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Confirmation of Personality Types Using Visual Evoked Potential with User Interface Design Stimulus – A Research Plan

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Abstract

Identification of personality types is one of the activities commonly carried out by organizations to select human resources (HR). The personality type is adjusted to the job description that must be done by the selected individual. Maximum individual performance is the reason why personality tests are needed by organizations. The personality test method commonly used is to get a response in the form of a written answer from a questionnaire. Another method is proposed which takes into account individual facial expressions. Both methods use an iterative process to achieve consistency in individual responses. The repetition process is carried out with a limited frequency and the implementation takes a long time. This limited frequency has the potential to cause errors in inferring personality types. Inconsistent responses from individuals identified with personality types make the reliability level of personality tests less than optimal. Reliability that is not optimal can have a negative impact on decision-making in the selection of selected human resources. Based on these problems, this study proposes the use of electroencephalography (EEG) to confirm individual personality types. The EEG used is a stimulated wave because the individual sees a visual form known as Visual Evoked Potential (VEP). Visual stimulus is the user interface design of a job support application. The stimulus is generated with a lot of frequency so that it can be relied on in knowing the consistent response. It is hoped that the recorded VEP pattern will reach a very good permanent level. An excellent permanent VEP rate can be determined by comparing between recording sessions. The permanent level of the VEP becomes the actual individual VEP. VEP comparisons between individuals will be compared for the classification process. The resulting classification is expected to show that individual VEP corresponds to each individual's personality type from the results of personality tests carried out by conventional methods.

Keywords: Personality type, visual evoked potential, user interface design.

1. Introduction

Organizations can achieve their goals by managing resources such as people, raw materials, machines, money, and information (including data) as well as possible (**McLeod & George, 2007)**. Human

resources (HR) obtained correctly are key to success in running an organization's business **(Gatewood et al., 2011**). Selection of the right human resources is carried out by taking into account the job analysis results, which consist of job specifications and job descriptions (**Dessler**, **2013**). Job specifications contain qualifications such as education level and human resource abilities needed to fill a job (**Mondy R.W., 2016**). The job description contains a list of activities that HR must be able to do (**Torrington et al., 2016**). HR personality affects many things in work. Therefore it needs to be given the main attention (Robertson & Callinan, 1998) so that the HR personality is expected to match the job description (**Armstrong** & **Taylor, 2014**).

In the selection process, personality has an indirect effect on performance but depends on the work environment (**Fullarton et al., 2014**). Certain individual personalities prefer tasks that they are interested in. Therefore, there needs to be an adjustment to the type of work, one of which is to pay attention to personality factors (**Capretz et al., 2015)**. Personality in teamwork affects performance (**Soomro et al., 2016**). HR performance is seen as important for the organization. Therefore, it is necessary to prevent personality types susceptible to mental and health problems because they can affect work-related matters (**Mols & Denollet, 2010**). In anticipation of this, there is a tendency for organizations to instill personality mining to determine personality to support the recruitment process (**Faliagka et al., 2012**).

Personality testing is an early personality mining process used at the recruitment stage, namely identifying and classification individual personalities at the selection stage (**Stark et al., 2014**). At the selection stage, a personality test program is expected to help individuals accept organizational culture (**Sugerman, 2009**). Some popular examples of personality tests include the Myers-Briggs Type Indicator Instrument (MBTI), the Five-Factor Model (FFM) or otherwise known as the Big Five, Eysenck Model, Sixteen Personality Factor Questionnaire (16PF) (**Fatahi et al., 2016**). Organizations need to identify individual personalities and know their strengths to maximize results or minimize weaknesses (**Kay, 2005**). Personality tests are intended for organizations to get good decision results and prevent employees from losing their chance of being accepted (**Stabile, 2000**).

