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Human Studies

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Zeynel KARACAGİL

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Biometric Data Harvesting: Proposals on Remote Biometric Data Harvesting and Measurements in Human Behaviours Scope

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***Neslihan Erdem*[3]**

Introduction

Research on human behavior and human interaction with other beings dates back to ancient times. Today, the widespread use of information technologies shows that people are in intense interaction with internet tools, especially computers and smart phones. Optimizing this interaction, improving the user experience and designing usable systems/interfaces can be realized by examining human behavior.

Besides HCI, human behavior is studied extensively in the marketing discipline. Trying to predict consumer behavior and examining various factors such as demographic and psychological characteristics of individuals from past to present have been the subject of many studies. Despite this, the prediction of consumer behavior, increasing product and service diversity, hedonic consumption orientation, the effect of media technologies and trends, exposure to a large number of marketing stimuli, etc. becomes increasingly difficult due to many factors. It has recently emerged that the consumer acts more emotionally instead of acting rationally in purchasing decisions, and biometric methods that can collect emotional and physiological responses to understand the consumer are gaining importance (Jung & Yoon, 2011; Brunner-Sperdin et al., 2012; Grundey, 2008).

People's reactions to video content, images and dialogues are evaluated within the scope of human behavior in the field of media and communication. Widespread use of social media, increased interest in digital broadcasting platforms, creates a need to measure user/audience experience. Not only on digital platforms, but also physically on the stage, the effect of a performance on the audience can be determined by measurements that include the unconscious level. It is possible to perform these measurements through biometric data harvesting. In this study, biometric data harvesting tools (FACS, Eye Tracking, HR, GSR) that require remote and/or hardware will be introduced and research topics that can be done with these tools will be suggested.

Biometric Data Harvesting

Biometric data harvesting (BDH) is a technique that covers the processes of collecting data consisting of people's psycho/physiological responses to a certain stimulus with biometric tools and obtaining mature mixed data as a result of supporting these data with traditional methods such as questionnaires and interviews. The data obtained with BDH are converted into numerical and/or visual outputs by means of various software and enable to reach meaningful information. With qualitative techniques such as retrospective interviews and focus group interviews, it is possible to go down to the source of the psycho/physiological responses obtained as a result of BDH and to verify and mature the biometric data. Biometric tools such as GSR, eye tracking and heart rate that perform and assist the BDH process will be mentioned.

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GSR

Emotion recognition from physiological signals constitutes an important part of human-computer interaction. Because it is a complex phenomenon that affects emotion, thought and behavior and consists of cognitive components (Panahi et al., 2021: 1). GSR is used to objectively evaluate people's approaches to a product, situation or service. Although the expansion of GSR is expressed as Galvanic Skin Response or Galvanic Skin Reflex, it now covers different electrodermal phenomena and activity processes (EDA) and it is recommended to be used as GSR (Boucsein, 2012: 3).

GSR is a physiological measurement; however, GSR, which was discovered more than a century ago, has become one of the widely used methods (Boucsein, 2012: 11). GSR is defined as a change in the electrical properties of the skin. The response occurs as an increase in the electrical conductivity of the skin along the palms or soles (Acevedo et al., 2021: 2). The signal is not a conscious activity as a parameter of sweat gland activation, but is used to capture autonomic nerve responses (Critchley, 2020: 132).

In emotional arousal measured by GSR, an increase in skin conductivity from positive to unpleasant in emotional value is observed. It has been found that skin conductivity changes systematically in varying emotional arousals such as calm and excited (van Dooren et al., 2012: 299). Therefore, the GSR measures the intensity of the emotions, not the emotions.

Eye Tracking

Eye tracking is scientific methods used to track the eye movements of people in a certain time interval and between certain points. These methods, which have been used since the 1960s, have started to be preferred frequently in multidisciplinary fields in the past two decades (Carter and Luke, 2020: 7). The significant relationship between an individual's interest in a particular stimulus and eye movements is the main reason for the increase in multidisciplinary studies on eye tracking. Eye movements are largely reflex-based as a reflection of cognitive activity. So much so that, as the studies have revealed, many people cannot clearly remember the points they look at on an image and the order of these points (Clarke et al., 2017; Kok et al., 2017). In this direction, different equipment and software are used in order to detect eye movements and interpret the obtained data correctly. Eye tracking data can be obtained remotely through physical hardware such as Tobii Eye Tracker, SMI Eye Tracking Glasses and EyeLink 1000 Plus or software developed by companies such as Emoty.AI and iMotions.

