ABSTRACT

Some people think the vast amount of pornography on the internet is submerging, even threatening. Debates have started on the topic of cyberporn and legislation has been created to gain some control and set boundaries. Filter software has been built and people are coming up with solutions for what seems to be a problem: the great extent of cyberporn and the high chance of encountering it without purpose. This paper will address the research related to this topic that has already been done and will present some areas where research is needed.

Keywords
Cyberporn, pornography, internet, children, legislation, censorship.

1. INTRODUCTION

Pornography is in all media. But internet in particular makes it very easy to access. This cyberporn includes not only pictures and video clips of naked people, with people having actual intercourse or suggesting any sexual activity including sexual abuse and eroticized sexual inequality, but also offensive texts on websites. Educational material, like pictures from sexual health related sites are not meant by it.

Sexual curiosity, the lack of age-related barriers and the indiscriminate and coercive characteristic of the internet are the three reasons why exposure to pornography is so easy [Flo07]. This makes offensive material available for people who normally won’t get access to it. This is a benefit for people that are looking for that material but can’t or will not look for it in public. On the other side, internet also makes it possible for people that aren’t looking for pornography to encounter such material.

Some people are now afraid of their children being affected negatively by these occasions. The fast increase of cyberporn and its characteristics have triggered a debate. It handles about if and how we should protect ourselves against this phenomenon.

For instance, an article in Time Magazine in 1995 [Elm95] discussed the shocking results of the Carnegie-Mellon study [Rim95] which stated that 83.5% of the images on Usenet Newsgroups where images were stored were pornographic in nature. The article has gotten lots of attention, especially when a senator misinterpreted that figure as evidence for introducing S. 892 (the Protection of children from Computer Pornography Act in the U.S. Congress).

Nowadays, big parties on the internet are already offering filtering of content based on several techniques [AO04], [LHF05] and other solutions are being explored [Opv06]. But there are still a lot of questions remaining. Like, “is there really a problem or are we overreacting?”, “should we intervene?”, “does it really effect people negatively?”, “what can be done or is already done by legislation?” etc.

Some of these questions are (partially) answered and/or have been researched. But there is still a lot to do, especially in the area of Information Systems. This paper provides an overview of the research already done on the topic of cyberporn.

Therefore different aspects of cyberporn are discussed. First the research question will be presented, as well as its significance, followed by the research method. Then papers that contributed to one or several aspects of cyberporn will be presented and synthesized.

2. ASPECTS OF CYBERPORN

Different aspects of cyberporn can be thought of. For instance, the authors of [TL04] state that there are three elements important for the protection of children online: Public policy and law enforcement, technology, and education. This document uses the aspects depicted in the figure beneath to describe the subject:

![Figure 1: Aspects of Cyberporn](image)

Because these areas show only little overlap, they will be discussed separately and to categorize the research subquestions in the next section.

3. RESEARCH

3.1 Research Question

The research area of cyberporn is still very new. There are some important papers available, but there are only a few papers on cyberporn in the top 25 IS journals, listed by the authors in [MT01]. When we look for papers that satisfy the keywords (pornography AND (internet OR online OR on-line)) OR cyberporn) in the search engine Ingenta we will get 76 results. Most of the results cover the sociological, psychological or legislative aspect. Unfortunately, Ingenta doesn’t have an easy function to narrow the search to only
those journals that cover information system topics. Web of Science however, can do this and it still covers the top 10 IS journals. If we narrow our search space here to IS journals with the same keywords, we only get 7 results of which some still concentrate on legislation and sociologies. Searching on the keywords (offensive OR objectionable) AND web AND content) and (web AND content AND filtering) also gives small results (<20) in the several search engines. This tells us that there isn’t done a lot of research in the IS area on this topic.

Moreover, the existing papers handle topics that are very broad and need some refinement or they are too specific and leave great gaps in the area still to be researched. Thus, that would make it easy to pick something to research. But the time for this research is limited and that eliminates the time-intensive researches.

Also, since the topics already researched show only a little overlap, it is hard to see the overall picture of the cyberporn research area and to pick a topic that needs to be researched.

That’s why this research became some kind of state-of-the-art, an overview of the research area, to map which topics are covered already by research and which topics need attention.

