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# COMPUTER AIDED ANALYSIS OF TURKISH AND AUSTRALIAN CARTOONS•

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**Abstract**
Art and science show progress together and they are one of the most important parameters of development levels of countries, nations and societies. Moreover, art generates new concepts, environments and tools with the contributions of science and technology. Cartoon as an art discipline, as for all other fields of art, needs to be defined through new approaches such as Wavelet Transform and Neural Networks Methods which are commonly being used in image processing, compression, classification in various medical and biomedical fields. In this study, it is planned to apply such digital and analytical methods on Turkish and Australian cartoon data. Due to parallelism on drawing styles and characteristics of same periods' or following periods' cartoons of artists; physical classification and separation of cartoons may become harder. In addition, criticisms on cartoons commonly are to be interpretative without exact analytical indicators.
**Keywords:** Cartoon, Neural Networks, Art and Science.

## 1. INTRODUCTION

Art, if considered as a journey beginning with images that made to walls of caves, history of art is as old as human history. In prehistoric times, cartoon-like deformation is noticeable in some of the drawings made on walls of caves. However, the first samples of modern cartoon were produced in 16th century. During the Renaissance, despite efforts of drawing and painting "perfectly", Carracci Brothers began to exaggerate figures in their workshop established in Bologna (McPhee& others, 2011). There, the first modern examples of the cartoon were drawn by Italian painters. With the discovery of printing techniques, cartoon began to reach more people and became a popular and funny device and branch of art. There are many different definitions for cartoon. It is possible to define cartoon as a branch of painting that interprets any event or thoughts in a criticizing and humorous way by using drawing techniques. Cartoons can be "exaggerated" drawings, basically (Balcioglu, Ongoren, 1973; Yavuzdogan, 2012).

Cartoon is scattered to world through European countries, and accepted and applied by almost every country of the world. In this paper, Turkish and Australian cartoons are selected as clustering and classification. Despite the geographical distance between Turkey and Australia, there is a great, holly connection between two nations. During the First World War, Anzac soldiers joined to English Army and attacked to Ottomans in Canakkale. Even though Ottomans and Australians were enemies in the beginnings of 20th century, after the war, relationship between Australia and Turkey became stronger than ever. For the memory of the First World War, many Australians are visiting Canakkale every year as "Anzac Day", and art contests and exhibitions are being organized between two countries.

In terms of cartoon history, Turkey and Australia have similar progress dating back to 19th centuries. In Turkey, the beginnings of cartoon history can be extended to Ottoman Empire. Modernization of Ottoman Empire was pioneered by III. Selim (1789-1807); developed by II. Mahmut (1808-1839), and gained importance more than ever with "Imperial Edict of Gulhane" (Ceviker, 2010). Ottoman Empire, which was the leading empire of Asia, Europe and Africa for ages, could not adopt itself to geographical discoveries, economic and technologic progresses of Europe. Especially in the period of stagnation in Ottoman, sultans had great aspiration to "old" by ignoring the facts of new world.

19th century was the period that Ottoman accepted the supremacy of Europe and made revolutionary changes in this direction to become compatible with European countries and technology. "Imperial Edict of Gulhane (1839)" was the physical sample of this policy. In this sense, 19th century is also important for the history of Turkish humor and cartoon. First newspapers and articles were published in

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19th century. The first Turkish newspaper in Ottoman Empire was published by Mehmet Ali Pasa in Egypt under the name of "Vakayi-i Misriye (1828)". Takvim-i Vekayi (1831), Ceride-i Havadis (1840) became the other newspapers. In 1860, Agah Efendi and Sinasi published Tercuman-ı Ahval (1860) and in 1862, Sinasi published his own newspaper, Tasvir-i Efkar (1862) (Ceviker, 2010). The first humor magazine of Ottoman Empire was Diyojen (1870) by Teodor Kasap (Balcioglu, 1998). During the first formations of humor press in Ottoman Empire, people already had knowledge and interest on humor with Karagoz and Hacivat. The role of humor magazines was to make people "readers" more than "spectators" as they were used to be. The most significant humor magazines of this period can be listed as Diyojen (1870), Cingirakli Tatar (1873), Hayal (1873) and Caylak (1876).

