

BioBeAms: A MULTIMEDIA SYSTEM FOR ASSESSMENT OF ATTACHMENT ORGANIZATIONS AND HEART-RATE

*Zhan-Jian Li¹, Isabel Soares², Maria Carolina Silva³,
Armando Pinho², Lúcia Neves², Ovídio Costa⁴,
João Paulo Silva Cunha¹*

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Abstract

In this paper, we present a multimedia system named BioBeAMS (Bio-signal Behavior Attachment Multimedia System) for assessment of attachment organizations and heart rate in Strange Situation experimental procedure for mother to child attachment study (a widely used psychological procedure). Attachment patterns assessed through this procedure have been conceived as different strategies to regulate the access to relevant attachment information and to process distress-related information. The psycho-physiological activation led by emotional processing of attachment experiences during the Strange Situation procedure may be a critical factor for understanding the subject's psychological attachment strategies. BioBeAMS is an application, which integrates the bio-signal, video/audio of the psychological experimental procedure and the rater's coding together, running in the MS Window 95 environment on a PC. Using this system, we can acquire ECG signal and capture video/audio in a synchronous way. It also enables the raters to subsequently analyze and evaluate psychological and physiological events during review to study possible relations.

¹ INESC/Departamento de Electrónica e Telecomunicações, Univ. de Aveiro.

² Departamento de Psicologia da Univ. do Minho.

³ Lab. de Biometria do Inst. de Ciências Biomédicas Abel Salazar, Univ. do Porto.

⁴ Centro de Medicina Desportiva do Porto e Faculdade de Medicina da Univ. do Porto.

Keywords

Psycho-physiology, Strange Situation procedure, ECG, Multimedia, video server, synchronization.

Introduction

In light of Bowlby's conception about the biological function of the attachment system [1,2,3], this study aims to analyse the relations between heart-rate and attachment organizations in infants and their mothers assessed during the Strange Situation.

The Strange Situation [4,5] is a standard laboratory procedure presented as accumulative-stress situation constituted by eight episodes, with two separations and reunions. Based on the analysis of the scenarios of mother-child interactions during the Strange Situation, each dyad is classified in terms of one of the three patterns: secure (group B), insecure-avoidance (group A) and insecure-ambivalent (group C).

The Strange Situation conceived as a stressful setting leading to the activation of the attachment system that may be of special relevance for the study of the interplay between physiological and psychological processes.

In order to study this issue, it is necessary to collect and to analyse data in a synchronous way. This paper introduces the BioBeAMS, a multimedia system developed for the assessment of attachment organizations and heart-rate during the Strange Situation. This system is a fully digital system which implements this conceptual framework by acquiring ECG, video and audio in a synchronous way and storing them in an integrated format in a PC. Multimedia review and editing procedures can be performed enabling the different specialists to identify events over the different type of data and analyse posteriorly relations between all (psychological and physiological) events.

The Setup of the BioBeAMS System

The setup of the system is presented in Fig. 1. A camcorder is used for collecting video and audio information from the clinical procedure. This camcorder is connected to a digital video acquisition board plugged into a PC computer bus. This board enables the digital acquisition of video and audio data to the PC hard disk at up to 30 frames per second with a compression rate up to 20:1 provided by a dedicated video processor corresponding to a throughput of 800 Mb/hour approximately.

The Electrocardiogram (ECG) and heart rate are acquired by two portable units designed for this purpose (one attached to the mother and the other to her child) which send the digitized signals to the PC through standard serial ports. These units are specially designed to implement all the necessary protections for patient electrical insulation and are even resistant to defibrillator actuators.

