Analysis of intelligent systems for the prevention of depression, a systematic review

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Abstract
Depression strikes different people regardless of their social status, education level, or gender. For this reason, it is important to detect this disease as soon as possible to avoid negative consequences in people who suffer from it. This study is a review of scientific literature, where 200 articles have been collected from the following databases: Ebsco Host, IEEE Xplore, Science Direct and Scopus.Based on our inclusion and exclusion criteria, 40 articles were systematized. Having good results on the topic of the most common intelligent systems and the approach that is recommended when developing an intelligent system.
Keywords:Artificial intelligence, prevention of depression, systematic review.

Introduction

Depression is a disease that affects all types of people. People who suffer from this disease can be of different ages, different social status or educational level. Depression is a common mental disorder that presents feelings of sadness, loss of interest, anger, frustration, guilt, lack of appetite, lack of energy, and lack of concentration. These feelings can occur in episodes or attacks in the affected person.The consequences of not treating this disease can range from negatively affecting your daily activities both at home and at work to causing the death of the affected person. It is estimated that more than 300 million people around the world suffer from this disease (Organización Mundial de la Salud, 2020). Furthermore, particularly in Peru, depression is the most common mental disorder in adolescents. Take the city of Lima for example, 8.7% of all resident adolescents suffer from this disease. And this fact is repeated in all corners of the country.(Honorio Delgado Hideyo Noguchi, 2008).

There are different factors that can make a person develop a depressive disorder and this depends mostly on the age of the patient. The causes of the disorder in young people can be bullying, negative family relationships, counterproductive social interactions, extracurricular activities and stress (Runcan, 2020).Other factors that can cause depressive disorder can be the following. As a first factor we have low self-esteem, this is a factor that influences in an important way if a person can develop this disorder and

that should be taken into account when evaluating a possible patient (Jayanthi and Rajkumar, 2014).As a second factor we have the COVID-19 pandemic. Different countries around the world have taken preventive measures against this evil. One of the best known and most effective is social isolation. Unfortunately, this measure has had negative effects on people. It has been obtained as a result of research that has generated an increase in cases of anxiety and depression in young people and adults since the beginning of this pandemic.(Zhang *et al.*, 2020).

Smart systems are advanced technology that perceives and responds to the world around them. These systems can take different forms, from automated vacuum cleaners like the "Roomba" to facial recognition programs like Amazon's personalized shopping suggestions. (University of Nevada, s.f.). These current systems have the ability to evaluate the different responses of a person so many positive and negative. In an investigation, a chatbot had conducting surveys of a specific product to a group of people. This research resulted in the chatbot performing correctly in all interactions and at the end of each conversion it gave a report of the responses of each person to the company. (Xiao *et al.*, 2019). Having different applications both for the sale of articles and to help users of a system today. It can be said that entities with artificial intelligence are taking a leading role over the years. And mental health cannot be oblivious to this change. An investigation that uses a chatbot to reduce stress and lack of encouragement in a group of employees in companies gave the following result. The result was that there is the possibility of reducing the stress and lack of encouragement of a group of employees who used the chatbot as an advisor and confidant. (Kamita *et al.*, 2019).

Methodology

For this research, a systematic literature review had to be carried out. For which it was necessary to review research articles from different databases. The keywords used in the searches will be mentioned in future sections of the article as established in the default order of this research format.

   A. Type of Study

For the elaboration of the article, the systematic review of the scientific literature will be used.

   B. Research questions:

These are the questions posed for this systematic review:

RQ1. What are the most common smart systems in recent years focused on preventing depression?
RQ2. What is the recommended approach for smart systems when collecting information from users?

C. Search strategies

To answer the research questions, a search was conducted of different articles collected from the following databases: EBSCO, SCOPUS, IEEE Xplore, and Science Direct. In total 40 scientific articles were collected.

