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Research article

Contemporary pornography: deepfake as a form of abuse

Pornografia contemporanea: il deepfake come forma di abuso

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Abstract
Introduction: The non-consensual creation of intimate images through deepfake is on the rise. Nudifiers, new AI tools that realise nudification of uploaded images, are a new method of content production that can be used for abuse. **Methodology:** Through empirical and qualitative analysis, we examined the use and outcome of these applications. **Results:** Respondents showed difficulties in recognising real images from nudified ones and rare forms of deterrence in the misuse of these tools. Discussion: The use of nudifiers poses serious ethical and legal problems, highlighting the need for more effective deterrence measures. **Conclusion:** It is crucial to develop tools and laws to counter the misuse of nudifiers and protect the privacy of those involved.

Keywords: women; abuse; pornography; NCII; education; AI; deepfake; nudifier.

Sommario
Introduzione: La creazione non consensuale di immagini intime attraverso il deepfake è in aumento. I nudifier, nuovi strumenti di IA che realizzano nudificazioni delle immagini caricate, sono un nuovo metodo di produzione di contenuti che possono essere utilizzati a

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scopo di abuso. **Metodologia:** Attraverso un'analisi empirica e qualitativa, abbiamo esaminato l'uso e il risultato di queste applicazioni. **Risultati:** Gli intervistati hanno mostrato difficoltà nel riconoscere le immagini reali da quelle nudificate e rare forme di deterrenza nell'uso improprio di questi strumenti. **Discussione:** L'uso di nudifier pone seri problemi etici e legali, evidenziando la necessità di misure deterrenti più efficaci. **Conclusioni:** È fondamentale sviluppare strumenti e leggi per contrastare l'abuso dei nudifier e proteggere la privacy delle persone coinvolte.

Parole chiave: donne; abuso; pornografia; NCII; educazione; AI; deepfake; nudifier.

1. Introduction

Devices and the Web have radically altered our lives. Multimedia by its inherent characteristics of diffusion and modification has already shown the first dark sides of digital affecting especially, and as is always the case, the most sensitive segments of the population. If the problem of dissemination of intimate content in non-consensual mode shows no signs of abating, now artificial intelligence is adding a new element of abuse: the creation of pornography through the practice of deep faking. In this research we will focus on the operation and use of new tools that enable the "nudification" of images, so-called nudifiers.

Also taken into consideration in the study of this phenomenon is the ease of use by younger people and the impact this may have in the production of child pornography.

1.1. Non-consensual dissemination of intimate images

The web has certainly built inclusion and support for many categories of people who before IT globalization remained isolated or even excluded from the main stream media. At this juncture, the ability to communicate from below through the web is certainly an excellent achievement.

At the same time, this same tool has also irreversibly contributed to new forms of violence that, just as in the real world, primarily target the most sensitive segments of the population. In the patriarchal system in which we currently live these are identifiable in mainly young or very young female people, trans people and queer people.

In 2023, 99% of deepfake pornography involved female subjects, and in a single year between 2022 and 2023, there was a 464% increase in the production of AI-generated pornographic images (Home Security Heroes, 2023).

Compared to deepfake, a currently growing phenomenon is Deepnude, which consists of the use of generative artificial intelligence software that "nudifies" images uploaded by the user. The danger of these new applications stems mainly from the extreme ease of use and the results that can be obtained.

The possible consequences related to the use of these tools are not very different from those made with real images stolen or used without the consent of the person portrayed so they can result in Revenge Porn or Sextortion.

The phenomenon known as Revenge Porn, an entirely inadequate and guilt-inducing term towards those who suffer it, consists of the dissemination of media (usually images or videos) without or in violation of the consent of those involved.

Being part of the broader and semiotically more correct category of Non-consensual intimate image sharing, in English Non-consensual intimate image hence the acronym NCII, only this expression will be used from now on.

Sextortion is a word born from the fusion of the words "sexual" and "extortion" and indicates the use of intimate material to blackmail, defraud, or threaten those portrayed and also falls under the NCII macrocategory.

The 2023 report from Revenge Porn Helpline[2] (Papachristou, 2023), a service established in 2015 in the United Kingdom that provides help and support to people who are abused through sharing intimate images, shows a 106 percent increase in reports between 2022 and 2023. The same source also indicates that women are disproportionately affected by both the sharing and the amount of images distributed, about 28 times more than those with male subject matter.

Both phenomena falling within NCII are likely to be further increased by these new types of software for the use of which all that is needed is a Web connection and an image, possibly but not necessarily in underwear or swimsuit, of the person to be targeted.

