Exploring the Cosmos A Web-Based Application for Pollution, Constellation and Moon Phase Recognition

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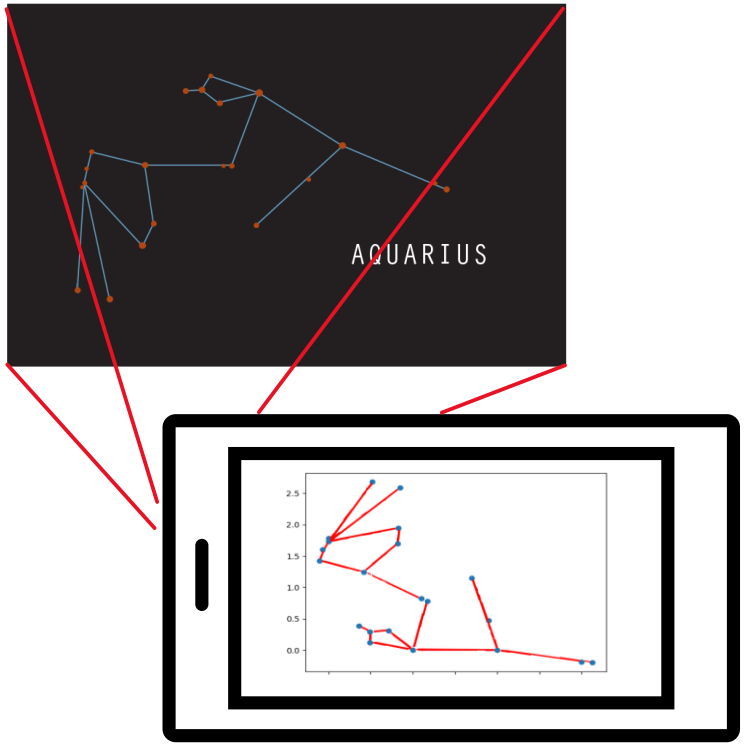
Introduction

- 1. Constellations
- 2. Recognition methods
- 3. Why this topic?
- 4. Light Pollution

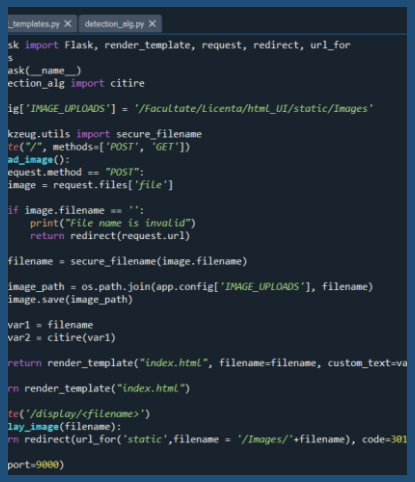
Objectives

Materials and methods

- How does it work?
- Devices
- Moon Phase

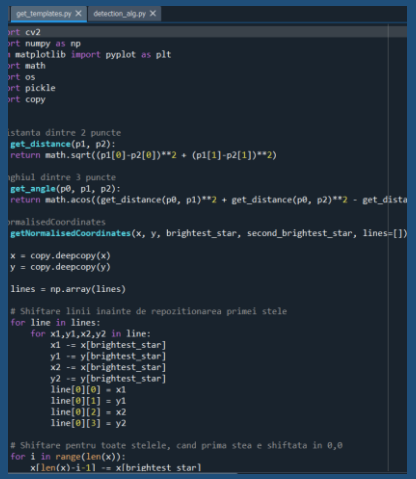


Components



```
_templates.py ×  detection_alg.py ×

sk import Flask, render_template, request, redirect, url_for
s
ask(__name__)
ection_alg import citire

ig['IMAGE_UPLOADS'] = '/Facultate/Licenta/html_UI/static/Images'

kzeug.utils import secure_filename
te("/", methods=['POST', 'GET'])
ad_image():
equest.method == "POST":
image = request.files['file']

if image.filename == '':
    print("File name is invalid")
    return redirect(request.url)

filename = secure_filename(image.filename)

image_path = os.path.join(app.config['IMAGE_UPLOADS'], filename)
image.save(image_path)

var1 = filename
var2 = citire(var1)

return render_template("index.html", filename=filename, custom_text=va

rn render_template("index.html")

te('/display/<filename>')
lay_image(filename):
rn redirect(url_for('static',filename = '/Images/'+filename), code=301

port=9000)
```

