Human User Identification Using Multi-Sensor Data Fusion

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Abstract - A single sensor cannot predict all the information accurately. So in this topic, we make use of multiple sensors in order to get all the information accurately and performing the activity of data fusion which fuses the data of all the information that we get from sensors. Data fusion has been under research for past decade. It has various applications some of which have been successfully implemented. The application that we propose deals with multi-sensor data fusion that will result into human-unique identification.

Keywords : **Data fusion, CAPTCHA, sensors, User identification, database, authorization.**

I. INTRODUCTION

Due to advance in technology in the fields of computers, communications, navigation systems and military applications there has been a significant rise in the throughput and capacity of system. Therefore it is essential to have an accurate data in all these sensitive fields. So we need to have a system which will gather the relevant inputs and give the optimal output. A single sensor cannot give the efficient result and therefore a system will require a number of sensors to get more specific information as an input. In order to get the best output from these sensors, we require the technique of fusing data called as data fusion. Data fusion refers to the combination of data from multiple sensors (either of the same or different types), whereas information fusion refers to the combination of data and information from sensors, human reports, databases, etc.
[1]M*ulti-sensor data fusion* which we define as "the theory, techniques and tools which are used for combining sensor data, or data derived from sensory data, into a common representational format". While performing data fusion, we need to improve the quality of the information, by using data from various sources possible. [1]The above definition implies that the sensor data, or the data derived from the sensory data, consists of multiple measurements which have to be combined. The multiple measurements may, are produced by multiple sensors.

II. DATA FUSION

[2] Data fusion is the process of integration of multiple data and knowledge representing the same real-world object into a consistent, accurate, and useful representation.
The performance of the system improves significantly on combining the data from different systems rather than depending on individual systems involved in the process. [2]However, it also seeks to combine information from multiple sources (including sensors, human reports, and data from the Internet) to achieve inferences that cannot be obtained from a single sensor or source, or whose quality exceeds that of an inference drawn from any single source.

A. Components of Data Fusion:

The components of data fusion are:
DB/search engine selector- Select systems to fuse
Query dispatcher- Submit queries to selected search engines;
Document selector-Select documents to fuse
Result merger- Merge selected document results.

III. DATA FUSION PROCESS MODEL

The JDL process model, which is intended to be very general and useful across multiple application areas, identifies the processes, functions, categories of techniques, and specific techniques applicable to data fusion. At the top level, shown in Figure below, the data fusion process is conceptualized by sensor inputs, human–computer interaction, database management, source pre-processing, and six key sub-processes:
Level 0 processing (sub-object data association and estimation) is aimed at combining pixel or signal level data to obtain initial information about an observed target's characteristics.
Level 1 processing (object refinement) is aimed at combining sensor data to obtain the most reliable and accurate estimate of an entity's position, velocity, attributes, and identity.
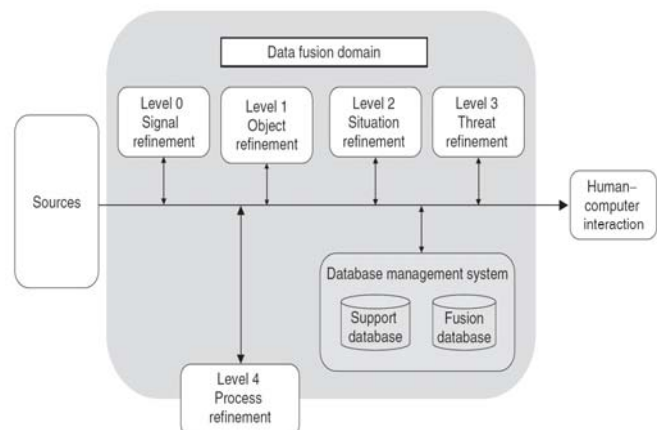

Figure 1 Joint Directors of Laboratories process model for data fusion

Level 2 processing (situation refinement) dynamically attempts to develop a description of current relationship among entities and events in the context of their environment.

Level 3 processing (significance estimation) projects the current situation into the future to draw inferences about enemy threats, friend and foe vulnerabilities, and opportunities for operations.

Level 4 processing (process refinement) is a meta-process that monitors the overall data fusion process to assess and improve real-time system performance.

