

Research on the Application of Artificial intelligence and AI Robotics in Product classification using QR code

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ABSTRACT

The article presents the application of artificial intelligence and AI Robots in classifying products using QR codes. The robot's integrated arm allows the picking and sorting of products. Using a high-precision Servo motor, road detection sensor, and an ultrasonic sensor to detect objects and determine distance and coordinate location to perform product selection, monitoring, and receiving operations image format through camera.

Keywords: AI robots; QR code; Product classification; Image recognition via camera.

1. Introduction

We already understand that Artificial intelligence (AI) is revolutionizing the way we live and get work done. AI will learn by itself, find the cause, and correct errors because AI has become a master of knowledge. In this article, we will better understand AI - how this artificial intelligence platform has made great strides and its application in classifying products by QR codes.

First, AI has made data distributed and used more efficiently. In today's era, to get a more general view of data, businesses have changed the way they use data a lot over time. Data about people is being analyzed to map poverty and climate change. Automation in agriculture and irrigation is developing and happening at breakneck speed. Additionally, in areas such as healthcare, making predictions about consumption patterns, rationalizing energy use, and waste management are also among the AI topics of interest. In this article, we will learn about typical AI applications such as:

- Planning.
- Machine learning.
- Natural language processing.
- Computer vision.
- Robotics and artificial intelligence.
- The brain system processes information received from the senses and also plays a major role in telling the body what to do. Similarly, AI robots also have the same structure and activities as humans. How does a vacuum cleaner (AI robot) work?

Some people will choose to clean their house once a week, and some people will visit, but what they all have in common is that they all have to move house. Therefore, AI robots with the function of automatically cleaning

the house are always an ideal choice and very attractive to everyone. They help us reduce time and effort and still have the clean and beautiful house we want. Today's artificial intelligence-integrated robot vacuum cleaners are very different from early robot vacuum cleaner models. Now, you don't have to search or rummage around the house to find the robot vacuum cleaner in case the battery runs out or the power runs out. Current AI vacuum cleaner products will clean your house effectively, and don't forget to arrange them accordingly to increase the robot's cleaning efficiency. Besides, you should pour the dirt from the vacuum cleaner into the container and build a path so it can automatically return and charge the battery when necessary.

1.1. Artificial intelligence in self-driving cars

Long-range radar, cameras, and LIDAR, many technological advancements have been applied in the autonomous vehicle segment. These technologies are used in different capacities and each technology collects different information. Information is only worthless when it is not processed or cannot derive any value.



Figure 1. AI self-driving car model

This is where artificial intelligence is used and where it can be compared to the human brain. Some of its uses in autonomous vehicles are:

- Navigate the vehicle to the gas station when the vehicle is low on fuel.
- Adjust the route to take based on traffic congestion so the vehicle can reach its destination fastest.
- Incorporates voice recognition for more advanced communication with passengers.
- Virtual assistance technology.

1.2. Artificial intelligence in healthcare

This is the most important thing that people need today. Health is a precious resource, and the rate at which people are trading it for other things is truly shocking. AI artificial intelligence technology will help answer customer questions. It creates virtual assistants that help doctors organize their schedules more easily and also reduce time and costs for both doctors and patients by streamlining processes.

Artificial intelligence also helps open up new paths for this industry. AI technology has assisted disease researchers in analyzing tissue samples and making diagnoses more accurate: AI helps support decision-making

and research; AI helps integrate medical, software, and scientific activities; AI helps synthesize knowledge into a content-rich treasure for future medical and scientific communities.