Flask Application



```
get_templates.py ×  detection_alg.py ×

rt cv2
rt numpy as np
 matplotlib import pyplot as plt
rt math
rt os
rt pickle
rt copy


istanta dintre 2 puncte
get_distance(p1, p2):
return math.sqrt((p1[0]-p2[0])**2 + (p1[1]-p2[1])**2)

ghiul dintre 3 puncte
get_angle(p0, p1, p2):
return math.acos((get_distance(p0, p1)**2 + get_distance(p0, p2)**2 - get_dista

rmalisedCoordinates
getNormalisedCoordinates(x, y, brightest_star, second_brightest_star, lines=[])

x = copy.deepcopy(x)
y = copy.deepcopy(y)

lines = np.array(lines)

# Shiftare linii inainte de repozitionarea primei stele
for line in lines:
    for x1,y1,x2,y2 in line:
        x1 -= x[brightest_star]
        y1 -= y[brightest_star]
        x2 -= x[brightest_star]
        y2 -= y[brightest_star]
        line[0][0] = x1
        line[0][1] = y1
        line[0][2] = x2
        line[0][3] = y2

# Shiftare pentru toate stelele, cand prima stea e shiftata in 0,0
for i in range(len(x)):
    x[len(x)-i-1] -= x[brightest_star]
```

Code for Template Database

```
get_templates.py ×  detection_alg.py* ×

    distances = np.sqrt((test[0] - train[0][i]) **2 + (test[1] - train[1][i]) *
    min_dist = min(distances)
    if(min_dist < threshold) :
        count += 1
        error += min_dist

return count , error

test_runner(constellation) :
test_coordinates = test_normaliser(constellation + '.png')
true_label = constellation[:]

file = open('Template Coordinates' , 'rb')
template_coordinate = pickle.load(file)

score = -1
pred_label = 'None'

plot_points = []

for bright_perm in range(len(test_coordinates)) :
    for constellation in template_coordinate :
        x_template , y_template , n_stars , normalised_lines = template_coordin

        e = simillarity_error((x_template, y_template) , test_coordinates[brig
        cur_score = e[0] * (e[0]-2) / (n_stars * e[1])

        if e[0] > 2 and score < cur_score < 1e+3 :
            pred_label = constellation
            score = cur_score


            plot_points = (x_template, y_template, test_coordinates, normalise

return pred_label

citire(poza):
poza = os.path.splitext(poza)[0]
# if(test_runner(poza) == poza):
return("You just found the constelation of: " + str(test_runner(poza)))
```

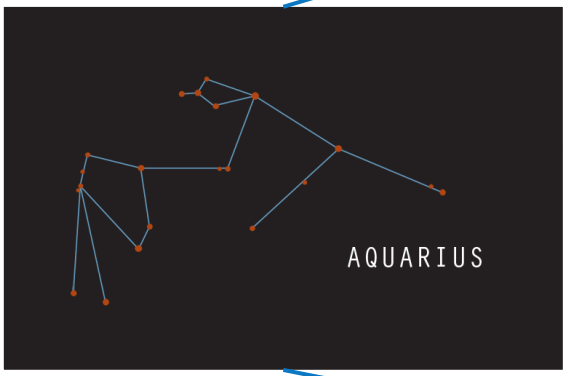
Matching Algorithm Code

```
main.py  index.html ×
s > index.html > ...
    <div class="sec" id="sec">
        <h2>Bigger Than The Whole Sky</h2>
        <p>
            <br>Stars are some of the most fascinating objects in the
            <br>One way that humans have made sense of the stars is by
            <br>One of the most famous constellations is the Big Dippe
            <br>The study of stars and constellations has led to many
        </p>
    </div>

    <div class="form" id="form">
        <form method="post" action="/" enctype="multipart/form-data">
                {%  if filename %}
                <div class="new_image"><img src="{{ url_for('static',
                <p class="custom_text">{{ custom_text }}</p>
                {%  endif  %}
            <p>
                <input type="file" name="file" autocomplete="off" requ
            </p>
            <p>
                <input type="submit" value="Submit">
            </p>
        </form>
    </div>

    <footer>
        <a href="#" class="logo">Mountain Guide</a>
        <ul>
            <li><a href="#">Moon Phase</a></li>
            <li><a href="#">Horoscope</a></li>
            <li><a href="#">Stories about the sky</a></li>
        </ul>
```

