

2008 IEEE International Conference on System of Systems Engineering

(SoSE)

**Monterey, California, USA
2-4 June 2008**

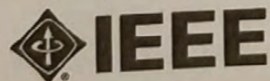


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TABLE OF CONTENTS

HF Skywave FMCW OTH-B Systems Expected Emitter Footprint	1
<i>B. Y. Liu, P. E. Pace, J. B. Knorr</i>	
Simulation of Network-Enabled Radar Systems to Assess the Value of Jamming in a General Radar Topology	7
<i>Y. Q. Chen, P. E. Pace</i>	
Simulation of Information Metrics to Assess the Value of Networking in a General Battlespace Topology	12
<i>Y. Q. Chen, P. E. Pace</i>	
Low-Power Carry Select Adder Using Fast All-One Finding Logic	18
<i>S. Yan, Z. Xin, J. Xi</i>	
Wireless Home Security Architecture Using PDA and Hand Held Devices	23
<i>Ijazzudin, A. U. Din</i>	
Using System Dynamics to Model the Transition to Biofuels in the United States	29
<i>B. Bush, M. Duffy, D. Sandor, S. Peterson</i>	
System of Systems Architecting via Natural Development Principles	35
<i>C. H. Azani</i>	
Design of a Low Cost Underwater Robotic Research Platform	41
<i>M. A. Joordens</i>	
Simulation of Underwater Robots Using MS Robot Studio	47
<i>J. Prevost, M. A. Joordens, M. Jamshidi</i>	
Low Cost Underwater Robot Sensor Suite	52
<i>M. Joordens, J. Serna, S. Songer, C. Friday, J. Hoy, R. Seiger, W. Madalinski, M. Jamshidi</i>	
Modeling Human Cognition Using a Transformational Knowledge Architecture	58
<i>S. H. Rubin, G. Lee, W. Pedrycz, S. C. Chen</i>	
List based Matching Algorithm for Classifying News Articles in NewsPage.com	64
<i>T. Jo, G. Yeom</i>	
From UML Activity Diagrams to Specification Requirements	69
<i>D. Drusinsky</i>	
Automated Network Feature Weighting-Based Intrusion Detection Systems	74
<i>D. Tran, W. Ma, D. Sharma</i>	
Multistage Security for Hybrid, Large-scale, Mobile Wireless Sensor Networks for Missile Defense	80
<i>G. Katsis, T. O. Walker, P. Katopodis, M. Tummala, J. B. Michael</i>	
Optimization Flow Control: A Queue Proportional Algorithm	86
<i>D. Dalalah</i>	
A Human Health Monitoring System of Systems in Bed	94
<i>Y. Hata, H. Yamaguchi, S. Kobashi, K. Taniguchi, H. Nakajima</i>	
Information Mining System Design and Implementation Based on Web Crawler	100
<i>S. Lin, Y. M. Li, Q. C. Li</i>	
Cost Effective Portable System for Sign Language Gesture Recognition	105
<i>Y. Khambaty, R. Quintana, M. Shadaram, S. Nehal, M. A. Virk, W. Ahmed, G. Ahmedani</i>	

