Facial Recognition System

by Nenny Anggraini

FACIAL RECOGNITION SYSTEM FOR FATIGUE DETECTION USING INTEL REALSENSE TECHNOLOGY

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Abstrak

The excess of fatigue could result in someone's death. The result of questionnaire which author had distributed to 50 people that have workhour more than 8 hour mentioned that 80% respondents detected to be fatigue, but from the percentage of the total, who consulted it to a doctor just as much as 5%. Intel, the giant microprocessor maker in the world, has made a camera that can capture image condition of person's face. In this study, the author used the Intel camera technology to create a system that is capable of detecting fatigue. Face can be used as input of the form PERCLOS, mouth movement, and head nodding. The whole aspect then processed using fuzzy mamdani to form output data of level fatigue user along with its solution. Author used RAD (Rapid Application Development) as developing method, and testing using blackbox and whitebox testing. Methode of data collection include interview, questionnaire and study of literature. System development using C# language, Visual Studio 2013, and Intel Realsense SDK. The testing of application shows from 7 people that test this application 28% of the test result go accordingly to a international testing standars using SSRT (Subjective Self Rating Test).

Keyword : Intel RealSense, fatigue, fatigue detection, camera

I. INTRODUCTION

I.1. Background

At the end of 2013, appears quite horrendous news for the world of work in Indonesia, on December 15, 2013, a copywriter named Mita Diran, who works in advertising company died from exhaustion, He worked for 30 hours without stopping by just to consume supplements the body (Republika.com, 2013). Meanwhile, in China, Li Yuan, a 24 year old young man who works in the advertising company Ogilvy also found & died in may 2013. Li Yuan is known to work too hard without stopping and always overtime until 11 pm local time, for almost a month (Merdeka.com, 2013). Earlier in Japan, a similar case also overwrite the Motoyasu Fukiage in 2010, an employee who was found dead due to illness of the heart while sleeping after a known working an average of 14 hours for for 4 months in the restaurant Nikonkai Shoya Japan, 112 hours of work with overage per month. Motoyasu 272 hours spent his life in the works (telegraph.co.uk, 2013).

According to the survey conducted by the author on job burnout by involving as many as 50 respondents randomly. It was found that as much as 80% or as much as 40 respondents experiencing fatigue. Some of the causes are less comfortable working environment, high work pressure, and the number of breaks is inadequate. As many as 70% of respondents (28 people) to know the factors of fatigue, and as much as 58% of respondents (23 people) to find out the impact of fatigue, but were never consulted a doctor about kelalahan only by 5% (2) of the total sample. This means only a small percentage of the respondents who follow these issues seriously or because it is too busy activity that causes them no time to consult a doctor. In questions about the work, as much as 90% of respondents (36 people) to work every day at the computer, it could be a step forward to facilitate the solution of all people, especially the workers busy in order to hold consultations without having to see a doctor.

Companies world-renowned microprocessor maker, Intel, has developed a camera that is equipped with a depth camera technology. With this technology allows developers to create a system capable of performing face recognition and face tracking or face recognition and tracking a user's face. With this capability, the application developers can capture facial features, position of the face to all the movement in the face every second. It can dimaanfaatkan to get symptoms of fatigue through the face. Intel Realsense is a new technology which in 2015 released in the market. Utilization there is still very little and there is no literature that utilize this technology in the form of any research. This is an opportunity for authors to be able to become a pioneer in the development of applications with Intel technology base Realsense.

II. LITERATURE AND THEORY BASIS
III.

2.1. Fatigue Concepts Work

2.1.1. The introduction of Work Fatigue

According Suma'mur (2009) Fatigue various state employment is accompanied by a drop in work efficiency and durability, which can be caused by:

a. Fatigue is the main source of the eyes (visual fatigue)
b. General physical fatigue
c. Nervous exhaustion.
d. Exhausted by monotonous environment.
e. Chronic fatigue by continuous environment as a factor permanently.

