

# 參賽隊伍人員及機器人簡介

## Team Member and Robot Introduction

組別：遙控組 自動組

指導老師：許東亞老師

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(School : ) National Taipei University Technology (Team name : ) Shiang Yu Tsu  
Jiang Yu

### 壹、參賽隊伍人員(team member)：

#### 一、指導老師(teacher)

許東亞老師 Sheu Dong-Yea



#### 二、組員(team member)

詹雅安 Chan Ya-an



賴家禎 Lai Chia-yin



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曾詩絜 Tseng Shih-chieh

楊鵬蔚 Yang Chuan-wei



### 貳、機器人簡介(robot' s introduction)

#### 一、構想與策略分析(Vision and strategy analysis)

##### 1. 成員工作分配(Member assignments):

(1)曾詩絜、楊鵬蔚：車體架構，機構設計及組裝。

Tseng Shih-Chieh, Yang Chuan-wei: Body architecture  
-ing. Mechanism designing and fabricating.

(2)賴家禎：電路版設計及製作。

Lai Chia-yin: PCB designing and manufacturing.

(3)詹雅安：8051 晶片之組合語言程式設計。

Chan Ya-an: Using 8051 by assembly language.

##### 2. 行走路線(Route):

出發區→山崩區→搬運落石→山崩救援區→沿山崩區

原路回起點→土石流區→過障礙物→土石流救援區→沿山

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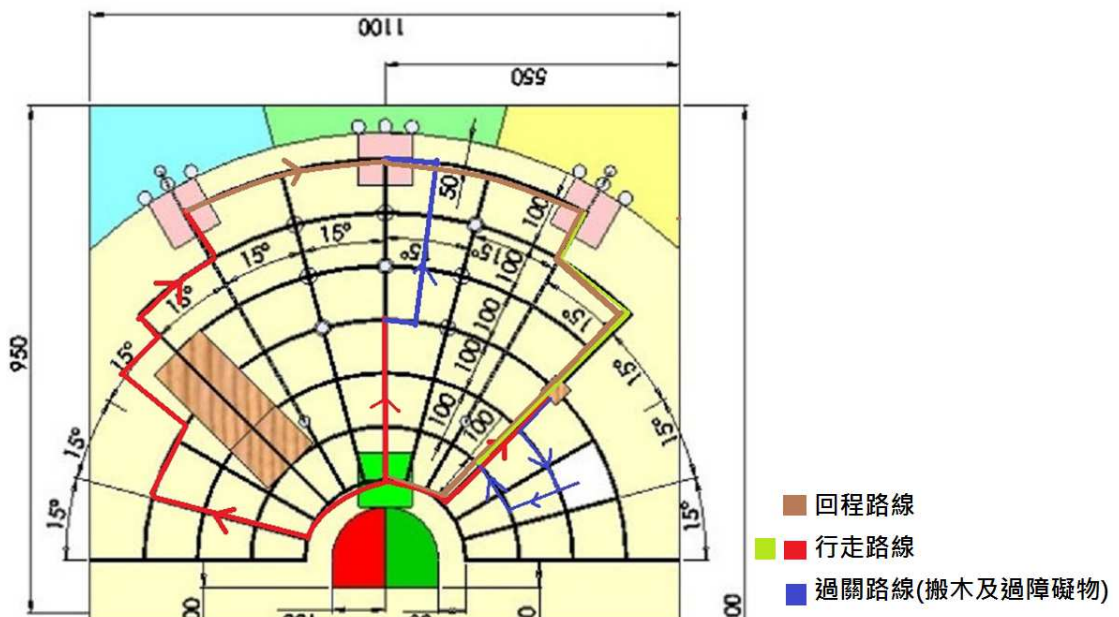
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崩區原路回起點→淹水區→淹水救援區→沿山崩區原路回  
出發區。

start place→Landslide area→transporting the rock →  
Rescue area of Landslide area→By landslide area

start place→Mudslide area→Obstacle passing→Rescue  
area of mudslide area→By landslide area→Flooded area

→Rescue area of flooded area→By landslide area →  
start place。



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### 2. 關卡過關方式(ways of stages passing)：

#### (1)搬運落石(transporting the rock)：

置一垂直地面之鐵片於車頭，當車行走至木塊前一條黑線時，將鐵片以伺服馬達轉動，使鐵片水平地面。車向前使鐵片水平置於木塊下方。停止並將鐵片稍許上抬使木塊離開地面。達目的地後，將鐵片轉至水平，車倒退走，使木塊落於目的地區，即完成。

Let the iron sheets perpendicular to the ground in front of the car, when car walking pass a black line in front of the wood, iron tablets servo motor rotation, so that the level of iron tablets ground. The car forward so that the level of iron plates placed pieces of wood beneath. Stop and iron tablets slight elevation so that the pieces of wood off the ground. Reach their destination, go to the level of the iron plates, car backwards to go, so that the pieces of wood to fall in the areas of destination, to complete.

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(2)救援(rescue)：

於車上擺放三個爪子(爪子詳細機構於機構設計部分說明)，車抵達救援區後，三個爪子同時進行夾取三隻娃娃之動作。待回到出發區，先停在其中一顏色邊緣，辨色後爪子放下相對應顏色之娃娃，另一色亦如此。

Placed on board three paw (claws institutions on institutional design part of the description), the car arrived at the rescue zone, three claws gripping three dolls action. Pending the return to the starting area, the first stop on the edge of one color and color vision claws lay down corresponding to the color of the doll, another color as so.