The study conducted on Italian youth in 2023 (Brighi et al., 2023) provides an initial understanding of the NCII phenomenon by showing how, unlike the social and media perceptions that relegate it to the digital world, in reality these virtual modes of abuse are often closely intersected with offline experiences of violence.

The organization Inhope[3] , which works to quickly identify and remove material child pornography from the digital world by supporting many of the hotlines around the world that deal with this issue, in its 2023 annual report shows a 5 percent increase in victims between the ages of 14 and 17, specifying that 95 percent of the victims depicted are female and that there is a decrease from the previous year in male victims (from 7 percent in 2022 to about 3 percent in 2023).

In the context of this research, the denudification of images through the use of artificial intelligence is placed within the NCII phenomenon, and one of the purposes of this analysis is to understand whether these images resulting from the nudifiers can appear real and as such go on to constitute new modes of abuse.

1.2. Generative AI

Over the past few years, the use of the term Artificial Intelligence has spread like wildfire; everyone has at least once heard of this new technology.

Although the popularity of the term is relatively recent, AI has well-established origins in the history of computing: it can even be said to have been born with it.

Questioning the analytical capabilities and solving mechanisms of machines is already the first programmer in history, Ada Lovelace, who in 1842, writing about Charles Babbage's invention, argued that machines will be able to solve problems that we humans have already found solutions to, not being able to anticipate any analytical relationships or truths.

[2] https://revengepornhelpline.org.uk

[3] https://inhope.org

A century later, Alan Turing wondered about the emergence and development of digital technologies capable of simulating the functioning of the human brain; in his well-known essay "Computing Machinery and Intelligence" (Turing, 1950), he defined the famous test that can determine whether a computer is capable of "thinking" like a person.

The term Artificial Intelligence was coined later, in 1955, when mathematicians and computer scientists McCarty, Minsky, Rochester and Shannon wrote a proposal for the organization of the "Dartmouth Summer Research Project on Artificial Intelligence" conference.

AI is a term that describes the ability of machines to mimic human reasoning. AI applications mainly make use of machine learning, algorithms that are able to learn autonomously and improve based on experience. The basis of this area of research is data.

Algorithms need to be "trained" through analysis of massive amounts of data, which are broken down, reprocessed and converted into numerical values on which, through statistical analysis, predictive models based on probability calculation are developed.

A subset of machine learning methods makes use of artificial neural networks for problem solving and is called deep learning.

All the AI applications we know today are part of the so-called Artificial Narrow Intelligence (ANI) and focus on completing one specific task, having no real reasoning capabilities. There is currently theorizing about the future emergence of Artificial General Intelligence (AGI) that will have human-like cognitive capabilities and can learn to perform any intellectual task.

For the past few years, so-called generative AIs have been developed that can produce new data in the form of text, images, or video. The generative models of these AIs learn patterns and structures of the data used for the training phase and based on these generate new data with similar characteristics.

Models capable of generating images, are based on Generative Adversarial Networks (GANs), developed by Ian Goodfellow (Goodfellow, 2014), consisting of two neural networks, one that generates data, and the other that acts as a discriminator, capable of recognizing images that are truthful or not. The two networks challenge each other, with the former attempting to fool the latter and this competition leading to the creation of realistic artificial data.

GANs are evolving rapidly, generating better and better images, so in 2017 thanks to a Reddit user the term deepfake was born, denoting deep learning systems for generating artificial content capable of deceiving those who see it. These tools, useful for example in the field of special effects in film productions, also facilitate the creation of content that can corroborate fake news, or be used for illicit purposes and the production of non-consensual pornography. Thus, in parallel with the development and evolution of deepfake technologies, methods for recognizing synthetic images and videos (deepfake detectors) emerge (Almars, 2021).

In 2021 OpenAI launched the first public tool for generating images from textual prompts, DALL-E. This is quickly followed by other similarly functioning algorithms, such as MidJourney, Stable Diffusion, and Google's Imagen.

The images generated quickly reached such a level of realism that in March 2023, a synthetic image was awarded the Sony World Photography Awards (Parshall, 2023).

The time is now ripe for the first algorithms for generating video from text; at the time of the writing of this article OpenAI has announced the launch of Sora, a tool that from the promotional material seems to exceed all imagination.

1.3. Research Objectives

The objective of this research is an analysis of the current state of generative artificial intelligence tools dedicated to Deep Nude and the ability to produce images exchangeable for real.

Keeping in mind that the evolution of these software is extremely fast and constantly improving, this paper focuses on studying the current state by comparing some of the various applications available.

The elements on which the survey will be set concern functionality, images produced, possible deterrents in use, and level of attractiveness and ease of use for users.