Fatigue for each person has a special meaning and are subjective. Tired are various circumstances that accompanied the decline in work efficiency and durability. According Chavalitsakulchai and Shahvanaz (1991) in Setyawati (2010), fatigue is a complex phenomenon which is due to biological factors at work processes as well as internal and external factors influenced. Internal factors influence the occurrence of fatigue that is not adequate environment, and external influences that work fatigue psychosocial problem. Meanwhile, according to Tarwaka (2010) Fatigue is a protective mechanism of the body to the body avoid further damage resulting in the recovery after the break. It can be concluded by the authors that fatigue is a condition when the body breaks deficiency that causes the efficiency and durability of the body itself is reduced. Work fatigue can also cause performance degradation that can result in an increase in work-related errors and accidents.

2.1.2. Fatigue Measurement

Up to now there is no way to measure the levels of fatigue default because fatigue is a subjective feeling that is difficult to measure and required a multidisciplinary approach (Tarwaka, 2010). The measurements were conducted by previous researchers only form of indicators that show the occurrence of fatigue. According to Grandjean (1993) in Tarwaka (2004) classifies the measurement of fatigue in several groups as follows:

1. The quality and quantity of work doneIn this method, the output quality is described as the number of work processes (time spent on each item) or process operations performed per unit of time. However, many factors must be considered as a factor of social and psychological behavior in the workplace. While the quality of the output (product damage, penolkan product) or frequency of accidents can describe the occurrence of fatigue, but these factors are not a causal factor.

2. Test psycho-motor (psychomotor test)In this method involves the function of perception, interpretation and reaction motors. One way that can be used to measure reaction time. The reaction time is a period of giving an excitatory come to a moment of realization or implemented activities. In a test of reaction time may be used lights, tinkling sound, touch the skin, or body sway. Terjadinta elongation reaction time is indicative of a slowdown in the process of nerve and muscle function. 3. Test loss flicker (flicker-fusion test) Under conditions of the tired, the ability of labor to see flicker will be reduced. The more tired the more longer it takes for the distance between the two flicker. Test flicker, in addition to measuring fatigue also shows a state of alert workers. 4. Measurement of electrical waves in the brain with Electroenchepalography. 5. Test Bourdon Wiesman In this method the concentration is one approach that can be used to test the accuracy and speed in completing the work. Bourdon Wirsman Test is one tool that can digunanakan to test the speed, precision and concentration. 6. Feelings of fatigue subjectively (subjective feelings of fatigue) Subjective Rating Self Test (SSRT) of the Industrial Fatigue Research Committee (IFRC) Japan, is one questionnaire that can be used to measure the level of subjective fatigue. The questionnaire contains 30 questions list consisting of:

a. 10 questions about the weakening of activity: feeling of heaviness in the head, the whole body tired, heavy legs, yawning, anxiety, drowsiness, no burden on the eyes, the movement awkward and stiff, standing unstable, want to lie down.
b. 10 questions about the debilitating motivation: difficulty thinking, leleah to speak, nervous, not concentrating, difficulty concentrating, forgetfulness, confidence down, anxious, difficult to control the attitude, not diligent in work.
c. 10 questions about the picture of physical exhaustion: headache, stiff shoulders, pain in the back, shortness of breath, thirst, hoarseness, dizziness, spasms in the eyelid, tremors in the limbs, feeling unwell.

Shape measurement by using subjective methods often done before, during and after activity a job and resource exhaustion can be concluded from the test results. Nevertheless, the results of a measurement has a very relative significance, because the results will be compared with healthy labor conditions, or at least they are in conditions of stress. These conditions cause up to now no one way of measuring fatigue is considered absolutely true (Monica, 2010).

2.2. Face Recognition

Face or the face is the front part of the head, in humans covering an area from forehead to chin, including the hair, forehead, eyebrows, eyes, nose, cheeks, mouth, lips, teeth, skin, and chin (KBBI, 2009). The elements that's what made the difference between

face one another. In addition to the physical element there are other factors that affect the face, namely: the nerves and blood vessels, physical trauma and surgical outcomes, the expression for vessels, tears and sweat, pain and fatigue, gender, race, and age growth.

