

In [1]:

```
from google.colab import drive
drive.mount('/content/gdrive')
```

Mounted at /content/gdrive

Method 1 : using easyocr

<https://github.com/JaidedAI/EasyOCR>

In [3]:

```
pip install easyocr

Collecting easyocr
  Downloading
https://files.pythonhosted.org/packages/34/49/c0bc96969a7f8167fb0478e50ad3f5ad2c6d93c99e20dc82875e92e0d78
yocr-1.1.10-py3-none-any.whl (48.9MB)
  |████████████████████████████████████████| 48.9MB 65kB/s
Requirement already satisfied: numpy in /usr/local/lib/python3.6/dist-packages (from easyocr) (1.18.5)
Requirement already satisfied: Pillow in /usr/local/lib/python3.6/dist-packages (from easyocr) (7.0.0)
Collecting python-bidi
  Downloading
https://files.pythonhosted.org/packages/33/b0/f942d146a2f457233baaafd6bdf624eba8e0f665045b4abd69d1b62d097
hon_bidi-0.4.2-py2.py3-none-any.whl
Requirement already satisfied: opencv-python in /usr/local/lib/python3.6/dist-packages (from easyocr) (4.
1.2.30)
Requirement already satisfied: scikit-image in /usr/local/lib/python3.6/dist-packages (from easyocr) (0.1
6.2)
Requirement already satisfied: torch in /usr/local/lib/python3.6/dist-packages (from easyocr) (1.6.0+cu10
1)
Requirement already satisfied: torchvision>=0.5 in /usr/local/lib/python3.6/dist-packages (from easyocr)
(0.7.0+cu101)
Requirement already satisfied: scipy in /usr/local/lib/python3.6/dist-packages (from easyocr) (1.4.1)
Requirement already satisfied: six in /usr/local/lib/python3.6/dist-packages (from python-bidi->easyocr)
(1.15.0)
Requirement already satisfied: networkx>=2.0 in /usr/local/lib/python3.6/dist-packages (from scikit-image
->easyocr) (2.5)
Requirement already satisfied: PyWavelets>=0.4.0 in /usr/local/lib/python3.6/dist-packages (from scikit-i
mage->easyocr) (1.1.1)
Requirement already satisfied: imageio>=2.3.0 in /usr/local/lib/python3.6/dist-packages (from scikit-imag
e->easyocr) (2.4.1)
Requirement already satisfied: matplotlib!=3.0.0,>=2.0.0 in /usr/local/lib/python3.6/dist-packages (from
scikit-image->easyocr) (3.2.2)
Requirement already satisfied: future in /usr/local/lib/python3.6/dist-packages (from torch->easyocr)
(0.16.0)
Requirement already satisfied: decorator>=4.3.0 in /usr/local/lib/python3.6/dist-packages (from networkx>
=2.0->scikit-image->easyocr) (4.4.2)
Requirement already satisfied: python-dateutil>=2.1 in /usr/local/lib/python3.6/dist-packages (from matpl
otlib!=3.0.0,>=2.0.0->scikit-image->easyocr) (2.8.1)
Requirement already satisfied: pyparsing!=2.0.4,!<2.1.2,!<2.1.6,>=2.0.1 in /usr/local/lib/python3.6/dist-
packages (from matplotlib!=3.0.0,>=2.0.0->scikit-image->easyocr) (2.4.7)
Requirement already satisfied: cycler>=0.10 in /usr/local/lib/python3.6/dist-packages (from matplotlib!=3
.0.0,>=2.0.0->scikit-image->easyocr) (0.10.0)
Requirement already satisfied: kiwisolver>=1.0.1 in /usr/local/lib/python3.6/dist-packages (from matplotl
ib!=3.0.0,>=2.0.0->scikit-image->easyocr) (1.2.0)
Installing collected packages: python-bidi, easyocr
Successfully installed easyocr-1.1.10 python-bidi-0.4.2
```

In [4]:

```
import easyocr
import PIL
from PIL import ImageDraw
reader = easyocr.Reader(['en'])
```

Downloading detection model, please wait. This may take several minutes depending upon your network connection.