Level 5 processing (cognitive refinement) seeks to improve the interaction between a fusion system and one or more user/analysts.
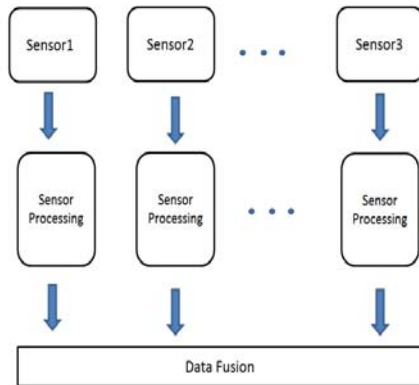
Multi-sensor data fusion

Figure 2 Example of Multi-sensor data fusion

Multi sensor data fusion includes multiple sensors taking various physical data. This data is still discrete and has different data types. In order to draw conclusion from the set of data acquired by the sensors, we need to bring all the data down to one common format. This is done by the concept of data fusion.

IV. USER COMPUTER INTERACTION-A PROPOSED SOLUTION

User computer Identification is a process to identify an authorized user in front of the system with the help of sensors. In real world where security is given utmost importance it is essential to identify an authorized person thereby not allowing an hostile person to enter into the system. The sensors will detect the user via face, gestures etc. to recognize the user and thus maintains the security in the system.

User computer identification is required for a variety of purpose. Consider a social networking website where many people share their important information. In case, if an individual forgets to log out and leaves his place urgently for some time, then there is a possibility of some other person logging into your account which will in turn threaten the individual's personal information. So to prevent this, we propose use of environmental sensor which will detect the presence of user through environmental factors and will automatically log out from the system if no one is present in front of the system.

A. Replacement of CAPTCHA
CAPTCHA had been traditionally used for security purpose to login into the system. There are a number of

disadvantages in CAPTCHA approach such as it difficult to read, they are not compatible to users with disability, time-consuming to decipher and technical difficulties with certain internet browsers.

So we propose a multi-sensor data fusion for user identification to replace the CAPTCHA system. With the help of sensors, the authorized user will be identified through his face without requiring to enter any other information like CAPTCHA for security.
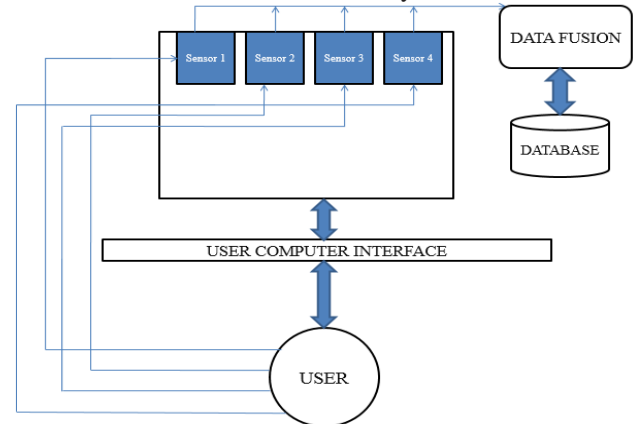

Figure 3 proposed block diagram of user computer identifiaction

The sensors mentioned above perform well under normal circumstances. However, under aberrant conditions like noise, ambiguous signals etc., they might not perform accurately on individual level. This can be very harmful for sensitive systems which only depend on a particular sensor for its data. Hence we propose a system having multiple-sensor data fusion so that a system does not rely on a single sensor. The combined data eliminates possible individual inaccuracies, and hence gives an accurate conclusion.

B. Environmental sensors
Environmental sensors are those sensors which will calculate the atmospheric parameters like carbon-dioxide (CO_2), NO_2, humidity, CO and oxygen levels in the atmosphere in order to detect a human being. For example if a person is present in front of the computer, there is change in atmospheric carbon dioxide and oxygen levels because of the person's respiration because of which there will be an increase in the carbon dioxide and decrease in oxygen level. By this, the system will recognize the presence of user in front of the system. [3]The sensing element is composed of a metal oxide semiconductor layer formed on a sensible substrate of a sensing chip together with an integrated heater.

C. Image analysis sensors
Image analysis are those sensors which check the facial components of a user which means it will check the retina of eyes, the size of nose, posture of face to detect the authorized user. If an unauthorized user tries to access the system, these sensors would not allow him to enter the system. [3]A stream of a common USB webcam is used to generate a series of frames that are analyzed by the feature extraction module

V. CONCLUSION:

In this paper, we conclude data fusion is essentially required for combining relevant information from all sensors. Also, we proposed the user presence identification with the help of multi-sensor data fusion. We also discussed about replacing conventionally used CAPTCHA with multi-sensor data fusion which will help us to improve the overall performance of the system.

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