HTML Code

Components

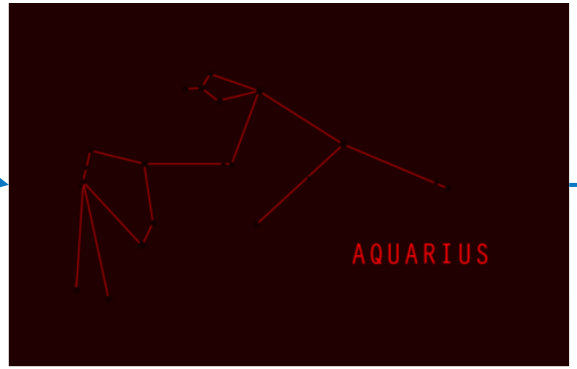
Original



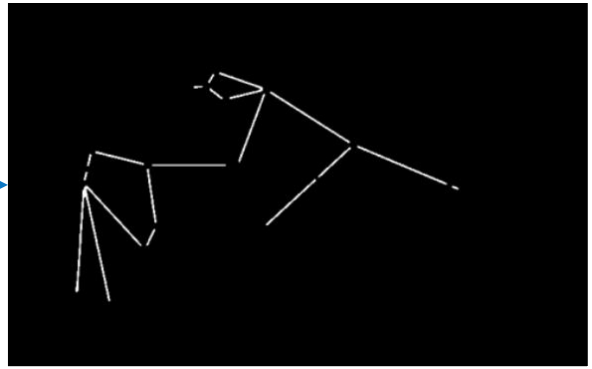
Blue Channel

Binarized Stars

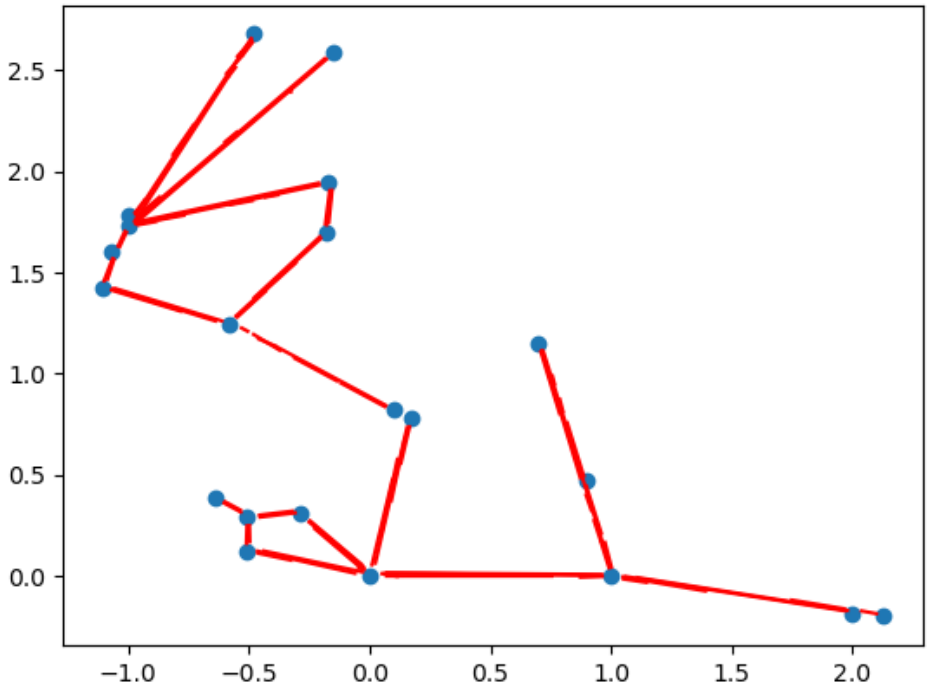
Red Channel



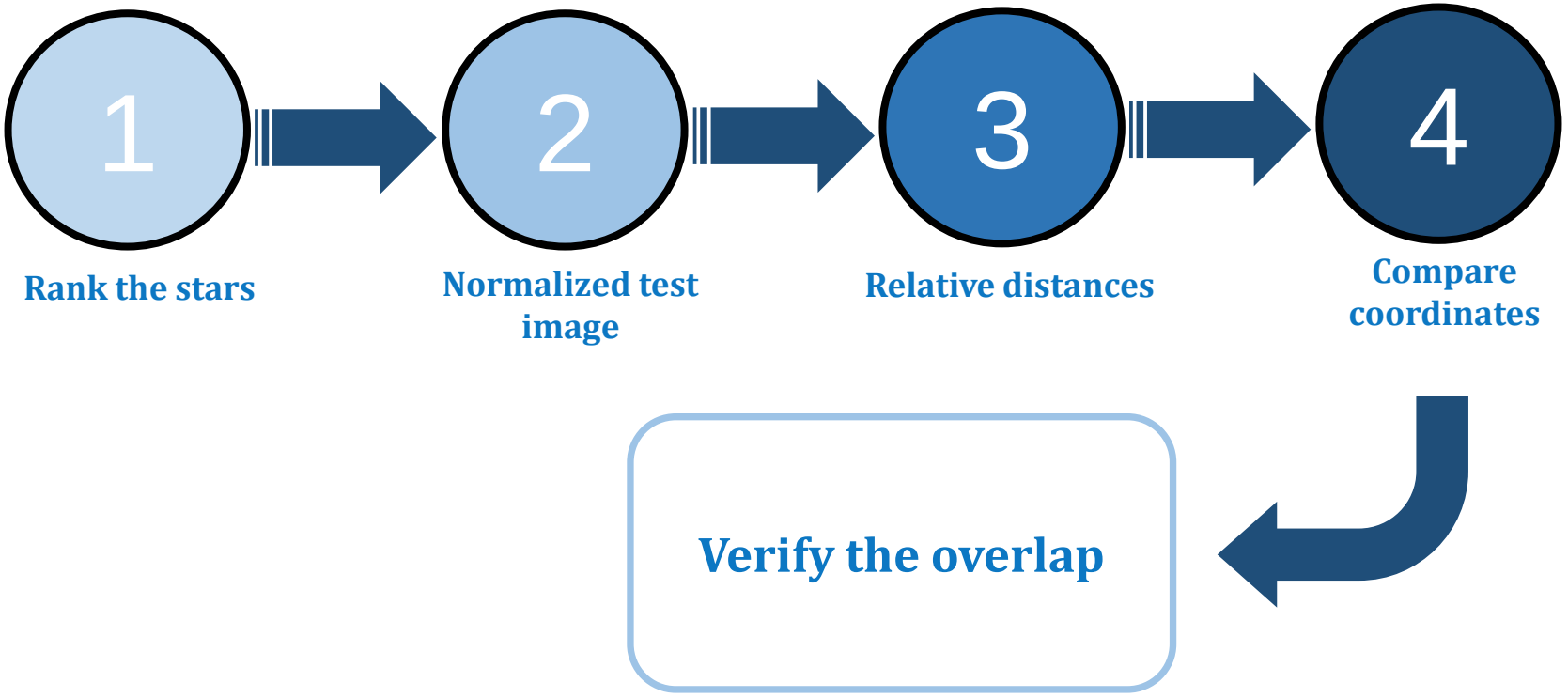
Binarized Lines



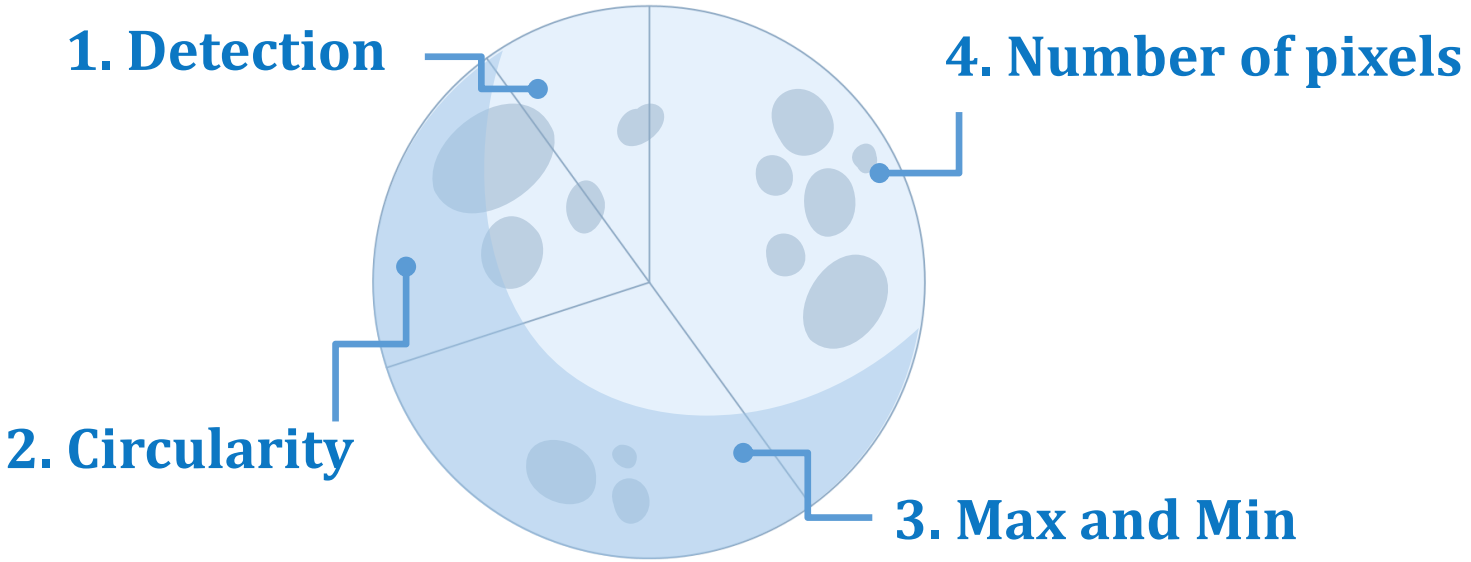
The Normalized Template



Process of the Algorithm