Downloading recognition model, please wait. This may take several minutes depending upon your network connection.

In [49]:

```
# Draw bounding boxes
def draw_boxes(image, content, color='white', width=5):
    draw = ImageDraw.Draw(image)
    for bound in content:
        for j in bound:
            if type(j) == str and len(j)==14:
                j=j.split(' ')
```

```

if len(j)==3:
    p0, p1, p2, p3 = bound[0]
    l = (p1[0]-p0[0])*9/14
    #print(bound[1])
    draw.rectangle([(p0[0],p0[1]),(p0[0]+l,p3[1])], fill=color, outline =color)
return image

```

In [46]:

```

img = PIL.Image.open('/content/gdrive/My Drive/aadhar_image_folder/img1.jpeg')
content = reader.readtext('/content/gdrive/My Drive/aadhar_image_folder/img1.jpeg')
draw_boxes(img, content)

```

3429 2099 3643

Out[46]:

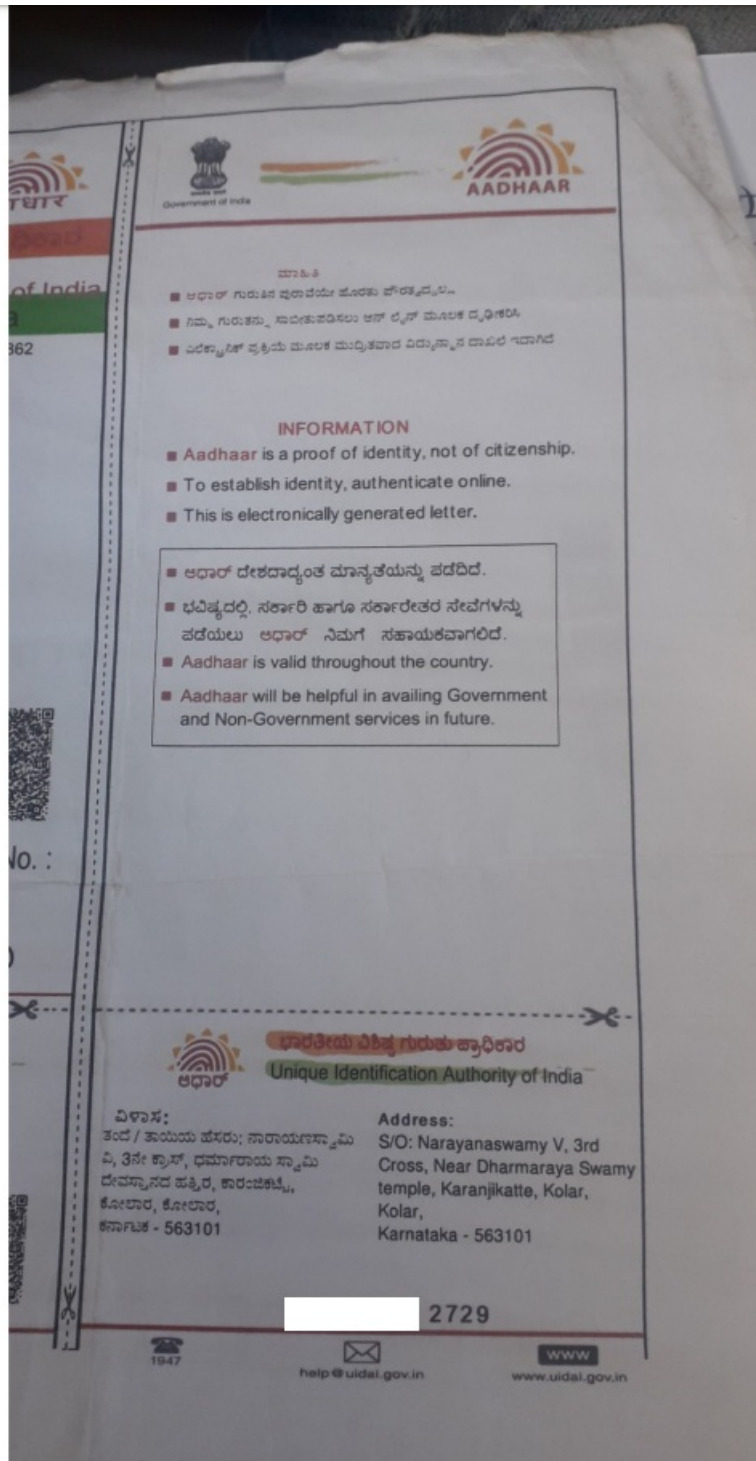


In [47]:

```

img = PIL.Image.open('/content/gdrive/My Drive/aadhar_image_folder/Capture47.png')
content = reader.readtext('/content/gdrive/My Drive/aadhar_image_folder/Capture47.png')
draw_boxes(img, content)

```



In [50]:

```
img = PIL.Image.open('/content/gdrive/My Drive/my_aadhar.png')
content = reader.readtext('/content/gdrive/My Drive/my_aadhar.png')
draw_boxes(img, content)
```

I have tried with my aadhar card, and in this image at three places we have the number and it's able to

Out[50]:



भारत सरकार
Unique Identification Authority of India
Government of India

नामांकन क्रम/Enrolment No.: 1047/29495/40911

To
नेहा सिकरवार
Neha Sikerwar
D/O Krishan Kumar Sikerwar
19/442 C
Primiya Nagar
Opp. Tilak Kunj
Koil
Aligarh Aligarh
Uttar Pradesh - 202001
7533849394

Download Date: 20/02/2017

Generation Date: 02/01/2017

Signature Not Verified
UNIQUE IDENTIFICATION AUTHORITY OF INDIA
