

що сприяє ідентифікації ключових вузлів та потенційних джерел загроз. Автоматизація збору даних та аналізу інформаційних потоків стає критично важливим для попередження дезінформації та координаційних атак. Результати дослідження дозволяють сформулювати рекомендації щодо покращення моніторингу й захисту інформаційного середовища, спрямовані на підвищення рівня кібербезпеки.

Список використаних джерел

1. О. Борсукова. (2022). Які повідомлення у соцмережах шкідливі під час війни? Українська правда. <https://life.pravda.com.ua/society/2022/03/09/247739/>
2. О. Мороз. (2022). Як відрізнити шкідливу інформацію від корисної? Громадське радіо. <https://hromadske.radio/podcasts/freeourfamily/1061123>
3. Au N., Polani D. (2008). Information flows in causal networks. *Advances in Complex Systems*, 11(01), 17–41. <https://doi.org/10.1142/s0219525908001465>
4. Lyon W., Lesica G. Information Flow Through a Network. *Neo4j*. <https://neo4j.com/graphgists/information-flow-through-a-network/>
5. Telethon's Documentation. Telethon. <https://docs.telethon.dev/en/stable/>.
6. C.Brew. (2024). From content to harm: how harmful information contributes to civilian harm. ICRC Humanitarian Law & Policy blog. <https://blogs.icrc.org/law-and-policy/2024/02/27/from-content-to-harm-how-harmful-information-contributes-to-civilian-harm/>

METHOD FOR NEURAL NETWORK DETECTING CHANGED IMAGES OF PEOPLE'S FACES USING CNN

Pokhytun Andrii

Postgraduate student

Mazurets Oleksandr

Ph.D in Engineering Science, Associate Professor

Molchanova Maryna

Teacher

Tyschenko Olena

Teacher

Computer Science Department

Khmelnytskyi National University, Ukraine

In today's world, changing your appearance based on a photo is not a difficult task. One of the most influential factors is the emergence of generative models that are able to create fairly realistic images of people's faces, or change them. Generative models are types of machine learning that can generate new data similar to those on which the model was trained [1]. It can be not only images, but also photos, texts, videos, etc.

Among the large number of types of modifications, we can single out a few that are most popular [2]:

- digital filters and cosmetic changes;
- deep fakes;
- morphing;
- image processing algorithm.

Digital filters are one of the most common types of photo modifications in modern society. This type of photo modification gained its popularity due to the increase in the number of users of social networks. With the help of filters, users could change their appearance in just a few clicks on the screen.

Deep fakes are a technology that allows you to change the face in a photo or video using a neural network. Algorithms used in this technology allow not only to create new images, but also can superimpose images on images, which allows replacing only the face of a person in the entire photo.

Morphing is a technology that allows you to create fake images using a smooth transition from one photo to another. Morphing can be used by attackers to forge identity documents.

Image processing algorithms are algorithms that include simpler methods of changing images using software [3]. One of the most famous examples of software is the well-known Adobe Photoshop. Adobe Photoshop is a powerful graphic editor that is usually used to work with bitmap images.

Image processing algorithms are also often used in cinematography. With the help of various software, you can change facial features, skin texture, skin color, hair color and much more [4, 5].

In the modern world, there are quite a lot of opportunities for adjusting, editing and processing images [6, 7], so it is important to be able to distinguish fake images from real ones, because modified photos can be used not only for fun, but also for forging documents, harassment, which can have quite negative consequences.

The purpose of the work is to develop a method for detecting modified images of people's faces using neural network technologies, which is designed to transform input data in the form of a dataset of modified images of people's faces and working images for classification into output data with a conclusion or modified photo, as well as the types of modifications used.

A method for detecting altered human face images using neural network technologies is designed to process the input data, which is represented by a training set of face images for the training stage, a test set of images for verification, and a working face image for classification. The method includes the steps of training and evaluating the neural network using the training set of face images, as well as the process of detecting changes in the working face image.

