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Short paper

COMPUTER APPLICATION FOR MASTERING THE NUMERICAL ALPHABET

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Vladimir V. Stanković, Dušan A. Halas, Miloš N. Ilić

University of Niš, Faculty of Electronic Engineering, Department of Computation and Informatics, Niš, Republic of Serbia

Abstract. *As one of the various memorization systems, the so-called numerical alphabet has been established. It enables transforming numbers into words. In that way memorizing numbers is highly alleviated, since words are to be memorized instead of numbers, which is substantially easier. The essence of the numerical alphabet is to assign 2 or more consonants to each of the 10 digits. That way each 2-digit or 3-digit number may be transformed into a single word by combining the proper consonants with vowels. This means that, by using the numerical alphabet, memorizing a 20-digit number may be reduced to memorizing a series of 7 to 10 words. In this paper we describe a computer application we have developed, that helps the users to adopt the numerical alphabet, so they can easily memorize numbers.*

Key words: *memory techniques, numerical alphabet, memorizing numbers, education, learning*

1. INTRODUCTION

In almost everything we do there is a lot of data that should be memorized - phone numbers, credit cards, passwords, various codes. Students of various universities who study for their exams to obtain proper education have to memorize vast amounts of data. In lots of cases the material that is to be memorized is abstract, which makes it difficult to memorize. In situations like these we may use so-called mnemonics. Mnemonics represent any learning techniques (or devices) that aid information retention. The essence is to 'translate' information into a form that our brain can retain better than the original form. Mnemonics are based on the fact that the human mind more easily memorizes

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Corresponding author: Vladimir V. Stankovic
Faculty of Electronic Engineering, Aleksandra Medvedeva 14, 18000 Niš, Republic of Serbia
E-mail: vladimir.stankovic@elfak.ni.ac.rs

spatial, personal, surprising, strange, comic or otherwise 'relatable' information, than more abstract or impersonal forms of information. The most famous examples of mnemonics are rhymes and acronyms. An interesting example for memorizing the first 7 digits of the number Pi (3.141592) is the sentence "How I wish I could calculate pi". In this sentence each word corresponds to a proper digit, and the digit is represented by the number of letters of the corresponding word.

Even though there are lots of memory techniques which allow everyone to easily and efficiently memorize all types of data, lots of people have no knowledge of their existence. This paper represents an attempt of the authors to contribute to the popularization of the memory techniques, giving emphasis to probably one of the most challenging areas - memorizing numbers. The reader is referred to [1, 2] for a more comprehensive study of various memory techniques. In this paper we will explain the numerical alphabet and how it can be used for memorizing numbers, and describe the application we have developed, that helps the user to adopt the numerical alphabet. The paper is organized as follows. In section 2 we explain what numerical alphabet is and how it can be used for transforming numbers into words. In section 3 we describe the developed application. In section 4 we consider the related work. Section 5 is the conclusion.

2. NUMERICAL ALPHABET

Numerical alphabet represents an instrument which is used for transforming numbers into words, so that each 2-digit or 3-digit number may be transformed into a single word, which represents that number. That way memorizing a 20-digit number is reduced to memorizing 7 to 10 words, which is substantially easier. The idea is to assign at least 2 consonants to each of the 10 digits. Then, when memorizing some 2-digit or 3-digit number the consonants are combined with vowels, to make a convenient word. The numerical alphabet, defined in [1] for the Serbian language is given in Table 1.

Before explaining Table 1, let us first clarify the main difference between Serbian and English that makes using the numerical alphabet easier in Serbian. In English you have to know how to spell and pronounce each word. The same letter may be pronounced differently in different words. For example the letter 'c' is pronounced in one way in the word 'car' and in another way in the word 'cell'. In the first example the 'c' is pronounced as /k/ and in the second example as /s/. If we apply Table 1 to the word 'car' we get the number '04' ('c' stands for 0 and 'r' stands for 4). However, since in 'car' the 'c' is pronounced as /k/, if we apply 'k' instead of 'c' then we get '74' instead of '04'. So the question is should we take care of the spelling or the pronunciation of words? There are no such situations in Serbian - each letter is always pronounced the same and each sound has one and only one letter, so using the numerical alphabet in Serbian is much more convenient than in English. Another reason why we have chosen Serbian over English is the fact that we were not able to find a complete table of the numerical alphabet for English (a table that contains all the consonants and not just a subset of them), so we decided to develop the application for Serbian. Finally, the third reason was the fact that the application was developed mainly for students of the Faculty of Electronic Engineering in Nis, Serbia, where the first author of this paper works as an assistant-professor. That however, does not mean that the same thing cannot be done for English or some other language. A partial numerical alphabet, similar to the one given in Table 1, is used in [2]. The author of [2], Ron White, is an American, who was a USA national memory champion. White has done many demonstrations of memorizing numbers (among other things) that to ordinary people may seem supernatural. On one occasion White memorized the prices of a few dozens of articles in the supermarket by just hearing them once. The technique White used for this is practically the same as the one described in this paper and, in White's own words, literally every human being is capable of doing such things.