(3)過障礙物(Obstacle passing)：

車往前行至障礙物區的第一條線(中間無障礙物)，始右轉後進入黑線及黑線中間，關閉循線。通過三條黑線後，開循線駛進救援區。

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The car forward line to the first line of the obstacle area (there are no obstructions in the middle), and beginning to turn right into the middle of the black line and the black line shut down through the line. By three black lines open through the line entering the rescue area.

(4)爬梯(stairs climbing)：

不進行爬梯，直接繞過階梯進行救援。

Won't do the stairs climbing, directly bypassing the stage to go to the rescue area.

## 二、機構設計(Mechanism Design)

1. 設計技術內容(Design of technical content)：

(1)應用材料(Applied Materials)：

(a)車體材料(Body materials)：

a. 正方形中空鋁管(Square hollow aluminum tube)：外

徑 10mm，內徑 8mm，厚度 1mm，穩

固車架。(An outer diameter of

10mm, inner diameter 8mm, a

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thickness of 1mm, and a solid frame)

b. 長方形中空鋁管(Rectangular hollow aluminum tube): 長寬 25×12(mm), 厚度 1mm, 穩固車架。(Length and width of 25 × 12mm, a thickness of 1mm, and a solid frame.)

c. L 型鋁板(L-shaped aluminum): 寬 2.5mm, 厚度 0.5mm, 連接以及部份穩固。(Width 2.5mm, thickness 0.5mm, connected, and part solid.)

d. 鋁片(aluminum): 厚度 2mm, 長寬 20×25(mm), 通關以及部分支撐。(thickness 2mm, length and width of 20 × 25 (mm), pass stage as well as some support.)

e. 圓形空心鋁管(circular hollow aluminum tube): 外徑 8mm 厚度, 1.5mm, 支撐夾爪。(diameter 8mm thickness, 1.5mm,

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supporting the grippers)

f. 釣線(fishing line)：控制夾爪高低。(control the level of the grippers.)

g. 螺桿(screw)：夾爪之張合。(control the grippers' opening and closing.)

h. 連接材料(connecting material)：3 或 4 mm 不等長度之螺絲釘、墊片、螺帽。(the range of 3 or 4 mm length of the screws, washers, nuts.)

(b) 夾爪材料(Gripper material)：

a. 壓克力(Acrylic)：兩種尺寸 75×10×2、50×10×2 (mm)。(two sizes of 75 × 10 × 2, 50 × 10 × 2 mm.)

b. 保麗龍膠(Styrofoam glue)：夾爪黏著。(the grippers adhesion)

c. 連接材料(connecting material)：3 mm 不等長度之螺絲釘、墊片、螺帽。(ranging from 3 mm length of the screws,



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washers, nuts)

(c)馬達(motor)：

a. 輪胎馬達(Tire motors)：

i. 型號 IG-32GM 03&04 TYPE。(models IG-32GM 03 & 04 TYPE)

ii. 減速比 1/51。(to deceleration than 1/51)

iii. 定格扭力 3.4 kg-cm(freeze torque 3.4 kg-cm)

iv. 定格回轉數 117 rpm。(freeze the number of rotation 117 rpm.)

b. 夾爪收線馬達(clip claw up motor)：高速扭力小馬達。(high-speed torque motor)

c. 夾爪張合馬達(jaws opening and closing motor)：

i. 型號 S3003。(model S3003)

ii. 扭力 3.2kg·cm。(torque 3.2kg · cm)

iii. 速度 0.23sec/60°。(speeds 0.23sec/60 °)a

d. 外張伺服馬達(the outer Zhang servo motor)：同上。(ibid.)

e. 搬木塊伺服馬達(move the pieces of wood servo motor)：

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- i. 型號 S777CG/6BB。(model S777CG/6BB)
- ii. 扭力 35 kg·cm。(torque 35 kg · cm)
- iii. 速度 0.15 sec/60°。(speed 0.15 sec/60°)

(d)輪胎(Tire)。

(2)結構分析(結構分析)：

(a)車身(body)：使用空心鋁管構成車架，組成如H字形狀的框架，運用空心鋁管輕的特性，讓車體的重量達到最輕，至於H字型則可使車體更加穩固，再加上車體下方的四方形構造，車身更加得不易搖動。

(A hollow aluminum tube frame, composed of the H-shaped frame, the use of the characteristics of the hollow aluminum tube light, so that the weight of the body to achieve the lightest The H-shaped, the body can be more stable, plus bodywork below the four-square structure, the the body more was not easy to shake.)

(b)搬木塊(Moving pieces of wood)：利用四伏馬達與空心

鋁管的結合，再將鋁片與其進行組裝即可以達

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到轉動的效果，順利將木塊抬起。(The combination of the four-volt motor with hollow aluminum tubes, then aluminum and its assembly that can achieve the effect of rotating smoothly lift the pieces of wood.)