The input data of the modified human face image detection method is a training sample of face images and a working image for classification (Figure 1).

Neural network training takes place with the help of a prepared dataset, which includes different types of modifications and different levels of complexity of modifications.

Neural network testing takes place by sampling images of various types and complexity of modifications.

Detecting the type of modifications is that the method returns not only the result or a modified photo or not, but that it returns a specific type of modifications.

The process of classifying a working image of faces consists in the fact that the user loads an image of a face into a previously trained model, after which he receives a certain result.

The output data of the method of detecting modified images of human faces is whether the result is a modified photo or not, and also, if the photo is modified, the type of modification.

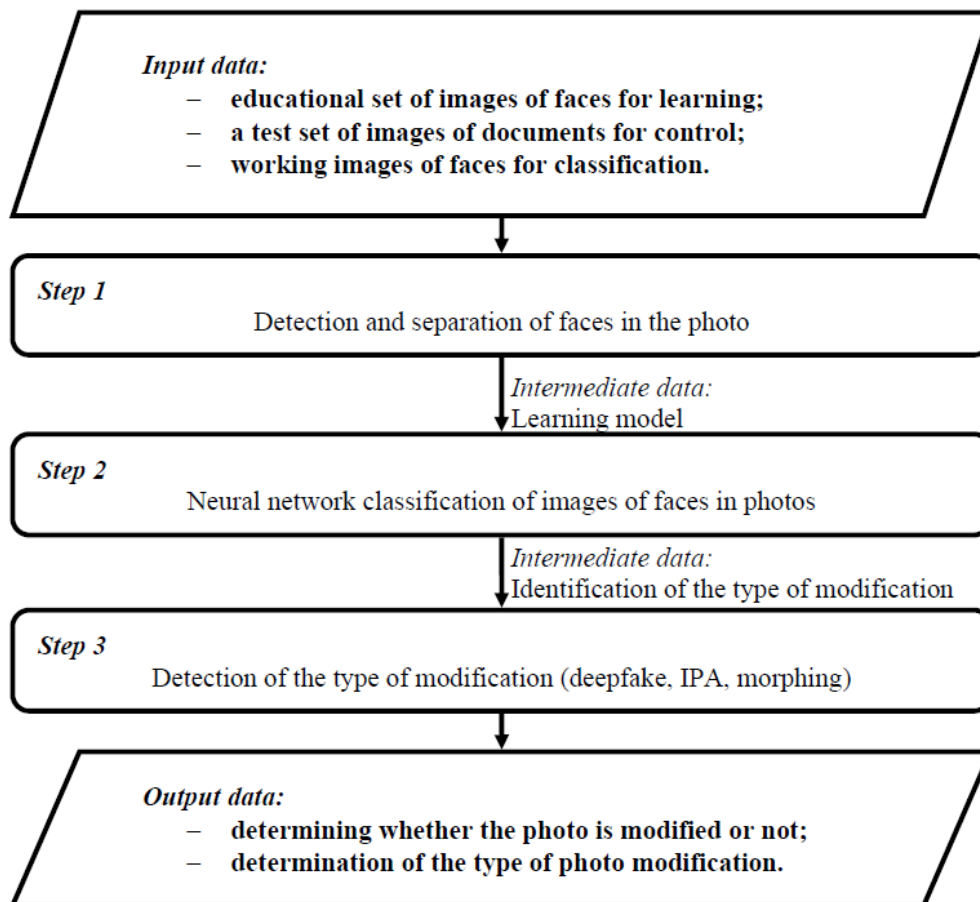


Figure 1. Scheme of the method of detection of modified images of human faces

So, it was described how the method should work for detecting modifications of images of people's faces by means of neural networks. The method is designed to transform the input data in the form of a dataset of modified human face images and work images for classification into output data with the conclusion whether the photo is modified, as well as the types of modifications used.

