International Journal of Technology and Engineering Studies
volume 6 issue 1 pp. 16-22 doi: https://dx.doi.org/10.20469/ijtes.6.10003-1

Intelligent Tutoring System for the Impact Analysis and Assessment of Online Ads and Intuitive Online Ad Serving

Arturas Kaklauskas*
Vilnius Gediminas Technical University,
Vilnius, Lithuania

Ieva Ubarte
Vilnius Gediminas Technical University,
Vilnius, Lithuania

Ingrida Vetloviene
Vilnius Gediminas Technical University,
Vilnius, Lithuania

Darius Skirmantas
Vilnius Gediminas Technical University,
Vilnius, Lithuania

Abstract: The objective of this research is to explore neuro-advertising by integrating research methods and to develop ViNeRS, a new method, and system. Real-time ad personalization is a major research area in modern marketing. The ViNeRS method can process big data and offer automated online tips on making ads more effective. Well-targeted ads can make businesses more efficient, help save resources, attract more users, and create opportunities for faster expansion. The research aims to create an intelligent tutoring system for the impact analysis and assessment of online ads and intuitive online ad serving. Thus, the system will analyze and assess the impact of online ads (unfinished ad content), the efficiency of ads at each stage of their creation, determine their advantages and disadvantages, improve them until the most catchy version is achieved. As a result of this study, ViNeRS has been created, implemented and evaluated. It can be concluded that ViNeRS is an efficient method and system such that it could determine how many times a promotional message should be repeated in a certain part of a video to achieve an effective promotional campaign. It enables integrated assessment of neurobiological viewer response and can make the real-time selection of the most effective ad option. Useful insights regarding the significance of ViNeRS are enlisted for scholars and practitioners.

Keywords: *Neuromarketing, intelligent tutoring system, personalization, analysis, online ads*

Received: 11 September 2019; ***Accepted:*** 27 December 2019; ***Published:*** 28 February 2020

I. INTRODUCTION

To understand the increasingly complex consumer decision-making and consumption environment, modern marketing scholars have started to study drivers of consumers' purchasing decisions from a multidisciplinary perspective [1]. Real-time ad personalization is a major research area in modern marketing. Many neuromarketing scientists published articles in this area [1, 2, 3, 4, 5, 6, 7]. An analysis of articles suggests that, in the field of decision theory, the term "neuromatrix" is an innovation worldwide. The emotional (happy, sad, angry, surprised, scared, disgusted, or neutral), affective (bored, interested, and confused), and physiological (facial temperature, heart rate, respiratory rate, sex, age, etc.) data obtained as part of the neuromatrix research contribute about 90% of new extra data; that can ensure more relevant and accurate neuro analysis results.

The research object is the advertising cycle, any involved stakeholders with their personal goals (viewers, the advertiser, screenwriters, directors and producers), and the external environment as a whole. For a comprehensive analysis of the research object, the ViNeRS method was created. The method integrates Damasios somatic marker hypothesis [8], Russell's circumplex model of effect [9], biometric, physiological, affective computing, statistical analysis (LOGIT, KNN, MBP, RBP),

*Correspondence concerning this article should be addressed to Arturas Kaklauskas, Vilnius Gediminas Technical University, Vilnius, Lithuania. E-mail: Arturas.Kaklauskas@vgtu.lt

decision-making, recommender, big data, and text analytics, categorical, spatial and personalized affective content and mapping analysis and self-analysis methods, as well as five multiple criteria analysis methods developed by the applicants.

Let us look at the main attributes that clearly show this neuromatrix is a global-scale innovation and reflect the ambitiousness of the research goals. The integrated ViNeRS method and neuromatrix developed by the authors of this article can produce about 90% of new extra data and thus can ensure more relevant and accurate neuroanalysis results. A neuromatrix theory developed by Melzack [10] is of a completely different nature, albeit related to neuromatrixes. Chapman [11] discusses the theory of the neuromatrix of pain which posits that the human brain perceives painful stimuli through a network of neurons, effectively a neuromatrix, with the active generation of subjective experiences, rather than a passive recording of information about the damage suffered by the body's tissues. Melzack [10] believes that the terms neural network and neuromatrix are synonymous. Various studies on the brain discuss pain and neuromatrixes [12, 13, 14]. The neurodecision matrix and the neuromatrix theory proposed in our research [15], however, are related in name only, but the topics discussed are completely different.

