參賽隊伍人員及機器人簡介
Team Member and Robot Introduction

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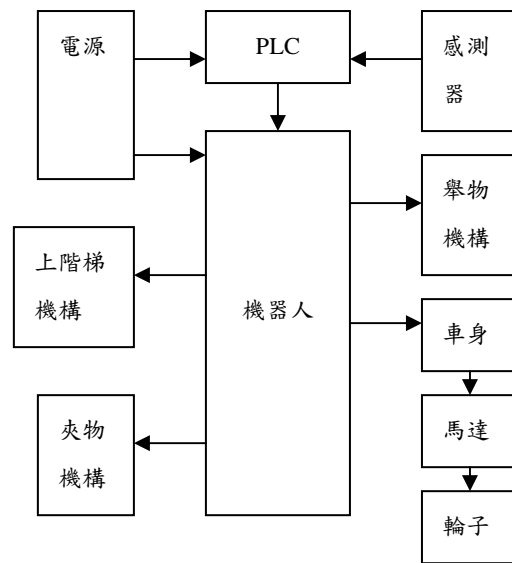
貳、機器人簡介

一、構想與策略分析

　　本自動組競賽機器人須滿足能判斷路徑、舉物、移物、夾物、上下階梯的車身機構。以及可達到顏色感測、路徑感測、距離感測等要求。本機器人設計以鋁合金車架為主要結構，搭配 PLC、配線、直流馬達、繼電器、感測器等，達到比賽要求。在競賽策略上，以先能通過土石流障礙區，並夾取娃娃後回到救援區放置。再到山崩區移動障礙物與夾取娃娃，回到救援區放置。最後，再通過淹水區，行走階梯，並夾取娃娃後回到救援區放置。

　　The auto-robot race is necessary to design the robot be capable of judging the path, lifting and moving the box, clipping the doll and up-down the stair.　It also can sense the black line, red or green color and the position of block.　The chassis is constructed by the aluminum frame to reduce the weight, together with the PLC, DC motors, relays, sensors, etc.　The strategy of the race robot to overcome the three gates is to pass the rocks region and get the dolls back to saving-region firstly.　And then go through the landslide region to move the block box and catch the dolls back to saving-region also.　Finally, the robot needs to pass the flooding region and steps up the stair to get the dolls back.

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┌──────┐     ┌──────┐     ┌──────┐
│ 電源 │────▶│ PLC  │◀────│ 感測 │
│      │     │      │     │ 器   │
└──┬───┘     └──┬───┘     └──────┘
   │            │
   │            ▼
   │         ┌──────┐     ┌──────┐
   │         │      │────▶│ 舉物 │
   │         │      │     │ 機構 │
   │         │      │     └──────┘
┌──┴───┐     │      │
│ 上階梯│◀────│ 機器人│     ┌──────┐
│ 機構 │     │      │────▶│ 車身 │
└──────┘     │      │     └──┬───┘
             │      │        │
             │      │        ▼
┌──────┐     │      │     ┌──────┐
│ 夾物 │◀────│      │     │ 馬達 │
│ 機構 │     │      │     └──┬───┘
└──────┘     └──────┘        │
                             ▼
                          ┌──────┐
                          │ 輪子 │
                          └──────┘
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圖一 設計架構方塊圖

Figure 1 Design Blocks

二、機構設計

本機器人設計架構分為車身底盤、行進機構、夾物機構、舉物機構、上下階梯機構、感測與控制中心等。車身底盤採用鋁材當作車身架構材料以減輕重量，車身尺寸為 80cm(高)、40cm(寬)、60cm(長)。行進機構使用直流馬達作為驅動元件，搭配 12V/24V 為電源。使用 PLC 為控制核心，使用顏色感測器感測黑線，並使用顏色感測器判別娃娃顏色，據以判斷放置救援區的位置。上下階梯機構搭配超音波感測器判定，並以直流馬達搭配齒條與支撐機構。夾物機構採直流馬達配合夾爪設計。舉物機構參考堆高機的設計。本機器人具有精簡的結構達重量輕與省電的要求，搭配 PLC 程式易於撰寫與修改，整體符合比賽規則之要求。

The robot designed is classified by six parts, including chassis, moving, clipping, lifting, stepping, sensing and control center. The chassis which the size is about 80cm(height)× 40cm(width)× 60cm(length), is constructed by Aluminum frame to reduce the weight. The moving part adopts the DC motor to drive. The power is supplied by DC 12/24V battery. The PLC is used for the control center because of its easily maintained. The color sensor is chosen for sensing the black line. Also the color sensor is applied to find the color of the doll for judging where it to put. The up-down stair part of the robot is combined the gear and rack and support with DC motor for driving and uses the ultra-sound sensor to sense the position of the stair. The clipping part is composed by the Dc motor and clipped. The lifting part is referred to the forklift design. The robot has the advantage of simple mechanism,