Convolutional neural networks are the basis for image processing and analysis in current computer vision tasks. Their popularity is explained by the ability of ANNs to extract significant features from images without the need to do it manually. The

tensorflow.js library already has several ready-made basic functions that only need to be modified for a specific task (Figure 2).

The first, the input layer (input) is the layer responsible for the size of the input image, where 128x128 is the size of the image, and 3 is the number of channels (RGB).

The input layer is followed by several convolutional and several pooling layers. Convolutional layers apply 32x32 filters to the input image to extract local features. Each filter generates a feature map that stores spatial information.

After each convolutional layer, it is desirable to apply an activation function in order to add nonlinearity to the model [8].

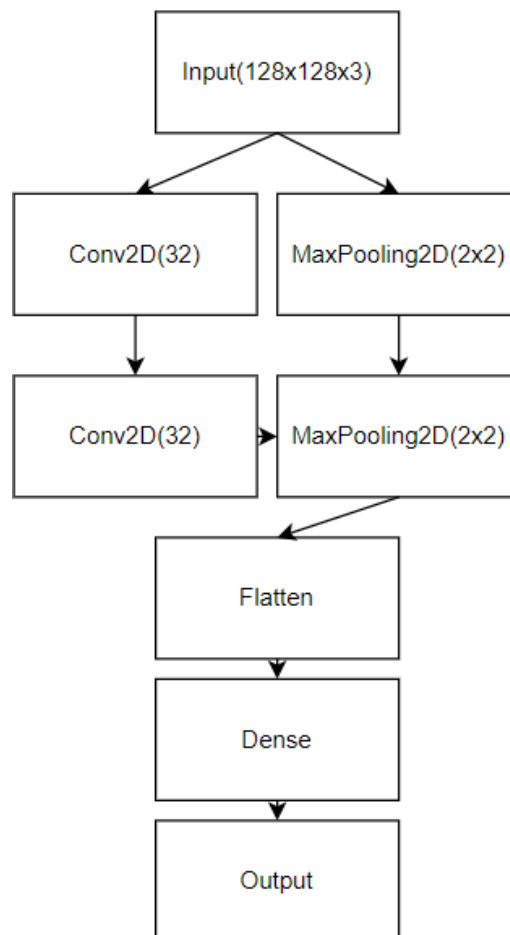


Figure 2. Basic convolutional neural network architecture using tensorflow.js

Pooling layers (maxPooling(2x2)) are applied after the convolutional layers. These layers reduce the feature map by half, which allows for dimensionality reduction and removal of insignificant features, increasing computational efficiency.

The flatten function is a function that converts a multidimensional output into a vector for further use.

After converting the multidimensional array into a vector, the dense function is applied, which processes and extracts features from the image. And pass the result to the output function that outputs the result.

Therefore, a method for detecting altered human face images using neural network technologies was proposed to process the input data, which is represented by a training set of face images for the training stage, a test set of images for verification, and a working face image for classification. The method includes the steps of training and evaluating the neural network using the training set of face images, as well as the process of detecting changes in the working face image. The created method for detecting modified images of human faces is designed to transform the input data in the form of a dataset of modified images of human faces and working images for classification into output data with the conclusion whether the photo is modified, as well as the types of modifications used.

