Wireless Charging Smart Tracking Car

Team 6

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Introduction

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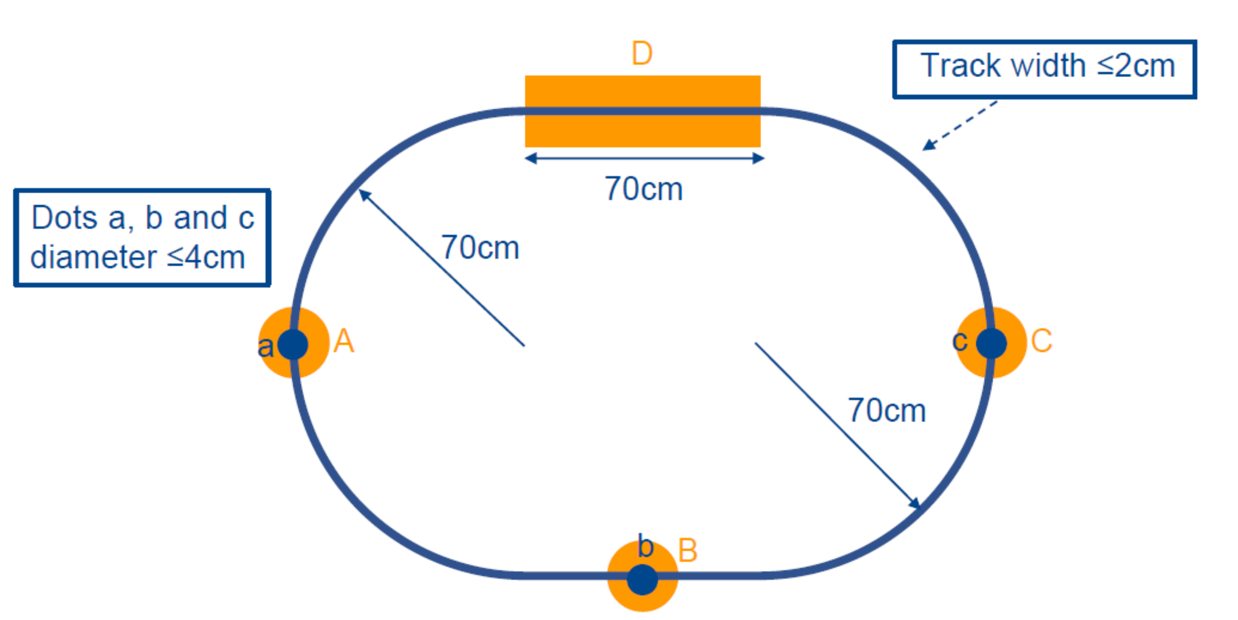
Task 1



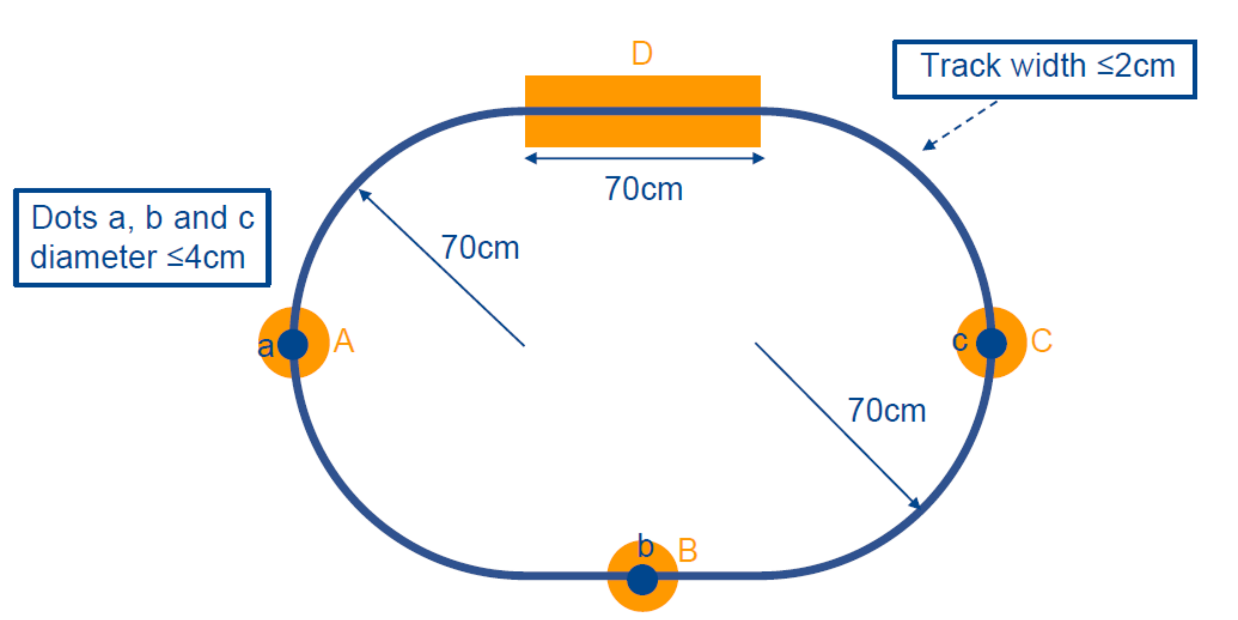
Requirement

The car can be charged at A for 60s. When times up, the car should automatically run and track the black line.

Scoring criteria

1. Number of laps.
2. Voice broadcasting for laps.
3. Remaining power display.

Task 2



Requirement

Four points all provide 180s charging. Car must start after charging at point A for 60s and points B,C,D can only be docked for 30s or not.

