# LOGOTYPE DETECTION FOR CHILD LOCK ON INTERNET TELEVISION

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**Abstract:** Presently, Internet offers to all users easy and constant access to TV programmes through the Internet TV. These programmes are not always appropriate for all users (eg childern) on account of presented content. There are diverse methods of TV programmes blocking In order to check TV programmes content broadcasted through the Internet. However, the problem of automatic blocking is not solved. It does not take a note of the method that consist in verification of the program mes through the identification of the image broadcasted from the video stream. The paper presents a method invented by the authors of the paper based on automatic identification of the provider's logo. The programme's provider reconnaissance will be realized on-line through the automatic identification of the static logo object together with the programme in a sequence of video images. The automatic identification of the provider's logo allows to block access to TV broadcast of the selected transmissions according to the transmission schedule. This method performs a temporal and spatial segmentation of the logo. In order to extract the regions of the logo's contours the Sobel operator is applied. Next, the averaged binerization of the image is obtained through the Otsu method, which identifies its threshold. The vector used in comparison process is calculated through the projection method. The findings received in this work confirm the effectiveness of that method. The method has been tested on transmissions available in the Internet TV. It allows to achieve over 98,7% correct results of the Internet TV programmes blocking on-line.

**Keywords:** logotype identyfication, child lock, contour image

## 1. Introduction

The problem of underage persons' easy access to the multimedia video with inappropriate content and its consequences is well known [3,15]. One of the sources enabling the access to such video programmes is the widely available Internet TV.

Zeszyty Naukowe Politechniki Białostockiej. Informatyka, vol. 7, pp. 31-45, 2011.

There are numerous methods which are used to control the content of the television programmes transmitted via the Internet. These include, among others, blocking video materials at certain hours [19-21] or filtering chosen IP addresses and keywords on web pages [18]. There are also parental control modules, which can be embedded in the anti-virus software, web browsers and operation systems. All these well-known methods do not, however, solve the above mentioned problem completely. Thus, in the case of a temporary access block on Internet TV, parents must be involved in the process of programme assessment and selection. With regard to IP address filtering, the problem concerns a rapidly growing number of keywords, which the filter should block, as well as easily made changes of the IP addresses by Internet providers.

Another solution is to do an analysis of the provider's logo transmitted together with the video stream. In a video production, logos are used to convey information about the provider's programme content, which can be used in the selection of age-appropriate programmes while broadcasting video. There are related applications which try to identify brand logotypes in video data [5, 6, 12, 16] by using the static character of the logo. In order to identify the logo, some logo detection algorithms use neural network and image analysis procedures [1,7,8,10,17]. However, the selection of an adequate neural network's models, their over-fitting capacity and the high computational cost of the methods limit their applications in practice.

The logo identification in the programme categorisation is presented by Cozar et al. 2007 [4]. This method performs a temporal and spatial segmentation by calculating the minimal luminance variance region of the set of frames and the non-linear diffusion filtering. However, 95% of correct identification has been achieved only when the analysis is conducted on-line. A different solution is presented by Ozay, Sankur [14]. This time, an algorithm performs a detection of the logo by morphological operations. Nevertheless, online tests for detection and recognition on running videos have achieved lower than 96% average accuracy. In [2] logo detection techniques have been used to differentiate advertisements from TV programmes. This approach assumes that a logo exists if a region with stable contours can be found in the image. No temporal information is used and the method has not been tested on video material in a real time transmission, which has resulted in many false detection cases.

Contrasting the aforementioned methods, the paper presents a more effective method for automatic identification of the provider's logo based on an original image of sequence analysis. The automatic identification of the provider's logo allows to block access to video programmes of the selected providers. It takes place regardless of the transmission time, IP address or the keywords used to find a required website.

The method has been tested on some transmitted video, achieving over 98,7% of correct identification.

The article consists of several parts. Section 2 contains a description of the logo detection algorithms based on spatial segmentation. It additionally presents the logo identification and its comparison with logo patterns. Section 3 concentrates on testing the presented method on chosen video streams and illustrating the results of its application. The article ends with Section 4, which includes main conclusions and presents plans for the further development of the above method.

