

Mask and Emotion: Computer Vision in the Age of COVID-19

Serhiy O. Semerikov

Kryvyi Rih State Pedagogical
University
Kryvyi Rih, Ukraine
Kryvyi Rih National University
Kryvyi Rih, Ukraine
Institute for Digitalisation of
Education of the NAES of Ukraine
Kyiv, Ukraine
University of Educational
Management
Kyiv, Ukraine
semerikov@gmail.com

Tetiana A. Vakaliuk

Zhytomyr Polytechnic State
University
Zhytomyr, Ukraine
Institute for Digitalisation of
Education of the NAES of Ukraine
Kyiv, Ukraine
Kryvyi Rih State Pedagogical
University
Kryvyi Rih, Ukraine
tetianavakaliuk@gmail.com

Iryna S. Mintii

Kryvyi Rih State Pedagogical
University
Kryvyi Rih, Ukraine
Institute for Digitalisation of
Education of the NAES of Ukraine
Kyiv, Ukraine
irina.mintiy@kdpu.edu.ua

Vita A. Hamaniuk

Kryvyi Rih State Pedagogical
University
Kryvyi Rih, Ukraine
vitana65@gmail.com

Vladimir N. Soloviev

Kryvyi Rih State Pedagogical
University
Kryvyi Rih, Ukraine
vnsoloviev2016@gmail.com

Olga V. Bondarenko

Kryvyi Rih State Pedagogical
University
Kryvyi Rih, Ukraine
bondarenko.olga@kdpu.edu.ua

Pavlo P. Nechypurenko

Kryvyi Rih State Pedagogical
University
Kryvyi Rih, Ukraine
acinonyxleo@gmail.com

Svitlana V. Shokaliuk

Kryvyi Rih State Pedagogical
University
Kryvyi Rih, Ukraine
shokalyuk@kdpu.edu.ua

Natalia V. Moiseienko

Kryvyi Rih State Pedagogical
University
Kryvyi Rih, Ukraine
n.v.moiseenko@gmail.com

Vitalii R. Ruban

Kryvyi Rih State Pedagogical
University
Kryvyi Rih, Ukraine
vitas.uno@gmail.com

ABSTRACT

Computer vision systems since the early 1960s have undergone a long evolution and are widely used in various fields, in particular, in education for the implementation of immersive educational resources. When developing computer vision systems for educational purposes, it is advisable to use the computer vision libraries based on deep learning (in particular, implementations of convolutional neural networks). Computer vision systems can be used in education both under normal and pandemic conditions. The changes in the education industry caused by the COVID-19 pandemic have affected the classic educational applications of computer vision

systems, modifying existing ones and giving rise to new ones, including social distancing, face mask recognition, intrusion detection in universities and schools, and vandalism prevention, recognition of emotions on faces with and without masks, attendance monitoring. Developed on the basis of Microsoft Cognitive Toolkit and deployed in the Microsoft Azure cloud, a prototype computer vision system integrates emotion recognition of students and detection of violations of the mask regime, additionally providing the ability to determine gender, smile intensity, average age, makeup, glasses, hair color, etc. with a high degree of reliability.

CCS CONCEPTS

• **Human-centered computing**; • **Social and professional topics** → **User characteristics**; • **Computing methodologies** → **Computer vision tasks**;

KEYWORDS

computer vision, COVID-19, education, mask detection

1 EDUCATIONAL APPLICATIONS OF COMPUTER VISION SYSTEMS

1.1 The Origins and Current State of Computer Vision Systems

The first mentions of machine vision or computer vision appeared in the late 1950s, and today the “computer vision” term is much more frequently mentioned (figure 1).

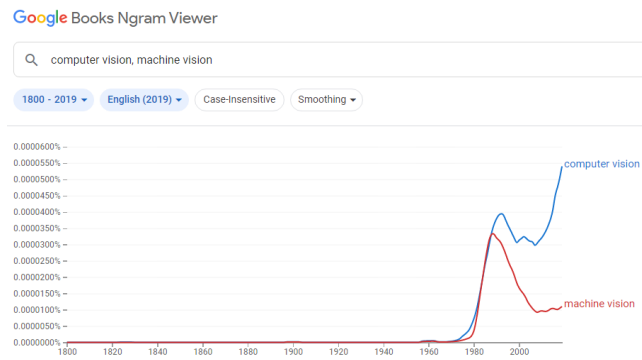


Figure 1: Mentions of computer / machine vision [1].

Gunnar Rutger Grape in his report [8] mentions the pioneering dissertation “Machine perception of three-dimensional solids” [14] by Lawrence Gilman Roberts. Completed with the assistance of Claude Elwood Shannon at MIT Lincoln Laboratory, this dissertation, like that of Ivan Edward Sutherland [17], laid the foundations for computer graphics.

Roberts [14] points out that the basis of machine recognition of simple images in the 1960s was based on the traditional use of artificial neural networks, such as perceptrons, which divide the set of input images (patterns) into classes by choosing link coefficients (weights) [17, p. 11]. However, the existing developments in letter recognition were not suitable for recognizing images constructed using straight lines: the problem concerned both flat (two-dimensional) and spatial (three-dimensional) images – the latter was the focus of the dissertation [17].

Roberts [14] relied on psychological researches on human perception of depth and recognition of figures, especially those of James Jerome Gibson [6]. The result of this work was a system for converting photographic images into three-dimensional models (figure 2).

10 years after the work of [14], the state of art in the field of computer vision has changed significantly. Grape [8] presents a system for computer vision, which is based on two-dimensional prototypes, and which uses a hierarchy of features for mapping purposes. The visual input is provided by a TV-camera, and the

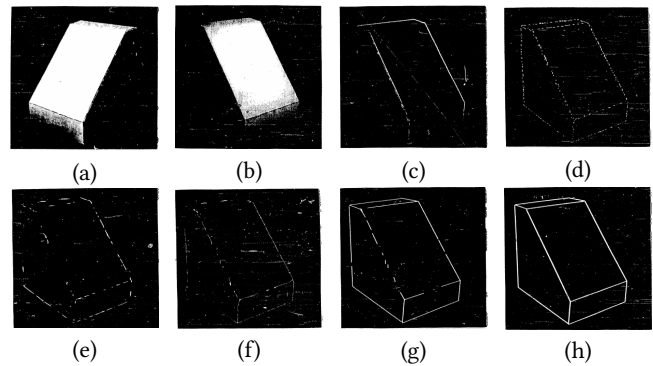


Figure 2: Transformation of the picture to line drawings: (a) original picture; (b) computer display of picture; (c-g) picture transformation; (h) final line drawing [14, p. 35-36].

problem is to interpret that input by computer, as a projection of a three-dimensional scene. The system proposed and demonstrated in the [8] uses perspective-consistent two-dimensional models prototypes of views of three-dimensional objects, and interpretations of scene-representations are based on the establishment of mapping relationships from conglomerates of scene-elements line-constellations to prototypes templates. The prototypes are learned by the program through analysis of – and generalization on – ideal instances (figure 3).

Determining the future directions of the development of computer vision systems, Grape [8] proposed a conceptual model for processing of information flow in a three-dimensional system (figure 4).

Ten years after Grape’s report, the first generalization of the current state of the art in the field of computer vision was made. The authors of the first textbook on computer vision [4] Dana Harry Ballard and Christopher M. Brown considered methods of image formation, pre-processing (recovering intrinsic structure, filtering the image, finding local edges, surface orientation from reflectance models, optical flow and resolution pyramids), boundary detection, region growing, texture, motion, representation of two-dimensional geometric structures (boundaries, regions), representation of three-dimensional structures (solids, surfaces, cylindrical), knowledge representation and use (knowledge bases, semantic networks), matching, inference, goal achievement [4].

Ballard and Brown [4] proposed 4 categories of image representation in computer vision systems (figure 5). In the table 1 shown the main areas of application of computer vision systems as seen by the authors in 1982.

“Computer vision and machine learning have gotten married and this book is their child” is an Amazon review given by William T. Freeman to Simon J. D. Prince’s “Computer Vision: Models, Learning, and Inference” [10]. This book outlines the fundamentals of machine learning needed to support current applications and research in computer vision.

Thus, over 60 years of development, computer vision systems have spread to a significant number of industries, including education, where they are used to implement immersive e-learning resources. However, changes in the educational industry caused

Table 1: Examples of image analysis tasks [4, p. 11]

Domain	Objects	Modality	Tasks	Knowledge sources
Robotics	3D outdoor and indoor scenes Mechanical parts	Light X-rays	Identify or describe objects in scene Industrial tasks	Models of objects Models of the reflection of light from objects
Aerial images	Terrain Buildings, etc	Light Infrared Radar	Improved images Resource analyses Weather prediction Spying Missile guidance Tactical analyses	Maps Geometrical models of shapes Models of image formation
Astronomy	Stars Planets	Light	Chemical composition Improved images	Geometrical models of shapes
Medical (macro)	Body organs	X-rays Ultrasound Isotopes Heat	Diagnosis of abnormalities Operative and treatment planning	Anatomical models Models of image formation
Medical (micro)	Cells Protein chains Chromosomes	Electronmicroscopy Light	Pathology, cytology Karyotyping	Models of shape
Chemistry	Molecules	Electron densities	Analyses of molecular compositions	Chemical models Structured models
Neuroanatomy	Neurons	Light Electronmicroscopy	Determination of spatial orientation	Neural connectivity
Physics	Particle tracks	Light	Find new particles Identify tracks	Atomic physics

by the COVID-19 pandemic [18] could not but affect the classical educational applications of computer vision systems, modifying existing ones and giving rise to new directions.

1.2 Changes in Educational Applications of Computer Vision Systems Caused by the Spread of COVID-19

Nico Klingler, the developer of Viso Suite, the no-code computer vision platform for teams to build, deploy and operate real-world applications, gives an overview of computer vision in education [9]. Let's focus on the applications of computer vision in education relevant to the current COVID-19 pandemic.

Enforcing social distancing is a key strategy to combat the spread of COVID-19 at public facilities such as schools and universities. Deep learning systems can be used for crowd monitoring to analyze social distancing, identify bottlenecks, and trigger alerts in case of persistent violations (figure 6).

The tools needed for social monitoring are inexpensive surveillance cameras that some schools already have. The main advantage of controlling social distance using computer vision systems is non-contact and automation.

In [25] a key features of social distancing recognition using computer vision are defined:

- automated detection and tracking of multiple people in real time using surveillance cameras;

- analyzing the people's moving trajectories and rate of social distancing violations;
- identification of high-risk areas with the greatest danger of possible virus spread.

The latter takes on additional significance in the context of the spread of highly contagious strains of COVID-19, such as Omicron [11].

Masked face detection is a way to monitor compliance and adherence to wearing masks in crowded public places such as universities or schools. Deep learning algorithms automatically detect people without mask and track mask mandate violations. The masked face detection model based on computer vision is non-invasive, scalable, and comparably easy to implement because any camera feed can be used (figure 7).