2.2.1 The concept of Facial Recognition

Face recognition is one of the methods oriented introduction to the face. This introduction can be two parts, namely: Recognized and unrecognized, after comparison with the previous pattern stored in a database. This method should also be able to recognize objects instead of faces.

Calculation models of face recognition have some problems. Difficulties arise when the face represented in a pattern that contain unique information that distinguishes other face (Marti, 2010). According Haisong Gu, Ji Qiang, and Zhiwei Zu (2002), face recognition in general use in getting the 3 stages:

1. Face Detection
2. Facial Expression Information Extruction
3. Expression Classification

Behind the ease of recognizing faces, there are some problems and errors that arise in the process of face recognition, namely: the change scale, change positions, change pencayaan, until the change in detail and facial expressions.

2.3. Fatigue Detection

According to Sari (2014), fatigue occurs in three different types: the sensory fatigue, muscle fatigue, and cognitive fatigue. Only the sensory fatigue and muscle fatigue just that until now could be measured, whereas cognitive fatigue has yet to be found and measures.

According to Rau (2007) in Sigari (2014) the relationship between the state between visual stimulation and response is one way to determine primary measurement of fatigue. This situation using a parameter called Psychomotor Vigilance Task (PVT) which indicates the speed of a person's response to visual stimulation given to him. Furthermore, there is a very close relationship between PVP and closing of eyelids percentage within a certain period.

The percentage of closed eyelids in a certain period of time called PERCLOS.

Therefore, a lot of fatigue detection system uses this relationship to estimate a person's fatigue. In the system of monitoring fatigue, signs of fatigue are divided into three general categories, namely: Alerts based eye area, The sign by the oral region, Alerts based regional head These signs are almost all people and can be used as a reference, but the quality and pattern of these markers will be different from each other. (Sigari, 2014)

2.4. Intel

Picture 2. 1 Logo Intel

Intel Corporation is a multinational company based in the United States and is renowned for the design and production of microprocessors and specializes in integrated circuits. Intel also makes network cards, motherboard chipsets, components, and other tools. Intel has advanced research projects in all aspects of semiconductor production, including MEMS.

In 2012, Intel collaborated with several companies such as Nuance, Total Immersion, and SoftKinect introduce technology with Intel Perceptual Computing and name from 2014 known as the Intel RealSense.Intel RealSense has three main missions, namely, NII (Natural, Intuitive and Immersive) that is described as follows:

1. Natural, Intel Technology RealSense tried to use the method commonly used by humans to communicate. Humans naturally communicate with sesame them using voice and hand gestures.
2. Intuitive, Intuitive can be interpreted easy to use and easy to understand. Users can interact with the computer without having to learn specifically or read the user too much. Users can quickly find out how to interact with the computer as if often do as well as interaction with fellow human beings.
3. Immersive, When interacting with our computers connected via a device and actually had to "hold" the devices such as keyboards, mouse, and touchscreen. Intel RealSense trying to eliminate these limits where users no longer need to interact with "holds" a device of any kind.

Picture2. 2. Intel Realsense

2.5. Fuzzy Logic

According to Sri Kusumadewi & Hari Purnomo (2010) fuzzy logic is one of the fundamental building blocks of soft computing. In this case, fuzzy logic is used as a way to map the problem of inputs leading to the expected output.

2.5.1.Mamdani method

According to Sri Kusumadewi & Hari Purnomo (2010) method is often known mamdani Max-Min method. This method was introduced by Ebrahim Mamdani in 1975. To get the output, required four stages:

1. Formation of fuzzy sets
2. Application function implications
3. Composition Rules
4. The assertion (defuzzy)

2.5.1.1.Establishment of Fuzzy Association

According to Sri Kusumadewi & Hani Purnomo (2010) on Mamdani method, both the variable input and output variables are divided into one or more fuzzy sets.

2.5.1.2.Function Application Implications

According to Sri Kusumadewi & Hani Purnomo (2010) on Mamdani method, the implication function used is Min.