Fixation or short and rapid movement (saccade) of the eye at a certain point for a while is one of the important findings obtained in eye follow-up studies. The eye, which is fixed at any point on the visual stimulus, cannot transfer all the details in the relevant area to the brain. For this, the eye must constantly move around the points on the stimulus. Although the pause time of the eye at these points generally varies between 180-275 milliseconds, this time varies according to the nature and complexity of the stimulus (Rayner, 2009: 1482). Shorter movements (saccade) between points is another variable that should be interpreted within the scope of eye tracking studies. In this type of eye movement, the eye pauses at certain points for a maximum of 40-50 milliseconds (Abrams et al., 1989: 537). Obtained from eye tracking analysis; Basic data on fixation of the eye and short and rapid movements (saccade) in the eye are insufficient to explain why the person concentrates on certain points on the image he sees. For this reason, more precise results can be reached regarding the user experience in line with the mood change and heart rate data collected from the participants through GSR and FACS techniques.

Eye tracking devices are produced to detect and show where individuals are looking. Eye tracking technique can be hardware (screen-based eye tracking device, example: Tobii Pro Fusion, eye tracking device used in glasses form: Pupil Invisible), software tracking via webcam (example:

Emoty.ai, Realeye.io, iMotions) can also be. By using eye trackers, researchers can obtain 3 types of output from the users' gaze experience (Moran, 2019):

- Gazeplots (qualitative)
- Gaze repetitions (qualitative)
- Heatmaps (quantitative)

Heart Rate

Biometric data studies are used to measure the physiological and psychological responses of individuals to different stimuli. Heart rate measurement is one of the pioneering techniques used in this context. The measurement of heartbeat with biometric data collection tools is based on two basic principles. The first of these is the recording and analysis of the sounds that occur during the beating of the heart, and the second is the measurement of the electrical signals that occur in each beat (ECG) (Akhter et al., 2015: 18). On the other hand, heart rate data can also be collected through PPG (photoplethysmogram) signals in recent years. PPG signals are obtained by measuring oxygen saturation in the blood. Along with respiratory and cardiac activities, some psychological factors can be detected through PPG signals. The fact that the hardware cost is quite low compared to ECG is one of the biggest advantages of PPG (Lei et al., 2020: 2). Although heart rate measurement is one of the most frequently used methods in studies using psycho/physiological methods, it is not sufficient on its own to accurately measure user experience.

Remote Biometric Data Harvesting

The only difference that separates remote biometric data harvesting (Remote BDH) from BDH is that data collection is done remotely. To put it simply, the participant enters the system offered by the software via the link he receives and provides data anywhere via the Internet and a computer with a camera. Remote BDH enables multinational studies to be carried out faster and with less cost. Remote BDH, which allows participants to participate in the experimental study through their natural environment, also reduces the impact of environmental factors such as the experimental environment that may affect the research results. Facial action coding systems stands out as a software technique evaluated within the scope of Remote BDH.

Facial Action Coding Systems (FACS)

Facial expression is one of the most powerful and universal means of communicating one's intention and emotional state. Facial muscles, which are the least obedient to the will, can sometimes alone give away a light and temporary feeling (Darwin et al., 1998: 75). The relationship between emotions and facial expressions has been the subject of theoretical curiosity. Studies on the effect of emotions on facial expression have been going on since the 1920s. Although comparative studies were conducted, it was insufficient to find consistent answers to basic questions such as the validity and universality of the information provided by facial expressions of emotions (Ekman and Oster, 1979: 528). Today, however, it is possible to measure emotions through facial expressions with biometric data tools. Due to the complexity and variability of facial expressions, the difficulty of recognizing facial expressions with high accuracy continues (Shan et al., 2009: 803). However, in the new dimension reached by human-computer interaction, experimental and theoretical studies can be handled on a universal scale by teaching artificial intelligence about facial muscles and thus emotions through facial expressions.