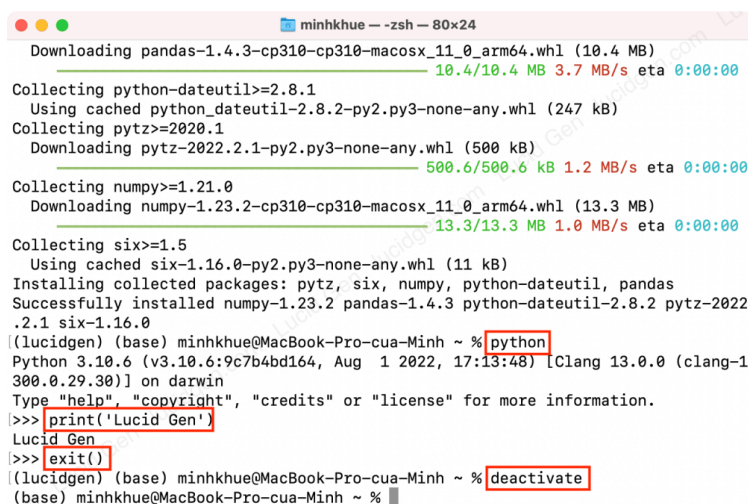
2. Design solution when building an operating model of an AI Robot that classifies products by QR code

Build a hardware model to simulate the operation of a QR code product sorting robot with some requirements as follows:

1. Flexible moving system design with high stability.
2. Design a monitoring and image recognition system via camera.
3. The integrated arm model allows the product picker to sort products with some basic operations as follows, 360 degree rotation on the rotating axis, flexible joints with wide angle up to 180 degrees. Use Servo motor with high precision.
4. Use the line detection sensor to determine the line for the Robot to move, the ultrasonic sensor detects objects and determines the distance to create a position to perform the product picking operation.
5. Robot operates stably when moving and when classifying products, classifying accurately according to set requirements.

2.1. Python programming language

Many languages can write image processing programs, but Python is the language most popular language. Python is a high-level, multi-item object-oriented programming language destination. Additionally, learning Python is quite simple and easy. Python is also a language, interpreted, meaning the language does not need to be compiled into an executable file, but reads the code and runs it.



```

minhkhue - zsh - 80x24
Downloading pandas-1.4.3-cp310-cp310-macosx_11_0_arm64.whl (10.4 MB)
10.4/10.4 MB 3.7 MB/s eta 0:00:00
Collecting python-dateutil>=2.8.1
Using cached python_dateutil-2.8.2-py2.py3-none-any.whl (247 kB)
Collecting pytz>=2020.1
Downloading pytz-2022.2.1-py2.py3-none-any.whl (500 kB)
500.6/500.6 kB 1.2 MB/s eta 0:00:00
Collecting numpy>=1.21.0
Downloading numpy-1.23.2-cp310-cp310-macosx_11_0_arm64.whl (13.3 MB)
13.3/13.3 MB 1.0 MB/s eta 0:00:00
Collecting six>=1.5
Using cached six-1.16.0-py2.py3-none-any.whl (11 kB)
Installing collected packages: pytz, six, numpy, python-dateutil, pandas
Successfully installed numpy-1.23.2 pandas-1.4.3 python-dateutil-2.8.2 pytz-2022
.2.1 six-1.16.0
(lucidgen) (base) minhkhue@MacBook-Pro-cua-Minh ~ % python
Python 3.10.6 (v3.10.6:9c7b4bd164, Aug 1 2022, 17:13:48) [Clang 13.0.0 (clang-1
300.0.29.30)] on darwin
Type "help", "copyright", "credits" or "license" for more information.
>>> print('Lucid Gen')
Lucid Gen
>>> exit()
(lucidgen) (base) minhkhue@MacBook-Pro-cua-Minh ~ % deactivate
(base) minhkhue@MacBook-Pro-cua-Minh ~ %

```

Figure 2. Install modules for Python on Ubuntu

2.2. Raspberry Pi 3 Model B

Raspberry Pi 3 Model B is the third generation Raspberry Pi. In this generation, there is the addition of BCM43438 Wi-Fi chip, Built-in chip. There is also Bluetooth low Energy on board making the Pi an additional

