組　　別：□遙控組　■自動組	指導老師：邱創標
學校名稱：中洲科技大學	隊伍名：放課後ティータイム
(School：) Chung Chou University of Science and Technology	(Team name：) After School Tea Time

※內容需中、英對照※

壹、參賽隊伍人員：

一、指導老師

邱創標

二、組員

張旭豐、曾景鴻、張修誠、賴柏維

貳、機器人簡介

構想：

要完成這次 TDK 第 16 屆的比賽，製作出一台機器人，必須分別做出許多的機構，再加以組裝再一起，可以將機器人畫分為以下幾點：

1. 底座:

將馬達加上軸承使它成為一個聯軸器的機構，再讓輪胎與其座結合，使得機器人能夠擁有行走得功能，製作出固定座來將馬達固定在底層的下方，完成了最基本的構造。

2. 基本型體:

為了能讓機器人做出許多的功能，我們將它分為二層的構造與第一層前後兩個構造，後層是馬達所驅動的主要組件，也將電池放置在此層，而前層則負責感測路線使其沿著軌道前行，在前後兩層分別放置兩根鋁料，目的是與第二層的齒輪機構相對應，讓它能夠做出上升與下降機構。

3. 使用材質:

在設計以及構思了許多的想法之後，開始了我們的機器人製作，一開始使用了一塊木板與數根鋁材所製成的架構，由於目的地在於放置控制元件，所以使用重量比較輕盈的材質組裝。

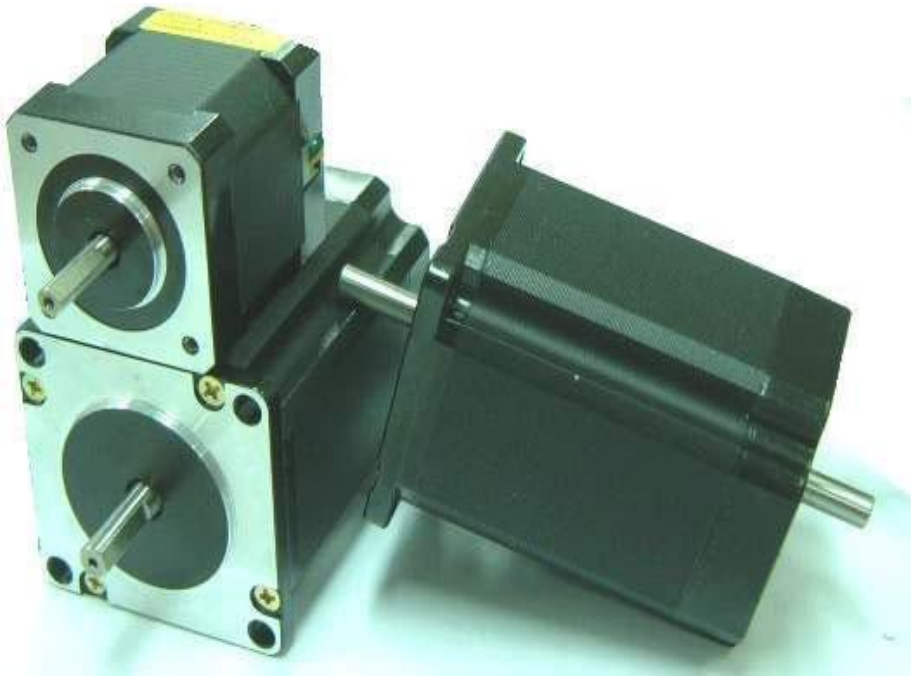
4. 尋跡:

在這個部分又要詳細分為，主線尋跡、支線尋跡以及弧度尋跡，要同時克服這三點事項，我們採取五個光纖感測器來做感應與判斷配合著程式，將三個光纖個間距50㎜，來做判斷是否偏離軌道、到哪一個點要轉彎或迴轉等動作，或是已經走了多少距離。

圖(一) 模擬與測試路線

5. 動力輪：

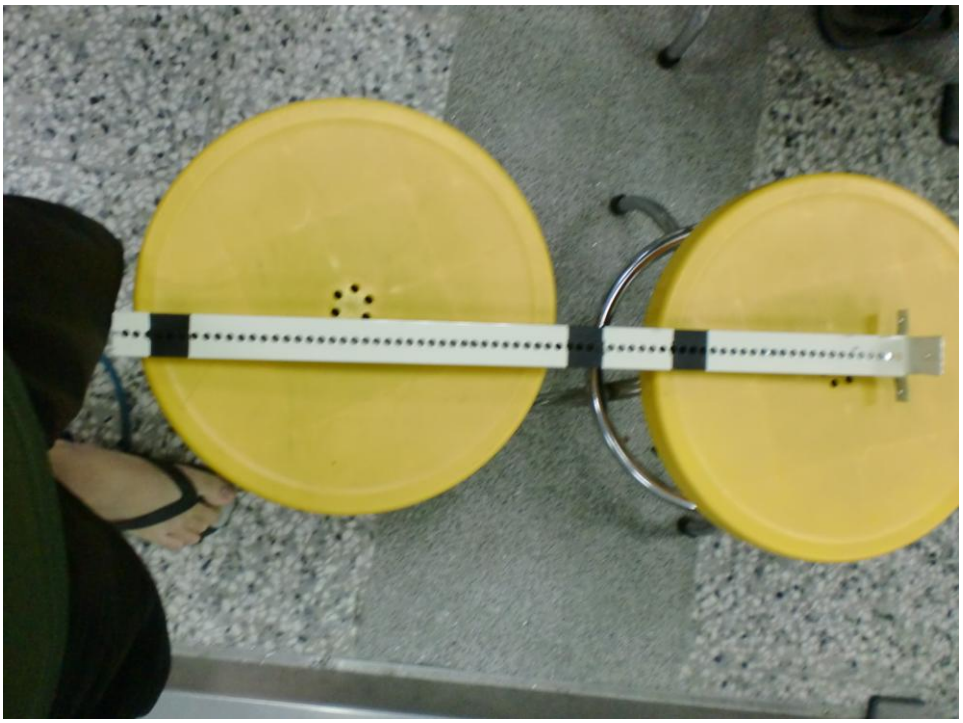
我們採用兩顆步進馬達來做為動力輪，步進馬達可以計算出行走多少距離 (脈波)和控制速度，由於我們採用雙馬達傳動所以我們以步進馬達配合程式已達道直線趨近同步動作，並配合跑弧度的設計或轉彎之設計，基於以上幾點所以我們採用步進馬達來做為雙動力輪。



圖（二）步進馬達

6. 上升機構：

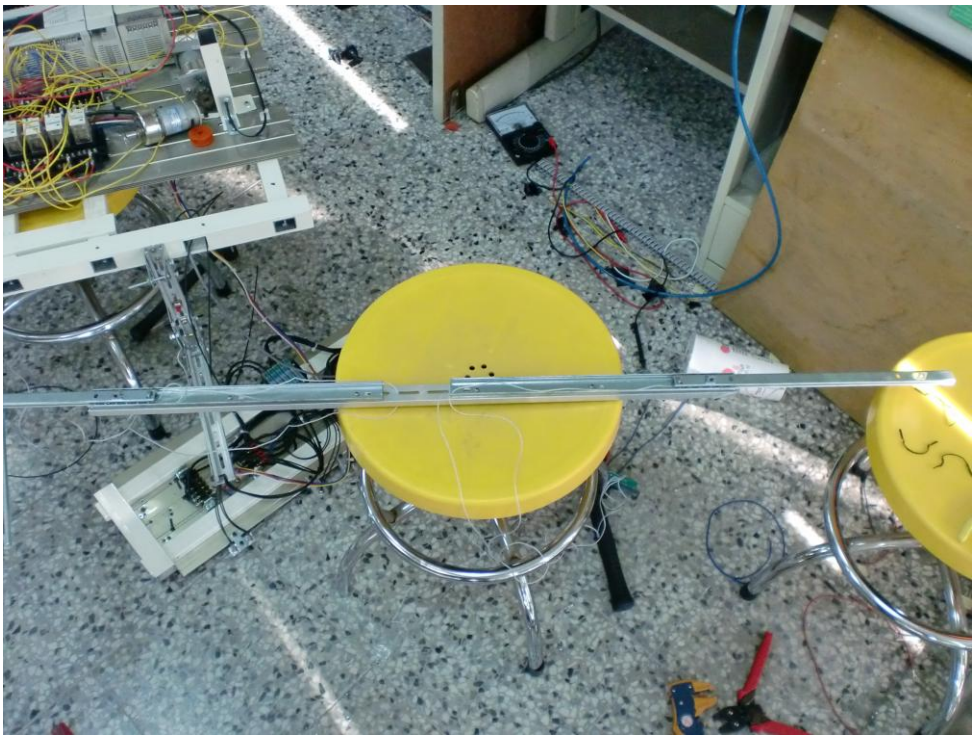
原先設想使用鏈條以及鍊輪來做為驅動機來上升與下降的機構，因為夠兼顧和傳動夠穩，不過如果要使用鏈輪與鏈條來動作的話，以我們的設計就要將鏈條以焊接方式來焊接上導軌上方才可以與鍊輪緊密接合，但這樣會讓重量隨之增加，並且也不好焊接，這也就是淘汰這個設計的主要原因了，之後我們採取定點定距的方式來鑽孔鋁管模擬鏈條的設計，這樣比較省材料，也可以大量的減輕重量。



圖（三）模擬鍊條機構

7. 夾爪：

原先採用一般平行夾爪與擺臂來變形夾取以設計來說可以達到三個救難區都可以適用於達到夾取娃娃的功能，但因重量過重導致機器人重心不穩，加上不好控制和製作，所以淘汰，之後採用滑桿、滑塊與馬達變型的設計來完成夾爪的功能。



圖(四)馬達滑軌變型

⅄ 策略分析：

我們打算先過第一關落石區清開落石障礙之後製造一個淨空的回去路線，夾完娃娃後回到放娃娃的地方，第二條路線我們過中間的土流區域尋跡後閃避障礙物到救援區救取娃娃後走第一關落石區回去放置娃娃，再來到第三條淹水區尋跡爬升到 40cm 高台後到救援區，夾取娃娃從第一關回到原點完成所有關卡與動作。

參考資料：

圖（二）：

http://www.1111motor.com/product01_1.htm

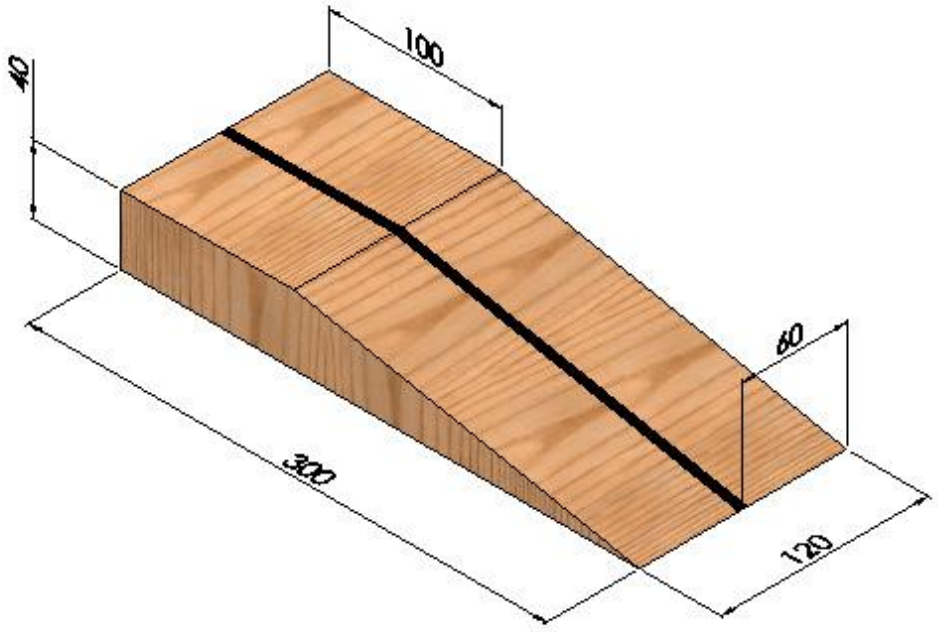
⅄ 機構設計

目的：

為了因應所有困難的障礙，一定必須要完善的機構，要有完善的機構最少會需要足夠的位置、足夠的強度，所以相對的會導致重量較為重、大小較大，所以我們以限制為上限的設計一個功能較完善的自動化機器人。

1. 淹水區：

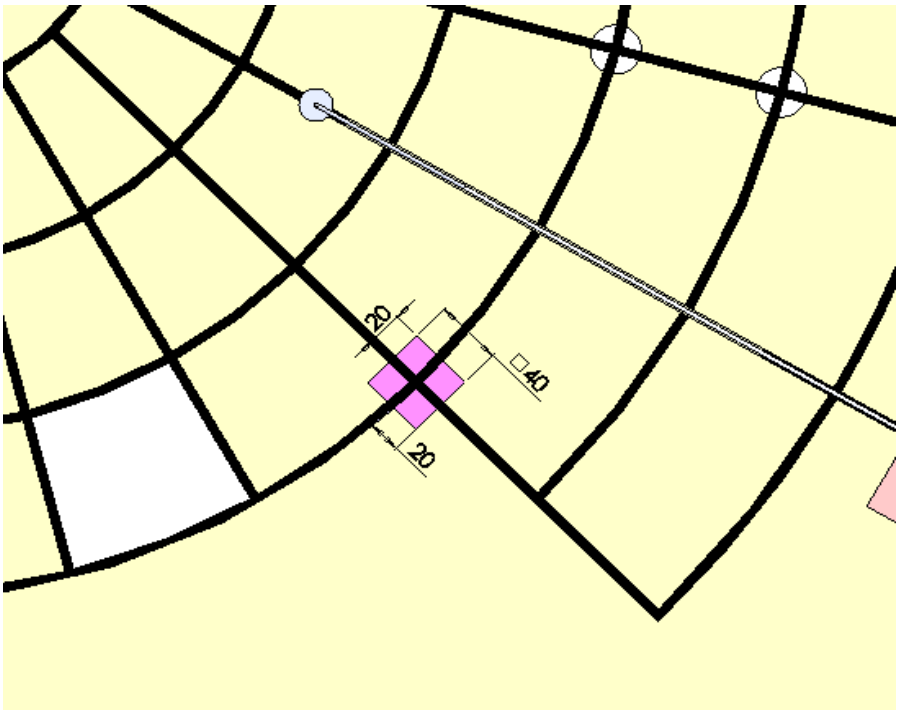
這關卡障礙是一個離地面 40cm 的平台，需要讓機器人本體上升至平台上，所以我們採用兩層的設計，為了讓機器人本體牌生 40cm 更為的順暢所以我們把下底盤分為兩層分為前後兩層，並在前曾設置尋跡感測器讓機器人尋著地面的尋跡路線繼續爬升和前進至救援區。我們上升下降系統是參考鏈輪及鏈條的資料去做一個生出縮回的原理，因為鍊條不夠穩固，所以做一個能代替鏈條的齒條，我們是以鋁管來定點鑽孔目的是減輕鏈條的重量並能達到我們要的功能，以齒輪的轉動帶動上伸下降，以保固我們可以爬過 40cm 繼續其他的救援工作。



