

# Web声纹认证系统实现-项目汇报

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成果展示

## a)根据用户知道的信息进行认证

**文本口令、图像口令**

容易被肩窥、猜测、字典攻击、重放攻击、木马攻击

随着个人账号增多，记忆成本增加

单因素身份认证无法满足互联网身份认证安全性需求

## b)根据用户拥有的东西进行认证

**动态令牌、智能卡、USB KEY**

## c)根据用户具有的生物特征进行认证

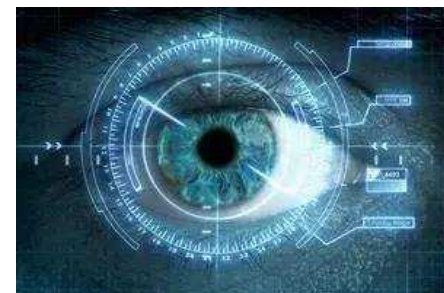
**生物特征：指纹、声纹、掌型、虹膜、脸型等**

**行为特征：签名、行走步态等**

**部分生物识别进行身份认证需要高昂的采集设备，比如指纹、虹膜、脸部识别**

**应用范围限制：指纹、虹膜、脸部识别等无法用在电话委托系统、电视遥控等应用场景**

**人在讲话时使用的发声器官在尺寸和形态方面的差异很大具有一定的辨识度**



# 概述

## a) Microsoft Speaker Recognition API

识别较为精准，处理速度快

口令串标准，易被攻击者利用，付费使用，非开源



## b) Bob (Idiap Research Institute, Switzerland )

Idia开发的一套声纹识别工具箱

工具箱安装会占用大量空间和内存

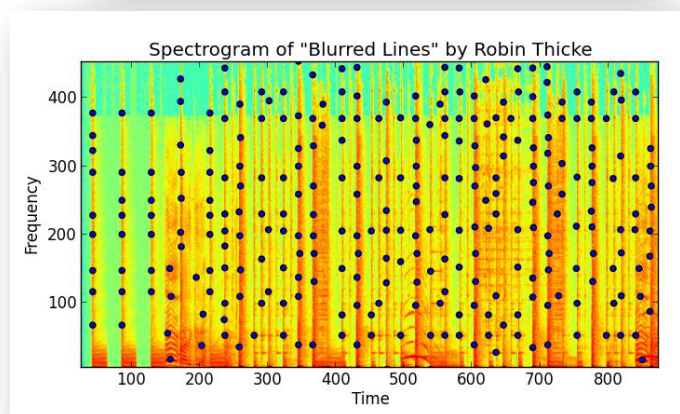
语音处理的时长较长



## c) Dejavu (Will Drevo, Python and Numpy)

轻量、易用、准确的Python音频指纹库

MIT的Will Drevo基于Python and Numpy开发



## 用户注册过程

- ✓ 输入用户名和文本口令
- ✓ 记录用户环境噪声
- ✓ 从语料库中随机抽取单词构成口令，用户需朗读该口令进行语音注册（3次）
- ✓ 使用LTSD拟合音频轨迹，消除背景噪音干扰
- ✓ 对去噪后的音频进行语音识别，将识别结果与临时口令串进行模糊匹配，判断阈值
- ✓ 提取梅尔频率倒谱系数MFCC特征并正则化
- ✓ 为注册用户建立高斯混合模型GMM

## 用户登录认证过程

- ✓ 待认证用户输入用户名和文本口令
- ✓ 记录环境噪声
- ✓ 提示待用户朗读口令
- ✓ 背景噪声去除
- ✓ 对去噪后的音频进行语音识别，将识别结果与语音口令进行模糊匹配，判断阈值
- ✓ 提取音频信号的MFCC特征、建立GMM模型，与注册用户数据库中的GMM模型进行对数似然估计，进行阈值判断
- ✓ 决定是否授权用户登录





- 基于Linux环境, Fedora 27 64bit
- Python 2.7
- MySQL
- VMware Pro 14, Windows
- 部分依赖包: pyaudio, ffmpeg, pydub, numpy, scipy, matplotlib, MySQLdb等

- 开发IDE: PyCharm 2017
- 轻量级 Web 应用框架: Flask 0.12.2
- Web前端开发框架: Bootstrap
- 音频指纹、识别库Dejavu (<https://github.com/worldveil/dejavu>)



## Audio Fingerprinting with Python and Numpy

November 15, 2013

The first day I tried out Shazam, I was blown away. Next to GPS and surviving the fall down a flight of stairs, being able to recognize a song from a vast corpus of audio was the most incredible thing I'd ever seen my phone do. This recognition works though a process called [audio fingerprinting](#). Examples include:

- Shazam

Will Drevo

ML at [Coinbase](#).