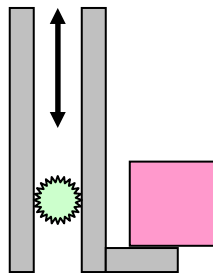light weight and low power.　　The PLC program is easily to construct and maintain.
The robot has been test and verified to meet the race requirement.
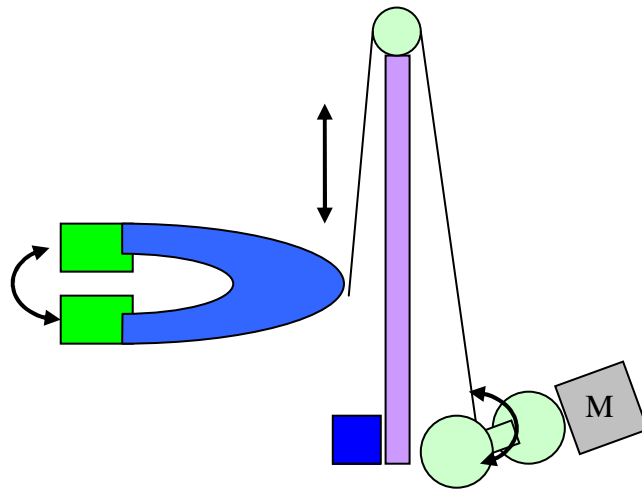
圖二　夾物機構示意圖
Figure 2 Clipping mechanism

圖三　舉物機構示意圖
Figure 3 Lifting mechanism

三、輪子驅動設計

　　　以直流馬達直接驅動輪子，需考慮軸心穩固。

　　The low speed DC motor together with the small size wheels are used for driving
the robot.　　The axle center of the motor-wheels composition needs to firm and be
co-axial.

圖四　輪子機構

Figure 4 Wheel mechanism

四、電路設計

馬達透過繼電器驅動，感測器直接接至 PLC，用 12V 電池串聯成 24V，用 DC/AC 轉為 AC110V 供應 PLC。

The PLC is used to control the relays and sensors.　The motors are directly connected to the relays and controlled by PLC program.　Two 12V DC batteries are used and the 24V DC is got by two 12VDC batteries connected in series. The DC/AC converter is used to convert the DC power to 110V AC power.
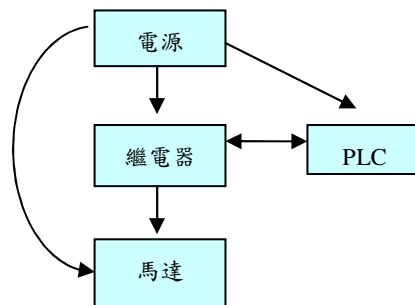
圖五　電源配置

Figure 5 Power arrangement

五、感測器設計(遙控組無免填)

路線感測使用黑色感測器 5 個，以判斷黑線、轉彎、叉路等。採用可感測紅、綠的感測器，用來辨識娃娃顏色。以超音波感測距離，以判斷障礙物、木箱以及階梯位置。

Five sensors are used for robot to find the black line and judge the root where to turn.   The color sensors are applied to distinguish the color of the dolls.   The ultra-sound sensors are utilized to sense the distance for estimating the location of blocks, boxes or stair.
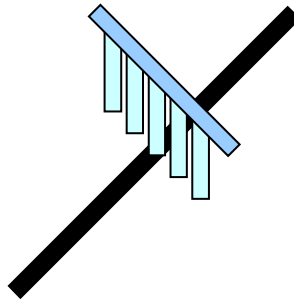
圖六　感測器配置

Figure 6 sensors arrangement
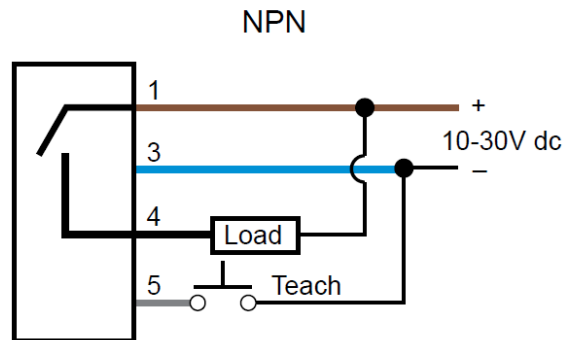
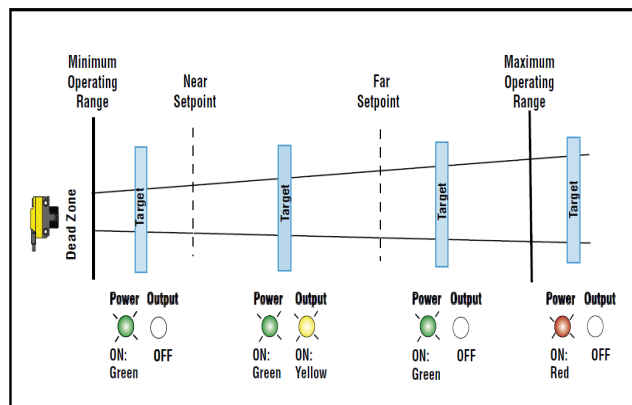圖七　顏色感測器接線圖