圖（一）階梯斜坡尺寸

2. 山崩區：

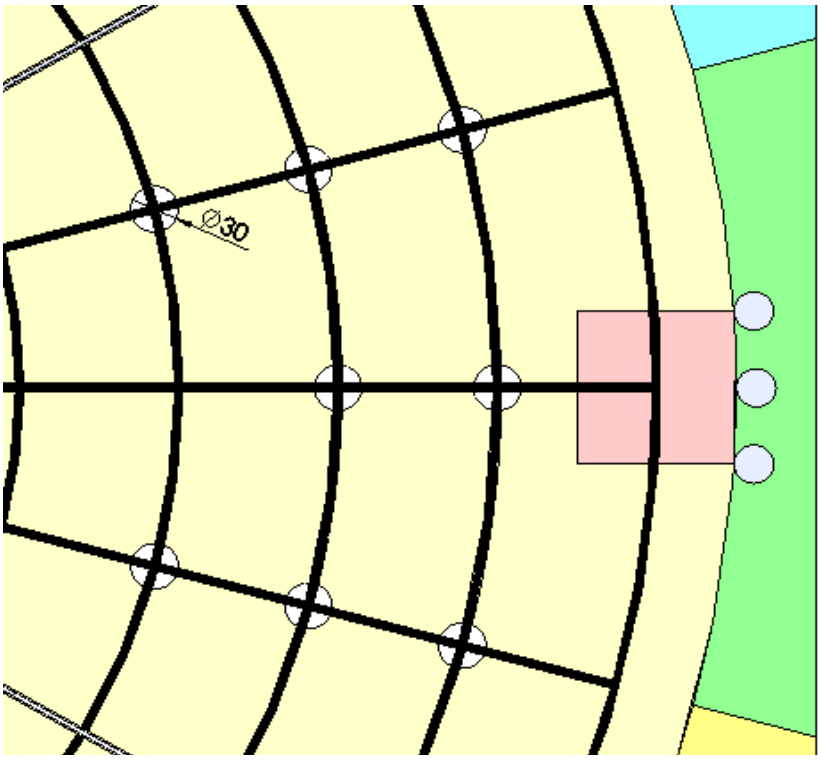
山崩區關卡目標是搬運一個落石障礙，並且是以推高機的機構，我們便以參考到的資料模擬它的動作，並和我們原本的上升下降機構作結合已達到功能過同利用，以兩橫柱往前抵住障礙物在以我們第二層的上升下降機構來舉起前進制規定位子，並考量到會影響到其他關卡的過關品質，我們將它設置在機器人的後端，並以尋跡方式將障礙移置規定的區域上。



圖（二）落石障礙位置圖

3. 土石流區：

為了避開障礙物，我們需要顆感測器能感測到遠方物體，並防止因照光較強的地區，所以選顆都符合條件的感測器。當到達土石流區後，尋跡該關卡，如前方有物體機器人將會避開於障礙到達救援區拯救娃娃，並判斷最短距離回到初始位置。

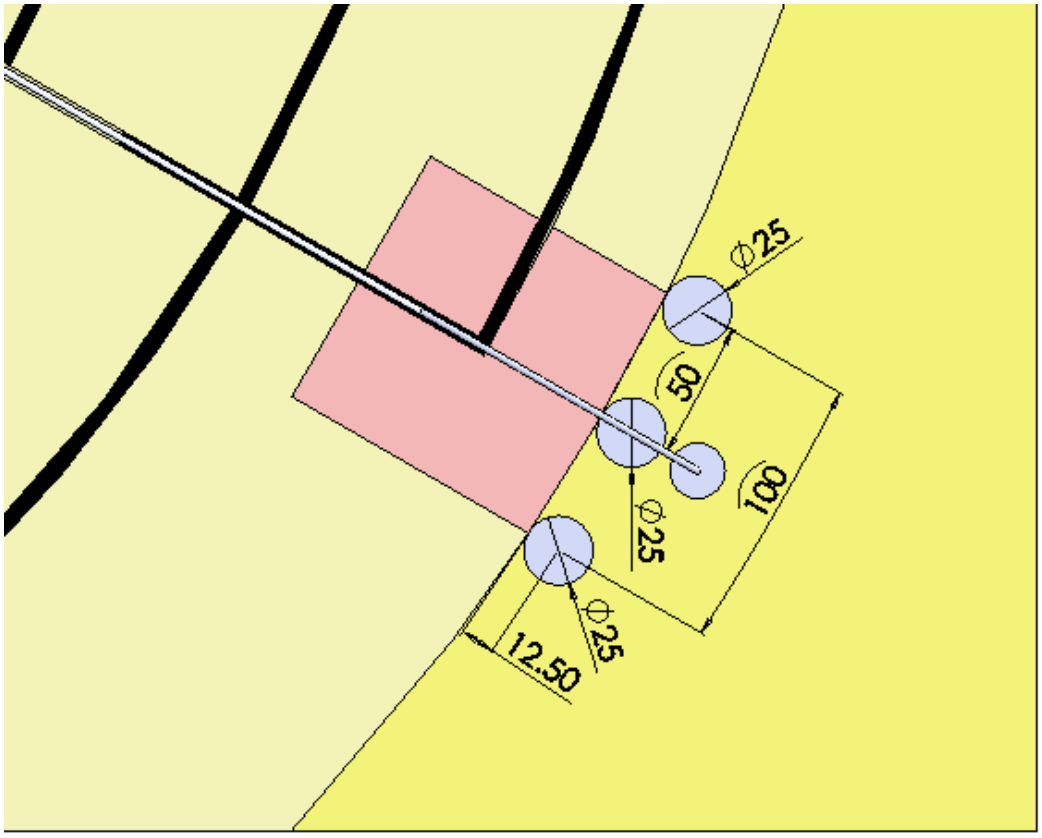


圖（三）土石流區障礙路線圖

4. 夾爪：

我們是以滑軌與滑塊來作動，以馬達正反的旋轉傳動給鋁塊，再以兩個鋁塊作為導桿配合著滑塊來作動，達到開合的效果，滑軌的部分以鋁製空心的軌道做為滑軌，為了能做出符合條件的夾爪，我們使用了滑塊加上鋁軌的特別機構，讓夾爪可以準確的到達想要的地方，娃娃在條件上是可以任意擺放在圈圈內的任何地點，為了預防因為感測不到娃娃而夾取不到，於是將夾爪做到最大寬度，使得娃娃不論擺放在何種地方都可以抓取到，但娃娃的抓取最大寬度是 1.5m 的範圍，夾爪是以鐵製的牙

條所製成，為了夾取配合三種不同高度的娃娃，我們也以抓取娃娃的脖子為目的。

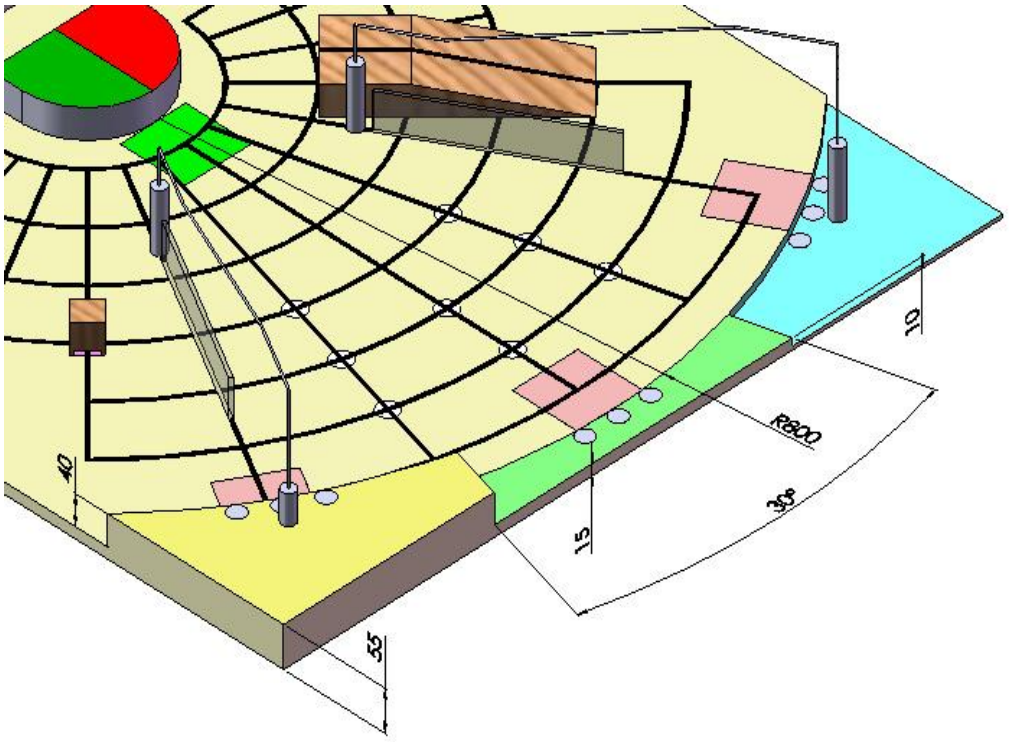


圖（四）娃娃擺放位置

5. 夾抓的馬達變形：

因為我們夾爪的機構無法應付三種高度，因而我們想出了要把夾爪變形，並且克服機器人只能 1m 娃娃最大寬度卻到 1.5m，所以我們以抽屜軌道和馬達做變型，以馬達旋轉傳動導輪轉起抽屜軌道的線，收線會讓抽屜軌道兩邊收回，放線讓抽屜軌道伸出，達到 1.5m 這樣就可以配合夾爪達成我們所期望的理想範圍與位置，因為有三種

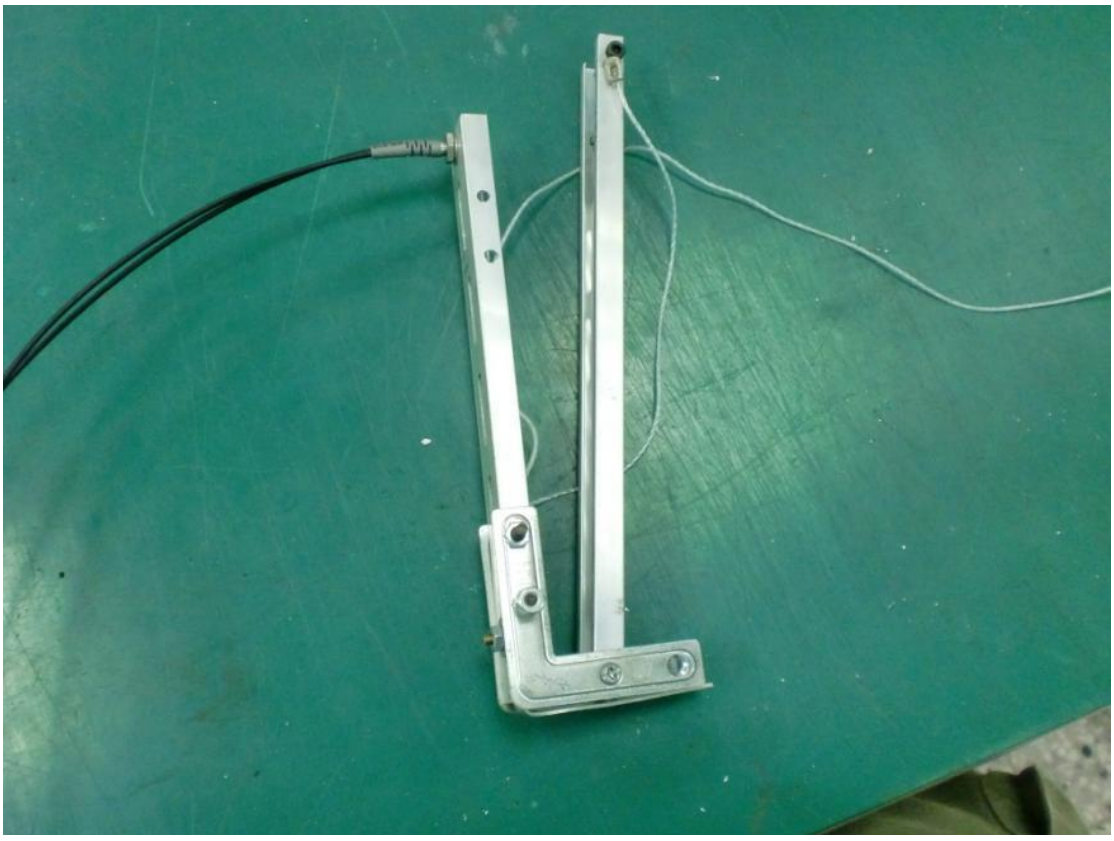
高度，所以我們用馬達配合夾爪基本底座用馬達直接傳動旋轉達到我們所期望得角度與位置，當我們到山崩區高度 40cm 夾爪不變形也不旋轉，但當到土石流區高度跟平地一樣，我們第二層下降到最底部，變型馬達旋轉像下轉動，讓夾爪可以夾到娃娃的脖子，達到我們的需求，當我們到達淹水區的救援區時，他的高度是往地面向下 10cm，就跟土石流區一樣降到最底部，再以馬達變型旋轉望下伸展，這樣就可以達到我們的夾娃娃需求。



圖（五）山崩區、土石流區與淹水區之高度圖

6. 堆高機：

因為我們機器人本身分為上下兩層，並且曾經可以上升下降，所以我們把兩個功能並用，達到共用與減輕重量的效果，我們把堆高機系統安裝在前面方便我們控制，但因為我們在山崩區需要緊貼 40cm 高度的平台來方便我們控制與夾取娃娃，所以我們把堆高機變形，把他改造成可以收放的機構，我們是以一些鋁製的軌道來組合，再用線與馬達的傳動來控制與收放，並在極限的地方設置集線開關，和感測要堆高的物品，所以我們並在堆高機系統上安裝了幾個感測器，方便控制和確保動作是否確實完整做完。



