Workshop on image processing, computer vision and graphics
Applications of IP
class:6, 29.06.2011, time: 11.15am to 1.15 pm

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Overview

▶ Introduction

▶ Motivation

▶ Doctoring methods

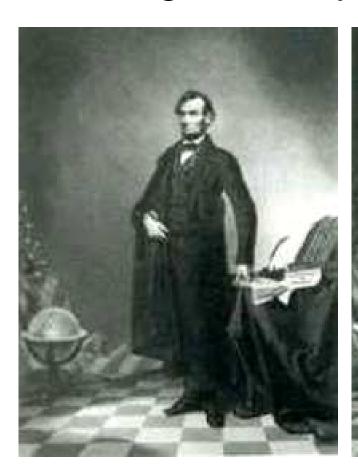▶ Detecting doctored images

▶ Applications

Doctoring

- ▸ Alteration/modification of images:
  - in order to deceive people
  - to amuse
  - to mislead
  - an attempt to rewrite history
- ▸ Modifications are carried using:
  - beyond direct methods of image edition
  - often doctoring inserts or deletes a key element

Doctoring contd..

▸ Doctoring is wide spread

▸ More people are interested

▸ Photo-editing software becoming more sophisticated

▸ Instant distribution via Internet

▸ It been easier to create and spread hoax images

Created using the body of John Calhoun

Lebanon war

▸ The Reuters news agency withdrew this photo showing   bomb damage in Beirut

▸ During the 2006 Lebanon War after bloggers pointed out that repeat patterns in the   smoke looked alike

▸ They had been created by Adobe Photoshop's **clone** tool, with the exaggerating effects of the Israeli assault

Lebanon war contd..

▸ Reuters admitted that it had been doctored by Adnan Hajj, the Lebanese freelancer who took the original photo

▸ Removed all his images from their archive

▸ Bloggers have accused Hajj of manipulating other photos during the conflict.

Iran missile
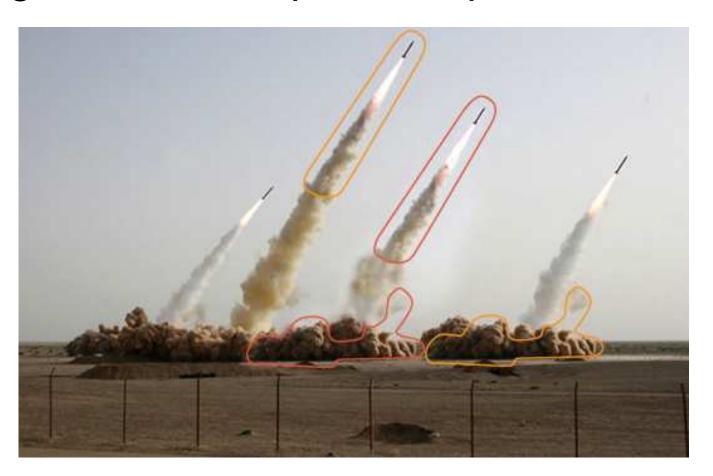
Using **clone** tool of photoshop: original

Using **clone** tool of photoshop: doctored

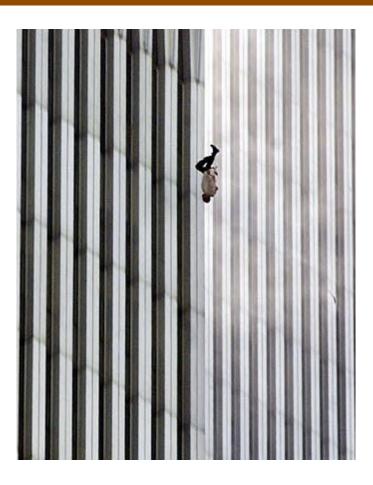# *Iran missile contd..*

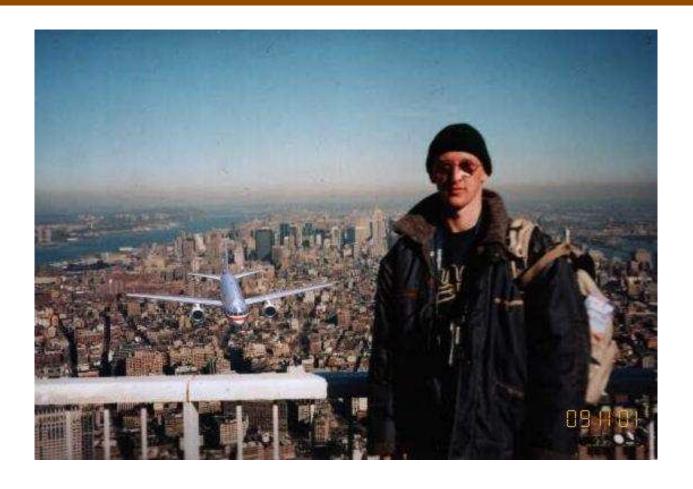## Using **clone** tool of photoshop: doctored

World Trade Centre

World Trade Centre contd..