Table 1 Numerical alphabet for Serbian

Digit	Consonant
0	C, Z, S
1	D, T
2	N, NJ
3	M, J
4	R, H
5	L, LJ
6	Š, Ž, Č, Ć, DŽ, Đ
7	G, K
8	V, F
9	B, P

Let us try to give an example how the numerical alphabet is used for transforming numbers into words. Let us say we have to memorize the 6-digit number 579340. The first thing is to separate this number into 2-digit numbers - we will have 57, 93, 40. For the first number, 57, we can form words like *leg* or *look* - 'l' stands for the digit 5 and 'g' or 'k' stands for the digit 7. Then for 93 we can have *bam* - 'b' for 9 and 'm' for 3. Finally, for 40 we can have *race* - 'r' for 4 and 'c' for 0. Of course, each person will come up with their own words that will suit them best. Now all that is left is to memorize the obtained words. How to memorize a series of several words is outside the scope of this paper, but the interested reader is referred to [1] or [2]. There is a technique, called chain of association method, for memorizing series of 10, 20, even 50 or more words, that can be learnt in literally 10 minutes. The idea is to make mental images of each pair of words so that something unusual is happening - the essence of mnemonics. For example, if we are to 'pair up' the words 'skate' and 'bottle', we could visualize a skater wearing bottles instead of skates performing various pirouettes. In this way we should connect each pair - the first two words, then the second and the third word, then the third and the fourth word, etc. until the last two words. A variant of the chain of association method is to make up a funny story in which the elements that are to be memorized appear in order in which they should be memorized. In our example we could visualize *legs* that are running so fast that they make the sounds *bam* in some sprint *race*. It will be enough to see and hear this for a few seconds and we will practically memorize the 6-digit number above. We should also mention here another technique, suitable in cases where we have no more than 3 or 4 words to memorize - we could try to make a sentence from the words, i.e. when making the words in the first place we could try to make such words so as to get a logical sentence. For example, we could use *beam* instead of *bam* and *rice* instead of *race*. Now we can simply form the sentence '*leg* is *beam*ing *rice*', which is funny and as such is easily memorized.

After a little practice a person may start to form groups of 3 digits. This demands more skills to form proper words, but it also demands less number of words that have to be memorized. For the same example we will have two 3-digit numbers: 579 and 340. For these two numbers we could, for example, use the words *lookup* and *mars*.

Let us now explain the rules of the numerical alphabet, i.e. let us explain Table 1.

The letter 'C' looks like the digit '0', it is almost like a full circle, so 'C' is assigned to '0'. The letters 'Z' and 'S' are pronounced similarly to 'C' (at least in Serbian), so they are also assigned to the digit '0'.

The letter 'T' reminds of the Roman sign for '1', it just needs the lower line, so 'T' is assigned to the digit '1', and the letter 'D' is pronounced similarly to 'T', so it is also assigned to the digit '1'.

The small letter 'n' is written with 2 strokes downward, so 'N' is assigned to the digit '2', as well as the Serbian letter 'NJ', which is similar to 'N'. We should emphasize here that the Serbian letter 'NJ' does not have a proper 1-letter Latin equivalent, so it is shown here with 2 letters. The proper Cyrillic representation for this letter is 'Њ'. We have similar situation for the letters 'LJ' ('Љ') for number 5 and 'DŽ' ('Џ') for number 6.

Similarly to the previous case, the letter 'm' is written with 3 strokes downward, so 'M' is assigned to the digit '3'. Also, if the letter 'M' is rotated for 90º clockwise, we will get a symbol similar to '3'. The letter 'J' is also assigned to the digit '3', since if we write two letters 'J' one above the other, we will get a symbol similar to '3'.

