

Analysis Of Emotion Recognition Using Facial Expression With OpenVINO

Albert Yakobus Chandra, Ine Shinta Dewi
Departement of Information Technology
Mercu Buana University of Yogyakarta, Indonesia

Abstract— The Industrial Revolution 4.0 is the culmination of technological developments that have brought new changes from the digital era to the global information era that integrates all fields fundamentally to achieve effective and efficient productivity. With the rapid development of technology that has experienced breakthroughs in all disciplines, including of artificial intelligence. The interaction between human beings and computers will be more natural if computers are able to perceive and respond to human non-verbal communication such as emotions. At this time there are many machines that can interpret a certain condition or situation using AI, one of which is Emotion Recognition using Open VINO which will be implemented to recognize various kinds of facial expressions in humans such as emotions were classified: sadness, anger, happiness, surprised and neutral state. This article is expected to provide knowledge about the application of open vino in detecting facial expressions in humans, along with the development and research potential in it.

Keywords— Artificial Intelligence, Industrial Revolution 4.0 , Emotion Recognition, Facial Expression, Openvino, Internet of Things, Object Detection

1 INTRODUCTION

The Industrial Revolution 4.0 is the culmination of technological developments that have brought new changes from the digital era to the global information era that integrates everything first happened in England in 1784 where the invention of the steam engine and mechanization began to replace all human jobs and triggered the rolling of volume one industrial revolution. The second revolution was marked by production machines powered by electricity which took place at the end of the 19th century. Then the use of computer technology began to develop in 1970 which marked the third industrial revolution. The invention of computer and internet technology in the previous century provided the basis for the opening of the gates to the 4.0 revolution. Industry 4.0 is announced a priori because the actual event has not yet happened and is still in the form of ideas (Drath and Horch, 2014). The term Industry 4.0 itself was officially born in Germany to be precise when the Hannover Fair was held in 2011 (Kagermann, 2011). In this revolution, manufacturing technology has entered the trend of automation and data exchange. This includes at least five technologies that are the main pillars in developing a digital industry, namely the Internet of Things, Big Data, Cloud Computing, Additive Manufacturing and Artificial Intelligence.

According to the Coordinator and support action for global RFID-related activities and standards stating the internet of things (IoT) as a global network connection infrastructure, which connects physical and virtual objects through the exploitation of data capture and communication technology. The concept of the internet of things includes three basic elements, namely: physical or real objects that have been integrated into sensor modules, internet connections, and data centers on servers to store data or information from applications (David Setiadi, 2018)

Big data is a data set that has a size large and complex so the

traditional data processing software cannot manage them. Big Data can manage very large and diverse data, and process it into the information needed in a short time.

Cloud computing is a computation that utilizes computer network services, where the scale of the computation can be changed dynamically and the resources are provided in the form of services via the internet. (Ginting, 2018) Cloud computing is a computing model, where resources such as processors or computing power, storage, networks, and software are abstracted and provided as services on the network or internet using remote access patterns (Alfatih, 2015).

Additive manufacturing or called 3D printing is increasingly playing an important role not only in various fields of business but also in everyday life. Additive Manufacturing (AM) is a new breakthrough in the manufacturing industry by utilizing 3D printing machines to contribute widely in the Industry 4.0 generation to complete the tasks required in integrating design software and 3D printing machines in completing the manufacture of a product (Haleem, 2019). One of the best benefits of technology additive manufacturing is its ability to shape more and create different types of designs that conventional manufacturing cannot achieve.

Artificial Intelligence is a computer system capable of performing tasks that normally mimic human intelligence. AI can make decisions by analyzing it using the data available in the system. The processes that occur in Artificial Intelligence include reasoning, learning and self-correction. This process is similar to humans who conduct analysis first before making a decision. Machine learning is an application branch of Artificial Intelligence where machines can learn on their own and do not need to be explicitly programmed every time they receive a different output.

One of the branches of Artificial Intelligence is Computer Vision. Computer Vision can be defined as a science that is closely related in studying how computers can recognize objects through images or videos to be observed. In computer vision, there is object detection, which is the process of detecting a moving object in a video or image sequence, which is a sequence of pieces of an image from a video to be identified (Putri, 2016). In this study, the object to be analyzed is Emotion Recognition, which is a person's facial expression through digital video using OpenVino.