A Role-Based Secure Group Communication Framework	111
<i>J. Ban, U. Topaloglu, R. Seker, C. Bayrak, C. C. Chiang</i>	
SoS Aspects of Health Management Technology in Substrate Manufacturing Process	117
<i>H. Nakajima, Y. Hasegawa, H. Tasaki, K. Kojitani</i>	
The Modular Design and Implementation of An Intelligent Cruise Control System.....	123
<i>S. Echegaray, W. Luo</i>	
Architecting Communication Network of Networks for.....	129
<i>K. B. Bhacin, J. L. Hayden</i>	
Towards Net-Centric System of Systems Robotics in Air, Sea and Land	136
<i>T. Shaneyfelt, S. Erdogan, A. Maredia, G. Vemuri, B. Pachala, D. Yue, S. Karovalia, M. Z. Lu, S. Z. Yang, C. Gao</i>	
Computer-Aided Diagnosis System of Systems for Neonatal and Infantile Brain Using MR Images	142
<i>S. Kobashi, Y. Fujimoto, T. Oshiba, M. Ogawa, K. Ando, R. Ishikura, S. Imawaki, S. Hirota, Y. Hata</i>	
Analysis of Revealed Comparative Advantage in the E-Service Market	148
<i>S. Mohammadi, P. Yaghoubi</i>	
On the Optimized Sensor Location Performances in the Presence of Additive White Gaussian Noise.....	154
<i>P. Cotae, S. Yalamanchili</i>	
Parallel, Multistage Model for Enterprise System of Systems	159
<i>H. Kim, S. Lu, J. S. Kim, B. D. Kim</i>	
Enhanced "ULTRA GRIDSEC": Enhancing High Performance Symmetric Key Cryptography Schema Using Pure Peer to Peer Computational Grid Middleware (HIMAN).....	165
<i>M. S. M. Mostafa, S. H. Deif, H. A. E. Ismail Kholidy</i>	
Paradox: Systems Thinking at its Best or at its Worst	171
<i>J. W. Wirsbinski</i>	
Towards a Logical and Scientific Foundation for System Concepts, Principles, and Terminology.....	177
<i>C. E. Dickerson</i>	
Technology and Policy: Opposite Ends of the Paradox Spectrum?.....	183
<i>L. John, J. Boardman, B. Sauser</i>	
ACN: An Associative Classifier with Negative Rules.....	189
<i>G. Kundu, M. Islam, S. Munir</i>	
Modeling Paradox: Straddling a Fine Line Between Research and Conjecture	195
<i>W. C. Baldwin</i>	
System of Systems: Power and Paradox.....	201
<i>J. J. Simpson, C. H. Dagli</i>	
Reliability and Risk Analysis of the Internet: Case of Korean Internet Interconnections	206
<i>D. Kim</i>	
Complex Situations: An Alternative Approach for Viewing a System of System	211
<i>S. Kovacic, A. Sousa-Poza, C. Keating</i>	
An Overview of Content-Based Three-dimensional Model Retrieval Methods.....	217
<i>J. Jia, Z. Qin, Q. Zhang, J. Chen, Y. Liu</i>	
Optimal Allocation of Support to Small Manufacturing Enterprises in Defense Projects	223
<i>T. V. Huynh, X. L. Tran</i>	

Scrambling on Electrical Power Grids	229
<i>T. V. Huynh, J. S. Osmundson</i>	
Paradox: Holarchical View of System of Systems Engineering Management	234
<i>A. Gorod, B. Sauser, J. Boardman</i>	
Wireless Estimation of Canine Pose for Search and Rescue	240
<i>C. Ribeiro, A. Ferworn, M. Denko, J. Tran, C. Mawson</i>	
Tool Selection Process and its Management for Small and Medium Enterprises in Defense Projects.....	246
<i>X. L. Tran, S. Shoval, T. V. Huynh, T. Ferris</i>	
A Methodical Framework for the Design of Multi-Sensor Systems in Automotive Applications	253
<i>T. Herpel, C. Lauer, R. German</i>	
Design and Analysis of Hull Configurations for a Low-Cost, Autonomous Underwater Robot as an Enabling Technology for System of System Applications	261
<i>B. M. Nowak, Y. Ayhan, A. Derric, M. Daniel, M. Joordens</i>	
Analysis of the Influence of Power System Structure on the Central China Grid's Small-Signal Stability.....	267
<i>X. Shi, D. Liu, X. Pan, Z. Zhao</i>	
A Hybrid False Minutiae Removal Algorithm with Boundary Elimination	272
<i>S. Jabeen, S. A. Khan</i>	
An Autonomous Search Utility for Pervasive Storage Virtualization	278
<i>L. Liu</i>	
Sonar Based Autonomous Automatic Guided Vehicle (AGV) Navigation.....	288
<i>A. K. Ray, M. Gupta, L. Behera, M. Jamshidi</i>	
Distributed Protocol for Communications Among Underwater Vehicles.....	294
<i>K. Nagothu, M. Joordens, M. Jamshidi</i>	
Enhancing Canine Disaster Search.....	300
<i>J. Tran, A. Ferworn, C. Ribeiro, M. Denko</i>	
Implementing a Multi-Agent System for the Real-time Coordination of a Typical Supply Chain Based on the JADE Technology.....	305
<i>A. Shemshadi, J. Soroosh, M. J. Tarokh</i>	
Towards the Information Content Driven Product Model.....	311
<i>L. Horváth, I. J. Rudas</i>	
Automated Human Vision Assessment using Computer Vision and Artificial Intelligence	317
<i>J. Van Eenwyk, A. Agah, G. W. Cibus</i>	
Mobile Agent Based Automation of Distributed Workflow Processes	323
<i>M. Flores-Badillo, E. López-Mellado</i>	
Implications of a Rationalist Inductive Approach in System of Systems Engineering Research.....	329
<i>A. Sousa-Poza, J. J. Padilla, I. Bozkurt</i>	
A Discrete Event XML based System of Systems Simulation for Robust Threat Detection and Integration	335
<i>C. Parisi, F. Sahin, M. Jamshidi</i>	
CAPTCHA for Children.....	343
<i>S. Shirali-Shahreza, M. Shirali-Shahreza</i>	

