X - Bot

Badminton Shuttlecock Collector

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Advisor
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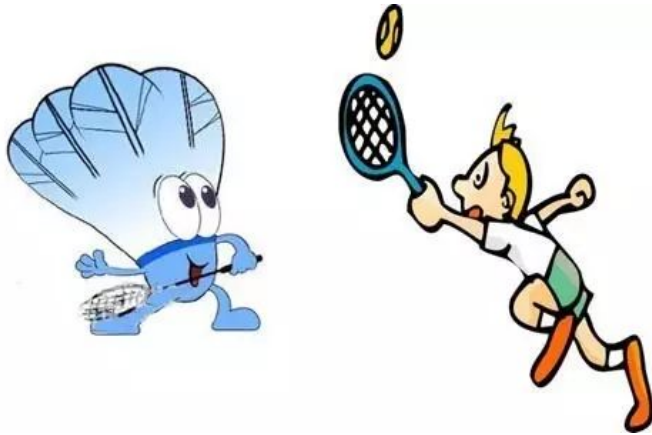- ➢ Team leader
- ➢ Software Design
- ➢ Hardware Design

Charlotte Wang

- ➢ Hardware Design
- ➢ Website Design

- Many people choose professional gymnasiums to practice badminton with family, friends and coworkers.

- Gymnasiums pay salary to staff to collect shuttlecocks.

- The main ways to collect and sort shuttlecocks are manual or semi-automatic.

- To save human cost and improve sorting efficiency, automatic robots would be welcome.

- With X Bot, the shuttlecocks on the floor will be sorted automatically with high efficiency and the sorted shuttlecocks will be transported to assigned collection centers.

Current Design Alternatives

Manual Collection:

🏸 Collection is relatively slow

🏸 Used for individuals rather than professional gymnasiums

🏸 Shuttlecocks are transferred to collection points manually

Design Alternatives

Handsome Tiger Collector:

https://item.taobao.com/item.htm?spm=a230r.1.14.228.359358e4SvqhpK&id=554389963439&ns=1&abbucket=15#detail

- Manual collection and sorting

- Product life cycle is short

- Cost: RMB75.00

Aisenwei Collector:

https://item.taobao.com/item.htm?spm=a230r.
1.14.200.359358e4SvqhpK&id=551518506597&ns=1&abbucket=
15#detail

- Collect without sorting

- Slow, used with a broom

- Short life cycle

- Cost: RMB88.00

Semi-automatic Collector:

https://v.youku.com/v_show/
　　id_XMTgxNDEzNTE3Mg==.html?spm=a2h0k.
　　11417342.soresults.dposter

- Semi-automatic

- Collect without sorting

- Cost: RMB2,000

What can we do with X - Bot?

- **Automatically collect and sort shuttlecocks with high efficiency**

- **Transmit shuttlecocks to assigned places via APP (application in cell phone)**

