A NOVEL STEGANOGRAPHY METHOD VIA VARIOUS ANIMATION EFFECTS IN POWERPOINT FILES

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Abstract:

In this paper, a novel steganography method that hides message via various animation effects in a PowerPoint file is proposed. The animation effects are designed for the presenter to emphasis the key points, control the flow or enrich the interesting in presentation. It is worth mentioning that adding animation effects does not change any content of the slides in the PowerPoint file. In contrast to other steganography methods, using various animation effects to hide message not only livens up on-screen presentations, but also keeps the real content of the PowerPoint file intact.

Keywords:

Steganography; Data hiding; PowerPoint file; Animation effects

1. Introduction

Due to fast growth of Internet applications, digitized data becomes more and more popular. Because of the property of digitized data, easy to duplicate and modify, the researches of information security become prosperous. The techniques of cryptography and steganography are usually used in privacy communication. The term of steganography comes from the Greek words, stegano and graphia, and means "covered writing" which is usually interpreted to mean hiding information in other information [1]. In contrast to cryptography which is about protecting the content of privacy messages, the steganography is about concealing their very existence. Many steganography methods [2-7] use various digital materials to cover privacy massage, for example using inter-word space to hide massage in electronic document [2], hiding data imperceptibly in a digital audio recording [3], hiding message in the least-bit plate of a digital image [4], and etc. Most of steganography methods acquire good performance of secret communication but cause little distortion of cover materials.

In this paper, we will propose a novel steganography method that hides message via various animation effects in a PowerPoint file. The animation effects can be applied in any object appearing on any slide of a PowerPoint file, such as a text box, a line, an image, etc. Since different animation effects are used to represent (hide) different message, the real content of the PowerPoint file can be kept intact.

In the remaining of the paper, the Microsoft PowerPoint and its animation effects will be described briefly in Section 2. In Section 3, we will present the proposed method. An example will be given to illustrate the embedding procedure in Section 4. Some conclusions will be made in the last section.

2. Microsoft powerpoint and animations

Microsoft PowerPoint is a ubiquitous presentation program and widely used by businesspeople, researchers, and educators. It is a powerful tool to create professional looking presentations and slide shows. In Microsoft PowerPoint, text, images, graphs, and other objects are positioned on individual pages or slides.

Microsoft PowerPoint lets user create "animations" to liven up on-screen presentations. Animations are applied on text, images, or other elements and appear on a slide at timed intervals or with a mouse click. Animations are often accompanied by a sound effect. They can be used to control how and when text, images, graphs, and other objects appear on your PowerPoint slides. For example, you can make images or text items appear one at a time and add visual or sound effects. Animation can aid in focusing attention during a presentation and make your Slide Show more interesting.

Figure 1 shows three different types of objects appearing on a slide of a PowerPoint file. Each of them is a text box, a directed line, and a sunset image. Here, we will give an example to illustrate the animation effects. Figure 2 shows a slide without animation effect. If we add the "Bold Reveal" animation effect in the text box "Steganography & Watermarking", the animation effect as shown in Figure 3 will appear when we click mouse. This will attract the

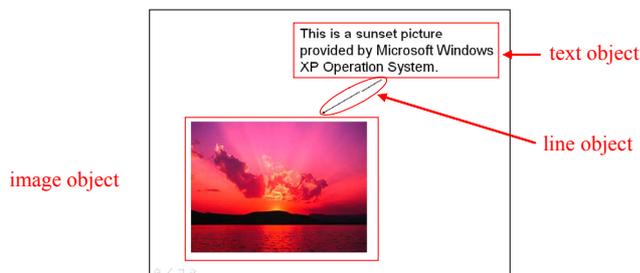attention of audience on the emphasized object.

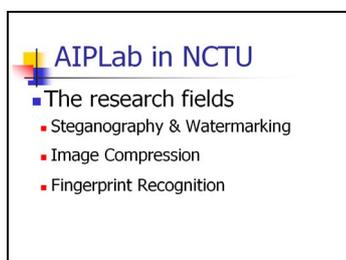Figure 1. Three different types of objects appearing on a slide.

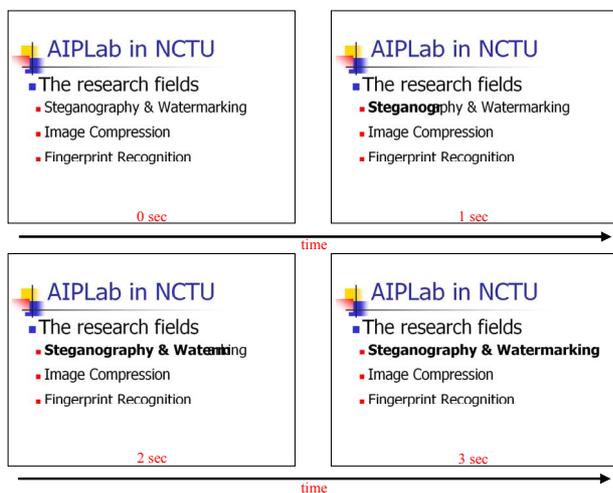Figure 2. The presentation without animation effect.