In [23] a key features of masked face detection using computer vision are defined:

- automated mask adherence monitoring is more consistent and accurate than human inspection;
- detecting unmasked people increases safety by reducing the risk of transmission of COVID-19 and other infectious diseases;
- masks or face coverings in the workplace can prevent outbreaks in schools and universities, especially during the spread of highly contagious strains.

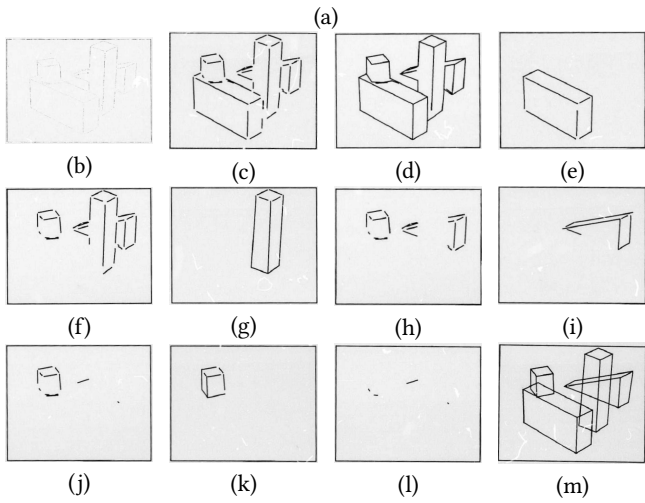
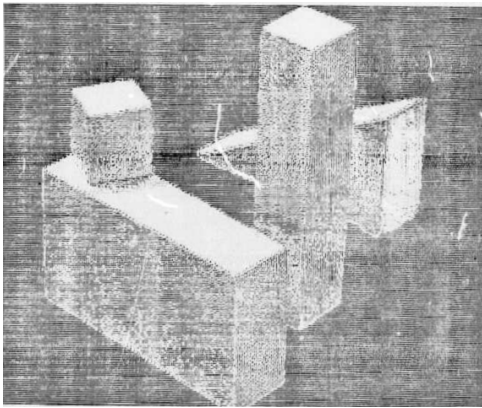


Figure 3: Image transformation: (a) TV-image; (b, c) edge-data – initial lines; (d, e) tentative vertices – first isolation; (f, g) amended scene – second object; (h, i) amended scene – third object; (j, k) amended scene – fourth object; (l, m) amended scene – final interpretation [8, p. 174-181].

Mahdi Rezaei and Mohsen Azarmi develop DeepSOCIAL [13], a hybrid computer vision and deep neural network model for automated detecting people in the crowds indoors and outdoors using closed-circuit television cameras (figure 8). The proposed deep neural network model in combination with an adapted inverse perspective mapping technique and SORT tracking algorithm leads to a robust people detection and social distancing monitoring. The model has been trained against two datasets – the Microsoft Common Objects in Context and Google Open Image datasets. The system has been evaluated against the Oxford Town Centre dataset (including 150,000 instances of people detection) with superior performance compared to three state-of-the-art methods. The evaluation has been conducted in challenging conditions, including occlusion, partial visibility, and under lighting variations with the mean average precision of 99.8% and the real-time speed of 24.1 fps. DeepSOCIAL also provide an online infection risk assessment scheme by statistical analysis of the spatio-temporal data from people’s moving trajectories and the rate of social distancing violations,

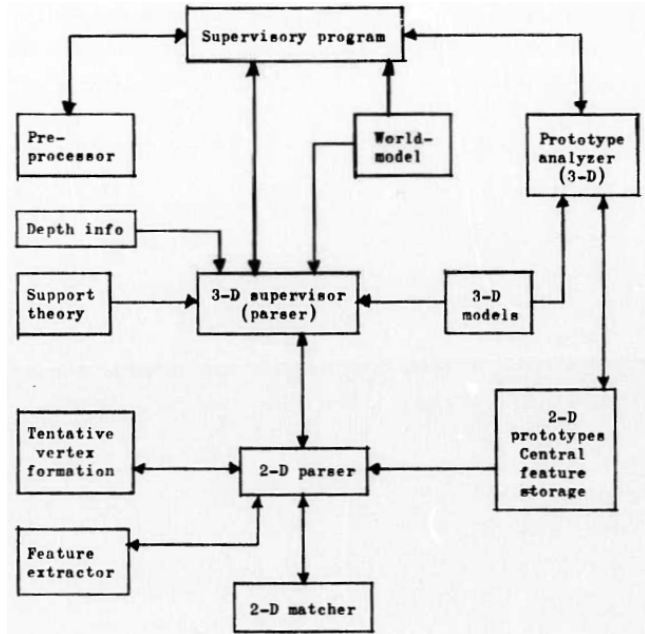


Figure 4: Possible information flow in a 3D system [8, p. 242].

and identify high-risk zones with the highest possibility of virus spread and infection. This may help authorities to redesign the layout of a public place or to take precaution actions to mitigate high-risk zones. The developed model is a generic and accurate people detection and tracking solution that can be applied in many other fields such as autonomous vehicles, human action recognition, anomaly detection.

Connor Shorten, Taghi M. Khoshgoftaar and Borko Furht in [15] presents a knowledge graph of deep learning and computer vision applications to fight COVID-19 (figure 9).

Parking management system for detecting the occupancy of parking lots in schools or universities is another classic computer vision application useful during a pandemic. Cameras that are also used for security surveillance provide a video feed that can be used to automatically determine and track the occupancy of multiple parking slots. Available parking information can be visualized in dashboards and sent to third-party systems to provide real-time data to students and teachers.

In [24] a key features of parking management systems for detecting the occupancy of parking lots in schools or universities are defined:

- parking occupancy detection based on deep learning computer vision saves money compared to costly sensor-based methods;
- parking optimization helps reduce traffic congestion during peak hours and traffic flows in cities caused by people cruising for a parking place (about 30%);
- no additional infrastructure is required for camera-based solutions, provided that the facility is equipped with closed-circuit television surveillance cameras covering the parking spaces;

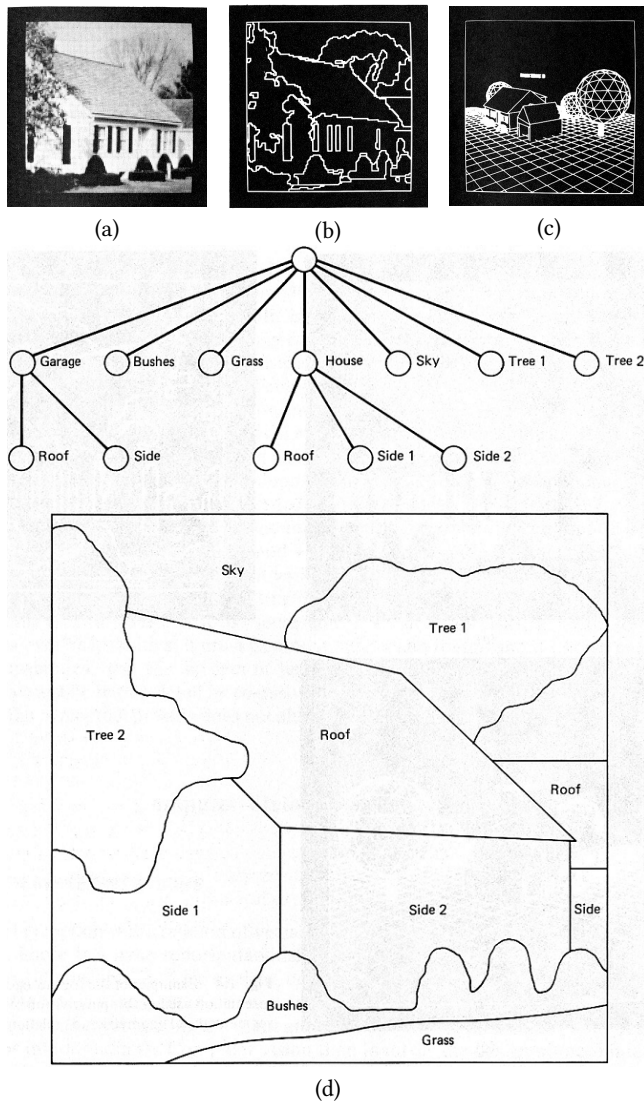


Figure 5: Categories of representation used in computer vision: (a) iconic, (b) segmented, (c) geometric, (d) relational [4, p. 7-8].

- computer vision-based solutions provide accurate location of a free parking space, which is a requirement for navigation of vehicles to free parking spaces.

Intrusion detection systems are an integral part of most physical security systems, critical infrastructure protection, and safety applications in transportation and manufacturing. *Intrusion detection in universities and schools* is the application of deep learning with surveillance cameras to monitor for perimeter and automatically detect intruders (figure 10).

In [22] a key features of intrusion detection systems are defined:

- real-time object detection algorithms to detect people and objects in the video of multiple cameras (high scalability);



Figure 6: Social distance monitoring with <https://viso.ai/application/social-distancing-monitoring/>.

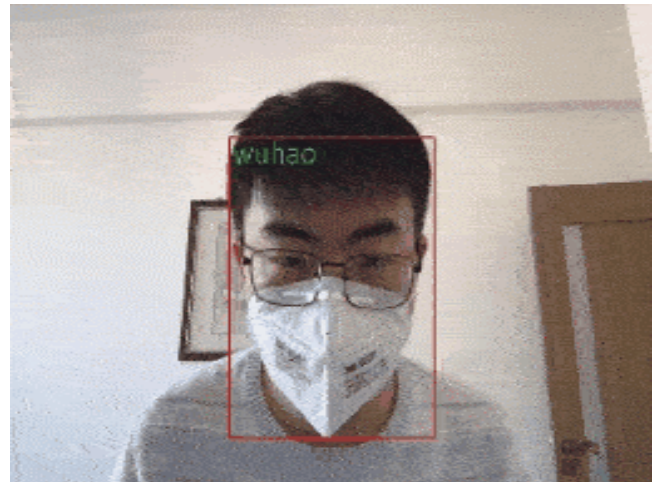


Figure 7: Masked face detection with <https://viso.ai/application/mask-detection/>.

- regions of interest can be visually determined by drawing and naming specific areas within camera frames;
- the ability to trigger alerts based on how objects are detected in those areas (for example, after a person enters the area for more than 5 seconds);
- edge AI with on-device machine learning allows privacy-preserving, high performance, and robust (offline capabilities) perimeter detection systems.

Vandalism prevention systems and systems for the detection of suspicious abandoned objects are used to detect suspicious behavior leading to vandalism and identify potentially dangerous items (suit-cases or bags that may contain explosives or biological weapons) placed in public places (figure 11).