## 2. Algorithm description

The video streaming Internet TV programme is a set of ordered frames through time. These frames can include one or several superimposed logos. Usually, a logo is defined as a small graphic or picture that appears behind the anchor person on the screen. Logo image areas show luminance variance values in narrower interval than other image areas, depending on the logo transparency. An important feature of a logo image is that the logo contours are stable, while the background varies during video broadcasting. Besides, during video broadcasting a logo can be present or absent, for instance during an interruption of the programme transmission. Logotypes are usually placed at any of the four corners of a frame. Therefore, four image corners should be considered as the regions of interest (ROIs). Moreover, their size is limited, since logos should not perturb video viewing (see Figure 1).

Furthermore, logo areas do not significantly change from frame to frame. A logo is a characteristic feature of any programme provider as well as its contents. Logo identification enables verification of various programmes providers, which makes it a tool of parental control, enabling blocking unsuitable programmes for underage viewers. A child's parent or guardian chooses logo patterns from a providers' base which are regarded as inappropriate for children. When a programme transmission takes place, its logo is identified and compared with the ones selected as unwelcome by the parent or guardian. Depending on the received information, the video signal is either blocked or allowed to flow.

Figure 2 illustrates a scheme of the proposed programme blocking system transmitted on-line.

When the logo of the transmitted on-line programme is not included in the data base, the system can add this new candidate logo to the logo patterns base. The new candidate undergoes a process of segmentation, yet it is not included in the currently transmitted logo identification process. Automatic logo adding to the logo data base can take place after it has been projected and recognised several times.

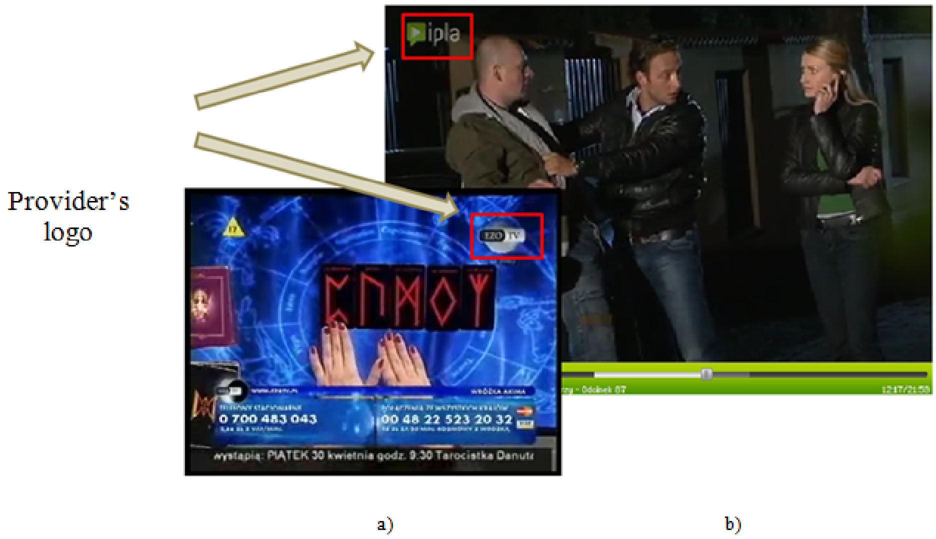



**Fig. 1.** Examples of the frames from broadcasting Internet video EZO (a) and IPLA (b) with the selected region of the provider's logo

Let a mathematical model of a logo image be a matrix, $\mathbf{I} = I(i, j),\ i = 1..m,\ j = 1..n$, where $m$ and $n$ define the size of the logo image. Initially, the digital image $\mathbf{I}$ of the analyzed logo region is converted to the monochrome image $\mathbf{I}'$. This operation includes the calculation of the brightness $I'(i, j), 0 \leq I'(i, j) \leq 255$, for each pixel of the RGB colour components $I'(i, j)$.

To extract contours of the logo regions of the monochromatic image $\mathbf{I}'$, the Sobel operator [9] is applied. Due to this operation an image of the logo contours is created $\mathbf{I}^*$. However, the extracted contours of the logo regions are often not salient because the result of the extraction depends considerably on the time variable background where logos appear. In order to achieve better quality of the contours, the adopted method averages the sequence of the logo contours $\mathbf{I}^*$:

$$\bar{I}(i, j) = \frac{1}{K} \sum_{k=1}^{K} I_k^*(i, j), \quad i = 1..m, \quad j = 1..n \tag{1}$$

where $I_k^*(i, j)$ is the $k$th logo contours image and $K$ - is the number of images $\mathbf{I}^*$. As a result of these stages, the average image of the logo's contours $\bar{\mathbf{I}}$ - is created. It seems clear that in the sequence (see eq. 1) the number of the processed frames $K$ depends mostly on the characteristics of the video stream. Thus, a video with a dynamic se-