An empirical analysis was used to assess functionality, blocks, and usage, while to understand the possible impact of the images produced and their ability to mimic them, a quality analysis was carried out using statistical data (benchmarks) obtained through a questionnaire. Within this framework, it was decided to also include a trial of child pornography image making to understand whether these tools could increase the production of this type of material.

We do not expect exhaustive or definitive results with respect to the topic, partly because it currently appears to be an evolving field, but the opening of a new stream of research on a topic that has all the qualifications to become an important topic in the near future.

2. Methodology

To carry out our analysis, software was selected for use by searching the Web for applications considered and advertised as best.

These rankings are updated frequently and can be found with very simple searches, in this case conducted through the Google search engine, using strings such as “Best nudify app” or “Best undresser app”.

List of apps found and usable: undress.app; undress.cc; pornx.ai; app.deepnude.cc; deepsukebe.io; ainude.ai; nudify.online; app.deepnudify.com; deepnudenow.com.

The study was divided into two parts: empirical analysis on the selected applications and benchmark analysis on the results produced through the software.

2.1. Empirical analysis

The research was carried out during the process of image nudification. The first part was accomplished by capturing screenshots of the various websites when first accessed.

Using the various software we realized the differences in access and result, and it is through the analysis of differences and similarities that we found a list of parameters to refer to when creating descriptive tables of the various behaviors of these applications.

Initial parameters considered whether the first access requires a "Captcha Bot" check or a login, whether there are any PopUp alerts, information or advice on which images to upload, how data retention is handled (i.e., preservation of uploaded images), and whether there are free and paid versions.

Subsequent to the various tests conducted, we also reasoned about the accepted ways of paying for premium versions and the breakdown of the various types of alerts, if any.
All these data were first collected by saving screenshots to be summarized later within comparative tables that could create a clear overview.

Ultimately it was decided to test these applications with the possible production of child pornography images.

To do so, we used images depicting the authors as prepubescent, without face censoring since AI often recognizes the subject's age precisely from facial features. The selected image was converted from analog to digital and then tested through an AI-based site[4] , which identifies people's age from the facial image, attesting the face of the image to an approximate age of 5 years.

We consciously chose a prepubescent (about 6 years old) female image, depicting the author of this article in a one-piece swimsuit with a still undeveloped body, in order to see the results through nudification software.

2.2. Benchmark Analysis

To collect data useful for the benchmark analysis of the nudificatory tools studied, it was decided to administer a questionnaire to volunteers who were asked to make subjective judgments about real and AI-generated nude images.

For the creation of the "nudified" images, we had to subject the found applications to an initial screening. Applications that produced images only for a fee, those that created only lingerie or blurred images for free, and others that had problems related to waiting times or inability to use temporary emails were eliminated.

The only applications that were found to be usable for creating the material needed to construct the questionnaire were: pornx.ai (currently the service has moved to xnude.ai) and ainude.ai.

Then the images to be nudified were selected. For this selection, we reasoned about the problem of using user-supplied images for building and expanding the database used for learning such applications and consequently chose to select images already present on the web within pornographic sites. To this end and after numerous searches, the best result was a casting site for porn films that contains within it the section models in which there are images with uniform backgrounds and with nude models, dressed and in underwear.

[4] https://howolddoyoulook.com

Before beginning to produce the images to be included in the questionnaire, numerous tests were conducted with both male bodies, which could only be nudified through the Pornx app, and with bodies that did not conform to gender stereotypes.

The male body was eliminated from the purpose of the questionnaire firstly because it did not relate specifically to the objective of the research and secondly because, reviewing even the software excluded at the outset, only a fraction of these applications turn out to be usable for the purpose. On the male body, this type of software turns out to be decidedly untrained, committing decidedly egregious errors with respect to the shapes of the clothed subject and the creation of the genital organ, such as the splitting of the penis.

Even with regard to body types that do not conform to gender stereotypes, the results propose totally inappropriate normalizations by failing to ensure truthful images.

In light of these issues and in order to understand the level of danger of this type of tool, we decided to select images with bodies that fall within the bias of artificial intelligence: white, stringy, and extremely "normalized". The main goal was to try to make those images appear absolutely real or at least truthful by searching accordingly for equally compliant real nude bodies.

The construction of the questionnaire consisted of four parts following a short introduction that by the authors' choice, in order not to influence responses, explained as little as possible but contained the main information[5].

In the first section of the questionnaire, we limited ourselves to asking for age and gender of the respondent.

We then subjected ten images, five made with nudifier software and five real, to volunteers by asking "Is this image real?" with two response options: real or generated with artificial intelligence.

In the third section, we created two pairs of images, each consisting of the same subject on one side nude and on the other side nudified by the software by asking the respondent, "Which of the two images do you like best?"

All the images in the questionnaire were anonymized by covering the face and using people with no special marks (tattoos, moles, birthmarks, piercings,...).

