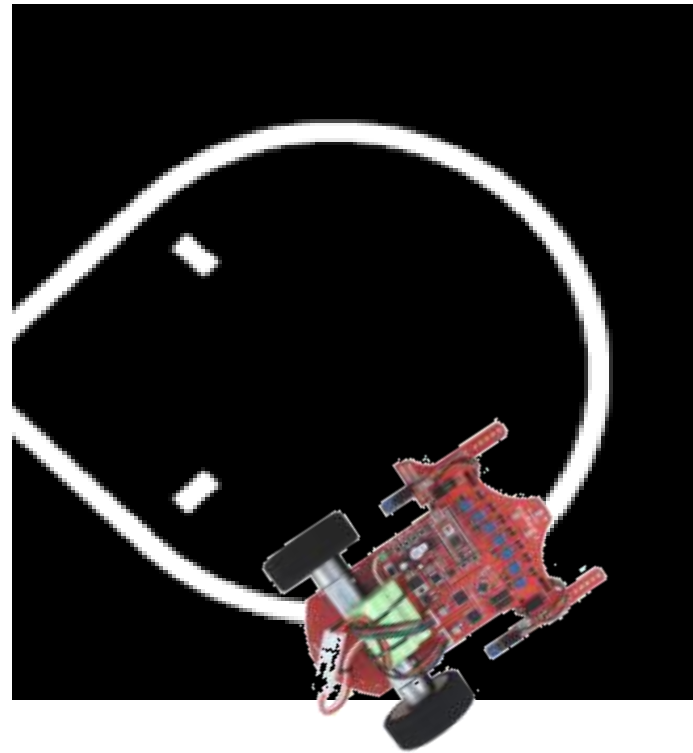
Track infrared sensing in digital or analog data.

Record track information including length, x- and y-axis average and maximum acceleration value, curve radius and direction.

Speeding on curve point

Built in two-axis accelerometer to measure the x and y-axis acceleration force and keep the information while running the route memorization.

Retrieve the information to calculate the curve radius and direction and accelerate on curves.



How to make the Innoracer run faster?

- Use high speed motors
- Overall lighter weight
- Route memorization
- Grip/traction: cleanness of wheels
- Adequate wheel base and track
- Adequate PID parameters
- Fully charged battery



Resources

Innoracer

- [Innoracer User Manual](#)
- [Innoracer sample code](#)

Line Racing Rules

- [Complete Rules](#)

Videos

- [2009 Tracer – Taiwan](#)
- [2009 Micom Car Rally – Japan](#)
- [Robo Grand Prix 2009 –Singapore](#)
- [2009 RoboTracer -- Japan](#)



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