(c)夾爪(Jaws)：夾爪的構造參考夾娃娃機，利用壓克力片輕薄的特性，使的夾爪重量達到最輕，減輕輪胎馬達的負擔，運用夾爪與螺桿和馬達做結合，使馬達能達成張合的動作，來進行娃娃的夾取。

(Jaws construct the reference folder doll using acrylic piece lightweight characteristics, so that the gripper weight of the lightest, to alleviate the burden on the tire motor, using the jaws with screw and motor combined, so that the motor can reach and close themthe action, doll gripping.)

(d)輪胎(Tire)：使用圓柱狀鋁材，車出適合的內外徑，再導出個螺桿，將馬達與工件結合，最後再與輪胎做組裝，裝上支架和培林，即可與車體結合。

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(Cylindrical aluminum car out of the inner and outer diameters of the right, and then export the screw, the motor with the workpiece, and finally assembled to do with the tire mounted on a bracket and bearing, and can be combined with the bodywork.)

### 2. 製作要點：(the production of key points)

#### (1) 製作經驗：

起初製作時，只有構想完全沒有考慮其他整合性的問題，等到機構每個部位逐漸逐漸設計出來，才發現整合起來的困難，以下列出幾點整理出來的製作經驗。

Production experience: When we started to produce, we did not think how to take into account other integrated problem. Until the agency each part gradually gradually design, we found that the integration difficulties. Production experience points listed below sorted out.

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(a)馬達位置(Motor position)：因為需要驅動所以得靠馬

達使其動作，一台車子的空間就是這麼大，

馬達如何擺放才不會互相干涉。

Because of the need to drive the motor is to rely on its action, and a car doesn't have big space, we have find motor how to position motors will not interfere with each other.

(b)重心(The center of gravity)：重心一偏，車子就無法

走直線，容易造成循線上的困擾。

The car will not be able to walk a straight line, if the focus of one-sided, likely to cause distress through the line.

(c)鑽孔(Drilling)：鑽孔時可先用中心春，先打出一個小

孔，實際鑽孔時比較不容易歪，鑽孔時也盡量避

免一次鑽到底，容易造成尖銳的聲響以及鑽頭的

損壞。

:Drilling can use the centre punch. First, hit a small hole, the actual drilling is not easy to compare. Second, it can avoid crooked and

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drilling a drill, and a sharp sound as well as damage to the drill.

(d)固定(Fixed)：一台車要穩固，不是只靠單一方向的固定，各方向都要考慮進去，只用鋁條穩定度也不夠。

A car is solid, not rely on a single direction. Fixed direction should be taken into account, and only aluminum strip stability is not enough.

(e)輪胎(Tire)：輪胎與馬達結合裝上車架，須與培林結合固定，馬達帶動工件，轉動培林，輪胎即可進行滾動。

Tire and motor combination mounted on the frame, and combined with bearing fixed. Motorized workpiece rotation bearings, tires can be scrolled.

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### 三、輪子驅動設計(Design of drive of the wheels)

採用四輪驅動，一個輪子一個馬達，左(右)邊兩輪胎同動。輪子馬達由 8051 輸出 PWM 波進入馬達驅動電路(詳細說明於電路設計部分說明)來驅動。

將 8051 之暫存器 R2 設為右邊馬達之峰值寬度，R3 設為左邊馬達之峰值寬度，R4 為週期。設週期 R4 值為 100，從 0 開始計算，每進一次計時中斷(約 50us 進入計時中斷一次)即加 1 並以 R2(R3)值減該值，檢查溢位旗標是否有變為 1，若溢位(1)即 off(0)馬達開關接腳，沒溢位(0)則 on(1)。

將上述形成之 PWM 波由晶片端輸入馬達驅動電路，即可控制馬達轉速，R2(R3)值若大則轉速快，反之則慢。

藉控制馬達轉速，即可使車子進行左(右)轉、直走之動作，例：  
R2=0，R3=70，左輪轉動，右輪不動，即為左轉，R2=70，R3=70，  
左右皆同轉速，即為直走。

Four-wheel drive, a wheel with one motor, the left (right) side of the two tires have the same moving. Wheel motors use PWM wave output by 8051 to drive the motor drive

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circuit. (described in detail in the circuit design part of the description)

Register R2 of 8051 is set to peak width of the right motor, R3 is set to peak width of the left motor and R4 as cycle. Set cycle R4 is 100, starting at 0 and calculated each into a timer interrupt (about 50us into the timer interrupt time) and calculate  $R2-R4$  ( $R3-R4$ ), then, check if the overflow flag becomes a overflow (1). If overflow (1), off(0) the motor.

Above the formation of PWM wave input motor drive circuit chip side, you can control the speed of the motor, R2 (R3) value if large fast speed, otherwise slow.

By controlling the rotation speed of the motor, you can make the car turn left (right), straight ahead of the action, for example:  $R2 = 0$ ,  $R3 = 70$  revolver rotation right wheel does not move, that is, turn left,  $R2 = 70$ ,  $R3 = 70$ , around the same as those speed shall be straight.