In Australia, in the nineteenth century, a rich political cartooning tradition was beginning to flower. The first Australian newspaper to feature political cartoons was the Cornwall Chronicle, in Launceston, Tasmania, first published in 1835. After, the Adelaide Month Almanac in 1850 and the Melbourne Punch in 1855, which both ran anti-government political cartoons, were published. Soon most state capitals had their own versions of Punch. In 1880, The Bulletin was founded, and a revolution of sorts began in political journalism in Australia. Sylvia Lawson said in her book, The Archibald Paradox, that "from 1880 to the years after Federation and the Boer War this journal penetrated its society and gripped attention in ways for which it is hard to find any parallel, even in the highest times of national radio and television". It was the first news magazine (as opposed to satirical magazine) to use political cartoons, and it did so from its very first issue. The biological nerve metaphor, which is either "inflamed" or "dulled" in response to the political decisions and directions of the state, is a powerful metaphoric conceptualization of the waxing and waning of political activism and engagement and of how political cartoons in particular engage with policy issues and the interventions that define political life (Driscoll, 2015).

In 1883, with the arrival on "The Bulletin"s staff of Livingston Hopkins, an American cartoonist, things really began to change. Hopkins brought with him Australia's first photo-engraving equipment, which made it far quicker and easier to reproduce cartoons for printing. Daily cartoons were now a technical possibility. One of Hopkins' images – The Little Boy from Manly, created in April 1885 – came to symbolize Australia. In his words, the Little Boy "typified the well-meant impetuosity of a young colony" (Australian Political Cartooning: A Rich Tradition, [28.11.2016]). On 17 July 1924, the world's first society of cartoonists, the Black and White Artists' Society, was formed in Sydney. Among its early members were some of the finest cartoonists Australia have produced – Sd Nichols, Bunk White, Greg Russ, Jack Quayle, John Wiseman, Jack Baird, Joe Johnson, Cyril Samuels, Frank Jessop, Brodie Mack, Mick Paul, Harry J Weston, Jack Warring, Sd Miller, Arthur Mainly (the Test cricketer), FH Cumberworth, Fred Knobbles and Stan Cross. Later, many more famous names joined –among them Emile Mercier, Jim and Dan Russell, Eric Olive, Monty Weeded, Bill Pidgeon- external site ("WEP"), Paul Anti, and James Kessler. The society now operates as the Australian Cartoonists' Association- external site, and continues to promote the cause of Australian cartoonists in a world where syndicated (US-based) cartoons are becoming more prevalent and powerful (Driscoll, 2015 ; Australian Political Cartooning: A Rich Tradition, [28.11.2016]).

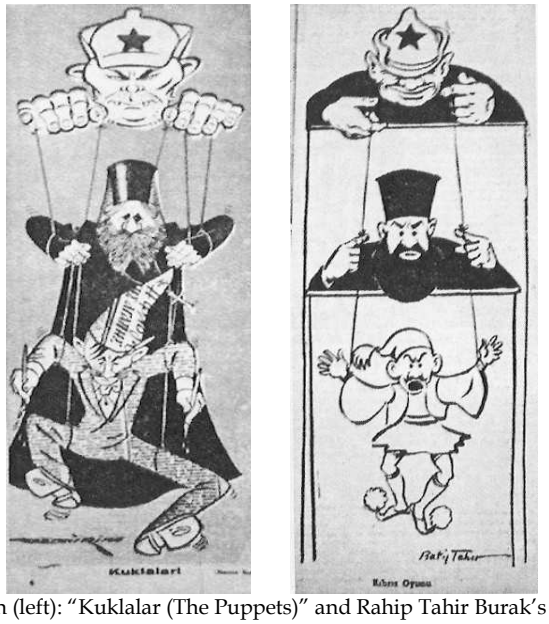
Cartoons remind the viewer of the identity of the subject through the use of symbolism or pictorial hyperbole. A symbolic cartoon seeks to evoke the subject's identity through the depiction of something previously associated with the subject (Gombrich, 1969). The subject's identity may be evoked by an item that is not part of the facial anatomy, such as Churchill's cigar, or by a distinctive feature of the face, such as Hitler's mustache. In these cartoons, the subject can only be recognized by viewers who share the artist's knowledge of the subject (Mauro, Kubovy, 1992, 433-435).