The last section of the questionnaire has four multiple-choice questions:

[5] This questionnaire is completely anonymous; we will have available only the information you want to give us. This module is part of a research project related to the issue of deepfake and abuse practiced mainly on female bodies. We ask only 5 minutes of your time to help us in this study, the questionnaire is really short. Some of the images you will see are real while others were produced with generative artificial intelligence applications. We ask you to take a few minutes to help us understand whether or not at the current state of this technology the images produced look real.

We will not collect your data other than generic data regarding gender and age that are necessary for a more accurate result. You cannot access the questionnaire if you are under 18 years old.

ALERT: Contains nude images. Images have faces censored and no distinguishing marks to ensure anonymity.

Have you ever used generative AI applications (Midjourney, Stable Diffusion, Dall-E, Copilot, ...)? [yes/no].

Were you already familiar with artificial intelligence applications that can strip people (nudifiers)? [yes/no].

Have you ever used or do you plan to use a nudifying application in the future? [yes/no/don't know].

In your opinion, could these applications be used for the purpose of harming someone*? [yes/no/doesn't know].

3. Results

This section presents the research results obtained through the two analytical approaches described above.

The ease of access and use, as well as the functionality of the various deep nude systems under analysis will be exposed through a comparative survey. Keep in mind that these tools are constantly evolving, and the data collected are at times necessarily fragmented.

Next, the analysis on the quality of the productions of these instruments will be evaluated by following a statistical approach on the collected data, trying to highlight trends or preferences based on gender or age of those who participated in the questionnaire administered.

3.1. Results empirical analysis

The first element of relevance in the research concerns the possibility of using the service as a full free version.

Table 1 shows the various applications tested and their results compared with the free version.

Only two software programs produce nudified and blur-free images in the free version: Xnude.ai (new version of Pornx.ai) and Ainude.ai. A total of three images are available for the former application while one per day is available for the latter.

Undress.cc, Deepnude.cc and Deepsukebe.io in the free version produce only images on which a blur is applied to the result.

Undress.app and Nudify.online remove lingerie only through payment, and if images already in undergarments are uploaded these are replaced.

Deepnudenow.com uses waiting times for the free version which, in the tests conducted can be between 75 and 240 minutes, but at the end of the elapsed time nothing is produced anyway.

For Deepnudify.com there is no data available because an unresolvable error always occurs during upload.

Table 1.

Comparison on free version image making

	Full images	Blur	Lingerie	Hold block
Undress.app			X	
Undress.cc		X		
Xnude.ai	3 per account			
Deepnude.cc		X		
Deepsukebe.io		X		
Ainude.ai	1 per day			
Nudify.online			X	
Deepnudify.com				
Deepnudenow.com				X

Source: Own elaboration (2024).

Table 2 shows a comparison of the various applications in relation to the presence of messages regulating their use with a view to preventing possible abusive use.

The columns reflect the messages found in at least one of the various software reviewed and are "18+" for blocking use by those under 18 years of age, "image permission (copyright)" for the notice to use images to which you have the rights to use, "entertainment purpose" to indicate use for entertainment purposes only, "acceptance Privacy and TOS" to confirm that all clauses in the privacy document and terms of service are accepted, "no underage images" and "no images in unconscious states" for those notices that contain restrictions with respect to the uploading of images depicting minors and unconscious persons.

The "U" checkmark means the alerts present in the image upload phase, "S" those present in the blur removal request, and "E" the Popups present at the site entry.

Table 2.

Comparison on messages and alerts for use

	18+	Image permission (copyright)	Liability for images generated	Proposed entertainment	Acceptance of Privacy and TOS	No underage images	No images in unconscious states
Undress.app	U	U	U		U		
Undress.cc	S	S	S				
Pornx.ai	E	E	E		E		
Xnude							
Deepnude.cc							
Deepsukebe.io							
Ainude.ai	E						
Nudify.online	E			E	E		
Deepnudify.com							
Deepnudenow.com		U				U	U

Source: Own elaboration (2024).

Table 3 shows the payment methods for accessing premium versions of applications. Out of 9 applications, 4 of them exclusively accept cryptocurrency payments.

Table 3.

Comparison of accepted forms of payment

	Cryptocurrencies	Credit cards	PayPal	Other payment methods
Undress.app	X	X	X	X
Undress.cc	X	X	X	X
Xnude.ai	X	X		
Deepnude.cc	X			
Deepsukebe.io	X			
Ainude.ai	X			
Nudify.online	X	X	X	
Deepnudify.com	X	X		X
Deepnudenow.com	X			

Source: Own elaboration (2024).