圖（六）堆高機構圖

參考資料：

ＴＤＫ自動組競賽規則

http://robot15.ccut.edu.tw/16th/update/update/1-0202-16TDK%E7%AB%B6%E8%B3%BD%E8%BE%A6%E6%B3%95-%E8%87%AA%E5%8B%95%E7%B5%841010127.pdf

⅄ 輪子驅動設計

⅄ 構思：

為了要成功完成尋機以及通過每一關的障礙物，必須要決定行走的方式，在歷屆 TDK 比賽中擁有許多種類"腳"，不管是何種種類的行走機構，都是歷代參賽者費盡心力所構想出來的結果，在這些種類下存在著個別的特色，並且擁有個別的特色與缺陷，以下是在決定最後所使用的種類以及其之前的預設設計介紹。

1. 在高職時期曾經學習過樂高機器人，並且組裝讓它作出尋跡的功能，尋跡功能中所依靠的是感測器，在判別到黑線後沿著它走出軌跡，並且還可以設計他作出幾度的轉角、幾秒之後作出何種動作，讓人覺得雖然樂高機器人很小，但卻擁有著基本大型機器人的功能，當設計機器人的行走方式時，第一個聯想到的就是它所行走的機構—履帶。

介紹：

履帶以**接合方式**來分.分成單銷式(SINGLE PIN)與**雙銷式**(DOUBLE PIN)。

單銷式	原理	兩個履帶塊相互結合之後以一根長鋼釘連結.兩端固定好。
	特色	零件組成比較少且不用記太多的步驟，雖有著單一部件重量較重的缺點，但也因為結構簡單又好加工，使重型土木作業機械都採用此一型履帶。
雙銷式	原理	兩個履帶塊直接在兩端固定接合。
	特色	為了減輕零件重量，將原本單部件的履帶細分成數個零件，但因為履帶本身就是要承載重量的，所以材料不能太差、重量也不能太輕.所以這型履帶整個組合起來，反而比單一部件式的履帶重上許多 。

優缺點：

行使中的速度並非快速，但當前進中可以保持一定程度的穩定，在越野的地面中前進時，能夠平均分散重量，使得經過鬆軟地區時可以保持穩定，且當有爬坡地時能夠擁有高抓地力，與車輪相比佔有優勢狀況。在條件上不得超過25Kg的重量，這是其中之一的考量，並且比賽場地並不會擁有越野場地，便失去了履帶的一個特色了，

而轉彎時的不便利更是使我們否決掉這個想法的最主要原因。

插圖 1: 樂高機器人

2. 否決掉履帶的想法後，觀看了某屆 TDK 的比賽錄影帶，發現了某一組團隊中的特別創意，此組創意是以模擬生態的方式呈現，以模仿「狗」來作出動作，在當時是比較突出的一種，但在轉彎時卻容易發生失誤，不過卻是個好的創意，而在某屆某組中的機器人模擬的是「蜘蛛」這種昆蟲，將機器人裝上八隻腳來進行移動的動作，前進與後退當然是沒問題的走法，而在轉彎時圖顯出了它的特別，如果只有四隻腳，在轉彎時必定會造成不穩定也不方便的狀況，但八隻腳卻可以克服這種障礙，使得行走時非常方便。

介紹：

多足的仿生機器人是一個很多人在研究的熱門領域，因為關節多，是深入研究運動學的重要部分；且因為關節多，能作出的動作就相對可以比較複雜，也可讓機器人進出比較困難的地形。常見的是十八軸六足，但要介紹的是特別的十二軸，這種設計主要是為了讓蜘蛛的控制更簡單，且因為腳尖的部分有平行四邊形的連動機構，這樣的設計可以讓腳尖那個機構“永遠垂直”地面，對於利用運動學，反運動學要去計算機器蜘蛛下一步動作和控制會簡單許多。

優缺點：

行進時有具體的生物可以充分表現出實際動作行程，在設計上擁有可以擁有許多的參照，並且有某組實際操作過證明為可行，速度上也不會產生太過於緩慢的問題，穩定性也有一定的程度。施工上擁有一定程度的困難此為重要原因，重量上也是一大考量，擔心腳會無法支撐住 25Kg 的重量，而耗電量也是一個問題，我們已經使用了

兩顆電池，在增加上去會對機體重量產生問題，驅動腳步行走用的馬達也是一大問題，且轉彎上無法成功的做出動作，雖然理論上可行但實際上卻不知道如何實行，沒辦法找到相關製作資料，多種不利的狀況下放棄了此種機構。

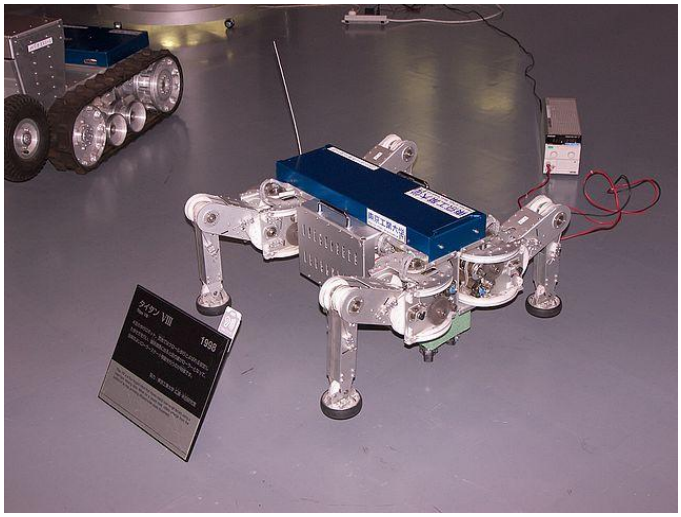


插圖 2: 四腳機器人

3. 經過了一段時間的構思之後，最後決定使用四驅車的傳動方式，此種方式是最為實用且簡單製作的一種，而轉彎也可以輕鬆的解決，也非常容易解決尋機，在編寫程式中屬於比較容易寫出的一種，而重量與前面所介紹的機構相比較為輕盈，而成功動作的信心來自於許多四輪傳動的機構，最為簡單的例子就是汽車，在眾多的考量之下，決定讓機器人以四輪的方式發展。

介紹：

四輪驅動：四輪驅動即英文 4WheelDrive 又稱全輪驅動，是主變速器通過一個輔助變速器將動力傳送到前輪和後輪，在前後車軸各裝一個稱為驅動橋的部件，變速器輸出的扭矩通過分力器和傳動軸，分別傳遞到前後車軸上的驅動橋，再通過驅動橋將扭矩傳遞到輪子上。

4WD 系統是將引擎的驅動力從 2WD 系統的二輪傳動變為四輪傳動,而 4WD 系統之所以列入主動安全系統,主要是 4WD 系統有比 2WD 更優異的引擎驅動力應用效率,達到更好的輪胎牽引力與轉向力的有效發揮,因此就安全性來說,4WD 系統對輪胎牽引力與轉向力的更佳應用,造成好的行車穩定性以及循跡性。

除此之外 4WD 系統更有 2WD 所沒有的越野性。4WD 目前大致可分短時(PART TIME 4WD)及全時(FULL TIME 4WD)四輪傳動系統,短時四輪傳

動系統可依駕駛者的需求,選擇二輪傳動或四輪傳動,這種傳動系統是屬於比較傳統的 4WD 系統,從越野性的觀點來看,此種傳動系統當選擇四輪驅動模式時前後輪系直接連結,可確保前後輪的驅動力輸出,因此此種系統系屬於適合越野的4WD系統。另一種為全時4WD系統,此種系 統不需要駕駛人操作,車輛總是處於四輪驅動系統,此種系統可經由前後驅動力的分配,可達到更完美的輪胎驅動力及轉向力的最佳化配置,係屬於高性能傳動系統,除了配置於一般的越野吉普車外,亦常用於一些高性能的轎跑車上。_

後輪驅動：在汽車剛發明時，基本上使用的都是後輪驅動，將發動機的動力通過一根傳動軸釋放到後輪，使用一部分零件可以分散到車輛後部，車身就能達到更好的配重 而且在加速時，牽引力由後輪發出，在彎道加速時駕駛員可以獲得更大的側向抓地力，以更快的速度過彎。缺點是空間相對受限。因為後驅系統會佔據底盤的部分空間，從而擠壓車內空間，而且動力要經過更多的零件傳遞後才能到達後車輪，所以相對來說不如前驅車動力來得直接。

前輪驅動：差不多二十世紀末，前輪驅動的汽車開始慢慢風行起來，因為所有後驅車的缺點前驅車都可以很好的地解決。首先就是空間問題，由於前驅車沒有複雜的傳動機構，駕駛室內變得寬敞且後排也更加舒適，此外沒有了後差速器，行李箱的空間實現了更好的利用；還有降低了製造成本，前驅車沒有通向後輪的傳動軸，也不用製造複雜的後橋殼，這樣不僅降低了製造成本，整車重量也跟著降低，對於提升車輛的加速性、燃油經濟性都有好處。
不過前驅車的新問題也隨之出現了，大部分重量都聚集在了車頭部，所以汽車後部的附著力就會變小，在快速操作時的穩定性欠佳，另外一個缺點就是前輪要同時負責轉向、加速和制動，而輪胎的抓地力是有限的，所以在快速駕駛時的極限要比後驅車來得早。

4. 在實際製作之後，我們修改了以四輪的方式，而是讓後輪以二輪傳動的方式前進，而前排機構則是使用滾珠滑動，在遇到需要轉角度的狀況下，能以 360 度的方向轉到適合的地方，讓機器人在尋軌是能夠更加便利，雖然四輪的方式並無任何的問題，但為了節省微薄的經費，打算以最小額度來製作。

插圖 3: 四驅車

參考資料：

履帶介紹：
http://tw.myblog.yahoo.com/f40h/article?mid=13933&prev=-1&next=13930

仿生機器人：
http://www.robotworld.org.tw/index.htm?pid=10&News_ID=5124

圖一：
http://pansci.tw/archives/10072

圖二：
http://www.cepolina.com/cr/robot_spider.htm

圖三：
ttp://big5.china.com/gate/big5/auto.china.com/zh_cn/gouche/wg/11026346/20110122/16355186.html

四輪驅動：
http://xing.glyx.cn/machine/2873.shtml

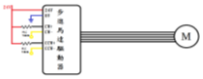
http://tw.knowledge.yahoo.com/question/question?qid=1105041702837

後輪驅動：
http://forum.dunyoung.com/viewthread.php?tid=146

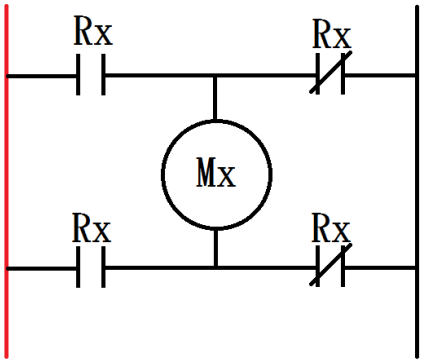
前輪驅動：
http://forum.dunyoung.com/viewthread.php?tid=146

電路設計

- 動力輪採用步進馬達來進行前進動力、轉彎的弧度、旋轉的角度、並且可以控制行進長度。



- 上升機構的馬達，必需要可以隨時上升以及隨時下降，並且附煞車功用，以免下滑或是定位不準確。



- 尋跡感測器電路，採用 3 顆光纖感測器來做尋跡感測，並間距 25mm 來作為感測的依據。

感測器設計

介紹：

我們機器人要達到上升與下降的功能、在場上擁有判別路線的尋機、落石關卡裡堆開障礙物的堆高機機構、最終達到救援娃娃的夾爪，這些是我們需要使用到的機構，而如何讓他們準確的達到目的地?則需要使用許多的感測器，以下是我們所使用到的感測器。

原理：

利用光纖，將光源所產生的光波導引至待測區，待測區中物理量，如應力／應變、溫度、折射率...，的變化將造成光波特性的變化，分析光波特性的改變，即可推得待測區中物理量之變化。由於光纖具有徑細質輕，訊息在其中傳遞，有高頻寬、不受電磁場干擾、同一光纖多點量測等優點，光纖目前已有廣泛應用於航太、醫學、化學...等各領域，至於工程量測，也有在航太結構的研究，嘗試將光纖埋入機身各部，形成可即時監控的智慧型結構，以增加航空器飛行的安全，或是將光纖鑲埋在橋樑及建築結構體中，作為即時的安全監控系統。

光纖感測器與傳統感測器之比較：

1. 傳統感測器一般採用應變計、電容、電感或壓電材料等作為調變機制或感測元件。這些傳統的方法，基本都牽涉到電壓或電流的量測，所以很容易被電磁雜訊及磁場干擾。光纖感應器則較不受電磁雜訊及磁場干擾，對於游離輻射的影響，也可以經輻射處理而避免，故適用於嚴格的環境，如核電廠中應用。

2. 光纖徑細質輕，又同一光纖可同時作為感測器與訊號傳導線，整體體積往往較傳統感測器加上導線小，故能夠被置於如細小或不容易到達的區域。另一方面，光纖感測器以光作為激發、傳輸介質，不像傳統感測器使用電流、電壓，故無處觸電的危險，頗為適合醫療上的量測。玻璃光纖又與高分子材料有不錯的相容性，不會造成脫層，適宜埋入高分子基複合材料中，以進行複合材料結構內部完整性及溫度等之監測與分析，這是應變計或壓電感測器所無法做到的。

3. 光纖材料不怕腐蝕，適於深海工程及具化學腐蝕的環境，也因此具有良好的生物相容性。

4. 玻璃光纖耐溫性比金屬應變計佳，長期之穩定性以及疲勞壽命均較電阻式應變計高，適合作為長期監測。

5. 因光纖本來即用在長距離通訊，因此光纖感測器相關技術很容易進行長距離的遙測。此外，光通訊的分波多工技術也有助於同一

插圖 4. 紅外線感測器

插圖 5. 光纖感測器

光纖中作多點的量測，目前也已有此方面之研究在開展。

6. 光纖感測器因其較為細小脆弱，裝置較為不方便。另一方面，用作製造光纖感測器的設備及讀取訊號的儀器價錢通常都相當昂貴。最後也是最重要的各種優於傳統感測器的特性，但較為脆弱，不如傳統感測器強韌，缺點是光纖感測器很多時候均對不只一個環境物理量敏感，例如光纖光柵便同時受溫度與應變影響而產生特徵波長的漂移，如何分離兩種物理量便成為重要的課題。

