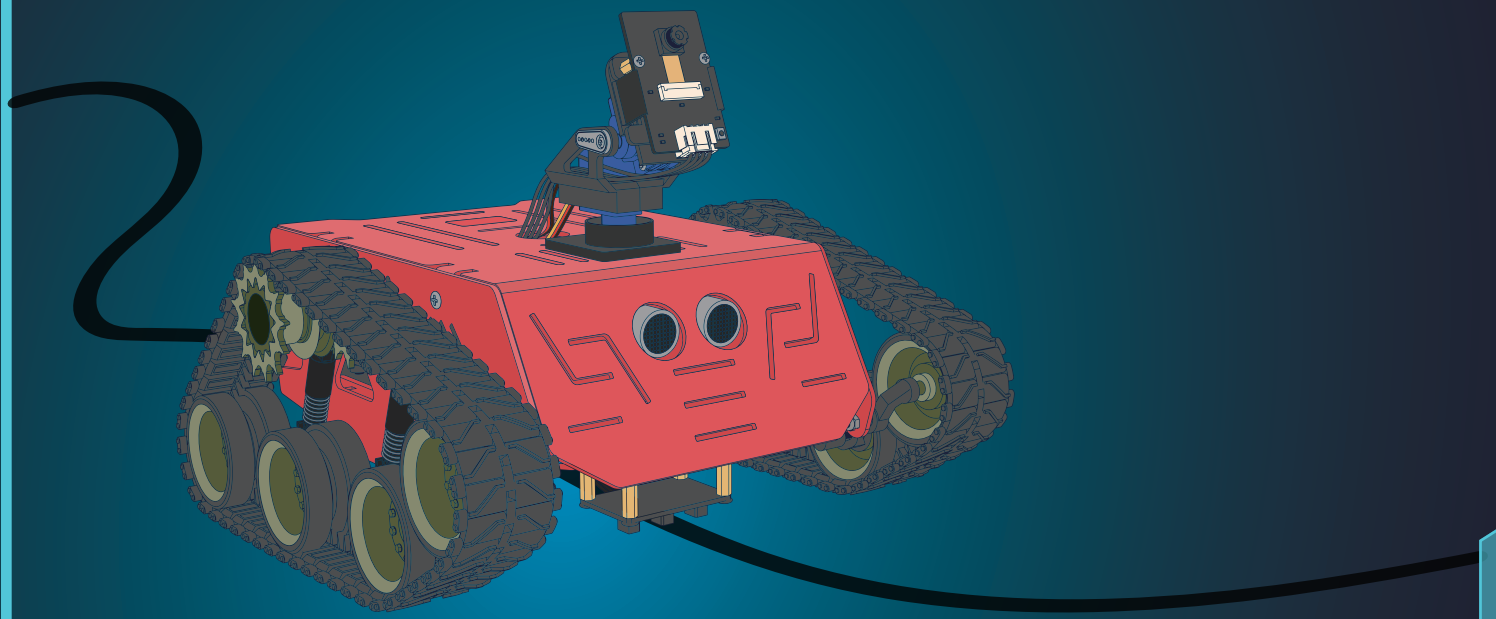
ELEGOO

3 Lesson

Tracking Control



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Introduction:

In this lesson, we will teach you how to achieve the line-tracking function of Conqueror Robot Tank Car and make it run according to the black line we have drawn in advance.

If you want to make your own runway, here are some suggestions for you.