World Trade Centre contd..

World Trade Centre contd..

▸ This hoax emerged on the Internet just weeks after the September 11 attack

▸ The rational assessment of the picture quickly reveals its flaws - how could the tourist not hear the plane? how did the camera survive?

Antelopes and trains in harmony

Antelopes and trains in harmony

▸ This image of a herd of Tibetan antelopes running undisturbed beneath a train on the new Qinghai

▸ Tibet railway was released by a Chinese state news agency, as evidence that the controversial high-speed line was not damaging the environment

Antelopes and trains in harmony

▶ It was named 'most memorable news photo of the year' by China Central Television

▶ Users of the photography website pointed out flaws in the image

▶ the photographer admitted that he had created it by stitching together two separate pictures.

Benito Mussolini, the fearless horseman

Benito Mussolini, the fearless horseman

Cover page of Star

Cover page of Star contd..

▸ In April of 2005, Star magazine featured a photograph of Brad Pitt and Angelina Jolie

▸ The cover was sensational

▸ It was also a fake:

- Pitt photo taken in the Caribbean in January 2005

- Jolie photo taken some time in 2004

Cover page of Star contd..

- ▸ The setting and shadows suggest that this photograph was taken outdoors

- ▸ Jolie's shadow cast onto the sand, the shadow under her chin, her evenly illuminated face, and the lighting gradient around her right leg, all suggest that she is facing the sun.

Cover page of Star contd..

▸ Given this position of the sun, we would expect the right side of Pitt's face to be illuminated. It is not. It is in shadow, which is impossible.

▸ It is clear that Pitt is facing the sun, which places the sun at a location at least 90 degrees different than the position of the sun illuminating Jolie

Example in sport

Example in sport contd..

▸ Nathan Noy, a rival of Rep. of Jean
  Schmidt (R-Ohio), contends that this
  picture on Schmidt's webpage showing
  her at a 1993 Marathon has been
  doctored.

▸ The photo shows Schmidt near the finish
  line with the time clock showing 3:19:06.

▸ But a newspaper list does not include
  Schmidt's name.

Example in sport contd..

▶ Joseph Braun, an attorney representing Schmidt, denied that the photograph is fake.

▶ He produced what he said was an official race results book, listing Schmidt as the fifth-place finisher in her age group with a time of 3:19:09.

▶ A four-member commission panel ruled that there was enough evidence to look into the complaint.

Example in sport contd..

▸ UPDATE: Citing the lack of evidence or witnesses, a unanimous Ohio Elections Commission dismissed the campaign complaint against Schmidt.

▸ After the hearing, Noy admitted he made a mistake pursuing the complaint.

Example in sport

Example in sport contd..

▸ Steve Bucknor: It has been known to happen where the technology has been used to make umpires look bad

▸ It all depends on who is operating the technology.

Example in sport contd..

▸ This ball is the one with which the batsman got out, but the one that is being shown is not the same one he got out with.

▸ When these things are happening, it makes life extremely difficult for the umpires.

Giant skeleton discovered in India

Giant skeletons discovered in India

▶ The National Geographic Society still receives inquiries about this photo

▶ This photo was published in an Indian newspaper in 2007 to support an article claiming that the Society's archaeologists had discovered the remains of giants

▶ The photo had been created for a photo-editing competition, had been circulating on blogs and websites

Bush photograph

Bush photograph contd..

▸ This photo of George Bush holding a picture book the wrong way during a visit to a school

▸ Some opponents of the Republican president, circulated this image

▸ However, press photos from the event in 2002 revealed that Mr Bush had been holding the book correctly

Varun Gandhi

Varun Gandhi contd..

▸ The debate over Varun Gandhi's communal speech has intensified aftermath party's poll debacle in recently concluded Lok-Sabha elections

▸ Varun Gandhi has received a huge setback with the forensic reports confirming that his hate speech CD was not doctored

Varun Gandhi contd..

▸ Varun had earlier claimed that the CD was doctored and he never made such hate speeches against the Muslim community

▸ According to reports in a section of media, the Forensic Science Laboratory in Hyderabad, has submitted its report to the District Magistrate of Pilibhit, in which it was confirmed that the CD was genuine

Other examples

▸ During nuclear deal issue, there was a video showing some political leaders had taken money to vote against there party.

▸ The party leaders supporting the nuclear deal were clamed that the video was doctored

Different methods of doctoring

▸ Cloning

▸ Lighting

▸ Re-touching

Cloning

▸ A digital image is first partitioned into small blocks

▸ The blocks are then re-ordered so that they are placed a distance to each other that is proportional to the differences in their pixel colors

▸ Re-order the sequence with identical and highly similar blocks neighboring each other

Cloning contd..