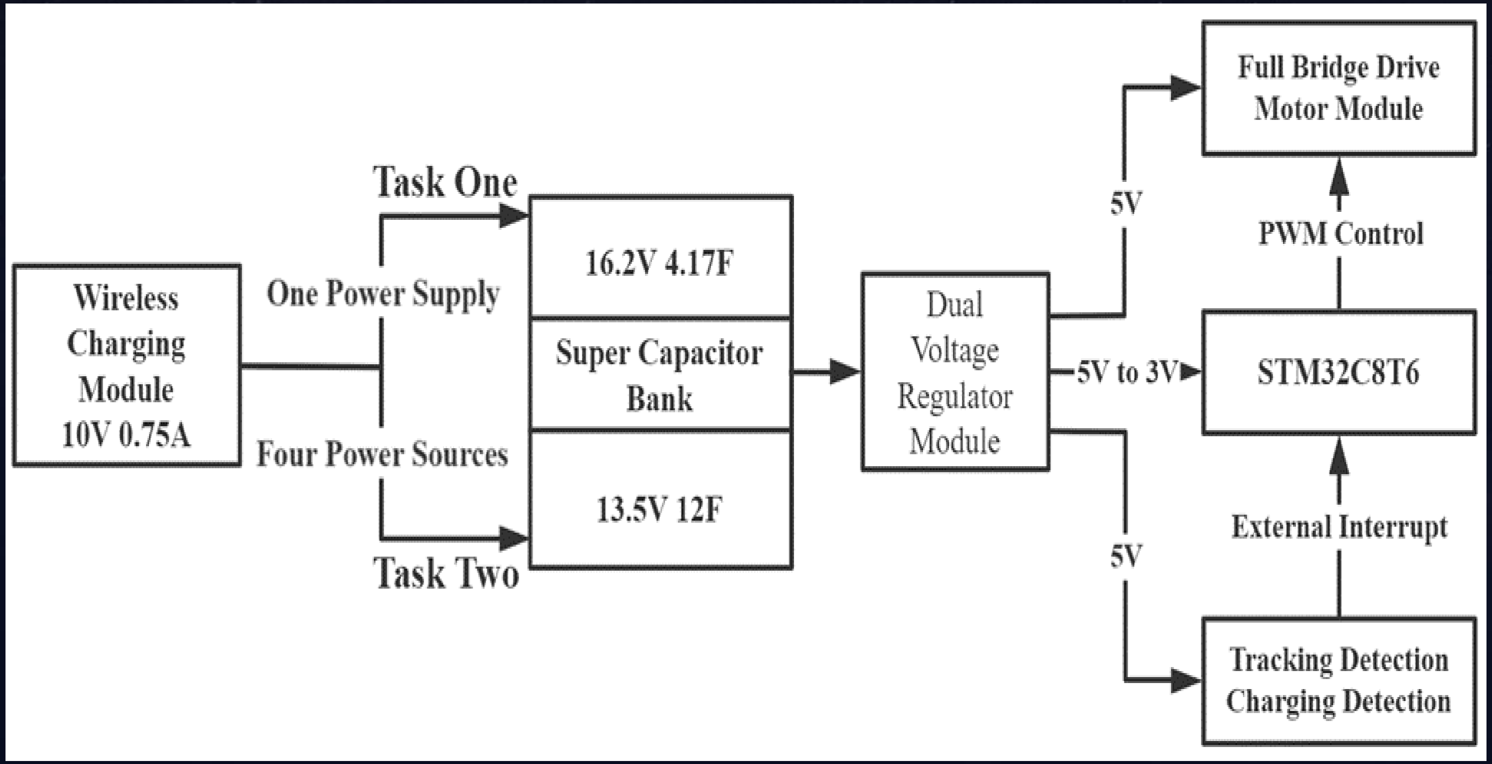
Scoring criteria

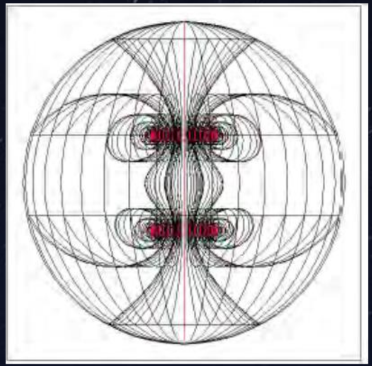
1. Number of laps.
2. Remaining power display.

02

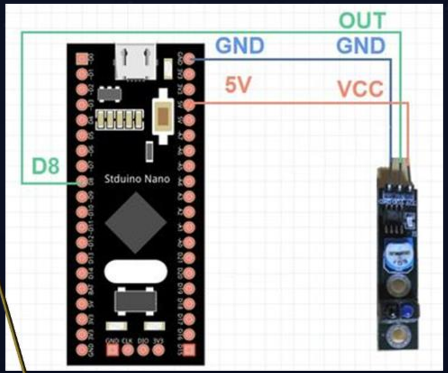
M e t h o d o l o g y

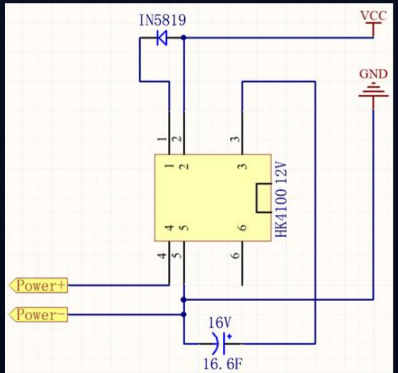
Methodology





Magnetically coupled resonant wireless power transmission system to charge super capacitors.