References

1. Zharnovskyi O., Sobko O., Klimenko V. Intelligent System for Neural Network Detection of Fake Document Images for Automated Personality Identification. Proceedings of IV International Scientific and Practical Conference «Innovative research and perspectives of the development of science and technology». January 29-31, 2024. Stockholm, Sweden. 2024. Pp. 337-343.
2. A site for creating fake photos and videos trymaveric.com: URL: <https://www.trymaverick.com/blog-posts/are-deep-fakes-all-evil-when-can-they-be-used-for-good>
3. Novak Y., Mazurets O. Practical Application of Method of Automated Personal Identification by Fingerprints Using Convolution Neural Networks. Proceedings of V International Scientific and Practical Conference «Modern strategies of global scientific solutions». December 27-29, 2023. Stockholm, Sweden, International Scientific Unity. 2023. Pp. 136-140.
4. Mazurets O., Sobko O., Vit R., Pasternak V. Practical Approach for Detection by Deep Learning of Target Objects of Subject Area Based on Semantic Connectivity Indicators in Audio Database. Proceedings of XXIV International Scientific and Practical Conference «Modern Scientific Challenges are the Driving Force of the Development of Scientific Research». May 22-24, 2024. Bruges, Belgium. International Scientific Unity. 2024. Pp. 91-96.
5. Mazurets O., Zalutskaya O., Tyschenko O., Bohdanova A. An Approach to Using MobileNet CNN-model for Gesture Recognition. Proceedings of XXIII International Scientific and Practical Conference «Problems of Science and Technology: the Search for Innovative Solutions». May 15-17, 2024. Munich, Germany. 2024. Pp. 59-64.
6. Mazurets O. V., Klimenko V. I., Molchanova M. O., Sultanov A. V. Object-Oriented Intelligent System for Neural Network Detection of Sugar Crystallization Zones. Global Science: Prospects and Innovations. Proceedings of the 10th International scientific and practical conference. Cognum Publishing House. Liverpool, United Kingdom. 2024. Pp. 198-207. Веб-сервіс для коригування фото fixthephoto.com: URL: <https://fixthephoto.com>
7. Mazurets O., Molchanova M., Klimenko V., Klopotivskyi D. Datalogic Model for Image Recognition by Convolutional Neural Network Using Cloud Services.

Proceedings of XXII International Scientific and Practical Conference «Modern Scientific Research: Theoretical and Practical Aspects». May 8-10, 2024. Oslo, Norway. 2024. Pp. 64-68.

8. Molchanova M., Mazurets O., Klimenko V., Kuflevsky Ev. Object-oriented model for neural network damage detection of mail packages. Proceedings of XIV International Scientific and Practical Conference «Solving Scientific Problems Using Innovative Concepts». March 13-15, 2024. Copenhagen, Denmark. 2024. Pp. 58-62.

ДОСЛІДЖЕННЯ МЕТОДІВ КЛАСТЕРИЗАЦІЇ ПРИ СТВОРЕННІ ОНЛАЙН-БІБЛІОТЕК

Щербакова Галина

д.т.н, професор

Манікаєва Ольга

к.т.н, старший викладач

Нікова Діана

здобувач вищої освіти магістерського рівня

Фурман Данило

здобувач вищої освіти магістерського рівня

Кафедра інформаційних систем

Національний університет «Одеська політехніка», Україна

В останні роки стало актуальним створення та використання інформаційних систем на основі фільтрування. Таке фільтрування спрямоване на виявлення серед великих обсягів даних – даних саме для певного користувача, тому що найкращим чином відповідають його потребам. З таких систем популярністю користуються рекомендаційні системи. Тому і прикладів таких систем можна навести багато [1]. Серед них можна назвати і системи книгарень та онлайн-бібліотек, які спрямовані на надання користувачу рекомендацій щодо вибору книг, методичних матеріалів, підручників.

В системі користувач має залишити інформацію про вподобання тим чи іншим чином, система фільтрує та зберігає її. Такі системи основані на припущенні, що люди зі схожими інтересами можуть мати схожі вподобання. Аналізуючи дані про читачів та їх вподобання (історію переглядів, рейтинги книг), ці системи мають визначити кількісні характеристики схожості між користувачами та/або обраною літературою. Ці дані використовуються алгоритмами машинного навчання для передбачення успішних рекомендацій читачам [2].

Тобто важливим етапом обробки даних в таких системах є саме визначення складу груп читачів, схожих по певним параметрам та/або вподобанням. Саме для цього використовуються алгоритми кластеризації чи навчання без вчителя (Unsupervised learning). Таких алгоритмів існує значна кількість. Вони діляться