The letter 'R' is the last consonant in the word 'four' in many languages (English, French, German, Serbian, etc.), so it is assigned to the digit 4. The letter 'H' is also assigned to the digit 4, since the small letter 'h' looks like a symbol similar to 4 if rotated for 180º.

The letter 'L' is the Roman sign for 50, so it is assigned to the digit '5', as well as the similar Serbian letter 'LJ'.

The Serbian word for six is 'šest', so the Serbian letter 'Š' is assigned to the digit 6. This digit also gets all the rest of the Serbian letters similar to 'Š' and an interesting convenience is that there are exactly 6 of them.

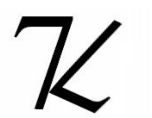

Fig. 1 The letter 'K' formed with two 7s

The letter 'K' can be 'written' with two 7s, one written ordinarily and the other rotated for almost 180º, as shown in Fig. 1, so 'K' is assigned to the digit 7. The letter 'G' is pronounced similarly to 'K' (in Serbian), so it is also assigned to the digit 7.

The hand written small letter 'f' reminds of the digit '8', so 'F' is assigned to the digit '8', as well as the similarly pronounced letter 'V'.

Finally, the letters for the digit 9 are 'B' and 'P'. Both small letters 'b' and 'p' look like the digit 9, if rotated for 180º, the letter 'b' rotated relative to its center and the letter 'p' rotated relative to its vertical axis.

We should mention that the described letter/number similarities may find roots in the Gestalt psychology. Its operational principle is that the brain is holistic, parallel, and analog, with self-organizing tendencies. The principle maintains that the human eye sees objects in their entirety before perceiving their individual parts, suggesting that the whole is greater than the sum of its parts. Also, the whole is anticipated when the parts are not integrated or complete. The gestalt effect is the form-generating capability of our senses, particularly with respect to the visual recognition of figures and whole forms instead of just a collection of simple lines and curves.

In our previous work [3], we have developed a video tutorial that explains each of the 'rules' of the numerical alphabet, described above. This tutorial contains a video animation for each of the digits, while at the same time a human voice explains all the important details. One of the drawbacks of this tutorial was that it lacked examples of how the numerical alphabet is to be used, i.e. it had no specific examples of transforming numbers into words. To correct this, we have added 2 new parts to the tutorial, which will be described in the remainder of this section. The first part consists of 2 subparts, which give examples of how the numerical alphabet can be used for memorizing 2-digit and 3-digit numbers. For numbers 34 and 748 we made proper video animations that show several Serbian words that can be used for memorizing these 2 numbers. At the same time the user can hear a human voice explaining all the details. Screenshots of specific moments of these two animations are shown in Fig. 2.

Fig. 2 Examples for memorizing a 2-digit (34) and a 3-digit (748) number

The second added part also consists of 2 subparts, realized as 2 video animations with a human voice explaining the important details. They show how to memorize an 18-digit number, by dividing it to 9 2-digit numbers or to 6 3-digit numbers. Screenshots for these two examples are shown in Fig. 3.

Fig. 3 Examples for memorizing an 18-digit number as 9 2-digit numbers (left) or 6 3-digit numbers (right)

Even though these additional videos complete the tutorial, we were not satisfied. Namely, in order for the user to really benefit from the numerical alphabet it is not enough to understand what consonant is assigned to each of the digits and see a couple of examples. One has to really automate the process of 'translating' the digits to consonants and vice versa. In [1] the reader is advised to make 10 cards and write the digits on one side of the cards and the proper consonants on the other side of the cards. Then, one should read the cards and flip them over any time one has free time, until one fully automates the numerical alphabet. Unfortunately, the average person is not at all patient to persist in this task. Many people will probably not even bother to make the cards. For these reasons, we have developed a completely new computer application that helps the user to adopt the numerical alphabet. In the next section we will describe this application.

