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To cite this article:

Aimiuwu, E. E. (2022). Preventing pandemic diseases: An augmented reality & artificial intelligence model. *International Journal of Technology in Education (IJTE), 5*(2), 321-332. https://doi.org/10.46328/ijte.231

IJTE
International Journal of Technology in Education
2022, Vol. 5, No. 2, 321-332 https://doi.org/10.46328/ijte.231

Preventing Pandemic Diseases: An Augmented Reality & Artificial Intelligence Model

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Article Info

Article History

Received:
13 September 2021
Accepted:
28 March 2022

Keywords

Artificial intelligence
Augmented reality
COVID-19
Disease
Pandemic

Abstract

As of April 18, 2021, the coronavirus or COVID-19 virus has affected 219 countries and territories, killed over 3 million people, and infected over 141 million people globally (Pattersson et al., 2021). The purpose of this literature review is to explore how augmented reality (AR) and artificial intelligence (AI) can help to stop the spread of a disease from becoming a pandemic by informing health agencies and national governments about when to implement healthy measures, close their borders, and restrict travel sooner in the future. Research shows that AR is an excellent tool for capturing incidents in three dimensions (3D) and has the ability to maneuverer data to be viewed and understood in all directions. Also, AI has the ability to analyze vast data, learn to improve itself in order to predict future situations, and make deductive or data-reliant decisions in real time. Despite much research on both AR and AI in the health field, this research focuses on how to use these tools to make quicker and better decisions than we did in 2020 for COVID-19.

Introduction

In March 11, 2020, the World Health Organization (WHO) declared that the novel coronavirus (COVID-19) disease had become a pandemic (Chappell, 2020) because it had affected about 123 countries; killed about 5,000 people globally; and infected about 132,000 people, mainly in Asia, Europe, the Middle East, and now the United States (Feuer et al., 2020). COVID-19 is a viral disease that started in Wuhan, China in December 2019; it is a respiratory illness that spreads between people; it has symptoms of cough, fever, as well as shortness of breath that can lead to death; and it takes about 14 days for symptoms to emerge after exposure to the virus (Sauer, 2020). COVID-19 became a pandemic just within 3 months and has affected millions of workers, travelers, the elderly, and loved ones in many countries. COVID-19 virus in the air from a cough or sneeze can still infect people after 3 hours, over 3 days from plastics and stainless steel, up to 24 hours from cardboard, and up to 4 hours from copper (Emery, 2020). This means that wearing a medical mask is essential, especially when you go outside for a few hours, as well as washing your hands regularly and wiping most-used surfaces with disinfectant wipes frequently.

COVID-19 can be transmitted from animals to humans, especially from cats and camels, and can also lead to kidney failure and pneumonia if hands are not washed properly and regularly, nose and mouth are not covered

properly or distance is not maintained, especially when around those coughing and sneezing, or when meat or eggs are not cooked thoroughly (WHO.org, 2020). Among the infected in China, about 18% are in severe or critical condition; only 2.3% have died (Vo, 2020). The death rate for people above 60 years of age ranges from 3.6% to 14.8%, the death rate for those with pre-existing conditions (cardiovascular, diabetes, and cancer) ranges from 5.6% to 10.5%, and about 51% of the cases are men (Vo, 2020). It seems it is best to keep some social distance from animals and sick people, as well as keep the elderly and those with pre-existing health issues away from the general population.

In March 17, 2020, the African continent had the lowest cases of COVID-19 infection, with 347 infections out of over 169,000 globally (0.2%) and just seven deaths out of about 6,500 globally (0.01%) because they implemented travel bans, against WHO's advice; restricted immigrants from highly infected countries to sustain tourism; encouraged social distancing and good hygiene; closed work and schools; and encouraged border closure (Adebayo, 2020). Putting wisdom, as well as value for both long life and good health ahead of money, travel, and trade when making policies against the spread of a disease outbreak is paramount. A sick or dying person cannot enjoy the pleasures from money, travel, and trade. As of January 8, 2021, the United States alone had passed 4,000 deaths in one day (Holcombe & Andone, 2021), and, as of April 18, 2021 has almost 32 million affected and almost 600,000 deaths (Hernandez et al., 2021). There is a justified need for citizens to put pressure on their workplaces, media, as well as travel and health agencies to demand that the government close national borders as well as restrict travel to and from infected countries within a week of an epidemic spreading to another country until the disease is under control.

