

The Design and Implementation of Visitor Recognition and Reminder System Based on Face Recognition

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Abstract:- Embedded IoT technology has promoted the landing and development of smart homes. Face recognition technology, one of the applications of artificial intelligence, is also widely used in daily applications such as payment, access control management and so on. This topic is proposed based on this background. The purpose of the project is to develop a visitor recognition and reminder system based on face recognition. The purpose is to apply it to residential access control management to achieve visitor identity recognition and intelligent reminder. The subject system adopts the front-end separation architecture, the back-end uses Python language Flask micro-Web framework, and the front-end uses Ajax to realize the data exchange with the back-end. The system mainly realizes the functions of visitor recognition, visit reminder, remote access control management, visitor management and so on based on face recognition technology. The system is developed and implemented in Python language, and the system has good portability and strong compatibility. The non-functional and functional tests after the completion of the system show that it can meet the application requirements, better achieve the identification and reminder of residential visitors, and improve the security and convenience of the living environment.

Keywords:- Visitor recognition and reminder; face recognition; Flask; Python.

I. INTRODUCTION

A. Subject background and significance

a) Background

Economic and social development has caused tremendous changes in people's living and living environment, and the pace of life has become faster and faster. Therefore, people hope that more problems in life can be solved or simplified by technical means [1]. As a result, the concept of smart home was proposed and defined. People hope that there can be smarter and more reliable solutions to issues such as residential security and personal privacy. For example, when there is a visitor, you can check and identify the identity of the visitor in the most convenient way, or get an intelligent reminder; when something goes out, relatives arrive, and you can perform remote access control.

The development of embedded Internet of Things technology has promoted the landing and development of the

concept of smart home. One of the application directions of artificial intelligence is the maturity of face recognition technology, which makes it widely used in daily applications such as online payment and access control management. This topic is proposed based on this background, and the purpose is to develop a visitor recognition and reminder system based on face recognition, which is an important part of intelligent access control management, bringing higher security and convenience.

b) Meaning

Reasonable application of computer application technology and artificial intelligence algorithms to facilitate life and improve the quality of life is the goal of smart homes. The realization of this subject will be an important part of the smart home system and an important attempt to realize indoor and outdoor management. Its purpose is to use face recognition technology to realize the intelligent recognition and timely processing of visitors, so that users can understand visitor information and processing conditions at any time.

The system has designed and built a complete access control application environment, based on smart devices to quickly identify visitors outside the door, and inform users of the identity of the visitor in the form of e-mail (unknown visitors only provide photos), and visitors can be visited no matter where they are respond.

The realization and application of the subject will improve the safety of residences and protect personal privacy, reduce some troubles in life, facilitate people's lives, and improve the quality of life.

B. Current research status at home and abroad

Nowadays, face recognition technology is developing rapidly and is widely used in finance, security and other fields. At the same time, the combination of this technology and access control system is realized more and more. The visitor recognition and reminder system based on face recognition designed in this subject is a part of the smart home environment.

From a foreign perspective, some foreign universities (headed by Carnegie Mellon University, Massachusetts Institute of Technology, etc., University of Reading in the United Kingdom) and companies (Visionics's Facit human insurance recognition system, Village's FACEFINDER identity verification system, Lau Tech) The engineering

research work of the Hunter system and the BIOD system in Germany, etc.) also focuses on public security and criminal matters. Its continuous development in video surveillance and access control has gradually become a reality from film and television and is rapidly popularized [3].

Domestically, with the vigorous development of face recognition algorithms, a large number of outstanding talents and companies have emerged at this stage. Although the United States has the largest number of scholars in the field of facial recognition in the world, China lags behind the United States and ranks second, but in terms of published literature, Chinese research literature surpasses English research literature. Obviously, China's research is faster and more mature. Some; such as the face recognition access control system developed by technology companies such as Geling Shentong, Yunmai, Shangtang Technology, Megvii Technology, etc., which are based on face recognition technology, with fast recognition speed and high accuracy, and will not be subject to makeup. The influence of external factors such as glasses and hats has improved the traffic efficiency of the entrances and exits of communities and buildings to a certain extent, and strengthened the management of the identity security of personnel entering and exiting, and ensured the safety of the community.

The face recognition access control system is coming at a rapid pace. The integration of face recognition technology into the visitor recognition and reminder system is undoubtedly an indispensable combination of smart homes. The application of Internet of Things technology and face recognition algorithms, combined with the email function to notify users of visitor information to build a complete system is not only the design idea of this project, but also a future development direction.