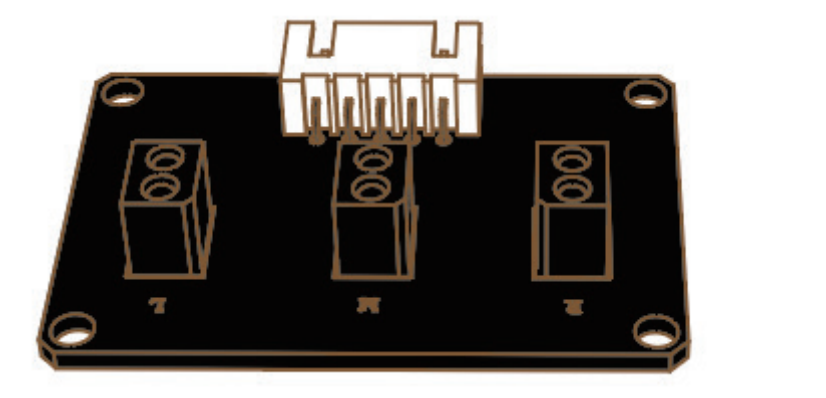
Tips:

(1)The curved part of the line should be as smooth as possible. If the turning radius is too small, the car will probably miss the runway.
(2)In addition to line tracking, we can also expand our imagination to develop other programs under the principle of line tracking. For example, we can develop an program
we can also use the principle of line tracking to expand our imagination and develop other programs, such as those that confine a car to an area regardless of its movement.

Material Preparation:

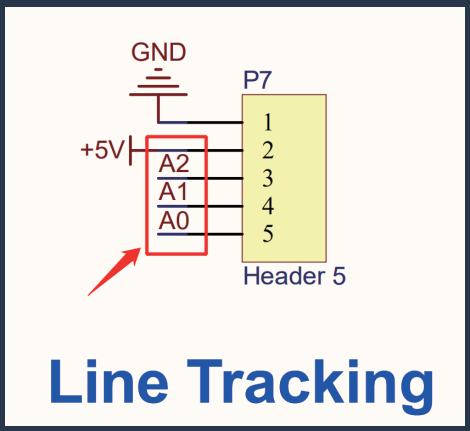
A Conqueror Robot Tank Car (with battery)
A USB Cable

In our kit, line-tracking function is achieved by tracking module, which is mainly composed of three photoelectric sensors and other electronic components.



Please open the last folder for more details: Related chip information -> ITR20001 and Conqueror-Shield

The photoelectric sensor is composed of an infrared pair tube (transmitting/receiving) and an NPN silicon phototransistor, which is equipped with a light source and an optical receiving device. The light emitted by the light source is received by the photosensitive element through the reflection of the object to be measured, and then the required information is obtained through the processing of relevant circuits. It can be used to detect the change of ground light and shade and color, as well as detect the presence or absence of close objects.



Finally, let' s see which pins of UNO the three photoelectric sensors are connected to and then we can start writing the program.

Please open the Demo1 in the current folder.

First of all, let’ s define the related pins and variables:

```
//in DeviceDriverSet_xxx0.h
/*ITR20001 Detection*/
class DeviceDriverSet_ITR20001
{
public:
  bool DeviceDriverSet_ITR20001_Init(void);
  float DeviceDriverSet_ITR20001_getAnalogueexxx_L(void);
  float DeviceDriverSet_ITR20001_getAnalogueexxx_M(void);
  float DeviceDriverSet_ITR20001_getAnalogueexxx_R(void);
#if _Test_DeviceDriverSet
  void DeviceDriverSet_ITR20001_Test(void);
#endif

private:
#define PIN_ITR20001xxxL A2
#define PIN_ITR20001xxxM A1
#define PIN_ITR20001xxxR A0
};
```

We need to initial the pins before employ, and set the three pins as input mode respectively.

```
//in DeviceDriverSet_xxx0.cpp
bool DeviceDriverSet_ITR20001::DeviceDriverSet_ITR20001_Init
(void)
{
  pinMode(PIN_ITR20001xxxL, INPUT);
  pinMode(PIN_ITR20001xxxM, INPUT);
  pinMode(PIN_ITR20001xxxR, INPUT);
  return false;
}
```

Then , put it into Setup() for call.

```
void setup() {
  Serial.begin(9600);
  AppITR20001.DeviceDriverSet_ITR20001_Init();
}
```