Many major sporting events around the world were either cancelled or postponed, which includes the Olympic Games, the National Basketball Association, the National Hockey League, Major League Baseball, Major League Soccer, NCAA's March Madness, the PGA Tour for Golf, and even European soccer's Champions League (Badenhausen, 2020). By January 2021, many of these sporting events had resumed, but coaches and players are required to wear masks on the bench and the games are played in an empty stadium or arena, which greatly reduces the revenue for the sport organizations. Due to the COVID-19 pandemic, the stock market in the United States has suffered its worst Dow Jones Industrial Index since 1987 after losing about 2,350 points, which is about 10% (Torres & Thorbecke, 2020). In case of disease outbreak, global citizens should try to take the lead and be proactive in self-travel bans and self-social distancing from work as well as sporting events, instead of reactively relying on the government and health organizations.

Local officials in Florida, USA proactively moved to shut down their beaches to prevent large crowds and spring breakers from gathering during the COVID-19 outbreak because the governor refused to close the beaches officially (Fieldstadt, 2020). People in one state or country in a digital age should be able to reach others in real time strategically in other states, countries, and continents about a disease outbreak that can affect the entire country or continent within a week to prevent a disease outbreak from becoming an epidemic or a pandemic. Despite the fact that there is some research on AR and AI in healthcare and diseases, there is limited study on using both AR and AI together towards stopping the spread of an epidemic becoming a pandemic. Now that we have discussed COVID-19 as a pandemic, we will explore the literature on how AR and AI can be

used together to stop a disease from becoming a pandemic. Then we will present the relationship model, methodology, and discussion. Lastly, limitations and the conclusion will be addressed.

Literature Review

Augmented Reality

AR is a user interface technology that enhances a user's physical environment by augmenting it with virtually created computer data of videos, images, sounds, graphics, global positioning systems (GPS), and texts retrieved from various sensors, and it permits the immersive capability to view content, navigate, communicate information, and change the way a user interacts with the physical environment (Barat & Liang, 2019). AR is a new approach that is integrated into any information or technological system to enhance information in the real world, as well as our daily lives in both an interacting and cognitive way by tracking reference points within the data, capturing and coordinating digital data, and displaying virtual information combined with the physical environment (Aslan et al., 2019). A new international or inter-continental integrated data-sharing protocol should be created to allow WHO and local health organizations to be able to use AR to capture images and sounds of people from cameras and speakers of smartphones, digital car videos, and digital speakers in any location in the world to observe their health conditions in real time. They can also use AR to communicate with local authorities to confirm or predict what is actually going on about the health issues in any part of the world in real time.

Many organizations expect the combination of big data and AR as a necessity because AR's ability to visualize data will enhance and improve development of creative solutions for needs-based concerns, organizational business strategy, mobile or smartphone technology, analysis of vast data from the internet of things (IoT), and social media in real time (Aslan et al., 2019). AR aids users to evaluate products or situations efficiently in 3D perspective before making a decision (Yoo, 2020). The new international or inter-continental integrated data-sharing protocol should encourage digital and social media users to allow WHO and local health organizations to access their digital data to view health concerns in any part of the world. The digital data can be viewed in AR's 3D from various IoT connected to the internet in order to come up with a strategy or solution to prevent an epidemic or a pandemic in real time. They can also retrieve and analyze vast data from social media conversations in order to make a health decisions for that locality or nation in real time.

AR user's insight of information quality (accuracy, objectivity, reliability, and relevance of content) and visual quality (appealing, clear, and concrete presentation of 3D graphics) directly influences both perceived diagnosticity (usefulness to learn and understand the situation with functional feature use) and satisfaction (psychological and emotional opinion that exceeds expectation after usage or experience); perceived diagnosticity directly influences satisfaction; and satisfaction directly influences loyalty, which is the user's repeated usage (behavioral) or both recommendation and commitment to brand (attitudinal) (Yoo, 2020), as shown in Figure 1. WHO and local health organizations can get accurate and relevant content from AR that has clear and appealing 3D graphics, which can be turned into useful health information that will lead to a satisfactory decision or solution.