C. Introduction to key technologies

a) Introduction to System development language

- Python and Flask framework: The Python language is an interpreted scripting language, also known as the "glue language", with a wide range of applications, including Web and Internet development, scientific computing and statistics, artificial intelligence, software and back-end development, and web crawlers. One of the micro-web framework-Flask framework is based on Werkzeug WSGI toolbox and Jinja2 template engine. The core of the framework is simple and there is no default database or form validation tool.
- JavaScript (JS) and Ajax technology: JS is a high-level interpretive scripting language belonging to the network. It is widely used in Web application development. It can add a variety of dynamic functions and request responses to web pages. Usually JS scripts are embedded in HTML. And the language also has cross-platform features. JS can run on multiple operating systems under the support of most browsers. Ajax refers to the web development technology that creates interactive, fast and dynamic web applications. That is, we can update some web pages without refreshing the web pages. At the same time, the technology can also exchange data with the

background server, which is very convenient and simple to achieve asynchronous web pages. renew.

b) Introduction to Face Recognition Technology

Face recognition technology is a kind of non-contact biometric recognition technology that is very hot today, and it has been applied to all aspects of our lives. It is currently widely used in: security management of enterprises and residences, electronic passports and ID cards, public security Judicial and criminal investigation, self-service, information security and other fields.

Its characteristics are:

- Face recognition is non-contact, because the user does not need to have direct contact with the device;
- Face recognition is not mandatory, because the recognized face image information can be actively obtained;
- Face recognition is concurrency, that is, multiple faces can be sorted, judged, and recognized in actual application scenarios.

However, this technology still has certain limitations, such as insufficient recognition accuracy due to the influence of ambient light, occlusion of human facial hair and accessories, and facial changes due to age [4]. Therefore, to further improve the algorithm research to solve the face recognition problem under the influence of the environment is still a big topic.

II. SYSTEM DESIGN

A. System overall architecture design

The system structure of this system is divided into two parts: camera client and cloud server. The system architecture is shown in Figure 1.

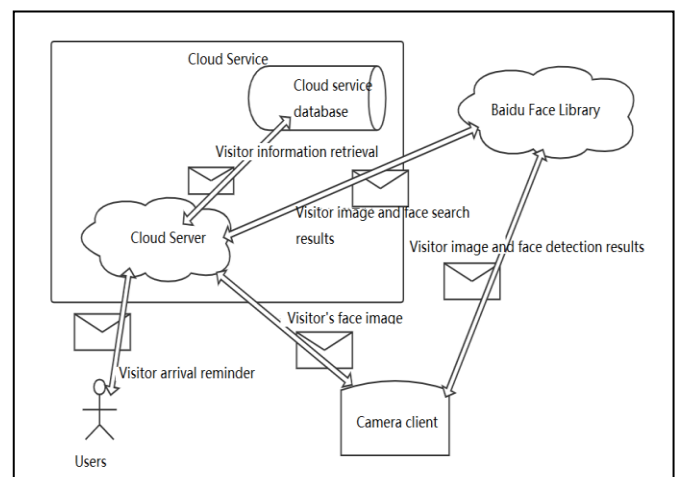


Fig. 1: System Architecture Model.

The camera client is responsible for functions such as taking photos, detecting faces, and sending face photos to the cloud server. The client needs to connect to the user table in the database for user binding. The client is mainly implemented by Python scripts.

The cloud server adopts an architecture that separates the front and back ends.

The back-end is responsible for the functional realization of the cloud service, such as connection access to the database and Baidu face database, visitor reminder, visitor management, user management, etc., mainly using the Flask micro-web framework of Python, which is lightweight and scalable Good features. The back end uses a layered architecture, which is logically divided into model package, service package, view package, and util package to complete the development and implementation of various functions.

The front end is responsible for function display, human-computer interaction interface, basic form verification, data request and display, etc. It uses HTML web pages to combine JS and Ajax technology, and uses Ajax to request data from the background and render front-end data display. UI design uses Bootstrap template style, which is beautiful and generous.

B. The design of the camera client

The camera client is mainly responsible for device binding, visitor image acquisition, and upload of visitor's face image to the cloud server.

a) Business logic design

This end uses the script command line to start. After the script is started, the user name and password are logged in to bind the device.

After logging in, the script saves the logged-in user name into a global variable in the script. The script starts to run uninterruptedly. It acquires the image outside the door through the camera, and converts the acquired image into Base64 encoded data to perform face detection through Baidu face detection API. When the detection is over, it will return whether there are human faces in the photo, that is, the number of human faces. Next, the Base64-encoded face photos, number of faces, and user names are packaged into a json format and sent to the cloud server. If the data from the cloud server is successfully received, the photo will be delayed for 10 seconds, and then the photo will continue. The business logic flow chart is shown in Figure 2.

