CS 293 Home Assignment 1

Steganography

July 24th, 2012

What is Steganography?

From Wikipedia:
"Steganography is the art and science of writing hidden messages in such a way that no one apart from the intended recipient knows of the existence of the message; this is in contrast to cryptography, where the existence of the message itself is not disguised, but the content is obscured.

Generally, a steganographic message will appear to be something else: a picture, an article, a shopping list, or some other message. This apparent message is the covertext. For instance, a message may be hidden by using invisible ink between the visible lines of innocuous documents.

The advantage of steganography over cryptography alone is that messages do not attract attention to themselves, to messengers, or to recipients."

Steganography...

- Look at this picture
- Does it raise any suspicion?
- But it has a secret picture hidden in!

Steganography (picture in picture)

- We can decrypt it, and get this picture out of it

Steganography...

- Look at this picture now...(called the cover image)
- Looks just fine!
- But it has a secret text message hidden in it

Steganography (text in picture)

- We can decrypt it and get this text out of it.

"Now you might think that I chose my second theme, the importance of imagination, because of the part it played in rebuilding my life, but that is not wholly so. Though I personally will defend the value of bedtime stories to my last gasp, I have learned to value imagination in a much broader sense. Imagination is not only the uniquely human capacity to envision that which is not, and therefore the fount of all invention and innovation. In its arguably most transformative and revelatory capacity, it is the power that enables us to empathise with humans whose experiences we have never shared."*

J K Rowling in her convocation speech in Harvard, 2006

Your assignment

- Write a simple steganography encryption and decryption
- Encryption:
  - Input
    - An image file
    - Secret text
  - Output:
    - Image file with text hidden in it

...Your assignment

- Decryption
  - Input
    - Image file
  - Output
    - Secret text that was encoded

How does steganography work?

Quite easy with digital images!

Digital Images Primer

- Digital images are made up of a fixed number of “pixels” e.g. a 800 x 600 2D image is made up of 480,000 pixels
  - 3D images are define by one more dimension
- Each pixel is generally made up of 3 “channels”: R, G, B (Red, Blue, Green)
  - These “channels” have numerical values representing the intensity of that colour in that pixel

...Digital images

- Suppose the R, G, B values are of type `unsigned char`
- Thus each uses 8 bits, and can have value 0 to 255 describing the intensity.
  - (0,0,0) : Black
  - (255, 255, 255): White
  - (255,0,0): Red
  - (255,0,255): Purple
  - And so on

Hiding data in Digital Images

- Any data can be hidden in digital images. The trick is as follows
  - Consider each channel of each pixel
  - Each channel has 8 bits
  - Let the original image use only the first (most significant) 5 bits
  - Use the lower three bits to encode your data (in binary)

Hiding data in digital images

- E.g. consider hiding the character 'a': its ascii value is 97, hence the binary representation is:
  - 01100001
- Now suppose the pixel at (0,0) – upper left by convention -has RGB channels (10, 200, 20).
  - In 8-bit binary, this is:
    - R: 00001010
    - G: 11001000
    - B: 00010100

Hiding data in digital images

- Now you can “hide” the binary version of 'a' in the RGB channels of this pixel as follows:
  - R: 00001010 → 00001011
  - G: 11001000 → 11001 000
  - B: 00010100 → 000101 01
- Thus 3 bits of R, 3 bits of G and 2 bits of B are being used for the character 'a'.
- Similarly, we can use 480,000 pixels to encode 480,000 characters.
  - We can get a pretty big message across!!

What happens to the image?

- The image will lose some clarity
- But it may not look very bad
- In the best case, the human eye may not be able to distinguish the modified image from the original image
- We can use fewer bits for encoding
  - Can encode lesser data

Assignment specifics

- Instructions on moodle
- You will need some image processing libraries
  - We have provided some demo code, links to the library, other useful links.
- We will use scripts partially, to grade this assignment also.
- RE-EVALUATION OVERHEAD WILL ATTRACT PENALTY. *FOLLOW INSTRUCTIONS AND AVOID THIS PENALTY.*

Assignment specifics

- Use piazza to ask questions to the class and instructors in case you are stuck
  - If you ask everyone, there is a better chance of getting a quick answer
- Follow guidelines of asking/answering questions – do not overstep
- DO NOT COPY OR USE ANY UNETHICAL MEANS.