Raspberry Pi 3 Model B

Dimensions
85.6mm x 56mm x 21mm

4 x USB 2 Ports

10/100 LAN Port

3.5mm 4-pole Composite Video and Audio Output Jack

CSI Camera Port

Full Size HDMI Video Output

Micro USB Power Input. Upgraded switched power source that can handle up to 2.5 Amps

DSI Display Port

MicroSD Card Slot

On Board Bluetooth 4.1 Wi-Fi

Broadcom BCM2837 64bit Quad Core CPU at 1.2GHz, 1GB RAM

40 Pin Extended GPIO

2.3. Module Pi camera v2

A Raspberry Pi Camera V2 module is shown, featuring a green printed circuit board (PCB) with a black camera lens and sensor. The board is labeled "Raspberry Pi" and "Camera V2". It is connected to a white ribbon cable with a blue tab, which has gold-plated contacts on the underside. The cable is labeled with various voltage and current ratings.

2.4. Arduino Mega 2560

Figure 5. Arduino Mega 2560

2.5. Servo motor MG996

The MG996 RC Servo motor is the most commonly used type in Robot or vehicle guidance designs. The MG996 RC Servo motor has strong traction, and the joints and gears are made entirely of metal so it is highly durable, the motor has a built-in driver that controls the internal motor according to the pulse generation-angle rotation mechanism so very easy to use.



Figure 6. Servo motor MG996

2.6. XL4405 5A pressure reduction circuit

Buck XL4005 5A DC-DC pressure reducer circuit uses the pulse pressure reduction method to reduce DC pressure with an output current of up to 5A, the circuit has a pulse frequency of up to 300Khz for high stability, low noise, suitable for applications Power supply applications: Microcontroller, camera, etc.

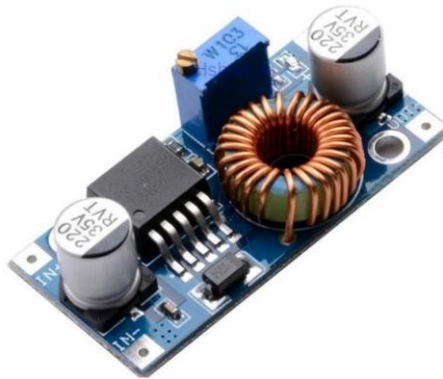


Figure 7. XL4405 5A pressure reduction circuit

3. Application of AI Robot in product classification by QR code

3.1. Solving the image recognition and processing algorithm on Raspberry pi

When starting to run the program on Raspberry pi, the library and pi camera will be declared and initialized. The system will turn on the camera and wait for images to be collected. If an image is detected, it will analyze and send the decomposed characters analysis for the Arduino microcontroller via UART serial communication and perform classification tasks in the execution block. On the contrary, if no image is detected, the pi camera will wait until an image is detected.

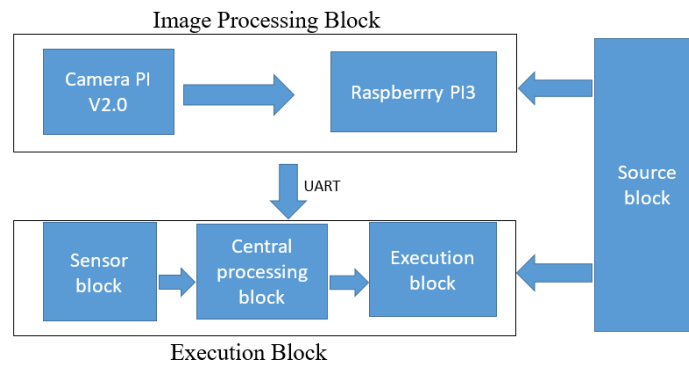


Figure 8. Block diagram of the system

3.2. Algorithmic explanation of how the robot works

When starting the program, the robot will automatically move along the line thanks to 2 line detection sensors. When it detects a distance of 8cm, the robot will stop and the arm will automatically move to pick up items in front. Then proceed to point at the camera to proceed with identification and classification. If the data sent has not been received, the arm will remain in position to wait for the pi camera to check.