Date: 20/02/2017 14:43:45



आपका आधार क्रमांक / Your Aadhaar No. :

6151

मेरा आधार, मेरी पहचान



भारत सरकार
Government of India



नेहा सिकरवार
Neha Sikerwar
जन्म तिथि/ DOB: 13/02/1996
महिला / FEMALE



6151

मेरा आधार, मेरी पहचान

सूचना

- आधार पहचान का प्रमाण है, नागरिकता का नहीं।
- पहचान का प्रमाण ऑनलाइन ऑथेंटिकेशन द्वारा प्राप्त करें।
- यह एक इलेक्ट्रॉनिक प्रक्रिया द्वारा बना हुआ पत्र है।

INFORMATION

- Aadhaar is a proof of identity, not of citizenship.
- To establish identity, authenticate online.
- This is electronically generated letter.

- आधार देश भर में मान्य है।
- आधार भविष्य में सरकारी और गैर-सरकारी सेवाओं का लाभ उठाने में उपयोगी होगा।
- Aadhaar is valid throughout the country.
- Aadhaar will be helpful in availing Government and Non-Government services in future.



भारतीय विशिष्ट पहचान प्राधिकरण
Unique Identification Authority of India

पता:
D/O कृष्ण कुमार सिकरवार,
19/442 सी, प्रीमियर नगर, तिलक
कुंज के सामने, कोल, अलीगढ़,
उत्तर प्रदेश - 202001

Address:
D/O Krishan Kumar Sikerwar,
19/442 C, Primiya Nagar, Opp.
Tilak Kunj. ., Koil, Aligarh,
Uttar Pradesh - 202001



1047



help@uidai.gov.in



www.uidai.gov.in

Scanned by CamScanner

In [51]:

```
img = PIL.Image.open('/content/gdrive/My Drive/aadhar_image_folder/img2.jpeg')  
content = reader.readtext('/content/gdrive/My Drive/aadhar_image_folder/img2.jpeg')  
draw_boxes(img, content)
```

```
# it is not able to capture the content of this img2.jpeg
```




In []:

Method 2 : using pytesseract

<https://medium.com/better-programming/highlighting-specific-word-in-an-input-image-1cf3d4f8ae27>

installing and importing libraries

<https://stackoverflow.com/questions/50655738/how-do-i-resolve-a-tesseractnotfounderror>