At the time of the search, the following keywords were used: "artificial intelligence and depression", "artificial intelligence and mental health" and "artificial intelligence and prevention of depression".
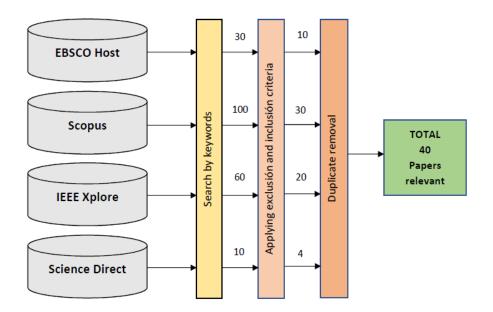

Figure 2. Inclusion and exclusion flowchart

D. Inclusion and exclusion criteria

For this systematic review, exclusion and inclusion criteria were applied. These can be seen in the following table.

TABLE 1. INCLUSION AND EXCLUSION CRITERIA

CRITERIA		
Inclusion	I1	Articles were found in English
	I2	The publicación years are from 2005 - 2020
	I3	Articles with the purpose of answering research questions
Ecxclusion	E1	Some ítems do not apply to engineering or medical areas
	E2	There were articles whose publication year was prior to 2005

	E3	Some articles that are not very related to artificial intelligence and depression
	E4	Those articles whose conclusions do not provide relevant evidence for the present study

Results

200 articles related to the research topic were analyzed, of which 120 had to be discarded because they were repeated or did not have a technological aspect as the main focus. After reviewing the remaining articles, 50 were selected, excluding 10 in accordance with the exclusion criterion and also that they did not help answer the research questions posed for this research. Obtaining 40 articles for the systematic review.
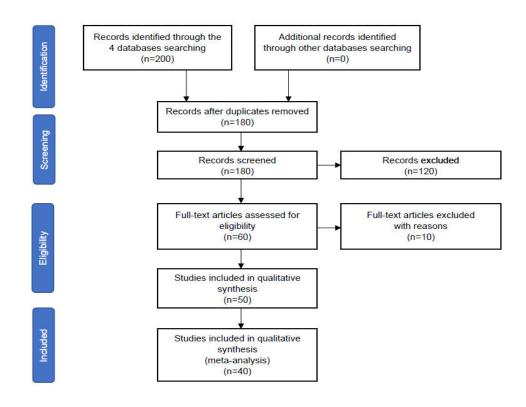

Figure 2. Prisma diagram methodology

The articles that will be used for this review are 40 in total. Now to be able to carefully observe the origin of each one. Next, a graph will be presented that separates them by their respective database.
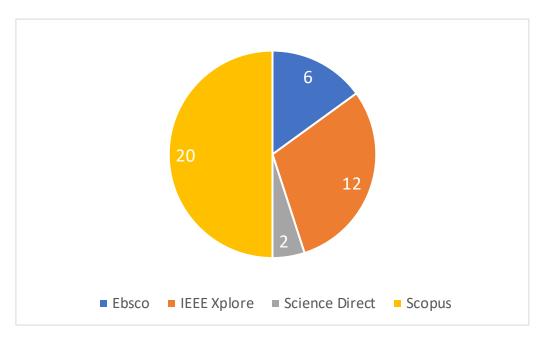
Figure 3. Articles by database

In order to have a general idea of in which country artificial intelligence is most important in research, the following graph can be observed.
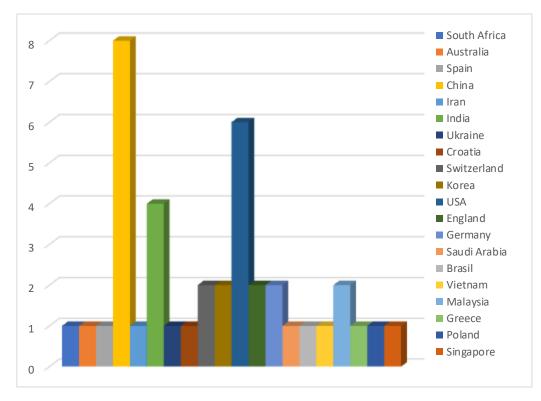