II. MODEL OF INTELLIGENT TUTORING SYSTEM FOR THE IMPACT ANALYSIS AND ASSESSMENT OF ONLINE ADS AND INTUITIVE ONLINE AD SERVING

The impact analysis and assessment method for online ads (dynamically generated ads) makes it possible to learn more about ad effectiveness at each step of its creation, reveals good qualities and flaws of an ad, and helps with its improvement to offer the viewer the most attractive option. It can pinpoint the exact video frame that makes a bigger impact on short-term and long-term memory, as well as the frames evoking the most intense impressions and feelings. This method can also suggest how many times a promotional message should be repeated at a certain point in the video to achieve an effective advertising campaign. With such information available, elements in a video can be switched to make the message more visible or memorable. A conceptual model (see Fig. 1), is a theoretical construct of the tutoring process, which analyzes multidimensional personalized ad by applying a system of methods. The main tasks of an intelligent tutoring system for the impact analysis and assessment of online ads (ViNeRS1) and Intuitive Online Ad Serving (ViNeRS2) conceptual model are:

- to deliver the essential meaning and main framework of the ViNeRS1 and ViNeRS2;
- to characterize the personalization process by a set of variables and a criteria system that describes them exhaustively;
- to symbolize the multiple criteria analysis of information, data, and knowledge in an effective and interactive personalization system;
- to analyze and assess the impact of online ads (unfinished ad content);
- to determine ads advantages and disadvantages, and improve them until the most catchy version is achieved;
- to develop the Neuromarketing Analysis Intelligent Tutoring.

System, which will be able to determine how many times a promotional message should be repeated in a certain part of your video to achieve an effective promotional campaign.

The ViNeRS equipment subsystem can monitor ad viewers and continuously analyze their body language (abundant non-verbal signals) to get hints for better advertising strategies and styles. Body language studies suggest that, in face-to-face communication, non-verbal signals account for 60-80% of the impact, followed by vocal characteristics at 20-30%, with the remaining 7-10% accounted for by words.

Modern Neuro Advertising Systems (NASs) are inferior to human advertising agents in terms of efficient viewer interaction/feedback. An important reason is that an advertising agent can interpret the viewer's body language, a means of effective communication to understand viewers better. If you focus on the way the viewer speaks, on their gestures or movements, you can understand the person's inner state and their emotions experienced while viewing an ad. An advertising agent can observe viewers watching an ad, analyze their emotional states (facial expressions, body movements, vocal characteristics such as tone, intonations, etc.) and thus achieve more effective communication and select a more rational ad style.