In [52]:

```

pip install pytesseract
Collecting pytesseract
  Downloading
https://files.pythonhosted.org/packages/17/4b/4dbd55388225bb6cd243d21f70e77cb3ce061e241257485936324b8e920
esseract-0.3.6.tar.gz
Requirement already satisfied: Pillow in /usr/local/lib/python3.6/dist-packages (from pytesseract) (7.0.0)
Building wheels for collected packages: pytesseract
  Building wheel for pytesseract (setup.py) ... done
  Created wheel for pytesseract: filename=pytesseract-0.3.6-py2.py3-none-any.whl size=13629 sha256=68e869
4adda0327a805bd4e78eeb80239f4a33e1c46ce992e02d0174eaeadd1d
  Stored in directory:
/root/.cache/pip/wheels/ee/71/72/b98430261d849ae631e283dfc7ccb456a3fb2ed2205714b63f
Successfully built pytesseract
Installing collected packages: pytesseract
Successfully installed pytesseract-0.3.6

```

In [53]:

```

pip install opencv-contrib-python
Requirement already satisfied: opencv-contrib-python in /usr/local/lib/python3.6/dist-packages (4.1.2.30)
Requirement already satisfied: numpy>=1.11.3 in /usr/local/lib/python3.6/dist-packages (from opencv-contrib-python) (1.18.5)

```

In [54]:

```

import pytesseract
from pytesseract import Output
import cv2
import numpy as np
from google.colab.patches import cv2_imshow

```

In [55]:

```
!sudo apt update
```

```

Get:1 https://cloud.r-project.org/bin/linux/ubuntu bionic-cran40/ InRelease [3,626 B]
Ign:2 https://developer.download.nvidia.com/compute/cuda/repos/ubuntu1804/x86_64 InRelease
Ign:3 https://developer.download.nvidia.com/compute/machine-learning/repos/ubuntu1804/x86_64 InRelease
Get:4 https://developer.download.nvidia.com/compute/cuda/repos/ubuntu1804/x86_64 Release [697 B]
Hit:5 https://developer.download.nvidia.com/compute/machine-learning/repos/ubuntu1804/x86_64 Release
Get:6 https://developer.download.nvidia.com/compute/cuda/repos/ubuntu1804/x86_64 Release.gpg [836 B]
Get:7 https://cloud.r-project.org/bin/linux/ubuntu bionic-cran40/ Packages [40.1 kB]
Hit:9 http://archive.ubuntu.com/ubuntu bionic InRelease
Get:10 http://ppa.launchpad.net/c2d4u.team/c2d4u4.0+/ubuntu bionic InRelease [15.9 kB]
Get:11 http://security.ubuntu.com/ubuntu bionic-security InRelease [88.7 kB]
Ign:12 https://developer.download.nvidia.com/compute/cuda/repos/ubuntu1804/x86_64 Packages
Get:12 https://developer.download.nvidia.com/compute/cuda/repos/ubuntu1804/x86_64 Packages [405 kB]
Get:13 http://archive.ubuntu.com/ubuntu bionic-updates InRelease [88.7 kB]
Hit:14 http://ppa.launchpad.net/graphics-drivers/ppa/ubuntu bionic InRelease
Get:15 http://security.ubuntu.com/ubuntu bionic-security/universe amd64 Packages [1,353 kB]
Get:16 http://archive.ubuntu.com/ubuntu bionic-backports InRelease [74.6 kB]
Get:17 http://ppa.launchpad.net/c2d4u.team/c2d4u4.0+/ubuntu bionic/main Sources [1,687 kB]
Get:18 http://archive.ubuntu.com/ubuntu bionic-updates/main amd64 Packages [2,165 kB]
Get:19 http://security.ubuntu.com/ubuntu bionic-security/main amd64 Packages [1,748 kB]
Get:20 http://archive.ubuntu.com/ubuntu bionic-updates/universe amd64 Packages [2,118 kB]
Get:21 http://ppa.launchpad.net/c2d4u.team/c2d4u4.0+/ubuntu bionic/main amd64 Packages [864 kB]
Fetched 10.7 MB in 3s (3,372 kB/s)
Reading package lists... Done
Building dependency tree
Reading state information... Done
31 packages can be upgraded. Run 'apt list --upgradable' to see them.