The research question is then:

*What research is already done on the cyberporn topic and what should be researched in the future?*

This question can be subdivided following the aspects mentioned above.

- How much content is on the web and how many revenue is made out of it? (statistics)
- What seems to be the problem of the upcoming cyberporn? (effects)
- Can it be harmful for people to encounter offensive material online? (effects)
- Should we protect ourselves against this forbidden fruit, or are there other ways to cope with it? (policy)
- Which laws have been made to restrict cyberporn? (legislation)
- Which possible (technical) solutions are there for protecting someone from encountering offensive material online? (policy and technical solutions)
- Is the porn industry willing to help with finding and creating a solution? (technical solutions)

### 3.2 Research Method

The research method that is used for finding answers to the research questions is a literature review. In addition, some Internet sources are reviewed too, due to the lack of research done on this topic.

Also, an employee from a Dutch company which runs a popular pornographic website has been interviewed to provide an extra perspective on this topic.

### 4. PROBLEM OR NOT?

People believe that enormous amounts of the internet are pornographic. But why is that so? And is it really true?

In 1995 the issue of cyberporn got hyped by an article in Time Magazine [Elm95] based on a research done by Martin Rimm [Rim95] before it got even published. In it there figures about the amount of pornographic content on the internet. In a detailed description of the events before and after publishing the study it appears that due to the great magnitude of the subject, there were already secrecy arrangements which hindered a good review [Mee95].

The article gained a lot of attention and due to this media attention the people really believed that the greater part of the internet consisted of pornographic material, although it seemed afterwards that the study contained big flaws. Even during the actual research critics had their doubts about the results of the Carnegie-Mellon study, but they were ignored. Still, people rather choose to believe these high numbers above the critics [Ada05].

So what should we believe? Are there any correct numbers of the amount of pornographic material online? Most websites presenting statistics about pornography already mention that the figures are hard to ascertain. They extract their statistics from several sources which may not always be as reliable as should be.

In this paper these figures are only included to illustrate the extent of the problem. Due to the time constraints it was not possible to collect data from more reliable sources other than the ones found on the web. Underneath are some of the available figures found on sites that like to inform or warn people for pornography. Again, these figures might not be complete or reliable.

#### 4.1 Amount of pornographic content on the internet

- 4.2 million websites are pornographic, which is 12% of all websites [Fam07] [Rop07]. The MSNBC/Stanford/Duquesne Study printed by The Washington Times in 2000 mentioned in [Pro07] even states that 60% of all websites are sexual in nature. The big difference between these numbers might be explained by a difference in definition, year in which the research was done and the method used.
- The amount of pornographic web pages increased from 14 million in 1998 to 260 million pages in 2003 [Wei07] [Saf07] and was approximately 420 million in 2006 [Rop07].

#### 4.2 Revenue from cyberporn

- In 2006 revenue in the US of pornography was $13.33 billion ($44.67 per capita) in the UK $1.97 billion ($31.84 per capita) and in the Netherlands $0.2 billion ($12.13 per capita) [Rop07].
- All revenue gained from internet pornography in the US was $2.84 billion in 2006 (21% of all pornography revenues) [Rop07].
- Worldwide, internet pornography revenues were only about 5% ($4.9 billion) of total revenues from pornography (in 2006) [Rop07].

As mentioned before, due to time constraints it wasn’t possible to determine the sources for these figures, which makes it hard to justify them. This of course illustrates that the so-called problem of the great amount of pornographic material on the internet might as well be a big bubble. The “Rimm-factor” shows us that the magnitude of a subject influences the way some people present their results and how unreliable they can be.
Although the whole issue might have been exaggerated over the years, cyberporn exists and the next chapter discusses the possible means of this phenomenon.

5. EFFECTS
This aspect of cyberporn handles with the effect it has on people when they encounter pornography on the internet, especially young children and adolescents. Listed below are some statistics about this group and cyberporn. These are also from webpages and their sources are not always known and thus might be unreliable:

- 34% of internet users received unwanted exposure to sexual material [Rop07]. One in four children was unwillingly exposed to images of naked people or people having sex (National Center for Missing and Exploited Children) [Dem06].
- The average age of children when they first encounter pornographic material is 11 [Rop07] [Fam07].
- Adolescents aged 12-17 are among the age groups most frequently exposed to pornography, following the Attorney General’s National Study Commission on Pornography, 1970 and 1986 [Pro07].
- 90% of the children aged between 8 and 16 have watched porn online (most while doing homework) [Rop07] [Fam07].
- 1 in 5 children (10 to 17 years old) receives unwanted sexual solicitations online (Youth Internet Safety Survey, U.S. Department of Justice, 2001) [Sa07].