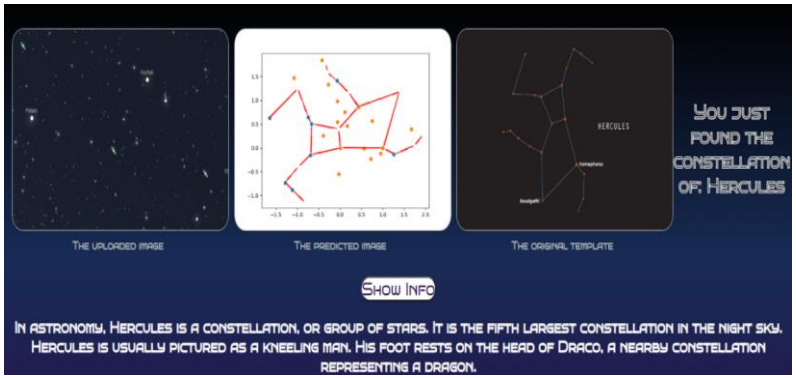


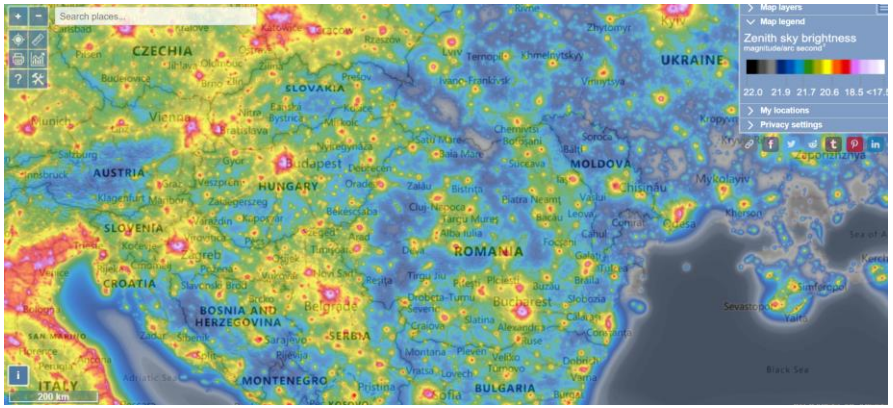
Moon Phase Detection



Results and discussions

- What we get?
- Is it useful?
- What is new?
- Future Light Pollution Tool?



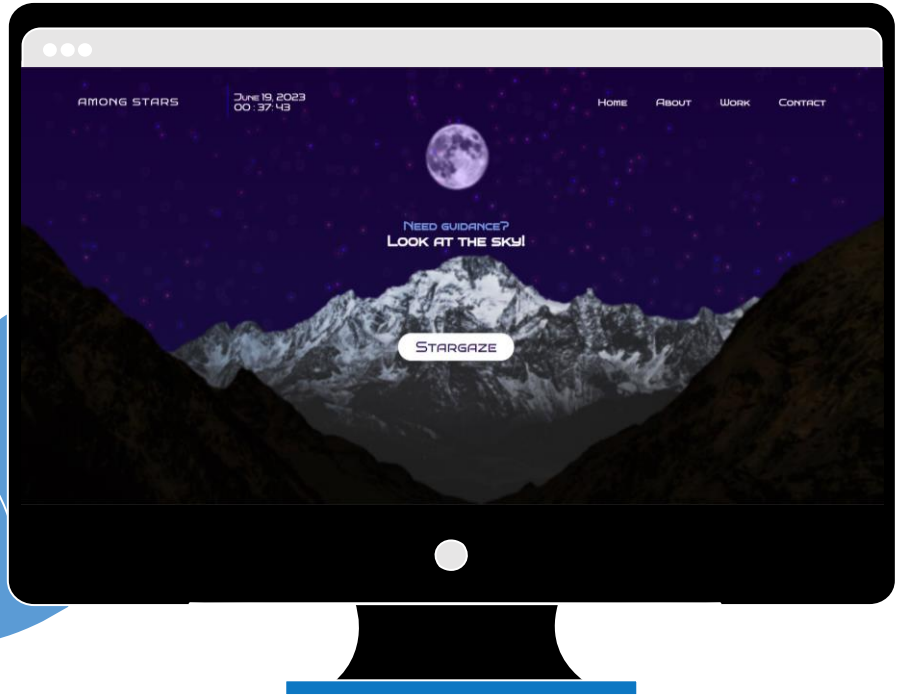


Is it really an impediment?

Less Polluted Sky **Light “contaminated” Sky**

Conclusions and recommendations

- Accuracy
- Detection improvement
- Light Pollution Detection
- Mobile application
- Learning feature



References

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- M. Petrou and C. Petrou, “Image Processing: The Fundamentals: Second Edition,” Image Processing: The Fundamentals: Second Edition, Jan. 2011, doi: 10.1002/9781119994398.Mobile application
- “Easily Identify Stars At Night | Mobile Stargazing | Essential Guide To Astronomy | Star Walk.” https://starwalk.space/en (accessed Jun. 06, 2023).
- “Observation - 88 Constellations.” http://astronomyonline.org/Observation/Constellations.asp (accessed Jun. 06, 2023).
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Thank you for your attention!

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