The Facial Action Coding System (FACS) is a system that uses the anatomical components of the face to measure and classify human emotions with changes in facial expressions (Taubert and Japee, 2021: 75). FACS records facial expressions via webcam and uses fully automatic computer algorithms while doing this (Chauhan et al., 2016: 41). With facial expression analysis, it is possible to measure emotional arousal regarding any product, service or content. Performing

FACS with a webcam allows research to be conducted remotely. It is important for the participant to participate in the research in his own comfort zone in order to carry out the study in a healthy way. Since devices such as fMRI used in emotion research are not portable, it eliminates the problem of accessing the participant. In addition, FACS does not have the difficulty of evaluating the outputs of EEG, which is another tool used in this field, which measures brain activity.

With FACS, 7 basic emotional states defined by Paul Ekman (Ekman, 1970: 1999) can be measured. These are anger, sadness, disgust, contempt, fear, happiness and surprise. These emotional states express the reactions of individuals participating in research to stimuli and are universally valid.

Result & Recommendations

Brain imaging (EEG, fMRI) and biometric techniques (eye tracking, facial coding) are described as neuromarketing techniques and are covered in this narrow scope. Biometric data harvesting techniques should not be perceived as being used only within the scope of marketing and consumer behavior. The use of these techniques in interdisciplinary studies has increased recently. Biometric methods are used in medicine, user experience, logo/packaging design, communication and media technologies, advertising, AR/VR experience, interior design, e-sports performance, website usability and a longer list (Boraston and Blakemore, 2007; Park et al., 2020; Leckner, 2012; Djamasbi et al., 2010; Koposov et al., 2020).

In this study, biometric data gathering techniques were evaluated within the scope of mixed method and made more specific. The technique, which covers the processes of collecting the data consisting of the psycho/physiological responses of people to a certain stimulus with biometric tools and supporting these data with traditional methods such as questionnaires and interviews, is defined as "biometric data harvesting" (BDH). BDH does not have a general nature like mixed methods, but expresses a specific methodology that focuses on psycho/physiological measurements and supports it with traditional methods.

The Covid-19 pandemic has caused difficulties in conducting experimental studies face-to-face, so the importance of biometric techniques that can collect data remotely has increased. In this study, biometric data harvesting techniques were evaluated under two headings in terms of remote execution or hardware requirement. Among these techniques, those who fall into the remote class can both perform emotion detection and collect eye tracking data remotely (for example, advertising activity or website user experience studies) via the FACS technique. In eye tracking technique, data can be collected via hardware, as well as biometric data can be obtained through device cameras via software. Therefore, eye tracking technique is included in these two classes depending on whether the equipment is used or not. The galvanic skin response (eg: shimmer) can collect data via hardware, so it is not included in the remote class. Heart rate data (PPG: Photoplethysmography) can be obtained through device sensors attached to the earlobe. Software is being developed to obtain PPG data remotely (eg: Emoty.AI software, Realeye.io software). It is estimated that the number of remotely collected biometric techniques will increase as various software can measure more biometric techniques.

Cross-cultural experimental academic studies can be carried out in a faster time and at less cost with BDH. In addition, in case of extraordinary situations such as Pandemic, it can be prevented that the field performance of the researches is negatively affected. The number of software companies that offer biometric techniques remotely is expected to increase. In addition, it is estimated that reliable and valid experimental studies conducted within the scope of human behavior will increase as a result of the support of these companies to researchers.

The fact that the FACS technique can also be used in the laboratory environment allows it to be used together with GSR, HR and eye tracking techniques. In this way, data richness and

reliability of research can be increased by making many psycho/physiological measurements together. It is recommended to use the Remote BDH technique in HCI and human behavior studies that are planned to be conducted in cross cultural. The same recommendation is valid for studies to be carried out within national borders. It seems possible and recommended to increase the sample volumes by reaching a large number of participants with the remote biometric harvesting technique.

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