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Body Odor as a Biometric Authentication

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***Abstract* - Research on biometrics has noticeably increased. Biometric systems such as Finger print, retinal scan, face, voice, iris, signature and hand geometry are in use today, but they have several drawbacks. Recent surveys revealed the uniqueness of human odor. The body odor as a biometric identifier has the lowest error rate (15%) in comparison to other biometric identifiers such as iris, fingerprints and face recognition. The advantage lies in the fact it is impossible to replicate human odor. Body odor exhibits strong authentication over other recently emerging biometric systems. This paper deals with the feasibility of creating a model system that authenticates people based on their body odor.**

***Keywords* - Biometrics, Body odor, Authentication.**

I.INTRODUCTION

Biometric authentication systems are gaining wide-spread popularity in recent years due to the advances in sensor technologies as well as improvements in the matching algorithms that make the systems both secure and cost-effective. Biometrics is the science of measuring physical properties of living beings [1].

It can be defined as any measurable, robust, distinctive physical characteristic or personal trait that can be used to identify, or verify the claimed identity of, an individual . However, a biometric template is a digital representation of an individual‟s distinct characteristics, representing information extracted from a biometric sample. [2]

Biometric templates are what are actually compared in a biometric recognition system. Odor biometric system has been identified by a number of researchers as a viable system for personal identification. The evaluation of odor characteristics and features is an important step to implementing odor as a personal identification and security system. Research has recently begun to identify some of the volatile organic compounds present in human scent, but there is still limited knowledge concerning the identity of target-vapor signature and the transport and detection mechanisms associated with a canine alert. Bank vaults are restricted areas which has restricted access. It has been long time since keys have lost their significance. Even hi-tech banks which boast of biometric fingerprint and retinal scan are not entirely safe. If the fingerprint system is replaced by odor recognition system, which monitors the vault to check for any unauthenticated user.

II.EXISTING BIOMETRICS

A.Fingerprint Verification

This is one of the oldest forms of biometric techniques which involves mapping of the pattern of the fingerprint of the individual and then comparing the ridges, furrows, within the template. The fingerprint given to the device is first searched at the coarse level in the database and then finer comparisons are made to get the result.

Fig 1:Fingerprint

B.Iris Recognition

In Iris and Retinal scanning, the iris and the retina are scanned by a low intensity light source and the image is compared with the stored patterns in the database template. This is one of the fastest forms of biometry.

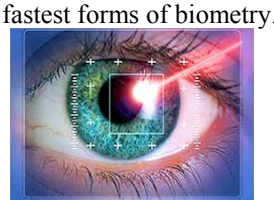

Fig 2: Iris

C.Facial Scanning

Facial scanning involves scanning of the entire face and checking of critical points and areas in the face with the template.

Fig 3: Face

D.Hand and Finger geometry

This method uses the data such as length, shape, distance between the fingers, overall dimensions of the hand and also the relative angle between the fingers. Modern systems use this technique in association with the Fingerprint scanning technique.

Fig 4: Hand and Finger

E.Voice Biometry

It is proved that the frequency, stress and accent of speech differ from person to person. Voice biometry uses this concept to solve the problem of illegal user. This system has been implemented in the latest laptops as well.

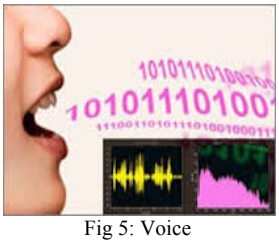

Fig 5: Voice

F.Keystroke dynamic

In this technique, the system analyses the rhythm of typing the password.

Fig 6: Keystroke

G.Signature Verification

It is a biometric identification method using a person's signature characteristics (writing speed, pen pressure, shape of loops, etc.) to identify that person.

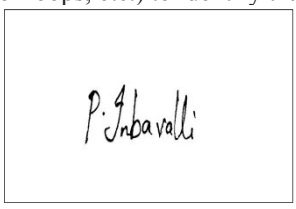

Fig 7: Signature

III.PROPOSED WORK

A.HUMAN BODY ODOR

Every human body exudes an odor that characterizes its chemical composition and which could be used for distinguishing various individuals. The primary odor of a person contains constituents that are stable over time regardless of diet or environmental factors. Secondary odor contains constituents that are present due to diet and environmental factors.Tertiary odor contains constituents that are present because of the influence of outside sources (i.e., lotions, soaps, perfumes). For an individual identification by human scent, the primary odor must have constituents that are stable over time and diverse across people. Compounds present in male and female axillary secretion extracts that contained the characteristic odors present in the axillary region have been isolated and identified.