In [19] a key features of Vandalism prevention systems and systems for the detection of suspicious abandoned objects are defined:

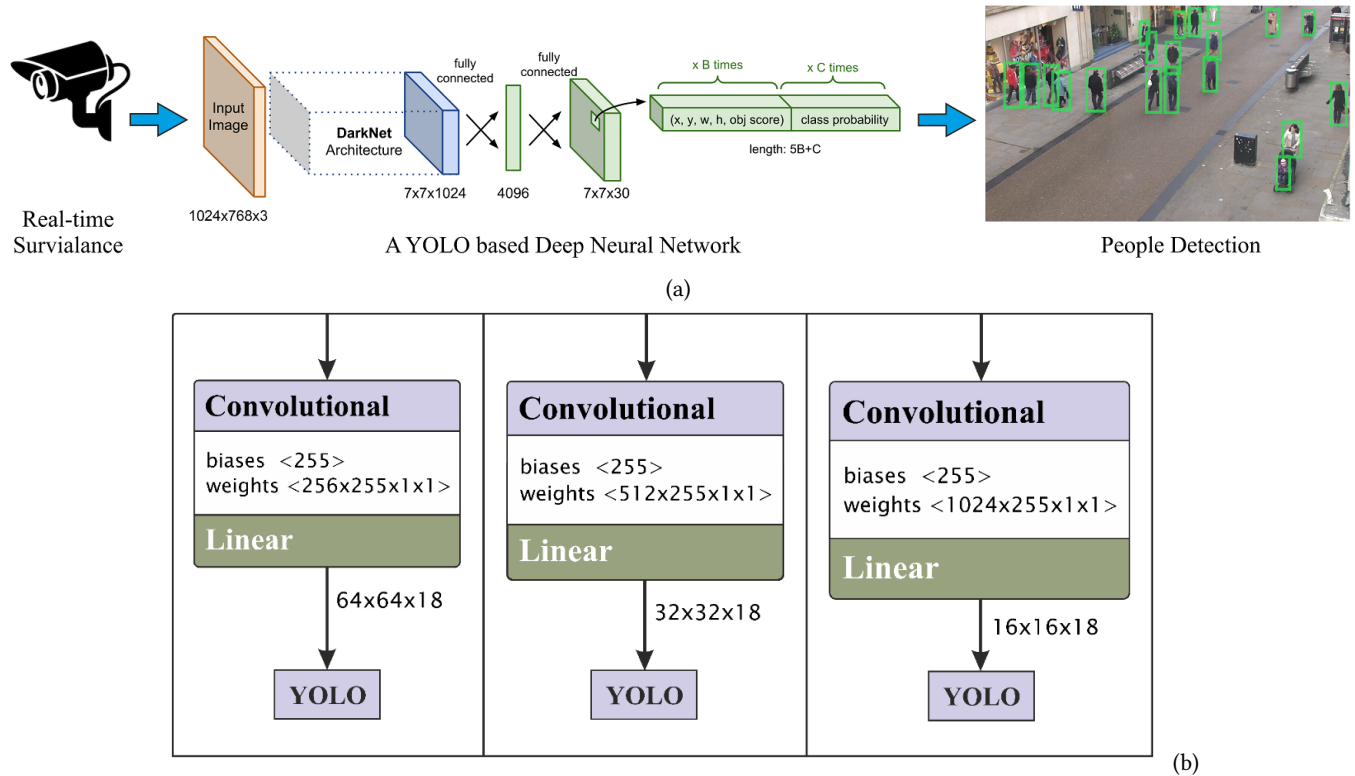


Figure 8: The general structure of the DeepSOCIAL people detection module (a) and the architecture of the neural network (b) [13, p. 7, 10].

- classification of objects to determine the type of item (suitcase, bag, etc.);
- focus detection on specific areas within camera streams (regions of interest such as platforms, surfaces, elevators, etc.);
- scalable and objective monitoring of public areas, public transport, schools, and hospitals;
- real-time early detection to assist humans in detecting suspicious items and initiating an evacuation.

The video stream from the cameras can be used to recognize the emotional states of one or more people, including the *recognition of the emotions of masked and unmasked faces* (figure 12).

Emotion recognition systems based on facial expressions allow [21]:

- detection of emotional states: sadness, anger, happiness, fear, surprise, and neutral state;
- identification of changes in emotional states based on specific conditions and events;
- measure the confidence score for the recognized emotions.

Attendance monitoring systems perform face recognition and find faces in an image database to identify students and register their attendance (figure 13).

Key benefits of attendance monitoring systems [20]:

- automated and non-invasive identification of one or multiple people;

- smart video surveillance for infrastructure protection in real-world settings;
- accurate deep learning models developed by Microsoft, Google, Meta, and others that are robust to occlusion, expression, lighting, and pose.

Attendance monitoring systems can be implemented at the hardware level based on Raspberry-pi [16] using convolutional neural networks – a class of deep neural networks most commonly used for visual images analysis [3, 12, 16] and implemented in software libraries such as Caffe, Deeplearning4j, Dlib, Microsoft Cognitive Toolkit, TensorFlow, Theano, Torch.

2 DEVELOPMENT OF A PROTOTYPE COMPUTER VISION SYSTEM FOR EDUCATIONAL PURPOSES

2.1 Computer Vision Libraries for Identification of Dynamic Objects

The most commonly used computer vision libraries for dynamic object identification are:

- *fastai* is a deep learning library that provides GPU-optimized computer vision features (Python);
- *IPSDK* is an image processing library optimized for 2D and 3D image processing (C++, Python);

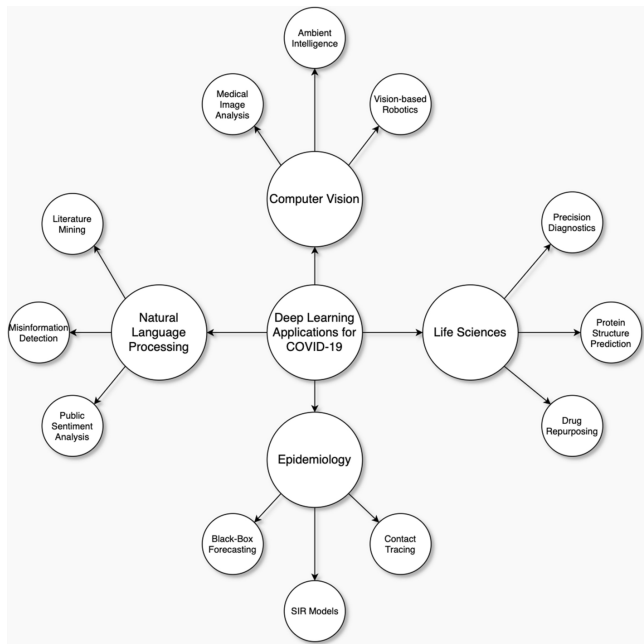


Figure 9: Application of deep learning to overcome the consequences of COVID-19 [15, p. 18].

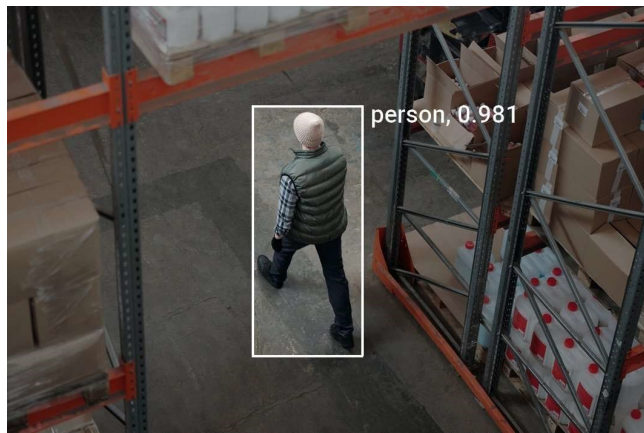


Figure 10: Intrusion detection using <https://viso.ai/application/intrusion-detection/>.

- *Imutils* is an OpenCV-based computer vision package (C++, Python);
- *Keras* is a high-level neural networks library that is capable of running on top of either TensorFlow or Theano and includes support for image recognition using both convolutional networks and recurrent networks (Python);
- *OpenCV* is a computer vision library that is focused on real-time applications and includes a number of modules for image processing, video analysis, object detection, etc (C++ and other languages);

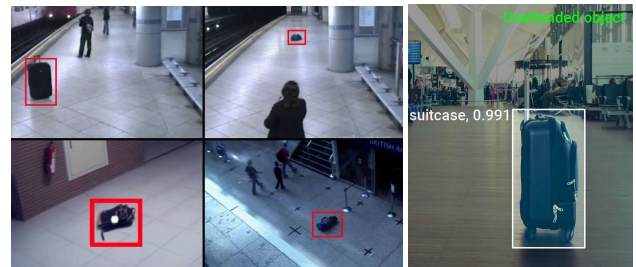


Figure 11: Detection of suspicious abandoned objects using <https://viso.ai/application/abandoned-luggage-detection/>.

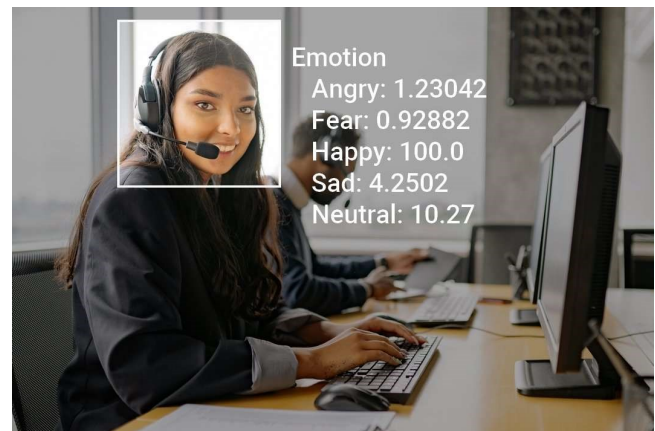


Figure 12: Facial emotion analysis using <https://viso.ai/application/emotion-analysis/>.



Figure 13: Face recognition using <https://viso.ai/application/face-recognition/>.

- *PyTorchCV* is a PyTorch-based framework for computer vision tasks: image classification, segmentation, detection, and pose estimation models. There are a number of implemented models in this framework, including AlexNet, ResNet, ResNeXt, PyramidNet, SparseNet, DRN-C/DRN-D and more (Python);
- *Scikit-Image* is an image processing toolbox for SciPy (Python);

- *SimpleCV* is a collection of libraries and software that provides a concise, readable interface for cameras, image and video streams manipulation (Python).

Common features of these libraries are free licenses, rapid prototyping with Python, image recognition using deep neural networks, and the ability to use web platforms to deploy computer vision applications. The latter is often a paid option, as is data processing in the developer's cloud.

Viso.ai is an all-in-one platform to build computer vision applications without code (e.g., [19, 21]). Despite a lot of features and high attractiveness, this platform has a high cost, which makes it unsuitable for the domestic education system. A similar situation is observed with other commercial solutions: for example, Adaptive Vision experts, comparing the functionality of OpenCV, MVTec HALCON and Adaptive Vision Library (AVL) [2], draw conclusions not in favor of the free OpenCV – especially significant differences in functionality in favor of commercial products HALCON and AVL in such components, important for the efficiency of recognition, as the region analysis, two-dimensional graphics, machine learning, and hardware support.