Multi-Domain Robotic Swarm Communication System	349
<i>P. Benavidez, K. Nagothu, A. K. Ray, T. Shaneyfelt, S. Kota, L. Behera, M. Jamshidi</i>	
A Novel Approach of Data Compression for Dynamic Data	355
<i>R. Gupta, A. Gupta, S. Agarwal</i>	
Autonomous Navigation Based on a Q-Learning Algorithm for a Robot in a Real Environment	361
<i>C. Strauss, F. Sahin</i>	
Integrating Statechart Assertions into Java Components Using AspectJ	366
<i>D. Drusinsky, J. B. Michael, T. W. Otani, M. T. Shing</i>	
ATS: Aerial Tracking and Surveillance System	373
<i>S. Kota, M. Jamshidi</i>	
Efficiently Maintaining Moving Micro Clusters for Clustering Moving Objects	374
<i>C. Lai, E. A. Heuer</i>	
An Approach to Surveillance an Area Using Swarm of Fixed Wing and Quad-Rotor Unmanned Aerial Vehicles UAV(s)	380
<i>A. Jaimes, S. Kota, J. Gomez</i>	
A Hybrid Fault Diagnosis and Recovery for a Team of Unmanned Vehicles	386
<i>M. M. Tousi, A.G. Aghdam, K. Khorasani</i>	
Texture Classification Using Wavelet Decomposition	392
<i>E. P. Lam</i>	
Using Wavelet Analysis for Image Scene Registration	397
<i>E. P. Lam</i>	
A Framework for Software Reuse in Safety-Critical System-of-Systems	402
<i>B. Warren, J. B. Michael, M. T. Shing</i>	
An Evolutionary Path Planning Algorithm for Military Applications	408
<i>M. K. Jha, C. C. Chen, P. Schonfeld, S. Kikuchi</i>	
System of Systems Engineering and Family of Systems Engineering From a Standards Perspective	414
<i>J. O. Clark</i>	
Interface Hazard Analysis for System of Systems	420
<i>P. J. Redmond, J. B. Michael, P. V. Shebalin</i>	
Appropriate Modeling and Analysis for Systems of Systems: Case Study Synopses Using a Taxonomy	428
<i>D. DeLaurentis</i>	
A Practical Framework for Data Collection in Wireless Sensor Networks	434
<i>S. Hanoun, S. Nahavandi</i>	
Optimal Multisensor Data Fusion for Linear Systems with Missing Measurements	440
<i>S. M. Korany Mohamed, S. Nahavandi, A. Deakin</i>	
Adaptive Modelling: an Statistical Approach in Designing a Mathematical-model-based Controller	444
<i>S. S. Mirsaeid Ghazi, M. Jamshidi</i>	
Application of Particle Swarm Optimization for Traveling Salesman Problem to Lossless Compression of Color Palette Images	448
<i>J. V. Hook, F. Sahin, Z. Arnavut</i>	
A System of Systems Engineering Environment to Deal with Complex Situations	453
<i>J. J. Padilla, B. Logan, A. Sousa-Poza, C. B. Keating</i>	

Boost Phase ICBM Engagement Using Space-Based Interceptors: A Comparison of Guidance Laws	458
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S. K. Jang, R. G. Hutchins, P. E. Pace

Author Index

CAPTCHA for Children

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Abstract - In some websites it is necessary to distinguish between human users and computer programs which is known as CAPTCHA (Completely Automated Public Turing test to tell Computers and Human Apart). CAPTCHA methods are mainly based on the weak points of OCR systems and using them are undesirable to human users. In this paper a method has been presented for distinguishing between human users and computer programs on the basis of choice of an object shown on the screen.