Views here are my own.

Previously an EIR at [Redpoint](#), co-founder of [two startups](#) and

## Bootstrap

直观、强悍的前端开发框架，让web开发更迅速、简单。

Bootstrap3中文文档(v3.3.5)

## Flask Web框架搭建

Verify your voice to finish logging in

{% if err %}

Your voice did not match your username. Please try again.

{% endif %}

record play save

Recording:

选择文件 | 未选择任何文件

Log in

Log in

{% if err == "username" %}

Username is not registerd. Please try again.

{% elif err == "password" %}

Password is incorrect. Please try again.

{% endif %}

Username

Password

Next

Don't have an account?

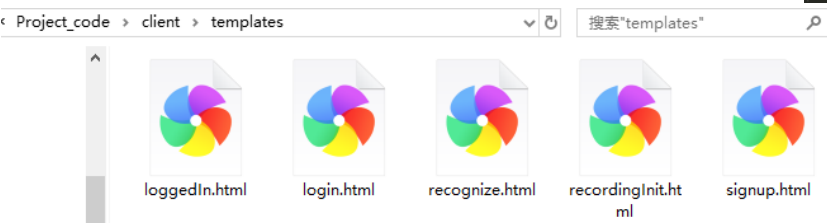
[Sign up](#)

```
@app.route('/signup', methods=['GET', 'POST'])
def signup():
    if request.method == 'POST':
        passwords[request.form['inputName']] = request.form['pswr
        req = {'username': request.form['inputName']}
        res = requests.post('http://192.168.56.132:5000/register')
        return redirect(url_for('main'))
    return render_template('signup.html', recordingPhrase=rw.rand
```

```
@app.route('/recognize', methods=['GET', 'POST'])
def recognize():
    global voice
    global username
    if request.method == 'POST':
        req = {'username':username}
        res = requests.post('http://192.168.56.132:5000/authentic
        confidence = int(res.text.split(',')[3].split(":")[1])
        if confidence > 0:
            voice = True
            return redirect(url_for('loggedIn'))
        return render_template('recognize.html', err="voice")
    if username == None:
        return redirect(url_for('main'))
    else:
        return render_template('recognize.html', err=None)
```

```
@app.route('/loggedIn', methods=['GET', 'POST'])
def loggedIn():
```

```
<!DOCTYPE html>
<html lang="en">
<head>
    <title>Test</title>
    <script type="text/javascript">
        var AudioContext=AudioContext||webkitAudioContext;
    var context=new AudioContext;
    //调整兼容
    navigator.getUserMedia=
        navigator.getUserMedia||
        navigator.webkitGetUserMedia||
        navigator.mozGetUserMedia;
    //请求麦克风
    navigator.getUserMedia({audio:true},function(e){
        var data,p;
        //从麦克风的输入流创建源节点
        var stream=context.createMediaStreamSource(e);
        //用于录音的processor节点
        var recorder=context.createScriptProcessor(1024,1,0);
        recorder.onaudioprocess=function(e){
            if(record.value=="stop")data.push(e.inputBuffer.getChannelData(0));
        };
        //用于播放的processor节点
        var player=context.createScriptProcessor(1024,0,1);
        player.onaudioprocess=function(e){
            if(!data)return;
            var i,s=data[p++];
            if(!s)return play.value=="stop"&&play.click();
            var buffer=e.outputBuffer.getChannelData(0);
            for(i=0;i<s.length;i++)buffer[i]=s[i];
        };
        //录音/停止 按钮点击动作
        record.onclick=function(){
            if(record.value=="record")
                return data=[],stream.connect(recorder),this.value="stop";
            if(record.value=="stop")
                return stream.disconnect(),this.value="record";
        };
        //播放/停止 按钮点击动作
        play.onclick=function(){
            if(this.value=="play")
```





## 基于Vmware虚拟机模拟Server端和Client端进行开发/测试

The image displays a VMware Workstation environment with two virtual machines (VMs) running Fedora 64-bit. The left VM is labeled "Fedora 64bit\_server" and the right VM is labeled "Fedora 64bit\_client". Both VMs are running a web application.

**Server端 (Fedora 64bit\_server):**

- The terminal shows the output of the `ifconfig` command, indicating the network interface `eth0` is configured with IP `192.168.117.130`.
- The web application code in `server.py` includes routes for `/register`, `/authenticate`, and `/recognize`.
- The `/register` route handles POST requests and saves user information to a file.
- The `/authenticate` route handles POST requests and checks if the user is registered.
- The `/recognize` route handles GET and POST requests and returns the recognized file.

