Image Processing Based Digitalization of Displays in Process Industry

B. Tech Project

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# Index

1. Introduction to Problem Statement

- Digital Reading
  - Easy for record keeping and traceback
  - Reducing redundant work
- Problems for applying central control system
  - Expensive
  - Cannot be applied to existing small scale industries - time issues
- Solution
  - Using image-to-text recognition technology

2. Seven Segment Display

- Started from Tesseract (Text based prediction)
  to Computer Vision (Image based) recognition


```
DIGITS_LOOKUP = {
    (1, 1, 1, 0, 1, 1, 1): 0,
    (0, 0, 1, 0, 0, 1, 0): 1,
    (1, 0, 1, 1, 1, 0, 1): 2,
    (1, 0, 1, 1, 0, 1, 1): 3,
    (0, 1, 1, 1, 0, 1, 0): 4,
    (1, 1, 0, 1, 0, 1, 1): 5,
    (1, 1, 0, 1, 1, 1, 1): 6,
    (1, 0, 1, 0, 0, 1, 0): 7,
    (1, 1, 1, 1, 1, 1, 1): 8,
    (1, 1, 1, 1, 0, 1, 1): 9
}
```
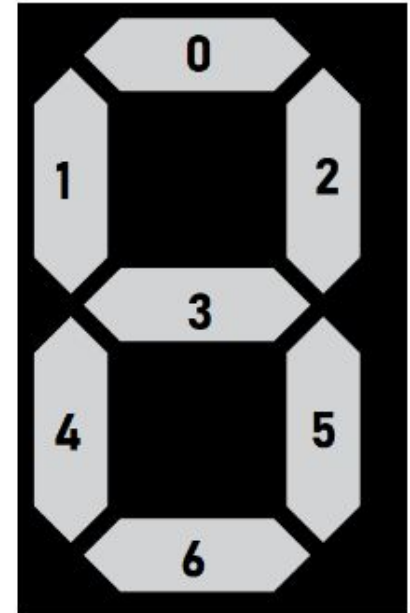
www.electricaltechnology.org
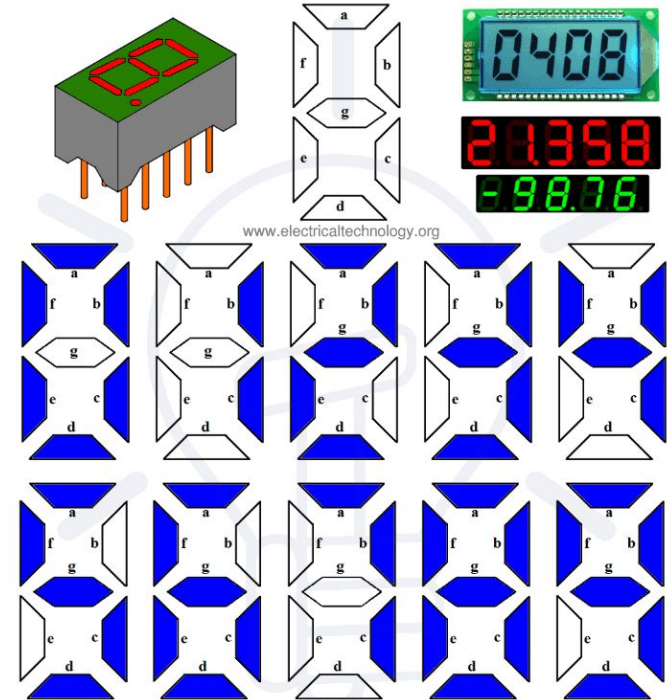
7-Segment Display - Its Typles, Working & Applications
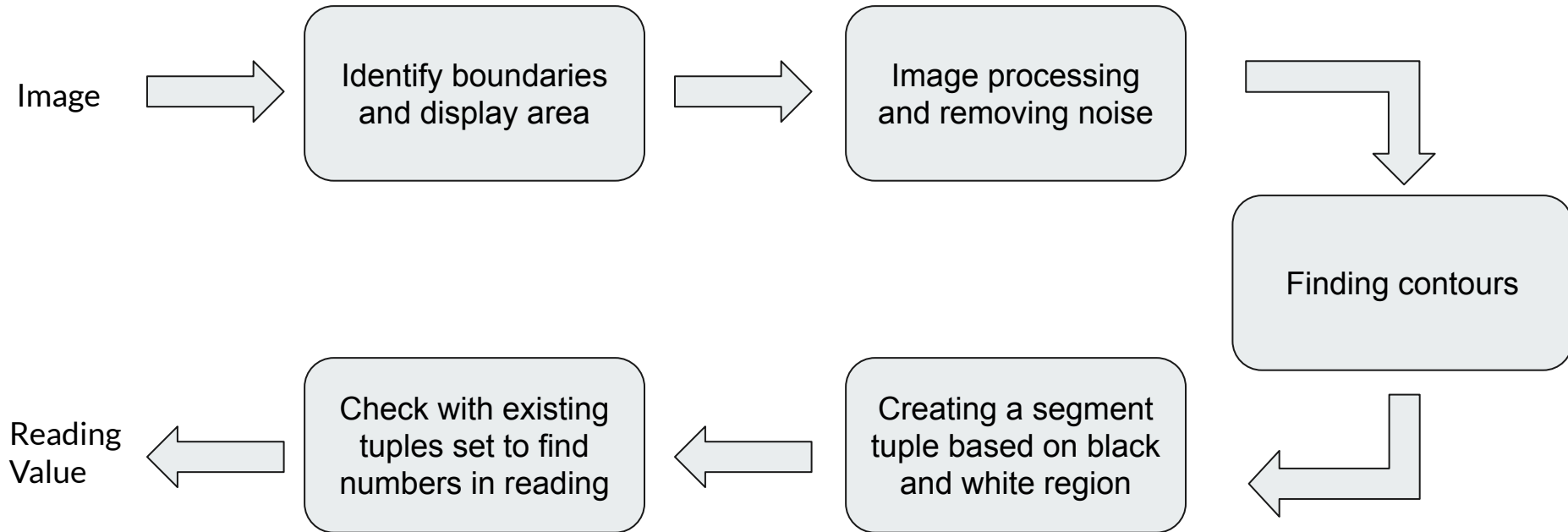
2. Seven Segment Display

```
DIGITS_LOOKUP = {
    (1, 1, 1, 0, 1, 1, 1): 0,
    (0, 0, 1, 0, 0, 1, 0): 1,
    (1, 0, 1, 1, 1, 0, 1): 2,
    (1, 0, 1, 1, 0, 1, 1): 3,
    (0, 1, 1, 1, 0, 1, 0): 4,
    (1, 1, 0, 1, 0, 1, 1): 5,
    (1, 1, 0, 1, 1, 1, 1): 6,
    (1, 0, 1, 0, 0, 1, 0): 7,
    (1, 1, 1, 1, 1, 1, 1): 8,
    (1, 1, 1, 1, 0, 1, 1): 9
}
```