B.WORKING MODEL

Studies conducted at the National Institute for Medical Research in London have shown that there is a current of warm air that surrounds the human body due to the natural body temperature.[3]

The current of warm air is approximately one-third to one half-inch thick, and it travels up and over the body at a rate of 125 feet each minute. Analysis of the air current indicates that it contains four to five times as many germs asthe air in the rest of the sampling room. The germs come from the bacteria that are shed with dead skin cells. Larger flakes of skin fall to the ground, but smaller ones are drawn up into the current. These currents can also be visualized through clothing. The warm air currents carry the rafts from the body into the surrounding area allowing for the deposit of human scent in the environment. The idea that human scent is produced through bacterial action on dead skin cells and secretions is the most common depiction of the creation of human odor. Other studies have suggested that odor is formed very quickly, supporting the idea that odor production is due to simple bond cleavage as opposed to a complex bacterial action. The main task of the working model is to perform the following tasks:

- Sniffing
- Delivery
- Reception
- Computation
- Authentication

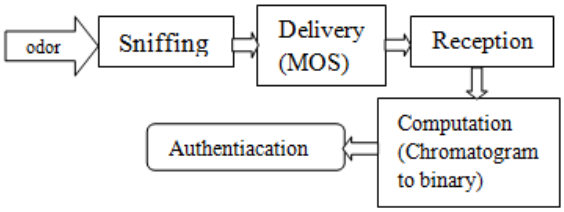

Fig 8: Block Diagram

1) *Sniffing*

This is done by using a pump which sucks in air from the immediate environment.

2) *Delivery*

It contains Metal Oxide Semiconductor when it comes in contact with volatile compounds, the sensor reacts, as they experience a change of electrical properties.

3) *Reception*

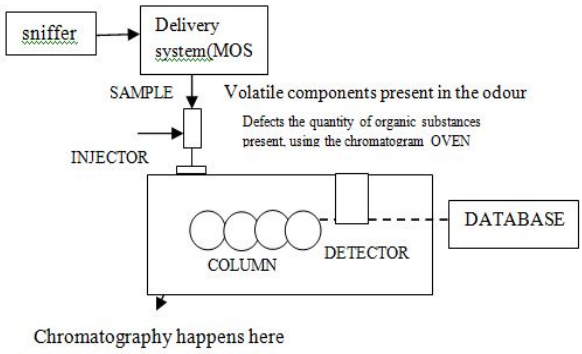

Fig 9: Block diagram of reception

4) *Computation*

The composition of scent is identified from the chromatogram obtained by observing the time taken by the substance to come out of the tube. This composition is converted to digital form.

5) *Authentication*

The digital equivalents of the body odor of all authenticated people are stored in a database.