In this paper, computer based methods (Wavelet Transform and Neural Networks Methods) are applied to Turkish and Australian cartoons for recognition and classification. In general, classification problem of Turkish and Australian cartoons are aimed to be come over with some sort of applications of artificial intelligence.

## 2. RESEARCH METHOD

### 2.1 Wavelet Transform Method

Wavelet Transform which is generally used to compress data and information, made significant progress since early 20th century, so it has been applied for many different disciplines. Since Wavelet Transform has been a successful method on signal processing and data compression, it becomes the main or helper model for engineering and computing applications. In the beginnings, Wavelet Transform was used in the fields of molecular dynamics, astrophysics, seismic geophysics, optics, turbulence and quantum mechanics efficiently; nowadays it is used in wider areas such as image processing, pulse and heart rate measurement, ECG analysis, DNA analysis, protein analysis, climatology, general signal processing, audio remembering, remembering visual and computer graphics (Uygunoglu, Yurtcu, 2006, 61).



**Picture 1.** Necmi Riza Ayca's cartoon (left): "Kuklalar (The Puppets)" and Rahip Tahir Burak's cartoon (right): "Kibris Oyunu (The Game of Cyprus)".

In this paper, Wavelet Transform and Neural Networks methods are used together on cartoons. Cartoons are selected from 1930s and 1950s years of Turkish cartoon history and over 100 selections are made to analyze and classify cartoons (Table 1). Australian cartoon data are also selected out of cartoons of 20th centuries (Table 2). The basic decision for making the selection is to use same periods' or following periods' cartoons of artists. Therefore, the problem becomes more complex due to similarities of drawing styles (Picture 1).

**2.2 Neural Networks Method**

Artificial intelligence can be defined as developing programs that act and think like human beings. In other words, artificial intelligence is the process to provide thinking ability to computers by programming them (Uygunoglu, Yurtcu, 2006, 63-64).

The first applications on artificial intelligence are improved by McCulloch & Pitts in 1940s. In 1950s, IBM created the world's first chess playing program and also organized the first international conference on artificial intelligence (Pirim, 2006, 81-83).

Artificial intelligence involves sub applications such as fuzzy logic, neural networks (NN), artificial neural networks (ANN), K-nearest-neighbor (kNN), fuzzy systems, genetic algorithms, etc. These applications can be used singular or together due to the problem's complexity. Artificial Neural Networks (ANN) is imitating neuron structure, basically [8]. ANN is a numerical modeling system that uses input and output data. ANN generates connection between inputs and outputs and has three layers:

1- Input Layers: It contains numbers of neurons same as entering neurons to system.

2- Hidden Layers: It may change in numerically by trial and error method.

3- Output Layers: It contains numbers of neurons same as exiting neurons to system.

In this paper, it is aimed to obtain wavelet coefficients of cartoons' digital images by applying neural networks (NN) using MATLAB (R2014b MATLAB neural networks and wavelet tools). As for the application, multilayer typed NN (Chaudhuri, Bhattacharya, 2000, 11-15) is practiced to distinguish same or following periods' similar cartoons. NN is a commonly used tool for two dimensional classifications and separations. Thus, this is a sort of classification problem. System is trained with MLP-NN (Back propagation) algorithms (Rumelheart & others, 1986) and results are analyzed. Fuzzy logic is another sub application in this paper with NN (Temel, 2009). It is defined by L.A. Zadeh in 1965 (Uygunoglu, Yurtcu, 2006, 65).