```

In [56]:

```

!sudo apt install tesseract-ocr

Reading package lists... Done
Building dependency tree
Reading state information... Done
The following additional packages will be installed:
  tesseract-ocr-eng tesseract-ocr-osd
The following NEW packages will be installed:
  tesseract-ocr tesseract-ocr-eng tesseract-ocr-osd
0 upgraded, 3 newly installed, 0 to remove and 31 not upgraded.
Need to get 4,795 kB of archives.
After this operation, 15.8 MB of additional disk space will be used.
Get:1 http://archive.ubuntu.com/ubuntu bionic/universe amd64 tesseract-ocr-eng all 4.00~git24-0e00fe6-1.2 [1,588 kB]
Get:2 http://archive.ubuntu.com/ubuntu bionic/universe amd64 tesseract-ocr-osd all 4.00~git24-0e00fe6-1.2 [2,989 kB]
Get:3 http://archive.ubuntu.com/ubuntu bionic/universe amd64 tesseract-ocr amd64 4.00~git2288-10f4998a-2 [218 kB]
Fetched 4,795 kB in 2s (2,959 kB/s)
debconf: unable to initialize frontend: Dialog
debconf: (No usable dialog-like program is installed, so the dialog based frontend cannot be used. at /usr/share/perl5/Debconf/FrontEnd/Dialog.pm line 76, <> line 3.)
debconf: falling back to frontend: Readline
debconf: unable to initialize frontend: Readline
debconf: (This frontend requires a controlling tty.)
debconf: falling back to frontend: Teletype
dpkg-preconfigure: unable to re-open stdin:
Selecting previously unselected package tesseract-ocr-eng.
(Reading database ... 144628 files and directories currently installed.)
Preparing to unpack .../tesseract-ocr-eng_4.00~git24-0e00fe6-1.2_all.deb ...
Unpacking tesseract-ocr-eng (4.00~git24-0e00fe6-1.2) ...
Selecting previously unselected package tesseract-ocr-osd.
Preparing to unpack .../tesseract-ocr-osd_4.00~git24-0e00fe6-1.2_all.deb ...
Unpacking tesseract-ocr-osd (4.00~git24-0e00fe6-1.2) ...
Selecting previously unselected package tesseract-ocr.
Preparing to unpack .../tesseract-ocr_4.00~git2288-10f4998a-2_amd64.deb ...
Unpacking tesseract-ocr (4.00~git2288-10f4998a-2) ...
Setting up tesseract-ocr-osd (4.00~git24-0e00fe6-1.2) ...
Setting up tesseract-ocr-eng (4.00~git24-0e00fe6-1.2) ...
Setting up tesseract-ocr (4.00~git2288-10f4998a-2) ...
Processing triggers for man-db (2.8.3-2ubuntu0.1) ...

```

In [57]:

```
!sudo apt install libtesseract-dev
```

```

Reading package lists... Done
Building dependency tree
Reading state information... Done
The following additional packages will be installed:
  liblptonica-dev
The following NEW packages will be installed:
  liblptonica-dev libtesseract-dev
0 upgraded, 2 newly installed, 0 to remove and 31 not upgraded.
Need to get 2,755 kB of archives.
After this operation, 13.8 MB of additional disk space will be used.
Get:1 http://archive.ubuntu.com/ubuntu bionic/universe amd64 liblptonica-dev amd64 1.75.3-3 [1,308 kB]
Get:2 http://archive.ubuntu.com/ubuntu bionic/universe amd64 libtesseract-dev amd64 4.00~git2288-10f4998a-2 [1,447 kB]
Fetched 2,755 kB in 1s (1,858 kB/s)
debconf: unable to initialize frontend: Dialog
debconf: (No usable dialog-like program is installed, so the dialog based frontend cannot be used. at
/usr/share/perl5/Debconf/FrontEnd/Dialog.pm line 76, <> line 2.)
debconf: falling back to frontend: Readline
debconf: unable to initialize frontend: Readline
debconf: (This frontend requires a controlling tty.)
debconf: falling back to frontend: Teletype
dpkg-preconfigure: unable to re-open stdin:
Selecting previously unselected package liblptonica-dev.
(Reading database ... 144675 files and directories currently installed.)
Preparing to unpack .../liblptonica-dev_1.75.3-3_amd64.deb ...
Unpacking liblptonica-dev (1.75.3-3) ...
Selecting previously unselected package libtesseract-dev.
Preparing to unpack .../libtesseract-dev_4.00~git2288-10f4998a-2_amd64.deb ...
Unpacking libtesseract-dev (4.00~git2288-10f4998a-2) ...
Setting up liblptonica-dev (1.75.3-3) ...
Setting up libtesseract-dev (4.00~git2288-10f4998a-2) ...

