EUHARMONIC, a universal multi sensor personal space recorder with secure digital forensic evidence qualification

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Abstract.—. Our research began to present a secure financial transaction portable unit for Trade Commerce and Industry. We analyzed the nature of various human senses according to inner personal space theory. We defined the human skin as the borderline of the legality to record all human activity. According to this concept we analyzed various sensors and devices in the market today and preliminary tried to form a personal recorder for digital forensic, law enforcement, sexual harassment and secure financial transactions.

Keywords— Sensors, personal space, recorders, digital forensic

I. Introduction

Methods are described for forensic characterization of physical devices such as digital cameras, printers, and RF devices, in order to verify the trust and authenticity the device and data it extracted[1]. Eoghan Casey in his paper discusses a problem concerning the digital forensic community's not establishing what basic knowledge, skills and abilities every practitioner should have so as to be verified as qualified.He argues that there are many certifications relating to digital forensics, with each one having its own requirements that applicants must have[2]. In 2008 the lack of core competencies was discussed coming to the conclusion that digital evidence has been processed not in forensic laboratories but by expert police officers and detectives. The problem consists on not having an agreed certification program or list of qualifications for digital forensic examiners and also on how experienced and trained they are[3]. Another paper focuses on the limitations first generation computer forensic tools have, such as EnCase and FTK products, that are outdated due to increased complexity and data volumes modern investigations have. It also introduces methods for measuring the efficacy and performance of computer forensic tools[5]. Ephraim Nissan presents a three-pronged overview,showing the reasoning about legal evidence, about tools for legal argumentation, and about forensic science's area selection by using AI techniques,taking care not to make mistakes leading to tools not being used by legal professionals[6].

Global Positioning system is a minor detail of our recorder but it concerns an example of the required future research. Dany Bradbury in his paper discusses about the cost and effectiveness of surveillance technology by using special cellphones that have parasite application that logs everything from cellphone tower ID to call logs and nearby handsets by using bluetooth connection, as to predict the moves that individuals make in order to be used in medical purposes[4].

A paper published in 2003 has a theme based on GPS solutions for several parts of science such as Earth and Space sciences along with Computer science[7]. An Earth science,Meteorology is the theme of a paper written by Jennifer M.Collins.She used a cell phone having GPS in order to prevent disasters and other emergencies with the participation of two other researchers[8].

Wearable computer was a previous stage of our research.Mann S. in his paper presents eudaemonic computing ,a method for computing integrated into ordinary clothing and has a tank structure allowing the weight to be evenly and comfortably distributed over the body providing privacy and sensing biological signal quantities.The paper discusses the use of similar devices in every day life[10]. The wearable computer, its control and accessibility as well as long battery

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lifetime, is the basic theme of another paper. It focuses on the design of a low-power real-time operating system called eRTOS that has about 9 KB footprint and is equipped with low-power techniques that show in experiments how energy can be saved up to 47% [11]. Billinghurst and Starner conclude in their paper that information nowadays is far more than people can deal with and try to find a solution to that problem.In this general theme they focus on computers that have transformed into wearable appliances ,always on and accessible and able to help people in managing, sorting, and filtering information in a daily bases [12].

For psychology and environment a team of scholars from around the world explores theories of our times. A book approaches many fields of disciplines linked to each other and focuses on the attitudes, beliefs, and behaviours destroying our environment and endangering our lives [9]. One of the major concerns of modern society,the relationship between public and private sections is being discussed by investigating this relationship socially and psychologically[14]. A team of researchers focused on ePerSpace project aiming to increase a user's acceptance of networked audiovisual systems and applications anywhere [15]. In Vanderbilt University researchers presented a wireless sensor network-based mobilecountersniper armory system in the US Army with great results [17].

II. HUMAN SKIN EUHARMONIC BORDER LINE

A. Inner vs Outer Personal Space

Robert Sommer gives the definition of personal space and its measurements and concludes in research findings[13]. The importance of realization of personal privacy control and demands in pervasive computing is discussed in a paper by researchers in Germany and Spain[16]. Wright State University came up with the subject concerning digital biometrics,meaning the measurements on physiological or behavioral characteristics of a person that determine the identity of a person[18]. Farzin Deravi in the UK was occupied in the field of biometrics and its future development by means of ISO's SC37 subcommittee concluding in the interactions between ongoing research into biometric systems and the standardization process[19].

A respectable personal life recorder must cover all human senses in all dimensions. We examine the following senses:

- Sight
- Hearing
- Taste
- Smell
- Touch
- Balance
- acceleration
- Temperature
- Kinesthetic sense
- Pain
- Other internal senses.

B. Personal Data retention

Personal data contains any sort of information including facts and opinions and all indication of intentions which relates to a living individual who can be identified from that information. For example: name, address, date of birth, National Insurance number, bank account details.

Sensitive personal data is information about your racial or ethnic origin, political opinions, religious beliefs, trade union membership, physical or mental health or condition, sexual life, criminal offences, proceedings and convictions. We can only collect and hold this information for specific purposes. However the violation of this rule is possible by:

- Illegal intrusion in the gathering or target system.
- Accidently data loss.
- Systematic hacking from the machine creator.
- And of course after a decision of court of law.