When using cloud-based recognition frameworks such as Google Cloud [7], the charges are incurred per unit (single image or page of a multi-page image). So, with a limit of up to 1000 units per month Cloud Vision provides the following features:

- CROP_HINTS – determine suggested vertices for a crop region on an image;
- DOCUMENT_TEXT_DETECTION – perform OCR on dense text images, such as documents (PDF/TIFF), and images with handwriting;
- FACE_DETECTION – detect faces within the image;
- IMAGE_PROPERTIES – compute a set of image properties, such as the image's dominant colors;
- LABEL_DETECTION – add labels based on image content;
- LANDMARK_DETECTION – detect geographic landmarks within the image;
- LOGO_DETECTION – detect company logos within the image;
- OBJECT_LOCALIZATION – detect and extract multiple objects in an image;
- TEXT_DETECTION – perform OCR for areas of sparse text within a larger image;
- WEB_DETECTION – detect topical entities such as news, events, or celebrities within the image, and find similar images on the web using the power of Google Image Search.

Any non-standard actions, in particular, using Vertex AI Training to build custom machine learning models, require additional payments, but for beginners often provided some credit – such policies are currently followed by Google Cloud, AWS, Microsoft Azure, which allows them to be considered as the technological basis for building computer vision systems for educational purposes.

2.2 Stages of Development of a Prototype Computer Vision System for Educational Purposes

2.2.1 Static Face Recognition with Microsoft Face API. Jim Bennett's "Happy, Sad, Angry Workshop" [5] provides an opportunity to develop a prototype of a computer vision system using the Azure Face API, a software interface that allows you to determine the position of a face on an image and collect 27-point face landmarks pointing to the important positions of face components, including the eyes position and mask detection.

To access the Azure Face API, you need a subscription key, which can be obtained through free registration at <https://azure.microsoft.com/en-us/free/students> (Azure for Students Starter) – it does not require the use of a credit card, although service credit is provided. Unfortunately, e-mail address in the second-level domain (in particular, the domain of Kryvyi Rih State Pedagogical University is kdpu.edu.ua) are not recognized as belonging to academic institutions – in this case, regular registration is recommended (figure 14).

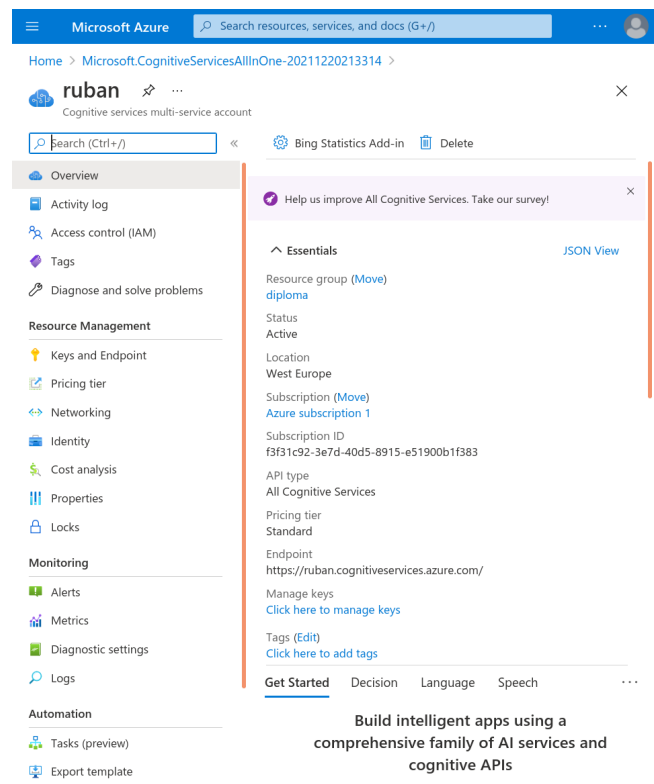


Figure 14: Regular registration in Cognitive Services.

After receiving the key, it must be verified using a test code (figure 15) or a web form (figure 16). If the key is invalid, the result will be a 400, 401, 403, 408, 415, or 429 error message:

```
b'{"error":{"code":"401","message":"Access denied due to invalid subscription key or wrong API endpoint. Make sure to provide a valid key for an active subscription and use a correct regional API endpoint for your resource."}}'
```



```

+ Code + Text
##### Python 3.2 #####
import http.client, urllib.request, urllib.parse, urllib.error, base64

headers = {
    # Request headers
    'Content-Type': 'application/json',
    'Ocp-Apim-Subscription-Key': '663cf5499f3748b4812146c23913f7e8',
}

params = urllib.parse.urlencode({
    # Request parameters
    'returnFaceId': 'true',
    'returnFaceLandmarks': 'false',
    'returnFaceAttributes': '{string}',
    'recognitionModel': 'recognition_04',
    'returnRecognitionModel': 'false',
    'detectionModel': 'detection_03',
    'faceIdTimeToLive': '86400',
})

body= urllib.parse.urlencode({
    "url": "https://kdpu.edu.ua/semerikov/cc.jpg"
})

try:
    conn = http.client.HTTPSConnection('westus.api.cognitive.microsoft.com')
    conn.request("POST", "/face/v1.0/detect?%s" % params, body, headers)
    response = conn.getresponse()
    data = response.read()
    print(data)
    conn.close()
except Exception as e:
    print("[Errno {0}] {1}".format(e.errno, e.strerror))

#####
b'{"error":{"code":"401","message":"Access denied due to invalid subscription

```

Figure 15: Key verification with a test code.

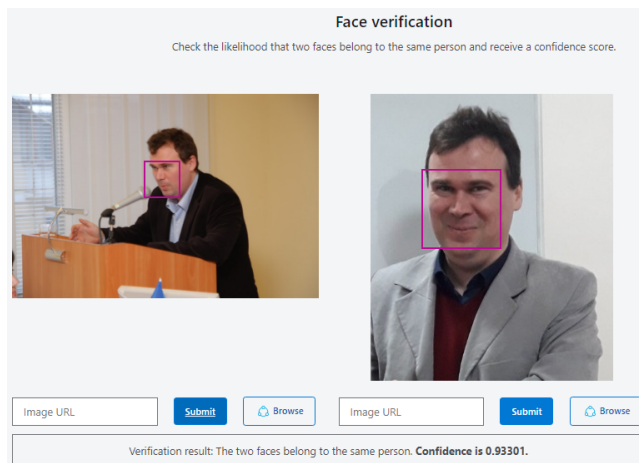


Figure 16: Static image identification results.

The result returned in JSON format allows you to get a large number of attributes associated with a face.

It should be noted that different face attributes are available for different face detection models (detectionModel): for detection_03 – headpose, mask, qualityforrecognition, for detection_01 – accessories, age, blur, emotion, exposure, facialhair, gender, glasses, hair, headpose, makeup, noise, occlusion, qualityforrecognition, smile.

We recommend the recognition_04 recognition model (recognitionModel), introduced in February 2021. At the moment, this is the only model that can be used to detect masks.

Azure also provides the ability to access the endpoint directly – in our case, it is <https://ruban.cognitiveservices.azure.com>.

Below is the code to get the properties of the right image from figure 16:

```

import os, json, requests
face_api_url =
"https://ruban.cognitiveservices.azure.com" +
'/face/v1.0/detect'
image_url =
'https://kdpu.edu.ua/images/ipm/%D0%90%D1%81%D0'+
'%BF%D1%96%D1%80%D0%B0%D0%BD%D1%82%D1'+
'%83%D1%80%D0%B0/%D0%B3%D0%B0%D1%80%D0'+
'%B0%D0%BD%D1%82/%D1%81%D1%81_2.jpg'
headers={'Ocp-Apim-Subscription-Key':
"secret subscription key"}
params = {
'detectionModel': 'detection_03',
'returnFaceId': 'true',
'returnFaceLandmarks': 'true',
'returnFaceAttributes':
'headpose,mask,qualityforrecognition', # detection_03
# 'returnFaceAttributes':
# 'accessories,age,blur,emotion,exposure,facialhair,'+
# 'gender,glasses,hair,headpose,makeup,noise,occlusion,'+
# 'qualityforrecognition,smile', # detection_01
'recognitionModel': 'recognition_04',
'returnRecognitionModel': 'false',
#'detectionModel': 'detection_01',
'faceIdTimeToLive': '86400',
}
response = requests.post(face_api_url, params=params,
headers=headers, json={"url":image_url})
print(json.dumps(response.json()))

```

To determine the presence of a mask on the face, we will use this code below. The result of the query for the second person from figure 16 is presented in table 2.

When we set returnFaceAttributes to 'accessories, age, blur, emotion, exposure, facialhair, gender, glasses, hair, headpose, makeup, noise, occlusion, qualityforrecognition, smile' and detectionModel to 'detection_01', we get the following attribute for the same face (table 3).

Setting detectionModel to 'detection_01' resulted in a high value of qualityForRecognition – for the same image, this corresponds to different algorithms used for image analysis.

2.2.2 Dynamic Face Recognition with Microsoft Face API. Adaptation of example [5] will begin with the change of the operating system from Windows / macOS to Linux – the latter is widespread in a higher education institutions. Any development environment can be used to work with Azure tools, including a specialized text editor Visual Studio Code, in which you need to install the Python Extension for Visual Studio Code and Azure App Service Extension for Visual Studio Code (figure 17).

Table 2: Face API request result for the detection model detection_03

attribute	value	comment
"faceId"	"1b98e2a9-0c6c-4864-91d7-b8281e9377cc"	an unique identifier of the detected face, created using the Face API, which can be used within 24 hours of receipt
"faceRectangle"	"top": 77, "left": 92, "width": 144, "height": 191	a rectangle within which a face can be found
"faceLandmarks"	"pupilLeft": "x": 122.8, "y": 156.0, "pupilRight": "x": 180.7, "y": 157.2, "noseTip": "x": 143.7, "y": 196.2, "mouthLeft": "x": 123.8, "y": 219.1, "mouthRight": "x": 179.4, "y": 220.6, "eyebrowLeftOuter": "x": 102.5, "y": 147.1, "eyebrowLeftInner": "x": 136.1, "y": 147.3, "eyeLeftOuter": "x": 113.8, "y": 156.1, "eyeLeftTop": "x": 123.1, "y": 152.9, "eyeLeftBottom": "x": 122.4, "y": 158.6, "eyeLeftInner": "x": 131.9, "y": 156.4, "eyebrowRightInner": "x": 161.3, "y": 147.0, "eyebrowRightOuter": "x": 202.7, "y": 150.0, "eyeRightInner": "x": 171.4, "y": 157.4, "eyeRightTop": "x": 180.3, "y": 153.9, "eyeRightBottom": "x": 180.5, "y": 159.8, "eyeRightOuter": "x": 190.6, "y": 157.6, "noseRootLeft": "x": 141.0, "y": 159.6, "noseRootRight": "x": 157.1, "y": 160.2, "noseLeftAlarTop": "x": 134.5, "y": 182.5, "noseRightAlarTop": "x": 161.7, "y": 183.0, "noseLeftAlarOutTip": "x": 128.6, "y": 194.4, "noseRightAlarOutTip": "x": 167.7, "y": 196.1, "upperLipTop": "x": 148.5, "y": 218.2, "upperLipBottom": "x": 147.8, "y": 222.1, "underLipTop": "x": 147.7, "y": 226.0, "underLipBottom": "x": 147.5, "y": 233.0	a collection of 27-point face landmarks pointing to the important positions of face components
"faceAttributes"		face attributes
"headPose"	"pitch": -14.2, "roll": 1.3, "yaw": -9.3	properties indicating head pose of the face: 3D angles of face pitch, roll and yaw
"mask"	"type": "noMask", "noseAndMouthCovered": false	the presence of a mask on a given face. Mask type if any of the face: 'noMask', 'faceMask', 'otherMaskOrOcclusion' or 'uncertain'. 'noseAndMouthCovered' is a boolean value indicating whether nose and mouth are covered
"qualityForRecognition"	"medium"	value indicating quality of image for recognition: low, medium, or high. Only high-quality images are recommended for identity registration, and medium or high-quality is for personal identification. This attribute is only available when using a combination of detection models detection_01 or detection_03 and recognition models recognition_03 or recognition_04.