3. The New Application

Fig. 4 shows the starting window of the application. The first option the user has to select ("Prikaži prvo") is whether the application should show first the digit, followed by its consonants or vice versa. This option is understandable, since the user has to know both the proper consonants for each of the digits, as well as the proper digit for each of the consonants. The second option ("Redosled") allows the user to choose changing the digits/consonants in order or randomly. It is obvious that in the beginning the first option will be chosen more often, while after some time the option for random changing will be chosen much more often. In case the option for random changing is selected together with the option to show first the consonants and then the digits, the application does not show all the consonants for a particular digit - it randomly chooses and shows only one consonant, and then shows the proper digit for that consonant. It then randomly chooses and shows another consonant, followed by the digit for that consonant, etc. The reason for this is the fact that it is more difficult to tell the proper digit for a particular consonant if you do not see the rest of the consonants for that digit. The third option ("Pauza") determines the pause when showing the digits and the consonants. The user can enter whatever value one wants, in seconds, so the pause can be several seconds long, or it can be just a fraction of a second. The value that is entered defines the amount of time that has to elapse after a digit is shown before the proper consonants for that digit are shown. Then, after the same amount of time elapses, the application shows the next digit, etc.

The bottom part of the starting window deals with the options for the display of the digits/consonants. The user can choose the desired font, enter the size ("Veličina") or change the color ("Boja"). The color is changed by clicking the colored rectangle, which opens a window with a color palette. Then the user can simply click the desired color. In the right part of the window the user can see how the chosen options will affect the display of the digits/consonants, i.e. how they will look like when shown on the screen ("Sample Text").

Clicking on the "Start" button will start the displaying of the digits and the proper consonants, according to the selected options. This, for number 6, is shown in Fig. 5. If the option to show first the digit and then the proper consonants is chosen, then the application will show first the digit (left part of Fig. 5). After the time interval that was entered as pause elapses, the application will show the proper consonants for that digit (right part of Fig. 5). After the same time interval the application will show the next digit, which will be the subsequent digit or a randomly selected digit, depending on the chosen option, and everything is repeated. Any time during the show the user can click on the Pause button, which pauses the show and the symbol for Pause turns into a symbol for Play. Clicking on the Play button will continue the show and the symbol for Play will turn back into a sumbol for Pause. If the user wants to stop the show, one can simply click on the Stop button, which will stop the show and display the starting window of the application. Then the user can change some of the options and start the show again.

