International Journal of Engineering Sciences & Research Technology

(A Peer Reviewed Online Journal)
Impact Factor: 5.164

IJESRT

RESEARCHERID
THOMSON REUTERS
[Huang *et al.*, 10(3): March, 2021]
IC™ Value: 3.00
ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

IJESRT
INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

WIRELESS CHARGING TROLLEY WITH VEHICLE-PILE COLLABORATION

Hao-Yu Huang[*1], Jia-Chen Xu[2], Jia-Hao He[3], Li-Xia Cai[4] & Mei-Ling Zhu[5]
[*1&2&3&4&5] Department of Electronics and Information Engineering, Tongji Zhejiang College, CHINA

DOI: https://doi.org/10.29121/ijesrt.v10.i3.2021.15

ABSTRACT

Most of the built carts will use a combination of lithium batteries, but the types of lithium battery connectors are cumbersome and their charging time is too long. In this project, a Faraday capacitor is used instead of the car's power source to store power in a wireless charging mode, by providing DC power to the transmitter coil along the road to induce a certain voltage to the secondary coil carried by the car to achieve the effect of storing power for the Faraday capacitor. A camera module openmv in the centre of the track captures images and uses a target detection algorithm to intelligently identify the position of the car to control the activation and deactivation of the coils to improve efficiency.

KEYWORDS: wireless charging, tracing, openmv vision recognition, target detection.

1. INTRODUCTION

Traditional wired charging trolleys have hidden problems such as cumbersome use and unsafe wire interfaces. In this project, it has been improved and upgraded to enhance the convenience of charging and to remove many of the safety hazards associated with charging. The wireless charging trolley in this paper can achieve fast charging while travelling, and the charging track can be intelligently identified, thus achieving efficient and energy-saving charging.

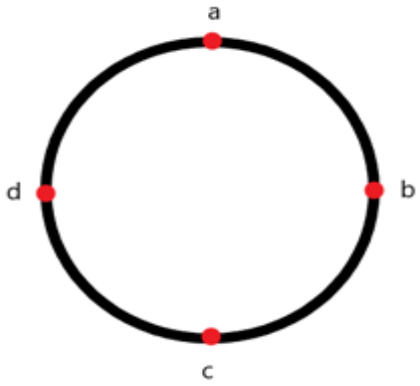
Based on this, this paper uses the openmv machine vision module and the Python image recognition algorithm library to realise the visual recognition function, and then transmits the electrical energy through resonant coupling, so as to carry out wireless fast charging.

2. MATERIALS AND METHODS

1 Overall system structure

1.1 Overall system scheme

The system is composed of two parts: the cart and the track. A circular track is built and four QR code markers are placed at four evenly divided positions to provide feedback to the system through the recognition effect of openmv, so as to control the switch of the track charging pile and judge when to conduct wireless charging.



ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

The power supply is divided into two parts, the first part is powered by the model battery, which is stepped down to 5v by the lm2596s buck module to provide a stable voltage to the track module and microcontroller; the second power supply is powered by a pair of capacitors to the gear motor, the two capacitors are connected in parallel and the lower capacitance one receives the wireless charging from the coil and then supplies power to the circuit. The motor requires a 12v supply and the capacitor supply is unstable and is boosted with a boost module xl6009. The motor is a 12v 620rpm geared motor, controlled by an l298n motor drive.