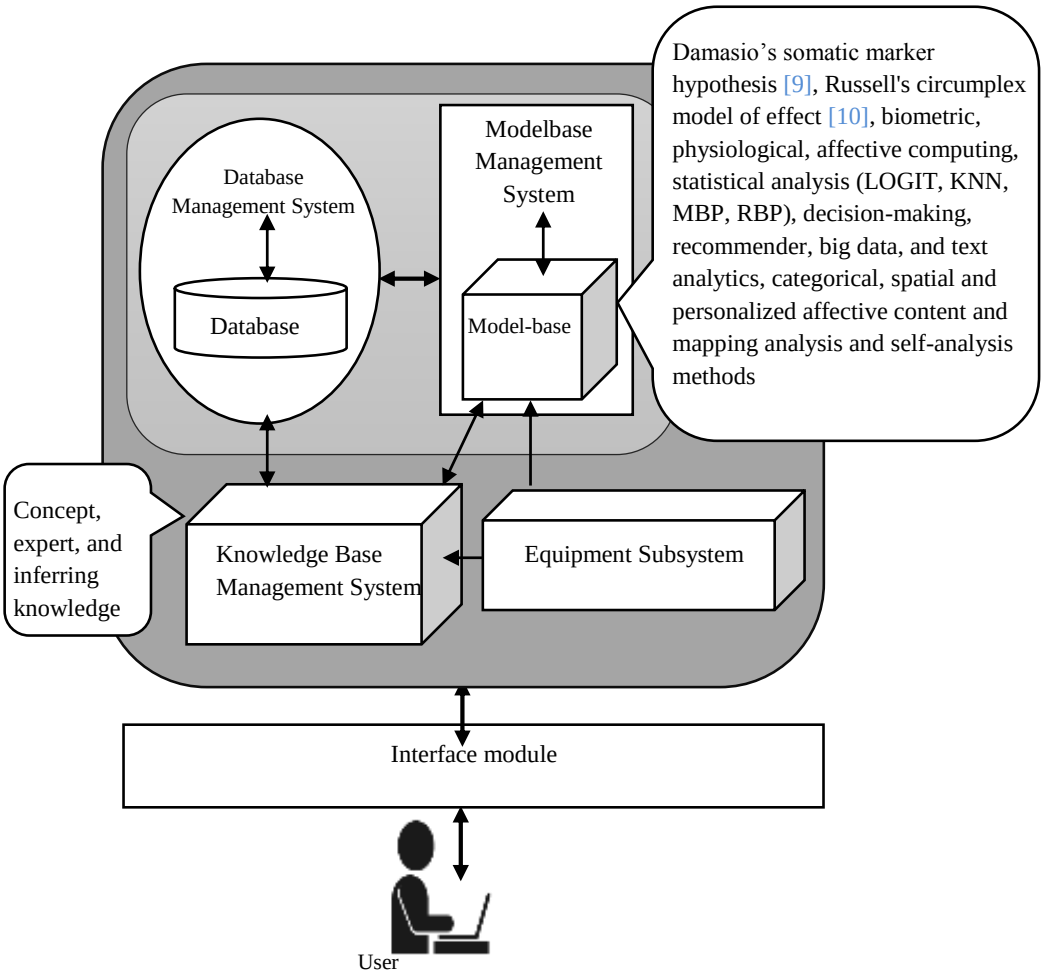

Fig. 1. Conceptual model of the intelligent tutoring system for the impact analysis and assessment of online Ads and intuitive online Ad serving

Scientists are now trying to transfer all this technology to NASs. This course is one of the main NAS improvement areas worldwide. For that end, many countries have launched studies to develop effective computing solutions and Intelligent Affective Advertising Systems (IAASs) based on the solutions. IAASs use biometric and intelligent technology to understand viewer body language and thus are better at responding to viewer emotional states. The process is neither simple nor straightforward because different viewers can experience a wide range of emotions at the same time.

The aforementioned research, centered on developing ViNeRS1 and using biometric technologies, did not consider the interest, productivity, and stress levels of learning students in an integrated manner and did not compile millions of alternative text variants. Furthermore, it does not consider to select a personalized, more suitable variant of a text for learning. These are precisely the main innovative elements of the offered Intelligent tutoring system for the impact analysis and assessment of online ads (ViNeRS1). The ViNeRS2 enables integrated assessment of neurobiological viewer response and can make the real-time selection of the most effective ad option

III. INTELLIGENT TUTORING SYSTEM FOR THE IMPACT ANALYSIS AND ASSESSMENT OF ONLINE ADS AND INTUITIVE ONLINE AD SERVING

A key step in the multiple criteria analysis of the video neuroadvertising cycle is to determine the values and weights of the criteria that define the alternatives. When we know the criteria values and weights we can use multiple criteria analysis methods to determine the utility degree, priority, and various values of the alternatives being compared.

Quantitative and qualitative criteria values are calculated for the entire ad. The values of qualitative criteria are usually determined by means of expert judgement.

The analysis results of video ads are summarised in a decision neuromatrix with its columns representing each of the alternative ads n, and its rows listing the quantitative and descriptive details of each alternative in question.

Quantitative and conceptual descriptions of alternative video neuroadvertising cycles cover various aspects of this form of advertising. Quantitative details include criteria systems, measuring units, values and initial weights, minimising/maximising factors, and details about the creation of alternative ad options. A description of the video neuroadvertising life cycle in a conceptual form, text, diagrams, charts, drawings and augmented reality provides descriptive details of the ads and their detailed criteria (the criteria are described, the choice of their system explained and justified, values and weights presented, and multivariate design opportunities disclosed). The descriptive details are required for a more detailed and accurate assessment of the alternatives in question. They not only provide more detailed information but can also help to come up with a more accurate criteria system and criteria values and weights.

A grouped decision neuromatrix separates criteria into two groups: quantitative and qualitative. This makes multiple criteria analysis of alternatives easier and makes the physical meaning of the calculations more obvious. Multiple criteria analysis usually entails processing large amounts of information, and neuromatrixes are, therefore, a rational choice. The alternatives and the quantitative and descriptive details of the video ads are in such case grouped in a certain manner to create a grouped decision neuromatrix. The matrix can then be used in multiple criteria analysis of the video neuroadvertising cycle.