With regard to nudification of male bodies only Pornx.ai (currently replaced by Xnude.ai) and Ainude.ai consider or include the choice of a male body although as previously written the results are decidedly unlikable.

High element considered is any FAQs and ethical reflections within the sites.

FAQs are present on only 3 of the sites analyzed (Undress.app, Xnude.ai, and Ainude.ai) and only on Ainude.ai do they have questions about software ethics:

> Can I remove clothes from a girl's photo? YES. The AINude.AI nude generator features advanced AI deepnude technology, which can strip a photo to turn it into a nude image. Simply choose the part of the image you want to remove clothes from, then click “Remove Item” to generate the nude girl image.
>
> Can I edit and alter the image of a flat-breasted girl by turning it into an image with big boobs or huge boobs? YES. If you upload an image with a flat-breasted girl, you can select the chest area and then type in the words to describe the type of chest you like. AINude.AI will change it to the perfect boobs or boobies you want after you click “Generate”.
>
> Is AINude.AI suitable for everyone? AINude.AI is developed to cater to adult users interested in AI nude image generation and deepnude services. Make sure you are over 18 years old when using the AINude.AI generator. Also, it is important to remember that the platform offers images of naked girls generated by artificial intelligence and that the characters do not exist in real life. It is up to each individual to determine whether the generated nude image is in line with their desires.
>
> Are artificial intelligence generators ethical? The ethics of the AI nude generator and deepnude app are being debated. Creating and distributing non-consensual porn content is unethical and potentially illegal.

> However, the responsible and consensual use of artificial intelligence technology in appropriate contexts, such as artistic or educational purposes, may be a matter of individual judgment and community standards[6].

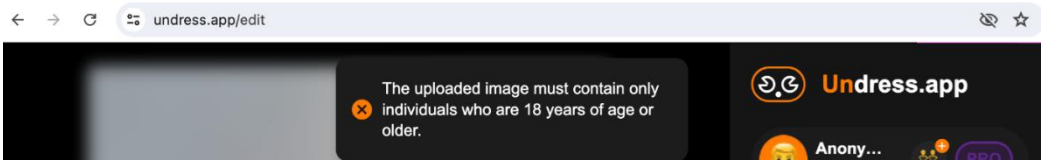
Regarding data retention 3 of these apps make explicit on the homepage, so outside the mandatory document "Privacy Policy" the policy with respect to data retention. Undress.app and Deepnudenow.com state that they do not save data and Deepsukebe.io that uploaded images are automatically deleted from the server after a few days and you can choose to delete the photo immediately after nudification.

We experimented with applications in the production of child pornography images using an image of the author identified through howolddoyoulook.com as age 5.

Only undress.app popped up an alert subsequent to uploading the file. The alert in question, shown in Figure 1, warns the user that the uploaded photo should contain only images of people over 18, but it lasts only a few seconds and then disappears.

Figure 1.

Alert undress.app



Source: Screenshots from https://undress.app.

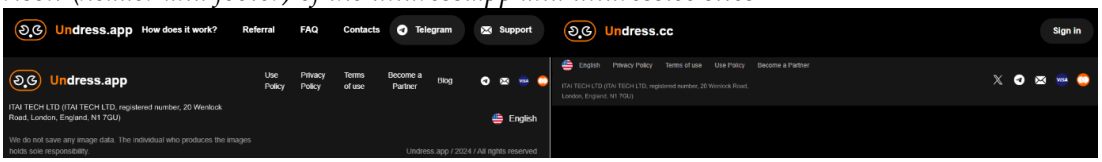
The other software whose data could be detected produces far-fetched images by treating the body as that of an adult woman and in some cases even increasing the shapes compared to results previously had with other uploaded images.

Finally, we checked the ownership of these applications as many similarities were perceived between some sites. Undress.app and Undress.cc have a very similar platform, consistent graphics and logo (Figure 2), but they behave in different ways, as visible in the tables presented. On closer inspection in the footer the same company is presented: ITAI TECH LTD.

In contrast, Deepnudify.com and Deepnude.cc work the same way but use two different graphics.

Figure 2.

Comparison (header and footer) of the undress.app and undress.cc sites



Source: Screenshots from https://undress.app and https://undress.cc.