- **Useful for both individuals and gymnasiums**

- **Requirements**
  - **Pick up & Transmit**
  Pick up shuttlecocks and transmit them automatically to collection centers with APP (application) in cell phone to control the robot (in MDR)
  - **Capture images**
  Capture images of shuttlecocks and the courts to pick up the balls automatically with the help of camera (in FDR)
  - **Data Analysis & Processing** (in FDR)
  1) Collect all shuttlecocks in shortest path
  2) Identify the shuttlecocks in 360 degree view
  3) Detect whether the collecting container is full
  4) Move all-around
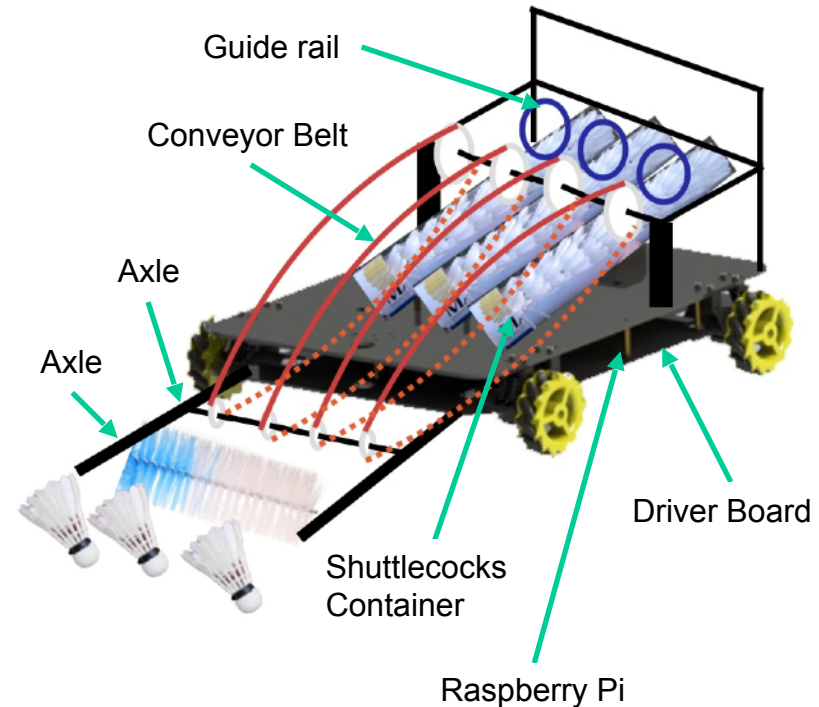 - **Interfaces**
  Bluetooth, WI-FI (in FDR)
  - **Battery**
  1) Chargeable
  2) Can use 1 hour after charging
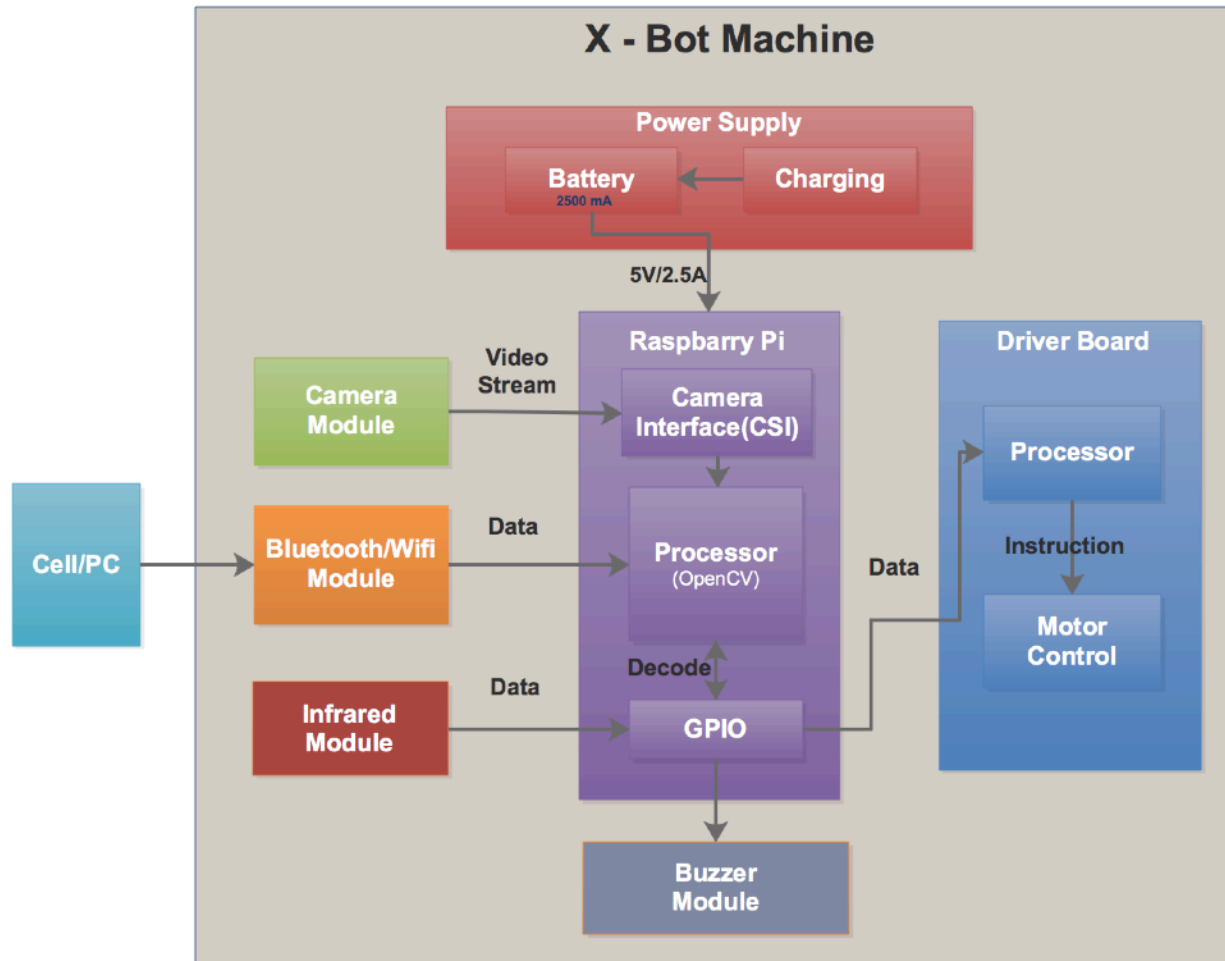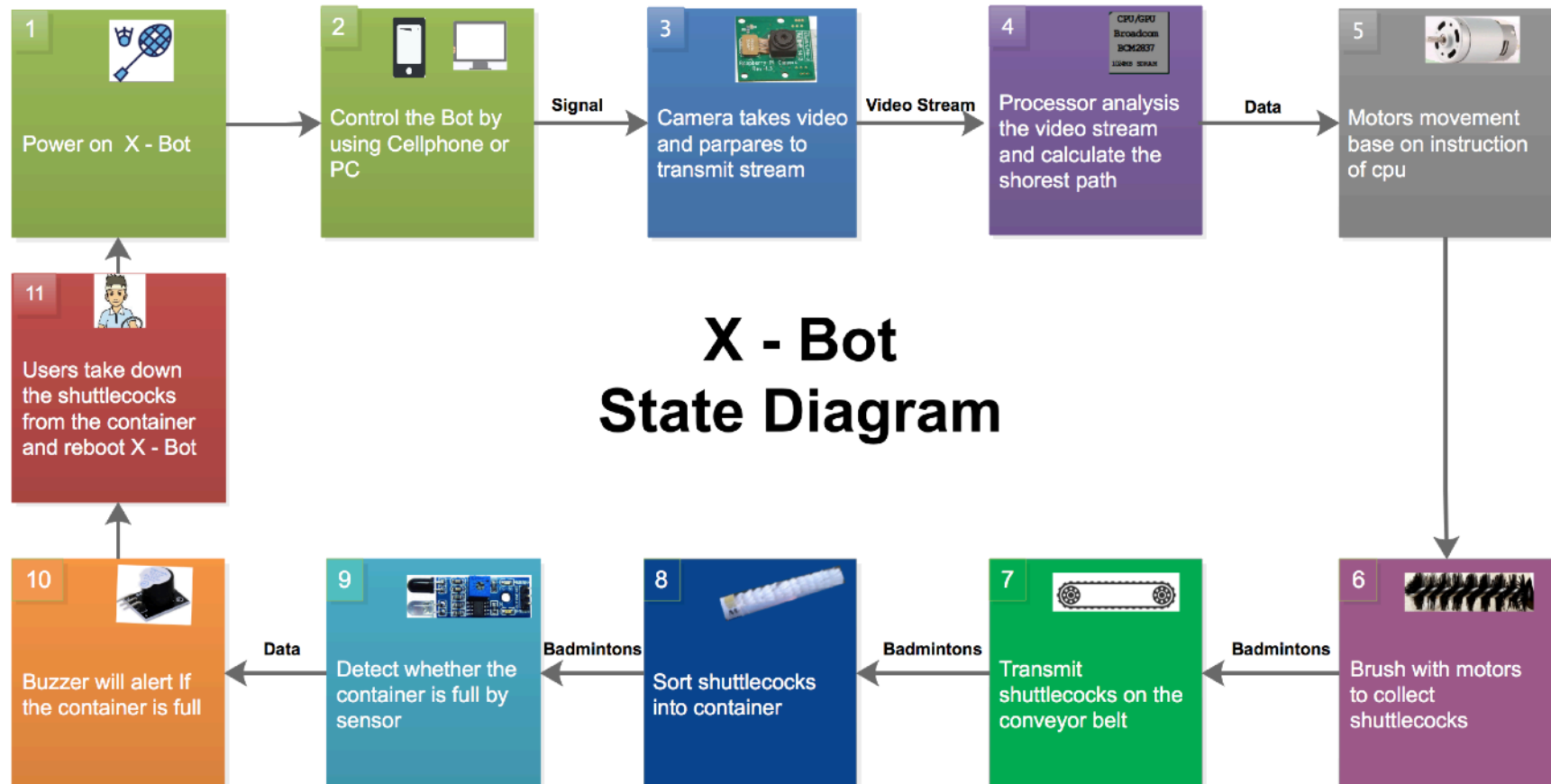
- **Chassis:**
  1 pc, 40*30*7 (L*W*H, cm)