Artificial Intelligence

AI is an intelligent system of tools, techniques, and algorithms that has the ability to think, learn, as well as decide and augment work, which requires the processing of machine learning ability (algorithms for learning), natural language (analyzing human language), and machine vision capability (algorithms for image analysis) (Jarrahi, 2018). AI learns from past experiences and data in order to develop intelligent solutions, has the ability to learn and improve itself for knowledge-based tasks, and is excellent for analytical decision making, while humans are necessary for intuitive decision making (Jarrahi, 2018). WHO and local health organizations can use AI to learn about past epidemics and pandemics, how they were resolved and the mistakes that were made, as well as predict what needs to the done differently in future to terminate diseases before they become an epidemic or pandemic. They can also use AI to predict the next city to be affected, analyze what strategies are needed to prevent the disease from spreading to those locations, and develop an intelligent solution or recommendation to prevent both an epidemic and a pandemic.

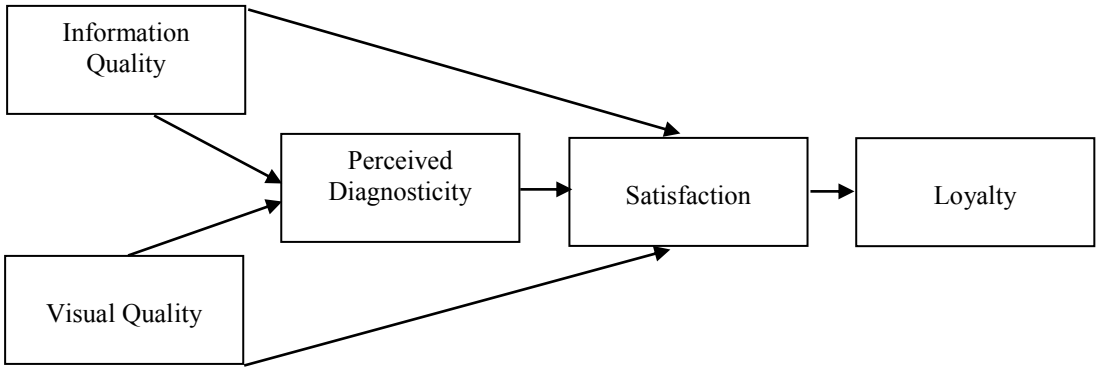

Figure 1. Five Key Features of Augmented Reality

The analytical approach of AI depends on the analysis of knowledge based on conscious reasoning as well as logical deliberation, but lacks the comprehension of common-sense and uncertain conditions, while the intuitive approach of humans depends on their instinct, gut feeling, and previous experiences, but has the edge of being creative and imaginative when it comes to decision making (Jarrahi, 2018). Fusing the ability of AI to analyze numerous data in real time with the edge of human intuition and discerning judgement is known as hybrid intelligence (HI) (Jarrahi, 2018; Dellermann et al., 2019), as shown in Figure 2. AI assists in upgrading human decisions by supplying predictions, while humans aid AI to learn the current machine learning models, so HI enables humans to gain from AI predictive ability and then humans utilize their intuition, imagination, and creativity to make decisions, usually based on AI's prediction, which has no discrimination of ageism, sexism, or racism (Dellermann et al., 2019). WHO and local health organizations can depend on updated or current expert systems models or HI to imitate the behaviors of experts that successfully dealt with past epidemics and pandemics, as well as apply the same methodologies without bias in their decisions and implementation of strategies in real time.

An expert system is a computerized HI and a form of AI that copies human expert behavior by retrieving and utilizing human experts as both data and rules within a computer program, which can be used to solve very

complex conditions (Abu-Nasser, 2017; Campbell, 2020). AI provides data-reliant reasoning from past cases; rule-based reasoning in an attempt to provide a new theory and deductive judgement; and biometrics for identification purposes, according to the physiological or behavioral characteristics for verifying and authenticating identities (Nissan, 2017; Campbell, 2020). WHO and local health organizations can depend on AI, expert system models, and HI to make intelligent decisions in real time, based on past disease outbreaks, rules for deductive reasoning, and biometrics to verify and authenticate disease and its characteristics of spreading.