**Client端 (Fedora 64bit\_client):**

- The terminal shows the output of the `ifconfig` command, indicating the network interface `eth0` is configured with IP `127.0.0.1`.
- The web application code in `app.py` includes routes for `/signup`, `/recognize`, and `/loggedIn`.
- The `/signup` route handles GET and POST requests and saves user information to a file.
- The `/recognize` route handles GET and POST requests and returns the recognized file.
- The `/loggedIn` route handles GET and POST requests and returns the logged-in user information.

## 数据库配置与连接

```

app = Flask(__name__)
app.debug = True
from dejavu import Dejavu
from dejavu.recognize import FileRecognizer
config = {
    "database": {
        "host": "127.0.0.1",
        "user": "root",
        "passwd": "",
        "db" : "dejavu",
    }
}

djv = Dejavu(config)
@app.route('/')

```

## 数据库连接与操作

```

import MySQLdb as mysql
from MySQLdb.cursors import DictCursor

from dejavu.database import Database

class SQLDatabase(Database):
    type = "mysql"

    # tables
    FINGERPRINTS_TABLENAME = "fingerprints"
    SONGS_TABLENAME = "songs"

    # fields
    FIELD_FINGERPRINTED = "fingerprinted"

    # creates
    CREATE_FINGERPRINTS_TABLE = """
        CREATE TABLE IF NOT EXISTS `%s` (
            `%s` binary(10) not null,
            `%s` mediumint unsigned not null,
            `%s` int unsigned not null,
            INDEX (%s),
            UNIQUE KEY `unique_constraint` (%s, %s, %s),
            FOREIGN KEY (%s) REFERENCES %s(%s) ON DELETE CASCADE
        ) ENGINE=INNODB;""" % (
        FINGERPRINTS_TABLENAME, Database.FIELD_HASH,
        Database.FIELD_SONG_ID, Database.FIELD_OFFSET, Database.FIELD_HASH,
        Database.FIELD_SONG_ID, Database.FIELD_OFFSET, Database.FIELD_HASH,
        Database.FIELD_SONG_ID, SONGS_TABLENAME, Database.FIELD_SONG_ID
    )

    CREATE_SONGS_TABLE = """
        CREATE TABLE IF NOT EXISTS `%s` (
            `%s` mediumint unsigned not null auto_increment,
            `%s` varchar(250) not null,
            `%s` tinyint default 0,
            `%s` binary(20) not null,
            PRIMARY KEY (`%s`),
            UNIQUE KEY `%s` (`%s`)
        ) ENGINE=INNODB;""" % (
        SONGS_TABLENAME, Database.FIELD_SONG_ID, Database.FIELD_SONGNAME, FIELD

```

## 指纹Hash处理

```
def generate_hashes(peaks, fan_value=DEFAULT_FAN_VALUE):
    """
    Hash list structure:
    sha1_hash[0:20]    time_offset
    [(e05b341a9b77a51fd26, 32), ... ]
    """
    if PEAK_SORT:
        peaks.sort(key=itemgetter(1))

    for i in range(len(peaks)):
        for j in range(1, fan_value):
            if (i + j) < len(peaks):

                freq1 = peaks[i][IDX_FREQ_I]
                freq2 = peaks[i + j][IDX_FREQ_I]
                t1 = peaks[i][IDX_TIME_J]
                t2 = peaks[i + j][IDX_TIME_J]
                t_delta = t2 - t1

                if t_delta >= MIN_HASH_TIME_DELTA and t_delta <= MAX_HASH_TIME_DELTA:
                    h = hashlib.sha1(
                        "%s|%s|%s" % (str(freq1), str(freq2), str(t_delta)))
                    yield (h.hexdigest()[0:FINGERPRINT_REDUCTION], t1)
```