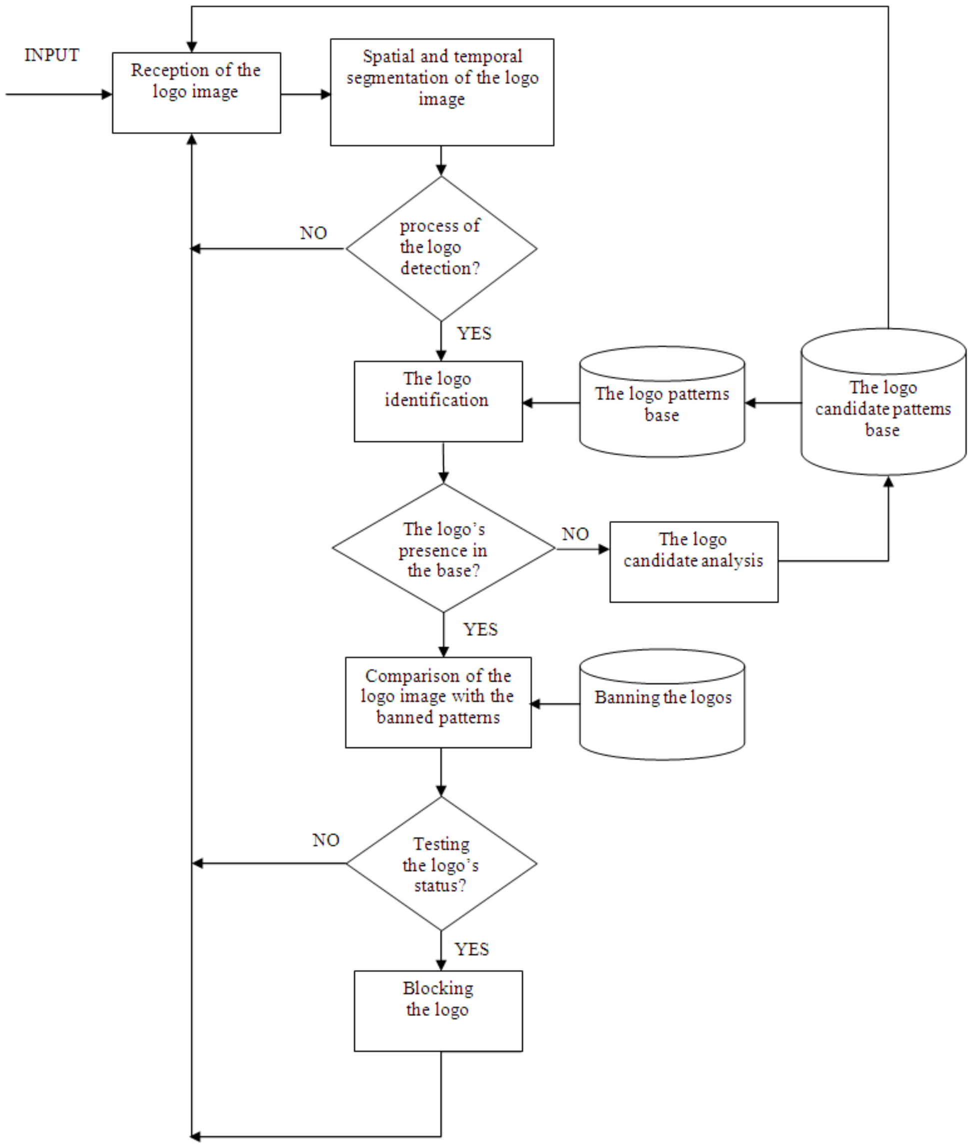



**Fig. 2.** An algorithm scheme for blocking programmes

quence of frames needs fewer frames to generate stable logo contours than the one with a static sequence. Therefore, $K$ value should be chosen experimentally. It seems plausible that a large value $K$ can guarantee better detection for logos which are static for a long period of time. However, a wrong logo contour image is obtained if logo changes occur within the $K$ frames. In this case, the number of frames $K$ used for the logo extraction must be decreased.