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### 四、電路設計(Circuit design)

#### 1. 馬達驅動電路(The motor drive circuit):

利用兩個繼電器來控制煞車及轉向，訊號(5V)進去經光耦合輸出至反向器，反向器再將訊號相反後傳至繼電器，繼電器反應之後將給的 12V 電源供應至馬達，達到啟動、轉向、煞車之目的；馬達驅動的電路板上還有四顆開關，分別為測試時用來控制 ON-OFF、轉向、煞車，還有一個開關是控制訊號可不可以進入用。

Two relays to control the braking and turning signal (5V) into the optically coupled output to the inverter. And then inverter opposite the signal and the signal spread relay, the relay reaction after will give the 12V power supplied to the motor to start, turn and brake. Motor driving circuit board, there are four switches, respectively, for testing when used to control the ON-OFF, the turning, braking, there is a switch control signals, whether they can use signal.

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### 2. 循線電路(Through the line circuit)

利用 CNY70 來循線，CNY70 在感應到黑白時，會有一個電壓輸出，在經過比較器之後，將黑變成訊號 1、白為訊號 0，進而達到循線的目的；我們把每個比較器的一端接上同一個可變電阻，經由調整電阻便可以分辨黑白，如（圖 13）。

To through the line we used CNY70. When CNY70 sensitive to black and white, there will be a voltage output, after the comparator, black becomes signal 1 and white signal 0, to reach the goal of through the line. Each comparator connect one end of a variable resistor, by adjusting the resistance will be able to distinguish between black and white

### 3. 晶片端電路(Chip side circuit)

8051 有 40 隻接腳，其中有 8 隻為特殊腳分別為 9-reset、18, 19-石英震盪器、20-接地、29, 31-不接東西、30-5V 電源、40-5V 電源，P1 部分為馬達訊號輸出(左右輪)，依序為 ON-OFF、轉向、煞車、encoder，P0 為辨色、開爪、拉線馬達

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使用，P2 為三隻爪子開合馬達使用；在第九隻腳的部分接了個無段開關以用來 reset；P3.7 腳接了個有段開關作為程式啟動使用，不過未來可能會換隻腳；5V 電源的部份我們用了 7805 的電晶體，提供的電源為 7.4V，在經過 7805 之後便可以降壓為 5V 的電源，如。

There are 40-pin on 8051, each 8 special pin of them is 9-reset, 18 and 19 - quartz oscillator, 20 - ground, 29, 31 - does not catch things, 30-5V power supply, 40-5V power supply. At P1, motor signal output (left and right wheels), the order of ON-OFF, turn, brake, encoder, P0 for color vision, open claw, pull motor, P2 for the motors of three claws open and close; in the ninth pin there was a stepless switch to be used to the reset. P3.7 pin there was a switch to start as a program to use, but the future may change the pin; 5V power supply part of our 7805 transistors provide power for 7.4V after 7805 after they buck as a 5V power supply

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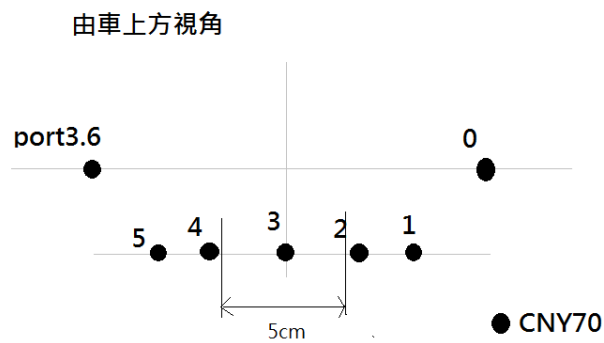
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### 五、感測器設計(Design of the sensor)

#### 1. 循線感測-CNY70(Sensor to through the line) :

由 7 顆 CNY70 組成，由右到左(車上方視角)分別接於 8051 之 P3.0-6 的接腳。P3.1-5 用來循線，P3.6 及 0 用來判斷接下來的動作。

7 CNY70, from right to left (car side perspective), respectively, then in 8051 of P3.0-6 pin. P3.1-5 is used



to follow the line, P3.6 and 0 is used to determine the next action.

(1)循線(through the line) :

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當正常情況走在直線上時，P3.3 在黑線上(回傳 1)，其他四顆皆走在白上(回傳 0)。當車偏向黑線的左(右)邊時，右邊兩顆 P3.2 及 1(P3.4 及 5)會感應到黑線(1)，程式此時會將右(左)輪停止，只留左(右)輪繼續轉(即為右左轉)，當轉到正常情況時，繼續直走。

When normal conditions are walking in a straight line, P3.3 return, at the black line (1), the other four were walking in the white (return 0). When cars tend to the left of the black line (right) side, the right two P3.2 1 (P3.4 5) senses the black line (1), the program at this time will be the right (left) wheel stop only stay left (right) wheels continue to turn (that is, the right turn left), go to the normal situation, continue straight ahead.

(2)跨線(Pass the line)：

使用 P3.6 及 0 來進行已經過幾條線的計算，先在主程式設定要經過幾條線後換下一個指令，每進入一次計時中斷，即判斷

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P3.6 或 0 是否有由 0 變為 1，若有，即將設定的值扣 1，直到扣到 0(表示已經過設定黑線數)，即可進行下一項指令。

Use the P3.6 and 0 have been a few lines of calculation, the main program is set to be replaced after a few lines of instruction for each entry timer interrupt, that judgment P3.6 or whether changes from 0 01, if any, is about to set the value of the buckle 1 to 0 until the buckle (that has been set to the number of black lines), can be carried out under a directive.