The reliability of a personality test prediction is known as reliability. Reliability is an indicator of the reliability of personality test tools in predicting individual personality types. Some personality tests such as the MBTI only achieved a reliability level of 0.815 (**Furnham, 1996**), the FFM achieved reliability between 0.59 and 0.79 (**Kappe & van der Flier, 2010)**, the Eysenck model achieved a reliability range of 0.72 to 0.89 (**Bale & Archer, 2012**), and the 16PF had a reliability range of 0.69 to 0.89 (**Noël et al., 2016**). Reliability is measured by comparing the test results by doing test replications to measure the level of consistency (**Whitley & Kite, 2013**). The inconsistency of the answers between the answers on the test and the answers on the retest resulted in low reliability in identifying personality types. That condition will impact the low level of the predictive validity of the test tool (**Gideon, 2012**).

2.Study Literature

Personality is a visible aspect of a person's character and tends to have immortal traits. Thus, personality is relatively stable and predictable (**Gruber et al., 2002**). The personality test is an attempt to predict the individual types of several groups. The survey shows that personality tests can only

achieve a success rate of predicting a maximum of 22 percent to get HR that has the performance expected by the organization (**Martin, 2014**).

The problem with the personality test's success on MBTI, FFM, Eysenck Model, 16PF (**Fatahi et al., 2016**) is due to the implementation process using the questionnaire method. Issues surrounding honesty and wise respondent participation are still significant and often address measurement error causes (**Gideon, 2012**). In the test in the form of a questionnaire, organizational concerns towards respondents or prospective workers pretend to be performed during a personality test during the selection process. There is a risk that participants may lie while taking a personality test (**Patterson et al., 2016**). This has the potential to affect the accuracy of the organization in making recruitment decisions (**O'Neill et al., 2016**).

Questionnaires are a method that is often used in software development, especially in developing human-computer interaction (HCI) as an example of research aimed at exploring the overall phone icons experienced by users including the operating system provided icons(**Ghayas et al., 2019)**. The use of questionnaires can involve users so that several user motivations are known, which are part of the user's personality that affects user satisfaction in using the software (**P. I. Santosa, 2009**), (**P. Santosa et al., 2005**). The HCI questionnaire development was used at the elicitation stage and the testing phase to determine satisfaction. That stage aims to explore user needs and the level of acceptance of the HCI design, for example to Acceptance validity test using two or more techniques at the elicitation stage is carried out to obtain valid information. This is because there is concern that if you rely on only one technique, such as a questionnaire, there is a concern that the results will not be optimal (**Zowghi & Coulin, 2005**).

Electroencephalography (EEG) is an electrical record of brain activity, represented as the voltage fluctuation resulting from ion currents in brain neurons (**Niedermeyer & Silva, 2005**),(**S & Sherly, 2021**). Researches using brain waves to biometric purposes are growing in use for individual recognition (**Alariki et al., 2018**). The development of an interface using brain waves was developed to be an alternative to validating the design (**Bang et al., 2011)**. Brainwave reading devices such as the P300 are increasingly effective and efficient for HCI development needs. Brain waves can determine the user's response directly to the interface design (**Zickler et al., 2013)**. Personality is related to visual design style, design suitability with visual design needs to be considered by adjusting the display object's location (**Ziemkiewicz et al., 2013**). The topic of research on brain waves for personality is an interesting domain to study (**Dickter & Kieffaber, 2014**). Celikel in (**Jordan, 2011**) states that personality types are reflected in the human brain.