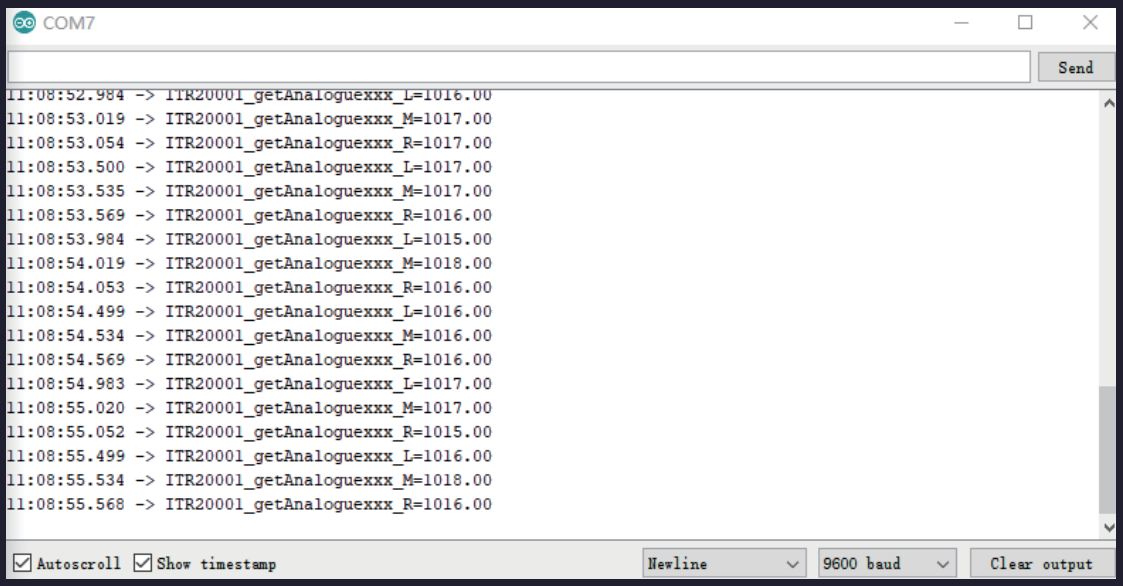
Finally, the data of the photoelectric sensor under the change of external environment is obtained by reading the analog quantity of three pins.

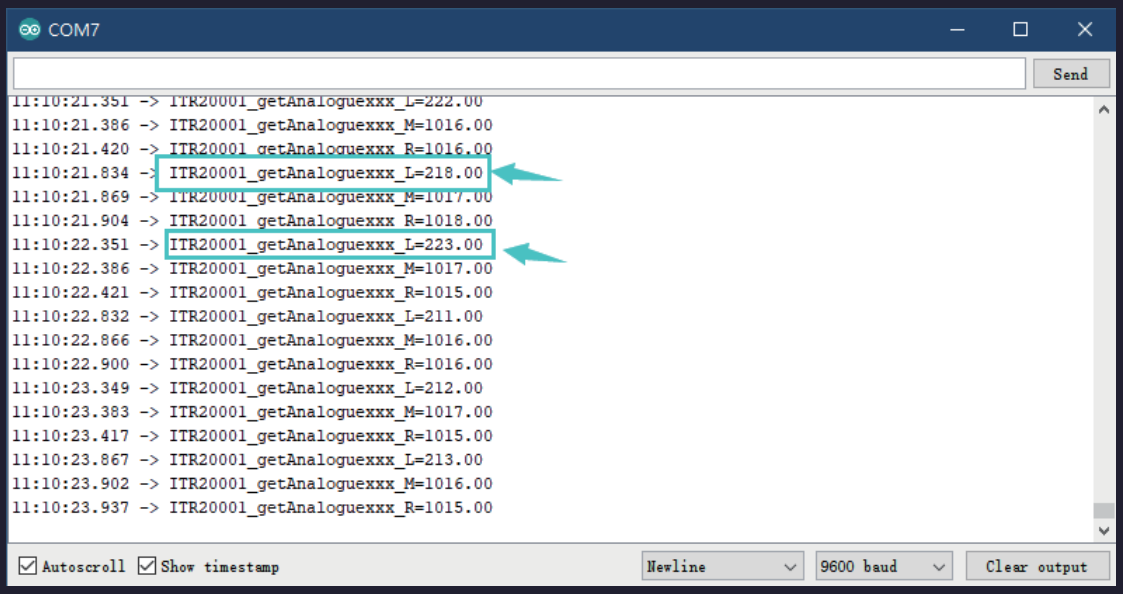
```
//in DeviceDriverSet_xxx0.cpp
float
DeviceDriverSet_ITR20001::DeviceDriverSet_ITR20001_getAnaloguexxx_L
(void)
{
 return analogRead(PIN_ITR20001xxxL);
}
float
DeviceDriverSet_ITR20001::DeviceDriverSet_ITR20001_getAnaloguexxx_M
(void)
{
 return analogRead(PIN_ITR20001xxxM);
}
float
DeviceDriverSet_ITR20001::DeviceDriverSet_ITR20001_getAnaloguexxx_R
(void)
{
 return analogRead(PIN_ITR20001xxxR);
}
```

