Evaluation of Current E-Safety Software

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Abstract

Filtering and blocking products are being marketed for the home users as a way of keeping their children safe on the internet. In order to evaluate the effectiveness of such products a framework was designed. The framework was conducted to evaluate the effectiveness of five filtering products in communication channels, search engines and in URLs filtering. During the test it was revealed that filtering companies advertise many features but these features have their limitations and can cause the false sense of security. None of the tested products proved accurate to safeguard the children from online risks and threats

Keywords

Internet filters, blocking software, e-safety products, parental control

1 Introduction

The internet usage by children has been increased for the last few years (Livingstone and Haddon, 2009). According to the Ofcom's report 2008, 99% of children aged 8-17 access the internet (Byron, 2008).Largest proportion of children (81%) access the internet at home and 86% at school (Ofcom, 2007). There is explosive growth of websites and web pages on the internet. For instance, there were more than a billion websites by 2000, and many of them were changing daily (Heins *et al*. 2006).The content on the internet can be inaccurate, unpleasant, offensive, and harmful for minors. For instance, pornographic, gruesome, racist, extremist, militancy, self harm, violence, suicide, bomb making and biased information can mislead the children because they lack the skills to evaluate and judge the reliability of online information. According to the findings of Livingstone and Bober, "four in ten (38%) of pupils aged 9-19 trust most of the information on the internet, half (49%) trust some of it, and only one in ten (10%) are sceptical about much information online" (Livingstone and Bober, 2005).

Parents are worried about the safety of their children whilst on the internet. For this purpose filtering and blocking products are being marketed to safeguard the children from these risks. According to a survey conducted by Euroberometer, half of the parents (49%) were using filtering software, 37% of parents were using monitoring software and 27% of parents were using both i.e. blocking and monitoring software (Euroberometer, 2008). But these products may have some of their limitations and over reliance on them may cause the false sense of security. Five filtering products that are being marketed for home users, as a way to safeguard their children from

online risks and threats, were selected to evaluate their effectiveness. In background section there will be

2 Background information

2.1 Online risks to children

Children are engaged in number of online activities that can expose them to certain online risks and threats. They can have three types of roles in an online environment: a recipient, a participant and an actor. These roles can be associated with three types of risks: content, contact and conduct respectively. In content risks, children can be the recipient of harmful and inappropriate content e.g. advertising, spam, sponsorship, violent, hateful, gruesome, racist, biased information, drugs, pornographic and sexual content (Livingstone and Haddon, 2009). However, exposure to such harmful content can either be intentional or unintentional. They can receive such content through pop up advert, search engines, general surfing and communication channels. Contact risks, may involve: giving personal information, being bullied, being harassed, being stalked, being groomed, and meeting with strangers, self-harm and unwelcome persuasion. Children can be engaged in certain online activities which provide the opportunities of communications and contacts e.g. Instant messaging, emails, chat rooms, voice chat, video chat, blogs, social networking sites and sharing information with others. Conduct risks, may involve: bullying or harassing others, creating or uploading pornographic material, providing advice of suicide and self harm, gambling, illegal downloads, hacking and online games (Livingstone and Haddon, 2009). According to a survey (2009), conducted by the National Campaign to Prevent Teen and Unplanned Pregnancy, in United States, "one in five teenagers had sent or posted online nude or semi-nude pictures of themselves and 39% had sent or posted sexually suggestive messages" (Jewkes, 2010).

2.2 E-safety products.

The use of e-safety software can be a good option to safeguard the children whilst on the internet. There is a range of e-safety software available in the market place offered by different companies. These products may come with a variety of features e.g. filtering, monitoring, reporting or any combination of these features. Monitoring software records the online activities of children and maintains logs, which parents can view to know the online behaviour and interactions of their child. For instance, parents can visit the websites that their child has accessed and they can view the online conversations of their child. Filtering software regulates the internet access. They block the access to objectionable content and allow the access to legitimate content (Ormes, 2009).