- **Wheels:**
  4 pcs, 7(D, cm)

- **Raspberry Pi:**
  1 pc, Raspberry Pi 3 (model: B plus)

- **Driver Board:**
  1 pc, 6.5*5.6*2.1 (L*W*H, cm)

- **Brush:**
  1pc, D=10cm, L=30cm

- **Mechanical parts:**
  1 set (frame, axles, plastic guide rails, etc.)
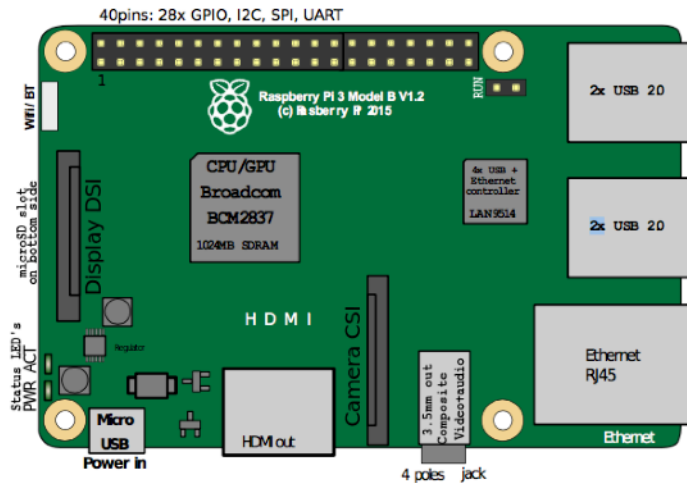
- **Shuttlecocks container:**
  3 pcs, D=7cm, L=40cm

Guide rail

Conveyor Belt

Axle

Axle

Driver Board

Shuttlecocks
Container

Raspberry Pi

X - Bot State Diagram

1. Power on X - Bot
2. Control the Bot by using Cellphone or PC
   — Signal →
3. Camera takes video and parpares to transmit stream
   — Video Stream →
4. Processor analysis the video stream and calculate the shorest path
   — Data →
5. Motors movement base on instruction of cpu
6. Brush with motors to collect shuttlecocks
   — Badmintons →
7. Transmit shuttlecocks on the conveyor belt
   — Badmintons →
8. Sort shuttlecocks into container
   — Badmintons →
9. Detect whether the container is full by sensor
   — Data →
10. Buzzer will alert If the container is full
11. Users take down the shuttlecocks from the container and reboot X - Bot