Then, print it out in loop().

```
void loop() {
   static unsigned long print_time = 0;
   if (millis() - print_time > 500)
   {
     print_time = millis();
     Serial.print("ITR20001_getAnaloguexxx_L=");
     Serial.println
     (AppITR20001.DeviceDriverSet_ITR20001_getAnaloguexxx_L());
     Serial.print("ITR20001_getAnaloguexxx_M=");
     Serial.println
     (AppITR20001.DeviceDriverSet_ITR20001_getAnaloguexxx_M());
     Serial.print("ITR20001_getAnaloguexxx_R=");
     Serial.println
     (AppITR20001.DeviceDriverSet_ITR20001_getAnaloguexxx_R());
   }
}
```

After successful uploading, open the serial port, you will see the data of the three photoelectric sensors fluctuates around 1000. If you block one of the sensors with your hand, the detected value will be greatly reduced.

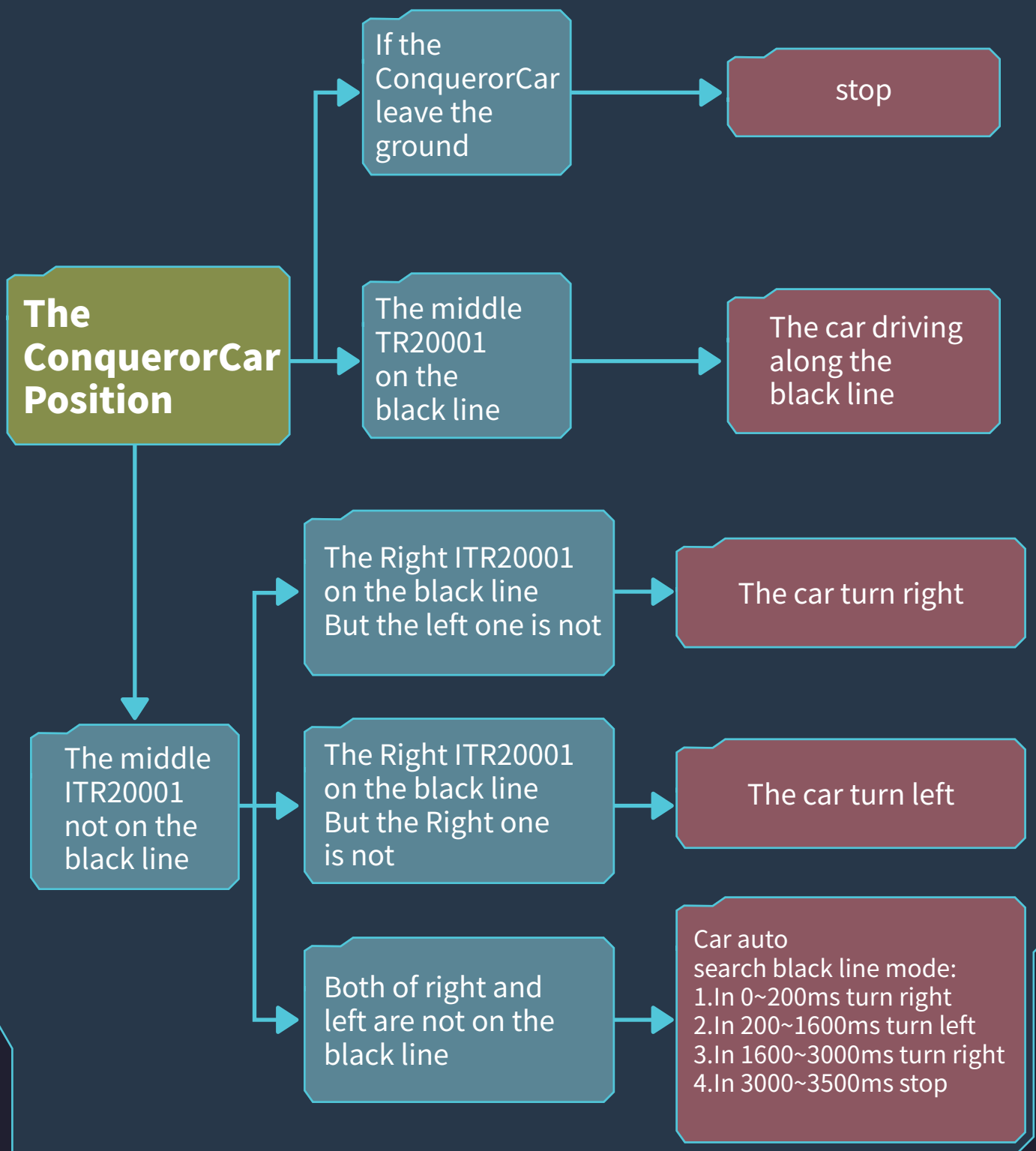




After the previous course learning, we have learned the use of photoelectric sensor. Then we will combine the car movement function and photoelectric sensor learned in the first class to realize the line-tracking function.

Let’ s take a look at the flow chart of the whole process of line-tracking mode:

Implementation principle of Tracking



Now, please open the Dome2 in the current folder:

Let’s take a look at the definition of line-tracking function first.

```
//in ApplicationFunctionSet_xxx0.h
class ApplicationFunctionSet
{
public:
  void ApplicationFunctionSet_Init(void);
  void ApplicationFunctionSet_Tracking(void);
  void ApplicationFunctionSet_SensorDataUpdate(void);
  void ApplicationFunctionSet_SerialPortDataAnalysis(void);
private:
  volatile float TrackingData_L;
  volatile float TrackingData_M;
  volatile float TrackingData_R;
boolean TrackingDetectionStatus_R = false;
  boolean TrackingDetectionStatus_M = false;
  boolean TrackingDetectionStatus_L = false;

public:
  boolean Car_LeaveTheGround = true;

public:
//If the value read by the photoelectric sensor is within 250 ~ 850,
the photoelectric sensor is in the black line.
  uint16_t TrackingDetection_S = 250;
  uint16_t TrackingDetection_E = 850;

//This is the minimum value obtained by the photoelectric
sensor if the car leaves the ground
  uint16_t TrackingDetection_V = 950;
};
```

Next, we need to program a function to judge the range.