2.3 Previous studies on e-safety products

In 2000, Hunter (Hunter, 2000) evaluated the four popular commercial filters e.g. CYBERsitter, CyberPatrol, Surf Watch and Net Nanny. This study was conducted in the context of under inclusive blocking and over inclusive blocking. If a filter failed to block the access to a site that contains 'objectionable material' it was under

inclusive blocking. On the other hand if a filter blocked the access to a site that did not have any 'objectionable material' it was over inclusive blocking. He employed the RASCi ratings to decide what is objectionable and what is non objectionable. RSACi classifies content into four categories e.g. Violence, Nudity, Sex and Language. Each category is associated with five levels of severity e.g. 0, 1, 2, 3, 4 and 5 (Ormes, 2009). He considered it 'objectionable' if any content of the site received RSACi rating of 2, 3 or 4. On the other hand the sites with RASCi rating 0 or 1 were considered 'not objectionable'. In test methodologies he selected 200 websites to evaluate the effectiveness of filters. He selected these web pages through search engines, popular search terms and portals. Interestingly, 164 web pages were 'not objectionable' and 36 web pages were 'objectionable' out of total selected 200 web pages. In evaluation he found that over inclusive blocking error rates of CYBERsitter, CyberPatrol, Surf Watch and Net Nanny were 14.6%, 9.1%, 7.3% and 3% respectively and the corresponding error rates for under inclusive blocking were 30.6%, 44.4%, 55.6% and 83.3% respectively. With all blocking decisions combined of four filters the over inclusive and under inclusive error rates were 21% and 25% respectively.

In 2001, U.S. Department of Justice commissioned the eTesting Labs to evaluate the effectiveness of five web content filtering products (eTesting Labs, 2001).They tested the five filtering products that were freely available for 30 day trial e.g. SmartFilter™, CyberPatrol, Websense Enterprise, N2H2™, and FoolProof SafeServer™. In test methodologies, Department of Justice provided them the specific criteria for defining content that should be blocked, and the filtering options to be applied for filtering products. According to that criteria, access should be blocked to "pictures, images, graphic image files, or other visual depictions that depict, describe or represent an actual or simulated sex act or sexual content, actual or simulated normal or perverted sexual acts or a lewd exhibition of the genitals and which lacks serious literary, artistic, political, or scientific values as to minors". In other words access to sexual or pornographic nature content should be blocked and such URLs were included in the list whose access should be blocked. They created a second list of URLs whose access should be allowed because their content did not meet the criteria that should be blocked. They randomly selected these URLs by using search engine and search phrase. In order to evaluate the effectiveness of five filters, they selected 197 objectionable URLs, whose access should be blocked, and 99 non objectionable URLs, whose access should not be blocked. They processed the both lists of URLs e.g. objectionable and non objectionable, and calculated the effectiveness of each filter. They calculated the Correct Blocking Ratio (CBR) for objectionable content and Incorrect Blocking Ratio (IBR) for non objectionable content. They computed the CBR as the total number of correctly blocked pages (CBP) divided by the total number of pages tested (TNP). Whereas they computed the IBR as the total number of incorrectly blocked pages (IBP) divided by the total number of pages tested (TNP). Higher value of CBR means the filtering product is more effective at correctly blocking objectionable content. Whereas lower value of IBR means the filtering product is better in allowing the access to non objectionable content. In other words lower value of IBR means less over blocking by filtering product. In their evaluation the computed CBR values of Websense, N2H2, CyberPatrol, Smart Filter, and SafeServer were 0.924, 0.980, 0.827, 0.944, and 0.761 respectively and the corresponding IBR values were 0.00, 0.01, 0.061, 0.071, and

0.091 respectively. It was clear by the results that Websense had the lowest IBR value, so it was doing lowest over blocking as compare to other four filtering products. On the other hand N2H2 had the higher value of CBR, so it was more effective in blocking objectionable content as compare to other four products. Interestingly, eTesting Labs, in addition to evaluate the effectiveness of filters, also looked at the other features of the filtering products e.g. Installation, configuration, content monitoring and blocking, and reporting and alerting.