Raspberry Pi 3 Model B+

Specifications

No.	Generation	Description
1	Architecture	ARMv8-A (64/32-bit)
2	CPU	1.4 GHz 64-bit quad-core ARM Cortex-A53
3	Console	Adding a USB network interface via tethering or a serial cable with optional GPIO power connector
4	Memory	1GB (shared with GPU)
5	On-board network	IEEE 802.11.b/g/n/ac Wireless LAN; Bluetooth 4.2, BLE; Ethernet 300Mbps
6	USB 2.0 Ports	4 (via on-board 5-port USB hub)
7	Size	85.60 mm × 56.5 mm × 17mm
8	Power source	5 V via MicroUSB or GPIO header
9	Environment	0-50℃

Model: L293D

Specifications

Stepper motor
Input ports
Motor 1
Motor 2
Motor 3
Motor 4
Power
Servo
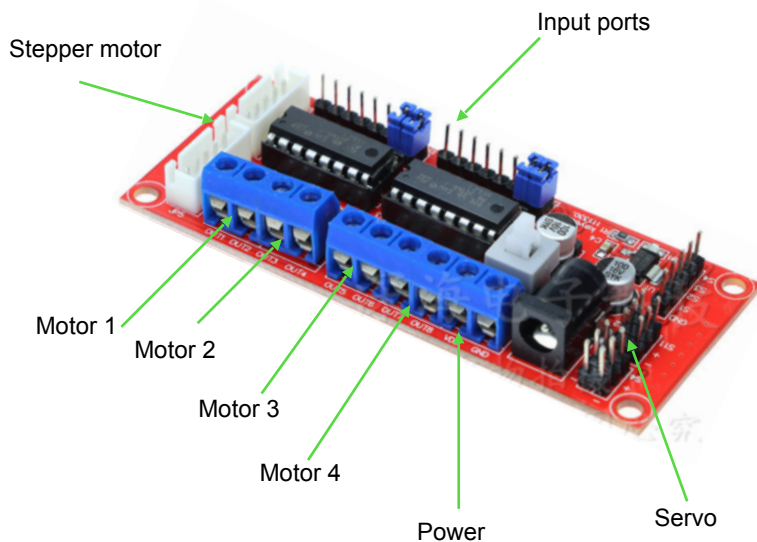
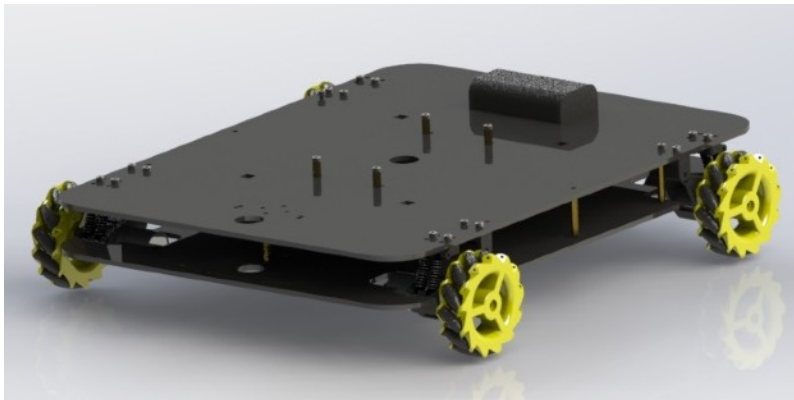| No.	Generation	Description
1	Servo ports	4
2	Motor ports	4
3	Stepper motor	2
5	Voltage	5V~16V
6	Size	37mmx90mm
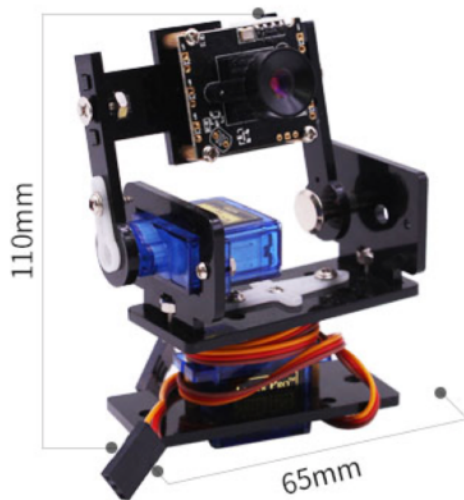
Camera