In this method some objects are chosen randomly and the pictures of these topics are downloaded from the Internet. Then after applying some effects such as rotation, all of the pictures are shown on the screen. Then we ask the user to choose a specific object. Instead of writing the question, it is said using a TTS (Text-To-Speech) system. Therefore children who maybe illiterate and cannot read, can easily pass the test. If the user chooses the right object, we can guess that the user is a human being and not a computer program. This method is specially developed for children websites. The main advantage of this method is its simplicity because the user does not have to read or type anything.

Keywords: CAPTCHA (Completely Automated Public Turing test to tell Computers and Human Apart), Children Websites, Collage Image, Image Recognition, TTS (Text-To-Speech).

1 Introduction

Many aspects of human life have been affected by the expansion of the World-Wide Web (WWW), so that, in industrial countries, many daily affairs, from daily shopping to education and commerce, are done on the Internet.

One of the common actions in most web sites, especially commercial and administrative ones, is to fill out registration forms for certain purposes. After filling out the forms by entering the required information, the individuals will be allowed to connect to that web site to carry out certain jobs.

Unfortunately, there are individuals nowadays who write programs to make automatic false registration in the web site. These programs automatically fill out a form with incorrect information to enroll in the site. This wastes a large volume of the resources of the site in favor of the profit-seeking programmers or reduces the performance of the system. Such attacks are known as "Denial of Services" or DoS.

Various methods have been presented in order to prevent such attacks, aiming at distinguishing human users from computer programs. The main characteristic of these methods should be their automaticity so as to be run only by using the computer; because examination of a large bulk of registration on the Internet web sites by human forces requires a great deal of time and expense and in some cases, such as email services web sites, using human force for examining the registration forms is practically impossible. Therefore, it is necessary to use automatic systems to distinguish human users from computer programs.

In the discussions of artificial intelligence (AI), a test known as the Turing test is proposed for testing the intelligence of a computer. In this test, a human person and a computer are put in two different rooms and a human interrogator in a third room asks them questions. If the interrogator cannot recognize which room the computer is in and which room the human, it is said that the computer has passed the Turing test.

A similar method to the Turing test should be used to distinguish human users from computer programs with the difference that the human interrogator should be replaced by a computer, which should ask questions to distinguish the human user from the computer program. This method is called CAPTCHA (Completely Automated Public Turing test to tell Computers and Human Apart). The main focus of this method is, therefore, on questions that the human user can easily answer but the present computer programs cannot answer them easily. They are similar to Turing test, but they differ in that the judge is a computer [1].

A category of methods used for distinguishing human users from computer programs use the pictures of words. These methods are based on the weak points of optical character recognition (OCR) programs.

OCR programs are used for automatically reading the texts, but they have difficulty reading texts printed with a low quality or reading manuscripts and can only recognize high-quality typed texts that use common standard formats. So, this defect of the OCR programs can be used by changing the picture of a word so that it can be recognized only by a human user but not by any OCR program. Next section will further elaborate on the methods used for this purpose.

The CAPTCHA method is now used in big web sites such as Yahoo! and Google for users' registration. Besides this method, in recent years, methods have been proposed for breaking these methods and automatically recognizing such word images [2, 3]. However, these methods usually disturb the users and also cannot be run on all systems because in mobile phones for example, it is very difficult to type words.

Therefore limited methods in which there is no need to type and do not use OCR systems have been presented so far. Some of these methods are Implicit CAPTCHA [4], Text-to-Speech method [5], and Drawing CAPTCHA [6]. In the next section we will explain these methods.

In this paper, a method for distinction between human users and computer programs is proposed. This method is based on the showing of picture. The picture includes some objects and the only thing that the users should do is to click on the wanted object. Therefore the computer requires two abilities to respond in this method:

1. To find out the shape of the concerned object.
2. To find the concerned object on the screen.

Considering the insufficient ability of the computers to carry out these tasks, only a human user can recognize and choose the concerned object.

In this method, instead of writing the question, it is said using a TTS (Text-To-Speech) system. Therefore children who maybe illiterate and cannot read, can easily pass the test. This approach makes the test more difficult for computer, because the computer needs to recognize the speech. In the third section we will discuss this method and its experimental results in full details.