2 LITERATURE REVIEW

Facial is one part of the human body that becomes the center of attention when interacting with other people. The definition of face according to KBBI Online is the front of the head; facial features; is part of the head; facial expression. The face is usually used to express oneself, appearance, emotions, and identity. Faces are unique in that no face in this world is absolutely the same, even in identical twins. (IGA Widagda, 2017).

Emotion Recognition for determining facial expressions, and detecting facial features by ignoring the background image, then identifying facial images. (Viola, 2011). In various situations, a person's face reflects different emotions according to the feeling that is being felt, so that it is intuitively difficult to detect, so it involves several variables to support the level of analysis accuracy, including source image, image processing result, extracted image and data. someone's profile a sensing device in the form of a camera sensor and a method is needed to determine whether the image captured by the webcam is a human face or not (Dodit Suprianto, 2013).

Intel Neural Compute Stick 2 or commonly abbreviated as Intel NCS 2 is a USB plug and play device designed to accelerate the computer vision process with the Artificial Intelligence application. Intel NCS 2 is specifically designed to build Artificial Intelligence algorithms with a combination of the vision Intel Movidius Myriad X processing unit (VPU) and the Intel Distribution of OpenVino, where this hardware is a processor that will accelerate image processing quickly.

OpenVino is a series of toolkits on the Intel platform that developers can use to develop the computing capabilities of Intel processors according to the needs of certain sectors. OpenVino is short for Open Visual Inference and Neural Network Optimization, which provides improved performance on neural networks. This software is open source that provides flexibility and availability for the developer community to innovate learning and provide solutions in the field of Artificial Intelligence in real time, effectively and cost-effectively.

Biometrics comes from the Greek words bios and metron. Bios means life and metron means measuring. So Biometrics can be defined as an automatic method to identify an individual based on one or more parts of the human body or the attitude of the human being himself that is special or special. (IGA Widagda, 2017) Biometric technology is usually applied to analyze the physical and human attitudes for the purpose of

authentication by making a quantifiable digital format.

Bilateral Filter is a technique to refine an image by maintaining the sharpness of the image edges. In general, the image has 3 color combinations, namely: red, green, and blue, or commonly referred to as RGB. The smoothness process separately will disturb the color balance, therefore the bilateral filter will process the three colors simultaneously and determine the middle value based on color match (C. Tomasi, 1998).

Canny is an edge detection algorithm that is widely used in various studies because it is considered as the most optimal edge detection algorithm. The first step in the Canny algorithm is to implement a Gaussian filter on the image to remove noise (Haris & Prasetyo, 2016). This Canny edge detection was discovered by Marr and Hildreth who researched a visual perception modeling in humans.

3 RESEARCH METHOD

The method used in this research is the Scrum development method which is an iterative method derived from Agile. Scrum is a widely used software development model. Scrum is also used not only for developing software but also for evaluating the application of technology. There are seven stages to the Scrum method.

- a. Product backlog, where the process of gathering needs is carried out by listing them according to their respective scales. At this stage, a needs analysis will be carried out for the emotion recognition system which will be used by the Information Technology faculty. The process of collecting these needs is carried out by collecting videos from Faculty students Information Technology with a duration of 30 seconds with various facial expressions.
- b. Sprint Planning is the stage of determining the time duration to reach the target system completion.
- c. The Sprint Backlog is a list of tasks that have been identified for the fulfillment process. From the results of the analysis of the need to conduct trials on OpenVino, namely with a video which will be identified and produce output in the form of sadness, anger, happiness, surprise and neutral state facial expressions. The system will process the image in an area of cells containing a few pixels of the image portion. Then convert it into a set of code and analogize the code with facial expressions that have been stored in database with various faces that had been coded similarly.
- d. Daily Scrum is an activity with a maximum 15-minute time limit and aims to synchronize the work among a team of developers. Each team member must update any reports that have been done the previous day and make plans for the next 24 hours.
- e. Sprint Review is the stage of demonstrating system improvement in one print period.
- f. The Sprint Retrospective is an opportunity for the Scrum Team to inspect itself and make plans for improvements that will be made in the next Sprint (Ken

Schwaber, 2017).

- g. Increment Is a development stage for Emotion Recognition using Openvino in accordance with the results of the sprint that has been done in the form of a prototype.