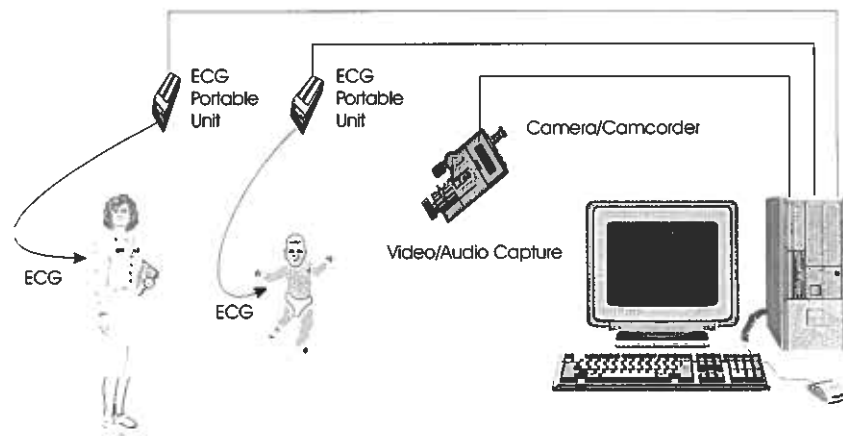


Fig. 1 - The Setup of BioBeAMS System.

BioBeAMS System's Architecture

In more detail, the system architecture is presented in Fig. 2. In the lower part of the diagram we depict the system's hardware components which are parts of the Setup already described above.

The software developed for this project is where the true multimedia integration takes place and is responsible for all the functionality of the system that enables the necessary analysis of the acquired information. This software follows client-server architecture and is written in C++ language.

BioBeAMS is composed of a video server and a main module (video client). The video server, which is a stand-alone process, answers to requests from the video client and is responsible for all the video related actions such as video capture, video playback, stop, step and jump, etc. The video client is responsible for the bio-signal acquisition, information edition, user interface and analysis procedures. The communication between the client and the server is performed through a MicrosoftTM Windows IPC (Win32API Inter-Process Communication) scheme, which is depicted as "Video Server Comm. Interface" module in Fig. 2. An internal timer with a resolution of one millisecond is used to synchronize the ECG/Heart rate signal and video frames.

The video server is implemented as a general one that can provide video and synchrony services to any application program that needs these functionalities. For this, we define a complete client-server communication API. Any application program, which acts as a video client, can communicate with the video server by this API, needless knowing any detail of video module. Thus, the video server module can be reused by other applications without recompile.

BioBeAMS was implemented following an object-oriented approach using inheritance/dynamic binding scheme to reduce service complexity and abstract the program code into several object classes as can be depicted in Fig. 2. An important feature of BioBeAMS is the bio-signal acquisition performed by "ECG Class" module. Bio-signal data is saved in a file with SIGIF format ("SIGnal Interchange Format"), which is an open bio-signal interchange format specified by INESC-Aveiro, Portugal [10,11]. SIGIF is freely available from the authors and a file access services class called "SIG Lib" is provided so that the programmer can use services like "get Signal" or "read SIGIF header" without having to program them. "Rating class" module is an object class related to rating functionality, e.g. information edit, user interface of rating and assessment procedures.

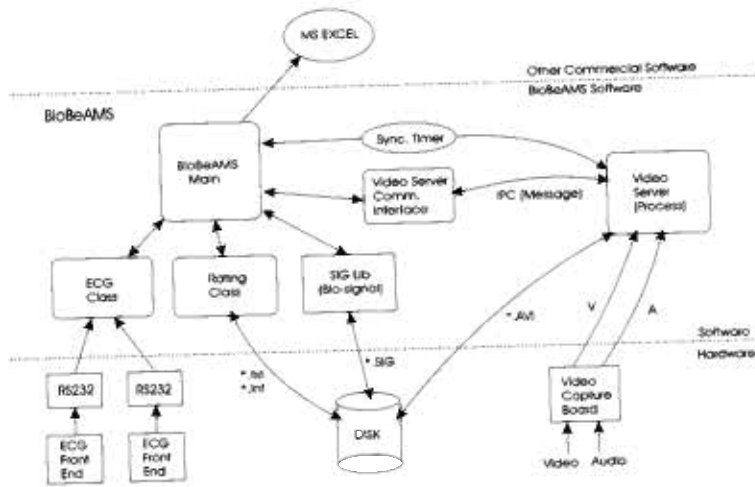


Fig. 2 - The Architecture of BioBeAMS System.