In the fourth section, the advantages of this method will be discussed. In the last section, we make the final conclusion.

2 Related works

It was first in 1997 when Andrei Broder et al devised the CAPTCHA method. In the same year, Altavista web site used this method to tell computer programs and human apart. In this method, a distorted English word was shown to the user and the user was asked to type it (Figure 1). Distortion was so that OCR programs could not recognize the word [7]. These systems were known as CAPTCHA systems and are now used in most well-known web sites such as Yahoo! and Microsoft.

2.1 Implicit CAPTCHA

The common methods to tell human users and computer programs apart usually troubles the users because he has to read a text that is usually very difficult to read and then type it. However, in the Implicit CAPTCHA [4] methods, the user has to make a simple click. For example, the picture of a mountain is shown to the user and he is asked to click on its top or a number of words are shown in an image and the user asked to click on a specific word. This method is an easier for the users although it is costlier. This method has similarities to our suggested method. We will compare these two methods in section 3.

2.2 The PIX recognition method

In PIX method [8], usual pictures (instead of pictures of words) are used to distinguish between human users and computer programs. A library of pictures with different subjects is prepared for this method and a number of these pictures that have a similar subject is selected and shown to the user while asking the user to select the subject of the picture shown from a list of subjects (Figure 2). However, this method requires a large space for keeping the pictures and the library should also be very extensive, which requires large expenses.

2.3 Text-to-Speech conversion method

In Text-To-Speech (TTS) conversion method [5], instead of showing an image, a sound is played which has been obtained by converting text to speech by certain programs. The user must recognize and type the word. Considering the many complexities of speech and applied effects such as adding noise, it is difficult for computer programs to recognize the played words.

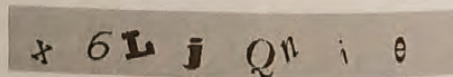


Figure 1. An Altavista CAPTCHA word [7]

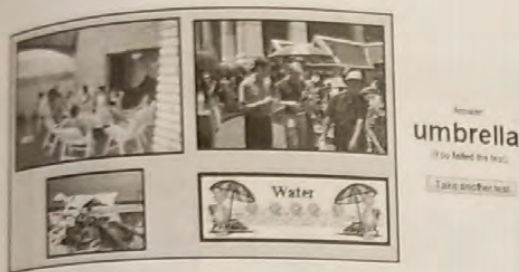


Figure 2. PIX method [8].

2.4 Drawing CAPTCHA

Drawing CAPTCHA method [6] is for devices using stylus pen like PDA (Personal Digital Assistant). In this method, numerous dots are drawn on a screen with noisy background and the user is asked to connect certain dots to each other (Figure 3). In view of the problems that computers face in recognizing the dots from the noise, only a human user can easily identify the special dots and connect them to each other. Unlike the other CAPTCHA methods, the users of any language and any age group can use this method. Also this method can be run on devices with more limited resources than the computer.

As we said earlier, there are also CAPTCHA methods which are using OCR like Persian/Arabic Baffle Text [9], ScatterType [10] and PessimPrint [11], which are different from our CAPTCHA method.

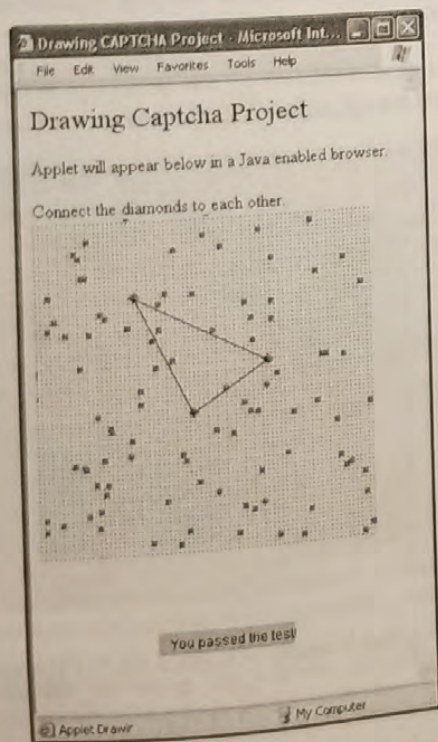


Figure 3. Drawing CAPTCHA project [6]