Photoresistor to detect the intensity of external light

Methodology

HK4100 12V Relay

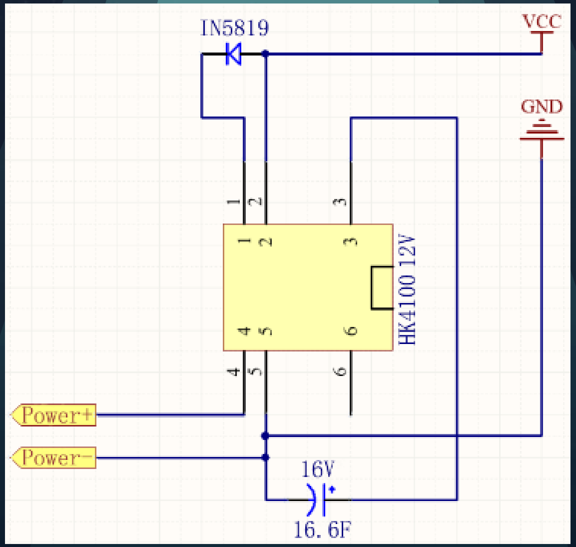
Turn-on voltage: 1.2V

Withstand voltage: 12V

1N5819 Schottky diode

Forward voltage drop: 0.6V at 1A

Average forward continuous current: 1A

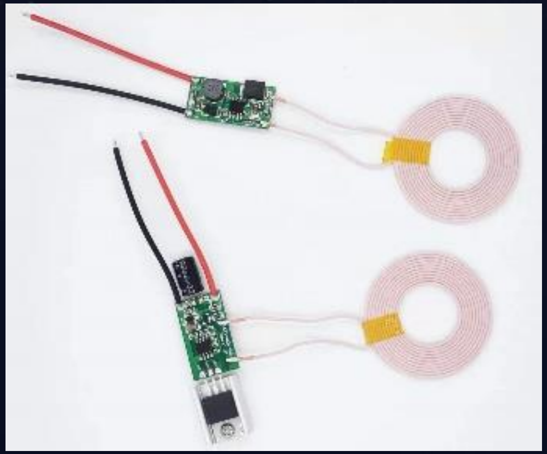


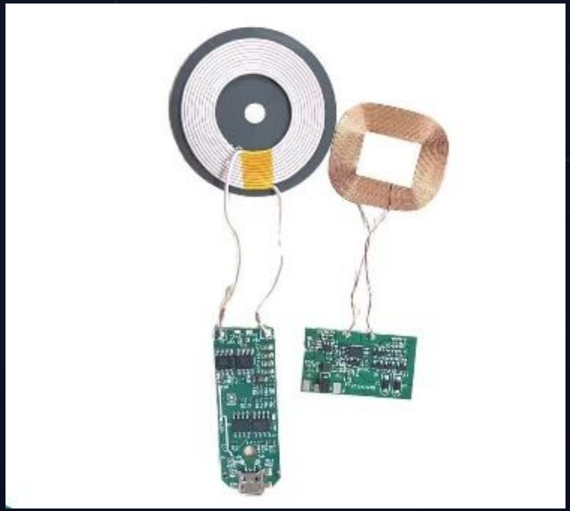
03

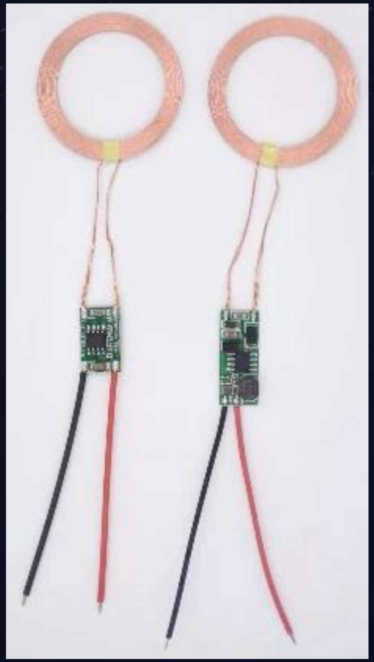
Procedure and Discussion

- Circuit
- Programming

How to choose coils?







How to choose coils?

Formula of voltage on the capacitor

$$v(t) = V_s + (V_0 - V_s)e^{-t/\tau}$$
$$i(t) = \frac{V_s - V_0}{R}e^{-t/\tau}$$

V_s is source voltage, V_0 is initial voltage on the capacitor, τ is time constant

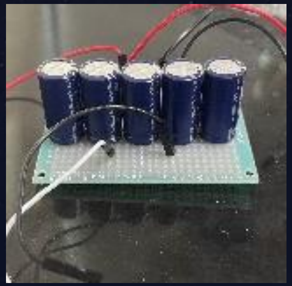
The higher source voltage, the higher final voltage on the capacitor and higher current.

How to choose capacitors?

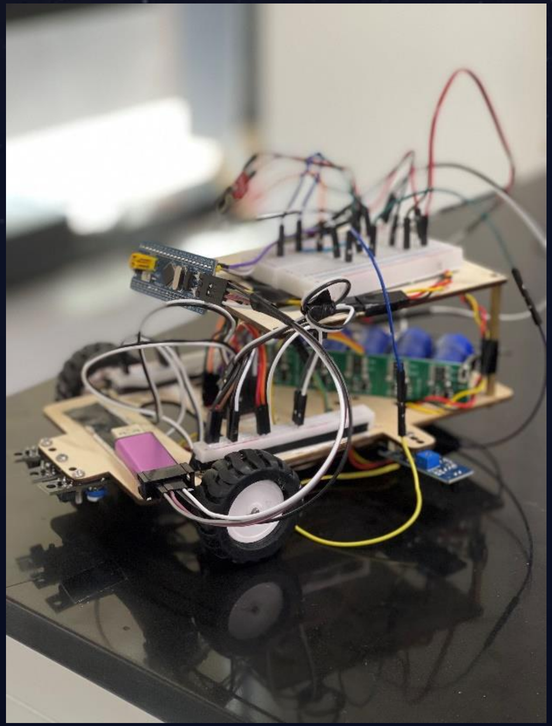
- The energy stored in a capacitor
- Large farad capacitors can store more energy but they will waste more energy.
- Small farad capacitors have fast charging speed and fast discharging speed, and vice versa.
- We need to do experiments.

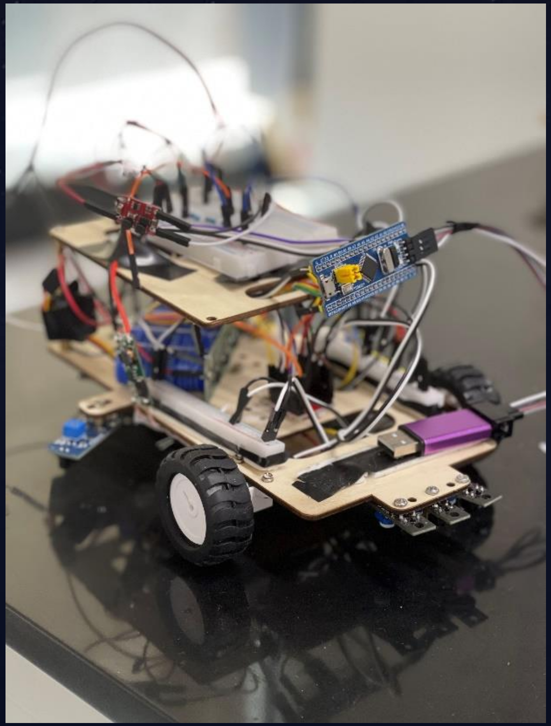
$$w = \frac{1}{2}Cv^2$$

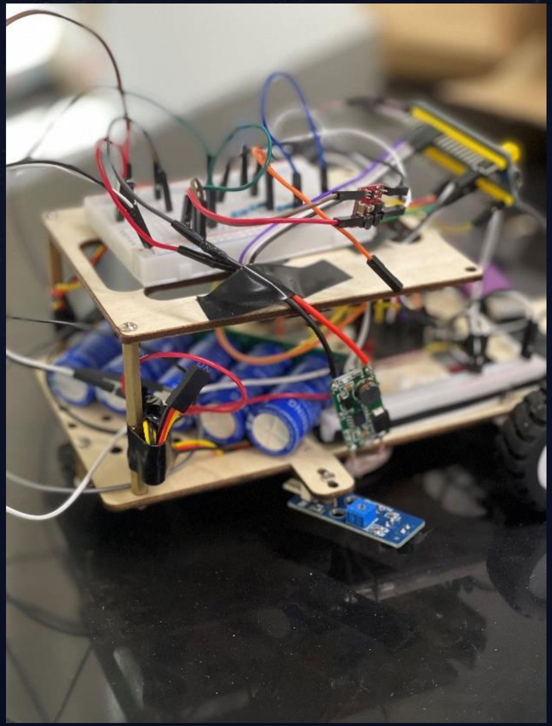
How to choose coils?