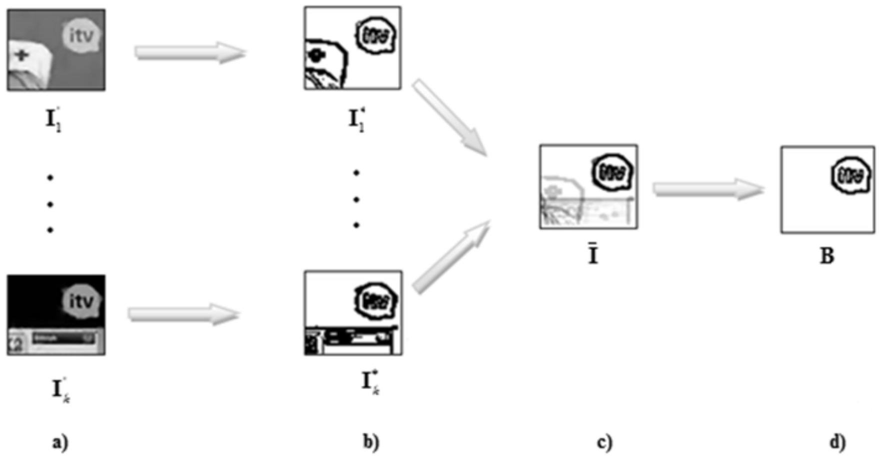



**Fig. 3.** Images obtained in each stage of the algorithm for a real sequence through time: logo monochrome image $\mathbf{I}'$(a), logo contour image $\mathbf{I}^*$(b), average logo contour image $\bar{\mathbf{I}}$ (c), binary logo image $\mathbf{B}$ (d)

In the next stage, a spatial segmentation of logo contours is conducted binarizing of $\mathbf{I}^*$:

$$\mathbf{B} = B(i,j) = \begin{cases} 0 & \text{for} \quad \bar{I}(i,j) \geq p_1 \\ 1 & \text{for} \quad \bar{I}(i,j) < p_1 \end{cases} \qquad i = 1..m,\ j = 1..n \tag{2}$$

where $\mathbf{B}$ is the binary image of the logo contours and the threshold level $p_1$ which are arbitrarily determined from a histogram. An appropriate choice of the threshold level $p_1$ is the basis of a proper process of identifying the logo contours from the image. In order to calculate the required level, average histograms of the logo contours are determined $\bar{\mathbf{I}}$, which, due to different backgrounds, vary considerably (see fig. 4).

The optimum level $p_1$ is calculated by means of the Otsu [13] method according to formula 3.

$$p_1 = \arg\max_p(\omega_0\omega_1(\mu_1 - \mu_0)^2) \tag{3}$$

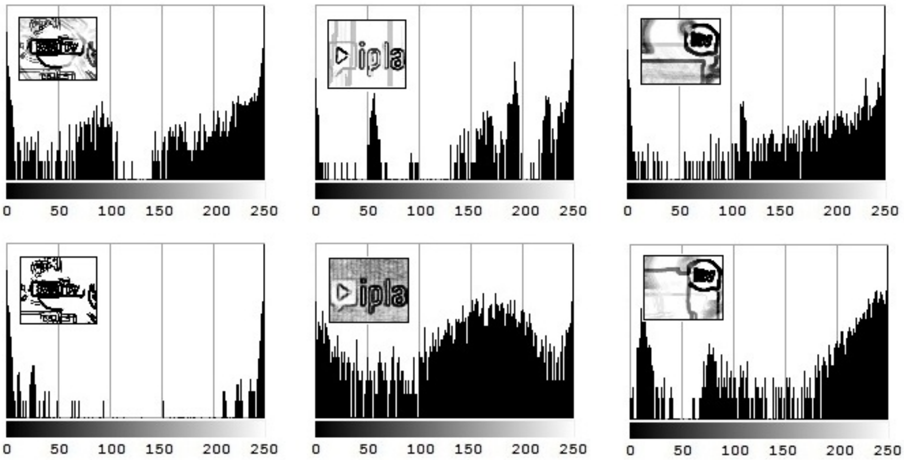
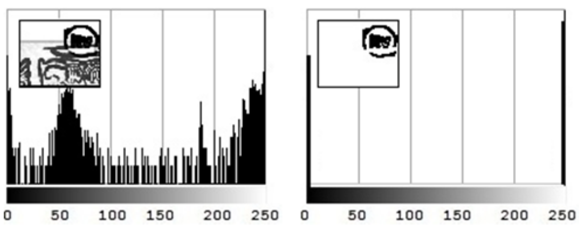