The assessment result of instance data can be used to generate result tables to document the clinical cases that will be grouped, saved in files, or exported to Microsoft™ Excel for further analysis.

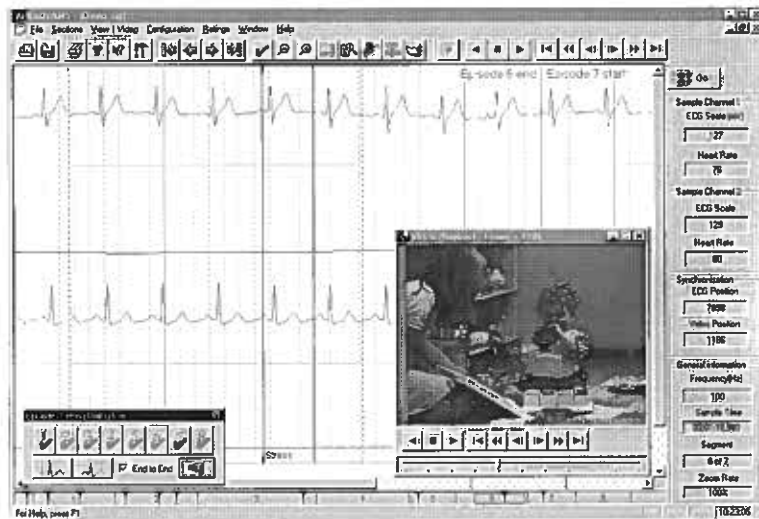


Fig. 3 - Main Human-Machine Interface of BioBEAMS.

BioBeAMS System Functionality

The BioBeAMS has functionality that enables the performance of the clinical procedure workflow. Fig. 3 shows an aspect of the human-machine interface of the system while working.

After the multimedia-integrated acquisition of video and bio-signals from the clinical procedure, the raters can visualize in real-time ("play mode") all the information in a synchronous way. They can have the video displayed in a window and the corresponding bio-signals will be displayed on another window where a dynamic cursor line shows the bio-signal sample that corresponds to the video frame played at each moment. The raters can then stop, watch frame by frame, add event labels, set episodes of the different phase of the procedure and introduce notes to the scene being analyzed, etc. Also user can drag & drop labels, episode boundaries by mouse, which is a very convenient way for users. All this editing information can then be saved into text file at the same time base of the previously acquired multimedia information. The users can also analyze the different parts of the procedures classified in a certain way, jump from one episode to another, and watch just the part of the procedure where a specific event was marked, and so on. BioBeAMS provided four score sheets for rating, one for the final result, three for individual raters, which allow several raters to evaluate the instance independently. BioBeAMS also provides a dialogue box for processing the instance result, e.g. grouping clinical case, saving to file and exporting to MS Excel.

Summary

Rapid evolving of digital multimedia technology during recent years made available the possibility of developing a digital technological solution for the psycho-physiological problems. In this paper, we present an overview of a Bio-signal Behavior Attachment Multimedia System (BioBeAMS) for Strange Situation application in the psycho-physiological field, which is a full digital solution. Compared to traditional solutions for this problem, the advantage of this solution is that it collects video/ audio, bio-signal and heart rate in the synchronous way. It also provides

a user-friendly interface to support the clinical procedure workflow, from analysis to rating codes, which simplifies greatly the clinician's work. The system is now under evaluation at the clinical environment and we are collecting comments from psychologists and cardiologists so that we can enhance and extend the functionality of BioBeAMS to make this multimedia system more widely applicable in the psycho-physiological area.

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