(3)轉彎:(右轉,左轉同原理)(turn(turn right and turn left use the same method))

當遇到十字時，P3.6 及 0 會先感應到黑(1)，關閉循線，

開始右輪反轉左輪正轉(即為右旋)，轉到左上角(P3.6)感應到黑(1)後，開始感應 P3.1, 2, 4, 5 是否全感應到白(0)，若是，則停止右旋繼續循線直走。

When Cross, P3.6 and 0 will be sensitive to black (1), shut down through the line,

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The start right wheel reversal revolves forward (ie, right-handed), after induction to the black (1) Go to the upper left corner (P3.6) to begin the induction P3.1 2, 4, 5 full induction to white (0 ), and if so, then stop dextral continue straight through the line.

### 3. 辨色感測-colorPAL(color sensor) :

運用 8051 晶片的串列通訊後接上 RS232 來傳輸入該感測器，須利用 ASCII code 來傳輸指令，傳入辨色指令後，該感測器即會回傳一 ASCII code 來表示其所讀取到的顏色，利用 8051 來讀取後再進行接下來的指令。

Use of 8051 chip serial communication to connect RS232 biography enter the sensor, to take advantage of the ASCII code to transmit instructions, the incoming color vision instruction, the sensor will return the ASCII code to said they readtaken to the color, then the use of 8051 to read the next instruction.

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### 六、組裝、測試與修改(Assembly, test, and modify)

#### 1. 車身(body)

(1)組裝(Assembly)：初期我們所設計的車身為了穩固因素考量，選擇的鋁材較為粗壯以及厚實，再加上有些材料為實心鋁柱，所以組裝起來整體車重有些偏重，而且車體較為龐大，為了能負荷此重量，所需的馬達也要較大顆。(Early body designed to stabilize the factors considered, the choice of aluminum is more stout and thick solid aluminum column, plus some material assembled some emphasis on the overall vehicle weight, and bodywork sheer



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weight, in order to be able to load required motor have to larger particles.)

(2)測試(test): 實際測試起來, 由於車重過高, 導致車子行進速度降低, 而且造成輪胎馬達的負擔。測試結果的顯示, 速度慢、馬達負擔高且車架略微歪斜。(Actual test, the vehicle weight is too high, leading to lower car speed and cause tire burden on the motor. The test results show that the slow motor burden is high and the frame is slightly skewed.)

(3)修改(modify): 由於測試的結果, 決定改變車身材料, 將車身鋁材進行替換, 改為使用較輕的方形中空鋁管, 以及較薄的鋁條。進行修改之後, 車體重量明顯減輕, 加上馬達進行實際測試, 車速增加, 且馬達也可進行更換, 換成較小顆且轉速較高之馬達, 這樣利於進行我們的闖關策略, 讓車體重量間到最輕, 速度到達最高。(As the test results, it is decided to change the body material, to replace the body aluminum instead of using a lighter square hollow tubes, and a thin aluminum strip. Be modified, body weight was significantly reduced, plus motor actual test, the vehicle speed increases, the motor can also be replaced, and replaced

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with smaller particles and the speed is high motor, so help we invented a strategy, let bodywork weight to lightest speed reaches the maximum.)

### 2. 搬木塊(Moving pieces of wood)

(1)組裝(Assembly):搬木塊的伺服馬達在進行組裝時發現,由於力×力臂造成搬取 2.5 kg木塊時,需要的力量偏大,而且左右的組裝有點互相干涉。(To move the pieces of wood servo motor during assembly, the move to take 2.5 kg wood block is caused due to the force × moment arm, the force required is too large and assembled around a bit interfere with each other.)

(2)測試(test):經過實際測試,確定小顆的伺服馬達無法達成關卡所需的力,而且左右的工件也需要進行些許的改變,否則轉動時將會互相干涉。(After the actual test, it is determined that the small pieces of the servo motor does not reach a hurdle force required, and the left and right of the workpiece also needs to be a little change will interfere with each other or rotated.)

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3. 修改(modify): 進行修改後, 將扭力矩較大的伺服馬達換上, 把左右進行固定的工件移動成較適位置。(Be modified after the twisting torque servo motor put around fixed workpiece to move into more suitable location.)

### 3. 夾爪(Jaws)

(1)組裝(Assembly): 原本夾爪的設計, 試採用 75×10×1、50×10×1 (mm) 的壓克力, 用 3 mm的螺絲釘進行組裝, 黏結處用保麗龍膠進行補強避免其脫落, 夾爪形式參考夾娃娃機的爪子設計, 為了將三爪進行組合, 中間的機構我們採用三片壓克力, 組成三角形構造穿過螺絲釘, 將螺絲釘的孔斜鑽, 這樣組裝上才會平穩。(The original design of the jaws, try using 75 × 10 × 1, 50 × 10 × 1 (mm) acrylic, with a 3-mm screws assembled bond at the Styrofoam glue reinforcement to avoid shedding jawsform of reference clip doll machine paws design, combined to three-jaw, the middle of the institutions we use three acrylic screws up the triangular structure through oblique drill the screw holes so assembled on will be smooth.)