4 RESULTS & DISCUSSION

As previously explained, Openvino short for Open Visual Inference and Neural network Optimization which provides developers with better neural network performance on multiple Intel processors and helps open cost-effective real-time vision applications. Openvino allows deep learning inference and easy heterogeneous execution across multiple Intel platforms (CPU, Intel Processor Graphics). Openvino is unique for the openness and flexibility of its software and extensive deep learning model. Apart from a limited binary package, OpenVino is also available as open source under the Apache 2.0 license. In this chapter we will discuss how to install OpenVino on the Raspbian OS Package.

- a. To start the installation, first download OpenVino, the latest version of the Intel Open Source Technology Center.
- b. When finished downloading, open the Open Vino file which by default will be saved with the file name `l_openvino_toolkit_runtime_raspbian_p_tgz`.
- c. After that, create a folder for the installation of `sudo mkdir -p / opt / intel / openvino`.
- d. Then Extract the file `sudo tar -xf l_openvino_toolkit_runtime_raspbian_p_tgz --strip 1 -C / opt / intel / openvino`.
- e. The Open Vino component is installed. Furthermore, there are some additional configuration steps that are still needed, namely by installing external software, and setting up the USB configuration so that Openvino can run according to its function.

Emotion Recognition OpenVino is created by utilizing the model train available from Open Vino and creating code in python to run applications with the following Main.py Source Code :

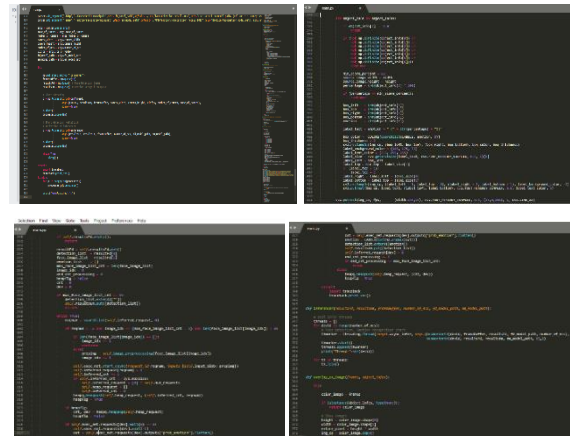
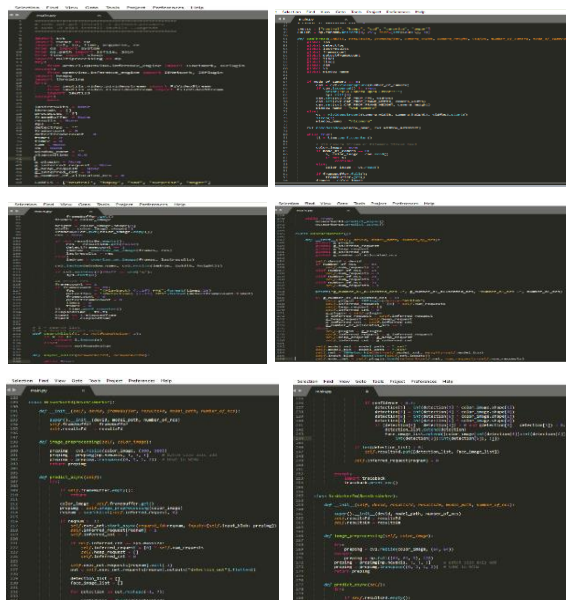


Fig 1. Source Code Main.py

In this study, there were four participants to be analyzed, consisting of two men and two women. The facial expressions that will be studied are neutral, sad, surprised, shocked, happy, and anger. To run the program in Figure 1, type the following code: `Python3 main.py-wd 320-ht240-nummcs 1`. After that, continue by adding videos with various expressions that had been prepared