To select the most effective video ad, a decision neuromatrix must be created and then multiple criteria analysis of the available video ad options performed. To do that, the values and weights of the criteria that define the video ads in question are compared by analyzing the descriptive details. The advertising life cycle being analyzed can only be described on the basis of a system of multiple criteria with different meanings and dimensions.

Developed ViNeRS1 could be found by the link: http://iti3.vgtu.lt/viners/ (Fig. 2). Scriptwriters, directors, and producers, when creating a video ad, anticipate what a rainbow of emotions and what intensity needs to be evoked in viewers in specific ad locations. People always feel a whole rainbow of ever-changing emotions, some of which are stronger and others weaker. An advertisement is displayed in the middle of the main window of the ViNeRS1 system (1). The subject (2) is visible on the right side of the screen. His emotions are represented graphically (3) and in the form of a table (Fig. 3).

Fig. 2. The main page of ViNeRS1

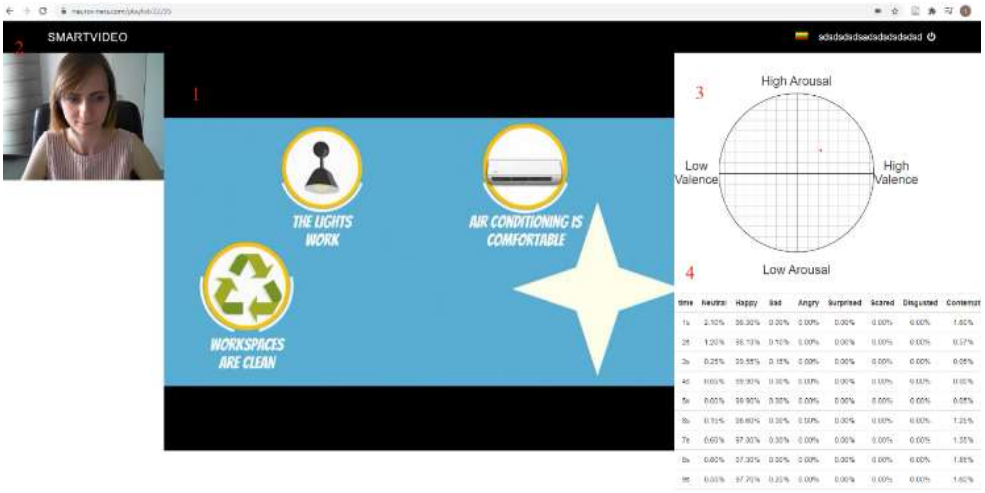

Fig. 3. Operation of the ViNeRS1 system

According to James Russells emotion model, emotions are distributed in a two-dimensional circular space encompassing the dimensions of arousal/excitation (from the weakest to strongest emotions) and valence/valence (from a pleasant state to dissatisfaction). The arousal is represented on the vertical axis, the valence on the horizontal axis, and the center of the circle shows neutral valence and a medium level of excitement. According to this model, emotional states of any level can be represented. The upper right quarter of the circle can depict positive (e.g., happy) strong emotions with high excitation and high valence. Negative (e.g., angry) strong emotions may be displayed in the upper left quarter (Fig. 3). The summarized excitation and valence results and emotion table on the right show that you like the video ad shown because the excitation and valence are above average. After watching the video, a questionnaire is filled in on what emotions were felt for each video frame separately (Fig. 4).

Emotion	Evaluation
Happy	Low emotion
Neurtal	Low emotion
Sad	Low emotion
Angry	Low emotion
Surprised	Low emotion
Scared	Low emotion
Disgusted	Low emotion
Contempt	Low emotion

Fig. 4. The viewer's emotions assessment table

The project produced the two-part video neuroadvertising (ViNeRS) method. Its first part is the impact analysis and assessment method for online ads (dynamically generated ads), also known as the ViNeRS1 method. This method makes it possible to learn more about ad effectiveness at each step of its creation, reveals the good qualities and flaws of an ad, and helps with its improvement to offer the viewer the most attractive option. It can pinpoint the exact video frame that makes a bigger impact on short-term and long-term memory, as well as the frames evoking the most intense impressions and feelings. This method can also suggest how many times a promotional message should be repeated at a certain point in the video to achieve an effective advertising campaign. With such information available, elements in a video can be switched to make the message more visible or memorable. The second part is the intuitive online ad serving method (ready-made ads), also known as the ViNeRS2 method, that enables integrated assessment of neurobiological viewer response and can make real-time selection of the most effective ad option. The following research conclusions summarise the intermediate project results related to the research we did to create the ViNeRS method:

- The research object is the advertising cycle, any involved stakeholders with their personal goals (viewers, the advertiser, screenwriters, directors and producers), and the external environment as a whole.
- The ViNeRS method was created for a comprehensive analysis of the research object. The method integrates Damasio's somatic marker hypothesis [8], Russell's circumplex model of affect [9], biometric, physiological, affective computing, statistical analysis (LOGIT, KNN, MBP, RBP), decision-making, recommender, big data, and text analytics, categorical, spatial and personalised affective content and mapping analysis and self-analysis methods, as well as five multiple criteria analysis methods

developed by the applicants.
- In our studies, the ViNeRS method was used to analyze 12 layers of data (over 200 million anonymized data points).
- This analysis revealed over 30,000 average and strong correlations.
- Compared to other available methods, the ViNeRS method is broader and deeper in scope.
- The ViNeRS method offers digital tips on ways to improve ads.
- The ViNeRS method was used to assess the integrated emotional market value.
- The ViNeRS method is used to analyse ad content maps linked to viewer affective attitudes, emotional states, and physiological parameters.
- On the basis of the neurocorrelation matrixes and the Russells circumplex model of affect [10], the ViNeRS neuroadvertising emotion model was created.
- The ViNeRS method is used in a neurosurvey.
- The ViNeRS method includes a negotiation method.
- The ViNeRS method includes text analytics.
- The ViNeRS method includes the neuromarketing circumplex INVAR model of emotional states and affective attitudes.
- The INVAR method determines the integrated hedonic-utilitarian value of the advertised product.
- The INVAR method determines the hedonic value of the advertised product.
- The INVAR method is used to create combined ad units.
- The impact analysis and assessment method for online ads (dynamically generated ads) has been developed. This method, also known as ViNeRS1, enables assessing ad effectiveness at each step of its creation, reveals good qualities and flaws of an ad, and helps with its improvement to offer the user the most attractive option. This method can pinpoint the exact video segment that makes a bigger impact on short-term and long-term memory, as well as the frames evoking the most intense impressions and feelings. It can also suggest how many times a promotional message should be repeated at a certain point in the video to achieve an effective advertising campaign.
- The method for intuitive online ad serving (ready-made ads) has been developed. This method, also known as ViNeRS 2, enables integrated assessment of neurobiological viewer response and can make a real-time selection of the most effective ad option.
- The ViNeRS method allows processing big data and automated serving of digital tips on ways to make an ad more effective.
- The ViNeRS method can be used to create hundreds of thousands of alternative ad options.
- The ViNeRS method determines the hedonic value of the advertised item; never before biometric and multiple criteria analysis methods have been integrated for that purpose.
- The ViNeRS method determines the emotional value of the advertised item; never before biometric and multiple criteria analysis methods have been integrated for that purpose.
- The neutrosophic INVAR method was applied to determine the integrated hedonic-utilitarian value of the housing being analyzed.
- The ViNeRS method helps with market segmentation. With the help of the ViNeRS method, our research in this project has been broader and deeper in scope than any previous neuromarketing studies worldwide.

IV. CONCLUSION AND RECOMMENDATIONS

The impact analysis and assessment method for online ads (dynamically generated ads) enable assessing ad effectiveness at each step of its creation, reveals good qualities and flaws of an ad, and helps with its improvement to offer the viewer the most attractive option. This method can pinpoint the exact video segment that makes a bigger impact on short-term and long-term memory, as well as the frames evoking the most intense impressions and feelings. It can also suggest how many times a promotional message should be repeated at a certain point in the video to achieve an effective advertising campaign. The following aspects make the ViNeRS method and system an innovation worldwide: creation and analysis of emotional, affective, biometric, and physiological ad content maps and neuromatrixes, the inclusion of a neurosurvey, and two ViNeRS methods. The impact analysis and assessment method for online ads (dynamically generated ads), also known as the ViNeRS1 method, enables assessing ad effectiveness at each step of its creation, reveals good qualities and flaws of an ad, and helps with its improvement to offer the viewer the most attractive option. This method can pinpoint the exact video segment that makes a bigger impact on short-term and long-term memory, as well as the frames evoking the most intense impressions and feelings. It can also suggest how many times a promotional message should be repeated at a certain point in the video to achieve an effective advertising campaign. The method for intuitive online ad serving

(ready-made ads), also known as the ViNeRS2 method, enables integrated assessment of neurobiological viewer response and can make a real-time selection of the most effective ad option.