Capacitor / Test Index				
Withstand Voltage	13.5V	16V	13.5V	16V
Farad	4F	4.1F	12F	16.6F
Charging Current	550mA	601mA	680mA	533mA
Capacitance Energy	182J	203J	251J	176J
Charging Efficiency	40.4%	45.1%	55.8%	39.1%

After All

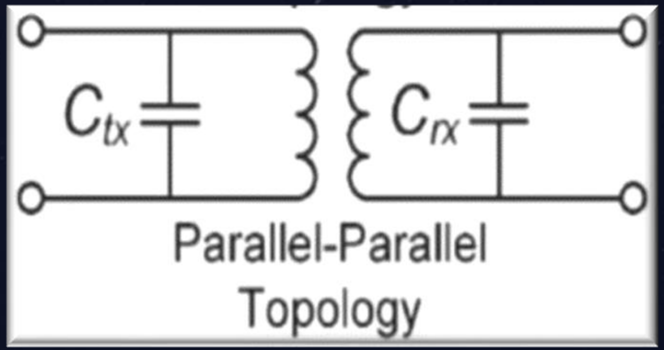






Procedure and Discussion

P-P Compensation Topology



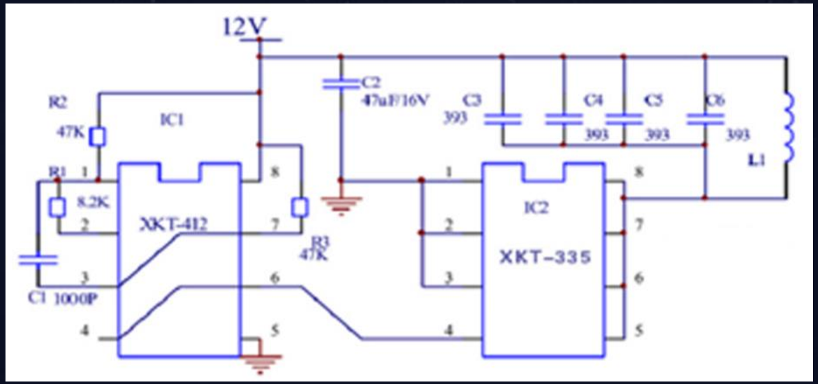
Comparison

Under the maximum output power, the transmission efficiency can reach 80%。

The s-s and s-p type compensation topologies are only 50%。

Procedure and Discussion

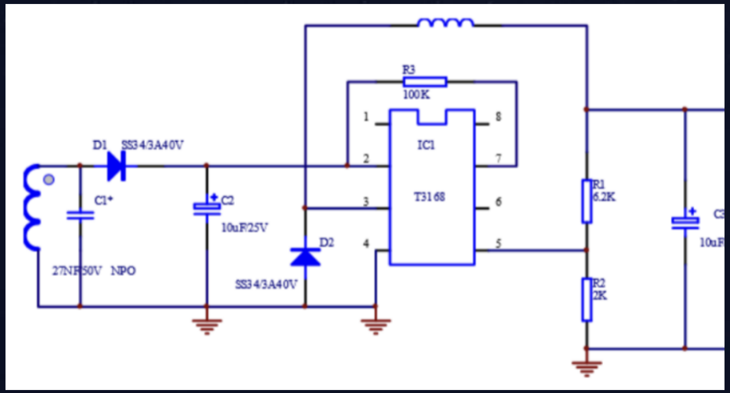
The wireless charging transmitter module allows 12V750mA input and wireless output 12V700mA



The wireless charging has a large working area, fast charging speed, and a well-designed internal over-current, over-temperature and radiation protection circuit.

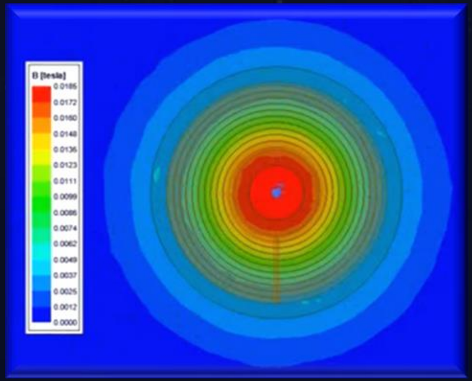
Procedure and Discussion

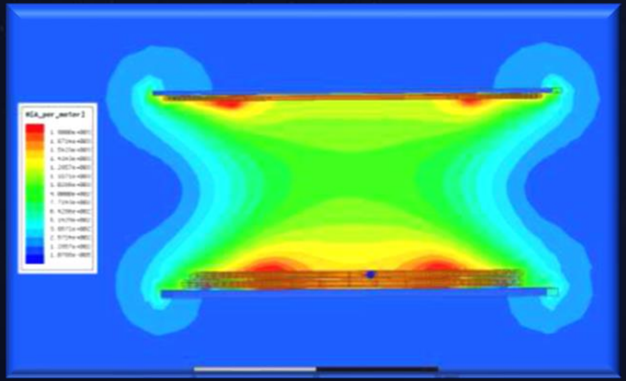
Use T3168 to receive integrated circuit



Small size, large output power, can be used with various wireless charging schemes