▸ Use a region growing algorithm to combine any significant number of neighboring blocks that are consistent with the cloning of an image region

▸ Since it is statistically unlikely to find identical and spatially coherent regions in an image, their presence can then be used as evidence of tampering

Lighting

▸ Method estimates the direction of an illuminating light source for each object or person in an image.

▸ By making some initial simplifying assumptions about the light and the surface being illuminated

▸ One can mathematically express how much light a surface should receive as a function of its position relative to the light

Lighting contd..

▶ A surface that is directly facing the light, for example, will be brighter than a surface that is turned away from the light.

▶ Once expressed in this form, standard techniques can be used to determine the direction to the illuminating light source for any object or person in an image

▶ Any inconsistencies in lighting can then be used as evidence of tampering

Re-touching

▸ Adjusting the contrast of the image is quite common and can be used to alter a photograph in trivial ways.

▸ We can develop a technique for detecting this form of tampering that exploits how a digital camera sensor records an image

▸ Virtually all digital cameras record only a subset of all the pixels needed for a full-resolution color image

Re-touching contd..

- ▸ Only a subset of the pixels are recorded by a color filter array (CFA)

- ▸ The most frequently used CFA, the Bayer array, employs three color filters: red, green, and blue

- ▸ The other two color samples need to be estimated from the neighboring samples in order to obtain a three-channel color

Re-touching contd..

▸ The estimation of the missing color samples is referred to as CFA interpolation or demosaicking

▸ In its simplest form, the missing pixels are filled in by spatially averaging its four recorded neighbors.

Re-touching contd..

▸ CFA is arranged in a periodic pattern, a periodic set of pixels will be precisely correlated to their neighbors according to the CFA interpolation algorithm

▸ When an image is re-touched, it is likely that these correlations will be destroyed

▸ As such, the presence or lack of these correlations can be used to authenticate an image, or expose it as a forgery

Detecting doctored images

▶ Many fakes can be exposed because of inconsistent lighting, including the specks of light reflected from people's eyeballs

▶ A doctored images could have been subjected to many operations like scaling, rotation, brightness adjustment, blurring, enhancement or some particular combinations

Detecting doctored images contd..

▸ It may involve cutting and pasting of another sub-image, which is skilfully manipulated and rendered into the original, to avoid any suspicion

▸ Based on the assumptions that some processing operations must be done on the image before it is doctored, and an expected measurable distortion after processing an image

Detecting doctored images contd..

▸ One can design classifiers that discriminates between original and processed images.

▸ There may be NO differences in well-made digital images copies or manipulated copies

Detecting doctored images contd..

▶ Differences in images and tampered images depend on the method of reproduction and the skill of the tamperer

▶ Differences in lighting, shadow, grain, contrast ratios, fineness of detail, color, etc. help to distinguish imaged that have been modified

Features used in detection

▶ Binary Similarity Measures

▶ Detecting doctored JPEG Images via DCT coefficient analysis

▶ Mean square distortion function

▶ Regularity of Wavelet transform coefficients

▶ Watermark method

▶ Blind deconvolution

▶ Robust image Hashing technique

Doctoring in Science

▸ Those in the media are not alone to the temptation to manipulate photographs

▸ In 2004, Professor Hwang Woo-Suk and colleagues published what appeared to be ground-breaking advances in stem cell research

Doctoring in Science contd..

▸ This paper appeared in one of the most prestigious scientific journals, Science

▸ Evidence slowly emerged that these results were manipulated and/or fabricated

Doctoring in Science contd..

▸ After months of controversy, Hwang retracted the Science paper and resigned his position at the University

▸ An independent panel investigating the accusations of fraud found, in part, that at least nine of the eleven customized stem cell colonies that Hwang had claimed to have made were fakes

Doctoring in Science contd..

▸ Much of the evidence for those nine colonies, the panel said, involved doctored photographs of authentic colonies

▸ While this case garnered international coverage and outrage

▸ In an increasingly competitive field, scientists get the temptation to exaggerate or fabricate their results

Doctoring in Science contd..

▸ The managing editor of the Journal of Cell Biology estimates that as many as 20% of accepted manuscripts contain image manipulation

▸ Better protect against this type of fraud by establishing a clear and strict editorial policy using more scientific findings, and more rigorous screening process

Doctoring in Law

▸ Very difficult to say images or videos are original or doctored

▸ Acorss the world the law ruled that 'virtual' or 'computer generated' images depicting a fictitious minor are constitutionally protected

▸ Many cases across the world: Varun gandhi

Applications

▶ Printing

▶ Medical

▶ Military

▶ Science

▶ Law

▶ Sports

▶ Politics

Reference

- ▶ Papers of Dr. Hany Farid, Associate
  Professor of Computer Science at
  Dartmouth College in Hanover NH, USA

  - ▶ http://www.cs.dartmouth.edu/farid/research/digitaltampering

  - ▶ http://www.cs.dartmouth.edu/farid/research/tampering.html

- ▶ M. Tagliasacchi, G. Valenzise, S. Tubaro

THANK YOU