**Fig. 4.** Images of averaged logo contours $\bar{\mathbf{I}}$ and their respective histograms

where $\omega_0$ - constitutes a standardised quantity of the logo contours (a quotient of the number of points belonging to the contours and the number of the image points), $\omega_1$ is the standardised number of the background quality, $\mu_0$ and $\mu_1$ are the averaged qualities of the points brightness for the contours and background respectively, $0 \leq p \leq 255$.
Figure 5 presents example of an image and histogram before and after the application of the Otsu method.




a) b)

**Fig. 5.** An image and its histogram before (a) and after the application of the Otsu binarisation method (b)

Generally, there are cases when the analysed video stream does not comprise any logo, for instance, during commercial breaks. To recognise such a case the following procedure of logo histogram analysis is proposed. Examples of images without logo $\bar{\mathbf{I}}$ and their respective histograms are presented in figure 6. The next step includes cal-

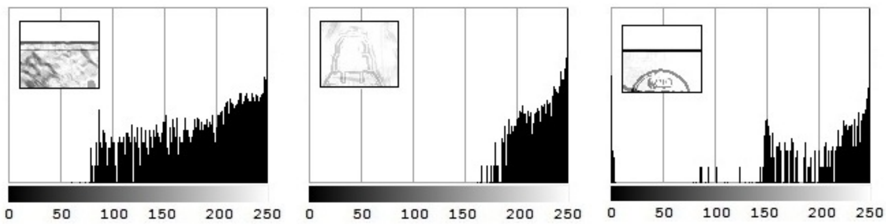



**Fig. 6.** Some images without logo $\bar{\mathbf{I}}$ and their respective histograms

culating sums $S_1$ and $S_2$ how often grey scale values $h(p)$ larger than $\frac{h_{max}}{2}$ appear into the two ranges $< 0..p_1 >$ and $(p_1..255 >$ respectively, where $h_{max}$ indicates the maximum of a histogram. If $S_1 \leq S_2$, it may be inferred that the logo is not included in the image. A graphic representation of the idea is shown in figure 7. When images un-

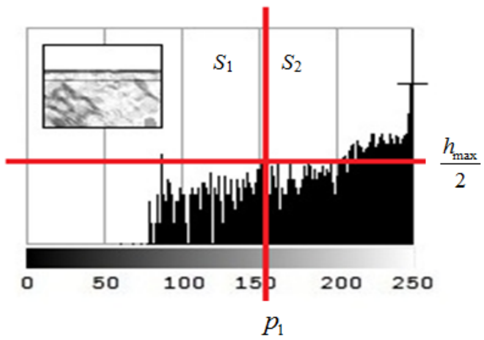
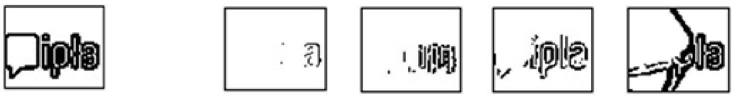



**Fig. 7.** An image without a logo and its histogram with a graphic presentation of calculating sums $S_1$ and $S_2$

dergo the analysis process, two kinds of errors may take place. The first one concerns a situation when the logo is present but has not been identified by algorithm. This happens when algorithm reads incomplete logo contours, i.e. when it identifies light contours in a light background. The case is illustrated by figure 8. The other error



a) b)

**Fig. 8.** Examples of binary image contours of the logo **B** presenting the logo of IPLA provider in real time sequences: full logo contours (a), and incomplete logo contours (b)

connected with the logo identification may take place when the logo is not present and algorithm identifies static contours of an object as the logo, and subsequently adds the identified contours to the data base as a new pattern. Some examples concerning such situations are presented in figure 9. The above situations may take place