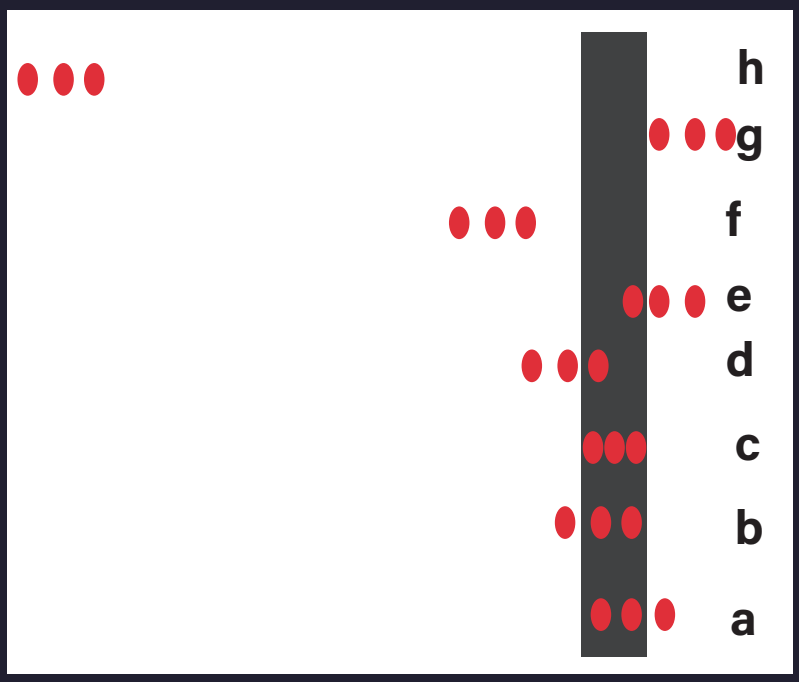
```
//in ApplicationFunctionSet_xxx0.cpp
static boolean
function_xxx(long x, long s, long e) //f(x)
{
 if (s <= x && x <= e)
  return true;
 else
  return false;
}
```

Then, we need to program the situation when the car is picked up.

```
//in ApplicationFunctionSet_xxx0.cpp
static bool ApplicationFunctionSet_ConquerorCarLeaveTheGround
(void)
{
 if (AppITR20001.DeviceDriverSet_ITR20001_getAnalogueexxx_R()
    > Application_FunctionSet.TrackingDetection_V &&
    AppITR20001.DeviceDriverSet_ITR20001_getAnalogueexxx_M()
    > Application_FunctionSet.TrackingDetection_V &&
    AppITR20001.DeviceDriverSet_ITR20001_getAnalogueexxx_L()
    > Application_FunctionSet.TrackingDetection_V)
 {
  Application_FunctionSet.Car_LeaveTheGround = false;
  return false;
 }
 else
 {
  Application_FunctionSet.Car_LeaveTheGround = true;
  return true;
 }
}
```

```
//in ApplicationFunctionSet_xxx0.cpp
void ApplicationFunctionSet::ApplicationFunctionSet_Tracking
(void)
{
.....
 if (Application_ConquerorCarxxx0.Functional_Mode
 == TraceBased_mode)
 {
  if (Car_LeaveTheGround == false)    {
    ApplicationFunctionSet_ConquerorCarMotionControl(stop_it, 0);
    return;
}
.....
}
```

The preparatory work was completed, and then we formally wrote the tracking function. Let's analyze the three ITR20001 online scenarios.



a, b, c: When the middle ITR20001 is on the black line and the black line can be detected, the car will keep going straight.

```
//in ApplicationFunctionSet_xxx0.cpp
void ApplicationFunctionSet::ApplicationFunctionSet_Tracking(void)
{
.....
 if (function_xxx(getAnalogueexxx_M, TrackingDetection_S,
TrackingDetection_E))
   {
    ApplicationFunctionSet_ConquerorCarMotionControl(Forward, 200);
    timestamp = true;
    BlindDetection = true;
   }
.....
}
```

d: When only the ITR20001 on the right is on the black line and can detect the black line, the trolley will turn right.

```
//in ApplicationFunctionSet_xxx0.cpp
void ApplicationFunctionSet::ApplicationFunctionSet_Tracking(void)
{
.....
 else if (function_xxx(getAnalogueexxx_R, TrackingDetection_S,
 TrackingDetection_E))
   {
    ApplicationFunctionSet_ConquerorCarMotionControl(Right, 200);
    timestamp = true;
    BlindDetection = true;
   }
.....
}
```

e: When only the left ITR20001 on the black line can detect the black line, the trolley will turn left.