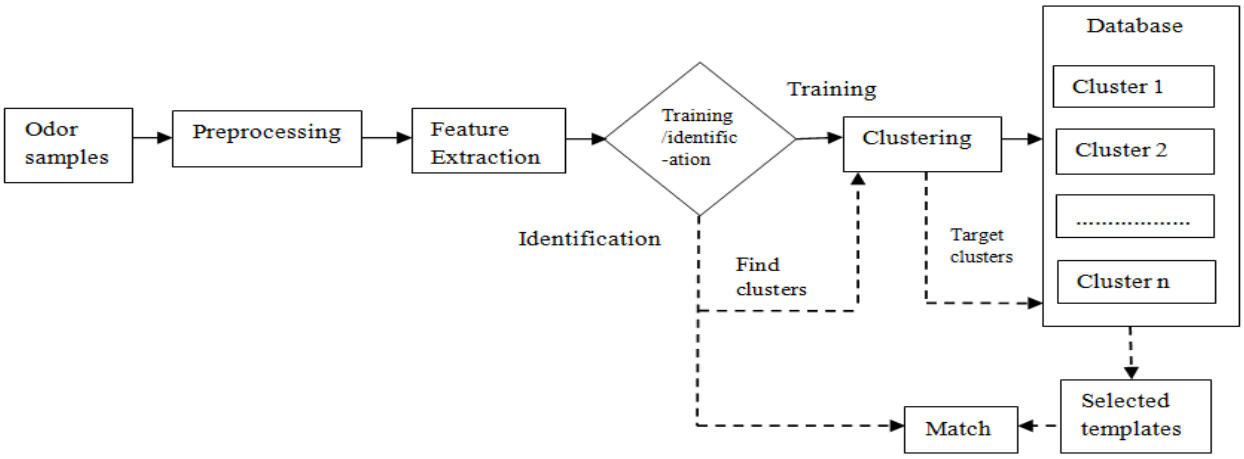

Fig10: A Typical Odor Biometric Identification System

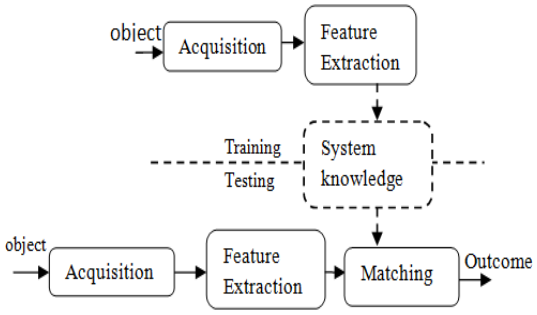

Fig 11: Odor Biometric Training and Testing System for identification

IV. ELECTRONIC NOSE

E-Nose is represented as a combination of two components: sensing system and pattern recognition system[4].