People are afraid that it might affect young children and adolescents negatively. For instance, concerns rise with respect to developing deviant sexual behavior, including sexual assault, negative attitudes towards women, and the acceptance of deviant or aggressive sexual behavior among peers.

The survey in [MFW03] showed that 25% of the youth who used the Internet regularly had one or more unwanted exposures to sexual pictures while online in the past year. And of those, 19% reported at least one symptom of stress at the level of more than a little or all the time during the days right after the incident happened. Long-term effects of the exposure were not examined in this research.

But it causes not only the emotional stress with young children and emotionally unstable people, pornography on the internet is also said to stimulate child porn, sexual aggression and other deviant behavior. In [MBF05] the authors see that sexual (as well as nonsexual) problematic Internet experiences in mental health settings indicate they merit attention.

Also, in 42% of the cases watching pornography on the internet during working hours was the cause of disciplination or even termination of employees, following a survey by Websense, Inc., [YC04].

Still, the question whether exposure to offensive material is harmful remains unanswered. Is it really a problem? In [Ku06] a comparison is made between the American and the Dutch culture with respect to handling with the vast amount of pornography. It is interesting to see that the Americans think that we must prevent people from being exposed to offensive material, while the Dutch think that you should rather teach people how to cope with such content.

Most researches done on this aspect of cyberporn conclude that a lot of research has to be done. The limitation of almost all reviewed papers is the small and homogeneous sample. In [Liv03] the author sums up more limitations of current research on related topics.

Future research should concentrate on bigger and more population-based studies. But it is, for ethical reasons also hard to do good research involving children and exposing people to material that might cause mental issues.

Table 1 summarizes some of the conclusions drawn by papers that did research related to pornography. Some conclusions did not end up in the table because they were not of a significant importance for answering the research questions.

Important results from the studies are:

- Lots of children are exposed to sexually explicit material. [FH03] [MWF07] [WMF07]
- Males of any ages show more interest in pornography [Flo07] and find sexually explicit images, movies and websites less offensive than females. [BFM06] [KS04]
- Although children encounter pornographic material accidentally a lot, there are some children that deliberately look for it. [Flo07] [Fre00] [YM05]
- Accidentally encountering sexually explicit material is often experienced as unwanted and unpleasant. [Flo07] [KS04] [MBF05] [WMF07]
- Some children were emotionally distressed when exposed to pornographic material. [MWF07]
- Exposure to violent and extreme pornographic material can affect people negatively. [Fre00] [DNG+06a] [DNG+06] [HSH+06] [MBF05]
- The psychological and domestic background and demographical differences can be of any significance regarding the exposure to pornography [Fre00] [MWF07] [SLP07] [WMF07] [YM05] as well as low self-control [BFM06].

From these results we can conclude that cyberporn may indeed cause harm to minors and may cause development of sexual deviant behavior. Regular consumption of violent and extreme pornography is a risk factor for boys and young men’s perpetration of sexual assault. And also, it could cause them to be more tolerant to others showing such behavior [FH03].

But still the question remains whether this means that we should protect ourselves against this phenomenon. For instance, it is natural that teenagers who are becoming curious about sexuality are deliberately looking for pornographic material. Even before the internet was so widely spread and accessible teenagers were looking for such material and with or without help from adults they gained access to it eventually.

Most important, of course, is to prevent people that are certainly not looking for pornographic material and do not want to encounter such material, from exposure. In [Fre00] those people say they feel forced to consume sexual explicit material. Warning pages when entering a site which contains sexual offensive material is a mechanism that could work. But this mechanism is not perfect, because links from other sites to such a site might directly link to a page without the warning. Different mechanisms for preventing people from...
exposure to offensive material are discussed in the IT paragraph.