The ViNeRS method can process big data and offers automated online tips on ways to make ads more effective. Well-targeted ads can make businesses more efficient, help save resources, attract more users, and create opportunities for faster expansion.

Declaration of Conflicting Interests

There is no known conflict of interest in this work.

Acknowledgment

This project has received funding from the European Regional Development Fund (project No 01.2.2-LMT-K-718-01-0073) under a grant agreement with the Research Council of Lithuania (LMTLT).

REFERENCES

[1] A. Stasi, G. Songa, M. Mauri, A. Ciceri, F. Diotallevi, G. Nardone, and V. Russo, "Neuromarketing empirical approaches and food choice: A systematic review," *Food Research International*, vol. 108, pp. 650–664, 2018. doi: https://doi.org/10.1016/j.foodres.2017.11.049

[2] W. M. Lim, "Demystifying neuromarketing," *Journal of Business Research*, vol. 91, pp. 205–220, 2018. doi: https://doi.org/10.1016/j.jbusres.2018.05.036

[3] E. H. Moors, P. K. Fischer, W. P. Boon, F. Schellen, and S. O. Negro, "Institutionalisation of markets: The case of personalised cancer medicine in the netherlands," *Technological Forecasting and Social Change*, vol. 128, pp. 133–143, 2018. doi: https://doi.org/10.1016/j.techfore.2017.11.011

[4] F. Babiloni and P. Cherubino, "Neuromarketing," in *Reference Module in Neuroscience and Biobehavioral Psychology*. Amsterdam, Netherlands: Elsevier, 2020.

[5] M. Doborjeh, N. Kasabov, Z. Doborjeh, R. Enayatollahi, E. Tu, and A. H. Gandomi, "Personalised modelling with spiking neural networks integrating temporal and static information," *Neural Networks*, vol. 119, pp. 162–177, 2019. doi: https://doi.org/10.1016/j.neunet.2019.07.021

[6] L. Mañas-Viniegra, P. Núnez-Gómez, and V. Tur-Vines, "Neuromarketing as a strategic tool for predicting how instagramers have an influence on the personal identity of adolescents and young people in Spain," *Heliyon*, vol. 6, no. 3, pp. 35–78, 2020. doi: https://doi.org/10.1016/j.heliyon.2020.e03578

[7] S. Kemp, "Consumers as part of food and beverage industry innovation," in *Open Innovation in the Food and Beverage Industry*. Amsterdam, Netherlands: Elsevier, 2013.

[8] A. R. Damasio, *Descartes' Error: Emotion, reason, and the human brain*. New York, NY: Putnam Berkley Group, 1994.

[9] J. Russell, "A circumplex model of affect," *Journal of Personality and Social Psychology*, vol. 39, no. 6, pp. 1161–1178, 1980.

[10] R. Melzack, "Phantom limbs and the concept of a neuromatrix," *Trends in Neurosciences*, vol. 13, no. 3, pp. 88–92, 1990. doi: https://doi.org/10.1016/0166-2236(90)90179-E

[11] J. Chapman, *VSA as a Tool for Eliciting Confessions*. New York, NY: State University of NY at Corning, 1989.

[12] G. L. Moseley, "A pain neuromatrix approach to patients with chronic pain," *Manual Therapy*, vol. 8, no. 3, pp. 130–140, 2003. doi: https://doi.org/10.1016/S1356-689X(03)00051-1

[13] K. K. Trout, "The neuromatrix theory of pain: Implications for selected nonpharmacologic methods of pain relief for labor," *Journal of Midwifery & Women's Health*, vol. 49, no. 6, pp. 482–488, 2004.

[14] P. S. Khalsa, "Biomechanics of musculoskeletal pain: Dynamics of the neuromatrix," *Journal of Electromyography and Kinesiology*, vol. 14, no. 1, pp. 109–120, 2004. doi: https://doi.org/10.1016/j.jelekin.2003.09.020

[15] A. Kaklauskas, "Neuro multiple criteria analysis system for university-industry partnerships," *Procedia Engineering*, vol. 212, pp. 93–100, 2018.