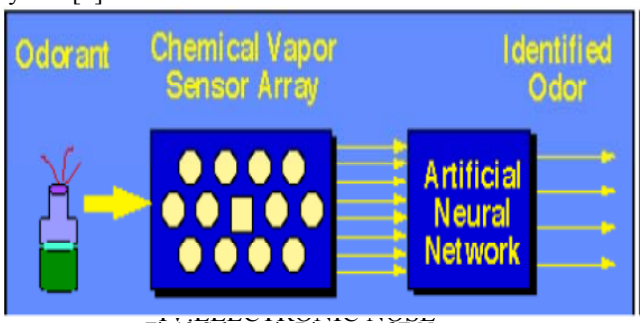

Fig12:Schematic Diagram of E-Nose

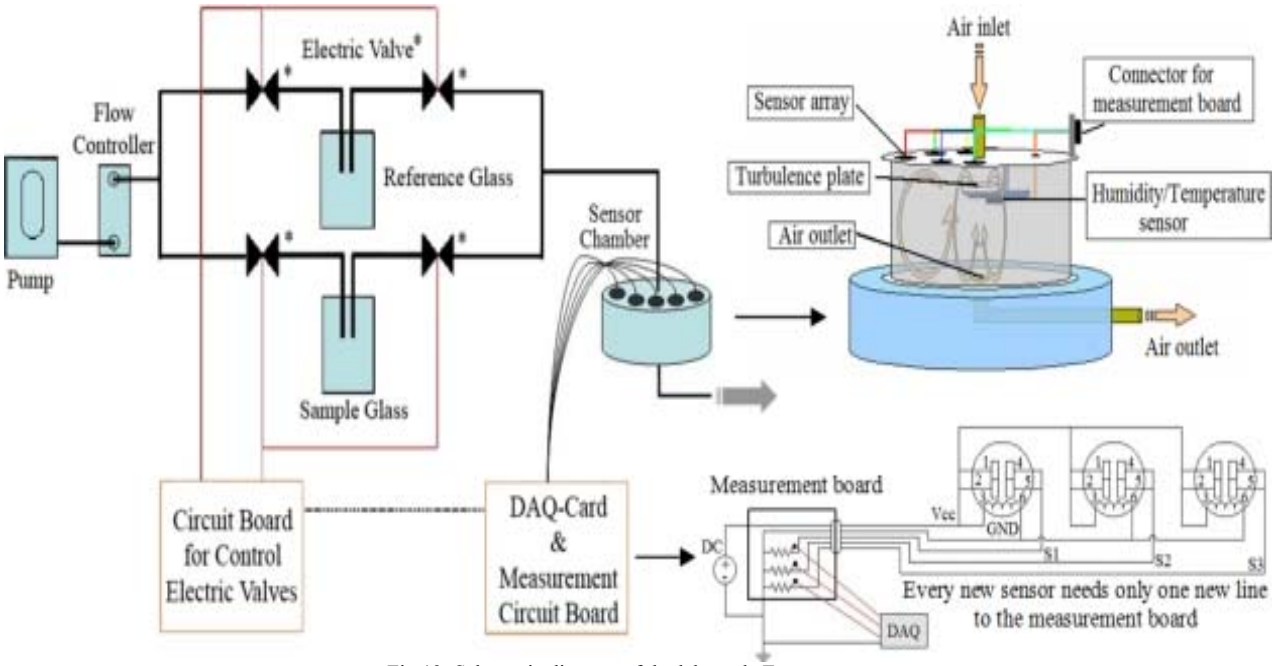

Fig 13: Schematic diagram of the lab-made E-nose system

A.Sensing System

Sensing system allows tracing the odor from the environment. This system can be single sensing device, like gas chromatograph and spectrometer. The second type of sensing system is an array of chemical sensors. It is more appropriate for complicative mixtures because each sensor measure a different property of the sensed chemical . Hybrid of single sensing device and array of chemical sensors is also possible. Each odorant presented to the sensing system produces a characteristic pattern of the odorant. By presenting a mass of sundry odorants to this system a database of patterns is built up and used to construct the odor recognition system.

B.Pattern Recognition System

Pattern recognition system is the second component of electronic nose used for odor recognition. Its goal is to train or to build the recognition system to produce unique classification or clustering of each odorant through the automated identification . State-of-the-art approaches do not make it possible to identify all components of the human body precisely. As such, recognition process incorporates several approaches: Statistical, ANN and Neuromorphic.

The signal processing and pattern recognition are explicitly discussed below:

1)*Preprocessing*

Preprocessing compensates for sensor drift, compresses the response of the sensor array and reduces sample-to-sample variations. Typical techniques include: normalization of sensor response ranges for all the sensors in an array; and compression of sensor transients.

2)*Feature extraction*

Feature extraction has two purposes: to reduce the dimensionality of the measurement space, and to extract information relevant for pattern recognition. Feature extraction is generally performed with linear transformations such as the classical PCA.

3)*Classification*

Classification is the problem of identifying to which of a set of categories (sub-populations) a new observation belongs, on the basis of a training set of data containing observations (or instances) whose category membership is known .It allows the electronic nose to function in the way similar to brain function when it interprets responses from olfactory sensors in the human nose.

4)*Decision Making*

The classifier produces an estimate of the class for an unknown sample along with an estimate of the confidence placed on the class assignment. A final decision-making stage may be used if any application-specific knowledge is available, such as confidence thresholds or risk associated with different classification errors. The decision-making module may modify the classifier assignment and even determine that the unknown sample does not belong to any of the odorants in the database.