After receiving the signal sent from the Raspberry pi, the letters 'a' classify the tray 'ABCD', 'b' 'EFGH' and the letter 'c' 'DEPARTMENT'. After classifying the products, the parameters of the arm's rotation angle will return to the original, and the robot will move. And stops when the 2 line detection sensors both receive the same value of 1, ending a working cycle.

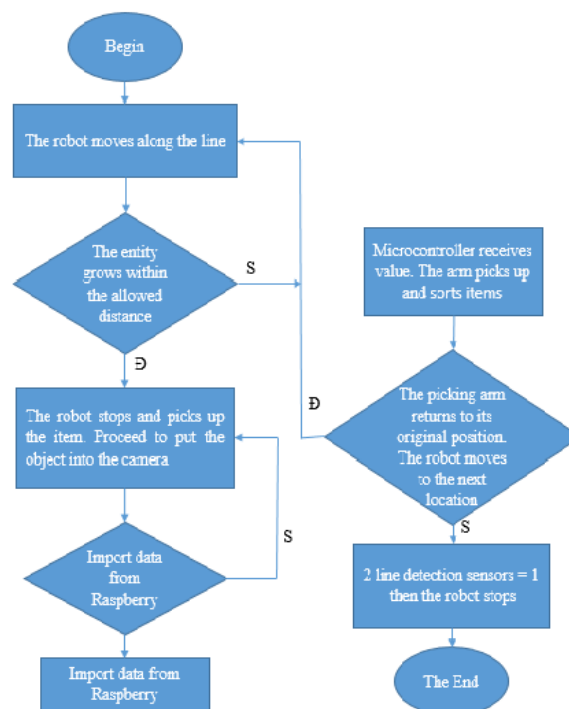


Figure 9. Flow chart of robot algorithm performing tasks

3.3. Steps to connect and operate the Robot

❖ Steps to perform image recognition on Raspberry Pi:

- Connect to Raspberry Pi via VNC Viewer.

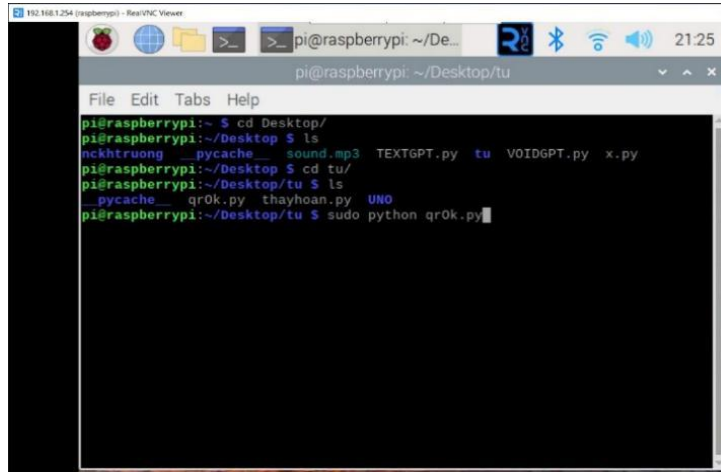


Figure 10. Connect to Raspberry Pi via VNC Viewer

- Camera recognizes the Qr code and sends it to Serial.