## 数据库指纹解码

```
def unique_hash(filepath, blocksize=2**20):
    s = sha1()
    with open(filepath, "rb") as f:
        while True:
            buf = f.read(blocksize)
            if not buf:
                break
            s.update(buf)
    return s.hexdigest().upper()

def find_files(path, extensions):
    # Allow both with ".mp3" and without "mp3" to be used for extensions
    extensions = [e.replace(".", "") for e in extensions]

    for dirpath, dirnames, files in os.walk(path):
        for extension in extensions:
            for f in fnmatch.filter(files, ".*%s" % extension):
                p = os.path.join(dirpath, f)
                yield (p, extension)

def read(filename, limit=None):
    try:
        audiofile = AudioSegment.from_file(filename)

        if limit:
            audiofile = audiofile[:limit * 1000]

        data = np.fromstring(audiofile._data, np.int16)

        channels = []
        for chn in xrange(audiofile.channels):
            channels.append(data[chn::audiofile.channels])

        fs = audiofile.frame_rate
    except audioop.error:
        fs, _, audiofile = wavio.readwav(filename)

    if limit:
        audiofile = audiofile[:limit * 1000]
```

server [~/PycharmProjects/server] - .../server.py [server] - PyCharm

File Edit View Navigate Code Refactor Run Tools VCS Window Help

server > dejavu >

Project ~ /PycharmProjects/server

server.py x random\_word\_generator.py x first\_try\_window.png x

```
43 @app.route('/register', methods=['POST'])
44 def register_user():
45     if request.method == 'POST':
46         username = request.form['username']
47         file1 = request.files['file1']
48         file2 = request.files['file2']
49         file3 = request.files['file3']
50         #/home/andrewcao/PycharmProjects/server/uploadfiles
51         file1.save('/home/andrewcao/PycharmProjects/server/t
52         recognizedFile = djv.fingerprint_file('/home/andrewc
53
54         file2.save('/home/andrewcao/PycharmProjects/server/t
55         recognizedFile = djv.fingerprint_file('/home/andrewc
56         file3.save('/home/andrewcao/PycharmProjects/server/t
57         recognizedFile = djv.fingerprint_file('/home/andrewc
58
59     return str(recognizedFile) or 'User not registered'
60
61 @app.route('/authenticate', methods=['POST'])
62 def authenticate_user():
63     if request.method == 'POST':
64         authenticate_user()
```

Run server

```
/usr/bin/python2.7 /home/andrewcao/PycharmProjects/server/server.py
/home/andrewcao/PycharmProjects/server/dejavu/database_sql.py:158: Warning: (1050L, "Table 'songs' already exists")
cur.execute(self.CREATE_SONGS_TABLE)
/home/andrewcao/PycharmProjects/server/dejavu/database_sql.py:159: Warning: (1050L, "Table 'fingerprints' already exists")
cur.execute(self.CREATE_FINGERPRINTS_TABLE)
* Running on http://0.0.0.0:5000/ (Press CTRL+C to quit)
* Restarting with stat
/home/andrewcao/PycharmProjects/server/dejavu/database_sql.py:158: Warning: (1050L, "Table 'songs' already exists")
cur.execute(self.CREATE_SONGS_TABLE)
/home/andrewcao/PycharmProjects/server/dejavu/database_sql.py:159: Warning: (1050L, "Table 'fingerprints' already exists")
cur.execute(self.CREATE_FINGERPRINTS_TABLE)
* Debugger is active!
* Debugger PIN: 264-309-068
```