Differing form digital's basic logic consisted of 0 and 1s; fuzzy logic is to determine intermediate values. In classical clustering, there are two results: true or false. To compare, fuzzy logic offers percentages based on analysis that can generate better approaches especially in the fields of social sciences. Fuzzy logic has input /output database, flocculants, fuzzy rule base; fuzzy inference and clarifications. In cartoon practice, it is more useful to apply a model based on percentages rather than a model giving certain definitions and results (X cartoon belongs to Y/ or not).

**3. ANALYSIS OF RESULTS**

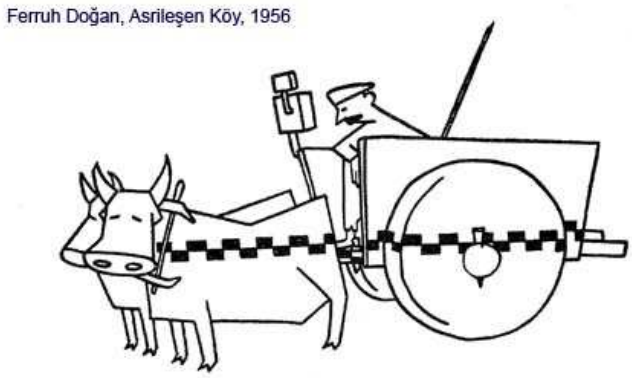
In this section, classification results are obtained on analyzed cartoons. Different values (momentum, minimum, maximum, variance and standard deviation) are calculated with four wavelets coefficients (estimated value, vertical, horizontal and diagonal). Through wavelet transform, for each cartoon obtained twenty two vectors (multilevel 2D wavelet decomposition, 2D approximation coefficients, etc.) have been

used as an input for NN [11]. Weka 3.8 is used for clustering output data obtained via different parameters of wavelet output. In this application, computer aided methods extend the possibility of identifying correct cartoons to 66% (Table 1). Compared to physical correctly selection chance of 25%, computer aided methods increase the possibility to appreciable levels.

Table 1. Variables of classification of Turkish cartoon data

| | |
|---|---|
| Correctly Classified Instances | 66 (66 %) |
| Kappa statistic | 0.0 |
| Mean absolute error | 0.4504 |
| Root mean squared error | 0.4743 |
| Total Number of Instances | 100 |

As for cartoonists of 1930s, Ratip Tahir Burak and Necmi Riza Ayca's cartoons (Picture 1); as for cartoonists of 1950s, Altan Erbulak and Ferruh Dogan's cartoons are analyzed (Picture 2 and Picture 3). These selected cartoonists are one of the most noticeable and well-known cartoonists of Turkish cartoon history.




**Picture 2.** "Asrilesen Koy (Aggression of the Village)", Ferruh Dogan, 1956.

Necmi Riza Ayca (1914-2001) was one of the leading cartoonists of early-republican periods of Turkey and worked for the famous cartoon magazines of that period which are Akbaba, Karikatur, Saka, Papagan, Pardon and Amcabey. Ratip Tahir Burak (1904-1977) was mostly famous of his comic strips and produced many fiction characters and stories based on Turkish history. Ferruh Dogan (1923-2000) and Altan Erbulak (1929-1988) were the cartoonists of later periods that named as "50 Generation. "50 Generation" had affected many cartoonists and younger generations but mostly in their beginning years in cartoon, they were affected by early-republican periods' cartoonists.




**Picture 3.** Sukru Eniste (Sukru Brother): the famous cartoon character of Altan Erbulak.

Table 2. Variables of classification of Australian cartoon data

| | |
|---|---|
| Correctly Classified Instances | 68 (68 %) |
| Kappa statistic | 0.0 |
| Mean absolute error | 0.4765 |
| Root mean squared error | 0.4888 |
| Total Number of Instances | 100 |

In the classification of Australian cartoons, cartoons of Norman Lindsay (1879-1969) and John Frith (1906-2000) are used (Picture 4 and Picture 5). Norman Lindsay and John Frith worked for the same magazine "The Bulletin" together which has a significance importance on being the first news magazine using political cartoons. As it is shown in Table 2, correctly clustered instances are 68 %. This amount may be seen higher to Turkish cartoon data (66 %) but in this case, it is a class of two groups of cartoons with

physical possibility of 50%. To compare, the success is greater in Turkish cartoon data since the classification is made out of four groups of cartoons. In this application, the exact interaction between Norman Lindsay and John Frith made the problem harder. Even though, contribution of computer aided methods to classify Australian cartoon data is clearly meaningful and useful.