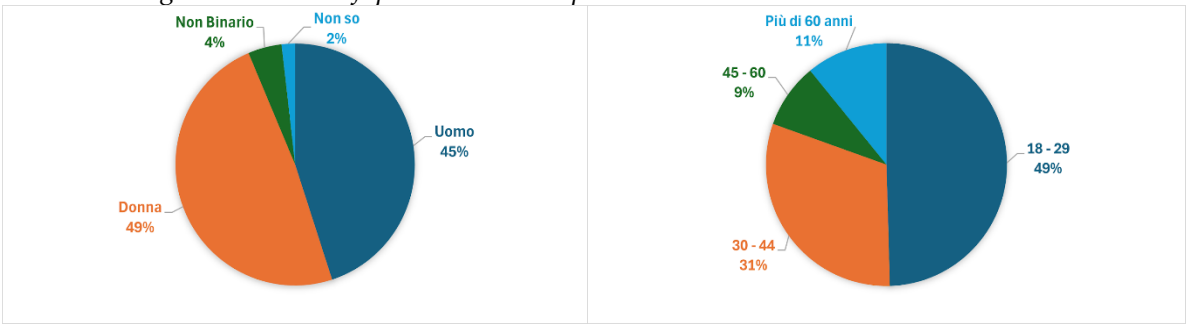
[6] https://www.ainude.ai/it

3.2. Results benchmark analysis

The purpose of this analysis is to evaluate the quality of the results produced by the deep nude tools studied.
The questionnaire was filled out by 220 people, and the data collected were then analyzed by looking for correlation between the answers given and the age and gender information of the volunteers.

Figure 3.

Gender and age distribution of questionnaire respondents



Man	Woman	Non-Binary	I don't know.	18 - 29	30 - 44	45 - 60	More than 60 years
99	107	10	4	109	68	19	24

Source: Own elaboration (2024).

The first of the three sections of the questionnaire proposed the viewing of 10 images, 5 of which were real and 5 generated by AI, asking people to label them as real or not. The data collected were treated as in the evaluation of a classification algorithm, namely by counting the number of times the images were labeled correctly.

Our population of volunteers was then considered as an algorithm with the task of recognizing whether an image was generated by AI: a binary classification problem. Then IA-generated images recognized as such are considered TP (true positive), IA images recognized as real are FP (false positive); in this way it was possible to calculate the precision (accuracy) with which the population of 220 volunteers identified the products of IA, as the ratio of the number of correct responses to the number of total responses.

Since this is a binary classification problem (AI/Real) if it were answered completely randomly, the accuracy would be 50 percent, which is why we usually consider a working system to have an accuracy of at least 75 percent.

Accuracy values were calculated for each test image, and then the average value over the 10 images was calculated.

Table 4.

Real and AI-generated image recognition test results

	Test 1 IA	Test 2 Real	Test 3 Royal	Test 4 IA	Test 5 IA	Test 6 IA	Test 7 Royal	Test 8 IA	Test 9 Royal	Test 10 Royal
Correct answers	162 (73,64%)	144 (65,45%)	183 (83,18%)	109 (49,54%)	173 (78,63%)	160 (72,72%)	156 (70,91%)	161 (73,18%)	159 (72,27%)	174 (79,09%)

Source: own elaboration (2024).

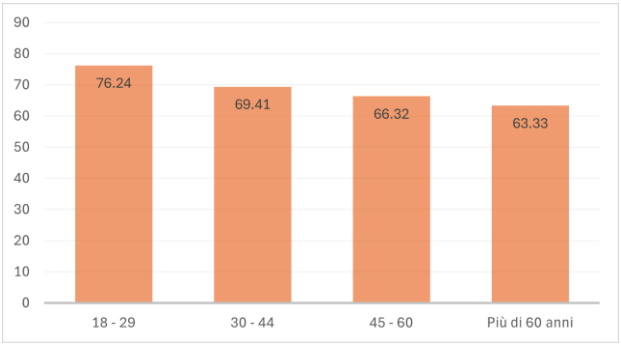
The average accuracy is 71.86 percent thus being just below the average value required for the reliability of the evaluation system.

The results are consistent by gender, presenting a very similar average accuracy, while it is evident that those in the younger age groups are more likely to be able to distinguish AI-generated images: the success rate of 76.24% for the 18-29 year old group of participants is reduced to 63.33% in the over 60s.

In particular, it is noted that the best accuracy level was achieved by women aged 18-29 years with a result of 78.33%; a real nude image (Test 10) achieved an accuracy of 79.09% in total and was detected by 91.67% of women aged 18-29 years.

Figure 4.

Accuracy by age group



Source: Own elaboration (2024).

We also note, that within the various age groups the results are consistent regardless of gender, except in the 45-60 age group where women achieve an accuracy of 78.75% while men only 57.27%. Note, however, that this age range is underrepresented in the samples of our analysis, and this finding could be confirmed in a future study.

In the second section of the questionnaire, volunteers were asked to make a preference judgment between two photos of the same model: one nudified and one real nude photo. It was not indicated which of the two was real or not, and it was not specified that either picture was real, so that subjective judgment would not influence the responses.