**Fig. 9.** Examples of binary logo **B** contours identified inappropriately as potential candidates for new logos

due to the nature of the discussed problem. Proper recognition of such cases by algorithm is, however, difficult. To identify the logo, it is first of all necessary to define the logotype database as a set of the logo patterns representing different broadcast providers of the Internet TV programmes. Let $\{\mathbf{B}_r^z\}$, $r = 1..R$, be the reference set of the $R$ logo patterns. Each pattern $\mathbf{B}_r^z$ is obtained by the same procedure as the one described above, when the background is stable. A good descriptor of the binary image **B** of the logo contours is the shape itself, but a long feature vector would be created. An important reduction of the feature vector size, without a great loss of accuracy, can be achieved if the $x$-axis and $y$-axis shape projections are used. Let

$$w_i = \sum_{j=1}^{n} B(i,j), \quad i = 1..m, \quad k_j = \sum_{i=1}^{m} B(i,j), \quad j = 1..n$$

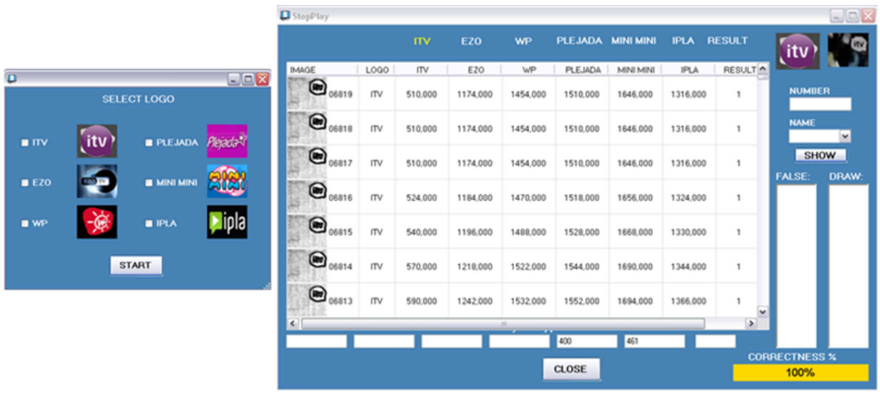
mean $x$-axis and $y$-axis shape projections of a binary image **B** of the logo contours. Then, a good metric to compare the feature vectors [**w**, **k**] and [$\mathbf{w}^z$, $\mathbf{k}^z$] of **B** and $\mathbf{B}_r^z$ respectively is the distance given by the following expression:

$$\min_r\left(\sum_{i=1}^{n} |w_i^I - w_{r,i}^z| + \sum_{j=1}^{m} |k_i^I - k_{r,i}^z|\right), \quad r = 1..R \tag{4}$$

Algorithm enables an automatic supplementation of the pattern data base. A candidate analysis of a new pattern is conduced according to of the rank of correlative factors τ Kendalla [10] between the analysed image and patterns. The method enables qualifying if the logo included in the transmitted programme exists in the data base or whether it should be added as a potential candidate.

## 3. Method verification

"*StopPlay*", a novel application shown in Figure 3, has been written in the C# language. The application analyses a video stream of the selected Internet television programmes in on-line regime. In order to verify the correctness of the algorithm in the process of the logo recognition, a set of six patterns of the logo { $\mathbf{B}_r^z$ }, $r = 1..6$ (see Figure 10) of popular Internet televisions was defined. The Internet addresses of Internet television programmes used in the tests include Inter Alia: *http://www.itv.net.pl*, *http://www.ipla.pl*. The logo images of dimensions 60x50 pixels are automatically




a) b)

**Fig. 10.** Set of chosen logotypes (a) main application window (b)

extracted from each frame in the video stream during the transmission of Internet television programme. The number of binary images needed to create an average contour image was set at *K=40*. As it is argued in Section 2, in order to rid the programme of disturbances and get clear contours of the logo in its background, qualities $p_1$ cannot be taken arbitrarily. Figure 11 presents examples of averaged contours of the logo and their respective binary images and histograms. The threshold levels $p_1$ are chosen according to the Otsu method and depend on the levels of grey shades in the image.
The use of such values allows to achieve approximately 99% of correct identification in the logo detection procedure. The only activity left for the user is to choose the