The Flask microframework for creating web applications is installed with the command

```
pip3 install flask
```

If pip3 is not installed, it can be added by calling the package manager:

```
sudo apt install python3-pip
```

Using Python 2.7 is possible but not recommended, although Azure provides options for using different versions of Python (currently up to 3.9). Let's configure Visual Studio Code to use Flask according to the procedure described by Bennett [5] (figure 18) – this makes it possible to debug the server part of the system. During the configuration process, it turned out that for Flask to work

correctly in the terminal, it is necessary to set the FLASK_APP environment variable to the full path to the server part of the system – the app.py file (figure 19), and make changes to the Flask configuration file in Visual Studio Code (figure 20).

In the process of debugging the server part of the system, its code can be changed – this will automatically restart Flask.

The client part of the system is represented by a single home.html file located in the templates directory.

To ensure the availability of the developed system, it is advisable to deploy it in the Azure cloud using such an Azure App Service component as Deploy to Web App (figure 21). This requires setting up an ability to login Azure directly from Visual Studio Code,

Table 3: Face API request result for the detection model detection_01

attribute	value	comment
"smile"	0.999	smile intensity, a number between [0,1]
"gender"	"male"	possible gender of the face: male or female
"age"	44.0	approximate value of "visual age" in years (how old a person looks, not actual biological age)
"facialHair"	"moustache": 0.1, "beard": 0.1, "sideburns": 0.1	properties describing facial hair attributes – moustache, beard, and sideburns, a number between [0,1]: 0 for the absence of facial hair, 1 for long or very thick facial hair
"glasses"	"NoGlasses"	glasses type if any of the face: 'NoGlasses', 'ReadingGlasses', 'Sunglasses', 'SwimmingGoggles'
"emotion"	"anger": 0.0, "contempt": 0.001, "disgust": 0.0, "fear": 0.0, "happiness": 0.999, "neutral": 0.0, "sadness": 0.0, "surprise": 0.0	facial emotion (anger, contempt, disgust, fear, happiness, neutral, sadness, surprise) in form of confidence ranging from 0 to 1
"blur"	"blurLevel": "medium", "value": 0.48	presence of blur within the image: blurLevel indicate a level of blurriness (low, medium, and high), value is a number indicating level of blurriness ranging from 0 to 1
"exposure"	"exposureLevel": "goodExposure", "value": 0.69	exposure level of the image: exposureLevel can be 'Good-Exposure', 'OverExposure', or 'UnderExposure', value is a number indicating level of exposure level ranging from 0 to 1: [0, 0.25) is under exposure, [0.25, 0.75) is good exposure, [0.75, 1] is over exposure
"noise"	"noiseLevel": "low", "value": 0.0	noise level of the image; noiseLevel can be low, medium, or high, value is number indicating level of noise level ranging from 0 to 1: the larger it is, the noisier the image
"makeup"	"eyeMakeup": false, "lipMakeup": false	presence of makeup on a given face: eye makeup and lip makeup
"accessories"	[]	any accessories on a given face: headwear, glasses, and mask; the empty array means the absence of accessories
"occlusion"	"foreheadOccluded": false, "eyeOccluded": false, "mouthOccluded": false	a boolean values indicating whether eyes, forehead, and mouth are occluded
"hair"		hair attributes
"bald"	0.22	A number describing confidence level of whether the person is bald
"invisible"	false	a boolean value describing whether the hair is visible in the image
"hairColor"	["color": "black", "confidence": 0.98, "color": "brown", "confidence": 0.97, "color": "gray", "confidence": 0.41, "color": "other", "confidence": 0.16, "color": "blond", "confidence": 0.08, "color": "red", "confidence": 0.04, "color": "white", "confidence": 0.0]	confidence levels for the different hair colors

determining the system name (the first part of the domain name), choosing the Python version, and pricing plan (figure 22).

Figure 23 shows the protocol for deploying a system to the cloud.

Machine learning models can be created as completely independently ("from scratch"), and on the basis of models created by others. Microsoft proposes a range of pre-trained models, called Cognitive Services. These models include recognizing images, recognizing speech, or translating between different languages. Face API implements machine learning models for detect faces in the image. To access it, you need a subscription key, which can be obtained from the Azure portal (figure 24).

The name of the generated resource must be *globally unique* because it will become part of the URL that must be accessed to identify the face in the image. The place to run this code (Azure region – datacenter group) is best to choose the nearest one.

The price level is essential for educational software. If your software will make fewer than 2,037 API calls per minute and fewer than 30,000 calls per month, you can choose the free F0 tier – only one per Azure service.

Upon successful setup, you can get secret keys and an endpoint for accessing the Face API (figure 26).

Both secret keys are equal – you can use any of them. The obtained endpoint can be used to access the Face API from multiple



Figure 17: Visual Studio Code extension required for development.

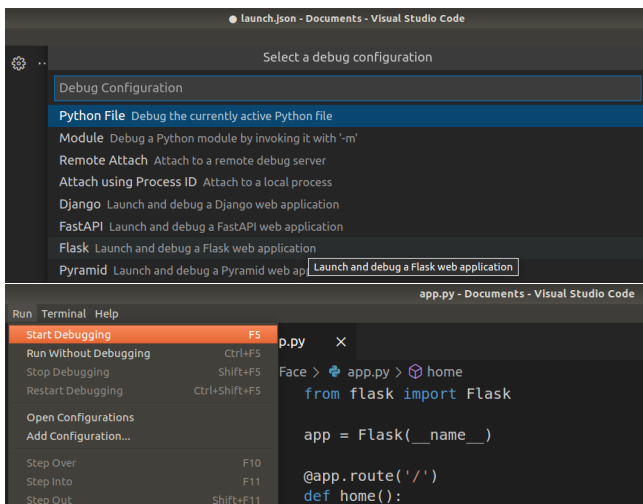


Figure 18: Configuring Visual Studio Code to run the server part using Flask.

applications, including the method described in subsection 2.2.1.

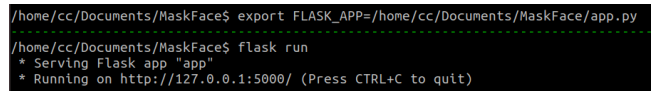


Figure 19: Running Flask in the standalone Linux terminal.

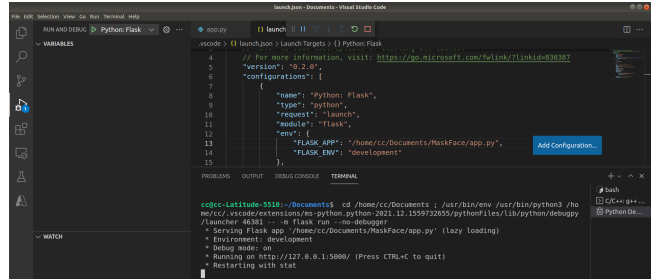


Figure 20: Running Flask in the Visual Studio Code built-in terminal.

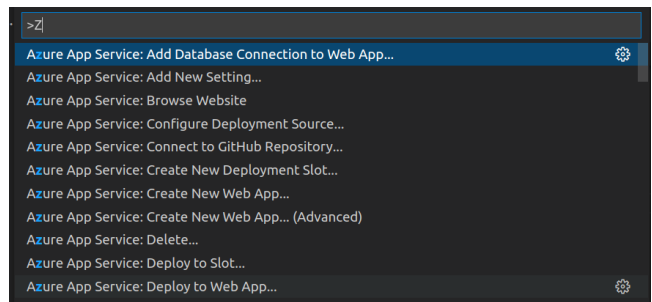


Figure 21: Setting up software in the Azure cloud.

Bennett [5] notes the inexpediency of storing secret data in the program code, seeing an alternative to storing them in third-party files such as .env.

In the process of finalizing the [5] code, the following main changes were made in the client side:

- (1) increased resolution to 1024x768 for better face recognition – Face API defines a minimum face size of 36x36;
- (2) due to the fact that the details associated with the mask are not compatible with other attributes, the two different handlers associated with buttons “Am I wearing a mask?” (figure 27) and “Analyze the face”.

The creation of buttons for capturing a dynamic image is related to the selected tariff plan: automatic calls to the Face API even 15 times per second exhaust the monthly limit in half an hour.

The server part has undergone the biggest changes

- (1) along with the best_emotion function, the best_color function was developed to determine hair color;
- (2) the check_results function, which handles the click on the “Am I wearing a mask?” button, uses the recognition_04 and detection_03 recognition/detection models to extract the mask attributes and return the corresponding response (“Your face is not masked”, “Your face is masked”, “Your face is covered by something”, “Impossible to determine if your face

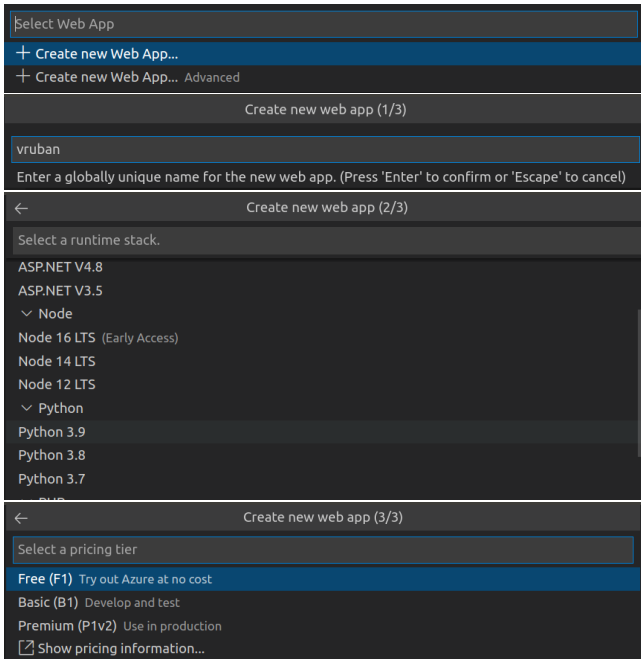


Figure 22: Cloud deployment steps.