- 用途：

1. 上升下降的機構當中，我們使用齒條與齒輪的方式，來使得機體能作出升降動作，為了使機器人能夠準確達到所要求的位子，於是裝置了光纖感測器這項機構，在齒條所需要定位的地方貼上黑色的電火布，但在測試之後得到失敗的結果，由於電火布的顏色不夠深沉，而使得判斷會有不確定的因素失敗，因此購買了一罐黑色噴漆，將黑色電火布的地方全部噴上黑色的漆，使得齒條上升時能讓感測器感測到黑色，而使得馬達停止轉動達到定位的功能。

2. 在堆高機這項機構當中，也將使用到這種感測器，由於我們的堆高機製作成能夠折疊的功能，為了讓這機構能準確的收回，而裝置在堆高機的內側，將木塊成功的移走並且放在指定位子後，收起堆高機讓之後的動作能夠更加流暢，使得夾娃娃時不會撞到娃娃台。

3. 在設定的條件裡，我們所構思的機器人在主要的機構上面，都會使用到光纖感測器，第一個用到的地方是尋機，場地中會貼著黑色

的膠帶來使機器人沿著軌跡走，為了能沿著軌道前進，在機體的底部裝置著三個感測器，分別判斷主線尋跡、支線尋跡以及弧度尋跡，在主線尋跡中，感測器(I)的功用在於能夠判斷黑線，使得機器人能夠筆直的向前前進，不會產生左晃右彎的現象，在尋跡當中佔很重要的部份。而支線尋跡則是當機器人在中線前進後，遭遇到了轉彎的地方，讓機器人作出轉彎的動作，在場地上會有許多地方需要轉彎以避開障礙物，我們讓感測器(L)與主線的感測器(I)和感測器(R)相互配合,L 與 I 與 R 是相同的感測器,為了區別而將他們標記代號,當判斷 L 與 I 並無感測到黑線時，便往 R 的方向轉向，使它作出右轉的動作，當 I 與 R 有感測到而 L 沒有時則轉向左轉。至於弧度尋跡這項功能，與轉彎是相同的道理，但在程式上卻是特別的需要有技巧，需要不斷的校正與測試，讓機體不會反應太大或太小，為有差異非常小的狀況下才能準確的作出弧度的尋跡，我們以這種定義下來進行尋機的判斷。

4. 另一個使用感測器的地方是夾爪,我們的設計是將感測器裝置在夾爪的中間，將會空出一段空間使得感測器不會產生損壞，由於我們的長度將會變形到夾娃娃的最大寬度，這樣在夾取娃娃是能夠不考慮娃娃的位子，直接將夾爪作出夾取的動作，在夾取到娃娃的同時進行顏色判斷，但並沒有要將娃娃放置於某處，而是直接夾住直到到達顏色分類的區域，放開夾爪使得娃娃能直接掉落在安全區，在此設計上能節省掉幾個感測器，大大的濃縮了花費的經費。

- 光纖感測器：FZ1

插圖 6: FZ1

- 環境條件：

1. 操作周遭亮度：鎢絲燈:最大承受 10000LX
日光:最大承受 20000LX

2. 工作溫度：+10℃~+60℃
   儲存溫度：-20℃~+70℃
   數個在封閉機箱中 1-4PCS:+10℃~+55℃
   5 個或 5 個以上:+10℃~+45℃
3. 操作週遭濕度：35~85%RH
4. 耐雜訊：使用 EMC 電子測試系統

電源輸入雜訊:1500V	週期:0.06mm	脈衝持續:5ms
電磁輻射:1KV	週期:10ms	脈衝持續:1μs
振輻:1.5mm	3 軸持續:2Hr	

5. 耐震動：10~55HZ
6. 耐衝擊 100m/s2—3 軸各 2 次
7. 耐電壓：AC500V—20MΩ(最小)

面板與功能:

1. SENS：靈敏度旋鈕(20Turns)
2. Timer：

0ms	正常動作
40ms	OFF 延遲 0.04 秒動作
400ms	OFF 延遲 0.4 秒動作

3. Mode
   L.on:入光時 on
   D.on:遮光時 on

規格表

1. 輸出模式:

出線式	FZ1—N	FZ1—P	FZ1—NI	FZ1—PI
端子式	FZ1—ND	FZ1—PD		

2. 發光源：Red LED 680 nm
   Infrared LED 850nm
3. 工作電壓：DC12~24V ± 10%
4. 消耗電流：40mA Max.
5. 負載電流：100mA Max.at DC24V
6. 輸出模式：

NPN L.on / D.on	PNP L.on / D.on	NPN L.on / D.on	PNP L.on / D.on

7. 反應時間：0.5 ms Max.
8. 隔離阻抗：20M V min.(DC500V)
9. 絕緣耐壓：AC500V 60Hz for 60 Sec.

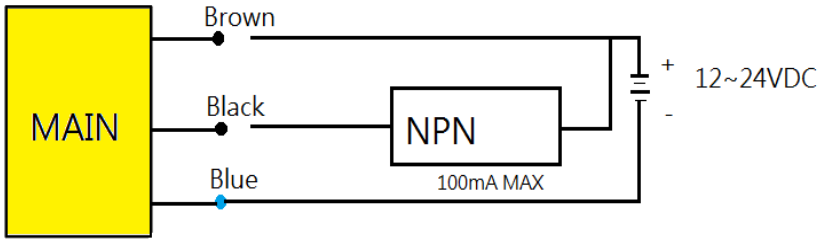


插圖 7: FZ1-N

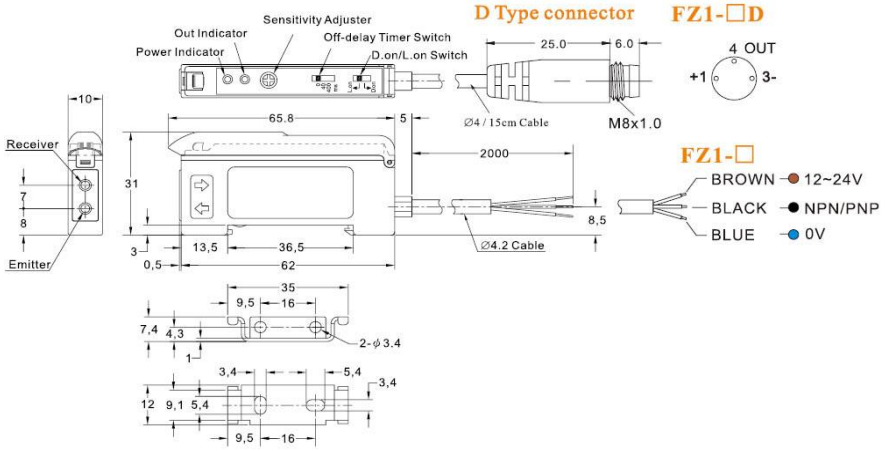


插圖 8: FZ1 尺寸圖

參考資料：

規格表：http://riko.com/photoectric/fz1.html
光纖原理：
http://www.iosh.gov.tw/Book/Message_Publish.aspx?P=22&U=214
圖一：
http://www.science.com.tw/company/index.php?route=product/product&product_id=870
圖二：
http://tw.page.bid.yahoo.com/tw/auction/e55075037;_ylt=AjXh11sod6by3ge81CiKfzKpFLJ8?u=Y5053112678&actsrch=srp3
圖三：

http://tw.page.mall.yahoo.com/item/p07183585194#ypsid

圖五：

http://riko.com/photoectric/fz1.html

⅄ 組裝、測試與修改

⅄ 組裝:

在設計以及構思了許多的想法之後，開始了我們的機器人製作，一開始使用了一塊木板與數根鋁材所製成的架構，由於目的地在於放置控制元件，所以使用重量比較輕盈的材質進行組裝。

1. 將馬達加上軸承讓它變成一個聯軸器的機構,再用輪胎與軸承機構結合，使得機器人能夠擁有行走的功能，製作出固定座來將馬達固定在底層的下方，這樣就完成了最基本的構造。
2. 為了能讓機器人做出許多的功能,我們要它分為二層的構造與第一層前後兩個部分機構，後層是由馬達所驅動的主要組件，也將電池放置在此層，而前層則負責感測路線讓機器人沿著軌道前進，前、後兩層則是分別放置兩根鋁料，目的是與第二層的齒輪與齒條機構相對應，讓它能夠做出上升與下降的動作。

3. 在前、後兩層製作完成後，開始建構第二層的流程，基本架構是與第一層相同的鋁料，但木板已經全部更換成鋁板，加工中失敗了許多次使得木版嚴重破壞，於是將它更換成鋁板這種材質，鋁板是現成的材料中重量最為輕盈的材質，因為取得容易所以優先考慮使用它，第二層製作出四個軸套，讓四個升降機構穿過軸套讓第二層能夠準確的向上升起。

4. 將馬達加上軸承與齒輪，使得馬達運作帶動鋁條達到升降動作，中間區域則是放置 PLC、電路板等許多的個別機構，而堆高機機構與夾爪機構將會放置於第二層的前端，現在所使用的堆高機是利用兩個鋁軌來加工製作而成，使用馬達來作為驅動裝置，並且安裝一塊塑膠滾輪與尼龍繩加以結合出來，使得堆高機可以做出放出與收回的動作，在製作完這些機構之後，將它放置在最前端的鋁材上，使用 M4 的螺絲加工之後把堆高機固定住。

5. 為了能做出符合條件的夾爪,我們使用了滑塊加上鋁軌的特別機構，讓夾爪可以準確的到達想要的地方，娃娃在條件上是可以任意擺放在圈圈內的任何地點，為了預防因為感測不到娃娃而夾取不到，於是將夾爪做到最大寬度，使得娃娃不論擺放在何種地方都可以抓取到，但娃娃的抓取最大寬度是 1.5m 的範圍，如果依照一般製作方式會造成超出範圍而變成犯規，為了避免這種狀況發生只好加裝夾爪再加上一組抽屜滑軌，讓機器人可以變型來成功夾取到娃娃，將夾爪裝置於第二層位於堆高機的後方，雖然是在後方但不會被堆高機機構阻礙到，這樣就完成了我們的初代機機器人。

⅄ 測試:

在製作機構完成並且成功的裝置上去之後，我們決定先做出測試，試試這台機器人是否能夠成功做出比賽的功能；一開始要測試的當然就是尋跡這項功能，尋跡是有關於能不能做出機器人的一大關鍵，只要有了尋跡就相當於是一台機器人，而不能尋跡則代表只是一台機構組合體。

1. 我們在實驗室的地板上黏貼了黑色電火布,用來模擬比賽時的情形來做出尋跡、尋軌、閃避障礙物；開始尋跡測試，一開始就產生了非常不順利的情形，在奔跑當中會產生吃步的行為，開始檢查原因，在找尋了一陣子之後仍然沒有辦法理解為什麼會產生吃步的行為，再一番調查並且有了旁人的協助才想出可能的原因，可能是馬達的扭力不夠導致無法負荷機人的重量，並且程式也有出現問題，在雙重的打擊之下導致機器人一蹶不振。

2. 而上升機構在安裝好之後也開始了測試,我們準備了八個繼電器來使得四根連桿機構可以各別做出動作，在配線方面有出過一些小問題，不過在組員強大的配線能力下順利的解決，於是開始了四根連桿機構的上升測試，各別操作了一番後都順利的做出動作，但在上升到接近頂部時卻出現問題。

原因出現在固定座做的不夠堅固，導致固定這項功能並沒有很順利完成，整體機台出現了歪斜的狀況，在意識到這種情形之後，決定先暫時不再上升開始測試下降功能，按下了下降按鈕之後，出現了滑軌的問題，四根腳開始發出了悽涼的慘叫聲，我們的心也涼了一半...，決定了我們的上升下降機構還必須加強。

3. 堆高機是在比賽中預定要過關的第二個關卡所需要的機構,製作完成之後接著就是測試了，使用馬達接著塑膠輪捲著尼龍繩再讓他進行運轉，在這完善的機構下成功的讓它做出了動作，只要馬達運轉就會帶動著尼龍繩被捲起，便產生了堆高機做出收起的情形，進行逆轉之後，理所當然的會讓它呈現放鬆的狀態，雖然在還沒經過測試時,打算先使用尼龍繩來當作試驗物品,但卻出奇意外的好用，原本是要使用電吉他弦來替代尼龍繩，但在尼龍繩如此成功的狀況下，也就繼續使用這尼龍繩，結論是一堆高機機構是可行的。

4. 夾爪在比賽中是尋跡之後的第二重要機構,主題是救災機器人，如果沒有夾爪是無法成功達到這項條件，製作完成後就是測試了，我們製作的機構都是以馬達為基礎製作出來的，在馬達的帶動下進行張開與縮回，馬達是裝置在夾爪中的滑塊上方，以倒插的方式固定在上面，雖然再固定方面有些許的困難，也有遇到許多的難關，

還是一一克服了，在開合方面也成功的測試完成。

5. 開始進行下一步，位於第二層的抽屜滑軌，一樣也是利用馬達讓他進行開合，在伸出的地方加上滑塊並且讓滑塊勾住滑軌，使它可以在回來時帶動他，雖然有一對抽屜滑軌，在經費的可行之下會使用兩顆馬達，但經費是我們一直困擾已久的問題，所以只能以一顆馬達帶動兩個抽屜滑軌，但這樣也擁有一個好處，就是可以節省重量，也可以讓兩邊的滑軌同步伸出與縮回，在協調性方面可使說是個意外的收獲，在夾爪與滑軌兩個機構結合在一起之後，開始配線與程式的努力，成功的完成這次的任務；開始做出測試，對於結果而言是個不錯的嘗試，雖然在各別啟動繼電器之後可以成功的完成動作，但在程式的寫入狀況下出現了問題，使得每一處機構都無法成功的動作，與心目中的想像差距很大，只好再多多努力。

▲ 修改：

雖然成功將機器人製作出來，但在許多方面都擁有問題，在比賽之前必須將它改善完畢，然而這只是我們的初代機，在未來將會有許多的改變與不同，但即使是初代機也擁有許多的好想法，在二代機當中也會利用到許多相同的原理，至少在大體的架構上不會有太大的變化，主要是會改變材質與機構，並且做出了許多的修改，或許會更加堅固也有可能會完全更換機構，雖然製作二代機是重要的一環，但目前會先以改造初代機直到它可以做出應有的功能，來一一克服比賽中的關卡，將會帶他出場比賽，以下是我們所需要改善的地方，並且做出了哪些動作去改變他。