Procedure and Discussion





Procedure and Discussion

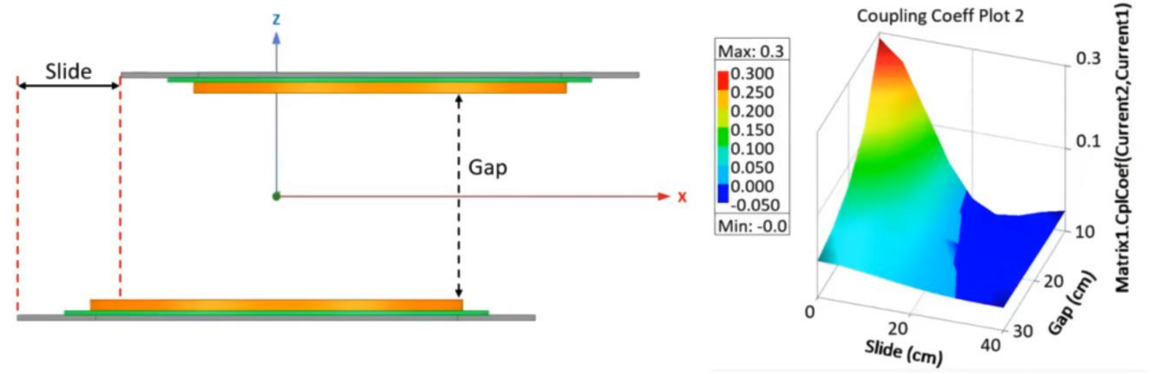
The Effect of Slip

Inevitable Slippage

We pursue higher transmission efficiency, so we simulated the slippage of the two coils and the corresponding efficiency graph, and recorded the corresponding data.

Procedure and Discussion

The Effect of Slip



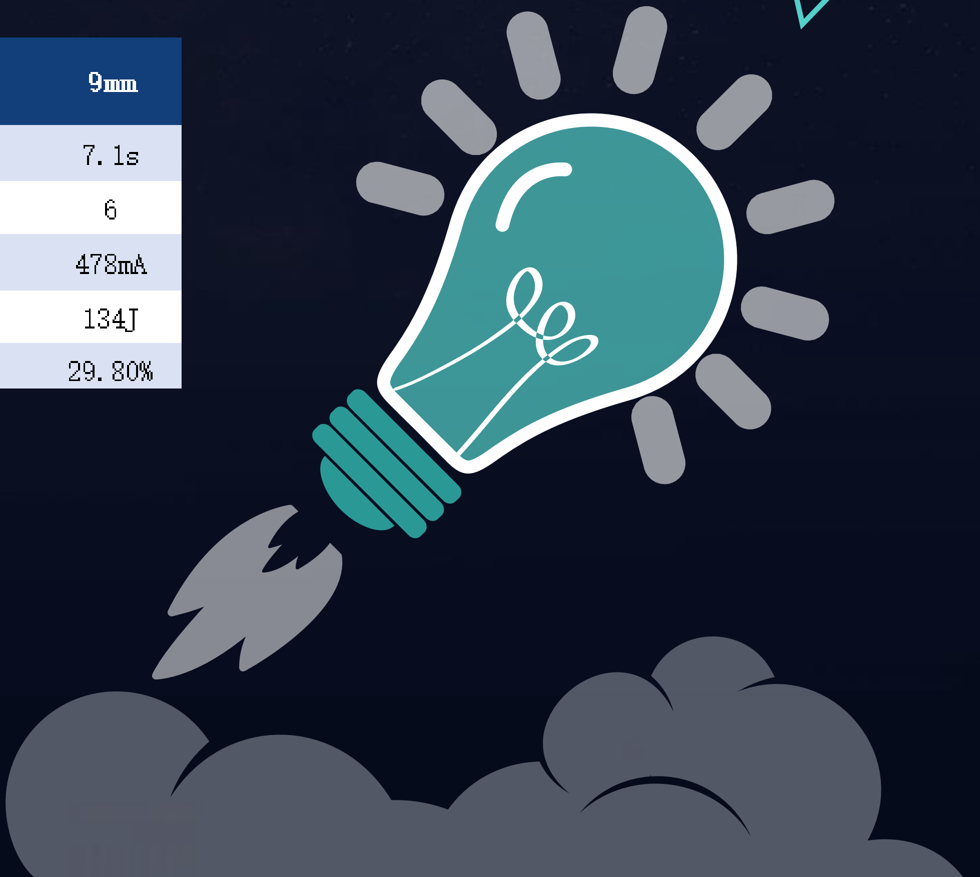
(Coil Structures with Misalignment) (3D Plot of Coupling Coefficient)

Procedure and Discussion

The Effect of Slip

Inevitable Slippage

Test index \ Coil spacing	5mm	6mm	7mm	8mm	9mm
Driving time	7.5s	8.2s	7.3s	8.6s	7.1s
Number of laps	7	9	12	9.5	6
Charging current	532mA	602mA	680mA	623mA	478mA
Capacitance energy	148J	186J	251J	196J	134J
Charging efficiency	32.90%	41.30%	55.80%	43.60%	29.80%