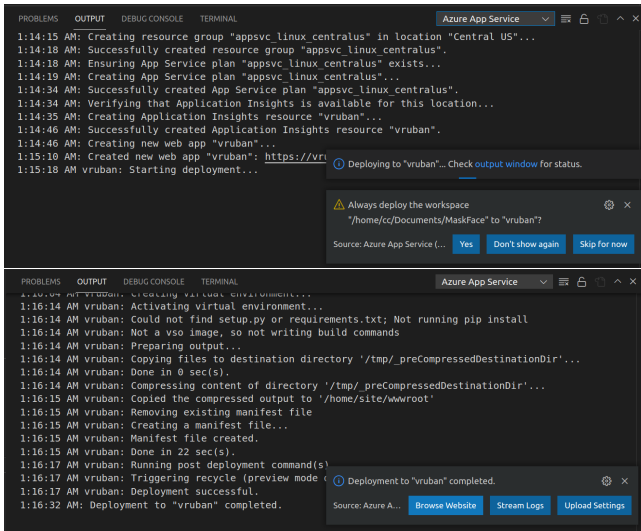


Figure 23: Protocol for deploying a system to the cloud.

is masked', 'Your mouth and nose are closed', 'Your mouth and nose not closed');

- (3) "Analyze the face" button returns such facial attributes as 'emotion', 'accessories', 'age', 'facialhair', 'gender', 'glasses', 'hair', 'makeup', and 'smile'.

2.2.3 *Testing the developed prototype.* Figure 27 shows the results of testing the system in the mask detection mode: out of 4 tests, 3 were performed correctly, and one (figure 27d) was partially correct (it was determined that the mouth was not covered by the mask).

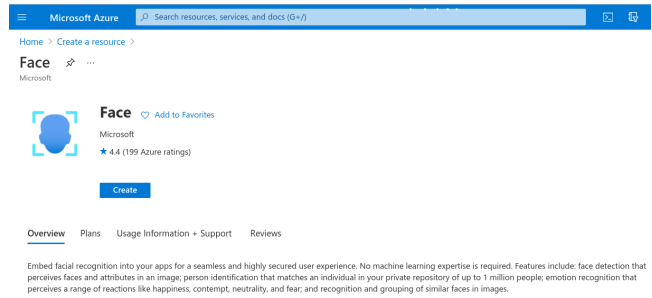
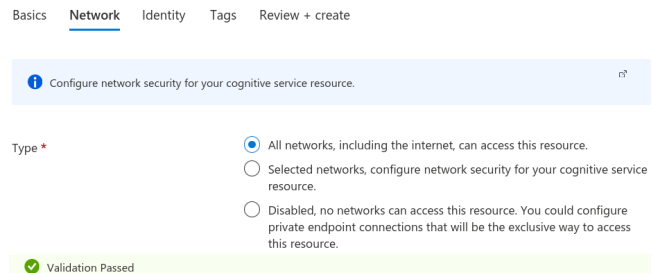


Figure 24: Create a Face API resource.



By clicking "Create", I (a) agree to the legal terms and privacy statement(s) associated with the Marketplace offering(s) listed above; (b) authorize Microsoft to bill my current payment method for the fees associated with the offering(s), with the same billing frequency as my Azure subscription; and (c) agree that Microsoft may share my contact, usage and transactional information with the provider(s) of the offering(s) for support, billing and other transactional activities. Microsoft does not provide rights for third-party offerings. See the [Azure Marketplace Terms](#) for additional details.

Basics	
Subscription	Azure subscription 1
Region	Central US
Name	ruban1
Pricing tier	Free F0 (20 Calls per minute, 30K call per month)
Network	
Type	All networks, including the internet, can access this resource.
Identity	
Identity type	None

Figure 25: Setting up a resource to use the Face API.

Appendix A presents the results of testing the system on mobile and stationary devices. Summarizing the test results allowed us to draw the following conclusions on face identification using pre-trained Face API models:

- (1) the "visial age" of faces significantly depends on the mood of their owners – the better, the closer to the biological age: this is due to the fact that learning took place on a set of predominantly smiling faces;
- (2) blond hair is the worst identified – depending on the lighting, it can be "any color" (falsely identified as gray, blond, black);
- (3) uneven lighting and shadows give rise to false effects of forehead occlusion and putting on headwear;
- (4) reading glasses and sunglasses with extra decorative elements can be identified as swimming goggles;
- (5) misidentification of the facial eye makeup of a face wearing sunglasses is common.

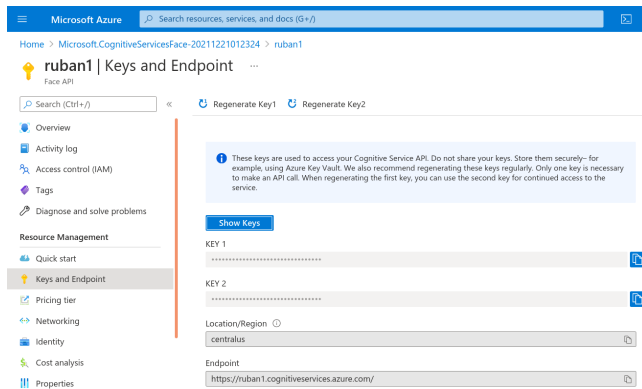


Figure 26: Obtaining secret keys and an endpoint to access the Face API.



Figure 27: Testing the system in mask detection mode.

3 CONCLUSION

During the study of the problem of new educational applications of computer vision systems in the context of the COVID-19 pandemic, the following results were obtained:

1. Computer vision systems since the early 1960s have undergone a long evolution and are widely used in various fields,

in particular, in education for the implementation of immersive e-learning resources. At the present stage of their development, the identification of dynamic objects in computer vision systems is performed primarily by machine learning tools. When creating computer vision systems for educational purposes, it is advisable to rely on computer vision libraries based on deep learning (in particular, various implementations of convolutional neural networks).

2. Computer vision systems for identifying dynamic objects can be used in education both under normal and pandemic conditions. The changes in the education industry caused by the COVID-19 pandemic have affected the classic educational applications of computer vision systems, modifying existing ones and giving rise to new ones, including social distancing, masked face recognition, intrusion detection in universities and schools, vandalism prevention, recognition of the emotions of masked and unmasked faces, attendance monitoring.
3. Among the large number of general-purpose computer vision libraries, the most appropriate in the educational process is the use of stand-alone libraries (in particular, OpenCV), whose common features are free licenses and the abilities to use Python for rapid prototyping, and neural networks for recognition. Commercial tools like MVTec HALCON and the Adaptive Vision Library provide much more functionality, and the use of viso.ai provides users with the ability to non-code development. Software deployment for computer vision systems is possible on various web platforms, the most suitable of which are Amazon Web Services, Google Cloud, and Microsoft Azure. The latter is a paid option, as is data processing in the developer's cloud, but it is offset by access to a set of pre-trained machine learning models, such as Cognitive Services.
4. Developed with the help of Microsoft Cognitive Toolkit and deployed in the Microsoft Azure cloud, a prototype of a computer vision system combines the recognition of emotions of participants in the educational process and the detection of violations of the mask regime, additionally providing the ability to determine gender, smile intensity, and the presence of glasses and age, color – with a high degree of certainty, and hairstyles, the presence of a headdress, makeup, etc. – with an average degree of certainty.

ACKNOWLEDGMENTS

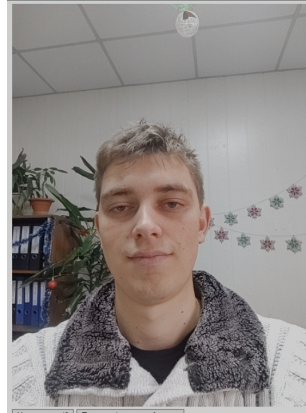
The authors thank the Armed Forces of Ukraine for providing security for this work. This work was carried out despite the ongoing aggression of the Russian Federation, which poses a threat to academic community of the world.

REFERENCES

- [1] 2021. Google Ngram Viewer. https://books.google.com/ngrams/graph?content=computer+vision%2C+machine+vision&year_start=1800&year_end=2019&corpus=26&smoothing=3&direct_url=t1%3B%2Ccomputer%20vision%3B%2Cc0%3B.t1%3B%2Cmachine%20vision%3B%2Cc0#t1%3B%2Ccomputer%20vision%3B%2Cc0%3B.t1%3B%2Cmachine%20vision%3B%2Cc0
- [2] Adaptive Vision. 2021. Libraries comparison. https://docs.adaptive-vision.com/avl/technical_issues/LibrariesComparison.html

- [3] Lakshya Agarwal, Manan Mukim, Harish Sharma, Amit Bhandari, and Atul Mishra. 2021. Face Recognition Based Smart and Robust Attendance Monitoring using Deep CNN. In *2021 8th International Conference on Computing for Sustainable Global Development (INDIACom)*, 699–704. <https://doi.org/10.1109/INDIACom51348.2021.00124>
- [4] Dana H. Ballard and Christopher M. Brown. 1982. *Computer Vision*. Prentice Hall, Englewood Cliffs. <https://homepages.inf.ed.ac.uk/rbf/BOOKS/BANDB/bandb.htm>
- [5] Jim Bennett. 2020. Happy, Sad, Angry Workshop. <https://github.com/jimbo Bennett/HappySadAngryWorkshop>
- [6] J. J. Gibson. 1950. *The Perception of the Visual World*. Boston.
- [7] Google Cloud. 2021. Vision API Product Search pricing. <https://cloud.google.com/vision/product-search/pricing>
- [8] Gunnar Rutger Grape. 1973. *Model Based (Intermediate-Level) Computer Vision*. Technical Report AD 763673. Stanford University. <https://apps.dtic.mil/sti/citations/AD0763673>
- [9] Nico Klingler. 2021. Top 8 Applications of Computer Vision in the Education Sector. <https://viso.ai/applications/computer-vision-in-education/>
- [10] Simon J. D. Prince. 2012. *Computer Vision: Models, Learning, and Inference*. Cambridge University Press.
- [11] Juliet R. C. Pulliam, Cari van Schalkwyk, Nevashan Govender, Anne von Gotberg, Cheryl Cohen, Michelle J. Groome, Jonathan Dushoff, Koleka Mlisana, and Harry Moultrie. 2021. Increased risk of SARS-CoV-2 reinfection associated with emergence of the Omicron variant in South Africa. *medRxiv* (2021). <https://doi.org/10.1101/2021.11.11.21266068>
- [12] Ashwin Raj, Aparna Raj, and Imteyaz Ahmad. 2021. Smart Attendance Monitoring System with Computer Vision Using IOT. *Journal of Mobile Multimedia* 17, 1-3 (2021), 115–125. <https://doi.org/10.13052/jmm1550-4646.17135>
- [13] Mahdi Rezaei and Mohsen Azarmi. 2020. DeepSOCIAL: Social Distancing Monitoring and Infection Risk Assessment in COVID-19 Pandemic. *Applied Sciences* 10, 21, Article 7514 (2020). <https://doi.org/10.3390/app10217514>
- [14] Lawrence Gilman Roberts. 1963. *Machine perception of three-dimensional solids*. Thesis (Ph. D.). Massachusetts Institute of Technology. <https://dspace.mit.edu/bitstream/handle/1721.1/11589/47>
- [15] Connor Shorten, Taghi M. Khoshgoftaar, and Borko Furht. 2021. Deep Learning applications for COVID-19. *Journal of Big Data* 8, 1 (11 Jan 2021), 18. <https://doi.org/10.1186/s40537-020-00392-9>
- [16] S A Sivakumar, Tegil J John, G Thamarai Selvi, Bhukya Madhu, C Udhaya Shankar, and K P Arjun. 2021. IoT based Intelligent Attendance Monitoring with Face Recognition Scheme. In *2021 5th International Conference on Computing Methodologies and Communication (ICCMC)*, 349–353. <https://doi.org/10.1109/ICCMC51019.2021.9418264>
- [17] Ivan Edward Sutherland. 1963. *Sketchpad, a man-machine graphical communication system*. Ph.D. Dissertation. Massachusetts Institute of Technology. http://images.designworldonline.com.s3.amazonaws.com/CADhistory/Sketchpad_A_Man-Machine_Graphical_Communication_System_Jan63.pdf
- [18] Viktoriia Tkachuk, Yuliia Yechkalo, Serhiy Semerikov, Maria Kislova, and Yana Hladyr. 2021. Using Mobile ICT for Online Learning During COVID-19 Lockdown. In *Information and Communication Technologies in Education, Research, and Industrial Applications*, Andreas Bollin, Vadim Ermolayev, Heinrich C. Mayr, Mykola Nikitchenko, Aleksander Spivakovsky, Mykola Tkachuk, Vitaliy Yakovyna, and Grygoriy Zholtkevych (Eds.). Springer International Publishing, Cham, 46–67. https://doi.org/10.1007/978-3-030-77592-6_3
- [19] viso.ai. 2021. Abandoned Luggage. <https://viso.ai/application/abandoned-luggage-detection/>
- [20] viso.ai. 2021. Face Recognition. <https://viso.ai/application/face-recognition/>
- [21] viso.ai. 2021. Facial Emotion Analysis. <https://viso.ai/application/emotion-analysis/>
- [22] viso.ai. 2021. Intrusion Detection. <https://viso.ai/application/intrusion-detection/>
- [23] viso.ai. 2021. Mask Detection: Automatically detect unmasked people in public spaces or indoors. <https://viso.ai/application/mask-detection/>
- [24] viso.ai. 2021. Parking Lot Occupancy. <https://viso.ai/application/parking-lot-occupancy-detection/>
- [25] viso.ai. 2021. Social Distancing Monitoring. <https://viso.ai/application/social-distancing-monitoring/>