Specifications

- Camera pixel: 8M

- Use CSI interface of Raspberry pi
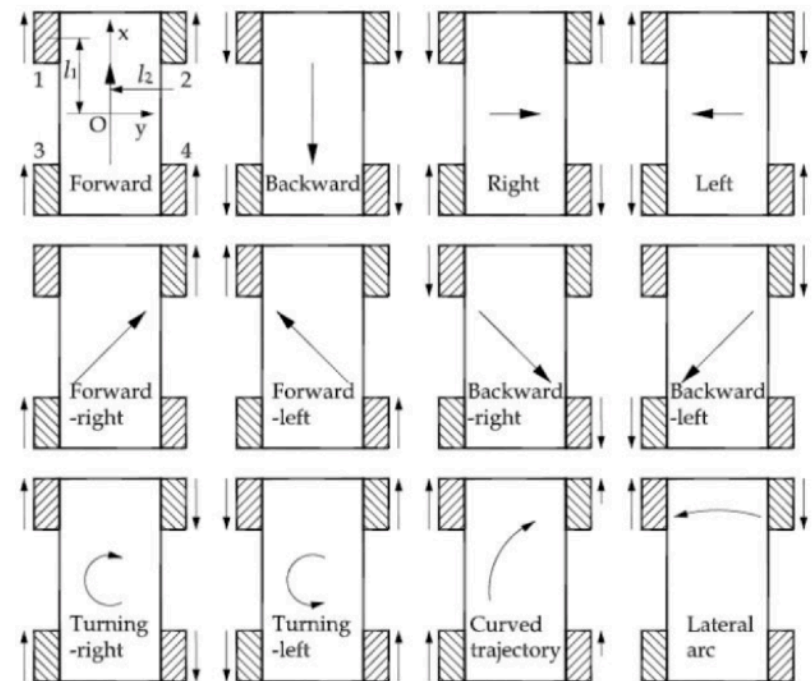
- One servo to control the rotation of 360°

Why use Mecanum wheels ?

- Flexibility
- Move all around
- Save energy

Mecanum Wheels
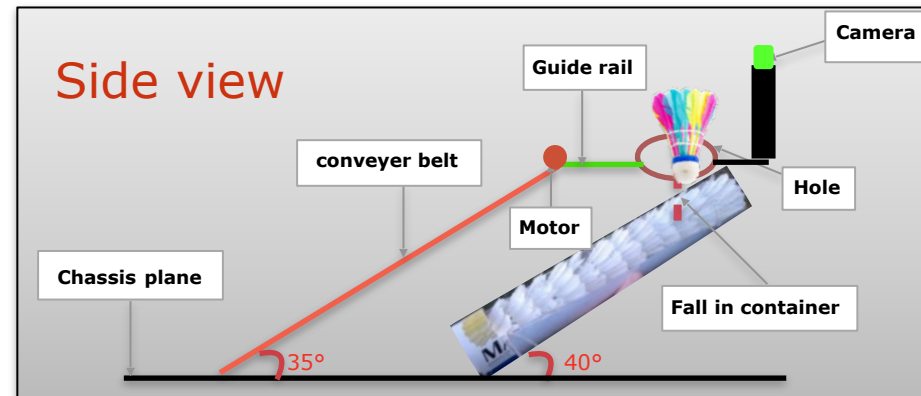
Rational

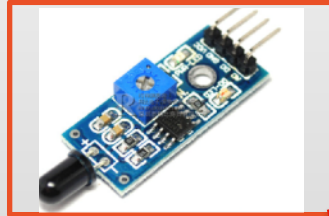- The shuttlecocks will bounce on the strings from bottom of brush