1. 首先要改造的是底層這個部份，在實驗中經常將底層鑽出了許多的坑坑洞洞，在製作第二層時已經是搖搖欲墜的狀態了，為了改善這個情形，我們已經有了許多好的想法，將鋁板的部份置換成壓克力的材質，一方面是因為鑽了許多的洞而不得不置換，另一方面則是在測試的途中發現了問題，在動作流程中會出現因為應力的關係而導致變形的情形，在一開始並沒有非常的明顯，但隨著測試的次數越來越多之後，漸漸的顯現出這個極大的問題，在採購材料的時候偶然發現這個材質—壓克力，測試了它的應力之後，覺得使用它會是個好選擇。

2. 解決完鋁板的問題之後還有個大問題，會決定我們的底層將來的樣子，以目前的設計是將一整個底盤分成前、後兩個部分，但在兩個機構中間並沒有任何的材質來連接，依照原本的設計，在通過斷崖的關卡中，將會將機體升高到跟斷崖相同的高度，之後在將前層做出上升的動作，在前層到達斷崖時收起後層，這時在驅動馬達前

進來經過斷崖這道關卡，但在這個設計當中有個問題，前、後兩層因為沒有連接起來而導致在行走時，會因為應力的因素將前、後兩層擠壓，而使得兩層會向內靠近，影響到升降機構的準確性並且也讓四根連桿機構變形，對於整台機器人來說是個致命的傷害，因此最主要的改善要從這裡開始。

3. 目前我們極度缺乏時間，打算先將鋁板的部分在重新製作，一樣使用著目前的材質，而在連接的地方則暫時以升降機構作為固定，雖然在測試中還是會出現變形，製做了許多的升降機構中的四根連桿，來暫時度過校內比賽的這段時期，比賽完到校外比賽這段時間，將會擁有相當充足的時間給我們大改造，因此會以校外比賽為規劃，而以校內賽為測試。

4. 第一層暫時以拖延的方式解決，而第二層中由於擁有大部分的機構，因此需要解決的問題也相當的多，先從升降機構來一一解決，在一開始測試當中是非常順利的狀況，但問題也是漸漸的浮現出來，我們是利用馬達加上齒輪的機構來驅動升降的功能，利用著齒條與齒輪的構造加以模擬，因此在齒條的材質上是不相同，我們使用鋁條來代替原本的齒條，在這特色中是重量!重量是我們機器人的一大考量，一般齒條是一種重量偏重的材質，但在條件內重量不得太重，所以使用最容易取得的鋁條來製作，由於一般的齒條是鐵的材質，因此不會產生出材質受損的狀況，但鋁料雖然輕盈卻是相當不堅固，在齒輪的捲動下如果出現出軌的情形，則會將齒條畫出一條刮痕，且在使用次數多了之後，也會將齒條的孔磨開而讓孔變得越來越寬，就會出現無法讓第二層上升的情形，即是沒讓齒輪咬合到孔。

5. 要改善這種問題，優先考量了幾種方案，其中一種是將材質更換掉，使用更加堅固的材質，但在觀察了許多種類的材質中，並沒有完全符合我們所需要的，要求是材質必須輕盈並且在硬度上要擁有足夠的硬度，但所看見的只有滿足其中一項，並沒有符合兩種條件的材質，於是否決掉使用堅固的材質，改用另一種方案，在中空的鋁條裡塞進一條壓克力，由裡向外來將鋁條支撐住，讓齒輪這種外向應力不會將齒條壓垮，實際製作當中還沒有想法，但這是目前所能想到的最好方案，在製作過程還需要商量。

6. 升降機構中解決了一部分問題，再來則是固定四根連桿機構的問題，我們原先所使用的是角鐵，使用角鐵的好處在於可以方便固定位子，可以在想要的地點方便固定，但在尋跡的應力擠壓下，逐漸將他變得歪斜，整台機器人都發生傾斜現象，升降機構當中也有充

當著整台機器人支架的功能，一但發生問題也相當於整台機器人發生問題，角鐵雖然容易固定但在堅硬度來說太過於柔軟，為了彌補這個缺點只好將他更換成別的材質，打算將他變更為市面上容易購買的角鋁，雖然鋁的材質並沒有鐵的堅硬，但角鋁的厚度卻是製作的相當厚，在固定時可以有效的達到要求。

7. 另一個解決辦法則是將四根連桿機構加以加工,連接底層的那頭機構鉅開，將四邊鉅成展開的樣子，再加以鑽孔、鎖螺絲讓他能夠固定在底層，經過實驗測試之後，確定他能夠支撐住而不會變形，但如果升降太多次的話還是會使他變形，雖然另一個方法比較能夠解決問題，但時間太過於緊迫只好先採取這種方案，將四根連桿機構暫時固定住，讓他不會產生變形。

⅄ 機器人創意特色說明

1. 機器人採用步進馬達這種驅動機構,步進馬達的優點在於可以設定許多變化的數值,用來達到該機器人所需達到的功能性質,以下是利用步進馬達的特色來做出的動作：

   1、 設定轉彎的角度：

   在本次場地中擁有許多的交叉點需要做出旋轉的動作，無論是順時針或是逆時針，都可以透過程式來達成，並且角度 1 度到 360 度也可以做出旋轉，能利用多種方式來做出旋轉的動作，全看程式如何編寫。

   2、 計算出行走的距離：

   在避開障礙物的部分，不管障礙物如何擺設，障礙物與障礙物之間都有 1 公尺以上的安全距離可以通過，只需要計算好角度，就可以從中間通過，不過必須計算機器人的行走距離，這點就必須利用到步進馬達的功能，步進馬達可以讓我用 PLC 計算出該輸出多少的脈波數量才可以到達需求位置停機。

   3、 跑曲線弧度：

   在比賽中需要利用到曲線的應用原理，雖然場地全部是同心圓，不過弧度上還是有所不同，但是只要設定好各個弧度的數值，機器人就可以跑出預想的角度,來讓機器人沿著弧度前進以通過各項關卡。

2. 上升機構：

   採用齒輪與齒條的替代品，利用鋁條來代替齒條，並且改為齒輪與定點鑽孔以利於輕量化，製作過程也更加得輕鬆，我認為這是我們機器人最有創意的地方。

圖一：上升機構

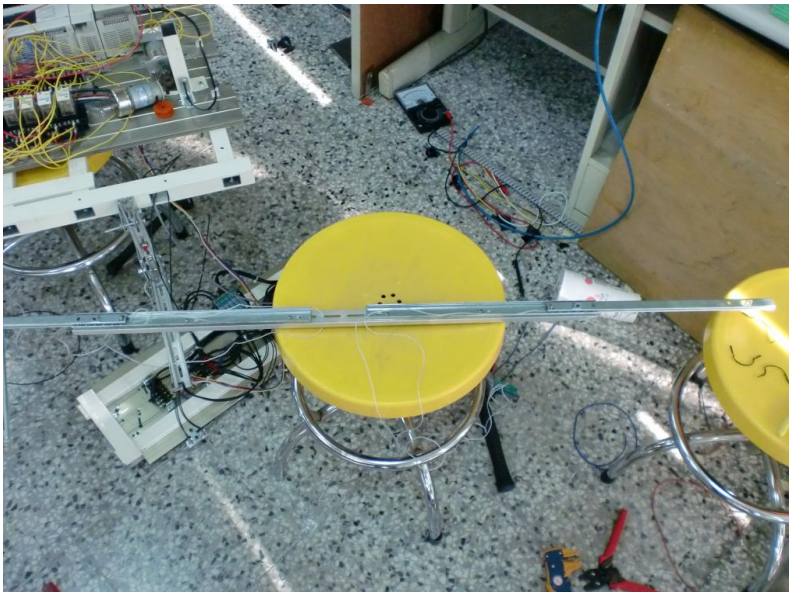
3. 尋跡感測器：

   採用光纖感測器來做定位，並且讓感測器個別間距 25㎜ 距離，剛好在黑線的中間與左右兩旁來判斷感測的位置，如果偏離 1㎜ 將可以

讓程式來做導正機器人尋跡的作用。

圖二：感測器

4. 中間定位感測器：
   功能為感測機器人是否在中間的位置，比賽中許多位置都有交叉點，這些交叉點可以用來判斷何時要轉彎或是何時要停機旋轉的動作，有了中間地為感測器可以更方便定位。
5. 夾爪變形：
   原先距離要縮小在於 1 公尺內，但是夾取娃娃的位置要再 125cm 的位置才可以夾取，為了對應這段長度所以採取變形的動作，在變形後採取滑軌與尼龍線的拉動方式來進行開合動作。



圖三：夾爪變形

6. 夾爪：
   本次比賽的娃娃放置大小約 ϕ25 的夾取位置，在機器人沒有搭載搜尋娃娃感測器的情形下，採用最大的夾取範圍來做精準夾取，不論對手將娃娃擺放在圈圈的何處，都可以順利的將娃娃夾取。

參賽隊伍人員及機器人簡介

Team Member and Robot Introduction

⅄ 討論

⅄ 在製作機器人這段過程中，我們團隊之間會擁有許多次的討論，再遇到問題或者是未來機構的設計，都會進行討論來決定方案，以團隊的意見來製作機器人，在意見上雖然會有許多的不合，但是擁有更多的討論、更多的意見，所出來的結果也會更加的豐富，在創意上也會增加更多的想像，造就出來的機器人會更有創意性，以下是我們所進行過的討論，以一段一段時間的方式來描寫。

1. 目標是將我們底盤(上)做一個簡單的組裝，由於目的只是放置控制元件，所以以較輕的材質組裝，以鋁架為架構，木板圍放置 PLC、繼電器等…的設備，由於因為還沒完成整體的尺寸，所以以最大限制 1M 為尺寸。

2. 對馬達的固定、連結器加工製作，以螺桿為連結器跟輪子的連結帶動，加工過的工件上鑽兩個小孔來固定馬達及螺桿，並用螺帽鎖緊輪子兩端防止鬆。作出的成品由於還會稍微偏心，所以往後可能需要重新在製作並改善。

3. 利用簡單的薄物體做尋跡的感測，並加上四個虎鉗加

重於底盤上，主要目的是要先測試新買進的感測器，並作載重測試，但由於做尋跡的物件會妨礙到行進的路線，導致無法正常的直線前進，將會購買黑色電火布來黏貼場地。

4. 到各五金行、大賣場尋找材料，目前所需要買進的材料有...三個萬向滾珠、黑色電火布、點火器的底座、兩顆 12 伏特機車用鉛酸電池，由於萬向滾珠比較少見到所以沒有尋找到，但並不妨礙整體試車。將電池配置上底盤後作直線載重的測試，多次的撞機，但少次能直線前進，由於沒有加裝萬向滾珠而沒有將重量分散，由於多次試車及撞車，導致底盤變型，底盤將會重製並加強強度。

5. 將買進的 SSR 配線至馬達上，並測試其功能如何，由於目前 PLC 功能不是相當完善，所以導致尋跡擁有困難的地方，將會使用別種方案作為改善。利用身邊現有的兩顆紅外線感測器裝置底盤上作為感測交叉路的功能，改善不能判斷交叉路口的情形。

6. 由於後底盤強度不足導致變型，所以要再重製後底

盤，規格也改進為長 70cm、寬 30cm。上伸機構以齒輪齒峰的間距以 7mm 鑽兩條 55cm 的鋁架，並嘗試讓齒輪在上面轉動測試，效果不佳，將有可能換成別種方案。

7. 製做前底盤兩支、後底盤兩支，共 4 支齒條，長為 70cm，以間距 7mm 為中心鑽 M6 的孔，並將它以角鐵固定在前底盤及後底盤，在齒條側邊及底盤上鑽 4.5mm 的孔將 4mm 的六角螺帽鎖置上面。

8. 由於加裝齒條使得前底盤長度不足，所以重作一塊第一層的前底盤，並將之前底盤的萬向滾珠安置在上面，再將前面部分鑽洞讓它足以固定感測器，之後將之前製作好的齒條固定置上面。

9. 為了防止上次底盤的變形，於是在後底盤上裝置萬向滾珠，並將鋁塊鋸成兩塊，將兩塊鋁塊加工成一塊 L 型的型狀，安裝置馬達上，以包裝馬達的方式再鎖緊至後底盤上，防止重量的施壓使得後底盤變形，製作兩組 L 型塊並安裝置上面，強度將會變強足以讓一個普通人的體重壓至上方。

10. 第二層底盤鋸出齒條的滑軌大小，並將鋁軌固定在齒輪的滑軌上，在第二層底盤上鑽出孔，將以角鐵固定在鋁軌及第二層。在齒輪滑軌上鋸出能讓齒輪轉動的口徑，將下底盤的前、後安裝上去，安裝上去後才發現下底盤前、後會干涉到，所以會把第二層鋸錯位置的地方換掉，並將再鋸在正確位置。

11. 因為我們是使用鏈條與鏈輪的原理，所以我們準備了 4 顆 90rpm 的馬達，並且製作能夠固定馬達上的固定座，為了防止馬達因上伸或下降時產生的力量導致變形，所以做個簡單的固定座鎖置馬達後面，這樣便不會造成嚴重變形。

12. 測試上伸及下降的機構，發現若繼電器以共 com 方式迴路配線，將會出現馬達無法同時轉動的現象，最簡單方式就是把每個馬達都加以配置上升及下降繼電器，這樣就能解決問題，但它被置共 8 個繼電器會使的位置變小，所以我們將會配置簡易自製的電路板來控制 4 個馬達上升及下降，不但簡省空間，也減少重量並達到美觀的功效。

13. 原先使用的自製齒條因測試上升及下降多次，加上第一次精度偏低，所以會導致滑牙的現象；鋁板鑽過多的孔，使得板子強度變低，也因馬達上升及下降的磨損，導致板子變形也會搖晃。綜述結論，我們將會更換新的板子，並將換成較精確的齒條。

14. 將新的上伸下降機構及板子換上，並將第一層的前盤及後盤裝置於第二層，且前盤及後盤水平於地面，將尋跡感測器調整到適當的感測位置及強度後，開始測試寫好的程式，在準備好的場地上測試幾天後到來的訪視，以捲尺量測 3m 長度，並每 0.5m 的距離貼上記號，使得瞭解完成幾公尺，測試結果為我們能尋跡 3m 且不會偏離尋跡路線。