A PROTOTYPE TESTING RESULTS



Ваш настрій - щастя, Ви посміхаєтесь на 86.8%, Ви виглядаєте на 21.0 років, Ви вусаті на 10.0%, бородаті - на 10.0% та "бакенбардаті" на 10.0%, Ваша стать - чоловіча, на Вас немає окулярів, Ваші очі не нафарбовані, Ваші губи не нафарбовані, Ваш рот нічим не закритий, Ваші очі нічим не закриті, Ваш лоб чимось закритий, на Вас головний убор, Ваше волосся для камери невидиме.

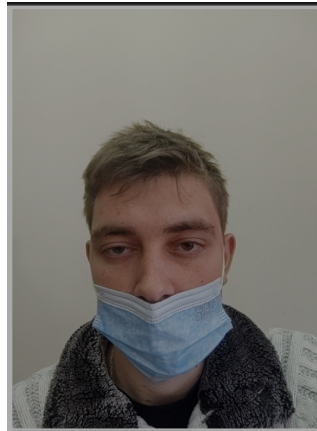


Ваш настрій - нейтральний, Ви посміхаєтесь на 0.0%, Ви виглядаєте на 23.0 років, Ви вусаті на 10.0%, бородаті - на 10.0% та "бакенбардаті" на 10.0%, Ваша стать - чоловіча, на Вас немає окулярів, Ваші очі не нафарбовані, Ваші губи не нафарбовані, Ваш рот нічим не закритий, Ваші очі нічим не закриті, Ваш лоб нічим не закритий, Ваше волосся для камери видиме, густина Вашого волосся - 86.0%, колір Вашого волосся - сірий.



Чи я у масці? | Проаналізувати обличчя

Ваш настрій - нейтральний, Ви посміхаєтесь на 12.1%, Ви виглядаєте на 22.0 років, Ви вусаті на 0.0%, бородаті - на 0.0% та "бакенбардаті" на 0.0%, Ваша стать - жіноча, на Вас немає окулярів, Ваші очі нафарбовані, Ваші губи не нафарбовані, Ваш рот нічим не закритий, Ваші очі нічим не закриті, Ваш лоб нічим не закритий, Ваше волосся для камери видиме, густина Вашого волосся - 79.0%, колір Вашого волосся - блондинистий.



Чи я у масці? | Проаналізувати обличчя

Ваш настрій - нейтральний, Ви посміхаєтесь на 8.7%, Ви виглядаєте на 26.0 років, Ви вусаті на 0.0%, бородаті - на 0.0% та "бакенбардаті" на 0.0%, Ваша стать - чоловіча, на Вас немає окулярів, Ваші очі нафарбовані, Ваші губи не нафарбовані, Ваш рот чимось закритий, Ваші очі нічим не закриті, Ваш лоб нічим не закритий, на Вас маска, Ваше волосся для камери видиме, густина Вашого волосся - 77.0%, колір Вашого волосся - чорний.



Чи я у масці? | Проаналізувати обличчя

Ваш настрій - нейтральний, Ви посміхаєтесь на 29.299999999999997%, Ви виглядаєте на 23.0 років, Ви вусаті на 10.0%, бородаті - на 10.0% та "бакенбардаті" на 10.0%, Ваша стать - чоловіча, на Вас немає окулярів, Ваші очі не нафарбовані, Ваші губи не нафарбовані, Ваш рот нічим не закритий, Ваші очі нічим не закриті, Ваш лоб чимось закритий, на Вас головний убір, Ваше волосся для камери невидиме.



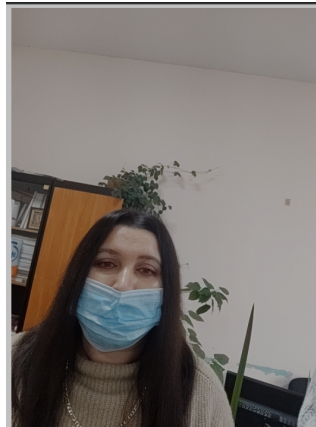
Чи я у масці? | Проаналізувати обличчя

Ваш настрій - смуток, Ви посміхаєтесь на 0.0%, Ви виглядаєте на 27.0 років, Ви вусаті на 0.0%, бородаті - на 0.0% та "бакенбардаті" на 0.0%, Ваша стать - чоловіча, на Вас немає окулярів, Ваші очі нафарбовані, Ваші губи не нафарбовані, Ваш рот чимось закритий, Ваші очі нічим не закриті, Ваш лоб нічим не закритий, на Вас маска, Ваше волосся для камери видиме, густина Вашого волосся - 89.0%, колір Вашого волосся - блондинистий.



Чи я у масці? | Проаналізувати обличчя

Ваш настрій - щастя, Ви посміхаєтесь на 60.099999999999994%, Ви виглядаєте на 34.0 років, Ви вусаті на 0.0%, бородаті - на 0.0% та "бакенбардаті" на 0.0%, Ваша стать - жіноча, на Вас немає окулярів, Ваші очі нафарбовані, Ваші губи нафарбовані, Ваш рот нічим не закритий, Ваші очі нічим не закриті, Ваш лоб нічим не закритий, Ваше волосся для камери видиме, густина Вашого волосся - 99.0%, колір Вашого волосся - рудий.



Чи я у масці? | Проаналізувати обличчя

Ваш настрій - нейтральний, Ви посміхаєтесь на 0.6%, Ви виглядаєте на 30.0 років, Ви вусаті на 0.0%, бородаті - на 0.0% та "бакенбардаті" на 0.0%, Ваша стать - жіноча, на Вас немає окулярів, Ваші очі нафарбовані, Ваші губи не нафарбовані, Ваш рот чимось закритий, Ваші очі нічим не закриті, Ваш лоб чимось закритий, на Вас головний убор, маска, Ваше волосся для камери невидиме.



Чи я у масці? | Проаналізувати обличчя

Ваш настрій - нейтральний, Ви посміхаєтесь на 12.6%, Ви виглядаєте на 37.0 років, Ви вусаті на 0.0%, бородаті - на 0.0% та "бакенбардаті" на 0.0%, Ваша стать - жіноча, на Вас немає окулярів, Ваші очі нафарбовані, Ваші губи нафарбовані, Ваш рот нічим не закритий, Ваші очі нічим не закриті, Ваш лоб нічим не закритий, Ваше волосся для камери видиме, густина Вашого волосся - 98.0%, колір Вашого волосся - чорний.



Чи я у масці? | Проаналізувати обличчя

Ваш настрій - нейтральний, Ви посміхаєтесь на 0.3%, Ви виглядаєте на 28.0 років, Ви вусаті на 0.0%, бородаті - на 0.0% та "бакенбардаті" на 0.0%, Ваша стать - жіноча, на Вас немає окулярів, Ваші очі нафарбовані, Ваші губи не нафарбовані, Ваш рот чимось закритий, Ваші очі нічим не закриті, Ваш лоб чимось закритий, на Вас головний убор, маска, Ваше волосся для камери невидиме.



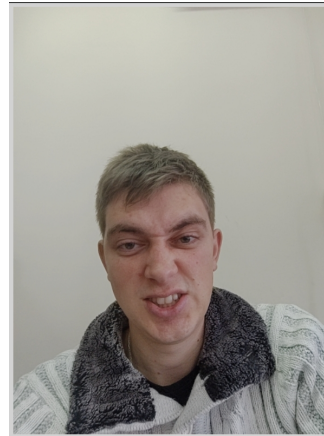
Чи я у масці? Проаналізувати обличчя

Ваш настрій - нейтральний, Ви посміхаєтесь на 6.6000000000000005%, Ви виглядаєте на 30.0 років, Ви вусаті на 0.0%, бородаті - на 0.0% та "бакенбардаті" на 0.0%, Ваша стать - чоловіча, на Вас немає окулярів, Ваші очі не нафарбовані, Ваші губи не нафарбовані, Ваш рот чимось закритий, Ваші очі нічим не закриті, Ваш лоб чимось закритий, на Вас головний убор, маска, Ваше волосся для камери невидиме.



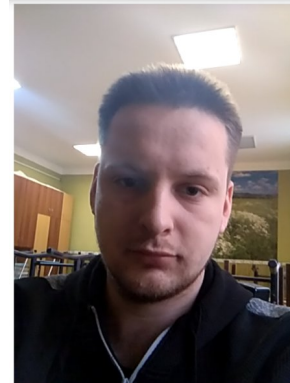
Чи я у масці? Проаналізувати обличчя

Ваш настрій - смуток, Ви посміхаєтесь на 0.0%, Ви виглядаєте на 30.0 років, Ви вусаті на 10.0%, бородаті - на 10.0% та "бакенбардаті" на 10.0%, Ваша стать - чоловіча, на Вас немає окулярів, Ваші очі не нафарбовані, Ваші губи не нафарбовані, Ваш рот нічим не закритий, Ваші очі нічим не закриті, Ваш лоб чимось закритий, Ваше волосся для камери невидиме, густина Вашого волосся - 40.0%, колір Вашого волосся - сірий.