- The strings deliver shuttlecocks to sorting table by guide rails

- The shuttlecocks are sorted into the containers from the holes of sorting table

Side view

Camera

Guide rail

conveyer belt

Hole

Motor

Chassis plane

Fall in container

35°   40°
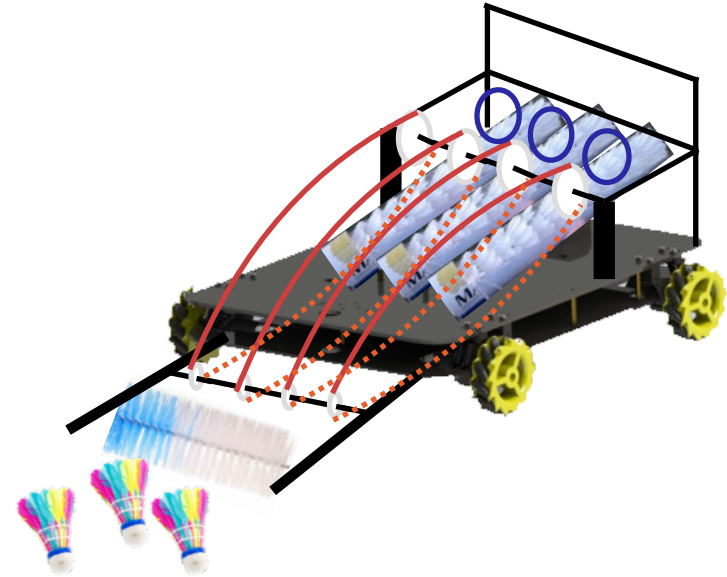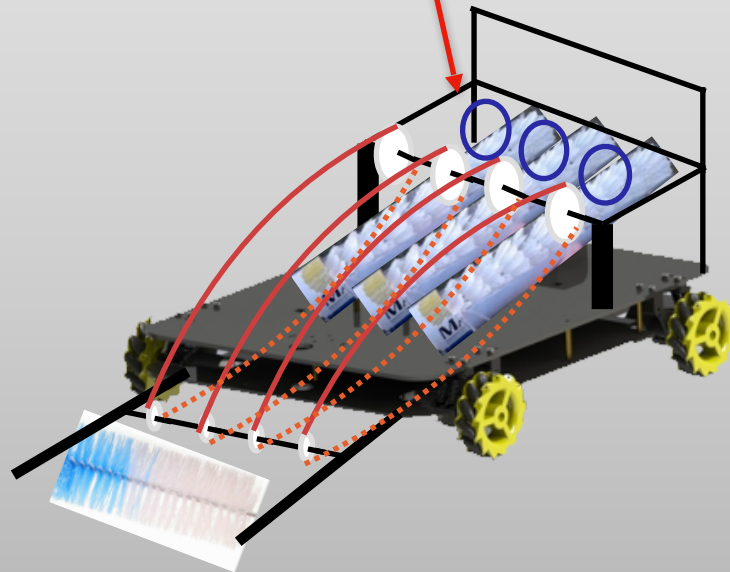
Infrared

How to use Infrared ?

- Set in sort table to detect shuttlecocks

- The machine will stay in place with a noise from a buzzer when shuttlecock containers are full or shuttlecocks stay on sorting table

- User needs to reset the system using the APP

How to select the battery ?