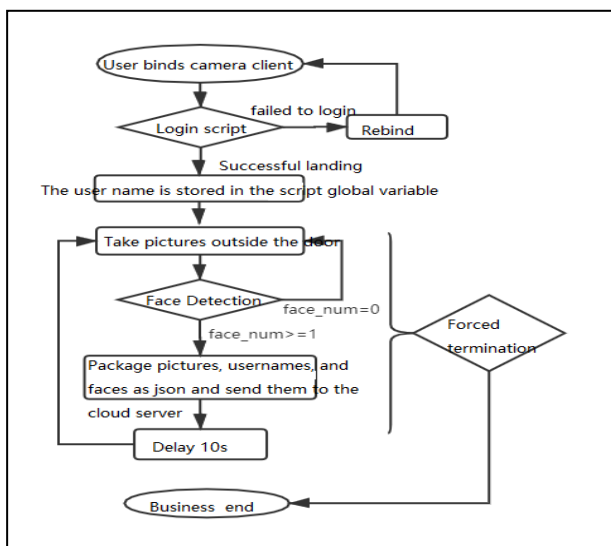


Fig. 2: Camera client business logic flow chart

III. SYSTEM IMPLEMENTATION

The functional modules of this system are divided into two parts, one is the camera client, and the other is the core cloud server.

A. The realization of the the camera client module

The camera client is started via a script command line, and then continues to run.

The core code is as follows:

a) Start script: main.py

```

# Use opencv to take pictures, and inherit the base64
format
def make_photo(capp):
    success, frame = capp.read()
    print(path)
    # cv2.imshow('camera', frame) # Show every frame
    time.sleep(0.2)

    if success:
        print("read ok")
        # img_gray = cv2.cvtColor(frame,
        cv2.COLOR_RGB2GRAY)
        img_base64 = base64.b64encode(frame).decode()
        return img_base64
    else:
        make_photo(capp)
    
```

b) Taking pictures: take_photo.py

```

# Script start function
def main():
    # Go to the next step to take pictures and face
    recognition
    cap = take_photo.camera_open()
    img = take_photo.make_photo(cap)
    res = face_detect.face_detect(img)
    if res:
        data = {
            'image': img,
            'face_num': res,
            'username': user['username']
        }
        headers = {
            "Content-Type": "application/json;
            charset=UTF-8"
        }
        url = "http://localhost:5000/face/reco_alert"
        res = requests.post(url, data = json.dumps(data),
            headers = headers)
        if res:
            time.sleep(10)
    
```

B. Implementation of Cloud Server Module

This project is developed using the Flask micro-web framework and Pycharm is used to complete the development.

The core code is as follows:

```
@blue.route('/reco_alert', methods = ['GET', 'POST'])
def reco_alert():
    if request.method == 'POST':
        img_base64 = request.form.get('image')
        face_num = request.form.get('face_num')
        username = request.form.get('username')
        if face_num == 1:
            v_id = baidu_api.face_search(img_base64,
            username)
            visitor_info = visitor.select_by_id(username,
            v_id)
        else:
            v_id_list =
            baidu_api.face_multi_search(img_base64,
            username,
            face_num)
            visitor_info =
            visitor.select_by_id_list(username, v_id_list)
            res = mail_util.visitor_mail(face_num,
            visitor_info)
            if res:
                return True
            else:
                return False
```

1) Visitor identification and reminder: *face_service.py*

```
#return : str or False
def face_search(image, group_id):
    image_type = "BASE64"
    res = client.search(image, image_type, group_id)
    if not res['error_code']:
        return res['result']['user_list']['user_id']
    else:
        return False
```

2) Baidu face database face management: *baidu_api.py*

IV. CONCLUSION

This article mainly discusses the analysis, design and implementation of each module of "Visitor Recognition and Reminder System Based on Face Recognition", using Python programming language, JavaScript scripting language and MySQL database. In the front-end and back-end separation architecture, the back-end uses the Flask micro-web framework. The back-end development is smoother and simpler due to the simplicity and efficiency of the Python language and the good scalability of the Flask framework [5]. The SQLAlchemy module performs database operations. The encapsulation process makes the connection and use of the database faster and more convenient; the front-end uses Ajax technology to interact with the back-end, and the front-end web page is refreshed asynchronously, making the human-computer interaction experience more friendly. The front-end and back-end development are separated, making the front-end and back-end boundaries very obvious, both from a development perspective and a user experience perspective.

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