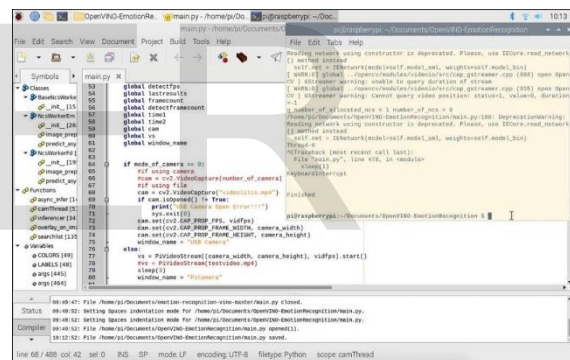


Fig 2. Running Program

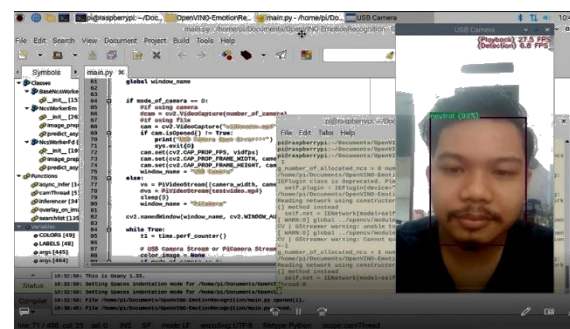


Fig 3. Neutral State

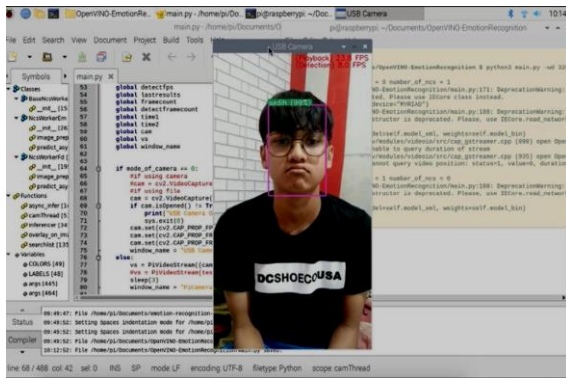


Fig 4. sadness

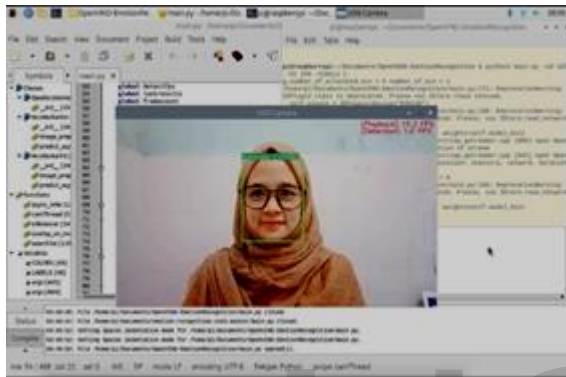


Fig 5. happiness

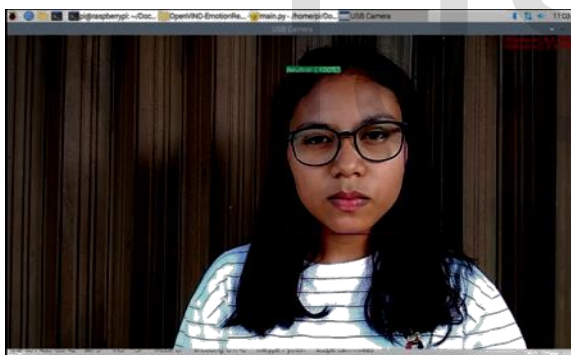


Fig 6. Anger

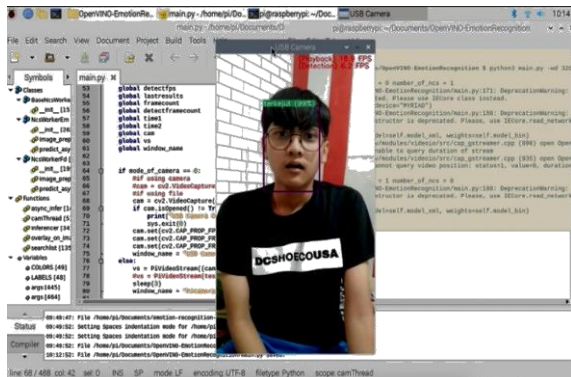


Fig 7. Surprise

tion process is carried out to produce realtime video images as shown in Figures 3, 4, 5, 6 and 7.