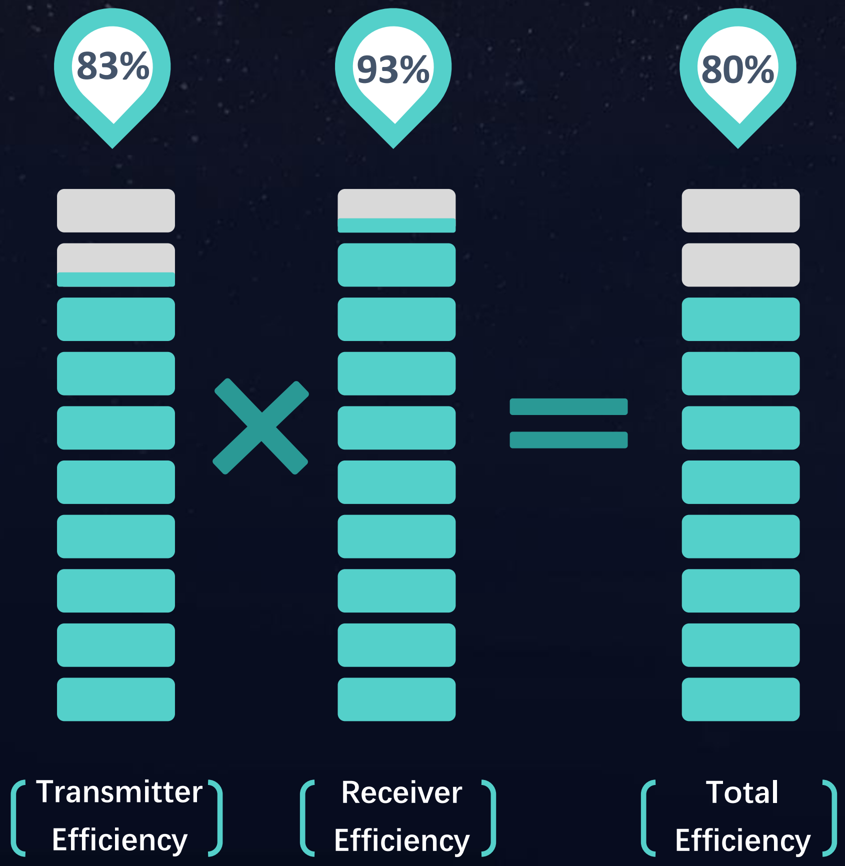
Procedure and Discussion

The Effect of Slip

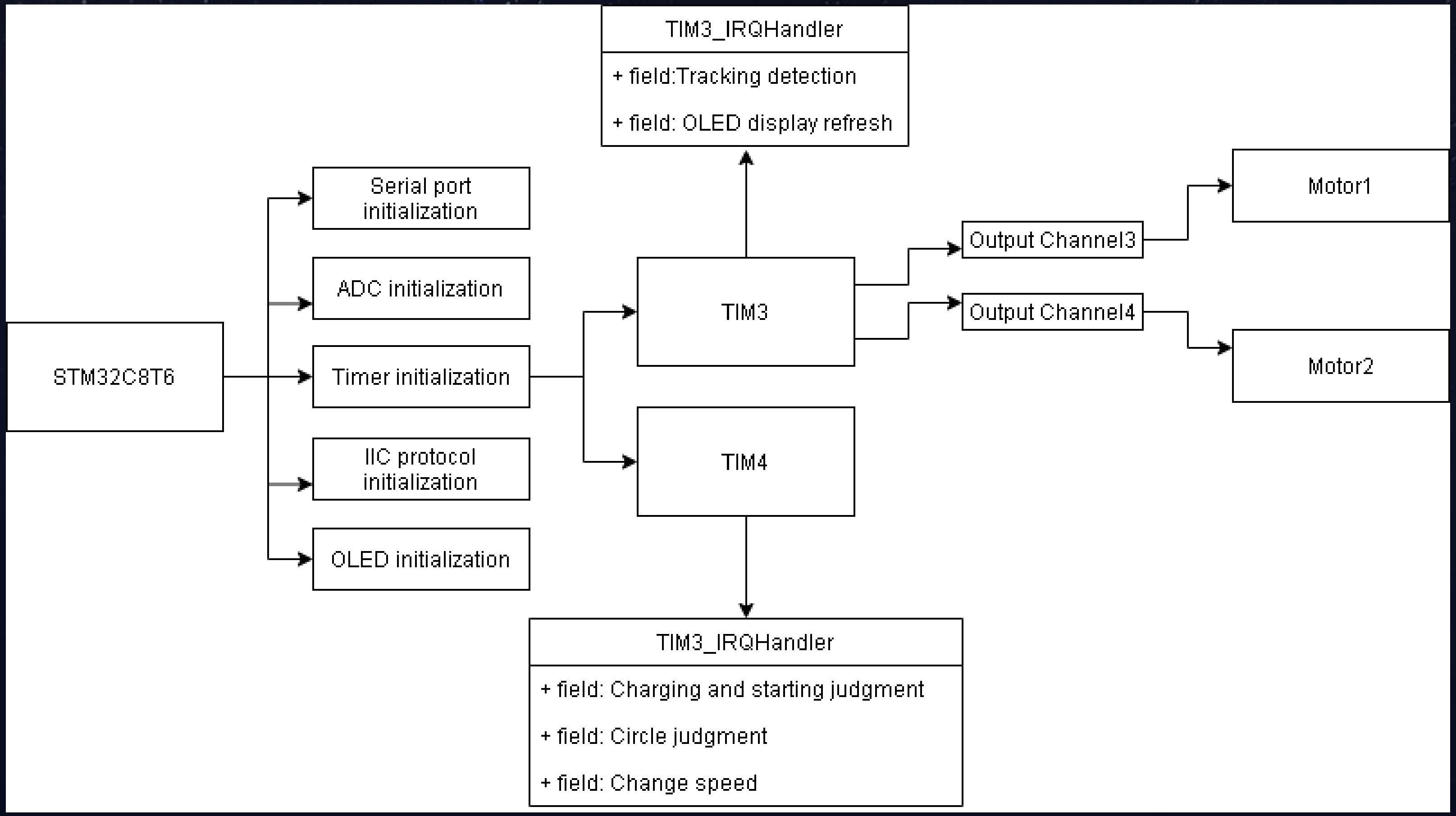
Final Result

We get the best distance between the two coils as 7mm and the efficiency as 55.8%

Procedure and Discussion



Logic of Program



Reboot → Peripheral initialization → Alternate execution of the main program and Interrupt

Function Achievement

How to design the function to achieve our goal !

Automatic charging

1. Use gray-scale sensors to determine parking spots
2. Automatically control the number of sensor detections to avoid misjudgment