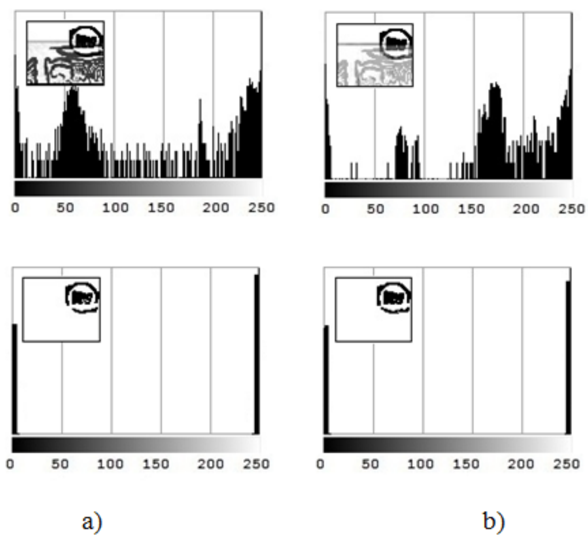



**Fig. 11.** Averaged images of the logo contours and their respective binary images with appropriate quality levels $p_1 = 35$ (a), $p_2 = 100$ (b) presented according to the Otsu method and their histograms

names of the provider (providers), whose logo should be recognised from a particular set of programmes. Figure 12 presents an analysis of the tested logos of the television programmes. The tests were conducted on an average of 20 000 video frames during approximately three hours' time on the three available TV sites: ITV, EZO, IPLA. The algorithm was tested during the TV programme transmission as well as during commercial breaks. The obtained results show that the presented algorithm detects the logo with an accuracy of over 99%.

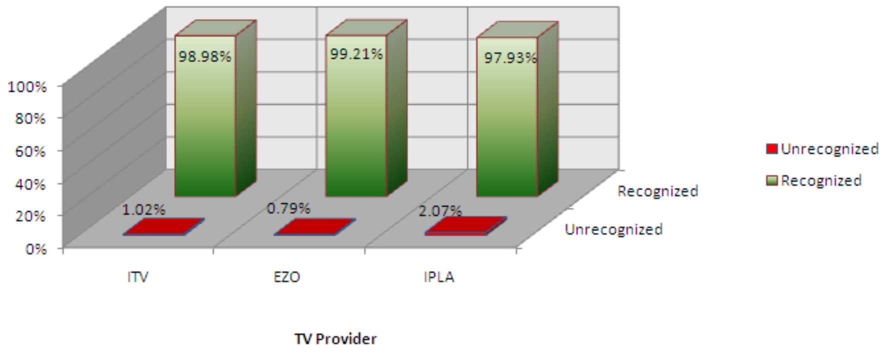



**Fig. 12.** Percentage chart for positive recognised logos in the selected broadcasting Internet video

The lack of proper recognition of the logo is due to cases when the logo and the background are in the same colours, i.e. without visible logo's contours, as well as cases when some permanent objects are present in the logo. When recording consecutive frames of video sequences these additional objects become regions identified in the algorithm as a logo. Figure 13 presents such tested logo patterns and examples of images of the logo contours $\mathbf{I}^*$ recognised (a) and unrecognised (b).

## 4. Conclusion

This article presents the logotype recognition algorithm and its application in the television programme providers in the on-line regime. The suggested method takes advantage of a multi-step segmentation of temporal and spacious logo, which enables detecting the image contours and eliminating the background objects from the on-line video images. A comparison of the achieved images of the logo with the patterns allows an automatic identification of the transmitted programme. The identification process takes into account situations when the logo is not present due to, for instance, an interruption of the transmission process. It has been proved that the implemented algorithm is capable of detecting images of the logo with an accuracy of over 98,7%. The cases which are problematic are due to situations when the logo and background images are in the same colours and when permanent objects appear in the logo region. Under such circumstances the algorithm identifies the entire regions as logos. However, in contrast to many other object recognition algorithms, the proposed algorithm does not require preparation of any learning set or application of any advanced methods for image processing. This allows for its practical and easy