C. Redefinition of Senses - Data Separation

For all these reasons and hundreds more a redefinition of the major concept of the personal recorder is necessary. All senses must be divided into an internal and an external part. A redefinition of senses follows.

1) Sight

Actual video recording of what an eye sees is illegal. However if somebody wishes to record still and video images with forensic capabilities there are alternatives like:

- Video encryption with decoding keys to be delivered directly to legal authority for personal data.
- Video encryption with user defined decoding key.
- Partially shaded blurring video that cannot by itself be used for identity verification.
- Recording at Infra red or other non visible spectrum.

2) Hearing

Hearing concerns the best example to prove our theory of senses diversification. Audio recording has two sources:

- Laryngeal, when the person speaks.
- Ear, when the person hears.

From these two only the first is legal or is accepted in front of the court of law. To record a portion of the hearing we could use all the methodology described above for the video encryption.

3) Touch

Touch sense is by definition only internal. All recordings of touch, pressure or intrusion to the border line of the personal space are perfectly legal.

4) Balance-acceleration- Other internal senses

All the other senses are only internal. Machine recordings do not violate other people personal data by no mean.

The human skin as the borderline of recordable user space is the key feature an issue of our research.

D. Euharmonic definition

EUHARMONIC stands for EUHARist Multimedia personal space bOrder forensIC recorder. From the dictionary **Euharmonic** is Producing mathematically perfect harmony or concord; sweetly or perfectly harmonious. The EU prefix is the Greek prothema for indicating the well being and acting, similar to a range of names given recently by our scientific team [20, 21].

III. EUHARMONIC, THE SYSTEM

A. Sensors

There are thousands of sensors serving todays industry from environment to defence [21, 22, 23] General range includes:

1. Microphone
2. Accelerometer
3. Speed sensor
4. Throttle position sensor
5. Breathalyzer
6. Carbon dioxide sensor
7. Electronic nose
8. Oxygen sensor
9. Smoke detector
10. Metal detector
11. Air flow meter
12. Free fall sensor
13. Odometer
14. Position sensor
15. Thermometer

Apart these general sensors we selected 9 personal recorder devices that could facilitate our concept.

- SenseCam
- iBangle
- Momenta
- The Neck or Throat Microphone
- Suunto X10 GPS wristop computer
- witterPeek
- tiny blood pressure sensor
- fitbit
- Taser AXON wearable surveillance kit

1) SenseCam

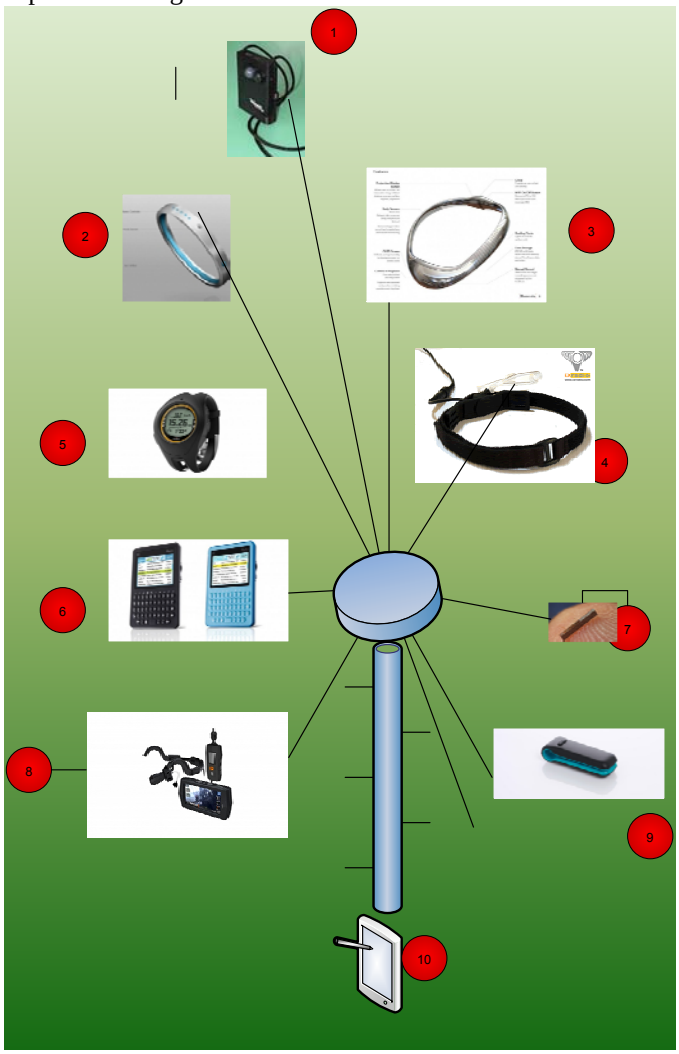
SenseCam was a wearable digital camera that takes photographs passively without user intervention. SenseCam does not have a viewfinder or a display but it is fitted with a fish-eye lens to maximize field-of-view. As a result camera captures everything in the wearer's view. SenseCam has subsystems like: light-intensity and light-color sensors, a body heat detector, a temperature sensor, and a multiple-axis accelerometer. These sensors automatically trigger a photograph to be taken driven by an internal software.