No.	Main Parts	Quantity	MAX electric current per unit	TTL electric current
1	Raspberry pi	1	500 mA	500 mA
2	Driver board (L293D)	1	36 mA	36 mA
3	Motor(N20)	6	400 mA	2400 mA
4	TTL requirement			2936 mA

Charging interface
(Micro USB)

Power putout
(USB-A)
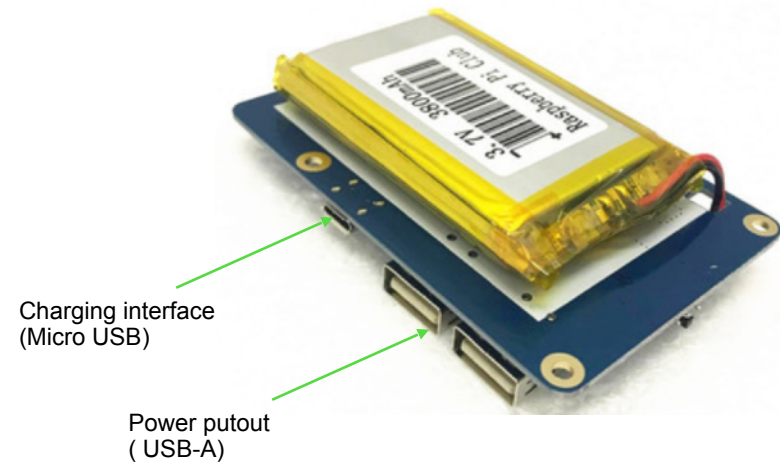
- **Capacity: 3800 mA**
- **Output : 5.1V ±0.1V**

How to control the X- Bot ?

- Five buttons

  - Start
  - Stop
  - Move
  - Deliver
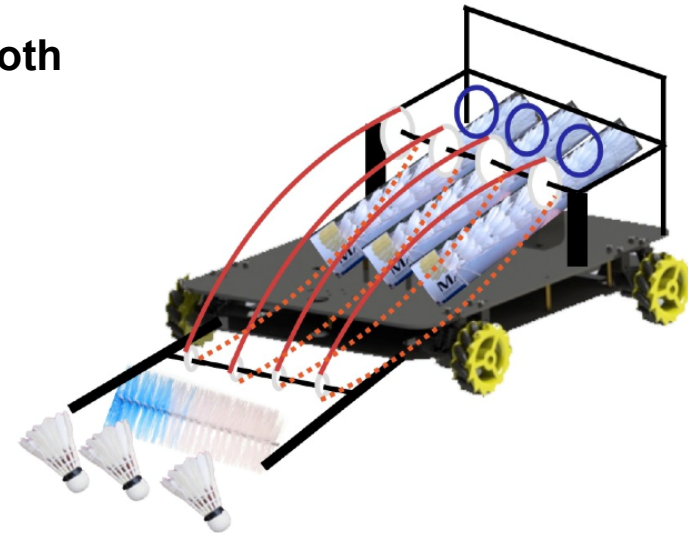 - Reset

- Connection: Bluetooth/Wifi

Parts List & Budget

No.	Item	Quantity	Cost(CNY)
1	Raspberry Pi 3	1	269
2	Driver board	1	100
3	Camera	1	100
4	Tyres	4	200
5	Motor	6	300
6	Chassis	1	50
7	Infrared module	1	19.5
8	Bluetooth module	1	50
9	WIFI module	1	30
10	Lithium battery + Packs +Charge	1	200
11	Pulley for string	6	18
12	String	3	5
13	Iron shelf	4	50
14	Badminton of bucket	2	50
15	Brush (DIY)	1	10
TTL			1441.5

- **Physical X - Bot**

   - Function

   1) Pick up a few shuttlecocks

   2) Deliver them to a container

   3) Transfer shuttlecocks to assigned places

   - Design

   As shown in the image on the right

- **App (application) in cell phone to control via Bluetooth**

- **Battery:**

   - Energy calculation

   - Charging method

   - Current: 2500mA

Q & A

Thank you