Voice broadcast driving distance

1. Decoding and encoding of strings
2. ADC detect the color difference of path

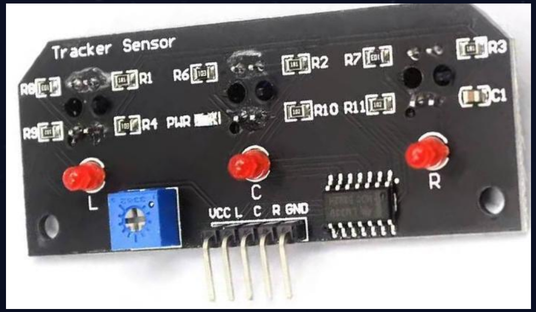
2 Timers

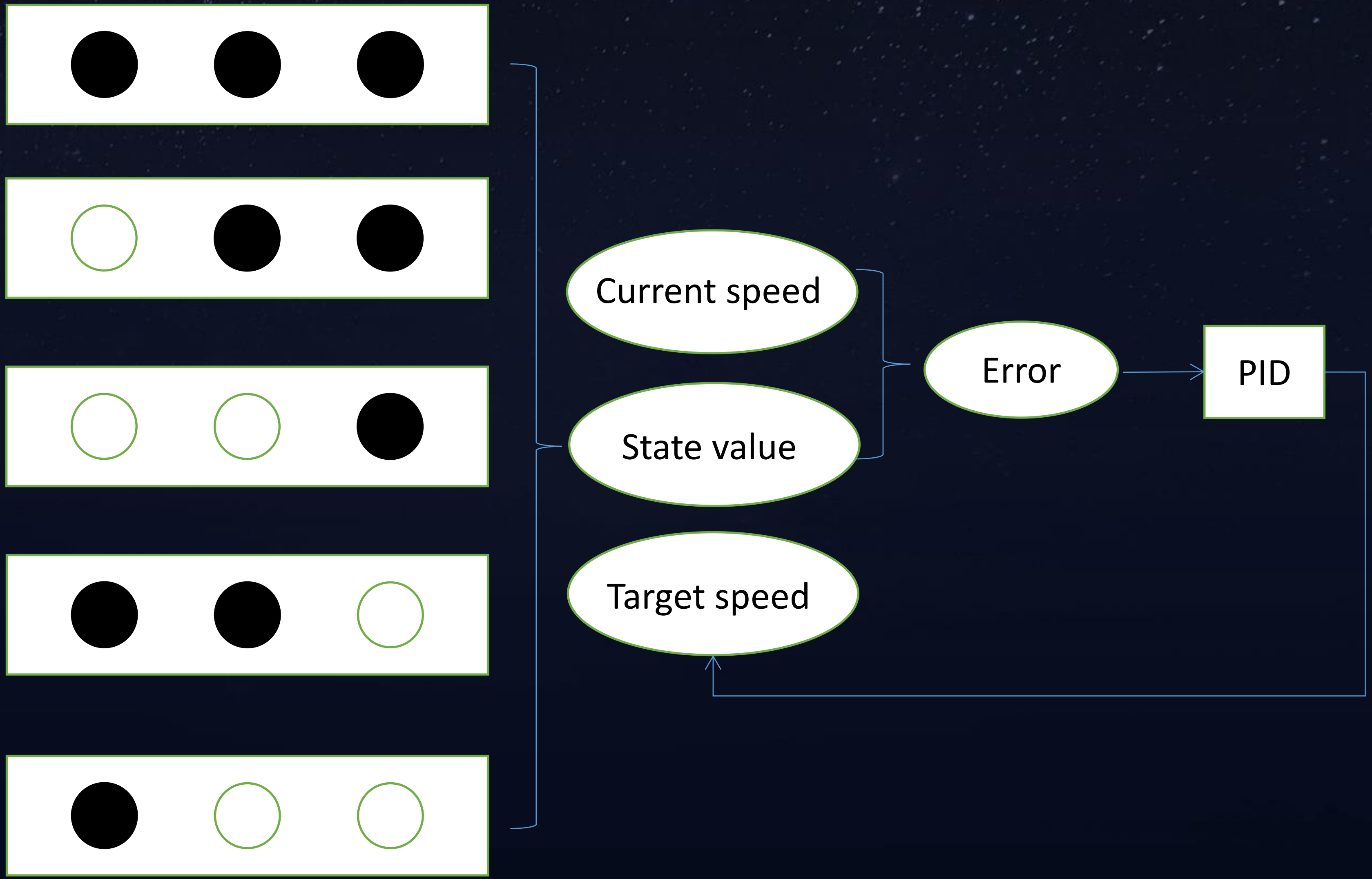
1. Perform tracking function
2. Control time delay
3. Provide PWM

Automatically change speed

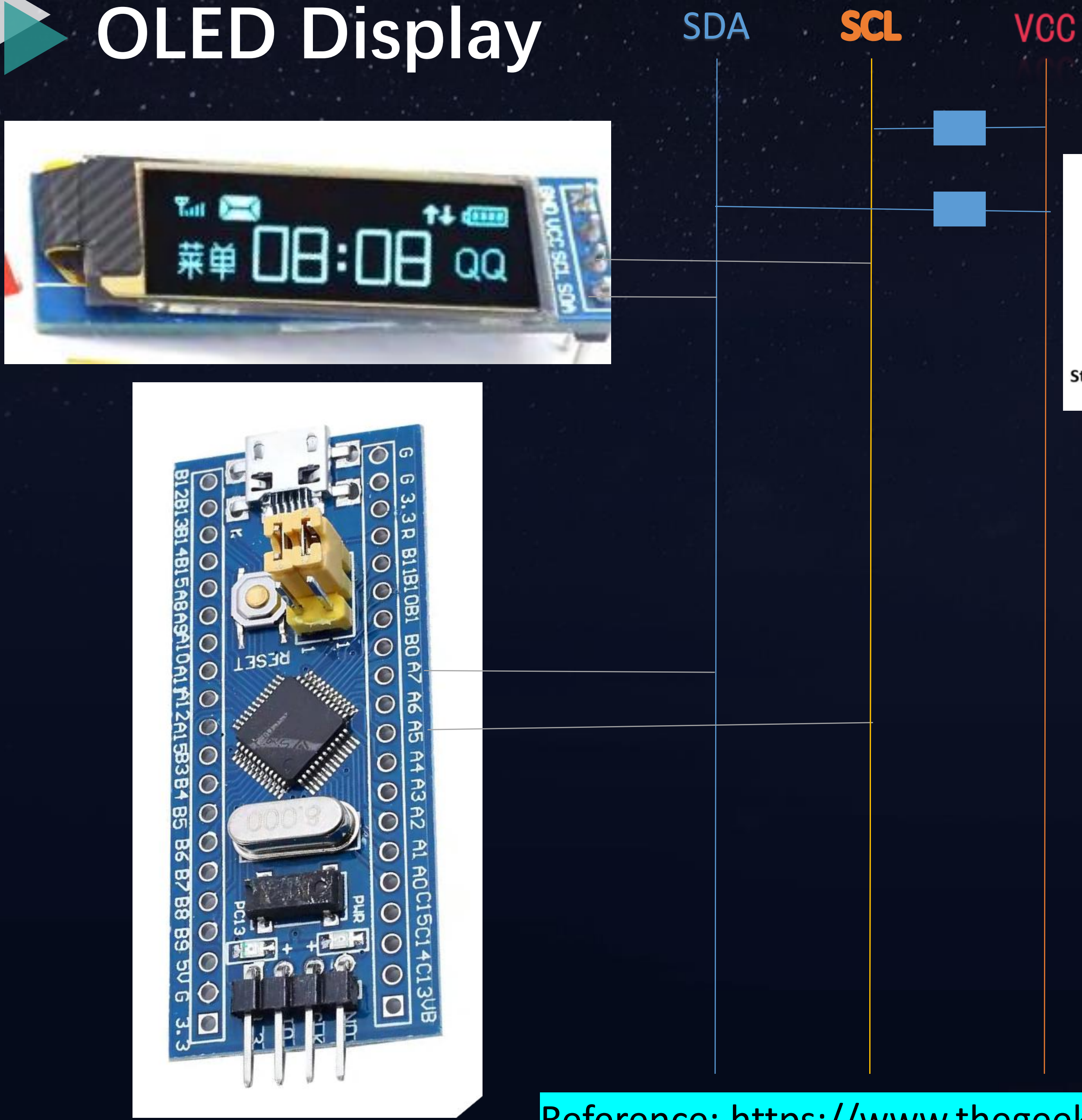
Realize automatic change of charging speed and driving speed