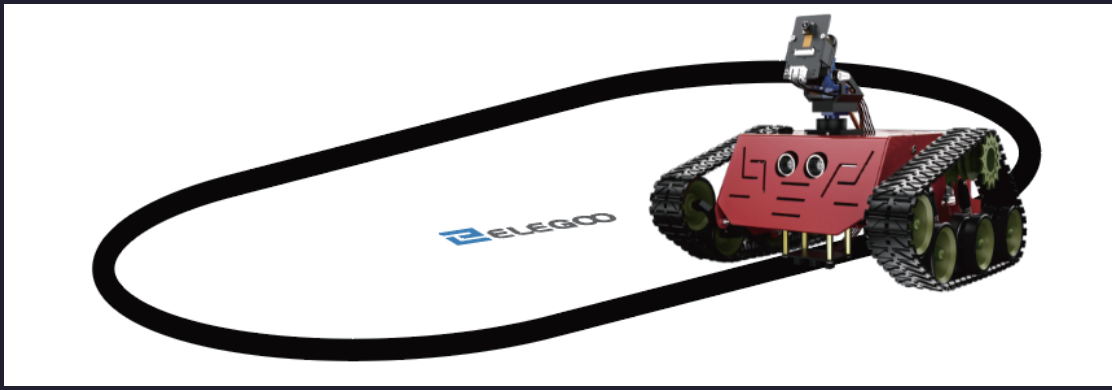
```
//in ApplicationFunctionSet_xxx0.cpp
void ApplicationFunctionSet::ApplicationFunctionSet_Tracking(void)
{
.....
 else if (function_xxx(getAnalogueexxx_L, TrackingDetection_S,
 TrackingDetection_E))
   {
    ApplicationFunctionSet_ConquerorCarMotionControl(Left, 200);
    timestamp = true;
    BlindDetection = true;
   }
.....
}
```

f, g: and h are the different conditions under the blind tracking mode.

Let's look at the case of f, when the car is away from the black line, the normal practice is to make the car rotate once to detect the black line, assuming that it rotates once to the left. But in the case of G, with the black lines so close together, is it necessary to rotate it once? Therefore, in blind seeking mode, the trolley should first rotate from left to right to judge whether there is a black line nearby at a certain Angle. If there is no black line detected nearby, it will rotate around to look for the black line.

```
//in ApplicationFunctionSet_xxx0.cpp
void ApplicationFunctionSet::ApplicationFunctionSet_Tracking(void)
{
.....
 else
   {
    if (timestamp == true)     {
     timestamp = false;
     MotorRL_time = millis();
     ApplicationFunctionSet_ConquerorCarMotionControl(stop_it, 0);
    }
    /*Blind Detection*/
    if ((function_xxx((millis() - MotorRL_time), 0, 200) ||
    function_xxx((millis() - MotorRL_time), 1600, 2000)) &&
   BlindDetection == true)
    {
     ApplicationFunctionSet_ConquerorCarMotionControl(Right, 250);
    }
    else if (((function_xxx((millis() - MotorRL_time), 200, 1600))) &&
    BlindDetection == true)
    {
     ApplicationFunctionSet_ConquerorCarMotionControl(Left, 250);
    }
    else if ((function_xxx((millis() - MotorRL_time), 3000, 3500))) //
    Blind Detection ...s ?
    {
     BlindDetection = false;
     ApplicationFunctionSet_ConquerorCarMotionControl(stop_it, 0);
    }
   }
 }
 else if (false == timestamp)
 {
  BlindDetection = true;
  timestamp = true;
  MotorRL_time = 0;
 }
.....
}
```

Upload program. (Please toggle the “Upload-Cam” button to “Upload” when uploading the program.) After uploading, put the car on the black line, the car will move along the black line. Otherwise, it will enter blind search mode to look for the black line, it will turn left and right first, and then revolve to the left.



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