```

In [8]:

masking functions

In [58]:

```

def img_mask(image_path):
    img = cv2.imread(image_path)
    d = pytesseract.image_to_data(img, output_type=Output.DICT, lang='eng')
    n_boxes = len(d['level'])
    overlay = np.ascontiguousarray(img)
    for i in range(n_boxes):
        c=i+1
        t=i+2
        u=i+3
        v=i-1
        if c<n_boxes and t<n_boxes and u<n_boxes and v>=0:
            if len(d['text'][v])==0 and len(d['text'][i])==4 and len(d['text'][c]) == 4 and len(d['text'][t])=
                print(d['text'][i], d['text'][c], d['text'][t])
                (x, y, w, h) = (d['left'][i], d['top'][i], d['width'][i], d['height'][i])
                (x1, y1, w1, h1) = (d['left'][c], d['top'][c], d['width'][c], d['height'][c])
                #(x2, y2, w2, h2) = (d['left'][t], d['top'][t], d['width'][t], d['height'][t])
                cv2.rectangle(overlay, (x, y), (x + w, y + h), (255, 255, 255), -1)
                cv2.rectangle(overlay, (x1, y1), (x1 + w1, y1 + h1), (255, 255, 255), -1)
    return overlay

```

first image

In [63]:

```

image_path = '/content/gdrive/My Drive/aadhar_image_folder/img1.jpeg'
overlay = img_mask(image_path)

```

3429 2099 3643

In [64]:

```

cv2.imshow( overlay)
cv2.waitKey(0)
cv2.destroyAllWindows()

```



second image

In [59]:

preprocessing functions, as other 2 images are not very clear and methods are failing to read the data

```
def get_grayscale(image):
    img = cv2.imread(image)
    return cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)

def remove_noise(image):
    return cv2.medianBlur(image,5)

#thresholding
def thresholding(image):
    return cv2.threshold(image, 0, 255, cv2.THRESH_BINARY + cv2.THRESH_OTSU)[1]

#dilation
def dilate(image):
    kernel = np.ones((5,5),np.uint8)
    return cv2.dilate(image, kernel, iterations = 1)

#erosion
def erode(image):
    kernel = np.ones((5,5),np.uint8)
    return cv2.erode(image, kernel, iterations = 1)

#opening - erosion followed by dilation
def opening(image):
    kernel = np.ones((5,5),np.uint8)
    return cv2.morphologyEx(image, cv2.MORPH_OPEN, kernel)

#canny edge detection
def canny(image):
    return cv2.Canny(image, 100, 200)

#skew correction
def deskew(image):
    coords = np.column_stack(np.where(image > 0))
    angle = cv2.minAreaRect(coords)[-1]
    if angle < -45:
        angle = -(90 + angle)
    else:
        angle = -angle
    (h, w) = image.shape[:2]
    center = (w // 2, h // 2)
    M = cv2.getRotationMatrix2D(center, angle, 1.0)
```



```

rotated = cv2.warpAffine(image, M, (w, h), flags=cv2.INTER_CUBIC, borderMode=cv2.BORDER_REPLICATE)
return rotated

#template matching
def match_template(image, template):
    return cv2.matchTemplate(image, template, cv2.TM_CCOEFF_NORMED)

# https://nanonets.com/blog/ocr-with-tesseract/
# https://www.pyimagesearch.com/2017/07/10/using-tesseract-ocr-python/

image_path = '/content/gdrive/My Drive/aadhar_image_folder/img2.jpeg'
gray = get_grayscale(image_path)
thresh = thresholding(gray)
#opening = opening(gray)
#canny = canny(gray)

#img = cv2.imread(image_path)
d = pytesseract.image_to_data(thresh, output_type=Output.DICT, lang='eng')
#ocr_result = pytesseract.image_to_data(imgg, lang='eng', config='--psm 10 --eom 3 -c tessedit_char_whi
n_boxes = len(d['level'])
overlay = np.ascontiguousarray(img)
for i in range(n_boxes):
    text = d['text'][i]
    print(text)