While in the first comparison the preference on the real image is 71.82% for the second comparison the percentage drops to 65.45%. In detail, the disparity in preference is most evident among men aged 18-29 for whom the real image is preferred in the first comparison with a percentage of 93.88% and only 57.14% for the second question.

The situation seems completely reversed for men aged 45 to 60 years prefer the real image in the first comparison by 54.55% and in the second by 81.81%.

The last section of the questionnaire sought to understand familiarity with tools that make use of AI and in particular deep nude tools.

Overall, just over 50% of volunteers used AIs (112 out of 220). Also noticeable here is a decrease in the percentage by age group: 69.72% of young people have used AIs, while the percentage decreases to 32.43% when aggregating the data for those over 30. The greater predisposition of men (63) than women (40) is indicative.

Only 32.73% of the questionnaire respondents already knew the nudgers, of whom 47 were aged 18 to 29, 19 were aged 30 to 44, and only 5 were aged 45 to 60: of these 41 were men and 24 were women.

Finally, only 8 individuals have used or think they might use deep nude tools: one woman aged 18-29 and 7 men placed in different age groups.

4. Discussion

The nudifiers available online are all variations of known algorithms for generating images or portions of images. In particular, they use the same approach that generative AIs use for the inpainting phase, i.e., replacing or reconstructing small portions of an image without changing its overall structure.

On one of the sites taken under analysis, it is specified that their tool is a modified version of the GAN architecture developed by NVIDIA in the opensource pix2pixHD project (Wang et al., 2018) trained with a dataset of nude images. Since the data used for training does not have enough images of clothed and nude people in the same pose, an iterative approach to solving the problem is used.

The AI has to be "helped" by the user for the recognition of the portions of the image to be processed, through the selection of clothes. Next, several Computer Vision algorithms work on resolving a series of complementary operations: initially, the pixels of the image that in the area selected by the user belong to the clothes and which ones belong to the subject are identified; then, the location and orientation of the different anatomical parts to be replaced are identified; then, drawing on the images in its database, the naked anatomical parts are identified, cropped, and replaced to the original image. Finally, filters are applied to correct inconsistencies in light, saturation and color of the generated image[7].

4.1. Discussion empirical analysis

The free production of these images while extremely limited, in the sense that few of these software provide for production or testing without the paid version, is by no means impossible or controllable.

Restrictions on access or warnings present are few and generally not particularly disturbing or blocking; in fact, only 3 of the 9 applications examined display a request to accept a PopUp on access that requires users to be of legal age.

[7] https://deepnudenow.com/info/how-it-works

A more important warning concerns image ownership, i.e., non-use of images protected by copyright, for 4 sites and liability for images generated 3 out of 9. Instead limitations regarding the person portrayed we can find them only on Deepnudenow.com, which uses a more limiting wording, although inserted in small print along with the requirements for good results:

> Using summer photos: the more skin exposed, the better the result jpeg, gif, png formats are allowed.
> Maximum file size: 10 mb.
> No content involving minors, animals, rape, incest, violence, blood, poop, vomit and other disgusting things.
> No people drunk, drugged, passed out or asleep.
> No copyrighted images unless you are the author or have the owner's permission to publish them.

The types of payment methods chosen also contribute to the same overall view. All of these sites accept cryptocurrency payments but only 5 out of 9 also accept other forms of purchase. Adding up these results, the exclusively economic interest of these software companies operating in the knowledge of the temporary legislative vacuum seems quite evident.

And it is precisely in this context that the alarming lack of interest shown by the almost complete absence of blocks or alerts in the possibility of producing denuded images of minors is not surprising. Although for all intents and purposes we were unable to produce through the free versions an image of child pornography, in addition to remaining doubtful of the possible results with the premium versions, it was surprising to find only one block on an application that does not report it in the alerts, namely Undress.app.

We should also point out that in the paid versions of some of the analyzed software there is the possibility of going to define body type,as well as breast size, and among them there is a skinny mode that could allow the creation of truthful child porn images.

Drawing conclusions, the element of ownership of these applications cannot be overlooked. As included in the results it seems clear, and was even blatant in the footer, that at least two of these software belong to the same company-Itai Tech Ltd. In doing further research, we found an article by Bellingcat entitled “Behind a Secretive Global Network of Non-Consensual Deepfake Pornography” (Koltai, 2024) in which the topic of the companies present behind the nudificatory software is also discussed.

Investigating Itai Tech Ltd, which is present on the Undress and Nudify domains and some cached versions of Clothoff domains (sites we did not directly analyze), and other similar companies the article concludes that all these properties operate in a way that cashes in through legitimate payment providers while hiding, through real or ad-hoc made front names, those who make money from this type of activity. Another element that emerges is the presence of multiplied sites to avoid service interruptions and consequently disruptions in payments. In the conclusion of the article Kolina Koltai, the author, points out that however, these organizations have not perfectly covered their tracks and there are real people who have lent their names, or even companies, to these platforms.