	Segments						
Digits	0	1	2	3	4	5	6
0	1	1	1	0	1	1	1
1	0	0	0	0	0	1	0
2	1	0	1	1	1	0	1
3	1	0	1	1	0	1	1
4	0	1	1	1	0	1	0
5	1	1	0	1	0	1	1
6	1	1	0	1	1	1	1
7	1	0	1	0	0	1	0
8	1	1	1	1	1	1	1
9	1	1	1	1	0	1	1

3. OCR Algorithm - How does it work?

Image → Identify boundaries and display area → Image processing and removing noise → Finding contours → Creating a segment tuple based on black and white region → Check with existing tuples set to find numbers in reading → Reading Value
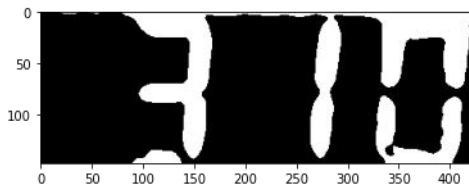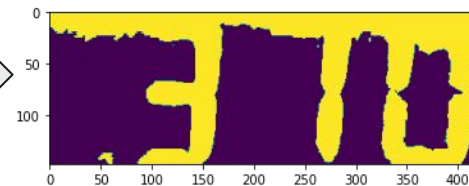
3. OCR Algorithm - How does it work?
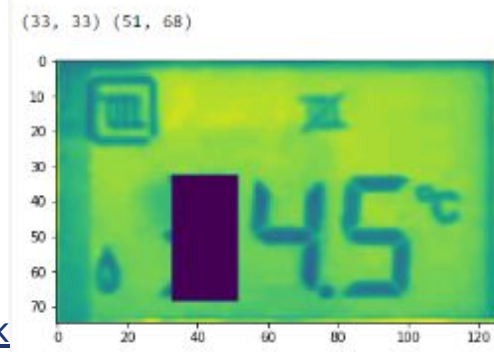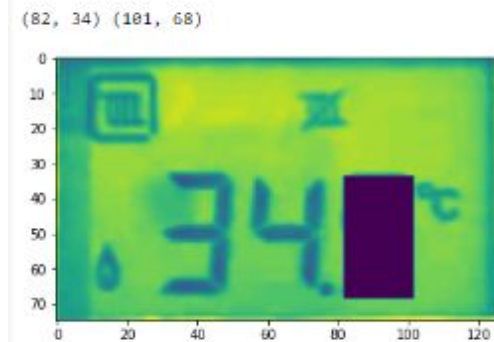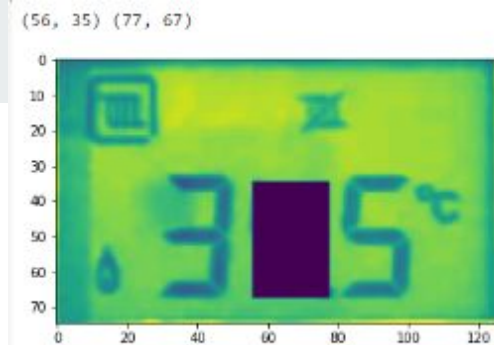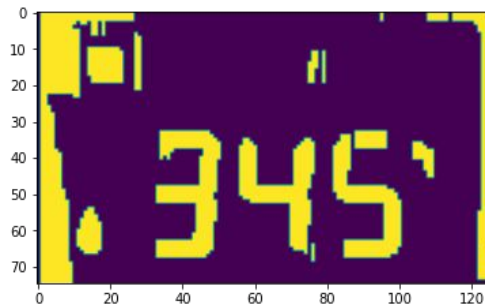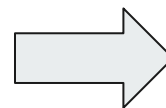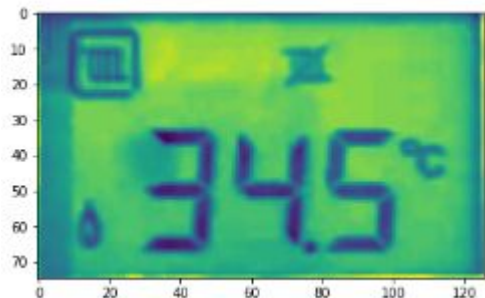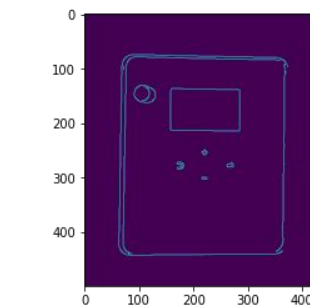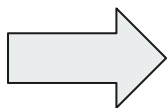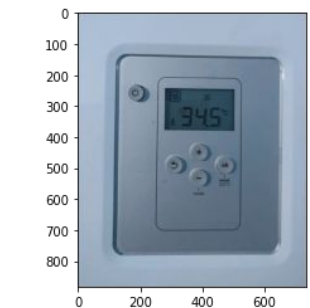
Link

3. OCR Algorithm - Image Processing Techniques

Library Used: openCV (an open source library maintained by Intel Corporation)

Image processing functions used from openCV library

- cv2.THRESH_OTSU
- cv2.MORPH_ELLIPSE and cv2.MORPH_OPEN
- cv2.medianBlur()
- cv2.convertScaleAbs()

4. Lab Image
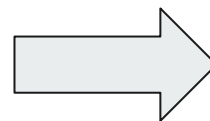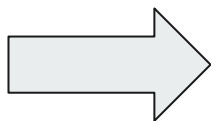
identified tuple [1, 0, 1, 1, 0, 1, 1]
and identified digit= 3
identified tuple [0, 0, 1, 0, 0, 1, 0]
and identified digit= 1
identified tuple [1, 1, 1, 0, 1, 1, 1]
and identified digit= 0