2.5.1.3.Composition Rules

According to Sri Kusumadewi & Hani Purnomo (2010) Unlike the monotonous reasoning, if the system consists of several rules, then the inference is obtained from the correlation between the rule set. There are three methods used in performing fuzzy inference system, namely: max, additive and probabilistic OR (probor). In this study, the authors use the method of composition atauran max (maximum). In Method Max (Maximum), the solution fuzzy set is obtained by taking the maximum value rule, then use it to modify the fuzzy area, and applying it to the output using OR operator (union). If all propositions have been evaluated, then the output will contain a fuzzy set which reflect the contribution of each proposition . In general it can be written:

$$\mu sf\,(xi) = max\,(\mu sf\,(xi),\ \mu kf\,(xi))$$

by:

$\mu sf\,(xi) =$ the value of membership of the fuzzy solution to rule all i;

$\mu kf\,(xi) =$ consequent fuzzy membership value to rule all i;

When used functions MIN implications, the method of composition is often referred to by name or MIN MAX-MIN-MAX or Mamdani.

2.5.1.4. Assertions (Defuzzy)

Input from defuzzification process is a fuzzy set obtained from the composition of fuzzy rules, while the resulting output is a dominant numbers in the fuzzy set. So if given a fuzzy set within a certain range it should be taken as an output value of a certain crisp. In this study

def ification method used is the centroid method. In the centroid method (Composite Moment) crisp solution is obtained by taking the center point (z *) fuzzy area. Generally formulated:

$$z^* = \frac{\int_z z\mu(z)dz}{\int_z \mu(z)dz}\ \text{for continuous variables, or}$$

$$xz^* = \frac{\sum_{j=1}^{n} zj\mu(zj)}{\sum_{j=1}^{n} \mu(zj)}\ \text{for discrete variables.}$$

III. DEVELOPMENT METHOD

3.1 RAD Design Workshop

The processes to be performed on stage design workshop are as follows: Creation of UML. , Design Interface, Application development which will use the C # programming language, debugging process. Workshop design phase is the phase when the writer devise a system that will later be developed later. Fatigue detection system design is aided by the Unified Modeling Language (UML) to describe how the modeling system to be created. Here are four of the thirteen models UML diagram that I use on the system design.

After system design is completed, the design of the system is implemented in the form of the program. Implementation phase is a phase for the system to be operated. The phase consists of two stages:

1. Stage script writing / coding using C # as the programming language RealSense Intel SDK and MySQL as the database.

2. System testing phase, to ensure the system can be used. Mechanical testing of the implemented system is blackbox functional testing techniques
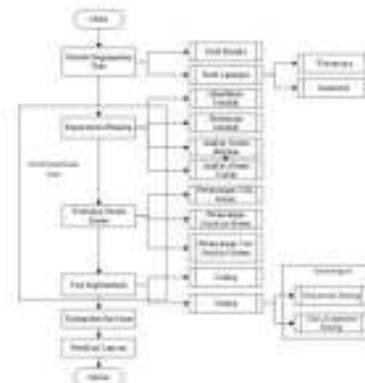
Picture 3.2 Thinking frame

After the writer distributing questionnaires on fatigue, the main problem is just as much writers get 5%

of the overall sample who follow their fatigue problem and want to consult a doctor. This means there are still many patients or fatigue sufferers who do not care and respond to this serious problem. There are various possibilities for this to happen, for workers who actively work more than 8 hours a day one of which is the lack of time for them to consult a doctor as a result of the consultation process itself is fairly time consuming. Because they are busy with their work so exhausted themselves was ignored. For which the author tries to create a system so that patients can check their fatigue and controlling over itself at any time, even when she was busy working.

3.2 Walking System Analysis

On systems running today someone who wants to check the level of fatigue should see a doctor beforehand and be checked by a physician directly to find out how much fatigue that happened to him.

Picture 3.2. Analysis of Current System

The system design writer is a system that detects fatigue by using Intel RealSense.