Table 1: Summary of papers that address unwanted exposure (of youth)

<table>
<thead>
<tr>
<th>Paper</th>
<th>Research subject</th>
<th>Research method</th>
<th>Sample (N = Sample size)</th>
<th>Results and Conclusions</th>
</tr>
</thead>
</table>
| [Fle07] | Exposure of youth to sexual explicit material.        | telephone survey      | N = 200; Australian youth; Ages: 16 and 17 | 1. > 40% of the boys have seen an X-rated movie  
2. > 20% of the boys have visited an sexually explicit website  
3. > 70% has been exposed accidentally to online pornography. |
| [HSI+06] | Reflections on pornography regarding the current sexual norm. | qualitative research: in-depth interviews with open-ended questions | N = 18; Young people; Ages: 16-23 | 1. This study revealed that pornographic media conveyed expectations and demands.  
2. The informants expressed contradictory feelings towards pornography and felt that sexuality was separated from intimacy.  
3. To deal with the current sexual norm, informants had different individual handling strategies and attitudes to pornography, namely liberal, normalization, distance, feminist or conservative. |
| [KS04] | Evaluations of unsolicited and harassing e-mail      | quantitative research  | N = 106; Undergraduates; Ages: 18-43 | E-mail messages with sexual content were perceived less favorable than similar e-mail massages without sexual content. |
| [MWF07] | Trends in unwanted exposure to pornography   | telephone survey      | N = 1500; Internet users Ages: 10-17 | 1. The overall incidence and 5-year trends of reporting unwanted sexual solicitations, harassment, and unwanted exposure to pornography varied by age, gender, race, and household income.  
2. The decline in the percentage of youth reporting sexual solicitations was apparent for both boys and girls, all age groups (which may be the effect of education and law enforcement activity on this issue in the intervening years), but not among minority youth and those living in less affluent households. |
| [WMF07] | Unwanted exposure to pornography and risks.  | telephone survey      | N = 1500; Internet users Ages: 10-17 | 1. 42% of youth Internet users had been exposed to online pornography in the past year. Of those, 66% reported only unwanted exposure.  
2. Filtering and blocking software reduced the risk of unwanted exposure, as did attending an Internet safety presentation by law enforcement personnel.  
3. Unwanted exposure rates were higher for teens, youth who reported being harassed or sexually solicited online or interpersonally victimized offline, and youth who scored in the borderline or clinically significant range on the Child Behavior Checklist subscale for depression.  
4. Wanted exposure rates were higher for teens, boys, and youth who used file-sharing programs to download images, talked online to unknown persons about sex, used the Internet at friends’ homes, or scored in the borderline or clinically significant range on the Child Behavior Checklist subscale for rule-breaking. |
| [YM05] | Exposure to Internet Pornography among Children and Adolescents | telephone survey      | N = 1501; Children and Adolescents; Ages: 10-17 | 1. The vast majority (87%) of youth who report looking for sexual images online are 14 years of age or older, when it is developmentally appropriate to be sexually curious.  
2. Children under the age of 14 who have intentionally looked at pornography are more likely to report traditional exposures, such as magazines or movies.  
3. Those who report intentional exposure to pornography, irrespective of source, are significantly more likely to cross-sectional report delinquent behavior and substance use in the previous year.  
4. Online seekers versus offline seekers are more likely to report clinical features associated with depression and lower levels of emotional bonding with their caregiver. |

Table 2: Summary of papers that address behavioral effects of cyberporn

<table>
<thead>
<tr>
<th>Paper</th>
<th>Research subject</th>
<th>Research method</th>
<th>Sample (N = Sample size)</th>
<th>Results and Conclusions</th>
</tr>
</thead>
</table>
| [BFM06] | The effect of low self-control on visiting sexual explicit web pages and downloading pornography | web-based survey      | N = 134; College students; Ages: 18-23 | 1. Being male is a significant factor in explaining internet behavior.  
2. Low self-control is related to online pornography use, especially the dimensions risk-seeking and self-centeredness turned out to be of significant importance.  
3. Opportunities for online pornography behavior when combined with low self-control were directly related to variations in frequency of downloading pornography. For instance the transition from high-school to university offers greater access to internet and thereby more opportunities to download pornography. |
| [DN06a] | The influence of alcohol and violent pornography on men’s likelihood of sexual aggression | quantitative research  | N = 82; Male social drinkers; Ages: 21-45 | The research suggests that alcohol-influenced sexual arousal may be one potential mechanism through which violent pornography exposure may potentially increase men’s likelihood of engaging in alcohol-related sexual assault. |
6. THE DEBATE, POLICY AND LEGISLATION

Because of the effects pornography might have on people and the beliefs people have about it, a debate began. On one side there were people who thought the government should take responsibility and make cyberporn completely illegal and on the opposite people thought of it as being the responsibility of every single user (or caregiver).