Figure 4. Articles by country

The following graph shows the type of technology that can be seen in each article and its respective year of publication.
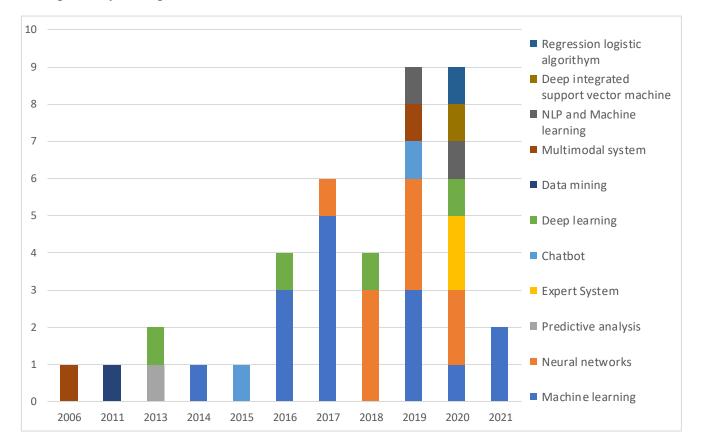

Figure 5. Technological approach of the articles separated by year of publication

The following chart shows the number of articles for each type of artificial intelligence technology.
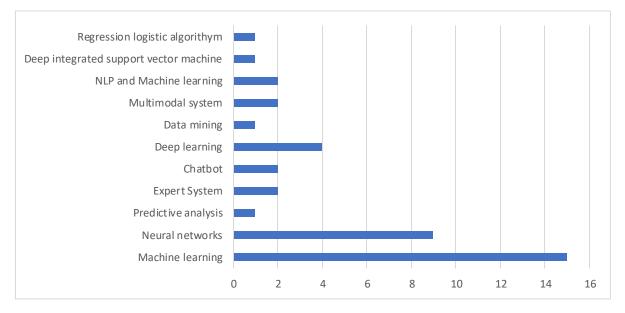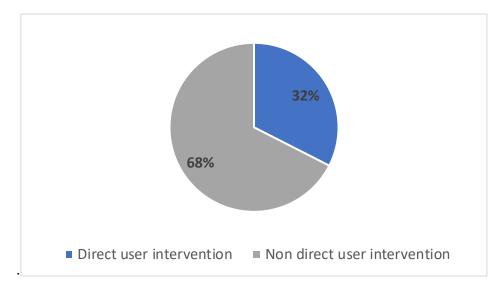

Figure 6. Quantity of articles by each kind of technology

The following graph shows in percentage values what type of interaction the user had in the different articles of this review

Figure 7. User intervention in the collection of information for the investigation of each article

The following table shows us the different articles in detail, what type of interaction they had and also the technology that was studied in that article.

TABLE 2 ARTICLES SEPARATED BY TYPE OF INTERVENTION AND TYPE OF TECHNOLOGY RESEARCHED

Intervention	Articles	Artificial Intelligence Techonology
Non direct user intervention with the technology	(Zhao *et al.*, 2019),(Dipnall *et al.*, 2016),(Ojeme and Mbogho, 2016),(Soundariya *et al.*, 2019),(Nadeem, 2016),(Reece and Danforth, 2017),(Shen *et al.*, 2021),(Wiesner *et al.*, 2012),(Pampouchidou *et al.*, 2019),(Subhani *et al.*, 2017)	Machine Learning
	(Singla *et al.*, 2018),(Baek and Chung, 2020),(Jabłońska and Zajdel, 2020),(He and Cao, 2018),(Shen *et al.*, 2021),(Lin *et al.*, 2020) ,(Aruna Kumari and Anuradha, 2019),(Trotzek, Koitka and Friedrich, 2018),(Wang *et al.*, 2020)	Neural Networks
	(Cho, Geem and Na, 2020)	Regression Logistic Algorithm
	(Kipli, Kouzani and Williams, 2013),(Jan *et al.*, 2018)	Deep learning
	(Ríssola, Aliannejadi and Crestani, 2020)	Expert System
	(Kim, Kim and Yacef, 2020).(Zhu *et al.*, 2019)	Multimodal System