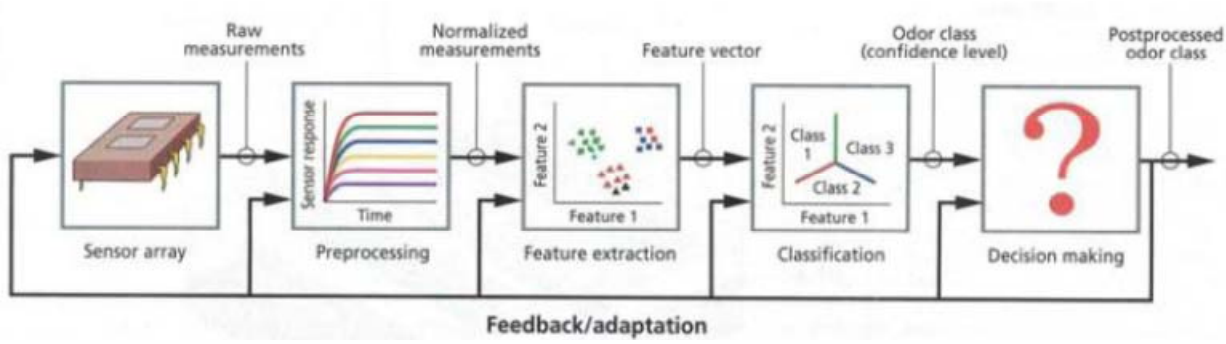

Fig 14:Signal Processing and Pattern Recognition systems stages

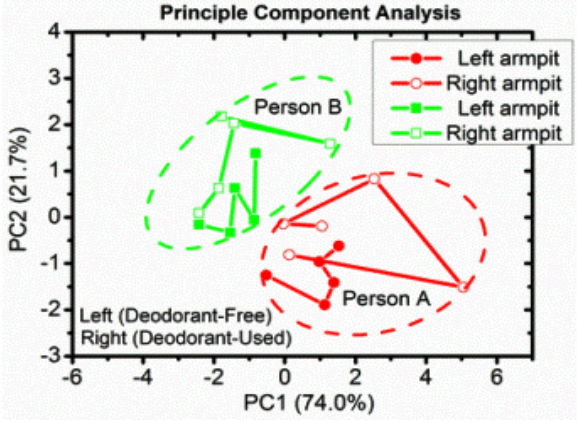

Fig 15. The 2D-PCA of armpit odors from two persons

V.PROTOTYPE OF ELECTRONIC NOSE

Electronic nose research groups have developed a number of prototype electronic noses[5].Some of them are presented in Figure.

Fig16: The 4440B (Agilent technologies), Prometheus (Alpha Mos) and A320 (Cyrano Sciences) electronic noses)

Usually, during operation a chemical vapour is blown across the array, the sensor signals are digitized and fed into the computer. Then ANN (implemented in software) identifies the chemical[6].

APPLICATIONS

- It can used for secure admission into bank vaults which permit only one authenticated user at a time.
- Its portable version can be used to detect drugs. Also in airports and harbors, smuggling of drugs can be detected by using this system.
- It can detect the presence of any excess gas in laboratories or factories or even in kitchens. The normal composition of the gas that can be present in the surroundings is fed into the database. If the content increases, it results in an alarm buzzing.
- The most important application nowadays of ENoses is in *medical diagnostics*. Odors in the breath can indicate gastrointestinal problems, sinus problems, infections, diabetes, and liver problems.
- *Environmental applications* of electronic noses include identification of toxic and hazardous wastes.

ADVANTAGES

- Fool-Proof
- Even deodrants and perfumes cannot mask the basic human odor. These artificial scents do not eliminate the organic compounds present in the odor. As of now, it is not possible to replicate human odor. Hence, intruders cannot break in without alerting the system.
- Reduce password administration costs.
- Replace hard-to-remember passwords which may be shared or observed.
- Reduces Human Labour
- This system is accomplished with an automated system, which reduces the amount of human work required to make a positive match.
- It's impossible to bribe or trick the system to get in, as might be a possiblity with a human.
- It is particularly useful in routine operations due to its ease of use and rapid response rate.

VI.CONCLUSION

In biometric domain, odor detection for authentication is a novel idea. This, when implemented would result in enhanced security systems. The added advantage is that, it is a contactless approach. A novice will never know that he is being monitored. Nowadays, our identity verification in most airports or border checkpoints is based on our physical resemblance to our ID card or passport photo. Even though the new electronic passports are difficult to forge, the usage of biometric techniques based on a person's physical features would increase the safety effectiveness of the border control checkpoints. Several biometric techniques like the iris and fingerprint have a low error rate. However, these two techniques are usually related to criminal records and for this reason when a person is required to identify himself is reticent to collaborate. On the other hand, other recognized biometric techniques like the face recognition have a high error rate. Therefore, the development of new sensors that allow the capture of body odor can provide a less aggressive solution because the identification could be at the same time when crossing the system stall.

FUTURE APPLICATIONS

- The first of them is the *Fight against crime*, recognition of terrorists. There are already orders on the human recognition system already from the British embassy in Buenos Aires, Saudi Arabia's National Guard, and private Indian and Japanese companies.
- Another important application is detection of humans buried in rubbles. It is actual task, for example, in earthquakes or damages on coalmines. To detect human body odor an electronical nose is applied.
- A more futuristic application of ENose has been recently proposed for *telesurgery* . The ENose would identify odors in the remote surgical environment.
- Airport security checkpoints and national borders.

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