Picture 3. 2.1 Analysis of Proposed System

IV. IMPLEMENTATION

4.1 Coding

After use case diagrams, activity diagrams, class diagrams, database design and drafting application's user interface is made next is the encoding stage. At this stage coding using C # programming language and use Visual Studio 2015.

4.2. Blackbox Testing

At this stage it will be testing the application. This testing is done to ensure that the program can work well when used. Of each test performed does not rule out the possibility of any error of applications that have been tested, but by doing this test can at least minimize the errors that exist in the application.

4.3 Display

The following is a user interface created in this application:

Picture 4. 1. Display Log

Picture. 2. Main Display

Picture 5. 3. Scanning Display Face Detection Results

Fatigue detection process by the user using the camera Realsense Intel has four stages that must be passed, namely: Phase Calibration Calculations Face Scanning Phase Extraction Fatigue Fatigue and Solutions In this study, researchers tested the sample application to 7 users who have a working time of more than 8 hours or break times of less than 5 hours.

V. RESULTS

The first phase is done at this time trial is a phase calibration of the user's face, at this stage of the calibration is user enters training face value of itself. Training value is used to determine the current value of his fatigue fatigue calculation process later. The calibration process must be done when the user is in fit condition and not sleepy. In addition to calibration values, user's facial image is also stored in the system database at the time of the calibration process is underway

5.1 Scanning Stage Face

Facial scanning stage is the stage where the user does a state of exhaustion himself today. The scanning stage to detect faces and take the value of the parameter of fatigue there is PERCLOS, Mouth Open and Nodding Head. Once scanned and retrieved parameter values, the value is then stored in a database before finally do the counting process.

5.2 Phase Counting Exhausted

This fatigue calculation stage is the stage where the scanning face value is calculated and compared with the value of training each user's face to get value of fatigue or not a user. Calculation of exhaustion is performed using fuzzy expert system with implications min-max system or method mamdani. Defuzzification done using centroid method to finally get the value of the fatigue.

5.3. Testing Results

The results obtained by the fatigue system needs to be compared with the results of other measurements expressed fatigue. One of the recognized measurement of fatigue in the International field measurements Subjective Rating Self Test (SSRT) of the Industrial Fatigue Research Committee (IFRC) Japan. This measurement is a measurement of fatigue in the form questionnaires that focus on the subjective opinion of yourself to fatigue they experience.

From the tests, it can be seen that the level of accuracy with conventional measurement applications is by 28% or by 2 match results. But other results to show that the value of fatigue taken by the application is not much different from using SSRT. It is also a better value especially SSRT today is not a definite reference on how to determine a person's fatigue but feel fatigue a person with subjekif ratings. By using this application, then we can get an objective assessment to detect fatigue as it relates to the natural behavior of the human body. Discussion

In accordance with what has been formulated in the formulation of the problem, so in this discussion will be presented regarding the relationship between the formulation of the problem and the results of research in which the author will try to find a conclusion to answer the problem formulation that has been determined.

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CONCLUSION

Based on the results of the research and writing of the authors explain, it can be concluded that the making of facial recognition system (Face Tracking) using Intel technology to detect the level of fatigue RealSenseTM user can do.

The author uses fuzzy expert system using mamdani implications, input is taken in the form of PERCLOS, Mouth Open and Nodding Head. This process began with the creation of fuzzy sets for the three inputs and one output, namely fatigue. After completion of fuzzy rules established to be used for the calculation. After completion of the implications for the function will be created and then proceed to the third input composition rules. The results of the composition process is further clarified by centroid defuzzification method.

The experimental results of this application to 7 users showed good results. When compared with tests that are already widely used today are SSRT (Subjective Rating Self Test) results of testing this application has a match of 28% while the remaining shows this is not too much different. This is because the SSRT detect exhausted just from the feeling of the user. When implemented will be different with the SSRT subjectively assess fatigue and feeling human use, these applications can be a valuable means of an objective test to exhaustion because he was watching the natural movement of the human body.

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