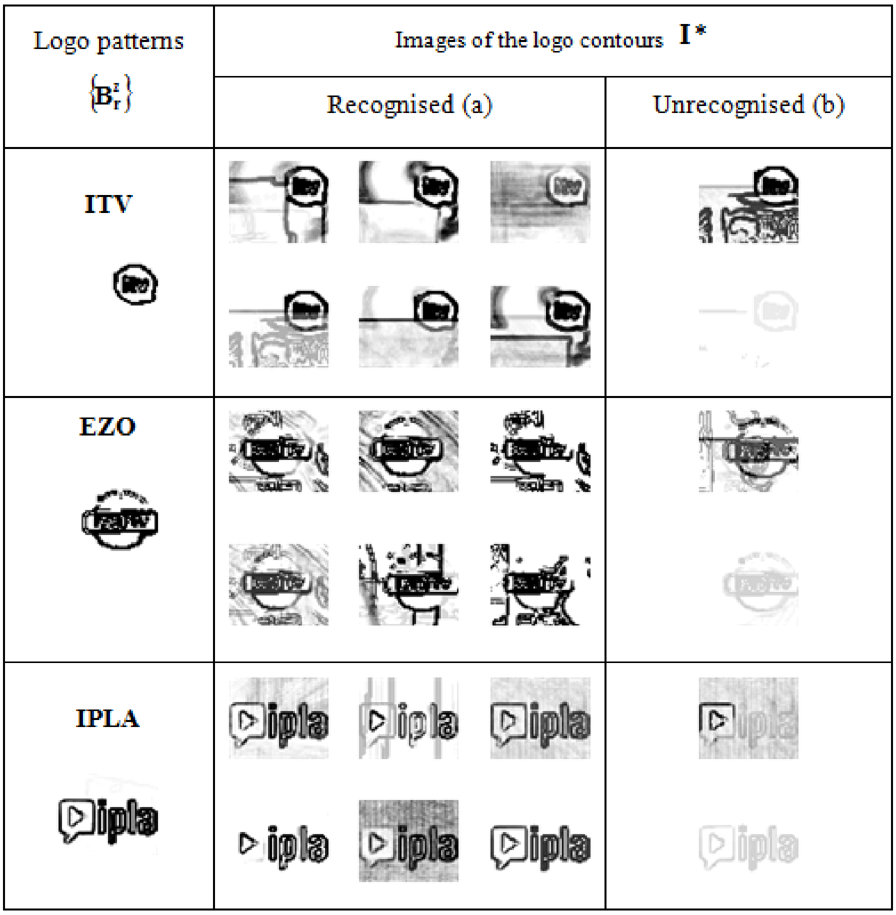



**Fig. 13.** Examples of patterns $\{\mathbf{B}_r^z\}$, and images of the logo contours $\mathbf{I}^*$: recognised (a) and unrecognised (b)

use in the application of automatic identification of television programmes and minimises the potential negative effects of Internet television on children. Further studies will include refinement of the algorithm and propose solutions to these recognition problems which have not been identified or detected by the algorithm.

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# DETEKCJA LOGO JAKO NOWA METODA BLOKOWANIA NIEODPOWIEDNICH DLA DZIECI TRANSMISJI W TELEWIZJI INTERNETOWEJ

**Streszczenie** W obecnych czasach Internet oferuje wszystkim swoim użytkownikom łatwy i stały dostęp do programów telewizyjnych dzięki telewizji internetowej. Z uwagi na prezentowane treści, programy te nie zawsze są odpowiednie dla wszystkich użytkowników (np. dzieci). Istnieje wiele metod, które są używane do sprawdzania zawartości programów przekazywanych w programach telewizyjnych. Jednakże problem automatycznego blokowania programów na podstawie treści nie jest całkowicie rozwiązany. Nie istnieją metody polegające na sprawdzaniu programu poprzez automatyczną identyfikację obrazu logo ze strumienia wideo. W artykule przedstawiono autorską metodę polegająca na automatycznej identyfikacji logo nadawcy programu. Rozpoznawanie logo nadawcy będzie realizowane online poprzez identyfikację statycznego obiektu logo emitowanego wraz z programem w sekwencji obrazów wideo. Automatyczna identyfikacja nadawcy programu pozwoli na zablokowanie dostępu do wybranych transmisji telewizyjnych konkretnych nadawców. Metoda wykorzystuje czasowo - przestrzenną segmentację logo. W celu wyodrębnienia regionów konturów logo, stosowany jest operator Sobela, a następnie binaryzacja uśrednionego obrazu z progiem wyznaczanym metodą Otsu. Wyznaczanie zaś wektora do porównań wyznaczane jest metodą projekcji. Otrzymane w pracy wyniki potwierdzają skuteczność metody. Metoda została przetestowana na wybranych programach telewizji internetowej, osiągając ponad 98,7% poprawnych rezultatów blokowania programów telewizji internetowej on-line.

**Słowa kluczowe:** identyfikacja logo, kontrola rodzicielska, detekcja obrazu