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BANGLADESH UNIVERSITY OF BUSINESS AND TECHNOLOGY

Assignment on

Biometric, Visual Recognition, and Forensic Applications

Course Code: CSE 467

Course Title: Pattern Recognition

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Introduction: Biometric, visual recognition, and forensic are three widely used technology areas. In real-world applications, all of them are used for different purposes. We can also see their applications in Bangladesh also.

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Part-1

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What is Biometric?

The term "biometrics" is derived from the Greek words "bio" (life) and "metrics" (to measure). Automated biometric systems have only become available over the last few decades, due to significant advances in the field of computer processing. Biometrics is measure of biological or behavioral features which are used for identification of individuals. Most of these features are inherit and cannot be guessed or stolen.

Biometric System: It is a system that takes an individual's physiological, behavioral or both traits as input, analyzes it and identifies the individual as legitimate or malicious user.

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Database

Input Interface (Sensors) → Processing Unit → Output Interface
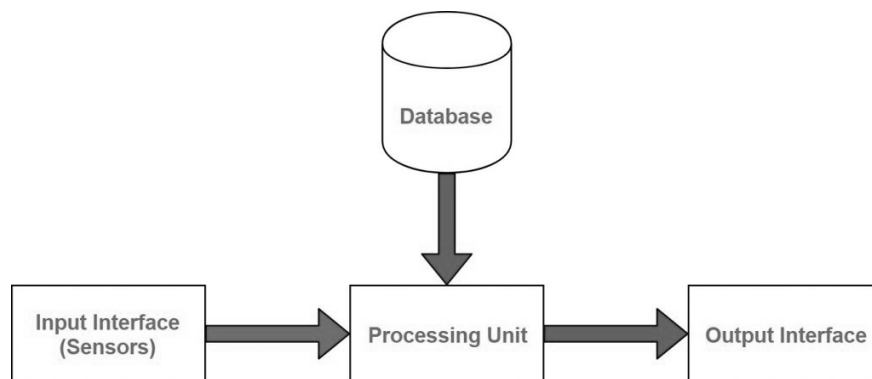
Figure 1: Biometric System

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Example: Fingerprint, palm veins, face recognition, DNA, palm print, hand geometry, iris recognition, retina and odor/scent etc.

➔ **Applications in Real-world:**

a) **Airport Security:** Using biometric technology to verify passenger identity has been used in some of the major airports around the world for several years and the use of the technology is now becoming more widespread. Delta Air Lines, in partnership with U.S. Customs and Border

Protection, Transportation Security Administration and Hartsfield-Jackson Atlanta International Airport, launched the first curb-to-gate biometric terminal in the U.S. at Atlanta's Terminal F.

b) **Law Enforcement:** Biometrics is widely used across law enforcement with agencies such as the FBI and Interpol utilizing biometrics in criminal investigations. An article by Wired reported that U.S. law enforcement agencies have the facial recognition data of 117 million Americans. The UK's Home Office announced £26m investment in police innovation with biometric technology.

c) **Mobile Access and Authentication:** Perhaps one of the most common uses of biometric technology is smartphone security. Apple were the first to introduce the Touch ID solution using fingerprint recognition technology and since then, mobile phone security has evolved to utilize a number of biometric technologies including facial recognition, iris recognition and voice recognition.

d) **Banking:** The banking sector is another embracing biometrics across a range of services in order to deliver a more seamless experience for customers. Seven Bank in Japan is rolling out a trial of Facial Recognition at ATMs. Facial Recognition will be used as an additional level of security to authenticate that the owner of the card is the person using the card.

e) **Home Assistants:** We all are familiar with Google Home, Alexa and Siri is already being accustomed for using voice recognition as a biometric identifier. Google Assistant that powers Google Home as well as the assistant on Android devices is compatible with a wide range of IoT (Internet of Things) devices including light bulbs, door locks, security cameras, security lights and more. Of course, when linking our home assistant with any of these connectable devices, security is imperative. we wouldn't want them controlled by just anyone. That's why Google Assistant's ability to recognize the voice of authorized users is critical.

What is Visual Recognition?