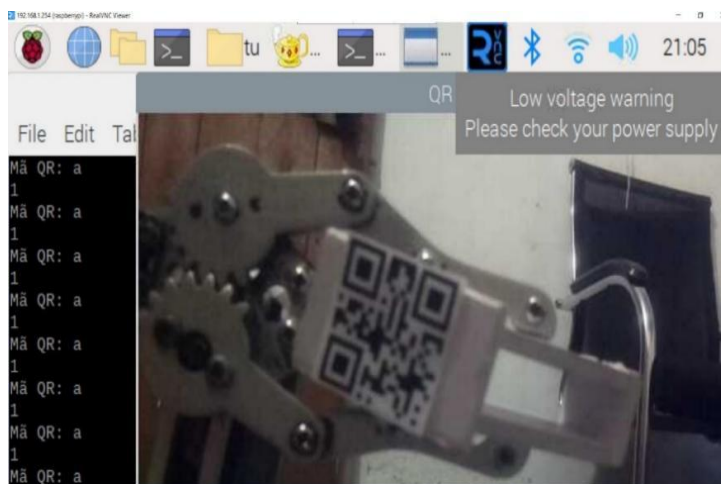


Figure 11. Camera recognizes the Qr code

Next we see AI robots are products of artificial intelligence and here are image results when the Robot operates:



Figure 12. Image of Robot automatically picking up products

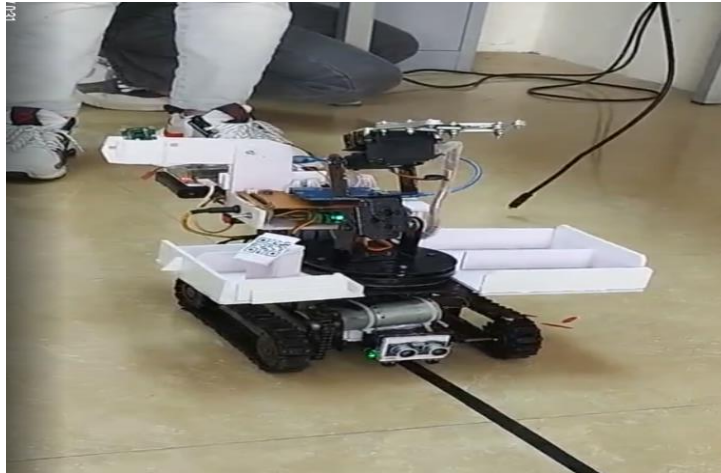


Figure 13. Self-propelled robot on the line

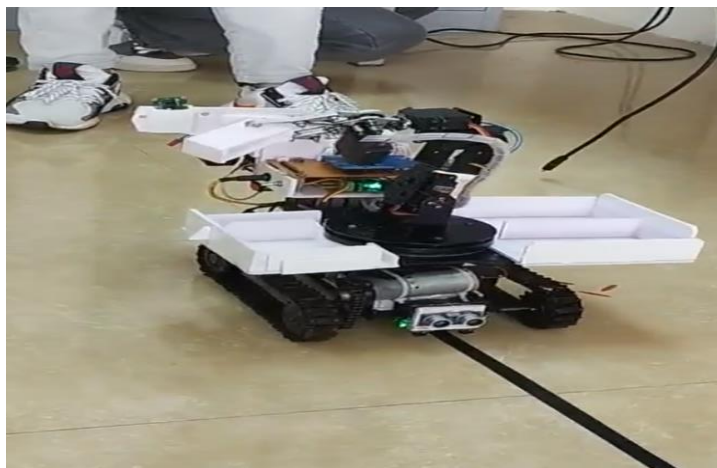


Figure 14. Robot checks and recognizes images via Pi camera

4. Conclusion

The article discussed and researched the application of a QR code recognition product sorting robot via a Pi camera. The system runs stably, recognition data and image processing through the camera is fast, and the software program is optimized, and runs stably without errors during the compilation process

Most studies on service robots have focused on narrowly defined technical issues and human perceptions of service robots. While there are several efforts at a literature review on service robots (Kahraman et al., 2020; McCartney, G.; and McCartney, 2020), there is a lack of a comprehensive systematic literature review of service robots based on the integrative view on service robot types and the technological foundation of service robots.

Declarations

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The study has not received any funds from any organization.

Competing Interests Statement

The authors have declared no competing interests.

Consent for Publication

The authors declare that they consented to the publication of this study.

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