Concerns about content place the government in an ideological dilemma between responsiveness to concerns of the public on one hand and a commitment to a free enterprise system of control on the other. [San03]

But it doesn’t only concern internet usage in households, but also at the workplace: employers would like to monitor their employees to see if their productivity is high enough and if they spend time watching porn and other inferring material. But how far can an employer go? What about the privacy of the employee? [PB02] looks at the legal basis for electronic workplace monitoring for pornography and sexual harassment.

To protect ourselves against accidental exposure several alternatives have been introduced and criticized. Besides legislation, warning pages and content control software are already being used.

6.1 Warning pages

With a warning page an entering page of a website is meant asking you to only enter the website if you are aged 18 or older. Several problems arise with this mechanism:

- A warning page is something the site itself will have to initiate: it is voluntarily. If a site generates revenue from advertising by being visited, such an warning page is not attractive to them.
- Sites often link to each other bypassing this warning.
- Whether someone is really 18 years or older cannot be checked.
- It causes a forbidden fruit effect. People might get curious but they also may feel attracted to do something that is prohibited [San03].

Thus such a warning will only be effective if one is entering a site via that page, will not lie and does not feel attracted to have a look.

In [Wil05] the author states that if the warning is merely informative, it would not be viewed as a challenge and there would be no strong ‘forbidden fruit’ reaction. By having this informed choice people are more likely to not open the site. But this will not always be the case as culture plays a big part in making such choice. In a country like the US or UK everything that is related to sex might cause a forbidden fruit reaction.

6.2 Content Control Software

Content control software, also known as ‘censorware’, is software designed for controlling what content can be viewed by a user and what not. It is used as an instrument for parents, schools, libraries and other public places for providing a safer internet environment, especially for children. It can detect sexual explicit material such as nude pictures and offensive use of language. How this works will be discussed in the chapter about technical solutions.

Although censorware is a good mechanism that contributes to a safer internet environment, lots of discussion about the worthiness of these systems is present, like on forums where parents meet. Disadvantages that are mentioned are listed below:

- Because new websites and content are created every day and because of the lack of structure of the World Wide Web, a 100% coverage cannot be granted.
- Educational and health sites might get censored.

So content control software contributes to solving the problem, but it is not a solution on its own. The research done in [Hun00] subscribes this by showing that 25% of the time the tested filters failed to block objectionable content and on the other hand they improperly blocked 21% of non-objectable content. Of course we have to note that filters will develop and get better over time.

6.3 Education and Alternatives

The authors of [FH03] propose other approaches. First, a school based educational program in which young people’s information skills are encouraged. High school children will
be encouraged to develop ethical norms and critically evaluate pornographic images and messages. Secondly, the authors believe that it would be much more effective if ISP’s apply filters to all content instead of end-users. Adults could then have the option to turn it off, but therefore age verification technologies should be developed.

Education has also been opted as (part of) the best solution in [Liv03]. But some parents lack the confidence to educate their children and regulate their internet use, being afraid of being overruled by their child which they expect to have more knowledge about the use of computers. This problem can be overcome by a school-based educational program, or a program in which parents are educated too. “Digibewust” for instance is a Dutch initiative (http://www.digibewust.nl) that primarily focuses on educating, not only children but also caretakers.

Education on internet usage has been researched in more detail in [Wis04] and they advised not to disable chat rooms and instant messaging at school, because this might cause problems if children use these systems in their less supervised and unfiltered environment at home. Teaching them how to use them appropriately and safely is a better option.

For young children, Krowser (http://www.krowser.nl/english.php) has been developed in the Netherlands. It is an alternative browser especially designed for young children, to provide a safe environment. Instead of filtering, it uses white listing. Sites on the white list are appropriate for children to visit and thus made available. The list can be adapted by caretakers.