Figure 3. The presentation with "Bold Reveal" animation effect on the text object "Steganography & Watermarking".

The Microsoft PowerPoint animation effects can be grouped into four categories: Entrance, Emphasis, Exit and Motion Paths. Entrance effects can be set to objects so that they enter with animations during Slide Show. Emphasis effects animate the objects on the spot. Exit effects allow

objects to leave the Slide Show with animations. Motion Paths allow objects to move around the Slide Show. Each effect contains variables such as start (On click, With previous, After previous), delay, speed, repeat and trigger. This makes animations more flexible and interactive.

After analyzing the animation effects, we find that the perceptive results of "Emphasis" and "Motion Paths" animation categories are similar somewhere. So we re-group the PowerPoint animation effects into three categories: Entrance, Emphasis/Motion Paths, and Exit. Two selected effects for each category are shown in Figure 4 to Figure 9.
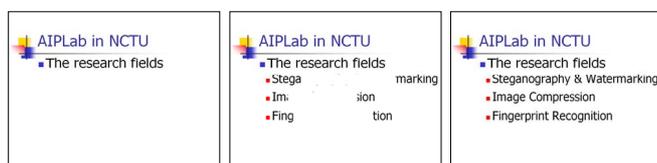

Figure 4. The "Box" effect of "Entrance" animation category.
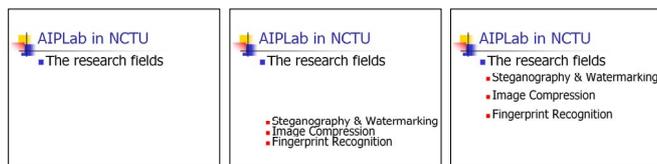

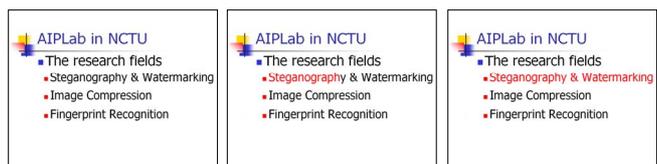Figure 5. The "Fly In" effect of "Entrance" animation category.

Figure 6. The "Color Wave" effect of "Emphasis/Motion Paths" animation category.

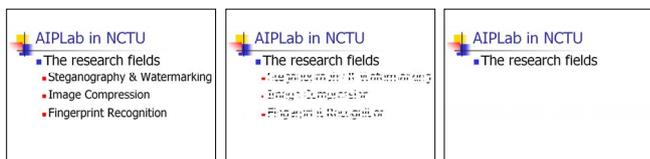Figure 7. The "Transparency" effect of "Emphasis/Motion Paths" animation category.

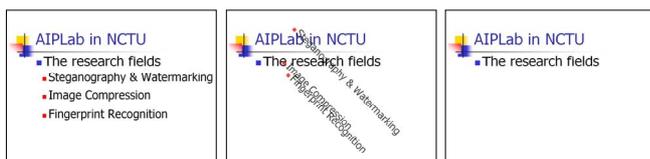Figure 8. The "Checkerboard" effect of "Exit" animation category.

Figure 9. The "Spinner" effect of "Exit" animation category.

As shown in the above figures, we can see that using animation effects in the presentation can help the presenter more easily to catch the attention of viewers on the highlighted object and keep the slide content intact. Based on this property, we will propose a method to hide messages via various animation effects in a Microsoft PowerPoint file. Different effects of animation will be used to represent (hide) different secret message, and the real content of the PowerPoint file can still be kept intact.

3. The proposed method

As mentioned previously, to make presentation more attractive, some animation effects are usually applied in a PowerPoint file. Here, we will present a novel method to embed secret message via these animation effects in a PowerPoint file. The proposed method uses different animation effects to stand for different characters, thus a codebook is designed to record the corresponding between the animation effects and characters and is used to convert the characters in a secret message to the animation effects or reverse the animation effects to the message. The proposed method contains two parts, one is the embedding process and the other is extracting process. Both processes use the same animation codebook as a look-up table. The detail will be described in the following subsections.