In the era of digital cameras, with people sharing billions of photos and videos daily, it's impossible to manage the content manually. Therefore, the necessity of automatizing visual recognition has rapidly increased, proportionally with social networks. Beyond social media, visual recognition can be used in various other domains: health sector, to trace visible symptoms on patients and contribute to the diagnostic, environment, to detect problematic areas, road traffic, to avoid accidents and build self-driving cars, and many others.
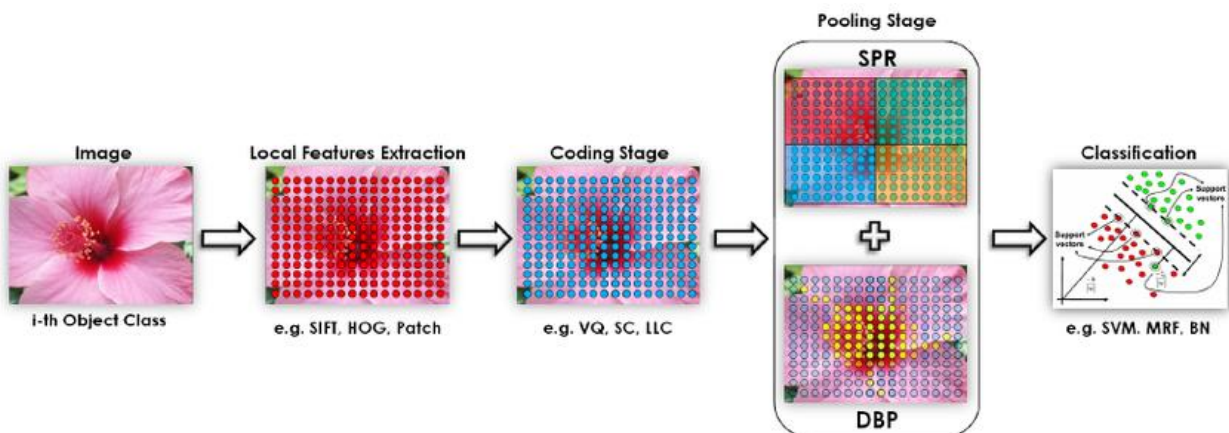
Visual Recognition System:

Figure 2: General pipeline for a visual recognition system

Example: Google Lens, Flow (Powered by Amazon), TapTapSee, Leaf Snap- Plant, Identification, Calorie Mama, Vivino, Screenshop etc.

➔ **Applications in Real-world:**

a) **Automobile Industry:** Not only the traditional car manufacturers are working on the self-driving cars but also the tech giants are getting their hands on manufacturing such cars. Last year at CES, Cisco announced its partnership with traditional car manufacturing company, Hyundai to help enable over the air updates for autonomous cars.

b) **Social Media Platforms:** Visual recognition is playing quite well in this ground as it has made easier for the marketers to find visuals within social media. In 2016, Facebook added a feature for visually impaired people by combining facial recognition technique and automatic text

technologies to generate an accurate description of the photo content as well as describing who exactly is in the photo without being tagged.

c) **Visual Search Engines:** This technology use image recognition to provide users with the best search results. Google and Bing being the oldest players in this platform, there are other visual search engines that do the same functions as the bigger players do. For instance, Picsearch is a traditional visual search engine that offers a massive image archive.

d) **Security Industry:** This emerging technology is playing one of the vital roles in the security industry. Whether it be an office, a smartphone, bank or home, security measures are an integral part in very platforms. Many security devices have been developed that includes drones, security cameras, facial recognition biometric devices, etc. At CES 2019, SimCam home security and home automation cameras that are enabled with artificial intelligence for facial recognition, pet monitoring and much more via location training. Netatmo, a smart indoor camera has a feature that starts recording video only when the system detects any unknown faces.

e) **Healthcare Industry:** The image recognition technology is providing immense help in the healthcare industry. It helps in driving meaningful changes across the journey of a patient. Microsurgical procedures in the healthcare industry powered by robots use computer vision and image recognition techniques. The use of this technique has incremented in the last decade due to the advancements in machine learning and artificial intelligence. Real-time emotion detection can also be used to detect the emotions of the patients to analyze how they are feeling during the time they are hospitalized or when they are about to get discharged.

Part-3

What is Forensic?

The term forensic has been derived from the Latin word forensis, which means a discussion or debate in public. As a discipline forensic science refers to the application of scientific methods and procedures to solve and prove that a crime has taken place. Forensic science is a broad field that includes; DNA analysis, fingerprint analysis, blood stain pattern analysis, firearms examination and ballistics, tool mark analysis, serology, toxicology, hair and fiber analysis, entomology, questioned documents, anthropology, odontology, pathology, epidemiology, footwear and tire tread analysis, drug chemistry, paint and glass analysis, digital audio video and photo analysis.