15. 目前有 PLC、馬達、繼電器、感測器、電源供應器、電池等，放置在第二層時發現位子大大的不足，原先決定要將第二層在加上一層小木板，但在考量動作狀態與限制 1m 之後否決掉了，最後將電池放置第一層，經過測試之後發現不會對動作有太大影響，在將剩下的經由特殊擺放勉強放置在第二層。

16. 在配置好了線路並且準備好程式之後，我們給予兩顆12V 電池，經過實驗之後，發現電池的給電量不足，使得馬達無法正常動作，並且無法同時啟動四顆馬達，原本決定經由配線更加節省電源來給予充分的電量，但是失敗了，最後買了尺寸比較小的電池來解決這次的問題。

17. 尋跡的過程中，整台機體發生傾斜的狀態，觀察中，發現上升機構的齒條前面與後面不平衡，由於計算長度時出現錯誤，並且也發現在爬上斷崖關卡時長度一樣短缺，決定再重新製作四根齒條，前面 72cm 後面 67cm、齒間隙 9mm、鑽 M6，由於後面有輪胎所以長度需要比較短的尺寸，再經由測試時已解決問題。

18. 起重機機構，是我們一直再思考的構造，最初我們採用的是現實中堆高機的機構，但在製造過程中發現許多問題，於是使用新的機構來解決卡到前方而無法夾取娃娃的問題，讓夾爪有了折疊的功能，之後還會再裝上泡棉止滑墊來防止落石滑落。

19. 夾爪在中途曾經想要改變其設計，不過設計的方案都

不夠完整，最後決定製作最先的設計，在第二層加裝滑軌使其能夠變形達到 1.5m，即為夾娃娃的最大長度，裝上夾爪機構、感測器，讓機器人能在抓取娃娃的同時判斷顏色，在達到定點時準確的放置於該顏色。

20. 在日期接近校內預賽的時間，開始在許多細節上下功夫，補強許多脆弱的地方並且將堆高機盡快完成，如今只缺少了程式，而在夾爪的部份則是選擇在決賽時在使用，由於時間緊迫而無法順利如期完成，選擇用路跑來獲勝的策略。

21. 在上升機構的定位感測中，發現黏貼黑色電火布的顏色不夠深，再討論下決定去購買一罐噴漆，聞著令人難受的味道之後，終於將它噴成了深黑色，實驗過上升機構之後定位的部份變得更加的順利。

22. 經過一番討論之後，決定了夾爪的設計，作出三個夾爪來同時抓取娃娃，我們以馬達作出前進後退的動作帶動滑塊在滑軌上動作，滑軌制作成兩段式，使得左右兩旁的夾爪能達到想要的位子，讓夾爪能直接伸出夾取到娃娃。

23. 校內預賽的初日，在昨天充份準備下前往比賽，在場上看見對手的機器人，也讓我們萌生了許多創意，在結束比賽之後，開始了反省與討論，準備在全國賽之前製作二代機，讓比賽變得更有把握，並且修改許多的缺陷。

參、參賽心得

這次的競賽

參加完這次的 TDK 機器人比賽，讓我們學習到了許多關於團隊的精神，我們每天盡心盡力、一點一滴的揮灑汗水，在這二百多天裡，有了伙伴們的努力，結合了在校所學與機械相關技術讓機器人，有了自我的生命價值。

雖然鎩羽，但有了如此寶貴的經驗，讓我們在競賽中，獲取關於機械與自動化工程相關技術。

Ideas:
To be completed in the the TDK 16th game, to create a robot must make many institutions, coupled to assemble together, can the robot painting is divided into the following:
1 base:
Plus the motor bearings makes it a coupling mechanism, let the tires to their seat combination enables the robot to have walking function produced holder motor fixed at the bottom of the bottom to complete the most basic structure.
Basic body:
In order to allow the robot to make a lot of functions, we will divide it into two-story structure of the first layer before and after the two constructed after layer is driven by the motor components, also the battery is placed in this layer, the previous layer it is responsible for sensing line before along the rail line, the two were placed in the front two layers of aluminum material, the object corresponding with a gear mechanism of the second layer, so that it can make the rise and fall mechanism.
Material:
Conceived many ideas to start our robot production, start using a framework made of a piece of wood and aluminum roots, because the destination is to place the control element, the use of light weight materials assembled .

Tracing: 4.

In this part also details divided into the main line tracing, the Extension tracing radians tracing To overcome these three matters, we take five fiber optic sensor to do the induction and judgment with the program, the three fiber pitch 50mm, do judge deviated from the track, where a point of turning or rotation action, or how much distance has gone.

Figure (a) simulation and testing route

5. Power wheel:

Two stepper motors do for power wheel, the stepping motor can calculate how much a walking distance (pulse) and control speed, so we use dual motor drive straight-line approach to the stepper motor with the program has reached the Road synchronized action with ran curvature of the design or the turning of the design, based on the above points so we use a stepper motor as a dual power wheel.

(B) stepper motor

6 rose institutions:

Originally envisaged to use a chain and sprocket do rise and fall of the institutions for the driving machine, enough to take into account enough stability and drive, but if you want to use the sprocket and chain to move to our design will be the chain by welding to weld on the rails just can work closely with the sprocket engaging, but this will make the weight increases, and is not good welding, which is out of the main reason for this design, and then we take sentinel fixed pitch drilling aluminum tube design of analog chain, this will save material, can also be a lot of weight reduction.

FIG (c) the analog chain mechanism

Jaws: 7.

Generally parallel to the jaws of the swing arm to deformation gripping design can achieve three rescue area can be applied to achieve the gripping doll

features original, but the weight is too heavy to cause the center of gravity of the robot, and poor control and production, so eliminated, after using the slider, the slider, and the motor variant designed to perform the function of the jaws.

Figure (d) motor sled variant

strategy analysis:

We intend to first over the first hurdle rockfall area Qing Kai rockfall barriers to manufactured after a clearance back route back to put the doll clip finished doll, dodge obstacles to the second route over the middle of the earth flow area tracing rockfall area take the first hurdle in the rescue area to save after the baby is taken to go back and place the dolls, and then came the third flooded tracing climb to 40cm high platform to the rescue zone, back to square one gripping doll from the first hurdle to complete all levels and action.

References:

Figure (b):
http://www.1111motor.com/product01_1.htm

mechanism design

Objective:

In response to all the difficult obstacles, certain institutions must be improved, the need for a sound body will be at least need enough, enough strength, so the relative weight cause more weight, size, so we limited to an upper design a better automated robot.

1. Flooded area:

This hurdle obstacles is a platform from the ground 40cm rise to the platform on the need to let the robot body, so we have adopted a two-tier design, in order to let the robot body cards Health 40cm more smooth so we under chassis is divided into two layers is divided into before and after the two-tier, and prior to setting tracking sensors allow the robot to continue to climb and advance to the rescue zone Looking back on the ground, tracing the route. We rise and fall system with reference to the sprocket and chain do give birth to a retracted principle, because the chain is not solid enough, so do a can instead of the chain rack, we in aluminum tubes to fixed-point drilling that aims to reduce the chain weight and achieve the functionality we want to gear driven

rotation stretch dropped warranty we can climb a 40cm continue rescue work.

Figure (a) stepped ramp size
. Landslides District:
Landslide area checkpoints target handling a rockfall barriers, and is pushing the high institutions of its reference to analog action, with the use of combination has been reached and the rise and fall mechanism and our original function over to cross-pillar forward up against obstacles raised proceeds Provisions seat institutions to decline our second rise, and taking into consideration the quality will affect other hurdle clearance, we will set it in the back-end of the robot, and tracing obstacles relocated under the area.

(B) rockfall barriers to location map
3 mudslide District:
In order to avoid obstacles, we need satellites sensors sensed distant objects, and to prevent because of the the Illuminated strong, so the election teeth are in line with the conditions of the sensors. When the after the mudslide District is reached, tracing the checkpoints, such as the front of the objects the robot will avoid the obstacles to reach the rescue zone rescue doll, and to determine the shortest distance back to the initial position.

Figure (c) mudslide obstacles roadmap
4 jaws:
Based on rail and slider actuator to rotary drive motor pros and cons to the aluminum block, two aluminum block as the guide rod with the slider moving to achieve the effect of opening and closing part of the rails to aluminum prepared a hollow rail as a rail, To can make Matching jaws, we use special body of the slider plus the aluminum rail, so that the jaws can be accurately reach the desired place on the condition, the doll can be arbitrarily placed in a circle within any location, in order to prevent not sense doll gripping less than to do the maximum width and, therefore, the jaws, making the doll placed regardless of what place can crawl, but doll crawling maximum width of 1.5m, the folder the claws is based iron teeth shall be made, gripping the doll with the three different height, we also for the purpose of crawling doll's neck.

Figure (d) doll placement

Pinch-grip motor deformation:

So drawer track and motor variant rotary drive motor in the jaws of the institution is unable to cope with three heights, so we came up with put the jaws deformed and overcome the robot only 1m doll maximum width of 1.5 meter has to guide line rotation from the drawer orbit, the closing line will make both sides of the drawer tracks to recover, actinomycetes let drawer tracks extend reach 1.5m so that you can fit the jaws to reach our desired ideal range and location, because there are three heights, so we achieve our desired angle and position rotary motor direct drive motor with jaws basic base does not rotate when we went to the the landslide zone height 40cm jaws is not deformed, but when the height with the ground to the mudslide area, our second layer down to the very bottom of the variant of motor rotation like rotation, so that the jaws can be clipped to the baby's neck, to meet our needs, when we arrived at the rescue area flooded him down to the ground 10cm height, just like mudslide area, like down to the very bottom of the rotation look under the motor variant stretch, so that we can achieve our clip doll needs.

Figure (e) the height of the landslide area, mudslide area flooded Figure 6 Stacker:

Because our robot itself is divided into upper and lower levels, and once you can rise and fall, so we put the two functions and to achieve the effects of sharing and reduce weight, we stacker system installed conveniently in front of our control, but because we are in a landslide areas need to be close to 40cm high platform to facilitate the control and gripping doll, so we Stacker deformation, he transformed into a retractable mechanism, we in some aluminum track to combine, then line with motor drive control and retractable in the ultimate place settings set line switch, and sensing heap high items, so we Stacker system installed several sensors to facilitate control and to ensure that action is indeed complete finished.

Figure (six) heap high organizational chart

References:

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參賽隊伍人員及機器人簡介

Team Member and Robot Introduction

8B% 95% E7% B5% 841010127.pdf

wheel drive design

idea:

To look for an opportunity to be successfully completed, and must decide the way to walk through each obstacle, has many types of "feet" in the previous TDK game, no matter what kind of running gear, are ancient contestants devoting himself are conceived in these types there are individual characteristics, and individual characteristics and defects, the following in determining the type used in the final before the default design introduced.

Vocational period once learning Lego robots and assembly let it make tracing tracing function relies on a sensor out along its trajectory discriminant black line, and can also design he made a few degrees of the corner, and after a few seconds, what action, people think Lego robots are very small, but it has the basic function of the large robot, when design robot walking, the first think is it walking institutional ─ crawler.

Introduction:

Crawler to engage way points. Divided into single-pin (SINGLE PIN) with two-pin type (DOUBLE PIN).

The principle of a single pin the two crawler block each other after a long nail Links. Both ends fixed.

Features of parts is relatively small and do not mind too many steps, although single components heavier shortcomings, but because of the simple structure sound processing, heavy civil work machinery have adopted this type crawler.

Two crawler block directly in the principle of the double pin fixed at both ends engagement.

Characteristics in order to reduce the weight of the parts, the original single track of parts is subdivided into a number of parts, but because the crawler itself to carrying the weight of the material can not be too bad, nor too light weight, so this type crawler combined, rather than single part-crawler heavy on many.

Advantages and disadvantages:

Exercise in speed is not fast, but advance can maintain a certain degree of

stability to evenly distribute weight forward in the off-road ground, making stable through the soft region, and to have high grip when climbing places fertility, and the wheels dominant status. 25Kg weight shall not exceed the condition, which is one of the considerations, and the venue and will not have cross-country venue, they lose a feature of the crawler not turn facilitate more veto the idea the most important reason.

2. Veto crawler thoughts, to watch a game session TDK tapes found in a specific group of special creative team, this group of creative the analog ecology presented, to imitate "dog" to make the action, is more prominent one at the time, but in turn they prone to mistakes, but it is a good idea, "spider" in a session of a group of robots simulated this insect, the robot is fitted with eight legs action, to move forward and backward, of course is not the walk of the problem, but when cornering diagram showing a particularly if only four legs will cause instability during cornering is not convenient condition, but eight feet but can overcome such obstacles, makes walking very convenient.

Introduction:
The bionic robot myriapod a lot of people in the hot area of research, because more joints, in-depth study of an important part of the kinematics; joint action to make relatively more complex robots out of the more difficult terrain. 18-axis hexapod common, but to introduce a special 12-axis, this design is mainly to let more simple spider control, and because the toe portion of the parallelogram linkage institutions, this design allows The toes that institutions "always vertical" ground using kinematics, anti kinematics going to computer spider next move and control will be much simpler.

Advantages and disadvantages:
Specific organisms can fully demonstrate the actual operating travel, can have many reference design has when traveling, and a group of actual operation proved successful, it does not produce too slow speed, stability a certain extent. Construction has a certain degree of difficulty this is an important reason for the weight is a major consideration, worried that the foot will not be able to support live 25Kg weight, and power consumption is a problem, we have to use two batteries in the increase up to be body weight, motor drive footsteps walking is a big problem, and not be able to successfully make the

turn action, although theoretically feasible, but in fact did not know how to implement, can not find the production of information, a variety of adverse conditions to give up such an institution.

After some time the idea of a final decision to use four-wheel drive in this manner is the most practical and simple making a turn also can easily solve, is also very easy to resolve to look for an opportunity, in the preparation of the program belongs to relatively easy to write a the weight previously described institutions compared to the more light, while confidence in the successful action from many of the bodies of the four-wheel-drive, the most simple example is the automobile, many under consideration, decided to let The robot development in four ways.

Introduction:
: Four-wheel-drive four-wheel drive English 4WheelDrive also known as all-wheel drive, is the main transmission through an auxiliary transmission power sent to the front and rear wheels in the front and rear axles of the tube called a drive axle parts, transmission output torque by force components and drive shaft, respectively, passed to the drive axle on the front and rear axles, the torque transmitted to the wheels by the drive axle.