5. Full system

Camera → Local Server → Database

6. Camera

- IP Camera
  - Features -
    - Wireless Control
    - 360° rotation [manual/automatic]
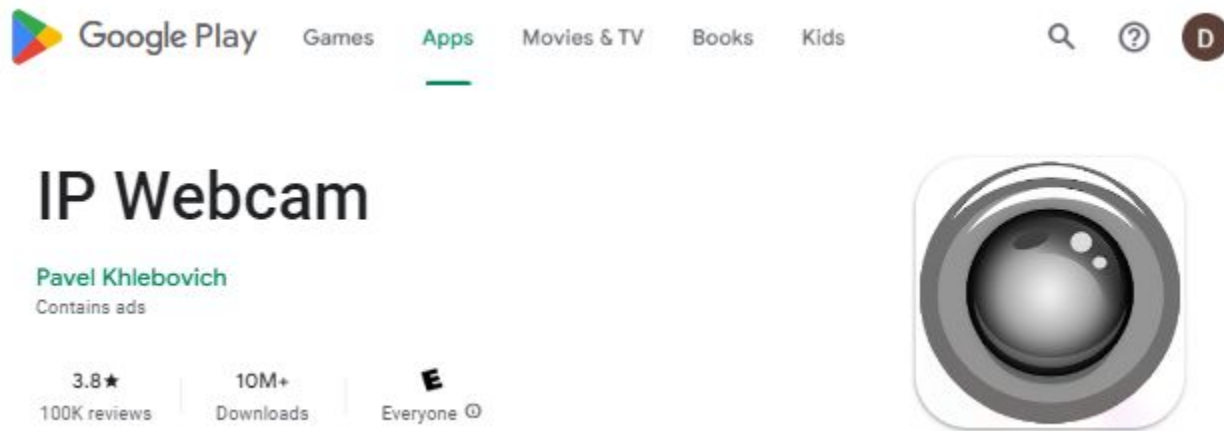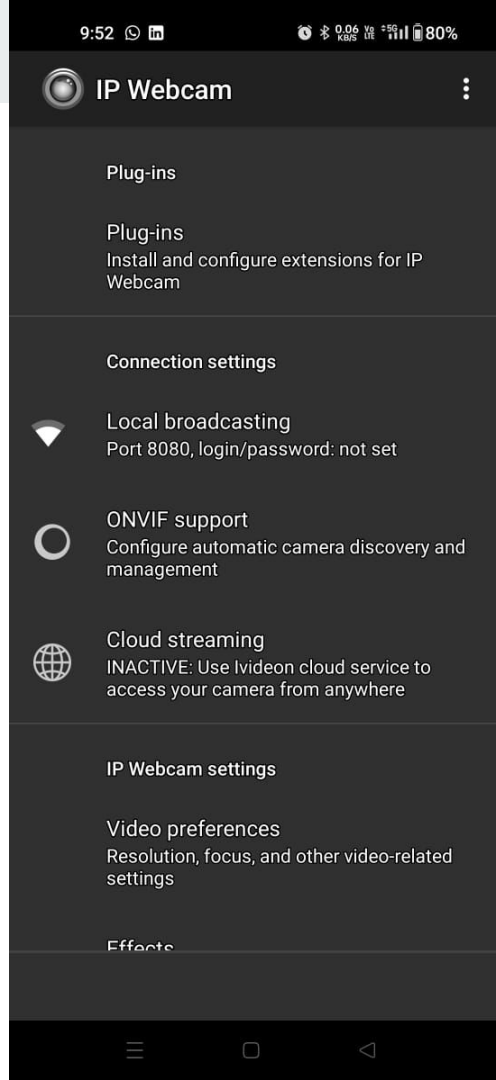   - 1080P/Full HD
  - Working

- Pricing
  - Security Cameras
  - Very cheap and high quality
  - 1k-2.5k (amazon.com)

6. Camera

Demo 1

IP Webcam

Plug-ins

Plug-ins
Install and configure extensions for IP Webcam

Connection settings

Local broadcasting
Port 8080, login/password: not set

ONVIF support
Configure automatic camera discovery and management

Cloud streaming
INACTIVE: Use Ivideon cloud service to access your camera from anywhere