Much more national and international initiatives have been started lately. A European example is Insafe (http://www.saferinternet.org). It is a network of national nodes that coordinate Internet safety awareness in Europe. Illegal content can be reported to a national INHOPE (Internet hotline for providers in Europe) hotline (http://www.inhope.org) and they will take the necessary actions in line with the national legislation.

6.4 Regulation
Regulation comes in two forms: self-regulation and external regulation. Self-regulation involves the users, parents/caretakers and organizations. Users can try to avoid exposure. Parents and caretakers can educate children about safe internet usage, monitor their internet behavior and use content control software. Organizations can regulate the internet usage of their employees by formulating ethical codes and make use of censorware. Even Internet Service Providers can perform self-regulation by deciding whether they allow pornographic material or not.

6.4.1 External Regulation
External regulation is performed by the government and is meant to protect the society from child pornography and inappropriate exposure of sexual explicit material to children. But this has to be done with much care. Not only is it a problem to regulate a medium that has a “borderless” character and is very unstructured, it is also important to secure the freedom of speech. Thus regulating the internet is a great challenge.

Different countries started to make legislation. In the United States for instance, they made a big step forward by having the Children’s Internet Protection Act (CIPA) approved by the US Supreme Court in 2003. The CIPA requires schools and libraries that receive federal funds for Internet access to block or filter access to visual depictions that are obscene, child pornography, or material harmful to minors. Prior attempts to make all commercial pornography illegal failed because they conflicted with the First Amendment (which protects freedom of speech). [Kui06]

In Australia a system of regulation of sexual content on the internet, known as the Online Content Co-Regulatory Scheme, was established by amendments to the Broadcasting Services Act in 1999. It includes a complaints mechanism managed by the Australian Broadcasting Authority (ABA) and specifies the obligations of Internet Service Providers and Internet Content Hosts in Australia. The ABA doesn’t review sites for offensive content but relies on complaints made by the public. Besides, content that would be classified by the Classification Board as RC, X or R is also prohibited. [FH03]

Because of differences in national legislation and differences in culture it is hard to make the regulation international. This would much better fit the “borderless” character of the internet. A lot of discussion will probably proceed, because there are still countries that don’t even forbid child pornography. Or people think that external regulation is not the right way to protect ourselves, like the author of the essay [Kop05]. He thinks that obscenity law is an unsuitable solution to the problem it seeks to address, and should be abandoned.

7. TECHNICAL SOLUTIONS
It is the technology that makes pornography so easy-to-access. And since this is part of the problem, people hope that technology itself can offer protection.

So company’s and search engines have already started to build filters that can recognize websites with offensive content. There are several methods researched on how this can be done. The three different sources on which they project their filtering techniques are:

- Text
- Meta data
- Images

Of course, combinations are used as well.

Although lots of different methods have already been tried, there are some problems with filtering that are still present in current software.

7.1 Text-based filtering
With filtering based on text or metadata the most commonly used approaches are list-based and keyword-based. With list-based filtering, providers keep blacklists of URL’s of web pages that are said to have pornographic content. But keeping these lists up-to-date is a big challenge, even if automatic updating is involved.

The keyword-based approach however suffers from overblocking. Health pages for example may get blocked because keywords occur in it, which are contained in the keyword dictionary. Secondly, porn sites might use anti-recognition techniques like deliberately misspelling important keywords [HWC+07] [JKR07]. And again, such lists should be kept updated. Also, they cannot handle images.

Beside these techniques, more intelligent filtering methods are developed, like methods that rely on Neural Networks (NN).
7.2 Meta data-based filtering

Besides methods that are looking for keywords in the metadata, another method uses metadata for filtering as well. In this case a website uses a metadata scheme like RDF (Resource Description Framework) proposed by the W3C. An implementation of this framework is PICS (Platform for Internet Content Selection). It is a labeling method that rates content categories. Software will process these labels and will decide whether or not to block the site. The authors of [JKR07] state that there are two issues that need to be resolved: “who does the rating?” and “is the rater’s rating consistent with the user’s beliefs?”. They use an isotonic separating approach to address these problems. Another problem of this approach is that cooperation of the site-owners is required. And that will not always be the case.

7.3 Image-based filtering

A totally different, but very important filtering method is image-based content filtering. The authors of [HWC+07] have divided current recognition of pornography into three groups: model-based, feature-based and region-based recognition.