Example: This area of forensics includes careers that examine and extract evidence from a victim's body. This includes the coroner, medical examiner, forensic pathologists and autopsy technicians.
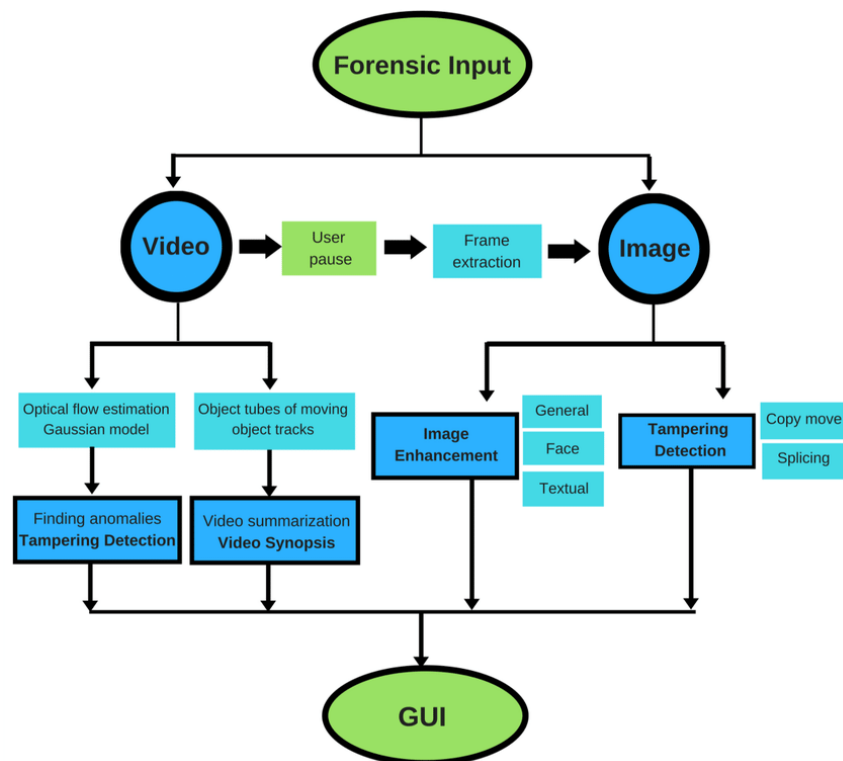
Forensic System:

Figure 3: Forensic system architecture

➔ **Applications in Real-world:**

a) **DNA Phenotyping:** While DNA gathered from a crime scene can be matched to a suspect by comparing samples, DNA can also be used to determine what a suspect physically looks like. Forensic scientists can sequence a DNA sample and provide investigators with identifying traits of the suspect, including hair, eye, and skin color.

b) **Biosensors for Fingerprint Analysis:** Like DNA, fingerprints found at a crime scene can be matched to a suspect by comparing them. However, fingerprints aren't always clear or readable. Forensic scientists can now use biosensors to analyze the minute traces of bodily fluids found in fingerprints to identify the suspect. Data that can be detected include age, medications, gender, and lifestyle.

c) **Block Chain-Based Solutions: Cloud Forensics:** Over 50 percent of personal and corporate data is now stored in the cloud, meaning on remote servers. As a result, digital forensic scientists have had to develop methods for collecting, analyzing, and evaluating data that has been collected from the cloud. Managing this data presents a number of security and privacy issues. To help protect the integrity of the data as well as maintain a custody chain, digital forensic scientists have begun to use block chain technology as it is virtually impossible to tamper with.

d) **Digital Vehicle Forensics:** Vehicle forensics has typically been an area where investigators gather physical evidence, including fingerprints, fluid samples, and trace materials like dirt. Also, they can physically examine the car to determine how an accident, crash, or terrorist attack occurred. However, as vehicles have become more technologically sophisticated, it has opened the field of digital vehicle forensics where scientists and investigators can gather data such as recent destinations, typical routes, personal data, and favorite locations.

e) **Social Network Forensics:** Over 3.6 billion people are on social networks, and this number is projected to increase to 4.5 by 2025. When social media first emerged, investigators and forensic scientists didn't have as much data to comb through. Now, the social media data for a particular subject can be daunting. Recently, to help evaluate this data, scientists have developed models for analyzing the information gleaned from social networks. In order for automated data analysis to be accepted in court, it has to be based on models that are reproducible, explainable, and testable.

3) Conclusion: Nowadays biometric, visual recognition & forensic are trendy words. All these technologies are mainly used for security concern & own safety. These three technology will become top-notch technology in the near future for security. We can use these technologies for social good.

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