The 4WD system is the driving force of the engine into a four-wheel drive, two transmission system from 2WD and 4WD system and are included in the active safety systems, mainly 4WD system than the 2WD superior the engines driving force application efficiency, achieve better tire traction and steering force effectively, security, 4WD system of tire traction and better application of the steering force, resulting in good driving stability, as well as tracking.
In addition to the 4WD system more the 2WD as off-road. 4WD generally can be divided into short-term (PART TIME 4WD) and full-time (FULL TIME 4WD) four transmission system, the short-time four transmission system according to the needs of motorists, select two-wheel drive or four-wheel-drive, this drive system belong to the more traditional 4WD system, from the viewpoint of the off-road, such a transmission system when a four-wheel drive mode is selected, the front and rear wheels as a direct link, the driving force output to ensure that the front and rear wheels, such a system is therefore are suitable for off-road The 4WD system. Another for full-time 4WD system, such systems

do not require the driver operation, the vehicle is always in a four-wheel drive system, such a system may be provided via the front and rear driving force distribution can be achieved more perfect tire driving force and steering force of the most Guardian configuration, the system is a high-performance drive system, in addition to the configuration in general off-road jeep, offenders are usually used for high-performance coupe.

: Rear-wheel drive car invention basically uses are rear-wheel drive, the release power of the engine through a drive shaft to the rear wheel, the use of part of the parts can be distributed to the rear of the vehicle, the body will be able to achieve a better counterweight and issued by the rear wheels during acceleration, traction, acceleration in the corners, the driver can get a greater lateral grip, faster cornering. The disadvantage is that the space is relatively limited. Rear-wheel drive chassis will occupy part of the space, thereby squeezing the interior space, and the power to go through more parts pass to reach the rear wheels, so relatively speaking, not as good as before the drive power is more directly.

The front-wheel drive: almost the end of the twentieth century, the front-wheel drive car slowly began to chill out, because all the shortcomings of the rear-drive before the drive can well solve. First is the space problem, the front-drive complex transmission mechanism, spacious and the rear is also more comfortable cab, In addition, no differential, trunk space to achieve better utilization; reduced manufacturing cost, before the drive with no access to the rear wheel drive shaft, they do not manufacture the complex rear axle housing, not only reduces manufacturing costs, also followed to reduce vehicle weight, improve vehicle acceleration, fuel economy are good.
However, the new front-drive problem appears most weight are gathered in the car the head, so the adhesion of the rear of the car will be smaller, poor stability in fast operation, another drawback is the front wheel to be also responsible for steering, accelerating and braking, and the grip of the tire is limited, so after the rapid driving limit than drive comes early.

After the actual production, we modify the way forward to the two drive to the four way, but let the rear wheels, front row institutions is to use the ball sliding in the face of the situation to the point, to 360 degrees of direction to the appropriate place, so that the robot tracking is more convenient, although the four way did not have any problems, but in order to save the meager funds,

intended to make the minimum amount.

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To circuit design

powered wheel with the stepper motor to the forward momentum, the turning of the arc, the angle of rotation, and can control the traveling length.

rise institutions Motor necessary can rise and decline at any time, and with brake function, in order to avoid decline or inaccurate positioning.

tracing sensor circuit, three fiber-optic sensors to do tracing sensing and pitch 25mm as the basis for sensing.

To sensor design

description:
Our robot to reach the rise and fall of the functions in the field with discriminant route to look for an opportunity, the the rockfall hurdle heap opened obstacles Stacker institutions, and eventually reach rescue doll jaws, these institutions we need to use to how to get them to reach your destination? need to use a number of sensors, sensor we used to.

principle:
The use of optical fiber, the optical waveguide produced by light directed to the analyte zone, physical quantities in the area under test, such as stress / strain, temperature, refractive index ..., the change would cause lightwave variation in characteristics of analysis lightwave characteristic changes can push the physical quantities of the change in the area to be tested. Fiber has a diameter thin lightweight message passing, in which a high-bandwidth, free from electromagnetic interference, the advantage of the same fiber optic multi-point measurement, fiber has been widely used in various fields of aerospace, medical, chemical ... As for engineering measurement in aerospace structures, try fiber embedded in the fuselage ministries, the formation of the real-time monitoring of smart structures to increase the flight safety of the aircraft or the fiber Mounting bridges and building structures, As a real-time safety monitoring system.

optical fiber sensors and traditional sensors compare:
Traditional sensor strain gauge, capacitance, inductance or piezoelectric

materials commonly used as a mechanism of modulation or the sensing element. These traditional methods, basically involves the measurement of the voltage or current, it is easy by the electromagnetic noise and magnetic interference. Fiber optic sensors are more immune to electromagnetic noise and magnetic interference, the effects of ionizing radiation, radiation treatment can be made by avoiding it applies to strict environmental applications, such as nuclear power plants.

Fiber diameter thin and lightweight, and the same optical fiber simultaneously as a sensor and signal conduction line, the overall volume is often worse than the traditional sensors plus wire, it is able to be placed in the area, such as small or not easily accessible. On the other hand, the fiber optic sensors to light as the excitation, transmission media, unlike traditional sensors use current, voltage, it is nowhere to risk of electric shock, quite suitable for measurements on the medical. Glass fiber and good compatibility with polymer materials, will not cause delamination, suitable embedded in a polymer matrix composite material for the monitoring and analysis of composite structures internal integrity and temperature of the strain gauge or piezoelectric sensors can not be done.

Fiber materials are not afraid of corrosion, suitable for deep-sea environment engineering and chemical corrosion, and therefore has good biocompatibility.

4. Glass fiber temperature resistance than metal strain gauge excellent long-term stability, and fatigue life compared with resistive strain gauge high, suitable as a long-term monitoring.

Due the fiber optic originally used in long-distance communication, Fiber Optic Sensor technology easily for long-distance telemetry. In addition, WDM optical communication technology also helps to multi-point measurements of the same fiber, and research in this regard has also been carried out.

Fiber Optic Sensor for its relatively small fragile device is inconvenient. On the other hand, the instrument price of the equipment used for the production of fiber optic sensor and read signals are usually quite expensive. Finally, and most importantly, a variety of characteristics superior to traditional sensors, but more vulnerable than traditional sensor tough drawback is that fiber optic sensors often are sensitive to more than one environmental physical quantities, such as the fiber grating by both temperature and strain impact characteristic wavelength drift, the separation of the two physical quantities has become the important subject.

purposes:

1. Bodies rise and fall, we use the way of the rack and gear, to cause the body to make the vertical movement, in order to make the robot to be able to accurately achieve the desired seat, so the apparatus of the Fiber Optic Sensor The bodies of the rack the need to locate a place to paste black cloth electrical fire, but after the test result of the failure, because of the color of fire, cloth is not enough deep, and makes judgment fails there will be an element of uncertainty, and buy a can of black spray paint, black electric fire cloth sprayed with black paint, so that the rack rise allows the Sensor to black, which causes the motor to stop rotation to achieve the function of positioning.

Stacker The institutions which will also use this sensor, due to our high stack mechanism made can be folded, so that agencies can recover accurate, while the inside of the device in the Stacker Collapse the Stacker let action smoother side, the pieces of wood were successful removed and placed in the designated seats, so that will not hit the folder doll doll sets.

3 in the set conditions, we conceived the robot used in the main body above, will to a fiber optic sensor, the first one used in place is seeking opportunities venue close to the black tape to make the robot along the trajectory away, the order to be able to advance along the track, at the bottom of the body of the device with three sensors, respectively, to determine the mainline tracking Extension tracking and radians tracking, in the main line tracing, the function of the sensor (I) is the ability to determine the black line, enables the robot to move forward, straight forward not produce left Akira right bend, accounted for a very important part in tracing them. Extension tracing when the robot in the forward of the center line, met with the turn of the robot to make turning action and presence on the ground there will be many places to turn to avoid obstacles, and we let the sensors (L) with the main line of the sensor (I) and the sensor (R) complement each other, L and I, and R is the same sensor, in order to distinguish them labeled Code, as measured when it is judged that the L and I had no sense to black line, immediately went to the direction of R steering so that it made a right turn movements measured when I felt with R and L do not turn to turn left. As for the curvature of tracing this function, with a twist is the same reason, but the program is a special need to have skills, requires constant calibration and testing, so that the body will not respond too big or too small, as there is very little difference the situation in order to make accurate tracing of radians, we define down in this judgment to look for an

opportunity.

The other uses sensors jaws, we design the sensor device in the middle of the jaw, will empty a space so that the sensor does not produce damage, due to our length will deformed to clip the maximum width of the doll, so that the gripping doll is able to not consider the doll's seat, directly to make the operation of the gripping jaws, in gripping the doll simultaneously carried out to determine the color, but does not want doll placed in somewhere, but directly pinched until it reaches the area of the color classification, release the jaws so that the dolls can directly drop in the safe zone, this design can save out a few sensors, greatly concentrated funds spent.

Fiber Optic Sensor: FZ1

environmental conditions:

1. Operating ambient brightness: Tungsten: bear 10000LX
Sun: Maximum 20000LX
Operating Temperature: +10 ° C ~~ +60 ° C
Storage Temperature: -20 ℃ ~ +70 ℃
In closed chassis 1-4PCS: +10 ℃ ~ +55 ℃
5 or more than 5: +10 ℃ ~ +45 ℃
Operation surrounding humidity: 35 ~ 85% RH
Resistance to noise: EMC electronic test system

Power input noise: 1500V cycle: 0.06mm pulse continued: 5ms
Electromagnetic radiation: 1KV cycle: 10ms pulse continuous: 1μs
Vibration spoke: 1.5mm 3 axis continued: 2Hr

Shock-resistant: 10 ~ 55HZ
6. Impact resistance 100m/s2 ─ 3 axis 2
7. Withstand voltage: AC500V ─ 20MΩ (minimum)

panel features:

1. SENS: sensitivity knob (20Turns)
2. Timer:
A 0ms normal operation
40ms OFF 0.04 seconds delay action
400ms OFF delay 0.4 seconds of action

3. Mode
L.on: Light on
D.on: shading on

Specifications
1 output mode:
Cable FZ1-N FZ1-P FZ1-NI FZ1 ─ PI
Terminal-FZ1-ND FZ1 ─ PD

Light source: Red LED 680 nm
Infrared LED 850nm
3 Operating voltage: DC12 to 24V ± 10%
Current consumption: 40mA Max.
Load current: 100mA Max.at DC24V
6 output mode:
NPN L.on / D.on PNP L.on / D.on NPN L.on / D.on PNP L.on / D.on

Reaction time: 0.5 ms Max.
8. Isolation impedance: 20M V min. (DC500V)
9 Dielectric Strength: AC500V 60Hz for 60 Sec.

References:

Specifications: http://riko.com/photoectric/fz1.html
Fibre principle:
http://www.iosh.gov.tw/Book/Message_Publish.aspx?P=22&U=214
Figure 1:
http://www.science.com.tw/company/index.php?route=product/product&product_id=870
Figure II:
http://tw.page.bid.yahoo.com/tw/auction/e55075037; _ylt = AjXh11sod6by3ge81CiKfzKpFLJ8? u = Y5053112678 & actsrch = srp3
Figure 3:
http://tw.page.mall.yahoo.com/item/p07183585194 # ypsid

Figure 5:
http://riko.com/photoectric/fz1.html

assembly, test and modify

assembly:

Conceived many ideas to start our robot production, start using a framework made of a piece of wood and aluminum roots, the destination is to place the control elements, so use a light weight material assembly.

Motor plus the bearing it becomes a coupling mechanism, and then the combination of the tire and the bearing mechanism, so that the robot be able to have the function of walking produce bezel to the motor is fixed below the bottom of the, so to complete the The most basic structure.

2 in order to allow the robot to make a number of features, we want it to be divided into the two-story structure with the first layer before and after the two parts of the organization, after the layer is driven by the motor components, also the battery is placed in this layer , and the front layer is responsible for sensing line to let the robot along the track, the former, the latter two are respectively placed two aluminum material, the object corresponding to the second layer of the gear and rack mechanism, to make it able to make rising and falling action.

Front, after two layers finished, began construction of a second layer of process, the basic architecture is the same as the first layer of aluminum material, but the wood have all been replaced with aluminum sheet processing failed many times makes woodblock severely damaged , so replace it into the aluminum plate this material, aluminum is the most light weight material in the off-the-shelf materials, made easy so the priority to use it, the second layer produced four bushings, so that the four lifting mechanism through the shaft sleeve to allow the second layer can be accurately rises upwardly.

Motor plus bearings and gear, making the motor operation, driven aluminum to achieve the lifting movements, the middle region is placed PLC board and many individual agencies, while Stacker institutions and the jaws of institutions will be placed in the second layer of the front-end, now stacker can make the release of two aluminum rails produced by processing, using the motor as a driving device, and install a plastic rollers with nylon Size of the pull to combine,

making the Stacker and action resumed in the production of these institutions, it is placed in the forefront of aluminum, use M4 screw machining Stacker fixed.

5. Meet the conditions of the jaws in order to be able to make, we use the slider plus special aluminum rails, so the jaws can accurately reach the desired place, the doll on the condition can be arbitrarily placed in a circle within at any place, in order to prevention because not sense doll and not gripping, so the jaws do the maximum width, making dolls placed regardless of what place can crawl, but the doll crawling maximum width range of 1.5m in accordance with generally produced out of range will cause become foul, in order to avoid the occurrence of such a situation had to retrofit the jaws together with a set of drawer slides, so that the robot can be variant to successfully gripping to the doll, in the second layer is located in the rear of the stacker gripper device is in the rear, but is not heap hinder high-Machine agencies to This completed our first generation machine robot.

Test:

Completed and after the success of the device up, we decided to make the first test, try this robot is able to successfully make the game; beginning to be tested of course, is tracing the function tracing in production organizations about The robot can make a big key With tracing is equivalent to a robot, and not tracing represents just one agency combination.

On the floor of the laboratory. Adhesive black electrical fire cloth used to the situation when the simulation game to make tracing, tracking, obstacle avoidance; began tracing test the outset had a very smooth situation in the run which will eat the behavior of the step-by-step, start checking the reason, still do not look for a while to understand why eating behavior of step, and then some investigation and with the assistance of others to come up with possible reasons , the torque of the motor is not enough to lead to people unable to cope with machine weight, and the program has problems, and cause the robot to slump under the double blow.