**Picture 4.** "The Magic Pudding", Norman Lindsay, 1918.

Norman Lindsay (1879-1969), artist, cartoonist, and writer, came from a family that produced five artists. Lindsay left home when he was sixteen to live with his brother in Melbourne. In 1901 he moved north to make his permanent home in the Blue Mountains, working for the Bulletin in an association that lasted almost to his death. His first novel was published in 1913, and by the 1920s he was both proficient and prolific in pen and ink drawing, etching, woodcuts, watercolours and sculpture. As early as 1904 his work was deemed blasphemous; in 1930 his novel "Redheap" was banned and the following year the police proceeded against an issue of Art and Australia that showcased his art. There were many critics of Lindsay's work but he remained popular with collectors, and Albert, the loyal but cranky "The Magic Pudding" from his classic children's book (1918) is still just as popular with today's younger generation (Norman Lindsay Gallery and Museum, [28.11.2016]).




**Picture 5.** "The Herald", John Frith, 10 June 1954.

John Frith was born and schooled in England before coming to Sydney in 1929. Not long after he arrived, on the basis of a caricature he made during a political meeting in Martin Place, he was employed by the Bulletin, writing gag lines, drawing cartoons and supplying ideas for artists such as Norman Lindsay and Ted Scorfield. After 15 years at the Bulletin Frith became the first daily cartoonist for the Sydney Morning Herald. Five years later, in 1950, over many drinks with Stan Cross, he signed up to Keith Murdoch's Herald in Melbourne, though he was later to doubt if a "more incomprehensible contract was ever signed in such dismal surroundings at such an hour". Although its management tended to discourage the expression of his political ideas, he remained with the Herald from 1951 to 1969. After he retired he continued to make cartoons in various forms, including a series of commemorative jugs for the Bendigo Pottery. Old Parliament House mounted the A Brush with Politics: the life and work of John Frith in 2001; following the success of the exhibition, it toured WA, NSW and Victoria (National Portrait Gallery, [28.11.2016]).

Table 3. Detailed analysis of classification of Turkish cartoon data

| TP Rate | FP Rate | Precision | Recall | F-Measure | MCC | ROC Area | PRC Area | Class |
|---|---|---|---|---|---|---|---|---|
| 1,000 | 1,000 | 0,660 | 1,000 | 0,795 | 0,000 | 0,431 | 0,627 | True |
| 0,000 | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 | 0,431 | 0,311 | False |
| 0,660 | 0,660 | 0,436 | 0,660 | 0,525 | 0,000 | 0,431 | 0,519 | W.Avg. |

Table 4. Detailed analysis of classification of Australian cartoon data

| TP Rate | FP Rate | Precision | Recall | F-Measure | MCC | ROC Area | PRC Area | Class |
|---|---|---|---|---|---|---|---|---|
| 1,000 | 1,000 | 0,610 | 1,000 | 0,758 | 0,000 | 0,481 | 0,601 | True |
| 0,000 | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 | 0,481 | 0,383 | False |
| 0,610 | 0,610 | 0,372 | 0,610 | 0,462 | 0,000 | 0,481 | 0,516 | W.Avg. |

Analytical concepts such as mean value, standard deviation, maximum value, minimum value, etc. are defined through cartoon visuals. In Table 3 and Table 4, such variations as TP Rate, FP Rate, precision, recall, F-measure, MCC, ROC Area and PRC Area are undertaken. In statistical analysis of binary classification, the $F_1$ score (F-measure) is a measure of a test's reliability. There is connection between precision, recall and F-measure, mathematically. Precision may be obtained by dividing the correct positive results to the number of all positive results; recall may be calculated by dividing the number of correct results to the number of positive results that should have been returned (Rijsbergen, 1979; Powers, 2011, 37-40).