2.4 Limitations of previous studies.

Hunter evaluated the four filtering products. It seems as if his context of evaluation was to know if these filtering products were First Amendment friendly or not. He selected 200 websites, out of which only 18% were objectionable and 82% were non objectionable. It can be possible that equal number of objectionable and non objectionable sites could give better overview of filter's performance.

On the other hand eTesting Labs, in their evaluation of five filtering products, selected 296 URLs, out of which 66.5 % were objectionable and 33.4%were non objectionable URL's. The higher percentage of objectionable sites can give a better overview of filters' effectiveness in protecting children from such sites. It seems their context of evaluation was to know if filtering products effectively blocked the access to those sites that were 'objectionable' according to the criteria specified by Department of Justice. In other words, to know if filtering products were efficiently blocking the access to pornographic nature sites and allowing the access to non objectionable sites. But content risks are not limited to only pornographic material because other harmful content like hate violence, racism, anorexia, self harm, promotional content of tobacco, alcohol and banned drugs also comes under this category. Although these studies provide a good overview of filters' performance but online risks and dangers are not limited to only content risks. For instance, many other risks and dangers come under the categories contact and conduct that are mentioned in earlier discussion. Because children are involved in number of online activities which makes them vulnerable to content, contact and conduct risks. Therefore there is need to evaluate the e-safety products for all the potential risks and dangers with respect to children's online activities.

3 Testing Methodologies

A framework was designed to evaluate the e-safety products. The framework was consisting of four phases. First phase was dealing with administration capabilities of e-safety products, second phase was dealing with communication channels, third phase was dealing with search engines and fourth phase was dealing with URLs. Framework was conducted to evaluate each of the selected products. However in this paper only last three phases of the framework will be discussed. The following five filtering products were selected. ParetoLogic PGsurfer is freeware whereas rest of the products were available for free trials. These products were obtained from corresponding vendors' website.

- Net Nanny version 6.5.1.10
- SafeEyes version 6.0.238

- CyberPatrol version 7.7.2.4
- CyberSentinel version 3.1.6.0
- ParetoLogic PGsurfer version 6.1.0

The configuration of the PC system used for performing experiments:-

- Operating System: Windows Vista™ Home Premium (Service Pack 1)
- Processor type: Intel(R) Core(TM) ² Duo CPU T5800 @ 2.00 GHz 2.00 GHz
- Memory (RAM):3.00GB
- System Type: 32-bit Operating System
- Browser: IE version 8

The system was connected to the internet via WiFi connection. Filters were installed one by one per vendors' instructions. Moreover contacts were made with vendors via emails and phone calls for different queries. The filters' were set to their full capacity of protection that were claimed to safeguard the children in their online activities. But it was done very carefully in order to be consistent in selecting categories for each filtering product. In other words efforts were made to enable same protection level for each filtering product.

The second phase of the framework was conducted to evaluate the filters' effectiveness to keep the children safe in communication activities. For this purpose six popular application based messengers were installed to engage in chat activities. Web based communication channels e.g. web based chat rooms, web based chat, Social networking sites and web based email were accessed to join communication activities. Moreover, file sharing applications were also installed to engage in file sharing activities. Filters were then evaluated against each activity for two aspects based on two assumptions.

- Parents who want to monitor the behaviour of their children in these channels.
- Parent who just want to block these channels.

First aspect was to evaluate the filter's effectiveness in recording, reporting and sending alerts for these activities. For this purpose intentionally unsafe behaviour was adopted to evaluate the filters' performance. For instance, in public chat rooms personal (but faked) information was sent, adult chat rooms were joined, personal messaging (PM) requests from strangers were accepted, advertisement hyperlinks in public chat rooms and emails were clicked, and spam emails were opened etc. Second aspect was to evaluate the filter's effectiveness in blocking these channels and applications.