Figure 7 color sensor wiring


Figure 2. TEACH Interface

圖八　超音波感測器概念圖
Figure 8 ultra-sonic sensor concept

六、組裝、測試與修改

　　本機器人機組裝測試後，可達到感測黑線、夾取娃娃、判斷顏色等功能，上下階梯因機構設計較為複雜，且採用之齒條、齒輪、直流馬達等重量過重，經測試無法滿足競賽 25 公斤之要求。舉物機構部分，堆高機的設計確可達到舉物與移物的功能。

　　After the assembly and test, the robot is verified to be able to sense the black line, catch the dolls and judge the colors. The gate of up-down the stair is hard to design because the mechanism is complicated. Besides, the weight of the gears and racks and DC motor applied to pass this gate is heavy and hard to meet the weight of 25kg limitation. The lifting mechanism simulated the forklift is test and proofed to lift the box and move it.
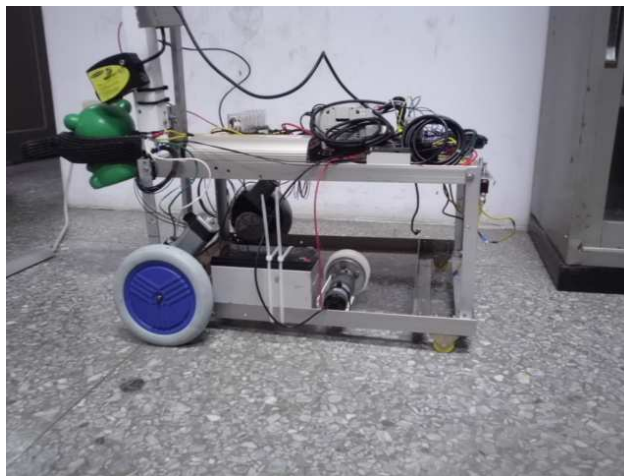
圖九　機器人成品圖
Figure 9 Final works

七、機器人創意特色說明

　　本機器人採用 PLC 當控制核心，程式設計容易、配線方便，不易出錯，易維護。夾物機構簡單方便，重量輕，適合此次比賽的吉祥娃娃重量與形狀，且捲線馬達容易將娃娃升起。 Ｌ型堆高機式的移物機構配合木箱尺寸，容易將木箱舉起，機構簡單。路線感測器 5 個，可以循跡、感測、判斷叉路。顏色感測器可判斷紅綠色，超音波感測判斷木箱與救援區位置。

　　The robot adopts the PLC as the control unit has the advantages of the easily programming, simply wiring and facility maintaining. The design of clipping

mechanism is simple and light weight and suit for the race needs.　The L-shaped forklift design is easily used to move the box and lift it.　The five sensors applied to find the root and judge where to turn.　The color sensors can be used to distinguish the red or green color.　The ultra-sound sensors are utilized to judge the location of the box, stair or saving region.　The originality of the robot is simple and light weight and easily designed.

參、參賽心得

　　因電機系的背景，在機器人機構雖有參考歷屆機器人的設計，但加工部分實在超過所學，且由於第一次參加這類的比賽，所以有很多地方都需要從頭來過。由於製作過程牽涉程式撰寫與機構搭配，通常無法同時滿足兩者要求，修改過程有相當大的挫折感。製作期間經常無法全員到齊，這也是困難之一。製作機器人需要隊員一起合作，並培養團隊合作的默契。出去比賽讓我們可以學到不少東西，可以看到別人的機構，別人的設計與競賽策略，增加自己的機電知識，這些都是參與比賽，才能親自體會。

　　Being the EE background, even refer to the works of predecessors, the manufacture of the robot is hard for us.　It is our first time to design and make robot. Due to lack of the experience, everything is new and almost learning it from the beginning.　The robot design need to integrate the electrical and mechanical design, and the PLC program is long and a little hard to fix.　This makes us setback during the process of the manufacture.　Also, the absence of partners during the period is our problem. It leads to the team members misunderstanding each other and making team work break down.　Anyway, we learn very much in this robot race, expanding our view, realizing the design from other teams, and enlarging the knowledge.