The personality test attempts to confirm the test results with a retest process to validate individual types into certain groups, such as MBTI divided into 16 types, FFM into 5 types, FFM with 16 types Eysenck Model only divides into 3 types (**Schultz & Schultz, 2009**). One attempt involved 160 answering a questionnaire given to determine the MBTI's performance to predict personality types, and the results showed the level of reliability was in the range of 0.815 (**Furnham, 1996**). The study, which involved 133 participants by filling out a questionnaire to see the predictive ability based on the FFM for college students, was found to have increased to a reliability range of 0.59 to 0.79 (**Kappe & van der Flier, 2010)**. Then, 150 participants were involved with attention to the nature of honesty, humility, and thoroughness. It was found that a personality test based on the Eysenck Model;

participants were asked to answer a questionnaire that was given to achieve reliability between 0.72 to 0.89 (**Bale & Archer, 2012**). The study used Cattell's 16 Personality Factor Questionnaire (16PF) to compare and differentiate personality traits between undergraduate men and women enrolled in liberal arts and business colleges, involving 293 samples by filling out a prepared questionnaire and the results having a reliability range of 0.69 to 0.89. (**Noël et al., 2016**).

Confirmation of personality type personality test results using facial recognition based on facial expressions of 30 participants who were involved differentiated by MBTI personality type achieved a predictive accuracy rate of 79 percent (**Chin et al., 2013**). Another study predicted that involving 50 subjects differentiated based on the FFM achieved a predictive accuracy rate of 75 percent (**Mihai Gavrilescu, 2016**). Subsequent studies examined facial expressions on video involving 442 subjects and achieved predictive accuracy in the 5 to 83.5 percent range (**Teijeiro-Mosquera et al., 2015**). A study predicting emotional facial expressions involving 64 subjects based on 16 PF achieved 80 percent predictive validity (**M. Gavrilescu & Vizireanu, 2017**). Another result that was performed using 186 data sets in facial expressions achieved a predictive accuracy of 53.37 to 82.02 percent based on 20 different groups(**Zhang et al., 2017**). Based on the classification of human personality types: optimistic, choleric, melancholy, and apathetic, with and involving 40 participants achieved a maximum predictive accuracy of 70 percent based on the four defined categories (**Setyadi et al., 201**5).

Based on the reliability level of both personality tests described earlier, it can be concluded that the conventional personality test method using retesting methods and facial recognition mostly still has reliability below 0.8. That will be an opportunity to use different methods to increase the reliability level of personality tests, using brain waves with a visual stimulus in the form of user interface design. Visual stimulus is done by repetitioning up to 100 times and using a classification based on the personality test used in an organization where the research is conducted.

The research questions (RQ) are as follows:

RQ1: What user interface design can be used as a stimulus to classify individual VEPs?

RQ2: What is the permanent rate of individual VEPs to user interface design?

RQ3: What is the VEP pattern after individuals are stimulated by interface designs commonly used in job support applications in their organizations?

RQ4: What is the level of VEP similarity based on personality types between individuals?

RQ5: What is the accuracy of personality types confirmation using VEP?

3.Review of Related Studies

The population in this study were organizational employees; the organization in question is an organization that has the following characteristics:

- Utilizing information technology for the needs of human resources work.
- Have standard employee recruitment using personality tests to classify the personality types of employees.

- Have HR performance data, which is the result of HR performance appraisal activities.

The samples to be selected are those that meet the following characteristics:

- Have worked for at least one full year and received a year-round performance appraisal.
- Employees who have good performance are supported by an information system specializing in data entry into applications in the organization's information system.

3.1. Material

The material used as data is EEG brain waves, which are participants' responsibility to visual stimuli when participants focus on paying attention to information system design. The design is in the form of a sketch of the information system display they often use in their work.

3.2. Instrument

The instrument used in this study is MUSE produced by InteraXon Inc., which can be used in the study (**Surangsrirat & Intarapanich, 2015)**. The shape of the MUSE device can be seen in Figure. 1.