The third phase of the framework was conducted to evaluate the filters' effectiveness to keep the children safe in search engines. For this purpose lists of objectionable and non objectionable keywords and search phrases were compiled.

The fourth phase of the framework was conducted to evaluate the filter's effectiveness in blocking the objectionable URLs and allowing the access to non

objectionable URLs. In other words over blocking and under blocking of filters were evaluated. For this purpose 500 URLs were selected i.e. 250 objectionable and 250 non objectionable. URLs were randomly collected through three search engines e.g. Google, Bing, and Yahoo. Moreover some of the URLs were collected from different chat rooms that were being sent by spammers and pornographic advertisers. Different "key words" and "phrases" related to different categories were searched. The objectionable URLs were not limited to only pornographic content. Other objectionable content categories were also included e.g. hateful, racist, illegal drugs, adult games, self harm, violent, suicide, bomb making, dating, alcohol and tobacco promotional sites. Each of the site was manually reviewed to decide if it is objectionable or non objectionable. In order to calculate ratio of over blocking and over blocking, two types of calculations were made .In first calculation formula used by e-Testing Labs were utilised and in second calculation accuracy percentage was calculated.

4 Results

4.1 Products's monitoring capabilities for communication channels

Activity	Net Nanny	Cyber Patrol	Cyber Sentinel	SafeEyes	ParetoLogic PGsurfer
Application Messengers					
Yahoo	Yes	No	No	Yes	No
Windows Live Messenger	Yes	No	No	Yes	No
ICQ	Yes	No	No	Yes	No
Google Talk	Yes	No	No	No	No
Skype	No	No	No	No	No
AIM messenger	Yes	No	No	Yes	No
Web based Chat rooms	No	No	No	No	No
Social Networking Sites					
Facebook	Yes	No	No	No	No
MySpace	Yes	No	No	No	No
Bebo	Yes	No	No	No	No
Twitter	Yes	No	No	No	No
Web based Emails					
Hotmail	No	No	No	No	No
Gmail	No	No	No	No	No
Yahoo	No	No	No	No	No

Table 1: Products' monitoring capabilities for communication channels.

4.2 Product's effectiveness in blocking communication channels.

	Net Nanny	Cyber Patrol	Cyber Sentinel	SafeEyes	ParetoLogic PGsurfer
Application messengers					
Yahoo	Yes	No	No	Yes	Yes
Windows Live Messenger	Yes	No	No	Yes	Yes
ICQ	Yes	Yes	No	Yes	Yes
Google Talk	Yes	No	No	No	Yes
Skype	No	No	No	No	Yes
AIM messenger	Yes	No	No	Yes	No
Web based Chat rooms					
camvoice.com	Yes	Yes	Yes	Yes	No
chat-avenue.com	Yes	Yes	Yes	Yes	No
ivideochat.com	Yes	Yes	No	Yes	No
chatforfree.org	Yes	Yes	No	Yes	No
youcams.com	Yes	Yes	No	Yes	No
byfchat.com	Yes	Yes	Yes	Yes	No
shockrooms.com	Yes	Yes	No	Yes	No
iwebcam.com	Yes	Yes	No	Yes	No
Social Networking Sites					
Facebook	Yes	No	No	Yes	Yes
MySpace	Yes	No	No	Yes	Yes
Bebo	Yes	No	No	Yes	Yes
Twitter	Yes	No	No	No	Yes
Web based Emails					
Hotmail	Yes	No	No	Yes	Yes
Gmail	Yes	No	No	Yes	Yes
Yahoo	Yes	No	No	Yes	Yes
P2P file Sharing					
LimeWire	Yes	No	No	No	Yes
Bit torrent	Yes	No	No	Yes	Yes
Proxy Sites	No	No	No	No	No

Table 2: Products's effectiveness in blocking communication channels.