IP Webcam settings

Video preferences
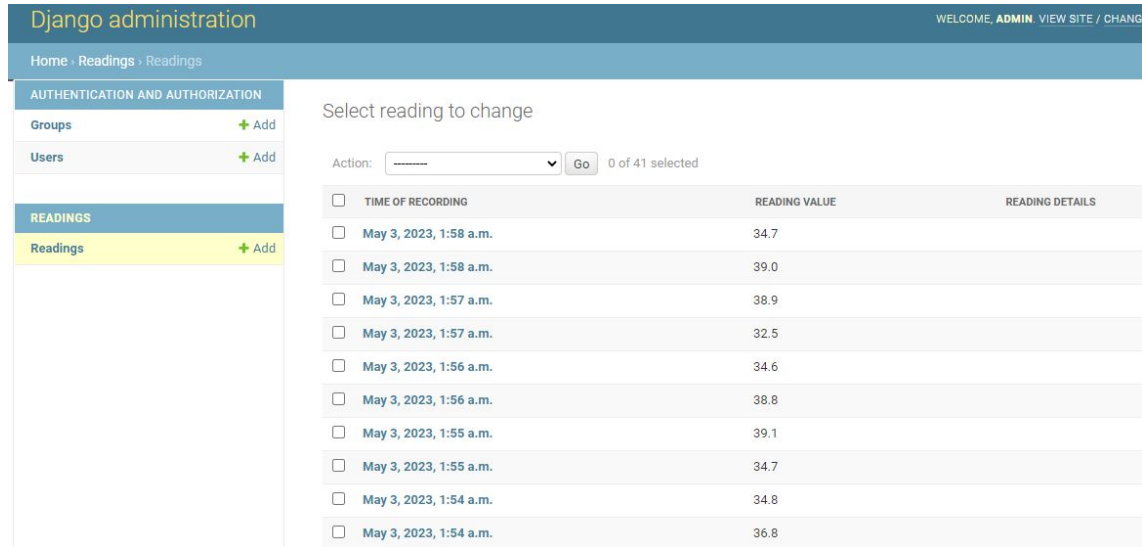Resolution, focus, and other video-related settings

Effects

7. Local Server

- Python file running on server
  - Tuning parameter - How much time between two readings?
- Additional Option
  - Arduino or Raspberry Pi with Flask based API system

```
PS C:\Users\A\Desktop\OCR Tuts\seven-seg> python ..\loop_reading.py
2023-05-03 01:53:34.813387
36.0
{'data': 36.0, 'time_of_reading': '2023-05-03 01:53:34'}
{'Status': 'Record Sucessfully Saved'}
2023-05-03 01:54:04.884561
36.8
{'data': 36.8, 'time_of_reading': '2023-05-03 01:54:04'}
{'Status': 'Record Sucessfully Saved'}
2023-05-03 01:54:34.939224
34.8
{'data': 34.8, 'time_of_reading': '2023-05-03 01:54:34'}
{'Status': 'Record Sucessfully Saved'}
```

8. Backend implementation

- REST Django framework

    - SQLite
    - Django Admin
    - Frontend Capabilities

- Alternate Option

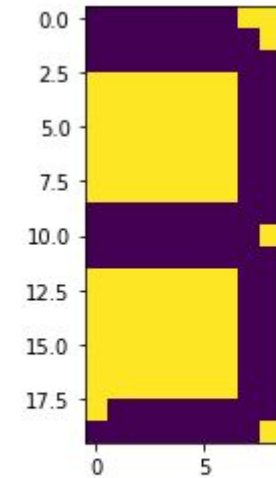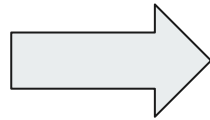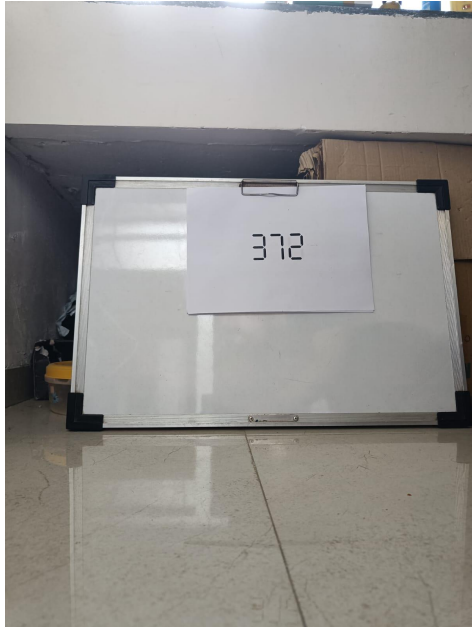   - Flask - python
    - Laravel - php