Figure 1. MUSE device

3.3. Data Collection and Retrieval Procedures

The pattern search was carried out for each HR with the best performance, and its personality type is known using the EEG method. EEG will record brain activity when HR pays attention to the display design on the organization's information systems.
The requirements that must be met by each participant are as follows:

- Identify the personality type based on personality tests that have been validated by the HR team.
- Physically and mentally healthy.
- Have been working for at least one year.
- Experience using information systems in organizations

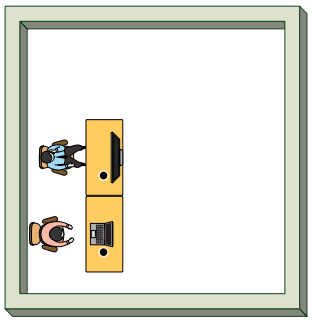

Figure 2. Data collection layout scenarios

The steps for taking EEG data follow the scenario that can be seen in Figure.2. :

- Participants were asked to fill in identity data and sign an agreement for EEG data collection.
- Participants sit comfortably facing the LCD screen with an adjusted distance [47], ready to pay attention to the stimulus to be displayed.
- Participants were asked to use MUSE so that it can be seen that the calibration process has successfully detected the four existing channels.
- The LCD screen displays the user interface design display that is displayed repeatedly 100 times with a duration of 0.25 seconds interspersed with a blank (dark) display for 0.45 seconds.
- Participants were asked to focus on paying attention to the response to the visual stimulus displayed.
- Data were recorded using the MUSE device. A recording is done on four channels, namely Fp1, Fp2, TP9, and TP10, as shown in Figure. 3.

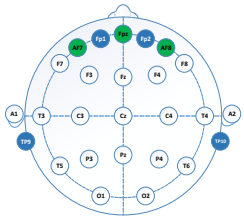

Figure 3. Channels used for recordings.

3.4. Data Analysis Process

The steps that need to be done in the data analysis process can be seen in Figure. 4. After the research data is obtained, the steps that need to be taken are to determine a valid sample from each recording. Then, the recordings were compared for each participant between the first and second sessions to see if they were permanent. In the next step, the VEP of each participant was checked whether permanent characteristics were found using Correlation. The next process is to transform the data by normalizing the stress data for calculations using Dynamic Time Warping (DTW). The next step is to find the regression coefficient, the average value of the voltage if the feature extraction stage is unsuccessful using the original VEP data. The final step is that the transformed data are analyzed using Linear Discriminant Analysis (LDA).

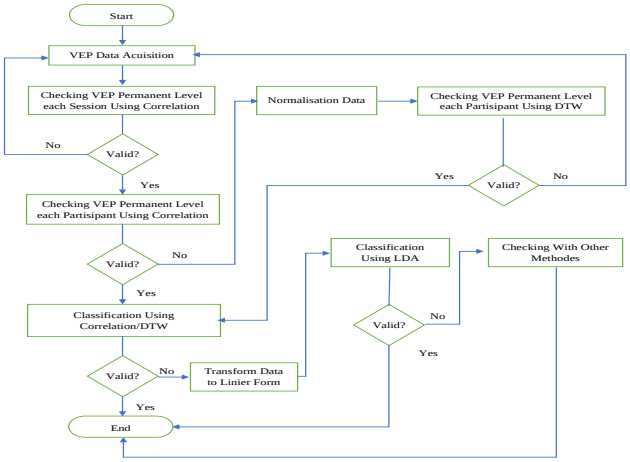

Figure 4. Flowchart of acquisition, preprocessing, feature extraction, and classification.

4. Research Implication and Practice

This research aims to use brain wave recording results to confirm personality types based on brain responses stimulated by user interface design in job support applications from HR while working. For this goal to be achieved, it is necessary to achieve the following sub-objectives:

- Getting a stimulus in interface design, which is the general form of display design for work support applications most often accessed while working.
- Knowing the permanent level of each individual's brain response to visual forms in the form of user interface designs.
- Knowing the brain response patterns of several participants involved.
- Obtain a classification of brain responses based on personality types commonly used in the research organization.
- Get the measurement results of the accuracy level of using VEP to confirm the personality types.

The method of confirming personality types using brain waves has benefits. Theoretically, it is using brain waves to confirm personality types.

The resulting method's practical benefits contribute to the organization, especially the HR department, to confirm the personality types at the HR job selection and placement stage.

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