andrewcao@localhost:~

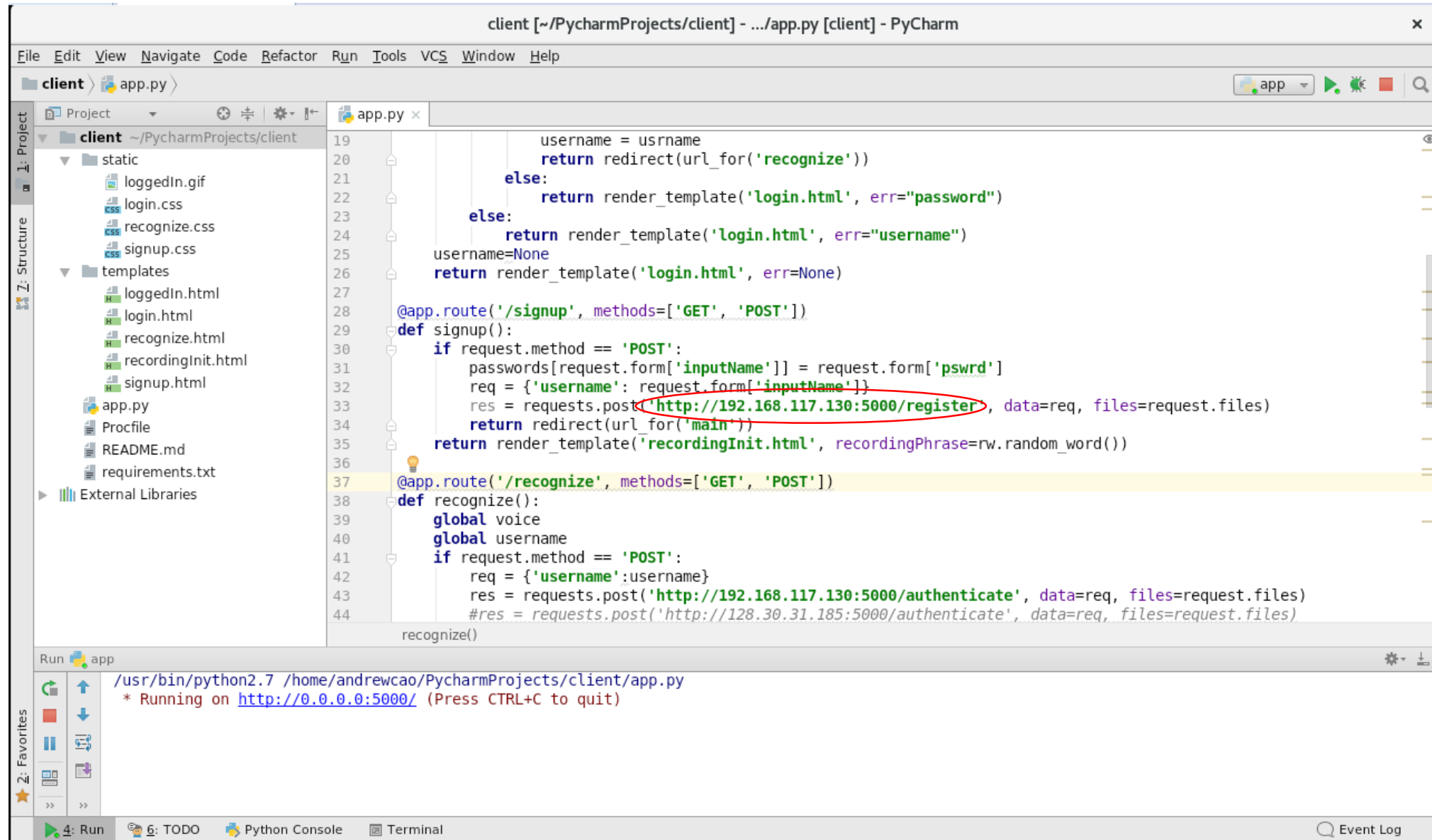
文件(F) 编辑(E) 查看(V) 搜索(S) 终端(T) 帮助(H)

```
[andrewcao@localhost ~]$ ifconfig
ens33: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 192.168.117.130 netmask 255.255.255.0 broadcast 192.168.117.255
    inet6 fe80::d8a0:3e38:20cb:c64 prefixlen 64 scopeid 0x20<link>
    ether 00:0c:29:00:b2:46 txqueuelen 1000 (Ethernet)
    RX packets 127249 bytes 162565307 (155.0 MiB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 27505 bytes 24446568 (23.3 MiB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING> mtu 65536
    inet 127.0.0.1 netmask 255.0.0.0
    inet6 ::1 prefixlen 128 scopeid 0x10<host>
    loop txqueuelen 1000 (Local Loopback)
    RX packets 245 bytes 27577 (26.9 KiB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 245 bytes 27577 (26.9 KiB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
```

Server端IP地址





## 数据库中的声纹hash值

```

andrewcao@localhost:~$ mysql -u root
Enter password:
Welcome to the MySQL monitor.  Command
Your MySQL connection id is 9
Server version: 5.7.20 MySQL Community
Copyright (c) 2000, 2017, Oracle and/or
Oracle is a registered trademark of Or
affiliates. Other names may be tradema
owners.
Type 'help;' or '\h' for help. Type '\

```

```

mysql> show databases;
+-----+
| Database |
+-----+
| information_schema |
| dejavu |
| mysql |
| performance_schema |
| sys |
+-----+
5 rows in set (0.02 sec)

mysql>

```

```

andrewcao@localhost:~$ mysql -u root
Enter password:
Welcome to the MySQL monitor.  Command
Your MySQL connection id is 9
Server version: 5.7.20 MySQL Community
Copyright (c) 2000, 2017, Oracle and/or
Oracle is a registered trademark of Or
affiliates. Other names may be tradema
owners.
Type 'help;' or '\h' for help. Type '\