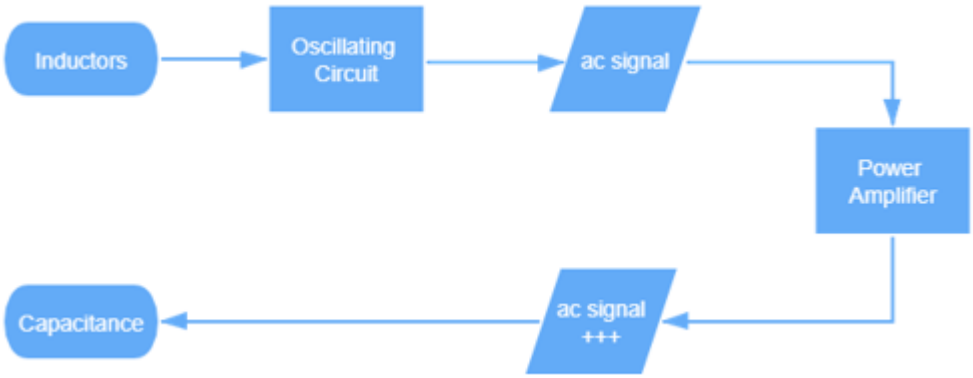
The trolley track is a 5-way track, controlled by an 89c51 microcontroller to achieve its track function and control the trolley to drive precisely on the black track line. A camera, Openmv, is mounted on the cart to provide visual recognition and feedback to the system. A microcontroller is also placed on the track to control the power on and off, and the data is transferred between the two microcontrollers using the hc05 Bluetooth module. This allows the microcontroller on the track to control the corresponding relay to control the start-up and shutdown of each charging post, thus allowing the system as a whole to gain automatic control to reduce unnecessary power loss.

1.2 Wireless charging module

Wireless charging uses the principle of electromagnetic wave induction or other related AC induction technology to send and receive the inductive AC signals at the transmitter and receiver side with corresponding devices for charging, derived from wireless power transmission technology.

The car is driven by a Faraday capacitor and a secondary coil is arranged on the back of the car to use near-field induction (inductive coupling) with the primary coil on the track to generate an AC signal via an oscillating circuit, which is then processed by the circuit to obtain the required current and ultimately to achieve the function of wireless fast charging.

The power supply from the track supplies the primary coil, the relay and the microcontroller (track), which turns the corresponding charging pile (primary coil) on or off when it receives the signal via Bluetooth.



The resonant coupling technology uses two resonant objects of the same frequency to create a strong mutual coupling, with the energy interacting between the two objects, using the coils and the flat capacitors placed at both ends to form a resonant circuit. The voltage transmitted to the car is processed by the circuit to supply the motor and to store the capacitor.

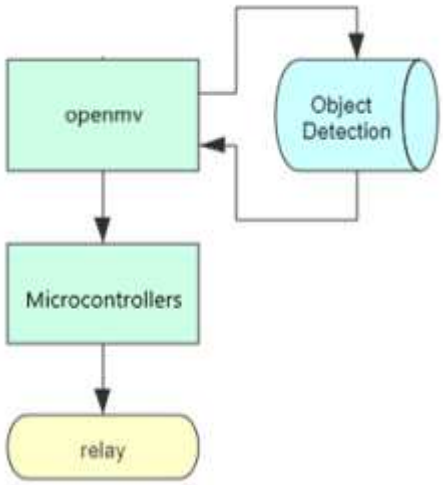
The theoretical basis of the electromagnetic resonance coupled wireless transmission technology is the "coupled mode theory". When the resonance frequency of the energy transmitter and receiver is the same, the transmitter first generates self-resonance under this alternating magnetic field and generates an alternating magnetic field of the same frequency. When the transmitter coil emits a square wave at the resonance point, the highest efficiency of power transmission is achieved.

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

Let the resonant circuit output frequency is, then the resonant frequency is equal to satisfy the following relationship $f = \frac{1}{2\pi\sqrt{L \bullet C}}$.

1.3 Visual recognition module

Machine vision algorithms on the OpenMV include finding colour blocks, edge detection, sign tracking, etc. By writing some simple Python code, it can recognize the QR code we prepare to determine whether wireless charging is performed. (See 2.1 for the specific code)