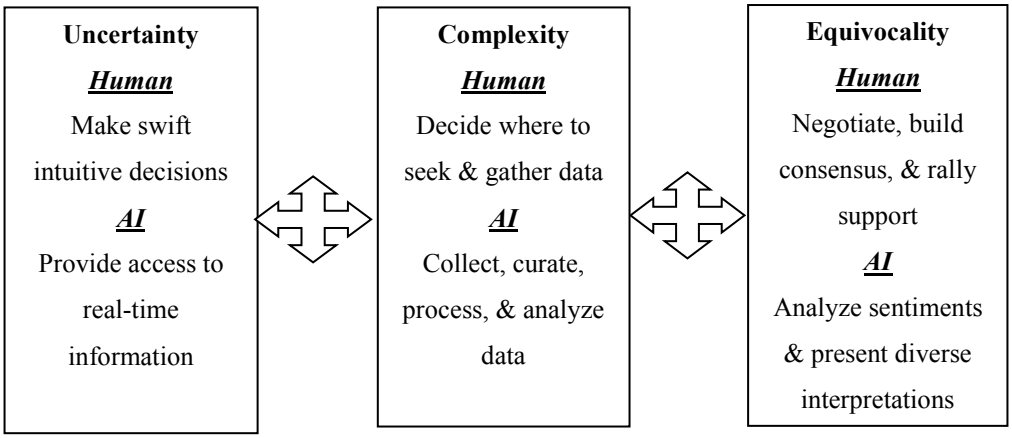

Figure 2. Hybrid Intelligence (Human & AI) Decision Making Situations (Jarrahi, 2018)

In the health industry, AI can retrieve data from public health surveillance, monitor disease outbreaks in real time, forecast and get briefings from government as well as health organizations (Bragazzi et al., 2020). AI can provide accurate predictions and readings in the future with effective data sharing (Allam et al., 2020), but AI is currently not efficient in epidemiology, pharmaceutical, and diagnostic perspectives because of lack of data or too much unintegrated data that needs a balance between data privacy and human-AI interaction in public health (Naude, 2020). Government and health organizations should be able to use the new international or inter-continental integrated data-sharing protocols from all information and communication technologies, such as smartphones and wearables, and various platforms such as social media, in order to integrate vast data in real time for adequate preventive AI reading, prediction, and forecasting.

AI can identify ongoing outbreaks within weeks, identify existing medication or discover new therapeutic options within months, and may take decades to have standardized protocols for sharing data and information during a health crisis (Bragazzi et al., 2020). AI can diagnose and prevent further disease outbreaks through containment as well as mitigation in order to sustain economies (Jibril & Sharif, 2020). Through adequate data sharing, disease outbreaks can be identified in time and provide both accurate molecular cure, as well as preventive lifestyle strategies sooner if proper data-sharing protocols between all networks, platforms, and communication technologies are in place now with proper privacy and preventive controls.

We need to cover the gaps in current health policies by designing and implementing disaster and emergency policies that are highly integrated, use risk assessments to forecast future events, and plan in advance to resist

and respond to any disaster in real time (Bragazzi et al., 2020). For efficient data sharing, there must be effective data protocols for sharing data across various networks and systems, which guarantees preventive and privacy controls, especially for medical data (Allam et al., 2020). Preventive and privacy controls are essential for both AI and AR to become more acceptable to both governmental and health agencies, as well as to global citizens.

Method

Since COVID-19 is a new disease, this study relied on medical experts in reliable news sources to provide updates in real time since March 2020, and did not want to make the content too medical or scientific. A total of 11 news sources were used to understand the nature of the disease, the health measures required to survive it, and the flaws of both national governments and health organizations to make a decisive decision sooner. A total of three articles were used to explain how AR works and its uses, and nine articles were used to understand the purpose of AI and its usefulness. The two medical sources from WHO and John Hopkins were used to explore what COVID-19 is and how to keep individuals safe from it.

The goal of this paper is to explore through a literature review of both experts in news outlets and academic journals how AR and AI can help health organizations stop the spread of an epidemic from becoming a pandemic, with the collaboration of national government, travel companies, digital companies, and even employers. Someone has to have the authority to stop business as usual when it comes to an epidemic disease becoming a pandemic, because a pandemic seems to kill and affect people faster than war, so an epidemic becoming a pandemic should be seen as a prioritized event to be controlled within a few months, rather than the pandemic controlling the entire world and our daily lives for years without end in the near future.

The strategy is to have WHO and local health agencies collect vast digital data from hospitals, health professionals, families of the sick or dead, and individuals in the epidemic region as soon as possible and repeatedly until AI can analyze the vast digital data and provide a credible and reliable decision that WHO, national governments, travel agencies, employers, and individuals should follow. This paper presents the view that the healthy person is the wealthiest and wisest person because the dead or the sick without hope of survival against a new pandemic has no use of the economy, travel, or trade.

Relationship Model

Due to the issues of privacy with AR and bias with historical data in AI, it is recommended that smartphone services and social media companies require that customers agree to share their digital data of disease outbreak or epidemics in any region of the world with WHO and local health organizations around the world to prevent a pandemic crisis. This request should be based on the new international or inter-continental integrated data-sharing protocol to combat diseases, emergencies, and disasters in real time or in weeks rather than in months or years. The spread of COVID-19 in 2020 was a global failure of WHO, national governments, and health organizations.

The model in this study recommends a global or inter-continental data-sharing protocol that allows WHO and local health agencies to retrieve any digital epidemic video, image, graphics, or sound from the location of an epidemic in real time for instant AI analysis. AI can rely on deductive reasoning from past pandemics rather than relying on the past failed responses, and can also use biometrics to identify possible remedies based on detected symptoms to make vaccine creation faster. Regardless of the consequences to the economy, travel, entertainment, or trade, once AI determines that the epidemic could become a pandemic and provides safety measures to follow, WHO and local health agencies should have the power to recommend the closure of borders and stop travel immediately until the epidemic is under control. Local health agencies are to ensure that national governments are involved in the pandemic prevention exercise.

The model in Figure 3 is founded on the integrated models in Figure 1 (Features of AR) and Figure 2 (Benefits of HI), which are to integrate both AR and AI to achieve the prevention of pandemic outbreaks in the future. Integrating AR with AI is simply using AI to analyze digital data provided by AR. There are a total of eight stages. Stages 1-3 display the role of AR, stages 4-6 show the role of AI, and stages 7-8 present both satisfaction and loyalty, which are derived from the first six stages.

The first three stages show how WHO and local health organizations may use AR. The second three stages present how AI may be used by them, along with AR. Stages 7-8 show how satisfied and loyal both government and citizens are with the use of both AR and AI to prevent a disease from becoming a pandemic, regardless of the types of people in the affected location.

The use of AR and AI, as shown in Figure 3 below, to prevent diseases from becoming a pandemic is, in fact, a cycle that moves from AR to AI to both satisfaction and loyalty, then returns to AR. This shows that the success of preventing diseases from becoming a pandemic through the use of both AR and AI together should be patronized by national governments, health organizations, and employers, if it leads to an accurate and successful prevention of epidemic and pandemic, regardless of what part of the world is affected or the types of people that reside there.

Results

It is assumed that in the future, an international and inter-continental integrated data-sharing protocol will be implemented to give WHO and local health agencies the right to recommend closure of borders, travel bans, and healthy measures against any epidemic from becoming a pandemic as soon as they have AR and AI evidence through integrated networks, systems, and platforms to show that it is similar or worse than the COVID-19 pandemic. National government, travel companies, employers, and individuals are to collaborate with the law or face harsh penalties for endangering humanity. The integrated AR and AI cycle for preventing a pandemic outbreak, as presented in Figure 3.

Stage 1 is for Information Quality: WHO and local health organizations can use AR to acquire reliable audio, accurate videos, and relevant pictures from car and smartphone cameras, street and building cameras, sounds

from digital speakers and microphones (such as Apple's Siri, Amazon's Alexa, and Google Assistant), as well as images about the location of disease from all angles and directions.

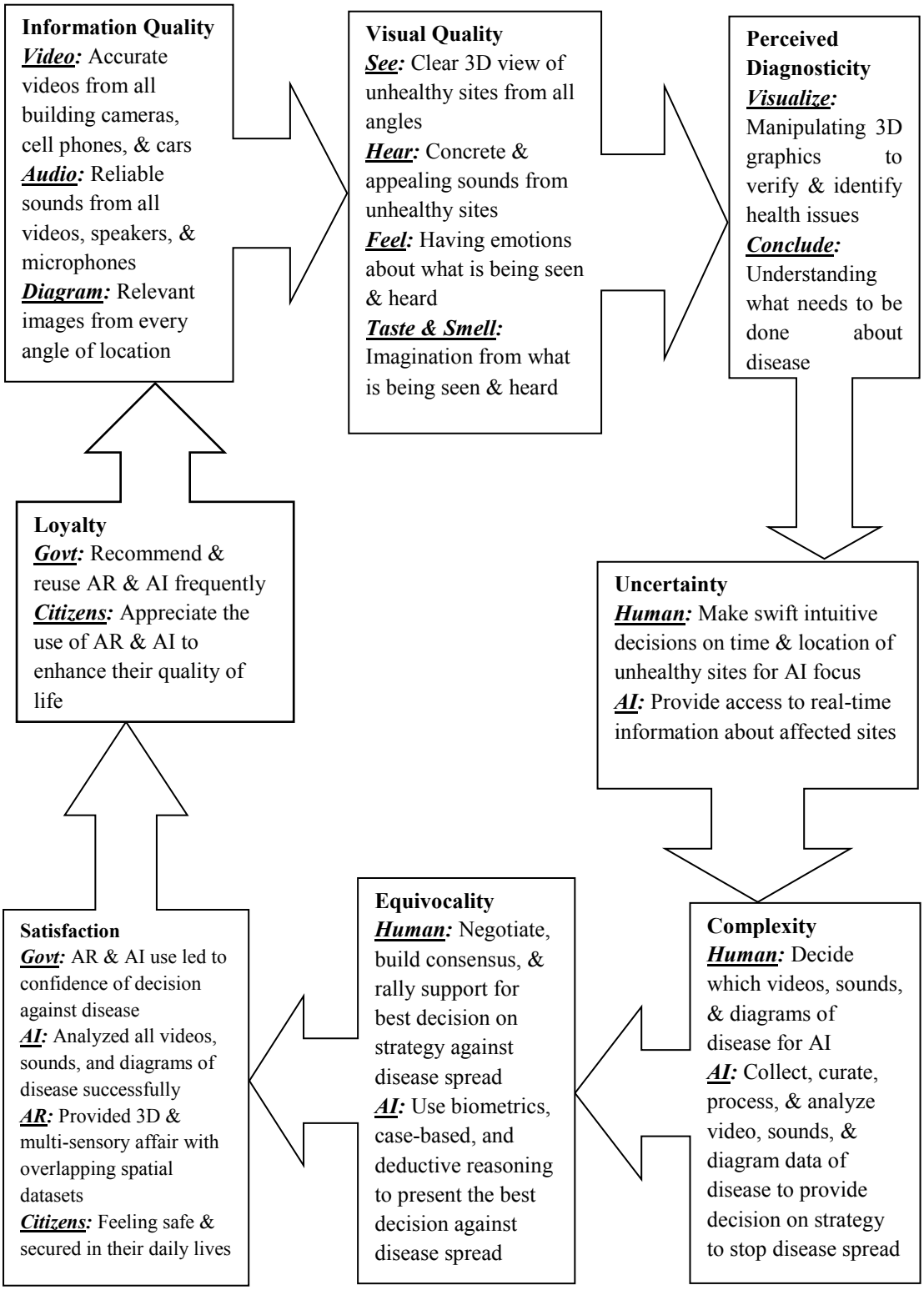

Figure 3. Combining Augmented Reality & Artificial Intelligence Cycle to Prevent Pandemic Outbreak

Stage 2 is for Visual Quality: WHO and local health organizations can use AR to be there at the scene despite

the subject being absent or far away in the real world, but there is still a need to validate what was seen and heard in order to prevent any bias. At this stage, the multisensory and multi-dimensional characteristics of AR are extremely important.

Stage 3 is for Perceived Diagnosticity: WHO and local health organizations are absorbed in the combined benefits of both information quality and visual quality, which gives them the advantage of playing with the functional features of AR to manipulate videos, sounds, images, and graphics in order to match the AR experience with what is actually happening at the scene of the health crisis.

Stage 4 is for Uncertainty: This is where WHO and local health organizations become AI users by integrating their AR experience with AI in order to attain a factual conclusion and make a credible decision without bias. This is the genesis of HI, because WHO and local health organizations become AI users that use their human intuition, imagination, and creativity to inform AI about the time, location, directions, angles, and coordinates of disease affected areas to focus on in order for AI to furnish real-time analysis of the disease and affected locality.

Stage 5 is for Complexity: WHO and local health organizations decide the videos, graphics, sounds, and images to be analyzed for adequate decision making, and AI uses its analytical characteristics to classify the vast data in order to finalize the decision of what is actually occurring in the affected area of the disease.

Stage 6 is for Equivocality: AI uses biometrics for verification and authentication of objects. It will be a great tool to verify and identify various disease patterns and how they spread to different places in real time. AI also has case-based or data-reliant reasoning for finding similar diseases from the past and recommending the adequate preventive practices used to prevent the spread of that type of disease in the present or future. AI can also use abductive or rules-based reasoning to apply logic from expert systems or computerized HI that mimics the decision or behavioral pattern of credible health experts who successfully prevented epidemic and pandemic diseases in the past.

Stage 7 is for Satisfaction: WHO and local health organizations are expected to be satisfied that the AR has supplied all the relevant digital videos, sounds, and graphics required to make a verifiable decision about the disease and the affected locality. WHO and local health organizations are also satisfied and assured that they supplied AI with adequate models for the actual location and time of the disease outbreak to be analyzed, as well as reliable sounds, relevant pictures, and accurate videos for objective decision making. Citizens are expected to be happy that both AR and AI are being used to keep them safe and secure from the spread of the disease and can enjoy their daily lives.

Stage 8 is for Loyalty: National governments, health organizations, and employers may believe that AR and AI together is a dependable way to factually find out what type of disease outbreak is affecting an area and recommend preventive strategies to stop the spread of that disease from becoming a pandemic. National governments, health organizations, and employers may be so pleased with both AR and AI that they would

recommend them to other organizations and reuse them as often as needed. Also, citizens may feel both safe and secure in their localities because their governments, health organizations, and employers are doing everything possible with the aid of both AR and AI to guarantee that their lifestyles are not interrupted by the spread of the disease.

Limitations

This study relied on research done by medical experts in news outlets (about 40%) and health organizations about COVID-19, as well as academic journals about AR and AI because COVID-19 is a new disease and the author did not want to make the content too medical or scientific to understand. The study could have been a qualitative research method with interviews of experts, but a literature review was used to show the possibility and capability of using both AR and AI to prevent the spread of a disease from becoming a pandemic.

Triangulation was not done to investigate the privacy laws of how AR could use private data from smartphones, car cameras, and building cameras to monitor diseases in real time. Also, international laws were not studied to understand how health organizations can be permitted to monitor or get past data from local databases within another country or territory. More research is needed to see if AI can provide adequate recommendations for WHO and local health organizations based on data from AR that are acceptable for strategic implementation and achieve the desired result of preventing a pandemic.

Conclusion

In summary, for both AR and AI to be effective and efficient tools in combating disasters, emergencies, and diseases from spreading into a pandemic, there must be a new and accepted international and inter-continental integrated data-sharing protocol to allow the sharing of integrated data across and between networks, systems, and platforms globally. National governments, health organizations, and first responders should be able to receive integrated data in the form of video, sound, text, emails, GPS, images, and graphics in real time while maintaining privacy controls to make adequate decisions.

This study shows that AR is capable of retrieving data in real time and can be manipulated in 3D to give WHO and local health organizations a good understanding of the nature of disease in various locations around the world in real time. AR can provide very clear, relevant, and concrete digital data in terms of videos, audios, graphics and GPS coordinates, where WHO and local health organizations can be involved to articulate the reality of the disease situation. AR provides information quality, visual quality, diagnosticity, satisfaction, and loyalty characteristics for their users.

Research shows that AI is excellent for gathering vast amounts of data and analyzing them in real time. AI also has the ability to learn to improve its predictions for the future and provide updated decisions or recommendations for national governments, health organizations, and employers about preventing the spread of disease, as well as protecting their citizens from a pandemic. AI can work with humans to form HI, which can

be used to make decisions from past disease experience, and use rules and theories to deduct reasoning for new and future diseases, and biometrics to verify and authenticate disease types.

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