3.1. Animation codebook

As mentioned previously, there are four animation categories in the Microsoft PowerPoint. Each animation category has some subcategories, and each subcategory has

some different effects and operative choice. For example, the Entrance-Subtle animation subcategory (a subcategory of the Entrance animation category) has four effects, "Expand", "Fade", "Faded Swivel" and "Faded Zoom", and each of which has three start types and five speed type operations. Therefore the Entrance-Subtle animation subcategory has sixty variations ($4\times3\times5=60$). The number of variations of each category is shown in Table 1. From Table 1, we can see that the volume of animation effects of the PowerPoint is very large. It is very helpful for us to design an animation codebook.

Table 1. The number of animation variations.

Animation Categories	Animation Subcategories	Number of Effects	Number of Variations
Entrance	Basic	19	570
	Subtle	4	60
	Moderate	12	363
	Exciting	17	255
	Total	52	1248
Emphasis	Basic	9	755022720
	Subtle	13	1006633095
	Moderate	4	754974735
	Exciting	5	503316525
	Total	31	3019947075
Motion Paths	Basic	18	540
	Line & Curve	30	900
	Special	16	480
	Total	64	1920
Exit	Basic	19	570
	Subtle	4	60
	Moderate	12	363
	Exciting	17	255
	Total	52	1248
Total number of variations			3,019,951,491

Note that we have regrouped the animation effects into three types, and we can apply these three types of animation effects to each object during presentation. That is, using "Entrance" animation to enter the object, using "Emphasis" or "Motion Paths" to highlight the object, and using "Exit" to make the object leave the slide. In order to make Slide Show look very natural, each character should correspond to at least one animation effect in each category. If a character corresponds to only one animation effect in a certain category, for example, an "Exit" animation, and when we want to embed the character and the current slide

is just appearing, we now enforce to add an "Exit" animation, this will make the slide presentation unusual. According to the antecedent discussion, we suggest two principles of designing an animation codebook as follows:

1. Re-grouping all animation effects into three types of animation effects: "Entrance", "Emphasis/Motion Paths", and "Exit" animation categories.

2. Every character in secret message should be represented by at least one animation effect in each category.

3.2. Embedding process

Before introducing the embedding process, we will make two general assumptions and three embedding rules at first, these will be followed by the proposed embedding process.

Assumption 1: The transmitter and receiver have the same animation codebook.

Assumption 2: The embedding animation effects applied on objects must obey the human perception.

Rule 1: If the object used for embedding message is not in a slide, only effects of the "Entrance" animation category can be applied.

Rule 2: If the object used for embedding message has been in a slide or has embedded message through an animation effect of "Entrance" animation category, only effects of the "Emphasis/Motion Paths" or "Exit" animation categories can be chosen to embed message.

Rule 3: If the object used for embedding message has embedded message through the animation effect of "Emphasis/Motion Paths" animation category, only effects of the "Exit" animation category can be used to embed message.

In the embedding process, we need three materials to create the embedded PowerPoint file. The first is the secret message M being transmitted. The second is the Animation Codebook (AC), which will record the corresponding between characters used in secret message and the animation effects. The last is the cover media, the PowerPoint file, which will be used to embed secret message. In the following, we will describe the embedding steps in detail.

1. Find out the set of objects, O, which could be text boxes, directed lines, and images, in all slides.

2. Generate a random binary sequence, R, with the number of 1 being the same as the length of secret message.

3. Process each object in O based on the binary sequence R.

4. For each object processed and the corresponding bit on R, R_i:

(1) If $R_i = 0$, either an animation effect not in AC is applied or no any animation effect is applied.

(2) If $R_i = 1$, the animation effect in AC corresponding to the secret character is applied.

5. Repeat step 4 until all characters in secret message are embedded.

Note that each object can be applied at most three animation effects, one of which belongs to the "Entrance" animation category, one belongs to "Emphasis/Motion Paths" animation category, and the other belongs to "Exit" animation category. This means that each object can embed at most three characters.

3.3. Extracting process

Similar to the embedding process, we need two materials to extract our secret message in the extracting process. One is the embedded PowerPoint file and the other is the same Animation Codebook, AC, used in the embedding process. The steps of the extracting process are described as follows.

1. Extract animation effects, applied in objects from the embedded PowerPoint file sequentially.

2. For each extracted animation effect, check if it is in AC. If yes, convert it to the corresponding character based on AC. Otherwise, skip.

3. Merge all extracted characters to form the secret message.

4. Experiments

Note that one of the most important works in the proposed method is to design an adaptive animation codebook, which will be used to embed and extract secret message. Here, we will give an example of codebook design. A simple codebook with 37 different characters/symbols is created and shown in Table 2. Every character/symbol can be represented by three different kinds of animation effects (Entrance, Emphasis or Motion Paths, or Exit animation categories); this makes information hiding securer and more natural. All of the animation effects in the codebook can be easily extracted by human vision or the customer animation function in Microsoft PowerPoint 2003.