```

In []:

In [65]:

In [69]:

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In [69]:

not able to read the aadhar number from the image even after preprocessing

third image

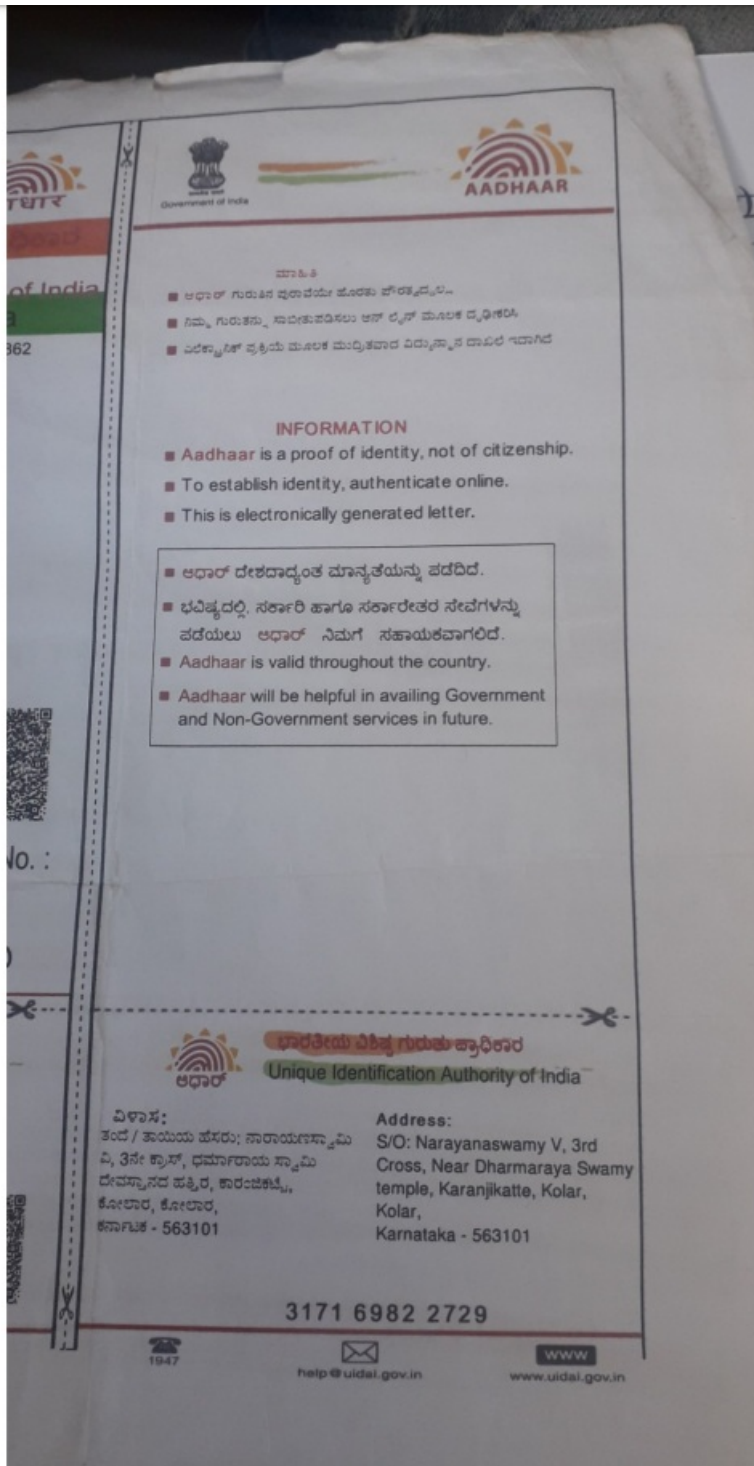
In [62]:

image_path = '/content/gdrive/My Drive/aadhar_image_folder/Capture47.png'
overlay = img_mask(image_path)