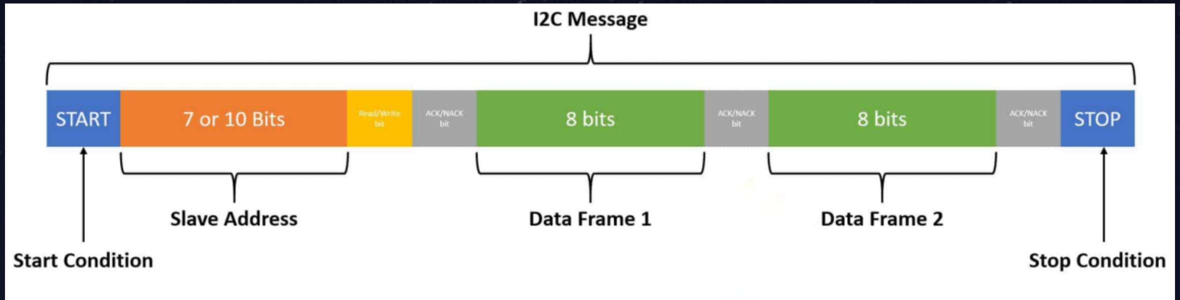
Tracking principle





OLED Display





Start Condition: The SDA line switches from a high to a low signaling the beginning of the communication.

Address Frame: 7 or 10 bit sequence that identifies the OLED on the bus that the MCU wants to send the message to.

The Read/Write Bit: specifying whether the mode is read or read.

The ACK/NACK Bit: If an address frame or data frame was successfully received, an ACK bit is returned.

Stop Condition: the SDA line switches from a low to high signaling the end of the communication.

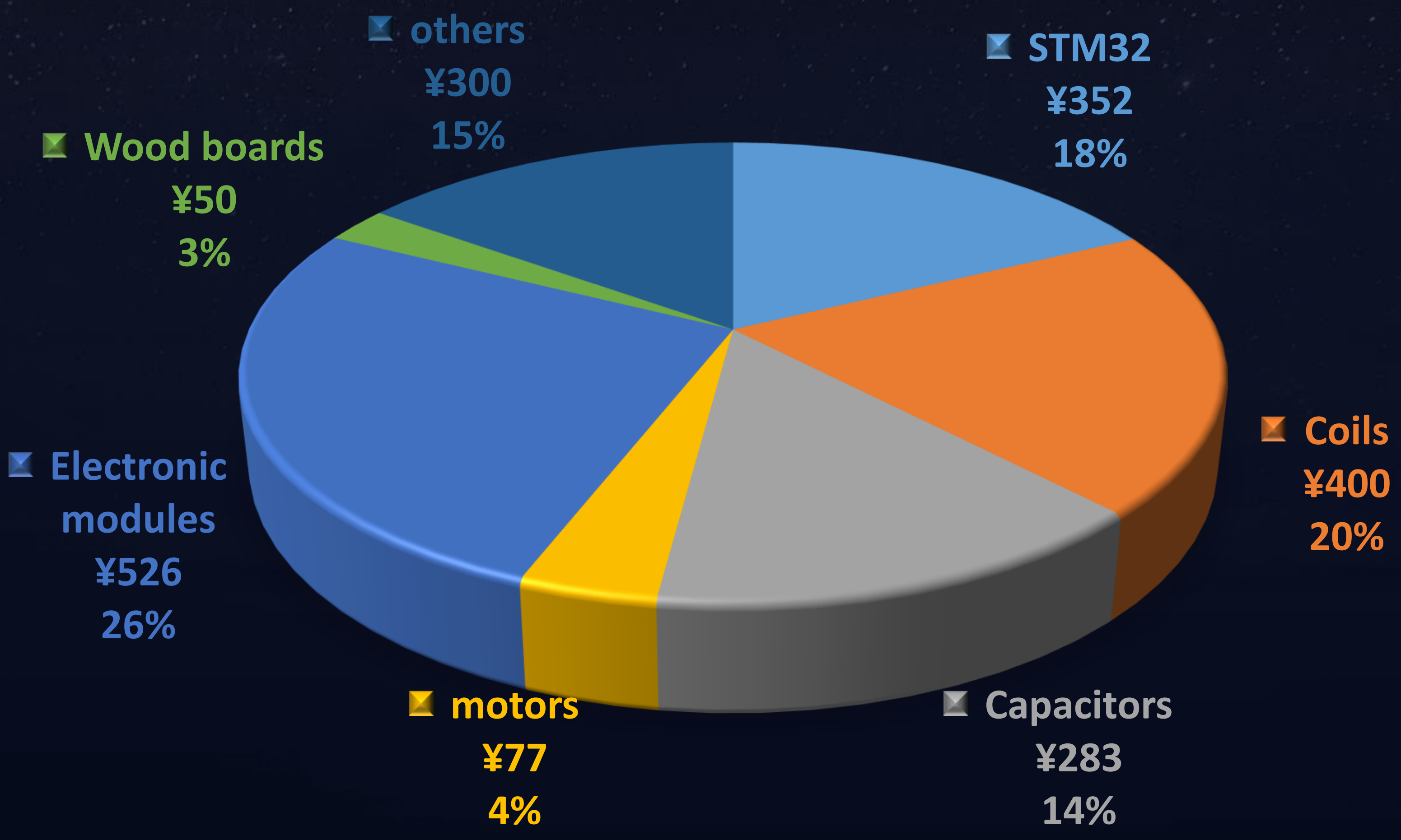
Reference: https://www.thegeekpub.com/18351/how-i2c-works-i2c-explained-simply/

04

Result

- Cost
- Score

Cost Estimation



Result

Task \ Test index	Number of laps	Charging efficiency
Task 1	17	53.30%
Task 2	28	37.30%

Task 1: Our car has successfully realized voice broadcasting of laps and display of remaining power. And, our car runs 17 laps finally . Through calculation, the charging efficiency is 53.30%.

Task 2: Our car charged at point A for 60s, and stopped to charge at points B and D for 30 seconds in the next two laps. What's more, we take advantage of dynamic charging. Our car finally reaches 28 laps, and the charging efficiency is 37.3%.

Thank you