The classical F-measure calculation is as below:

$$F_1 = 2.\frac{precision.recall}{precision + recall} \tag{1}$$

The basic formula for positive real β is:

$$F_\beta = (1+\beta^2).\frac{precision.recall}{(\beta^2.precision) + recall} \tag{2}$$

The formula defining relations of TP, FP, FN and $F_\beta$ is:

$$F_\beta = \frac{(1+\beta^2).TP}{(1+\beta^2).TP + \beta^2.FN + FP} \tag{3}$$

In this study, which targets to use computer based methods to solve artistic problems, in addition of making separations between cartoons-considering the similarities or differences on cartoons-cartoon is defined beyond the individual art critics and reviews, with analytical perspectives and values. In general, the objective of this study is to classify cartoons that have parallelism in drawing styles by computer aided methods. In this sense, cartoons are defined through analytical methods and tools, compatible with 21th century's interdisciplinary working conditions and it is planned to create engineering based solutions to problems of art.

**4. CONCLUSION**

Cartoon provides ideas to be defined on a single square that can take many pages by writing. It is commonly said that writers are a bit jealous of cartoonists for this reason. Cartoon art, first modern examples were drawn in 16th century, takes seriously in 19th century in Ottoman Empire. In Turkish cartoon history, the first known cartoonist is Cem. Cem's humor magazine was an active magazine since 1930s. 20th century may be considered as the most efficient period in Turkey in terms of cartoon art. In 1930s, Cemal Nadir, created the first Turkish cartoon character "Amcabey". Cemal Nadir, Ramiz Gokce, Necmi Riza Ayca and Rahip Tahir Burak were the leading cartoonists of early-republican periods of Turkey. Following years, cartoonists of 1950s are called as "50 Generation" and for many art researchers, 1950s are the brilliant years of Turkish cartoon history. In 1970s, "Girgir" humor magazine became one of the most popular humor magazines world-wide by publishing over 300.000. Cartoon museums, cartoonists association were also established in 20th century. In Australia, cartoon begun to gain popularity in 19th centuries, parallel to Ottomans. In 1883, "The Bulletin" was established which was the leading news magazine of Australia; with its contributions and reforms to Australian cartoon. Norman Lindsay, Ted Scorfield and John Frith worked for "The Bulletin" for many years. Livingston Hopkins, an American cartoonist, had also a basic role for the improvement of Australian cartoon that he brought photo-engraving equipment which made the process to reproduce cartoons easier and quicker. In 1885, "The Little Boy form Manly" was created by Hopkin with its technique and it became one of the symbols of Australia. In 20th century, as in Turkey, cartoon had its golden ages in Australia. On 17 July 1924, the world's first society of cartoonists, the Black

and White Artists' Society, was founded in Sydney and its early members were some of the finest cartoonists of Australia.

Australia and Turkey have sacred connection due to historical reasons and cartoons can be great documentaries of this historical linkage. In this purpose, cartoons of 20th centuries are examined through modern, computer based systems indicating the important years of Turkish and Australian cartoon history and results of analysis are obtained with usage of computer aided methods. Art and science interaction emerges as a consequence as not only for the branch of cartoon, as for the all other branches and disciplines of art. Thus, innovative practices and researches are needed providing interaction between art and technology for contribution on solving art based problems.

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**Picture 3:** Archive of Milliyet, [01.12.2016].
http://gazetearsivi.milliyet.com.tr/Altan%20Erbulak/

**Picture 4:** Norman Lindsay Gallery and Museum, [01.12.2016].
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**Picture 5:** Museum of Australian Democracy (Old Parliament House), 18 King George Terrace, Parkes ACT 2600 / Australia.

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