```

```

mysql> use dejavu;
Reading table information for completion of
You can turn off this feature to get a quick
Database changed
mysql> show tables;
+-----+
| Tables_in_dejavu |
+-----+
| fingerprints |
| songs |
+-----+
2 rows in set (0.00 sec)

mysql> desc fingerprints;
+-----+-----+-----+-----+-----+-----+
| Field | Type | Null | Key | Default | Extra |
+-----+-----+-----+-----+-----+-----+
| hash | binary(10) | NO | PRI | NULL | |
| song_id | mediumint(8) unsigned | NO | PRI | NULL | |
| offset | int(10) unsigned | NO | PRI | NULL | |
+-----+-----+-----+-----+-----+-----+
3 rows in set (0.03 sec)

mysql>

```

```

andrewcao@localhost:~$ mysql -u root
Enter password:
Welcome to the MySQL monitor.  Command
Your MySQL connection id is 9
Server version: 5.7.20 MySQL Community
Copyright (c) 2000, 2017, Oracle and/or
Oracle is a registered trademark of Or
affiliates. Other names may be tradema
owners.
Type 'help;' or '\h' for help. Type '\

```

```

andrewcao@localhost:~
文件(F) 编辑(E) 查看(V) 搜索(S) 终端(T) 帮助(H)

mysql> show tables;
+-----+
| Tables_in_dejavu |
+-----+
| fingerprints     |
| songs            |
+-----+
2 rows in set (0.00 sec)

mysql> desc songs;
+-----+-----+-----+-----+-----+-----+
| Field          | Type                | Null | Key | Default | Extra          |
+-----+-----+-----+-----+-----+-----+
| song_id        | mediumint(8) unsigned | NO   | PRI | NULL    | auto_increment |
| song_name      | varchar(250)         | NO   |     | NULL    |                |
| fingerprinted  | tinyint(4)           | YES  |     | 0        |                |
| file_sha1      | binary(20)           | NO   |     | NULL    |                |
+-----+-----+-----+-----+-----+-----+
4 rows in set (0.00 sec)

mysql>
mysql>
mysql> select * from songs;
+-----+-----+-----+-----+
| song_id | song_name                                     | fingerprinted | file_sha1                                     |
+-----+-----+-----+-----+
| 1       | andrewcao_file1                             | 1             | 0Eb00d0{000(w#c000 |
| 2       | andrewcao_file2                             | 1             | 0+0800kH0i00/8T0=0 |
| 3       | andrewcao_file3                             | 1             | -000000000v00t0r0G |
| 4       | andrewcao_file3                             | 1             | 0{0u6m!00S000=0y00 |
| 5       | Brad-Sucks--Total-Breakdown                 | 1             | 00?000jFY00y0,0000 |
| 6       | Sean-Fournier--Falling-For-You              | 1             | 0y000FsP00I0gY(+0. |
| 7       | Josh-Woodward--I-Want-To-Destroy-Something-Beautiful | 1             | 06@0000)yV을*0040 |
| 8       | The-Lights-Galaxia--While-She-Sleeps       | 1             | 5R#000C000^0h00u01g |
| 9       | Choc--Eigenvalue-Subspace-Decomposition     | 1             | X00'0P00}S`KC00L |
+-----+-----+-----+-----+

```

05

## 成果展示

Log in

Username

Password

Next

Don't have an account?

[Sign up](#)

正在打开 1514898572123

您选择了打开:

1514898572123

文件类型: WAV 音频 (128 KB)

来源: blob:

您想要 Firefox 如何处理此文件?

☐ 打开, 通过(O) 视频 (默认)

☒ 保存文件(S)

☐ 以后自动采用相同的动作处理此类文件。(A)

取消

确定

AndrewCao

.....

Record and upload yourself saying  
"section" three times.

record

play

save

Recording 1:

浏览...

未选择文件。

Recording 2:

浏览...

未选择文件。

Recording 3:

浏览...