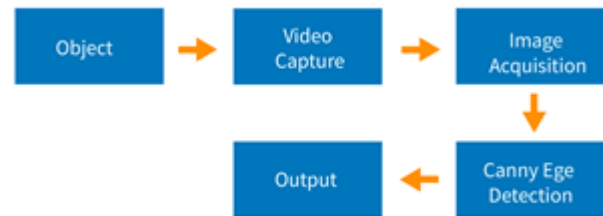


Fig 8. Diagram of Face Recognition Stages

Image processing is performed to identify an object in the form of a human face pattern. The image is obtained by indicating the presence of frame cells in real-time, image processed in stages, starting with detecting objects in the form of facial expressions in humans. The second stage enters the image processing stage, which is processing an RGB image into a grayscale image. The third stage is filtering using bilateral filters and then doing edge detection using canny edge detection to simplify image processing. The Canny Edge Detection algorithm that is used in realtime video image processing has a similar principle to the process of detecting digital still images or still images. The advantage of Canny Edge Detection is that it can translate realtime video images into an image display that has received an edge detection process using Canny Edge Detection so that the output can run according to realtime even though in moving conditions.

Table 1. Validity Test Result of the Research Instruments (Continuation) Source: Primary data processed by authors, 2020

Sample	position	Test	Emotion Recognition		accuracy
			valid	invalid	
Neutral	perpendicular	5	3	2	99%
Sadness	perpendicular	5	3	2	99%
Happiness	perpendicular	5	4	1	100%
Anger	perpendicular	5	4	1	100%
Surprised	perpendicular	5	4	1	99%

Table 1 is the average test results using 4 videos with various kinds of expressions. The neutral, sad and shocked expressions have an accuracy value of 99% and the happy and angry samples have an accuracy value of 100% where each expres-

In this process the object data is inputted and then the acquisition

sion has very high accuracy, which is above 50% so that the system can be sure to run as desired.

6 SUMMARY & CONCLUSION

The research test results of the system analysis showed it can be concluded that the average success rate of emotion recognition on human faces reaches 99% in various different conditions (object distance to sensors, lighting, position, attributes, and facial expressions) and software system integration with hardware is already running well. The error percentage of system integration is 1%. so that the system can output as expected.

REFERENCES

- [1] Alftih, H. d. R. M., 2015. Analysis of the development and design of a cloud computing-based smart academic information system at public high schools in the special area of Yogyakarta. *Jurnal Telematika*, 8(2), pp. 63-91.
- [2] Intel 2020. Openvino toolkit. [Online] Available at: <https://software.intel.com/content/www/us/en/develop/tools/openvinotoolkit.html> [Accessed 8 september 2020].
- [3] C. Tomasi, R. M., 1998. Bilateral Filtering for Gray and Color Images. *IEEE International Conference on Computer Vision*, pp. 1-8.
- [4] David Setiadi, M. N. A. M., 2018. Penerapan Internet Of Things (Iot) Pada Sistem Monitoring Irigasi (Smart Irigasi). *Jurnal Informatika*, III(2), pp. 1-8.
- [5] Dodit Suprianto, R. N. H. P. B. S., 2013. Sistem Pengenalan Wajah Secara Real-Time dengan Adaboost, Eigenface PCA & MySQL. *Jurnal EECCIS*, 7(2), pp. 1-6.
- [6] Ginting, M., 2018. Pemanfaatan Cloud Computing Pada Aplikasi e-Learning. *Jurnal Teknik Informatika Unika St. Thomas (JTIUST)*, Volume III, pp. 1-5.
- [7] Haleem, M. J. A., 2019. Additive Manufacturing Applications in Industry. *Journal of Industrial Integration and Management*, Volume IV, pp. 1-24.
- [8] Haris, A. & Prasetyo, A., 2016. Implementasi metode deteksi tepi canny pada objek sebagai model keamanan aplikasi pada smartphone android. *Jurnal pengkajian dan penerapan Teknik Informatika*, 9(1), pp. 1-6.
- [9] I G.A. Widagda, I. K. S., 2017. Pendeteksian target wajah manusia dengan metode violajones. pp. 1-32.
- [10] Kagermann, H. L. W. & W. W., 2011. Mit dem Internet der Dinge auf dem. [Online]
- [11] Ken Schwaber, J. S., 2017. Panduan Scrum. Panduan Definitif untuk Scrum: Aturan Main, pp. 1-19.
- [12] Putri, N. N., 2016. Aplikasi Pendeteksi Objek Bergerak Pada image Sequence Dengan Metode Background Substraction. *Jurnal Teknologi Rekayasa*, Volume XX, pp. 1-11
- [13] Viola, P. a. J. M., 2011. Rapid object detection using a boosted cascade of simple features. In: *In Proceedings of the IEEE Computer Society Conference on Computer Vision and Pattern Recognition*. Kauai: HI, p. 511-518.