Model-based recognition concentrates on the geometrics of the human body. Disadvantage is that the human body has a very complicated structure and the method has a very high computational complexity.

With feature-based recognition features of the image are extracted and analyzed. Examples of features are color histograms and textures.

Region-based recognition first detects the skin regions in the image, from which feature vectors can be extracted. Also the number of skin regions and their geometrics can be involved in the analysis.

Table 2 summarizes some papers that present their filtering methods and their results. Although the filtering software is evolving and results are getting better, there are still problems to overcome. So research is required for refining the existing algorithms and to keep up with the current technology.

<table>
<thead>
<tr>
<th>Paper</th>
<th>Based On Images</th>
<th>Text</th>
<th>Meta Data</th>
<th>Filtering Method</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>[AO04]</td>
<td>x</td>
<td></td>
<td></td>
<td>Image content is classified by investigating probable skin-regions, and extracting their feature vectors. These are based on color, texture, contour, placement and relative size information for a given region. For each picture, a generic algorithm gives a probability that a certain picture has erotic content. By running the image based classifier on all pictures of a site, the likelihood of erotic content is determent.</td>
<td>All 20 test sites were classified correctly. The image-based classifier is able to properly identify 89% of the evaluation images at an average processing speed of 11 images per second.</td>
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<tr>
<td>[LHF05]</td>
<td>x</td>
<td>x</td>
<td></td>
<td>English and Chinese web pages can be categorized by an intelligent categorization engine that employs the artificial neural network model for intelligent clustering, i.e. frequencies of keyword-appearance are used as the input to the Kohonen self-organizing neural network (KSOM). The web content categorization engine performs analysis on the nature of the web pages, and then the KSOM is used to categorize web pages into “neutral” and “objectionable”. Web pages categorized as objectionable are blocked from reaching the users.</td>
<td>Experimental tests show that the intelligent approach for web page categorization performs better than traditional methods. High accuracy and low latency is achieved by adopting the learning capability of NNs and a decoupling of the training (knowledge-based) construction and categorization processes.</td>
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<tr>
<td>[FF99]</td>
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<td>The system marks skin-like pixels using combined color and texture properties. These skin regions are then fed to a specialized grouper, which attempts to group a human figure using geometric constraints on human structure. If the grouper finds a sufficiently complex structure, the system decides a human is present.</td>
<td>The system demonstrates excellent performance on a test set of 565 uncontrolled images of human nudes, mostly obtained from the internet, and 4289 assorted control images, drawn from a wide variety of sources.</td>
</tr>
<tr>
<td>[HWC+07]</td>
<td>x</td>
<td>x</td>
<td></td>
<td>Web pages are first divided into the following categories: continuous text pages, discrete text pages and image pages. For recognizing pornography in the continuous text pages a Cellular Neural Network (CNN) is constructed. For the discrete text pages a naive Bayes classifier is used and for processing the image pages a Gaussian mixture model of a histogram of the color vectors and a color-based algorithm is used. Finally a fusion algorithm combines the results.</td>
<td>The CNN approach instead of a more traditional keyword-statistics-based approach gives better results. The contour-based algorithm outperforms the traditional skin-region-based algorithm and the fusion algorithm outperforms either of the individual classifiers.</td>
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<tr>
<td>[JKR07]</td>
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<td>It uses an isotonic separation filtering technique. Filtering occurs based on meta data that satisfies monotone conditions. Here the PICS standard is used. Through experiments with simulated Internet information rating data, its effectiveness was demonstrated, though more thorough studies with real data would be required in order to claim its effectiveness more convincingly.</td>
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<td>[HW04]</td>
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<td>It uses the Bayes classifier to recognize pornographic texts. It not only considers the influence of different words on the weights of the Bayes network but also assigns different weights to the same words when they appear in different web page components such as title, meta and body.</td>
<td>Systematic differences between pornographic and non-pornographic web pages were found, with Bayesian classification yielding 99.1% accuracy in text classification from pornographic and non-pornographic corpora.</td>
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8. INTERVIEW

It seems like everyone has an opinion on this topic. In the research field of sociology and psychology pornography is nothing new. In the IS field however, it is, as already mentioned in chapter 3, quite new. But whatever related paper you read, the perspective of the porn industry is never mentioned. For this paper, an interview was set up with Roald
Riepen, employee at Funix b.v., a company that runs the popular website FreeOnes.com.