	(Alghamdi *et al.*, 2020),(Tadesse *et al.*, 2019),	NLP and Machine Learning
	(DIng *et al.*, 2020)	Deep Integrated Support
Direct user intervention	(Yankovskaya and Kitler, 2013)	Predictive Analysis
	(Ćosić *et al.*, 2020)	Expert System
	(Cohen, Kampel and Verloo, 2016)	Deep Learning
	(Dosovitsky *et al.*, 2020),(Abd-alrazaq *et al.*, 2019)	Chatbot
	(Souza Filho *et al.*, 2021),(Sau and Bhakta, 2017),(Ríssola, Aliannejadi and Crestani, 2020),(Tuarob *et al.*, 2017),(Tran *et al.*, 2019),(Rahman *et al.*, 2020)	Machine Learning
	(Burns *et al.*, 2011)	Data mining
	(Jin *et al.*, 2020)	Deep Learning

Discussion

In this systematic investigation of scientific literature, the objective was to answer the following research questions.

RQ1. What are the most common smart systems in recent years focused on preventing depression?

In figure 6, we can see that there are two technologies that most of the articles focus on for the development of research, applications and innovations. These two are investigations based on Machine Learning and Neural Networks. We can mention some of these investigations such as the detection of depression based on posts on Reddit based on Machine Learning (Tadesse *et al.*, 2019)or the prediction of depression based on human behavior based on Neural Networks(Singla *et al.*, 2018)**.**

Now these two are not only the most popular as topics, as can be seen in figure 5. Machine Learning and Neural networks are the most popular in recent years, having 11 and 9 articles in total correspondingly. In general, the development of new technologies such as their research have a greater presence in two countries, the United States and China. The latter can be seen in figure 4 of this investigation.

This set of information gives us to understand that arithcial intelligence research has two pillars that stand out from the majority for its attractive development structure. In addition to this, these two technologies have been the basis for such interesting research in the field of preventing depression in people.

RQ2. What is the recommended approach for smart systems when collecting information from users?

If we look at figure 7, it can be seen that the collection of information indirectly is the most used in current research. This index is rooted in the way the user wants to interact with current technologies. The current user does not want to have to fill out a form if he does not use an application that is responsible for carrying out his measurements or studies without intervening in his daily life. An example of this could be a system that was developed and implemented with a wearable-type device capable of collecting information and then determining your mood based on the physical movement you perform.(Zhao *et al.*, 2019)**.**As can be seen in the figure, 68% of all articles have an indirect approach when obtaining information from different users. After obtaining user information, it is processed by systems or applications in order to fulfill a specific objective. Another example of this approach is the following investigations. These works obtain information from users through recognized social networks in this particular case the social network in question is Twitter (Nadeem, 2016; Lin *et al.*, 2020; Shen *et al.*, 2021)**.** In these studies the information is received through an API and then processed by their respective technologies in order to determine whether a person suffers from depressive disorder or not.

Now this does not mean that the other way of collecting information is wrong or inefficient as can be seen in table 2. A large number of articles that are based on different technologies use this approach. An example to highlight would be the following. An investigation develops and at the same time evaluates a chatbot. The researchers gather a number of people willing to chat with the chatbot and follow up on each one. The objective of this chatbot is to determine if any of the subjects may have depression or not (Dosovitsky *et al.*, 2020).

Now it can be said that the recommended approach to future research is to collect information from your test subjects in an indirect way because the trend tells us that people do not want to have to fill out a series of forms or have to have extensive testing sessions . Today's users want to be evaluated by information that already exists or simply not even notice that they are evaluated in the case of using applications that can be used in everyday life.

Conclusions

After having carried out a systematic review of the scientific literature of 40 articles related to artificial intelligence applied to the prevention of depression, the following can be concluded.

In recent years, the most common technologies that are aimed at preventing depression are Machine Learning and Neural Networks. In addition to these, the countries with the most interest in the development of these technologies are the United States and China. Now at this point we recommend looking for articles related to the topics of this review in these two countries due to the large number that originate from these countries.

Now the approach that is recommended to future research when collecting information from users in order not to have a negative impact on them. It is the approach of

collecting information indirectly, this is suggested because the tendency of the reviewed research prefers this to the approach directly. This is understood by the great changes that technology has today and its easy handling by current generations.

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