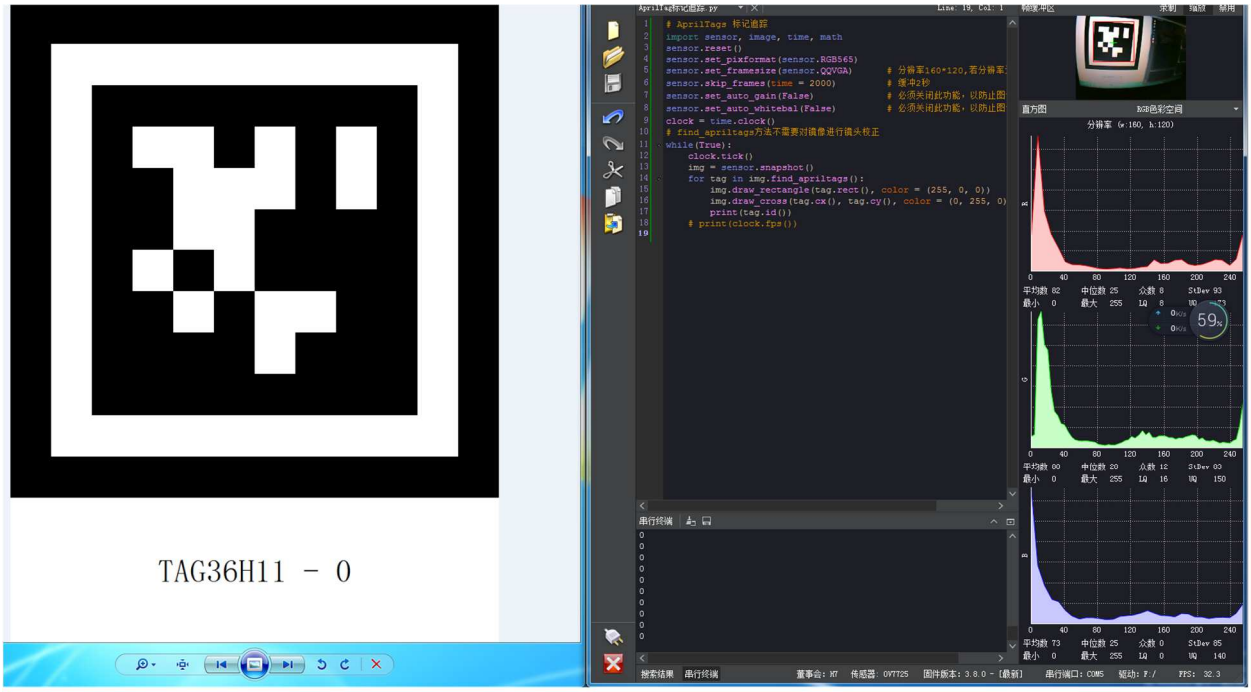


For the track part, the track is first divided evenly, a charging coil is placed at certain distance and a relay is used to realise the control of whether the coil is energised or not, then it is set to four points a, b, c and d, and four point QR codes are set, the openmv camera with the trolley captures the image and calibrates the position of the moving trolley through target detection, when it is judged that the trolley reaches the preset four a, b, c and d When the trolley reaches the four preset points a, b, c and d, the control circuit supplies power to the coil to charge the trolley by electromagnetic induction, and then turns off when the trolley leaves the point.

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

3. SOFTWARE DESIGN

2.1 AprilTag visual positioning Python implementation



The test procedure for the first point visual recognition and the code used

We have relied on the AprilTag visual benchmark library for openmv recognition and to quickly detect signs by means of QR codes and then calculate the relative position.

The main steps of AprilTag are divided into three parts: firstly detecting various edges in the image based on gradients, secondly finding the required quadrilateral pattern in the edge image and filtering it, edge detection through efficient use of AprilTag, determining the outer edge, eliminating non-straight pin edges, finding edge points of the same kind as that starting point, neighbouring edge finding at straight edges, and when scanning to the start point, a closed loop is formed, then the detection result is shown as a quadrilateral is detected. Finally, the 2D code encoding and 2D code decoding are carried out. The encoding is divided into three ways, and as the detected quadrilateral does not necessarily meet the experimental requirements, the quadrilateral obtained in the previous step needs to be decoded, matched and checked. As for the decoding content, an array of dots is generated within the detected quadrilateral to calculate the value of each colour block, and then a simple classifier is constructed to classify the colour blocks within the quadrilateral according to Local Binary Patterns (LBP), coding the positive example blocks as 1 and the negative example blocks as 0 to obtain the code of the 2D code. The code is then matched against the known library to determine if the decoded code is correct.