Demo 2 - Python Server + Django Server

9. Demo - Dummy reading system

[1, 0, 1, 1, 0, 1, 1]
3
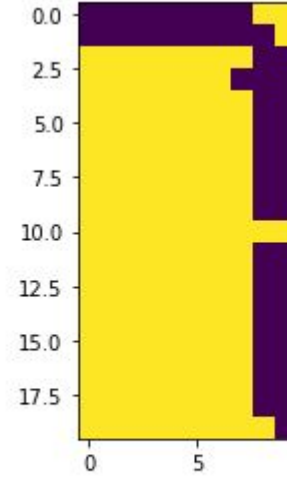
[1, 0, 1, 0, 0, 1, 0]
7
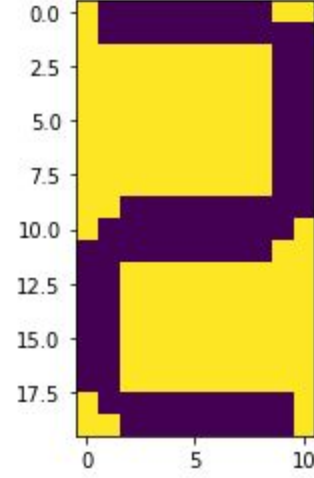
[1, 0, 1, 1, 1, 0, 1]
2

9.   Demo - Video

10. Future Work

- Testing system with Lab instrument
- Testing for changes in obstruction, light change, change in orientation errors

- Can add graphical representation of data in Django framework, safety alerts through notifications

- Can test with arduino/raspberry pi to enhance the scalability of application

identified tuple [1, 0, 1, 1, 0, 1, 1]
and identified digit= 3
identified tuple [0, 0, 1, 0, 0, 1, 0]
and identified digit= 1
identified tuple [1, 1, 1, 0, 1, 1, 1]
and identified digit= 0

Codes

GitHub link.

- https://github.com/DivyanshNatani/OCR-Display-Digitalisation
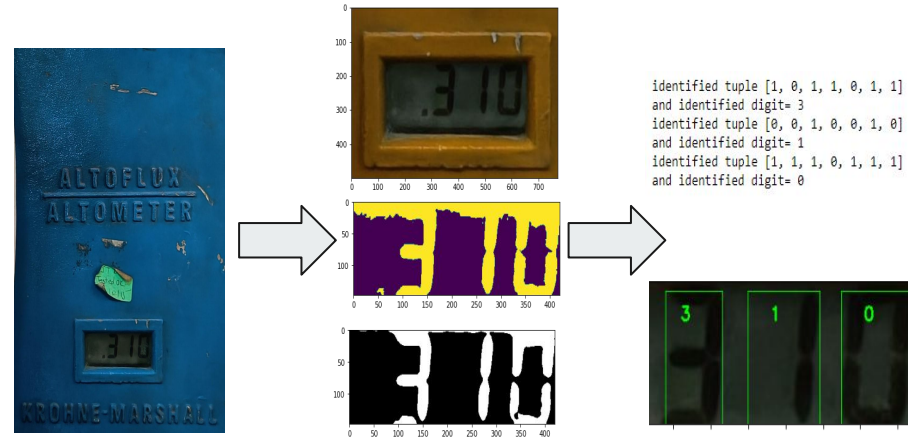
REST Django based Database application code can be accessed using this GitHub repository.

- https://github.com/DivyanshNatani/OCR-Display-Database

Thank You!

Open for feedbacks and question…

Appendix

IP Camera

Things to look for

- Wifi camera link should be accessible with Python -
    - Most IP Camera are based on this feature only. Product does not explicitly mention the link on shopping website, but is available on setup manual.
    - https://www.ispyconnect.com/cameras - Can check company on this website
- Quality of Video
- Movement (if possible)
- Price vs Feature analysis

Imou WiFi Wireless Security Camera 256GB SD Card Support, 1080P Full HD, Audio Recording, Night Vision, Abnormal Sound Alarm, Alexa Google Assistant Compatible with Cameras (White)

Visit the Imou Store

★★★★☆ ˅ | 817 ratings | 208 answered questions

-63% ₹1,799

M.R.P.: ₹4,900

✓prime One-Day
Inclusive of all taxes
EMI starts at ₹87 per month. EMI options ˅

Offers

Cashback	No Cost EMI	Bank Offer
₹200 cashback & ₹1,800 welcome rewards on Amazo...	Avail No Cost EMI on select cards for orders above ₹3000	Upto ₹ discou Credit C
3 offers ›	1 offer ›	2 offers ›

Roll over image to zoom in

Super Wide View Angle
Allows oversight of an entire room

Easy Installation
Mount it directly on metal surface with the magnetic bracket

Super Wide 131° View Angle

The 108° diagonal field of view allows viewing of an entire room.