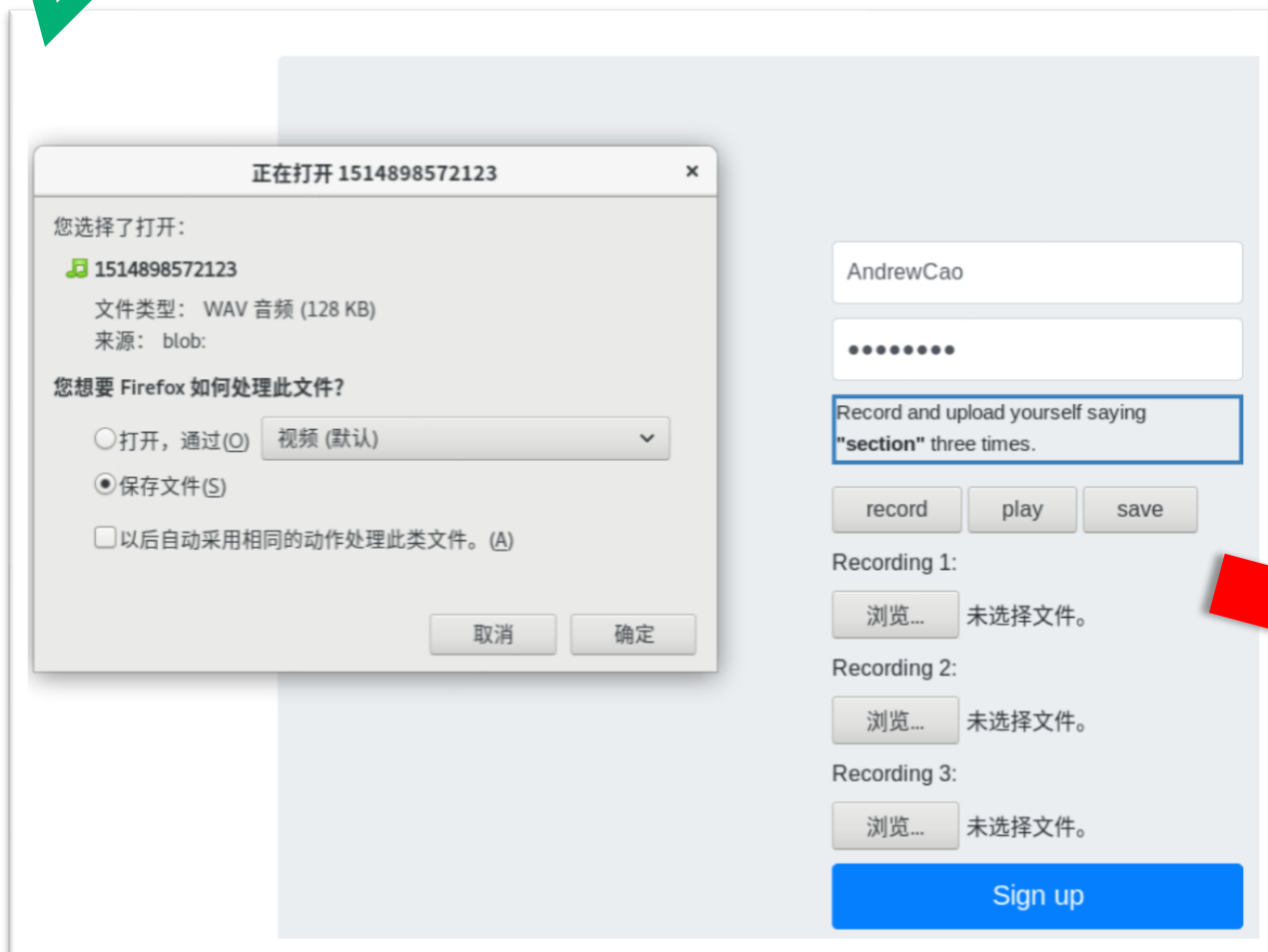
未选择文件。

Sign up

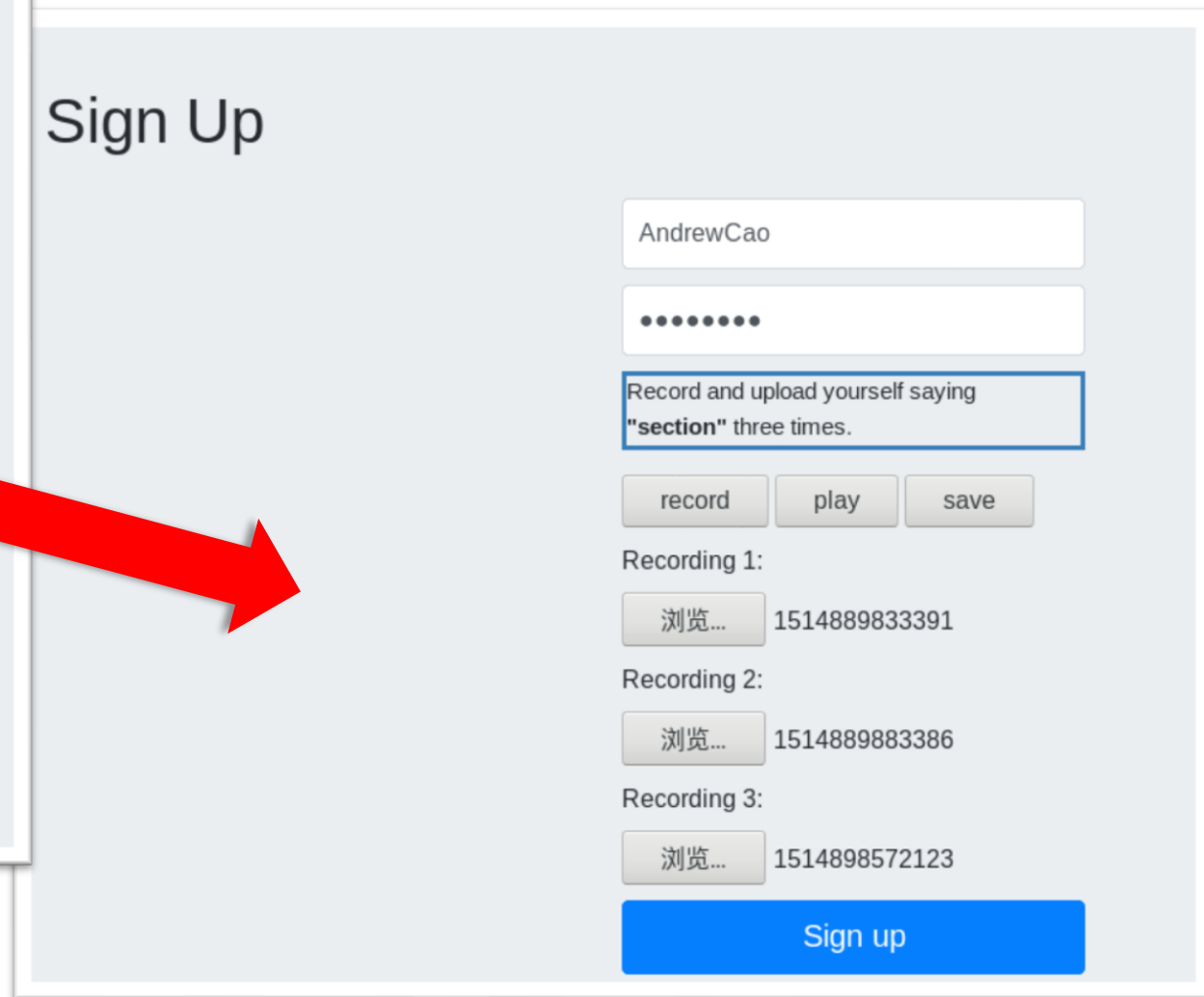


05

## 成果展示



## Sign Up



05

# 成果展示

Log in

AndrewCao|

.....

Next

Don't have an account?

[Sign up](#)



Verify your voice to finish logging in

record

play

save

Recording:

浏览...

1514889833391

Log in



0.0.0.0:5000/recognize



您是否要允许 0.0.0.0 使用您的麦克风?

共享的麦克风: (M)

☐ 记住此决定

不允许(D)

允许(A)

Logging in

record

play

save

Recording:

浏览...

未选择文件。

Log in

05

## 成果展示

Verify your voice to finish logging in

record

play

save

Recording:

浏览...

1514889833391

Log in