2.2 Trace recognition

Tracing is the ability of a trolley to follow a black trajectory line on a white ground accurately. Therefore, we need the trajectory detection module, which is like the eyes of the trolley and needs to return the road information to the brain, where it is processed by the brain information and then executed by the actuator.

The track module takes the detected black and white track lines, processes them and sends the results to the motor drive module for execution, thus completing the tracking. The track module is processed using binary, the track light always returns 1 when a white line is encountered and by checking for black lines, the track light returns 0

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

when a black line is encountered. when a black line is detected, the LED goes out. If the black line is seen on the right side of the trackpad, the left wheel of the trolley is accelerating forward and the right wheel is counter-accelerating backwards.
The infrared sensor five-way tracking module used in this project has five sensors, which control the analogue output by judging the different degrees of infrared reflection for black and white, feeding back parameters such as the distance of the black line.

4. RESULTS AND DISCUSSION

We put the made cart at point A of the runway to start driving, the cart itself with capacitor power supply at the same time, the runway to its wireless fast charging, after several tests secondary coil stable output 5v voltage. Although the car appears to have passed the charging point on the runway quickly, the wireless charging technology clearly increases the car's travel time in terms of time comparison.

5. CONCLUSION

This paper presents a wireless charging trolley with vehicle-pile collaboration. The system uses wireless charging technology and detects the corresponding trolley in operation to achieve fast charging. The wireless charging system plays a crucial role as an energy supply system for electric vehicles and has great development prospects in the future. Driven by Farrar capacitors, openmv visual recognition, Bluetooth transmits signals to control charging or not, and according to the coil inductive coupling, current is generated for charging. After several tests, the car can be more smooth and high-speed trajectory driving, wireless charging technology increases the distance of the car can travel time.

6. ACKNOWLEDGEMENTS

Through the design, analysis and testing of this project, we were able to deepen our understanding and application of the technology and develop our creative thinking. Not only did we realise how much work goes into creating a product that is perfectly suited to the current times, but we also realised that many products in our lives have many flaws and that we need to keep innovating.

This project received support from the Zhejiang College of Tongji University's Student Innovation and Practice Program,Item No.DCXM06200040.

REFERENCES

[1] Guo Hongxu. Dynamic wireless charging system for electric trolleys based on supercapacitors [J]. Information Technology and Security Network, 2020, 39(2): 57-61.
[2] Ye Jiahong, Luo Wanting, Zhang Ruiyi, et al. Application of supercapacitor film pack in wireless charging trolley [J]. Electrotechnology, 2019(06): 127-129.
[3] Deng Xinguang, He Gaoxiang, Chen Yonglin, Wang Wenfeng. Design of wireless charging receiver circuit based on electromagnetic induction [J]. Electronic Testing, 2020(01):95-96.
[4] Deng Kunwei. The future of battery and charging technology:from supercapacitor to wireless charging[N]. China Smart Manufacturing Network, 2017-09-29.
[5] Liao Chenglin, Li Junfeng, Ma Zhongyuan. Application of wireless energy transmission technology in wireless charging of electric vehicles [J]. Modern physical knowledge, 2015(2):51-53.
[6] Guo Yanjie, Wang Lifang, Li Shufan, et al. Dynamic modeling and characterization of mobile wireless charging system for electric vehicles [J]. Power System Automation, 2017(2):73-78.
[7] MACHURA P, LI Q. A critical review on wireless chargingfor electric vehicles [J] . 2019(104) : 209-234.
[8] ZHAO TIANSHU. Wireless charging circuit design for robots [J]. Electronic testing , 2019(01) : 66-67.
[9] Guo Haokun. Design of intelligent car based on microcontroller and Bluetooth control [J]. Electronic Testing , 2019(11) : 27-29..