In 1996, the site begun as a hobby, in a time when there weren’t so many porn sites as there are today. The business grew and now it is a healthy company employing 8 people. In February 2007, the site gained a lot of attention due to the cancellation of a big event which was powered by the website [Sno07].

The site is a success, illustrated by the top-5 place it holds at sextracker.com. 80% of its traffic is coming from the United States. The site is a “babe site” and functions as a portal. It contains a database of almost every female pornstar.

Revenue is gained from memberships and transferring users to other pages they trade with. They aim at people older than 18 and people that like to return to this site. Because they don’t use advertising and don’t hope for as much single page views as possible, there is no need for them to use “tricks” like buying trusted URL’s or using misspelled keywords. That is why it is very unlikely that visitors get to this site by accident. Which is why they don’t feel addressed by the debate going on nowadays. They don’t do anything that is illegal or unethical and they don’t have anything to hide. So this is a great example of a “healthy” porn site that is still very profitable.

They are not afraid that legislation will restrict their activities within a short time. And if it will, they can always host their site somewhere else. They’re not afraid of content control software either, because it is not used so widespread and people that really want to find pornography will find it in the end.

Pornography companies that don’t show any extreme, violating or illegal pornography are probably willing to be involved in finding a way to prevent people from being exposed unwontedly. This is already being done: RTA labeling is an initiative of Association of Sites Advocating Child Protection (ASACP). One part of the mission of the ASACP is to help parents prevent children from viewing age-inappropriate material online. The RTA (Restricted to Adults) label is free to use, voluntary, and universally available to any website that wishes to clearly and effectively label itself as being inappropriate for viewing by minors.

9. CONCLUSION

From the results during the literature review it can be concluded that the research done on the effects of cyberporn is far by complete. Especially in the IS literature this topic is somewhat ignored.

Although people feel that the amount of pornography online is overwhelming and the chances of getting exposed to it great, this might be a bit overblown. Some statistics do show that the amount is high and huge revenues are gained, but we cannot say for sure how reliable these figures are or how they have been collected.

Either way people got concerned about the vast amount of cyberporn available and the easiness in which someone can get exposed, deliberately or not. Research has shown that children come across these sites a lot and some really felt distressed afterwards, because they weren’t prepared.

But it is not only a problem for young children that have been exposed to cyberporn by accident. Children get sexually curious at a certain age and start to look for sexually explicit material deliberately. The problem than is that they might get exposed to material that gives a very unrealistic picture of sexual activities, like with violence and rapes. This can be harmful for developing the sexual morality of children as well as for adults.

Protection against cyberporn is already available. Family filters are used in search engines, sometimes provided by Internet Service Providers and of course for sale. Besides, other initiatives like PICS and RTA are developing and some pornographic sites offer a warning page where you are asked to verify that you’re eighteen years old or older. Unfortunately, labeling and warning pages are not mandatory and the technical solutions like filtering, although still developing and getting better, still have problems like overblocking or performance issues. They can’t guarantee a 100% safe internet.

Government involvement is also not very helpful at the moment. In most countries, at least, child pornography is prohibited. In the US, places with public internet access are required to provide some kind of filtering solution. The problem with restricting cyberporn is the freedom of speech. And due to its chaotic nature, internet is hard to regulate.

9.1 Future research

With respect to the aspects of cyberporn, there is still a lot to research. First of all, the research done on the effects of cyberporn has mostly been done with a relatively small sample size. Demographical background of people should get more attention in those surveys.

When it comes to policy and legislation, research could be done on the possibilities of regulating websites. Is it for instance possible to oblige webmasters to insert an age-requesting page?

Technical solutions are already present, but they only concentrate on filtering text and images. These mechanisms are getting better, but the topic is still very new. Besides on these filtering techniques, research should also be done on developing age verification systems in which someone can proof his age online.

Finally, because technical solutions and legislation can’t offer a safer internet at the moment, we should look at alternatives. One solution that probably works best (in cooperation with the technical solutions) is education. We should educate (not only) our children to create a safer internet environment so they can cope with this vast amount of pornography. Parents should not feel intimidated by a medium they think their children know better, but instead learn to know how they can give more guidance.
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