4.2. Discussion qualitative analysis

The average accuracy is 71.86% showing that, for the test participants, the distinction between real and generated images is not totally obvious: specifically, while only one real image was identified with an accuracy level above 80% (Test 3), a nudified image (Test 4) divided the volunteers perfectly, being labeled correctly by only 49.54% of them (61.62% of men and only 37.38% of women).

From the careful evaluation of the two images in question it appears that the only discriminating element is the presence of sharp marks on the skin left by the clothing elastics. In the case of the real image there is a red mark in the middle of the waist but even in the nudified image there remains a small mark that being outside the bikini was not reworked by the AI. It is therefore apparent that the presence of imperfections leads to the evaluation of the image as real.

Regarding the second section of the questionnaire, the preference in the first pair of images is significantly higher for the real photo. In the opinion of the authors, this preference can be justified by the fact that in the nudified image the aureoles are darker and more extensive than in the breasts of the real subject, which are more harmonious. Based on this analysis, we realized that all images produced by nudifiers always have halos with the characteristics identified above.

It is evident from the data collected in the last section of the questionnaire that the younger generation is more prone to the knowledge and use of AI tools, and thus we acknowledge a limitation of our research that could not collect and process data with respect to minors.

These data could lead to a further phase of research in which the increase in cases of child pornography image production on children between the ages of 14 and 17 [x] could be the result of violence perpetrated by peers.

4.3. Authors' reflections

Reflecting on the results that have emerged from the analyses conducted and the actual social danger of these tools, it is indeed complex to understand what methods might limit or at least discourage their use.

Tools such as shutting down or censoring these types of sites or applications is not considered by the authors to be a useful proposition. As already seen in lesser forms of torts against property, such as illegal streaming, the attempt to control the spread of certain platforms is almost always inconclusive, since on the Web the systematic movement of materials from a Web domain has become a common practice and in fact easy to accomplish.

Noting that the age group most likely to use these technologies is young people, the only option the authors see for limiting the use of these tools is a long-term educational operation. Referring back to one of the pillars of today's transfeminist struggle against patriarchal society, we believe that a serious sex and affectivity education, Comprehensive Sexuality Education, cannot be neglected beginning before secondary schools as the correct time to start such a course has been identified in the elementary school years.

This educational modality, described comprehensively by the Working Group for the Convention on the Rights of the Child (CRC Group)[8] , aims to provide children and youth with new knowledge, skills, attitudes and values that aim to improve health, well-being and dignity, develop more respectful social and sexual relationships, consider how their choices affect their own well-being and that of others, and understand and ensure the protection of their rights.

In addition, considering our professional profile aimed at teaching new technologies to students in their early twenties, we do not want to overlook the importance of a new mode of digital education that does not focus exclusively on professionalism in the use of IT tools but includes social and ethical considerations on the daily use of devices and emphasizes the possible risks associated with their use. It is recognized that this educational path should also be carried out in the preadolescent age, that is, before direct contact with technology.

4.4. Limitations and implications for future research on the topic

The results of the present research must be read with certain limitations in mind. The sampling technique used is not probabilistic, which implies that not all participants were equally likely to be drawn from the general population. This aspect limits the possibility of generalizing the results of the present study, e.g., questionnaire participants older than 45 years are a considerably smaller percentage than younger ones.

Another important element to take into account with respect to the benchmark analysis is the absence of those under 18 years of age, a choice made because of the type of explicit images to which the target audience was subjected. It is hoped that future studies will analyze the impact of this type of software on adolescents.

Keeping in mind that the evolution of these software is extremely fast and constantly improving, this paper focuses on studying the current state by comparing some of the various applications available.

It is hoped that the present research will be replicated by including new instruments and selecting more people, equally distributed by gender and age, to undergo this type of production.

5. Conclusions

The research conducted shed light on new AI tools called nudifiers.

Empirical analysis shows that it is very easy to use these applications; any restrictions can be circumvented through a form of payment. In addition, forms of deterrence to misuse and illicit use of the platforms under analysis appear to be practically absent.

While we have not obtained acceptable results, we cannot rule out the possibility of the production of child pornographic images in the premium versions of the software.

From the data obtained from filling out the questionnaire, there is little distinction between generated and real images. This finding correlates significantly with the age of the participants and their level of prior knowledge about generative AI systems.

[8] https://gruppocrc.net

According to the authors, in order to avoid the abusive implications of these new tools, the importance of introducing new sexuality and affectivity education pathways within elementary school along with innovative types of digital education becomes evident.

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