4.3 Products' effectiveness in filtering search engines

Activity	Net Nanny	Cyber Patrol	Cyber Sentinel	SafeEyes	ParetoLogic PGsurfer
Blocking search engines	Yes	No	No	Yes	Yes
Blocking image, video and text search	Yes	No	No	Yes	No
Filtering or refining the search results	Yes	No	No	No	No
Over blocking	Yes	Yes	Yes	Yes	Yes
Under blocking	Yes	Yes	Yes	Yes	Yes

Table 3: Products's effectiveness in filtering search engines.

4.4 Products' effectiveness for blocking Objectionable URLs

Action	Net Nanny	Cyber Patrol	Cyber Sentinel	SafeEyes	ParetoLogic PGsurfer
Correctly Blocked	237	221	196	226	163
Failed to Block	13	29	54	24	87
Total URLs	250	250	250	250	250
Accuracy percentage	94.8%	88.4%	78.4%	90.4%	65.2%
Under blocking percentage	5.2%	11.6%	21.6%	9.6%	34.8%

Table 4: Products' effectiveness for blocking objectionable URLs.

4.5 Filters' effectiveness in allowing access to non objectionable URLs

Action	Net Nanny	Cyber Patrol	Cyber Sentinel	SafeEyes	ParetoLogic PGsurfer
Correctly Accessed	241	235	243	248	237
Incorrectly Blocked	9	15	7	2	13
Total URLs	250	250	250	250	250
Accuracy Percentage	96.4%	94%	97.2%	99.2%	94.8%
Over blocking percentage	3.6%	6%	2.8	0.8%	5.2%

Table 5: Products' effectiveness in allowing access to non objectionable URLs.

4.6 Correct Blocking Ratio and Incorrect Blocking Ratio.

	Net Nanny	Cyber Patrol	Cyber Sentinel	SafeEyes	ParetoLogic PGsurfer
Correct Blocking Ratio(CBR)	0.948	0.884	0.784	0.904	0.652
Incorrect Blocking Ratio (IBR)	0.036	0.06	0.028	0.008	0.052

Table: 6 Correct Blocking Ratio and Incorrect Blocking Ratio.

5 Discussion

5.1 Monitoring capabilities for communication channels

The inconsistencies of filtering products for monitoring chat activities can be seen in the table 1.Net Nanny was able to record the chat activities in social networking sites but it was failed to record the chat activities in web based chat rooms. Although it was able to monitor the chat activities in five tested application messengers but it was failed to monitor the chat activities conducted through Skype. Moreover it was not able to monitor the web based emails. SafeEyes was able to monitor only four out of six tested application messengers and it was failed to monitor the rest of communication channels. CyberPatrol, CyberSentinel and ParetoLogic PGsurfer, were not able to monitor any of the tested communication channels. SafeEyes was able to monitor only four application messengers and it was failed to monitor the web based chat rooms, social networking sites, and web based email.

5.2 Blocking capabilities for communication channels.

Although Net Nanny was most efficient among other filtering products to block the communication channels but it was not able to block the Skype. There was only one product i.e. ParetoLogic PGsurfer, who blocked the Skype but it was not able to block the AIM messenger and web based chat rooms. CyberPatrol blocked all the tested web based chat rooms, but on the other hand it failed to block social networking sites. Moreover it was able to block only one application messenger. Similarly SafeEyes was not able to block one social networking site and two application messengers. CyberSentinel was able to block only three web based chat rooms.

None of the selected filtering products were able to block fresh proxy sites. There were only two products i.e. Net Nanny and ParetoLogic PGsurfer that were able to block tested peer to peer file sharing applications. However SafeEyes successfully blocked Bit torrent but it failed to block LimeWire.