In [64]:

cv2_imshow(overlay)
cv2.waitKey(0)
cv2.destroyAllWindows()

not able to detect



In [71]:

```
image_path = '/content/gdrive/My Drive/aadhar_image_folder/Capture47.png'
gray = get_grayscale(image_path)
thresh = thresholding(gray)
```

In [73]:

```
#img = cv2.imread(image_path)
d = pytesseract.image_to_data(thresh, output_type=Output.DICT, lang='eng')
#ocr_result = pytesseract.image_to_data(img, lang='eng', config='--psm 10 --eom 3 -c tessedit_char_whi
n_boxes = len(d['level'])
overlay = np.ascontiguousarray(img)
for i in range(n_boxes):
    text = d['text'][i]
    print(text)

# not able to read any data even after pre-processing
```

my aadhar image

In [60]:

```
image_path = '/content/gdrive/My Drive/my_aadhar.png'
overlay = img_mask(image_path)
```

```
3967 5830 6151  
3967 5830 6151
```

In [61]:

```
cv2.imshow('overlay')  
cv2.waitKey(0)  
cv2.destroyAllWindows()
```

```
# it is able to detect 2 out of 3 numbers
```




भारतीय विशिष्ट पहचान प्राधिकरण

भारत सरकार
Unique Identification Authority of India
Government of India

नामांकन क्रम/Enrolment No.: 1047/29495/40911

To
नेहा सिकरवार
Neha Sikerwar
D/O Krishan Kumar Sikerwar
19/442 C
Primiya Nagar
Opp. Tilak Kunj
Koil
Aligarh Aligarh
Uttar Pradesh - 202001
7533849394

Download Date: 20/02/2017

Generation Date: 02/01/2017

Signature Not Verified
UNIQUE IDENTIFICATION
AUTHORITY OF INDIA
Date: 20/02/2017 14:43:45



आपका आधार क्रमांक / Your Aadhaar No. :

6151

मेरा आधार, मेरी पहचान



भारत सरकार
Government of India



नेहा सिकरवार
Neha Sikerwar
जन्म तिथि/ DOB: 13/02/1996
महिला / FEMALE



6151

मेरा आधार, मेरी पहचान



Government of India



सूचना

- आधार पहचान का प्रमाण है, नागरिकता का नहीं।
- पहचान का प्रमाण ऑनलाइन ऑथेंटिकेशन द्वारा प्राप्त करें।
- यह एक इलेक्ट्रॉनिक प्रक्रिया द्वारा बना हुआ पत्र है।

INFORMATION

- **Aadhaar** is a proof of identity, not of citizenship.
- To establish identity, authenticate online.
- This is electronically generated letter.

- आधार देश भर में मान्य है।
- आधार भविष्य में सरकारी और गैर-सरकारी सेवाओं का लाभ उठाने में उपयोगी होगा।
- Aadhaar is valid throughout the country.
- Aadhaar will be helpful in availing Government and Non-Government services in future.



भारतीय विशिष्ट पहचान प्राधिकरण
Unique Identification Authority of India

पता:

D/O कृष्ण कुमार सिकरवार,
19/442 सी, प्रीमियर नगर, तिलक
कुंज के सामने, , कोल, अलीगढ़,
उत्तर प्रदेश - 202001

Address:

D/O Krishan Kumar Sikerwar,
19/442 C, Primiya Nagar, Opp
Tilak Kunj. ., Koil, Aligarh,
Uttar Pradesh - 202001

3967 5830 6151



1947



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In []:

Results

I have used 2 methods for the given task (masking 8 digits of aadhar number from aadhar card image) using OCR.

1. easyocr
2. pytesseract

If we compare the results, easyocr is able to detect the data from image more accurately. Even if aadhar number present at multiple locations. But both method failed for the second image. Means if image is too blurry, none of these method will be able to detect the data correctly. We will be needing strong pre-processing techniques to make it work.

In []: