

Implementation of Artificial Intelligence in Healthcare

Fariza Shielda Akzatria¹

¹*Data Science Technology, Faculty of Advanced Technology and Multidiscipline, Airlangga University, Surabaya, Indonesia*

Health is one of the pillars in determining human performance in their daily activities. Someone with good health can work optimally because there are no health problems they have. On the other hand, artificial intelligence is a form of technology that is developing rapidly. This technology has various benefits that can be provided, especially in the health sector to help health workers. The technologies that are often used are expert systems and artificial neural networks because of their ease of operation and accuracy in carrying out the work of health workers. Various other technologies are being developed to facilitate the performance of health workers to lighten their workload, such as robots to help paralyzed patients, automatic operating robots, and other technologies that can help ease the burden on health workers' performance.

Keywords—health, artificial intelligence, neural network, expert system.

I. INTRODUCTION

It is well known that technology was made to be able to ease people's daily activities such as transportation, communication, etc. The rapid improvement of technology in the past few years was astonishing, creating robots and other type of technology to support human activities. However, the rapid improvement of technology proves to be a double-edged sword. Although it helps people to perform better, technology also makes people become dependent on the technology, hence lowering the quality of human resource.

One of the more advanced and modern type of technology is artificial intelligence, which is still being developed to be more adaptive and intellectual technology. Essentially, artificial intelligence gives the ability to think and act like human to the machine, hence creating a machine that can process information using its algorithm and act based on the information that it processed. There are several aspects of artificial intelligence that need to be considered, which are artificial intelligence ethics, creation purposes, the complexity level of the algorithm, etc.

Health can be defined as a condition where a person is able to have a prosper life, where its physique, mental, and social needs

are fulfilled. A good health is required to perform well since it provides an optimal body and mind to do the activities. There are several obstacles that can have an impact on health of a person, which are infection caused by a virus or a bacterium, physical trauma, or any other kind of complications that can hinder one's health.

Being one of the main pillars of a healthy life, maintaining a good health is crucial to have an optimal day. With the advancement in the technology section and doctors finding new ways to cure more patients, the opportunity to create new inventions that can fight health complications and keep the people happy is huge. The Covid-19 pandemic is one of the most recent virus breakouts that has caused a lot of people fallen ill and caused a lot of city lockdowns. This event pushed the world to find a strategy to contain and hopefully cure the world from Covid-19. One of which is the usage of artificial intelligence to help the medical staff to suppress the numbers of Covid-19 infection around the world. By integrating the advanced technology in the medical world, the world will be much stronger to fight back the Covid-19 pandemic.

This article is made to compare the different types of artificial intelligence implementation in the healthcare section, enabling readers to know how artificial intelligence is used in the healthcare section, effectively helping medical staffs to keep the society health at its finest. By reading this article, the reader is expected to acknowledge the improvements of artificial intelligence in the healthcare section and gives inspiration on what kind of invention that can be made to further strengthen the world to fight back against diseases globally.

II. ARTIFICIAL INTELLIGENCE

Being a state-of-the-art technology advancement, artificial intelligence is a part of the computer world that pushes the boundaries of machine to be able to perform works that is equally as effective as a person [1]. Computers are designed in a way to be able to think dan work, so that the machine can help people on doing tasks. For an example, a pattern-recognition system that can recognize the buying pattern of a group of customers can provide an information on how the customers usually spend their money on. Based on the information, the

Corresponding Author:

Fariza Shielda Akzatria

Data Science Technology, Airlangga University, Surabaya, Indonesia

farizashielda@gmail.com

store then can prepare the goods that are most wanted by the customers to increase their earnings and cutting their losses.

The vast improvement of artificial intelligence is supported by the number of positive impacts that is given by the artificial intelligence that can help people. Not to mention that it has several upsides than natural intelligence. Artificial intelligence has a longer lifespan, enabling the computer to have the ability to remember and store more information longer than natural intelligence. Not only that, but it can also be replicate and spread information with ease, has higher speed and effectivity, also a consistent rate of work [1]. Advancement of artificial intelligence and other kind of technologies is aided by new inventions, such as stronger processors, that accelerates the process and upgrades the features that it has. Globalization enables information to be spread quickly and it creates a path for technology distribution and other types of advancement globally [2].

On the other side, the nature of technology that is ever advancing and being more used by people to help their daily activities creates a dependency of people toward technology. In other words, people are now leaning towards a concept of e-life [3]. People need to realize that technology are created to help people in doing their task so that they can be more effective in doing their job, and people can divert their energy to do tasks that machine cannot do well. While e-life creates a dependency from human to technologies, it pushes other to think to further develop technology and pushes humanity to be more modern than before.

In the modern era, there are various type artificial intelligence that are commonly used such as computer games, artificial neural network, fuzzy logic, robotics, and much more [4]. Implementation of each technology may vary and be engineered to fulfill the need from its user. In other words, artificial intelligence is a flexible and adaptive technology that can suit the user's needs.

III. HEALTH

In a daily life of a person, health is an important factor that has an impact on how a person do their daily activities. Health is defined to be a state of a person, where the optimal state of a person is when their physical and mental health is in a good condition. We can call a person to be healthy when that person does not have any medical complication physically, or any type of mental problems. The more complication that person has, the unhealthier that person is. People with many health complications needs more rest, hence making them less effective when they do tasks.

There are a lot of factors that can impact on how healthy a person is. Mainly, there are two types of factors which are internal factor and external factor. Things like genetics and hereditary diseases are internal factors that caused by the DNA from their parents. On the other hand, external factors are things that can be controlled or avoided such as environment conditions, daily habits, and much more. For mental health, it can also be divided in two main factors which are internal factors such as gender, age, marital status, and personality of each individual, and external factors such as workload, work duration, the amount and severity of conflicts, levels of

ambiguity that the person must face, and the social environment of that person [5].

From the factors that have been explained, majority of the external factors can be solved with help from an external party and especially self-motivation. Dealing with physical health problems can helped by medical staffs that gives a diagnosis and a few advice to suppress external factors that can trigger a health problem. For mental health issues, consultation with a psychologist may give a solution to the complication that the person is having. Preventive actions can reduce the number of people that are facing mental or physical health problems, hence increasing the prosperity level for people and creates a comfortable feeling to people because they can stay healthy for longer.

If a person has a physical health complication, sometimes the medical staff needs a technology that could be used to do an accurate and effective diagnosis of the complication that the person is facing. Improvement of technologies are supported by the widened reach of knowledge that caused a lot of tools that can help the medical staffs to do a good diagnosis and do necessary actions that are needed to cure the patient from its complications. Several examples from this statement is the x-ray that can detect broken bones and helps the medical staffs to cure the broken bone, or the MRI Scan that can help medical staffs to detect various diseases.

Technology has always been improving from time to time. Being the technology that could think, artificial intelligence is being implemented to be able to carry some of the workload of the medical staffs, so that they spend less energy to do the task. During the Covid-19 pandemic, innovations are made to help medical staffs battle the virus. Robotic nurses were made to diagnose and taking care of patients during the pandemic. Those robots can spray disinfectant that can reduce the number of Covid-19 viruses on the surface. Many kinds of robots are made to help the medical staffs do their task [6], [7].

Those type of robots are created due to the appearance of Covid-19 pandemic that caused people to create innovation that can do what the medical staff do without their appearance. By doing so, it reduces the number of contacts between the patients infected by the virus and the medical staffs that are attending the patients. Because of this pandemic, people are more focused to improve technologies in the healthcare section. Further technological improvements are being made to help the healthcare section in any matter such as administration, patient diagnosis, operation, and any other activity.

IV. RESEARCH METHOD

With the purpose to study the progress of artificial intelligence improvements in the healthcare field, this research is done by reading and making conclusion from the literature that provides the correct information. This procedure involves two major phases, which are literature selection and literature review.

During the first phase, literatures are selected based on the criteria that satisfy the purpose of this research. Topics that may satisfy this research are topics surrounding the artificial intelligence that is used in the healthcare section. The healthcare section can be about mental or physical health problems. Any kind of artificial intelligence that helped the

medical staffs handle physical or mental health complications are selected if the technology aids the medical staffs in doing their job. Technologies such as robots, expert system, deep learning, and other kinds of technologies are included.

Once the literature selection is done, it continues to the second phase, which is literature review. This phase is done by reading and making conclusions based on the text. Because the literature has the same topic, we can study and compare kinds of artificial intelligence and its effectiveness on its usage. By doing so, it can also give readers inspiration on what technologies should they create next.

V. RESULT AND EXPLANATION

Literature selection is done by using google scholar to find matching literature based on the stated criteria. After using the google scholar, twenty literatures were chosen with sixteen of them are Indonesian journals, while four of them are international journals. Title and writers of each literature can be seen from the table below:

Table 1 List of Literature's Title and Writers

Literature Title	Writer Name	Publish Year
Implementasi Data Mining untuk Prediksi Standar Hidup Layak Berdasarkan Tingkat Kesehatan dan Pendidikan Masyarakat [8]	Bofandra Muhammad	2019
Sistem Pakar Diagnosa Penyakit Gigi dan Mulut Manusia Menggunakan Knowledge Base System dan Certainty Factor [9]	Jaenal Arifin	2016
Kecerdasan Buatan dalam Diagnosis Retinopati Diabetik [10]	M. Yusran	2022
Pemanfaatan Kecerdasan Buatan (Artificial Intelligence) dalam Telemedicine: dari Perspektif Profesional Kesehatan [11]	Rita Komalasari	2022
Menavigasi Tantangan dan Menciptakan Peluang: Peran Vital Ilmu Psikologi di Era Kecerdasan Buatan [12]	Gumgum Gumelar	2023
Pemanfaatan Kecerdasan Buatan dalam Kesehatan dan Keselamatan Kerja di Bidang Kelistrikan [13]	Saccani Paramita Desiana Br. Ginting	2020

Penerapan Jaringan Saraf Tinuan dalam Memprediksi Gizi Balita pada Puskesmas Siantar Utara Kota Pematangsiantar [14]	Daniel Arbanus	2019
Kecerdasan Buatan dalam Teknologi Kedokteran: Survey Paper [15]	W. Halim P. Mudjihartono	2022
Implementasi Metode Fuzzy Logic untuk Sistem Pengukuran Kualitas Udara di Kota Medan Berbasis Internet of Things (IoT) [16]	Jaka Prayudha Ardianto Pranata Afdal Al Hafiz	2018
Implementasi Case Base Reasoning pada Sistem Pakar dalam Menentukan Jenis Gangguan Kejiwaan [17]	Reny Retnowati Ardi Pujiyanta	2013
E-Health Artificial Intelligence System Implementation: Case Study of Knowledge Management Dashboard of Epidemiological Data in Poland [18]	P. Ziuziański M. Fumankiewicz A. Soltysik- Piorunkiewicz	2014
Application of Artificial Intelligence (AI) in Healthcare: A Review [19]	Mohammed Yousef Shaheen	2021
Artificial Intelligence in Healthcare [20]	Kun-Hsing Yu Andrew L. Beam Isaac S. Kohane	2018
Artificial Intelligence in Medicine [21]	A.N. Ramesh C. Kambhampati J.R.T. Monson P.J. Drew	2004
Sistem Pakar Diagnosa Penyakit Gigi Menggunakan Metode Naïve Bayes [22]	Yuliyana Anita Sindar Ros Maryana Sinaga	2019
Prediksi Penyakit Diabetes dengan Menggunakan Artificial Neural Network [23]	Fathorazi Nur Fajri	2019
Aplikasi Sistem Pakar Diagnosa Penyakit pada Anak Bawah Lima Tahun Menggunakan Metode Forward Chaining [24]	Bagus Fery Yanto Indah Werdiningsih Endah Purwanti	2017
Implementasi Sistem Pakar Mendiagnosa Penyakit-Penyakit Gastritis Dengan Menggunakan	M. Rizky Fadhilah Ishak, S.Kom, M.Kom Puji Sari Ramadhan, S.Kom, M.Kom	2021

Metode <i>Teorema Bayes</i>			
Kecerdasan Buatan Untuk Mendiagnosa Penyakit Fungi pada Manusia	Syukriyanto Latif	2021	
Menggunakan Penalaran <i>Backward Chaining</i> Berbasis Web			
Sistem Pakar Diagnosa Keluhan Kesehatan pada Orang Dewasa berbasis Web dengan Metode <i>Backward Chaining</i> .	Yeni Kuryanti	2014	

After the literature selection phase has been through, then literature review can be done. We can now study and compare the technology that were used to help medical staffs take care of patients or do other kinds of job that can lower the workload of the medical staffs. Based on the literature that were selected, artificial intelligence type that were used are as follow:

Table 2 Literature Review Result

Literature	Technology	Implementation and Effectiveness
[8], [18], [19]	<i>Data Mining</i>	1. Prediksi standar layak kehidupan (Akurasi 82,32%) 2. Pencarian informasi data kesehatan Polandia 3. Prediksi kondisi pasien
[9], [17], [18], [22], [24], [25], [26], [27]	Sistem Pakar	1. Diagnosa Penyakit Gigi 2. Diagnosa penyakit jiwa 3. <i>Self-diagnose</i> 4. Diagnosa penyakit balita (akurasi 82%)
[10], [19], [21]	<i>Deep-Image Mining</i>	1. Diagnosa Retinopati (Akurasi 92,5%) 2. Diagnosa penyakit melalui gambar
[11], [13], [14], [15], [20], [21], [23]	<i>Neural Network</i>	1. Deteksi keganasan tumor otak (Akurasi tidak disebut) 2. Klasifikasi gambar 3. Prediksi Indeks Massa tubuh Balita (83%)

			4. Diagnosa kanker payudara (88-95,5%) 5. Diagnosa lesi kulit, penyakit mata, kanker, radiologi 6. Identifikasi kanker prostat (akurasi 90%) 7. Prediksi diabetes (akurasi 81,8%)
[12], [19]	<i>Natural Language Processing</i>		1. <i>Chatbot</i>
[13]	<i>Object Recognition</i>		2. IBM Watson (pencarian obat)
[13], [16]	Logika Fuzzy		1. Identifikasi Alat keselamatan 1. Identifikasi keadaan tanah (99,99%) 2. Identifikasi kualitas udara
[15]	<i>Support Vector System</i>		1. Analisis tumor otak MRI
[19], [20]	Robot (Gabungan beberapa teknologi)		1. <i>Exoskeleton robots</i> 2. Robot operasi otomatis
[19]	<i>Deep Learning</i>		1. Stetoskop
[20]	<i>Machine Learning</i>		1. Biomarker 2. Prediksi hypoxemia

Based on the literature review, there are various type of artificial intelligence that have been implemented in the healthcare section. Out of all the technology that has been used, expert system and neural network are the two most used, but other type of technologies are being developed to further improve the technological advancement in the healthcare section, effectively giving a better health system to the society.

Expert system is an agent where it has a purpose to give some advice to its user based on the knowledge it has when the user inputs information about their complication [27]. In the world of healthcare, a patient may have different kinds of complaints, hence a doctor is needed to understand the complaints and draw a conclusion from the complaints. Expert system is commonly used due to how much information that it can carry, and the system can use the information to determine the treatment. Information about the disease is inputted inside the expert system, hence granting the ability to correctly gives advice on a specific type of complaints. This type of technology is common because of how easy it is to be operated daily.

The other type of technology that is more commonly used in the healthcare system is the artificial neural network, where the system is a series of neuron at a layer with its connection pattern [13]. This technology is widely used because of its ability to receive information, process information, and produce a fine output [13]. Based on the literature review, artificial neural network is commonly used as an object identifier, pathogen or

disease recognition based on image, classification of image, and other types of technology that relies on information processing.

Although other type of technologies is less commonly used if we compare it to the number of technologies that uses artificial neural network and expert system, it does not rule out the possibility that other type of technology will continue to evolve and bringing new upsides to the healthcare world, giving the medical staffs more help and effectively creating a better world by keeping the health of the society safe. Various robots are being developed, such as a robot to do patient's surgery, monitoring patients in a hospital, and certainly any other type of robots that can do tasks automatically.

VI. CONCLUSION

The world's technology is having a constant development, especially after the recent event of Covid-19 pandemic that quickly triggers the rapid development of artificial intelligence to help the medical staffs taking care of Covid-19 patients. Many technologies are used to help the staffs do diagnosis and do other kind of things, but the artificial neural network and expert system are the most commonly used because of their effectiveness and their ease of operation.

REFERENCES

- [1] H. Jaya, Sabran, Muh. M. Idris, Y. A. Djawad, A. Ilham, dan A. S. Ahmar. "Kecerdasan Buatan," Januari 2018.
- [2] Nurhaidah, Musa, M. Insyah. "Dampak Pengaruh Globalisasi bagi Kehidupan Bangsa Indonesia," *Jurnal Pesona Dasar*, vol. 3, no. 3, pp 1-4, 2015.
- [3] Wardiana, W. "Perkembangan Teknologi di Indonesia," 2002.
- [4] H. Nasution. "Implementasi Logika Fuzzy pada Sistem Kecerdasan Buatan," *Jurnal ELKHA* vol. 4, no. 2, 2012
- [5] M. D. Y. Santoso, "Faktor-Faktor yang Berhubungan dengan *Burnout* pada Tenaga Kesehatan dalam Situasi Pandemi COVID-19," *Jurnal Keperawatan Tropis Papua*, vol. 04, no. 01, 2021.
- [6] Nur Aisyah D, Dkk. "The Use of Digital Technology for COVID-19 Detection and Response," Feb. 28, 2023. [Online]. Available: <https://i-jmr.org/2023/1/e41308/>
- [7] G. Feoh dkk. "Information Technology: Konsep dan Implementasinya," 2022.
- [8] B. Muhammad. "Implementasi Data Mining untuk Prediksi Standar Hidup Layak Berdasarkan Tingkat Kesehatan dan Pendidikan Masyarakat," *Jurnal Sistem Komputer dan Kecerdasan Buatan*, vol. 2, no. 2, 2019.
- [9] J. Arifin. "Sistem Pakar Diagnosa Penyakit Gigi dan Mulut Manusia Menggunakan *Knowledge Base System* dan *Certainty Factor*," *Jurnal Ilmiah Teknologi dan Informatika*, vol. 10, no. 2, 2016.
- [10] M. Yusran "Kecerdasan Buatan dalam Diagnosis Retinopati Diabetik," *Jurnal Kesehatan Universitas Lampung*, vol. 6, no. 1, 2022.
- [11] R. Komalasari. "Pemanfaatan Kecerdasan Buatan (*Artificial Intelligence*) dalam Telemedicine: dari Perspektif Profesional Kesehatan," *Jurnal Kedokteran Mulawarman*, vol. 9, no. 2, 2022.
- [12] G. Gumelar. "Menavigasi Tantangan dan Menciptakan Peluang: Peran Vital Ilmu Psikologi di Era Kecerdasan Buatan," *Jurnal Penelitian dan Pengukuran Psikologi*, vol. 12, No. 1, 2023.
- [13] S. Paramita, D. Br. Ginting, "Pemanfaatan Kecerdasan Buatan dalam Kesehatan dan Keselamatan Kerja di Bidang Kelistrikan," 2020.
- [14] Simbolon, dkk. "Penerapan Jaringan Saraf Tiruan dalam Memprediksi Gizi Balita pada Puskesmas Siantar Utara Kota Pematangsiantar," *Jurnal Penerapan Kecerdasan Buatan*, vol. 1, no. 1, pp. 48-54, 2019.
- [15] W. Halim, P. Mudjihartono, "Kecerdasan Buatan dalam Teknologi Kedokteran: *Survey Paper*," *KONSTELASI: Konvergensi Teknologi dan Sistem Informasi*, vol. 2, no. 1, 2022.
- [16] J. Prayudha, A. Pranata, A. Al Hafiz, "Implementasi Metode Fuzzy Logic untuk Sistem Pengukuran Kualitas Udara di Kota Medan berbasis *Internet of Things (IoT)*," *Jurnal Teknologi dan Sistem Informasi*, vol. 4, no. 2, pp. 141 - 148, 2018.
- [17] R. Retnowati, A. Pujiyanta, "Implementasi Case Base Reasoning pada Sistem Pakar dalam Menentukan Jenis Gangguan Kejiwaan," *Jurnal Sarjana Teknik Informatika*, vol. 1, no. 1, 2013.
- [18] P. Ziuziański, M. Furmankiewicz, A. Soltysik-Piorunkiewicz, "E-Health Artificial Intelligence System Implementation: Case Study of Knowledge Management Dashboard of Epidemiological Data in Poland," *International Journal of Biology and Biomedical Engineering*, vol. 8, 2014.
- [19] M. Y. Shaheen, "Applications of Artificial Intelligence (AI) in Healthcare: A Review," 2021.
- [20] K. Yu, A. L. Beam, I. S. Kohane, "Artificial Intelligence in Healthcare," *Nature Biomedical Engineering*, vol. 2, 2018.
- [21] A. N. Ramesh, C. Kambhampati, J. R. T. Monson, P. J. Drew, "Artificial Intelligence in Medicine," *Ann R Coll Surg. England*, 2004.
- [22] Yuliyana, A. S. R. M. Sinaga, "Sistem Pakar Diagnosa Penyakit Gigi Menggunakan Metode *Naïve Bayes*," *Fountain of Informatics Journal*, vol. 5, no. 1, 2019.
- [23] F. N. Fajri, "Prediksi Penyakit Diabetes dengan Menggunakan Artificial Neural Network," 2019.
- [24] B. F. Yanto, I. Werdiningsih, E. Purwanti, "Aplikasi Sistem Pakar Diagnosa Penyakit pada Anak Bawah Lima Tahun Menggunakan Metode *Forward Chaining*," *Journal of Information Systems Engineering and Business Intelligence*, vol. 3, no. 1, 2017.
- [25] M. R. Fadhilah, Ishak, P. S. Ramadhan, "Implementasi Sistem Pakar Mendiagnosa Penyakit Gastritis dengan Menggunakan Metode *Teorema Naïve Bayes*," *Jurnal Teknologi Sistem Informasi dan Sistem Komputer TGD*, vol. 4, no. 1, pp. 1-9, 2021.
- [26] L. Syukriyanto, "Kecerdasan Buatan untuk Mendiagnosa Penyakit Fungi pada Manusia Menggunakan Penalaran *Backward Chaining* berbasis Web," *Jurnal Teknologi dan Rekayasa*, vol. 6, no. 2, 2021.
- [27] Y. Kuryanti, "Sistem Pakar Diagnosa Keluhan Kesehatan pada Orang Dewasa berbasis Web dengan Metode *Backward Chaining*," 2014.