Table 2. An example of animation codebook.

Entrance Animation Effects	Emphasis or Motion Paths Animation Effects	Exit Animation Effects	Correspond-ing symbol/ character
Appear	Neutron	Blind	0
Blind	Change Font Color	Box	1
Box	Change Font Size	Checker-board	2
Checkerboard	Change Font Style	Circle	3
Circle	Change Line Color	Crawl Out	4
Crawl In	Grow/Shrink	Diamond	5
Diamond	Spin	Disappear	6
Dissolve In	Swoosh	Dissolve Out	7
Flash Once	Color Blend	Flash Once	8
Fly In	Color Wave	Fly Out	9
Peek In	Complementary Color	Peek Out	A
Plus	Contrasting Color	Split	B
Split	Bold Flash	Strips	C
Strips	Brush On Color	Wedge	D
Wedge	Brush On Underline	Wheel	E
Wheel	Darken	Wipe	F
Expand	Desaturate	Expand	G
Faded Swivel	Flash Bulb	Faded Swivel	H
Faded Zoom	Lighten	Faded Zoom	I
Ascend	Vertical Highlight	Ascend	J
Center Revolve	Flicker	Center Revolve	K
Color Typewriter	Grow With Color	Collapse	L
Compress	Shimmer	Color Type-writer	M
Descend	Teeter	Descend	N
Ease In	Blast	Ease Out	O
Grow &	Blink	Grow &	P
Turn		Turn	
Rise Up	Bold Reveal	Slink Down	Q
Spinner	Style Emphasis	Spinner	R
Stretch	Wave	Stretchy	S
Unfold	Bean	Unfold	T
Zoom	Buzz Saw	Zoom	U
Boomerang	Curved Square	Boomerang	V
Bounce	Curved X	Bounce	W
Credits	Curvy Star	Credits	X
Curve Up	Figure 8 Four	Curve Down	Y
Flip	Horizontal Figure 8	Flip	Z
Float	Inverted Square	Float	Space/blank

Based on this codebook, we will give an example to embed message in a PowerPoint file. Assume that Alice wants to make a date with Bob on July 30 at NCTU, she wants to transmit the message "NCTU0730" to Bob in secret. First, Alice creates a PowerPoint file which describes the ten research fields of the automatic information processing laboratory in National Chiao-Tung University (AIPLab in NCTU). The PowerPoint file contains two slides, the first one shown in Figure 10(a) lists the first five research fields, the second one shown in Figure 10(b) lists the last five research fields. Each research field is considered as a text object.
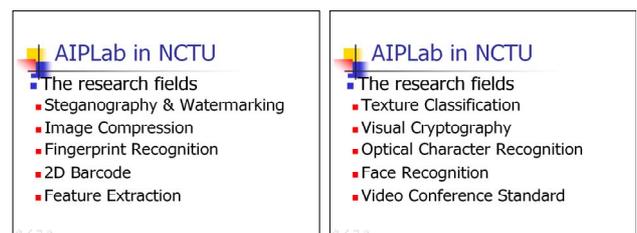
(a) The first slide.   (b) The second slide.

Figure 10. A PowerPoint file with two slides.

Then she generates the random binary sequence "11101001100101". After getting the random binary sequence, the secret message "NCTU0730" can be embedded in selected objects of the PowerPoint file. "N" can be embedded in the first five research fields considered as a text object through Entrance-Descend effect, "C" in the first research field through Emphasis-Bold Flash effect, "T"

in the second research field through Motion Paths-Bean effect, "U" in the forth research field through Motion Paths-Buzz Saw effect, "0" in the last five research fields considered as a text object through Entrance-Appear effect, "7" in the sixth research field through Motion Paths-Swoosh effect, "3" in the ninth research field through Emphasis-Change Font Style effect, and "0" also in the last five research fields considered as a text object through Exit-Blind effect. To see the animation effects, the embedded PowerPoint file can be downloaded from http://debut.cis.nctu.edu.tw/Reports/ppt/test.pps. In the example, two different kinds of animation effects are used to represent the same symbol "0", and a text object is used to embed three symbols via using Entrance (the effect how the object comes in the side), Emphasis/Motion Paths (the effect where the key point is in presentation) and Exit (the effect how the object leaves the side) animation effects sequentially.

From this example, we can see that the proposed method not only keeps the fidelity of the content of PowerPoint file but enriches the PowerPoint file in presentation.

4. Conclusion and Discussion

In this paper, we have proposed a novel steganography method via the animation effects in PowerPoint files and made a fictitious experiment to show the performance of the proposed method. In contrast to other steganography methods, our method does not distort the PowerPoint file and can naturally hide information in files.

Acknowledgments

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