5.3 Products' effectiveness in filtering search engines

Although Net Nanny was efficient for filtering search engines but over blocking and under blocking was seen. CyberPatrol and CyberSentinel were not able to block search engines. Moreover both failed to refine the search results e.g. all objectionable images were viewable. Safe Eyes was able to block search engines, image and video searches. But it was failed to refine the search results. ParetoLogic PGsurfer was able to block search engines but it was not able to refine search results.

5.4 Products effectiveness in filtering URLs

The results clearly illustrate that each product was doing over blocking and under blocking. Interestingly in each product there was more under blocking than over blocking. However, in some products balance of over blocking and under blocking was worst. For instance, in ParetoLogic PGsurfer, the ratio of under blocking was far more than over blocking. Similarly in CyberSentinel and SafeEyes the ratio of under blocking was far more than over blocking. Although in Net Nanny and CyberPatrol there was more under blocking than over blocking, but ratio of under blocking was not far more than under blocking. The higher value of CBR means the filtering product is more effective at correctly blocking objectionable URLs. Whereas lower value of IBR means the filtering product is better in allowing the access to non objectionable content.

According to this criterion Net Nanny had the highest value of CBR. Therefore it can be concluded that it was more effective in blocking objectionable URLs than other tested filtering products. On the other hand SafeEyes had the lowest value of IBR. Therefore it can be concluded that it was more effective in allowing access to non objectionable URLs than other tested products.

Interestingly results are very close to previous studies.For instance eTesting Labs (eTesting Labs, 2001) also evaluated the CyberPatrol, they calculated CBR= 0.827 and IBR=0.061 that is almost close to the results of this evaluation i.e. CBR=0.884 and IBR=0.06. These results are very similar to Hunter. For instance he calculated the over blocking error rate of Net Nanny and CyberPatrol 3% and 9.1 % that are close to results of this evaluation i.e. 3.6 % and 6% respectively.

6 Conclusion

The evaluation of five filtering products gives the overview of their effectiveness to keep the children safe from content, conduct and contact risks. During the test it was revealed that filtering companies advertise many features but these features have their limitations and can cause false sense of security. For instance SafeEyes advertises the features of safe search, and the blocking capability of social networking sites and peer to peer file sharing applications. But during the test it failed to prove these claims. Similarly CyberSentinel claimed to record and block IM conversations but during the test it failed to fulfil theses tasks. Similarly each product failed to monitor the web based chat rooms and web based emails. There was no such product that could block proxy sites. Over blocking and under blocking was found in each product. Each product had its own limitations. None of the products

proved accurate to safeguard the children from online risks and threats. However, these products can lessen the contact, conduct and contact risks. These products can be used as a layer of defence. In other words, some of the security is better than none of the security. But over reliance and the false sense of security can lead to potential harms.

Though this project has evaluated filtering products for number of online activities but this is just the overview of the effectiveness of filtering products. Because content on the internet is very diverse and there are billions of websites on the internet. For instance there were more than a billion websites by 2001, and many of them were changing daily (Heins et al. 2006). This point can be well explained by this example, if 250 objectionable websites are tested, and filter failed to block 30 websites. Then what will be the number of failure when there are more than one million objectionable web sites?

The focus of this evaluation was those products that are aimed for home users. Products aimed for schools, organizations, libraries, church, and ISPs may have complex structure, functionalities according to the requirements of their targeted customers. For instance, filtering products that are for networks and being deployed at server level may have different features and capabilities. In the future work those products could be evaluated for wider context. Nowadays smart phones are providing the feature of internet browsing. Children can access the internet via mobile phones or game consoles. Moreover there is rapid growth in internet technologies that are introducing new channels of threats. However there are some other limitations of this evaluation. For instance user content generated sites, personal web pages, and web blogs were not included in the evaluation. Children can upload their personal information, videos, and photographs there. Moreover, new channels introduced by web 2.0 are not limited to the evaluated channels. The future work can be carried out in these dimensions.

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