0-90° manual rotation allows you to view any place with your wish.

Attention: This is not a PT camera and will not rotate automatically. You have to adjust the angle manually.

Easy Installation

With the magnetic bracket, you can simply mount Cue 2C directly on metal surface.

- 1080P Full HD
- Manual Rotation

https://www.amazon.in/Imou-Security-Detection-Cue-2C/dp/B08HF1FJ6Q/

Conbre MultipleXR2 Pro {Upgraded} HD Smart WiFi Wireless IP CCTV Security Camera | Night Vision | 2-Way Audio | Support 64 GB Micro SD Card Slot

Visit the Conbre Store

★★★☆☆ ⌄ · 4,228 ratings

-55% ₹1,349

M.R.P.: ₹2,999

✓**prime**

Inclusive of all taxes

Save up to 10% with business pricing. Sign up for free Amazon Business account

EMI starts at ₹462 per month. EMI options ⌄

🏷 Offers

Cashback	**No Cost EMI**	**Bank Offer**
₹200 cashback & ₹1,800 welcome	Avail No Cost EMI on select cards for	Upto ₹ discoun

Roll over image to zoom in

4 VIDEOS

Specifications

- Effective Pixels: 1920*1080
- TF Card Support: Max. 64G
- Motion Detection: Supported
- Video Frame Rate: 25FPS
- Night Vision Distance: Up to 10M
- Phone monitoring: IOS, Android
- Detection and alarm: E-mail alerts, alarm client
- Network protocol:TCP / IP, UDP, IMCP, SMTP, HTTP, FTP, DNS, DDNS DHCP, PPPoE, etc
- Wireless:Supports 802.11b / g / n wireless mode
- Indoor: Yes

Box:

- 1 * Conbre V380 Dual Antenna
- 1 * Adapter
- 1 * User manual
- 1 * Mount Stand

- Cheap
- 360°C View

https://www.amazon.in/gp/product/B07ZMKFXVL/ref=ask_ql_qh_dp_hza

CP PLUS 2MP Full HD Smart Wi-fi CCTV Home Security Camera | 360° with Pan Tilt | 2Way Talk | Cloud Monitor | Motion Detect | Night Vision | Supports SD Card (Upto 128 GB), Alexa & Ok Google | CP-E21A

Visit the CP PLUS Store

★★★★☆ 2,399 ratings | 424 answered questions

-59% ₹1,949

M.R.P.: ₹4,700

✓prime Same-Day

Inclusive of all taxes

EMI starts at ₹94. No Cost EMI available EMI options ⌄

Offers

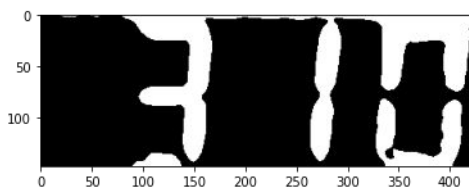| Cashback	No Cost EMI	Bank Offer
₹200 cashback & ₹1,800 welcome rewards on Amazo…	Upto ₹82.47 EMI interest savings on Amazon Pay ICICI…	Upto ₹ discou Cashb

- High Quality (2MP Full HD)
- 360°C View

https://www.amazon.in/gp/product/B07ZMKFXVL

CP Plus Intelligent Home Security Camera 360° 1080p

With in build Night Vision Camera and Full HD Recording

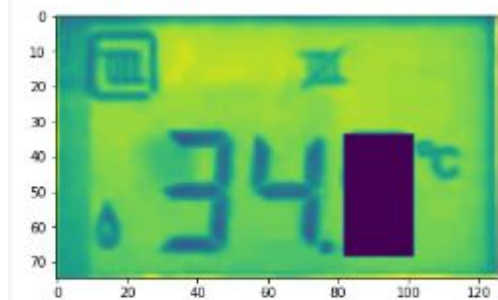| Full HD Video | 360 Degree | 2 Way Talk | Intelli-Fi | Motion Alert |

identified tuple [1, 0, 1, 1, 0, 1, 1]
and identified digit= 3
identified tuple [0, 0, 1, 0, 0, 1, 0]
and identified digit= 1
identified tuple [1, 1, 1, 0, 1, 1, 1]
and identified digit= 0

(56, 35) (77, 67)

(82, 34) (101, 68)

(33, 33) (51, 68)