3 Our proposed method

In this paper, a new method for distinguishing between human users and computer programs through recognition and finding the picture of an object among some other objects has been presented. The structure of the suggested method is simple and as follows:

At first, a bank of the names of some objects is prepared. These names include cars, animals, different persons, flags of countries, etc. The concerned program chooses some of these objects (e.g. 6 objects) randomly. Then the program downloads the pictures about these topics from the Internet [12]. The pictures are searched by Yahoo! image search [13] and their sizes are selected as medium. Each of these pictures is rotated a little. Then all the pictures are shown on the screen. The pictures are putted in random places but the pictures do not overlap.

Computer chooses one of the shown pictures as the goal and asks the user to click on the picture of that object. The question is said using a TTS (Text-To-Speech) system [14]. For example the program shows four pictures, car, rabbit, a few kids, and a bird and asks the user to click on the picture of the rabbit by saying its name. If the user clicks on the picture of the rabbit we can conclude that a human user has done the click and the user is not a computer program because a computer program should do two operations successfully in order to respond appropriately:

First the name of the object must be recognized from speech. After that the computer must recognize the wanted object and has knowledge of its shape. Then it must find the place of the object on the screen.

Awareness of the shape of the object is very difficult and even impossible due to the great number of the objects in the world. If the computer can do the first and second stages successfully then the recognition of the place of the object is difficult because the computer does not know anything about the color, dimensions, and other characteristics of the picture of the object. On the other hand the pictures of the objects have been rotated. As a result, the possibility of detecting the place of the concerned picture by the computer is minimized, unless the computer randomly chooses a place. We can minimize this possibility by increasing the number of the shown pictures.

Maybe in the first glance our method seems to be like the method 2.1 (Implicit CAPTCHA) but these methods are different from each other. In the Implicit CAPTCHA, methods under the name "Single-Click CAPTCHAs" have been presented which are similar to our method.

The first method is based on showing of a series of words, which have various pictorial effects, and in random places on the screen and asking for click on a particular word by user. For example in figure 4 the user was asked to click on the word SUBMIT.

In spite of many similarities between the aforesaid method and ours, this method is based on the OCR in which the computer program must recognize the words and then detects their places.

Nowadays methods have been invented which have been successful in recognition of these words in many cases [2], [3] while in our method we deal with showing the picture of the objects and the OCR methods have not been used at all. Furthermore the recognition of a picture, as explained earlier, is more difficult for a computer.

Another method which has been presented in "Single-Click CAPTCHAs" section is to show a picture and asking the user to click on a particular place on the screen. For example, a scene of a mountain is shown and the user is asked to click on the mountain top (Figure 5). In this method, the concerned points must be determined manually. As a result, developing this method is very time consuming while in our method the pictures are chosen randomly and we do not have to determine the points manually. Furthermore, in our method some pictures of different objects are shown and the user must choose the picture of the concerned object. On the other hand, in our method the pictures are rotated in order to complicate the recognition of the pictures for computer more.

In general, it can be said that our suggested method is the improved version of the Implicit CAPTCHA method in which we have effected many changes and combined it with the method 2.2 (PIX) and 2.3 (Text-To-Speech).

Our method has been implemented by Java programming language. In this implementation, at first a bank of the names of some objects is created. The program chooses the names of six objects randomly and the pictures of these objects are downloaded from the Internet. These objects' pictures are searched by Yahoo! image search [13]. The sizes of pictures are selected as medium to increase the downloading speed.

The program rotates the pictures by packages which have been defined for working with pictures in Java programming language. Then pictures are placed randomly in the screen. If the pictures are overlapped, a new random place will be chosen for the overlapped pictures.

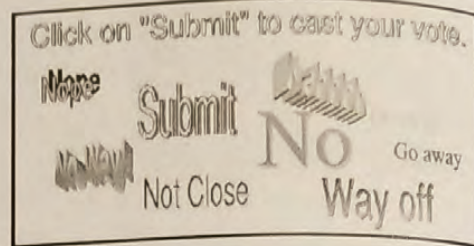


Figure 4. An example of Implicit CAPTCHA method which uses OCR weaknesses [4]

Finally the program chooses one of the six shown objects randomly and asks the user to click on the picture of that object (Figure 6). Instead of writing the question, it is said using a TTS (Text-To-Speech) system.