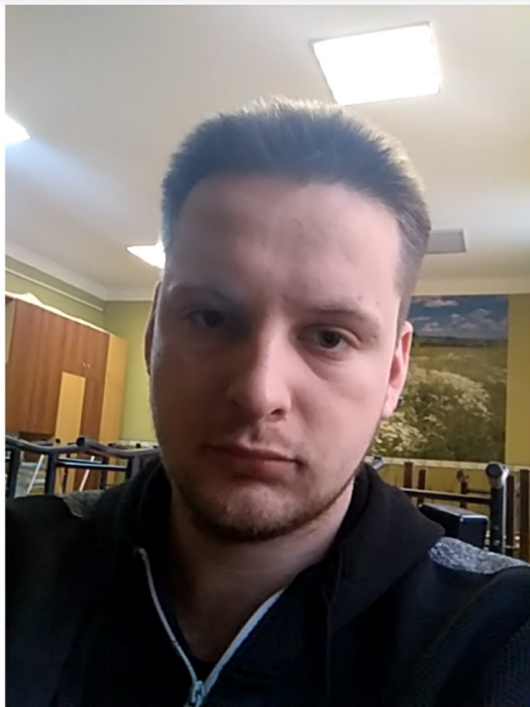
Чи я у масці? Проаналізувати обличчя

Ваш настрій - гнів, Ви посміхаєтесь на 38.1%, Ви виглядаєте на 27.0 років, Ви вусаті на 10.0%, бородаті - на 10.0% та "бакенбардаті" на 10.0%, Ваша стать - чоловіча, на Вас немає окулярів, Ваші очі не нафарбовані, Ваші губи не нафарбовані, Ваш рот нічим не закритий, Ваші очі нічим не закриті, Ваш лоб нічим не закритий, Ваше волосся для камери невидиме, густина Вашого волосся - 40.0%, колір Вашого волосся - сірий.



Чи я у масці? Проаналізувати обличчя

Ваш настрій - нейтральний, Ви посміхаєтесь на 0.3%, Ви виглядаєте на 24.0 років, Ви вусаті на 10.0%, бородаті - на 10.0% та "бакенбардаті" на 10.0%, Ваша стать - чоловіча, на Вас немає окулярів, Ваші очі не нафарбовані, Ваші губи не нафарбовані, Ваш рот нічим не закритий, Ваші очі нічим не закриті, Ваш лоб нічим не закритий, Ваше волосся для камери невидиме, густина Вашого волосся - 49.0%, колір Вашого волосся - сірий.



Чи я у масці? Проаналізувати обличчя



Чи я у масці? Проаналізувати обличчя

На Вашому обличчі немає маски, Ваші рід та ніс не закриті

На Вашому обличчі немає маски, Ваші рід та ніс не закриті



Чи я у масці? Проаналізувати обличчя

Ваш настрій - презирство. Ви посміхаетесь на 5.4%. Ви виглядаєте на 32.0 років. Ви вусаті на 0.0%, бородаті - на 0.0% та "бакенбардаті" на 0.0%. Ваша стать - жіноча, на Вас немає окулярів, Ваші очі нафарбовані, Ваші губи нафарбовані. Ваш рот нічим не закритий, Ваші очі нічим не закриті, Ваш лоб нічим не закритий, Ваше волосся для камери відлиме, густина Вашого волосся - 91.0%, колір Вашого волосся - коричнепий.



Чи я у масці? Проаналізувати обличчя

Ваш настрій - щастя. Ви посміхаетесь на 100.0%. Ви виглядаєте на 41.0 років. Ви вусаті на 0.0%, бородаті - на 0.0% та "бакенбардаті" на 0.0%. Ваша стать - жіноча, на Вас окуляри для плавання, Ваші очі не нафарбовані, Ваші губи не нафарбовані, Ваш рот нічим не закритий, Ваші очі нічим не закриті, Ваш лоб чимось закритий, на Вас окуляри, головний убір, Ваше волосся для камери невидиме.



Чи я у масці? | Проаналізувати обличчя

Ваш настрій - щастя, Ви посміхаетесь на 100.0%, Ви виглядаєте на 35.0 років, Ви вусаті на 0.0%, бородаті - на 0.0% та "бакенбардаті" на 0.0%, Ваша стать - жіноча, на Вас сонцезхисні окуляри, Ваші очі нафарбовані, Ваші губи не нафарбовані, Ваш рот нічим не закритий, Ваші очі нічим не закриті, Ваш лоб нічим не закритий, на Вас окуляри, Ваше волосся для камери видиме, густина Вашого волосся - 84.0%, колір Вашого волосся - чорний.



Чи я у масці? | Проаналізувати обличчя

Ваш настрій - нейтральний, Ви посміхаетесь на 5.3%, Ви виглядаєте на 37.0 років, Ви вусаті на 0.0%, бородаті - на 0.0% та "бакенбардаті" на 0.0%, Ваша стать - жіноча, на Вас сонцезхисні окуляри, Ваші очі нафарбовані, Ваші губи нафарбовані, Ваш рот нічим не закритий, Ваші очі нічим не закриті, Ваш лоб нічим не закритий, на Вас окуляри, Ваше волосся для камери видиме, густина Вашого волосся - 84.0%, колір Вашого волосся - коричневий.



Чи я у масці? | Проаналізувати обличчя

Ваш настрій - нейтральний, Ви посміхаетесь на 0.0%, Ви виглядаєте на 25.0 років, Ви вусаті на 0.0%, бородаті - на 0.0% та "бакенбардаті" на 0.0%, Ваша стать - жіноча, на Вас сонцезхисні окуляри, Ваші очі нафарбовані, Ваші губи нафарбовані, Ваш рот нічим не закритий, Ваші очі нічим не закриті, Ваш лоб нічим не закритий, на Вас окуляри, Ваше волосся для камери видиме, густина Вашого волосся - 96.0%, колір Вашого волосся - чорний.



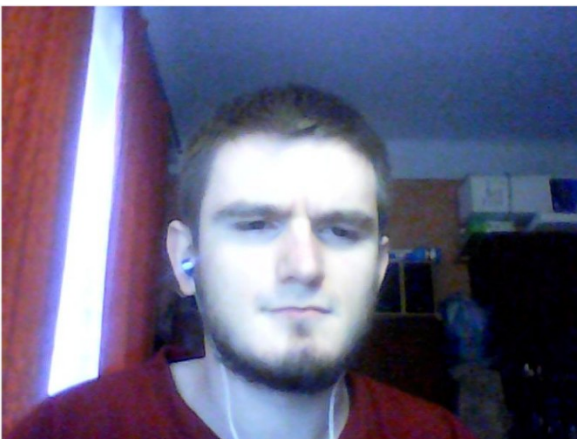
Чи я у масці? Проаналізувати обличчя

Ваш настрій - щастя, Ви посміхаєтесь на 99.5%, Ви виглядаєте на 22.0 років, Ви вусаті на 0.0%, бородаті - на 0.0% та "бакенбардаті" на 0.0%, Ваша стать - жіноча, на Вас сонцезхисні окуляри, Ваші очі нафарбовані, Ваші губи нафарбовані, Ваш рот нічим не закритий, Ваші очі нічим не закриті, Ваш лоб нічим не закритий, на Вас окуляри, Ваше волосся для камери видиме, густина Вашого волосся - 96.0%, колір Вашого волосся - чорний.



Чи я у масці? Проаналізувати обличчя

Ваш настрій - щастя, Ви посміхаєтесь на 99.8%, Ви виглядаєте на 21.0 років, Ви вусаті на 0.0%, бородаті - на 0.0% та "бакенбардаті" на 0.0%, Ваша стать - жіноча, на Вас немає окулярів, Ваші очі нафарбовані, Ваші губи нафарбовані, Ваш рот нічим не закритий, Ваші очі нічим не закриті, Ваш лоб нічим не закритий, Ваше волосся для камери видиме, густина Вашого волосся - 100.0%, колір Вашого волосся - чорний.



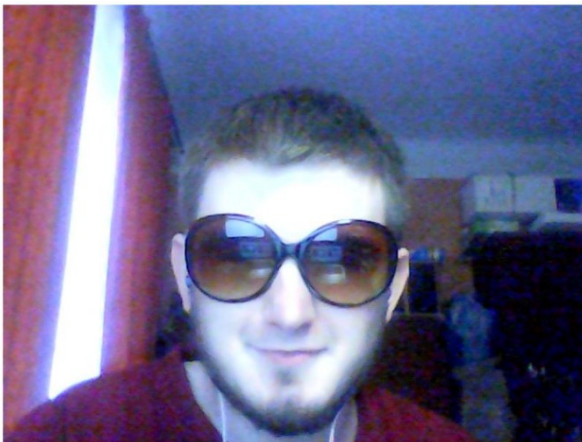
Чи я у масці? Проаналізувати обличчя

Ваш настрій - щастя, Ви посміхаєтесь на 78.600000000000001%, Ви виглядаєте на 30.0 років, Ви вусаті на 10.0%, бородаті - на 10.0% та "бакенбардаті" на 40.0%, Ваша стать - чоловіча, на Вас немає окулярів, Ваші очі не нафарбовані, Ваші губи не нафарбовані, Ваш рот нічим не закритий, Ваші очі нічим не закриті, Ваш лоб нічим не закритий, Ваше волосся для камери видиме, густина Вашого волосся - 98.0%, колір Вашого волосся - рудий.



Чи я у масці? Проаналізувати обличчя

Ваш настрій - щастя, Ви посміхаетесь на 78.60000000000001%, Ви виглядаєте на 30.0 років, Ви вусаті на 10.0%, бородаті - на 10.0% та "бакенбардаті" на 40.0%, Ваша стать - чоловіча, на Вас немає окулярів, Ваші очі не нафарбовані, Ваші губи не нафарбовані, Ваш рот нічим не закритий, Ваші очі нічим не закриті, Ваш лоб нічим не закритий, Ваше волосся для камери видно, густина Вашого волосся - 98.0%, колір Вашого волосся - рудий.



Чи я у масці? Проаналізувати обличчя

Ваш настрій - нейтральний, Ви посміхаетесь на 32.0%, Ви виглядаєте на 28.0 років, Ви вусаті на 10.0%, бородаті - на 10.0% та "бакенбардаті" на 10.0%, Ваша стать - чоловіча, на Вас сонцезахисні окуляри, Ваші очі нафарбовані, Ваші губи нафарбовані, Ваш рот нічим не закритий, Ваші очі нічим не закриті, Ваш лоб нічим не закритий, на Вас окуляри, Ваше волосся для камери видно, густина Вашого волосся - 74.0%, колір Вашого волосся - коричневий.