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(2)測試(test)：經過夾爪張合測試，我們發現用厚度為 1 mm 的壓克力太薄容易產生彎矩，而且鑽洞時較易斷裂，與馬達組裝進行夾取動作時，夾爪太薄會造成整枝爪子的不穩，且娃娃容易掉落。(After the jaws and close them a test, we found that with a thickness of 1 mm of acrylic too thin prone moment, easier to fracture and drill holes, the gripping action and motor assembly conducted jaw is too thin will cause pruning claws instability, and easy to fall doll.)

(3)修改(modify)：經過測試後，我們決定將壓克力片的厚度調為 2 mm，再次組裝，夾爪的穩定度有不少的提升，進行張合動作時，夾爪較不容易晃動，且比較不會產生偏移，在夾爪下緣處，我們將再裝上一段鐵絲，可利用三支爪子的三段鐵絲，將娃娃的頸部圈住，使的娃娃夾取上更穩定。(After testing, we have decided to adjust the thickness of the acrylic sheet 2 mm, again assembled a lot of improvement, jaw stability, Zhang and closing movements, the jaws are less easy to shake, and the comparison does not produce offset gripping jaw to the lower edge of the refill

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period of wire, the three paragraphs wire with three claws, the neck of the doll trapping, so the doll is more stable.)

### 4. 爬梯(Ladder)

(1)組裝(Assembly)：在一開始設計時，我們本來打算將車身設計為音符狀，但在用冰棒棍進行組裝時，發現用此方法上樓梯好像困難重重，不確定因素太多，即便在其車身在加上一個輪胎支撐，好像也有一點難度。(The design of the beginning, we had intended to the body design , but when assembled with popsicle sticks found on stairs seems difficult with this method, too many uncertainties, even in its body inplus a tire support, seemed to have little difficulty.)

(2)測試(test)：在實際用冰棒棍進行測試時，發現我們組裝時所考慮的問題，實際上真的有發生，像是馬達扭力的問題、車身向後向前傾的問題、還有車身重心的問題，都造成爬梯上的困難。(Actual test with popsicle sticks, we consider assembly actually really like motor torque, the body backward to forward, as well as the body center of gravity, causing the ladderon the difficulties.)

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(3)修改(modify)：最後我們決定，將車身整個修改，將車體大小縮減，且如同第一點車身所說的，我們採用較輕的空心鋁管，和較小得車身，快速的通關，不爬樓梯。(Finally, we decided that the entire amendment of the body, the body size reduction, and said as the first point of body, lighter hollow aluminum tubes, and a smaller body, the rapid clearance of climbing stairs.)

### 5. 輪胎(Tire)

(1)組裝(Assembly)：將輪胎和馬達進行組裝，把培林敲入緊配的L形板工件中，在與圓柱狀工件進行結合，組裝成馬達輪胎組。(The tire and the motor assembly, the bearing knockin tight fit the L-shaped plate in the workpiece, to be combined with the cylindrical workpiece, assembled into a motor tire group.)

(2)測試(test)：進行測試時發現，大輪胎和馬達，容易快速的消耗電

力，而且造成電路版的負擔，增加車重也使的車速降低，所以經過測試後，決定將馬達和輪胎同時做更換修正。(The test found, large tires and motor, easy consumption Force, and cause circuit

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version of burden, increase vehicle weight also makes the vehicle slows, so after testing, decided to do the motor and tire replacement correction.)

(3)修改(modify): 更換後輪胎改選擇較輕小的輪胎, 雖然其旋轉一圈所走的路徑較短, 但是較輕可以配合我們的小馬達, 較高的轉速和較小的扭力矩, 雖然走一圈變小但速度高, 所以相較起來車速還是增加不少。(Replacement tire change choose lighter small tires, walk the path of its revolution of shorter, but lighter with our small motor, higher speed and smaller torsional moment, although walk around smallerHowever, high-speed, so with growing speed or increase a lot.)

### 七、機器人創意特色說明(Feature of the robot )

由於比賽中不同的關卡, 我們特色過關方式有分好幾點, 以下一一說明。

Features clearance the partakers good points, due to the different levels of the game, following them out.

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### 1. 搬木塊(Transporting wood)：

第一關的搬木塊，我們採用的馬達為伺服馬達，相較於一般的直流馬達，伺服馬達較輕較小，而且它的轉動角度固定，搬木塊時馬達不需要轉到一圈，所以我們決定用伺服馬達，這樣角度也較好控制，而且伺服馬達比較輕小，也可減輕整體車身的重量，讓輪胎的馬達負擔降低，車速也不會因重量而被壓低。

The first hurdle to move pieces of wood, we use the motor for the servo motor, compared to a DC motor, smaller servo motor lighter, and the rotation angle is fixed, do not need to go to a lap motor to move the pieces of wood so we decided to servo motor, this angle also have better control, and the servo motor is relatively light and small, will also reduce the overall weight of the body, so that the burden of reducing the motor of the tire, the speed will not be depressed because of the weight.