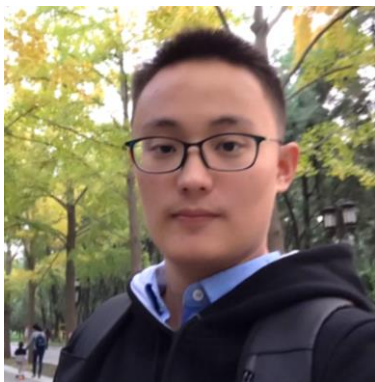
Welcome, AndrewCao!

You've successfully logged in.

Log out

# 项目分工

## 曹路



软件工程与数据技术系

- 课题总体调研
- 认证系统设计
- Flask框架搭建
- 项目汇报PPT撰写
- 项目汇报展示

## 李晖



网络软件与系统安全系

- 课题背景调研
- 开题报告撰写
- 展示PPT撰写
- 系统后续功能实现
- 后期系统测试
- 项目报告撰写

## 杜思佳



金融信息与工程管理系

- 前期系统原理调研
- 开题报告、PPT撰写
- 系统后期测试
- 项目汇报展示
- 项目报告撰写

## 储贤




网络软件与系统安全系

- 产品/国内外研究调研
- 开题报告撰写
- 系统设计与改进
- 认证逻辑设计
- 后期系统测试
- 项目汇报展示



# 致 谢

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项目地址: [https://github.com/andrewcao/ISE17\\_voice\\_fingerprint](https://github.com/andrewcao/ISE17_voice_fingerprint), 欢迎Fork or Star