2) iBangle

iBangle is the wrist wrapping music aplayer. It is a bangle bracelet that sits on the wrist while your tunes blast through wireless headphones. The aluminum bangle will feature a trackpad so your finger can slide and tap its way through your music.

3) Momenta

Momenta is a neck-worn PC and altogether a Black Box Life Recorder. Momenta captures only the previous five minutes of everybodys life and continues to an everlasting 5 minutes recording. Like sensecam it is triggered by heart rate to capture exciting moments.



4) The Neck or Throat Microphone

A single vibration sensor is attached to your neck by a simple strap. The single transponder are packaged with soft silicon rubber. It can be placed around a neck and still able to detect bone vibration signal generated from your vocal cord. The sensor will pick up the skin vibration signals generated from your neck bone, therefore the background noises are almost totally eliminated.

5) Suunto GPS wristop computer

The Suunto is a small and lightweight wrist-mounted GPS device which features hands-free operation, so you can focus on the action instead of worrying about dropping or losing your GPS. The Suunto X10 is compatible eith National

Geographic TOPO! and Google Earth. Also it includes an GPS mapialtimeter, barometer, digital compass and thermometer as well as standard time/stopwatch functions.

6) TwitterPeek

It concerns a dedicated Twitter mobile device. The "always-on" TwitterPeek has a full QWERTY keyboard, color screen and click scroll wheel. The obvious drawback - it's another device to carry around, but twitting sometimes is a necessity.

7) tiny blood pressure sensor

A new sensor being developed by Fraunhofer-Gesellschaft researchers together with the "Hyper-IMS" (Intravascular Monitoring System for Hypertension Patients) company aims to make blood pressure monitoring easier. With the new method a tiny pressure sensor, which has a diameter of about 1 millimeter is placed directly into the femoral artery in the groin and measures the patient's blood pressure 30 times per second. The sensor is connected via a flexible micro-cable to a transponder unit, which is likewise implanted in the groin under the skin.

8) fitbit

The Fitbit accurately tracks your calories burned, steps taken, distance traveled and sleep quality. The Fitbit contains a 3D motion sensor, it tracks your motion in three dimensions and converts this into useful information about your daily activities. You can wear the Fitbit on your waist, in your pocket or on undergarments.

9) Taser AXON wearable surveillance kit

The AXON is a tactical networkable computer worn by first responders that combines advanced audio and video recording capabilities. It consists of an audio-video earpiece imager, speaker and microphone that integrate into existing radio communications through a standard 3.5 mm headphone connection, providing two way communications in addition to full audio-video recording from a head camera the size and weight of a standard Bluetooth headset.

IV. APPLICATIONS

The EUHARMONIC device has unlimited uses. We only focus here to the concept that our digitally forensic recording is limited by the borderline of human skin. We investigated a few preliminary applications for the wearable device.

- Digital Forensic.
- Law enforcement.
- Secure financial transactions
- Sexual harassment.

A. Digital Forensic

The EUHARMONIC device is ideal for digital forensic applications once is constructed according to the strict rules of lawful design. Minimum specifications here are:

- Hermetically sealed device.
- Full identity assurance.
- Power alternatives.
- Various password schema options.

The machine could be used for a variety of circumstances:

- To defend the carrier in front of court.
- To demystify crime scene
- To facilitate a generally crime case.
- Law enforcement for evidence collection.

B. Sexual harassment

Two professors at a research institution wear during a testing period a simplified illegal version of the device. It was a camera watch with 8 hours of FMV capacity. Initially a demonstration was made to limited auditorium. Then they wear the watch all the time. To avoid law violation the recording device was set offline. As a result an invisible wall created around the professor, changing dramatically the behavior of young girls.

C. Secure financial transactions

The Initial triggering for EUHARMONIC concept has been launched by the necessity for secure electronic financial transactions. A small Athens financial advisor acting as a broker for the commodity stock exchange along with our research institution prepared an investment CFD based product to minimize the risk of consumable materials.

Every factory CEO in need of gold, metal, cotton makes two concurrent business deals:

- First, he orders the material to the supplier with the normal procedure.
- Second, he connects to the Commodity market and obtains an equal quantity through CFD (contract for Difference) procedures.

To accomplish the CFD transaction a secure EUHARMONIC device is necessary with features like:

- Portability and universality to adapt to real life factory needs.
- Secure operation to certify the multi million multiplication nature of the CFDs.
- Forensic features acceptable in front of law court.
- Simple user interface.
- On-line and offline operation.
- Integrated telecom and client for dedicated commodity stock market interaction.

V. – CONCLUSION

Our regional university research is limited to preliminary specifications and beta test of the operational machine. We cannot establish a world wide standard. Therefore our next step is front end processing around a black box secure black box personal life recorder. This could be limited only to our specific applications.

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