### 2. 爬坡(stairs climbing)：



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全隊最後決定是不進行此關卡的進行。因此有較多的時間，每個任務都可以穩穩的完成。少了爬坡的機構，也可以讓車體變得較輕，在行走過程也會比較快速。採用此策略，雖然少了分數，但比其他隊伍有更多的時間去進行他關的任務。

The the team final decision is not the conduct of this crossing. Therefore, more time, each task can be firmly. The less climbing organization, but also allows the body becomes lighter, will be relatively fast during walking. With this strategy, though a small scores than other teams have more time to carry him off the task.

### 3. 馬達(motor)：

因為最後我們決定不爬坡，所以車身的重量可以盡量減輕，而且車體的大小也可以縮小一點，這樣整體重量減低，就可以用較小扭力矩的馬達，扭力矩越小轉速越快，而且馬達本身的重也較輕，這樣就可以達成快速闖關的目的，這樣也是我們馬達的特色。

Because in the end we decided not climbing, body weight

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can minimize and the size of the body can also narrow point, to reduce the overall weight, we can use a smaller torsional torque motor, the smaller the torsional torque faster speed, and motor of this body weight is also lighter, so that we can achieve the purpose of rapid checkpoints. This is also the characteristics of the motor.

#### 4. 夾爪(jaws)：

夾爪方面，我們採用的方法類似夾娃娃機的爪子，運用較輕的壓克力材料做成的爪子，中間鑲嵌著螺帽，運用螺紋和螺帽互相接合，可使夾爪做出張合的動作，在加上夾爪下端的鐵絲環，可使娃娃夾取時更加的穩定，不因夾爪的晃動而將娃娃甩落。

Jaws. We use clip doll machine-like paws, and claws made of the use of lighter materials of acrylic middle studded with nuts. Use a thread and nut engaged each other, allows the jaws to make and close them action. Coupled with the lower end of the jaws of wire loop can make dolls more stable gripping, and not because of the shaking of the jaws thrown off the doll.

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### 5. 程式(Program)：

全部路線都沒有採用 計算馬達 encoder 的方式來行走，都是由黑線來決定指令，像是轉彎就是靠黑白來檢查是否已轉完而進入下一指令，又如，將會在車子最後面放一顆 CNY70，可用於娃娃救援時，因為靠近娃娃的地方沒有線，所以在後面那顆感應到黑線時，就會停車，開始進行夾取動作。如此，就不會因為場地的稍微不同，得數據全部重新調整，將可以有更高的容錯率及適性。

All routes have no way of calculating motor encoder to walking, are determined by the black line instruction, like turning rely on black-and-white to check whether they have switched to finish entering the next instruction, for another example, will be put in the car last surfacea CNY70, can be used for doll rescue near doll line behind sinking induction to the black line, it will stop, gripping action. So, not because the venue is a little different, data from

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all the re-adjustment, will be able to have a higher rate of fault-tolerant and adaptive.

### 參、參賽心得(reflection)

#### 一、程式：

一開始的進度很慢很慢，每個人每個部分都是第一次接觸這些東西，大家都不知道到底該怎麼開始、該怎麼做。但在看了很多的影片，還有學長的稍微引導下，漸漸的大家才開始進入狀況。因為對程式有興趣，所以分配工作時，選擇程式部分的撰寫組員。但組合語言跟 8051 是我從來沒學過的東西，也就因為知道自己的不足，所以開始自己用學長推薦的課本來研讀，在還沒放暑假前忙完課業有空就看一下 8051，有不懂的，學長也會認真的教導，學長更會給我作業，讓我試著從作業中去體會整個 8051 的運作。學會了基本程式後，學長拿了社團之前使用的自走車程式讓我參考，才發覺基本的程式真的很基本，要活用沒有那麼容易，花了好長一段時間才讀通整個參考用的自走車程式的精隨。之後開始

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撰寫自己比賽所要用的程式及研究了一些感測器的運作，也用自己的能力寫出了SRF05(超音波)的程式。在整合的時候，讓車子按照線來直走，自己看著線來執行動作，覺得很有成就感，單靠一顆8051，就讓車子有了小腦袋，可以自己走！不管是否得到名次，學了很多東西，不只程式，機構電路部分也學了不少。動手做跟平常課本看看，絕對是很不一樣的體驗。

The beginning of the progress is very slow and very slow, everyone every part of the first contact with these things, we do not know exactly how to start, how to do that. Read a lot of the movie, as well as seniors slightly guided gradually began to get into. Program, work is assigned, select the program part of the writing crew. But the combination of language with the 8051 is something I never learned, also aware of their deficiencies, so start with the seniors recommended textbooks to study, not busy working homework before summer break whenever you look at 8051, there do not

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understand, seniors will seriously teach, seniors will give me the job, let me try to understand the operation of the entire 8051 job. Learned the basic program, the self-propelled vehicle program before the seniors took Societies let me refer only to discover the basic program is really basic is not so easy to utilize, it took a long time to read through the entire reference the essence of self-propelled vehicle program. Then started writing their own game to use the program and the operation of a number of sensors, with their ability to write SRF05 (ultrasonic) program. In the integration of the time, let the car go straight and follow the line to yourself looking at the line to perform an action, I feel a great sense of accomplishment alone a 8051, let the car has a small head can go! Regardless of whether the ranking, learned a lot, learned a lot more than programs, agencies circuit part. DIY look is definitely a very different experience with the usual textbooks.