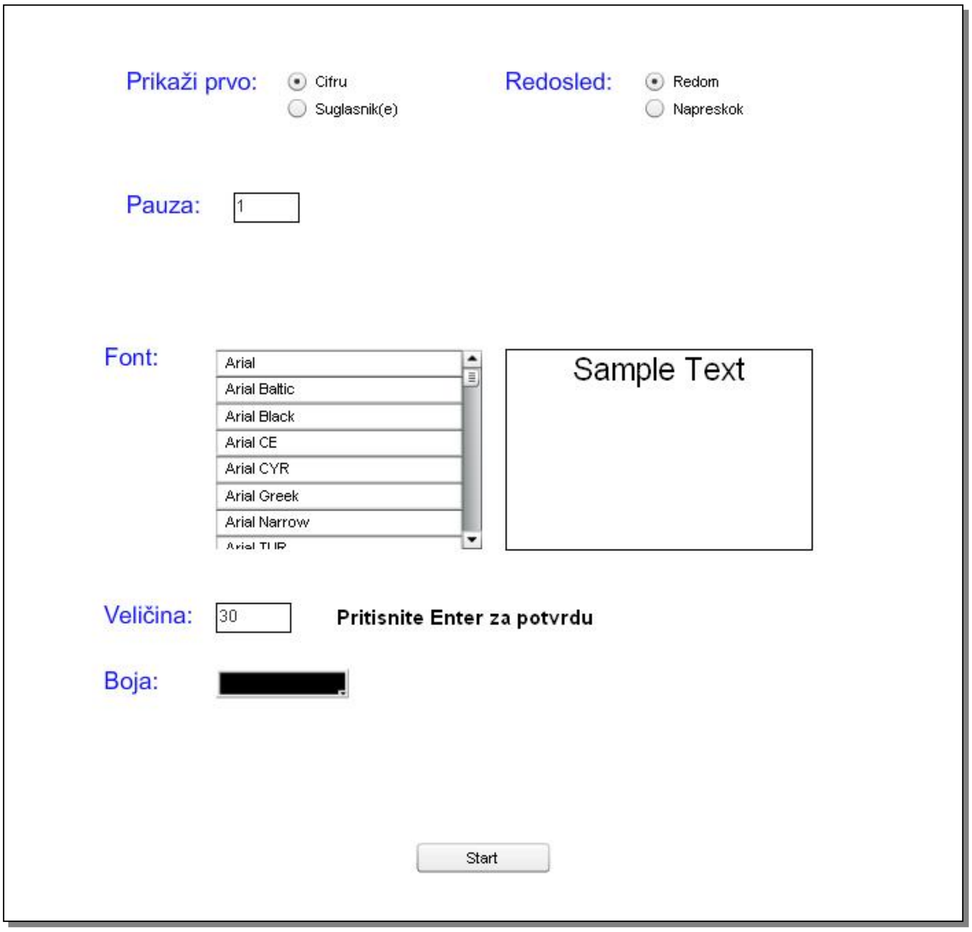

Fig. 4 Starting window of the new application

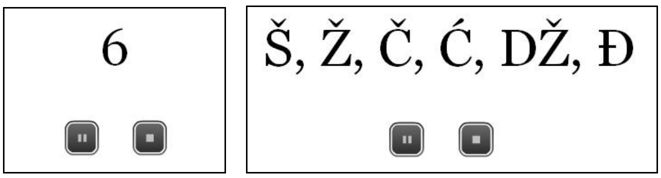

Fig. 5 Display of the consonants for the digit 6

As we can see, the application supports all the possible combinations for changing the digits and the consonants, as well as the proper options for choosing the font, its size and color, which makes the use of the application both useful and comfortable. The option for entering the time duration of the pause, with its variety of possible values, from several seconds to a tenth of a second, makes the application suitable for beginners, intermediate users, as well as experts. From all this we can conclude that a regular use of the application should highly contribute to mastering the numerical alphabet. Anyone who dedicates just a few minutes a day will be able to tell the proper consonants for each digit, as well as the proper digit for each consonant in just a fraction of a second. This will make the task of memorizing numbers interesting and easy, which was our main motive for developing this application.

4. Related Work

There are several computer applications or applications for mobile devices we have found that deal with memorizing numbers. Applications [4]-[7] give help the user with the number(s) one wants to memorize. The user enters the number(s) one wants to memorize and the application offers appropriate words [4]-[6] or appropriate images [7] that represent the number(s) the user has entered. The application [4] also has a part for practicing memorizing numbers - the user can time oneself to see how well one memorizes the chosen list of numbers. These applications are good help when some numbers are to be memorized but they do not help the user master the numerical alphabet like our application does - by using our application the user will be able to memorize any number in any situation without any help. There are also applications that are developed mainly for practicing memorizing numbers [8]-[11]. Among them the application [8] has a part in which the user can associate text and/or an image with each number from 0 to 999. These applications demand from the user to memorize numbers in various ways, and are good for practicing but they do not explain how the user is to deal with this task, they do not even mention the numerical alphabet. As we can see, neither of these applications has the important characteristic that our tutorial and application have - to help the user totally adopt the numerical alphabet, so one can completely memorize numbers in any situation.

5. Conclusion

There are a lot of situations in which memory techniques may help people. This is particularly useful in the case of techniques that transform a difficult and arid task, such as memorizing numbers into an easy and fun process. Memory techniques are applicable for experts in variety of scientific areas, as well as for 'ordinary' people. They are especially useful for students, no matter what faculty they study at, i.e. no matter what their scientific area is. One of the most challenging tasks for students is memorizing numbers. The capability to memorize numbers is important in practically all scientific areas. Students who study technical faculties need to memorize various mathematics and physics constants and other numerical values. Students who study Medicine have to memorize various amounts of drugs and medicines that are given to patients. Students who study history have to memorize dates. Students who study geography also have to memorize various numerical data. Practically there is no area in which memorizing numbers is not an important task in the process of acquiring one's education. In this paper we described a supplement to our video tutorial, as well as a completely new application we have developed that helps the user master the numerical alphabet. To our knowledge this is the first application of this kind. There are other applications that can help in memorizing numbers, but they either only give candidate words for the entered numbers, or only generate random numbers that the user has to memorize without explaining how the user is to deal with this task. Our application helps the user to totally master the numerical alphabet so one can memorize numbers in any situation. We also plan to upgrade the application by including additional functionalities and characteristics in the future. The authors hope that this paper will motivate the readers to begin studying memory techniques, and thus alleviate the execution of various tasks from their professional, as well as everyday life. We especially hope that our application, together with future improvements, will help students in their education.

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