In our implementation, we use FreeTTS as TTS engine. FreeTTS is a speech synthesis system written entirely in the Java programming language. It is based upon Flite, a small, fast, run-time speech synthesis engine, which in turn is based upon University of Edinburgh's Festival Speech Synthesis System and Carnegie Mellon University's FestVox project [14].

If the user chooses the right object and clicks on it, a message which reads as the successful response of the user is shown and he/she will be allowed to carry out the concerned operations.

A sample implementation of this project is available at: <http://www.hip.ir/ChildrenCAPTCHA/>.



Figure 5. Another Example of Implicit CAPTCHA method [4]

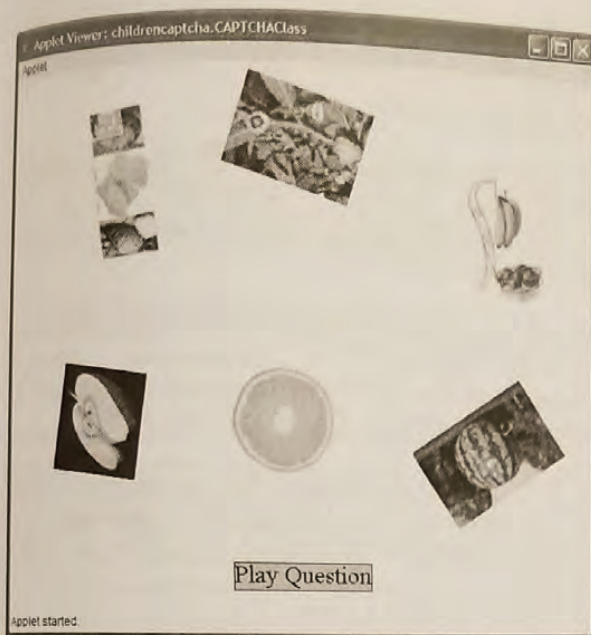


Figure 6. Our Children CAPTCHA method

4 Advantages

Some important features of our method are as follow:

- Children can easily use this method, even if they cannot read, because the question is said. Also they do not need to write anything and only must click on an image.
- It can be used by all ages, even elderly.
- Unlike the other CAPTCHA methods which are OCR-based, this method only needs to click on a picture. Sometimes, even human users have difficulty recognizing the displayed words but such a problem does not exist in this method.
- This CAPTCHA method is easy to use and takes little time to pass while not bothering the users.
- It does not require any processing on client side and can be used on small devices and devices with limited resources such as mobile phones. Also no keyboard is needed in this method because it only needs to click on the object. Therefore, it can be run on devices without a keyboard or devices in which it is difficult to use their keyboard, such as PDA's or mobile phones.
- Because we using the Internet for selecting our pictures, we have a large bank of pictures.

- By using the Internet for finding pictures, the costs are reduced, because there is no need to create a bank of pictures like methods 2.1 and 2.2. Making a local database for images needs more spaces for saving pictures and also needs a lot of time and other resources for creating it.
- We can change the difficulty of this method according to its situation. We can make it more difficult by increasing the objects present in the screen, decreasing the distance between the objects and using less familiar objects in a page. This way the recognition and finding of the objects will be more complicated and more difficult for a computer. The difficulty of test can be increased by adding noise to the sound or images. These operations will make the work more difficult even for a human user.

5 Conclusions

In this paper, a new method is presented for distinguishing between the human users and computer programs by showing some pictures simultaneously and asking the user to choose a certain object's picture. The main advantage of this method is its application for children who maybe illiterate and cannot read, because in this method the question is said using a TTS (Text-To-Speech) system.

Since this method consists of three stages (recognizing the speech, the object shape and finding the object) and each of these three operations cannot be done by computer appropriately, this method can resist the computerized attacks.

The Users can work with this method easily although we can increase the rate of its difficulty in order to improve its resistance against the attacks.

Considering the rapid growth of children websites, this method can be used widely.

This method is implemented entirely in Java language. Java is a platform independent language, therefore our method can be used on any systems.

Besides its advantage of covering every age group, disabled people can use this method easily. For example mobility-impaired people and people who have troubled vision can use this method easily because there is no need to read and type anything.

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