2. Rise institutions installed also began testing, we are prepared to eight relay makes four Linkage can individually make action out some minor problems in the wiring, but powerful crew smooth solution of the wiring capacity, and began a four link mechanism rise test, the respective working to make action after some problems, but they rose to near the top of.

Reasons appear on the bracket was not strong enough to do, leading to fixed this feature is not very successful completion of the overall machine skewed situation, aware of this situation, after the decision to temporarily no longer rise began testing decreased function, press down button under the rails, four legs start to issue the dismal screams, our heart is cold half ... decided we rise and fall of institutions must also strengthen.

Stacker game scheduled the second hurdle to cross the border agencies followed is to test the finished motor then rolled plastic wheel nylon rope to let him carry out the operation, in this perfect body it made the action successfully, as long as the motor is running will drive the nylon rope rolled a heap high machine to make the situation away after reversal, of course, will make it presented relax state, Although not tested, the intention to use nylon rope as test items, but surprisingly unexpected easy to use, was originally to use electric guitar strings instead of nylon rope, but so successful in nylon rope continue to use this nylon rope, the conclusion - Stacker institutions.

Jaws in the game after tracing the second most important institutions on disaster relief robot, if not jaw is unable to successfully achieve this condition, the test is finished, we are making the institutions for motor the basis of production, motor driven open and retracted the motor device above the slider in the jaws, inserted down fixed in the above, then fixed slightly difficult, there are also encountered. many difficulties, or overcome, and also succeeded in opening and closing the test is completed.

Start the next step, in the second layer drawer slides, like his opening and closing by a motor, projecting plus slider and slider hooked rails, so that it can come back led him, a pair of drawer slides, under the funding is feasible using the two motors, but the funding we been plagued by long-standing problem, so only one motor to drive two drawer slides, but such One benefit is that you can save weight, and allows both sides of the rails synchronization extended and retracted, allows coordination that is a windfall, in the jaws with two rails together, start wiring and programming efforts, successful completion of this task; began to make the test for the results in terms of a good try, although individual start relay can successfully complete the action, but write in the program status there is a problem everywhere institutions are unable to successfully action, with the eyes of imagination gap, and then had to put in more effort.

modifications:
Although successful robot production, but in many ways all have problems, before the race must will it improve the finished However, this is just our early-generation machines in the future will have many changes and different, but even the early generation machine also has many good ideas, in which the second generation will also use many of the same principle, at least not much change in the general framework, the main material and institutional change, and has made many modifications, perhaps will be more robust and will completely replace the agency, although the production of the second generation is an important part, but first to the transformation of the early generation of machine until it can make due, and to overcome the hurdle race will take He played the game, we need to improve, and make what action to change him.

First to transform this part of the underlying underlying experiments often drilled a number of pits in the production of the second layer is already crumbling state, in order to improve this situation, we've got many good ideas, the replacement of part of the aluminum plate acrylic material, on the one hand is a replacement had to drill many holes, on the other hand is a way to test discovered a problem in the action process appear because of stress and lead to deformation of the situation in the beginning is not very obvious, but as more and more number of test after gradually showing a great deal of problems in the procurement of materials when stumbled upon this material ─ acrylic, stress test, think to use it would be a good choice.

Solve the problem of finished aluminum plate there is a big question, will decide the future look of our underlying, the entire chassis is divided into before and after the two parts of the current design, but in the middle of the two institutions and no Material to connect, when closed by the level of the cliff, the body will be elevated to the same height with the cliff after the front layer to make the rising action, in accordance with the original design, the front layer reaches the cliff from the layer, when the drive motor forward to after this cliff hurdle, but there is a problem in the design which, before, after the two-tier walking because there is no link, because of the stress factor before and after the squeeze two layers, and makes two layers inward close, affecting the accuracy of the lifting mechanism and also let four link mechanism deformation fatal injuries robot, so the most important improvement from here begin.

3 present our extreme lack of time, intends to re-create the first part of the aluminum plate, like the use of current materials in connection temporarily lifting mechanism as fixed or deform, made test done four connecting rods, many of the lifting mechanism to temporarily spend the period of the school competition, the game finished school competitions this time, will have sufficient time to give us big transformation, so planning school competitions school race for the test.

First layer temporarily resolved to delay the second layer, with most institutions need to solve the problem quite start lifting mechanism to solve them, in the beginning the test, which is very smooth the situation, but the problem is gradually emerges by a motor and gear mechanism to drive the lift functionality using rack and pinion structure to be simulated, and therefore is not the same rack material, we using an aluminum bar to replace the original rack This feature is weight! weight is a major consideration in the robot, the general rack is a weight of emphasis of the material, but in the conditions of weight can not be too heavy, so use the most easy to obtain aluminum strip to produce Usually the rack is of iron material, and therefore does not produce a material damaged condition, However, although the aluminum material light is quite sturdy, movable under the gears volume if there is the case of derailment. rack will draw a scratch, and frequency of use, will grind the rack holes open and let the hole becomes wider, and there will not be able to rise in the second layer, the case that is not let the gear snap into the holes.

To improve this problem, priority several options, one of the material replaced, use a more sturdy material, but in many kinds of materials observed, not fully in line with our needs, requirements material must be light enough hardness and hardness, but saw only meet one, and did not comply with the two conditions of the material, so the veto sturdy material, to switch to another program in the hollow into an acrylic, aluminum bar from the inside out to an aluminum support housing, gear this outward stress does not overwhelm the rack, the actual production which also have no idea, but can think good program, also need to discuss in the production process.

Lifting mechanism to solve part of the problem, again fixed four Linkage problem, we originally used angle iron, angle iron advantage can be easily fixed seat can be convenient in the desired location fixed, but tracing the stress

squeeze gradually he became skewed, the whole robot tilted lifting mechanism which act as robots bracket function, but a problem is equivalent to the entire robot problems occur, angle iron easily fixed the stiffness too soft, to make up for this shortcoming had him replaced with other materials, he intends to change the angle aluminum is easy to buy on the market, although the aluminum material did not iron hard, but the thickness of the aluminum angle is produced relatively thick, can effectively meet the requirements of the fixed time.

Another solution to the four way sucked Linkage to processing connected to the bottom of the other end, giant open, the four sides Conrad expand the look, plus drilling, lock screw so that he can be fixed at the bottom, after experiments after the test, make sure he can support live without deformation, but if lifting too many words or make him deformed, another method is able to solve the problem, but the time was too urgent had to take this program, four linkage mechanism is temporarily fixed, so that he will not be deformed.

robot creative Features Help

The robot uses the drive mechanism of the stepper motor advantage of the stepper motor can be set to many changes in the value used to achieve the functional properties of the robot required to achieve is the use of the operation of the stepping motor characteristics do 出:

1 set turning angle:

Many need to make the intersection of the rotation movement in the venue, either clockwise or counterclockwise, can be achieved through a program, and the angle of 1 degree to 360 degrees of rotation can also be made, can use a variety of ways to make rotating movements, how to write it all depends on the program.

2, the calculated distance traveled:

In part to avoid obstacles, no matter the obstacles How furnishings, obstacles and obstructions between 1 m above the safe distance can only need to calculate the angle, from the middle through the robot, but must be calculated walking distance, this must take advantage of the functionality of the stepper motor, stepper motor allows me to calculate the number of the output pulse with PLC can reach the demand position downtime.

3, ran the curve arc:

Need to use the game to the application of the principle of the curve, although the venue all concentric circles, however radians or different, but as long as

the set values of each radian, the robot can be ran out of the desired angle to let the robot along radians forward through the various checkpoints.
. Rose institutions:
Gear and rack of alternatives to the use of aluminum bars instead of the rack, and instead gear with fixed-point drilling in order to facilitate lightweight, making the process more too easily, I think this is our most creative robot.
Figure 1: The rise institutions

Tracing sensors:
Using optical fiber sensors to do positioning, and allow the sensor pitch 25mm distance individually, just in the middle of the black line with the left and right sides to determine the location of the sensed, if the deviation from 1mm will allow the program to do the guide being the robot tracing role.
Figure 2: Sensor

4. Middle position sensor:
Sensing robot is in the middle position, a number of locations in the game has a crossover point, these intersections can be used to determine when to turn or when you want to stop the rotation action, with the middle for the sensors can be more convenient positioning.
5. Jaw deformation:
Original distance Refine lies within 1 meter, but the position of the gripping doll again can 125cm the position of the gripping in order to take the action of a deformation corresponding to this length so, after deformation to take the pull of the rails with nylon cord way conducted the opening and closing movements.
Figure 3: jaws deformed
Jaws: 6.
The game's doll placed about the size of ψ25 gripping position, doll sensors in the robot is not equipped with a search case, the largest gripping range do precise gripping, regardless of opponent the doll is placed in the circle Ho Department, can smooth the doll gripping.
discussion

in this process of making robots between our team will have a lot of discussion, and then encounter a problem or institutions designed, will be discussed to determine the program to make the robot team views views on there will be a number of irregularities, but have more discussion, more views, the result will be more abundant, will increase more in the creative imagination,

created out of the robot will be more creative, the following We have carried out the discussion, to describe a period of time manner.

1 goal is the chassis (on) a simple assembly, because the purpose is just to place the control element, the lighter the material assembled aluminum frame structure, boarded to place PLC, relays, etc. ... equipment, Since overall the size is not yet complete, so the maximum limit 1M size.

2. The manufacture motor fixed link, screw connector link with the wheels driven by machined workpiece to drill two small holes on the fixed motor and screw, nut locking the wheels at both ends to prevent loose. Make the finished product is also slightly eccentric, so back may need to re-produce and improve.

Using a simple thin object do tracing sensing, plus four vise heavier chassis, the main purpose is to test new sensor buy first, and for the load test, but do tracing The objects will hinder the route of travel, leading to not work properly straight forward, and will purchase the the black electrical fire cloth adhesive venue.

To the hardware line supermarkets looking for materials, the need to buy materials ... three universal ball, black electrical fire cloth igniter base, two 12-volt motorcycle lead-acid battery, due to Universal Ball relatively rare so not looking, but it does not hinder the overall commissioning. Battery configuration on the chassis made after a straight-line load test, many of the collider, but less straight forward, no retrofitting universal ball and did not disperse the weight of several commissioning and crash, resulting in the chassis variant, chassis will reproduce and enhance strength.

Will buy SSR wiring to the motor, and how to test its functionality PLC functionality is not quite perfect, resulting in tracing a difficult place, and other kinds of programs will be used for the improvement. With around two infrared sensor device chassis as the crossroads of the sensing function, to improve the situation can not determine the intersection.

6 due to insufficient strength of the rear chassis variant again reproduce the chassis specifications also improved as long 70cm wide and 30cm. Ascenders institutions to gear tooth peak spacing 7mm drill two 55cm aluminum frame, and try to get the gear rotation in the above test, ineffective, and may be

replaced by other kinds of programs.

Making the front chassis two rear chassis two of four rack length 70cm, to pitch 7mm center hole drilling M6 and angle iron fixed to the front chassis and rear chassis, in the teeth The bar side and chassis drill 4.5mm hole 4mm hex nut lock set above.

8 retrofitting rack such that the length of the front chassis, so remaking a first layer of the front chassis, and before the chassis universal ball placement in the above, then the front part of drill holes it enough to a fixed sensor, after previously making good rack fixed set above.

In order to prevent the deformation of the last chassis, so on the rear chassis device universal ball and aluminum block sawn in two, the two aluminum blocks processed into an L-shape, safety device motor on to packaging The chassis of the motor way and then tightened to prevent deformation of the weight of exerting pressure makes chassis, making two sets of L-shaped blocks and security devices above, the intensity will become strong enough to let the pressure of the weight of an ordinary person to the top.

10. Second layer chassis sawed to the size of the rack rails, and aluminum rails fixed on the gear rails in the second layer on the chassis drilled holes will Jiaotie the fixed to the second layer of aluminum rail. Sawing the gear rails allow the gear to rotate the caliber, under the front of the chassis, rear mounting up to install up after the discovery under the front of the chassis, after interference, so will be the second layer saw wrong position local exchange out, and saw in the correct position.

11 because we are using the principle of the chain and sprocket, so we prepared four 90rpm motor and produced holder can be fixed on the motor, in order to prevent the forces generated when the motor due to the ascenders or decline leading to deformation, so do a simple bracket lock set the motor behind, so it will not cause serious deformation.

12. Testing the axial downward institutions, found that the relay co com way circuit wiring, motor can not rotate the phenomenon appears, the easiest way is to each motor be configured rise and decline relay This will solve the problem, but it is home to a total of eight relay will make the position change is

small, so we will configure a simple home-made circuit board to control the four motor rise and fall, not only simple, space-saving, but also reduce the weight and achieve aesthetic effect.

The homemade rack 13. Originally used because of the the test rise and fall times, plus the first low precision, so will lead to slip teeth; The aluminum plate drill too many holes, so that board strength low motor rise and decline wear, leading to board deformation will shake. Summary of conclusions, we will replace it with a new board, and replaced by a more precise rack.

14 new upper stretch decreased institutions and the board replaced, and the first layer of the front disc and rear disc device in the second layer, and front disc and rear disc level on the ground, will be tracking sensors to adjust to the appropriate sensing the location and intensity, begin testing a program written in ready venue on the test a few days after the arrival of visits, measuring tape measure 3m length, and the distance of each 0.5m paste mark, making the understanding of the completion of a few meters, and the test results we can tracing 3m and will not deviate from tracing the route.

15 PLC, motors, relays, sensors, power supply, battery, placed seat deficiencies found in the second layer, originally deciding to second layer with a layer of wood, but considering action status and limitations 1m veto battery placed first layer, the action will not have much impact on the rest through special placed reluctantly placed on the second layer after tested.

16 line is configured and ready to program, we give two 12V battery, after the experiments, we found the battery to the lack of electricity, such that the motor can not operate normally, and you can not start at the same time four motor originally decided by wiring more to give full power save power, but failed, and finally bought the relatively small size of the battery to solve this problem.

17. Tracing process, the whole body occurs inclined state, observation, and found that the lifting mechanism of the rack front and rear unbalance, an error occurs due to the calculated length, and also found that the length of the climb cliff hurdles shortage, decided to re-production of the four rack, front 72cm back 67cm backlash 9mm, drill M6 longer need a short size back tire, and then solve the problem through the test.

參賽隊伍人員及機器人簡介

Team Member and Robot Introduction