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### 二、電路：

能參加這次這個比賽真的令我很開心，從小就很喜歡自己做東西，一直想說哪天可以做出機器人之類的，能讓他自己動作以完成目標，從六月的時候我們就開始一步步的在討論構想，看著車子逐漸成形，在經由電路、程式讓它動起來，感覺就像在懷孕生小孩一樣，在經過與多個月的醞釀成長，最後比賽就是換成它的舞台，由它去發揮了，在學校的學期過程中，我們可能會學到很多知識但都無處使用，一切都是紙上談兵，但在經由這個比賽，我們所學的知識都變成我們所能使用的利器，也讓我們知道還有很多東西等著我們去學習；我負責電路方面，才發現原來設計電路是多麼深的一個學問，訊號在經由驅動電路之後使得馬達開始動作，也學習了如何洗板子，這些都是在課本上學不到的經驗，雖然花了整個暑假，別人都出去玩而我們卻還要待在實驗室裡，但我覺得花這個時間都是值得的，希望可以得個好名次回家。

To join in this game really makes me very happy. In childhood, I liked to make things by myself and always thought that one day I can make a robot. To let it

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completes the goal by itself, from June, we began step-by-step in the discussion of ideas, looked at the car gradually forming, let it move through the circuit, the program feels like in pregnancy, baby growth after many months of deliberation. The last game is replaced by its stage and went to play it. In the course of the semester of school, we may learn a lot of knowledge, but have no place to use. Everything is on paper, but through this game, we have learned to become what we can use weapon and also let us know that there are a lot of things waiting for us to learn; circuit and I am responsible for, only to find that the original design of the circuit is how deep a knowledge. Signal through the drive circuit causes the motor to start action. And also learn how to wash the board, these are textbooks not go to school experience. Spent the entire summer, others are out to play but we have to stay in the lab, but I think are worth to spend the time. I hope you can get a good ranking to go home.



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### 三、機構：

製作機構的過程中，一開始的設計就讓我們想了很久，尤其是上樓梯和抓娃娃的結構。上樓梯的部分我們想了很多種方法，像是很多個輪胎、像戰車的鋁帶、多出來的支架、或是音符狀構造等.....，最後我們在初審前決定不爬樓梯，因為就整體而言，把時間拿去夾娃娃，以及過前兩關，其實就比賽而言會穩定一些，上樓梯的構造，雖然我們想了不少，但是未知因素實在是太多，而且馬達的扭力等問題也都是一大考量。

而夾娃娃的結構也很難做，遇到了很多困難，像爪子的重量、馬達不夠扭力，還有如何讓夾爪順利又平衡的張合，這些都是需要花一些時間來討論以及思考的。其他結構也常常有像是尺寸大小、重量的問題，所以初審後我們還花時間重做一部車。雖然途中我們遇到了很多困難，但我們也解決了很多困難，也許現在還是不斷的修修改改，不過有漸入佳境越來越好的感覺，而且我們也慢慢做出比較滿意的結構。

我們從一開始不知道怎麼做支架結構、不知道怎麼實體化我們的構想，現在我們已經可以想出很多製作上的解決方法，或是加強結構等

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等。我覺得我們從這比賽中學了很多。不只是結構方面，材料方面我們也接觸了很多，以前不知道很多材料的特性、鋁材的厚薄，現在我們可以很順利地找到我們需要的材料，比賽的結果名次雖然也重要，但是，我們從中學習到的，無論是機構也好電路也好亦或是程式，一定也都是很有價值的，雖然學習的過程中要不斷的嘗試失敗和挫折，但是，在抱怨辛勞的背後其實都有著經驗在默默累積，看似沒有什麼的動作，也許都有著深刻的意義也不一定，有付出有收穫，這場比賽，我們學到了很多。

In the process of making institutions, the beginning of the design let us think for a long time, especially on the structure of the stairs and grab the doll. Stairs part are many ways, like a lot of tires, like chariot ribbon, extra bracket or notes like structure ..... Finally, we decided not to climb the stairs in the first instance before on the whole, take the time to clip doll, as well as the first two hurdles, in fact, the competition in terms of stability — some stairs structure, although we would like a lot, but it is too much unknown factors, and motor torque, and other issues are also a major consideration.

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Doll folder structure also difficult to encounter a lot of difficulties, like the paw weight, motor torque is not enough, there is how to make the jaws smoothly and balance sheets together, all these need to spend some time to discuss and to think. The other structural often like size, weight problems, so after the first instance, we also take the time to redo a car. While en route we encountered a lot of difficulties, but we also solve a lot of difficulties, perhaps minor changes constantly, but getting better more and good feeling, and we slowly made relatively satisfied with the structure.

We do not know from the outset how do stent structure, do not know how the entities of our conception, we have come up with a lot of production on the solution, or strengthen the structure. I think from this game learned a lot. Not just structural materials we contact a lot, did not know a lot of the characteristics of the material, the thickness of the aluminum, we can successfully find the materials we need, ranking the results of the competition, although it is also important, however, from learn, whether institutional or

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circuit Hao also, or programs must also are valuable, although the process of learning to constantly try to failure and frustration, however, complaining about the hard work behind actually have experience quietly accumulated, seemingly without what action may have a profound significance not necessarily valuable harvest game, we learned a lot.