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# The Utility of Artificial Intelligence for Mood Analysis, Depression Detection, and Suicide Risk Management

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**Abstract:** Mood disorders are often an indication or a sign of depression, and individuals suffering from mood swings may face higher probability and increased suicidal tendencies. Depression—also called "clinical depression" or a "depressive disorder"—is a mood disorder that adversely impacts how an individual feels, thinks, and handles daily activities, such as sleeping, eating, or working. To be diagnosed with depression, symptoms must be present most of the time, nearly every day for at least minimum of 2 to 3 weeks. Feeling sad or having low emotional energy may be common among people. For most, however, these feelings are transitory and can be managed by changing daily life routines. But for some, prolonged mood disorders can lead to depression and foster suicidal tendencies. Suicide is a major public health concern. Over 47,000 people died by suicide in the United States in 2017. It is the 10th leading cause of death overall according to NIMH (National Institute of Mental Health). Suicide is complicated and tragic, but it is often preventable. Identifying the warning signs for suicide and how to get help can be a major mitigating factor. In this short communication, we are reviewing the promise and limitations of AI (artificial intelligence) with its integrated tools such as ML (machine learning) and DL (deep learning) for mood analysis as a means for detecting early signs of depression and increased suicidal tendencies for possible suicide risk management.

**Key words:** Depression, suicide attempt and suicide rate, youngsters, suicide risk management, augmentation of AI in depression treatment and suicide management.

## 1. Introduction

Whenever, you feel sad or empty hopeless most of the time all day and nearly every day, including loss of interest or pleasure in any of your hobbies or associating with your friends and family as well as having trouble of sleeping, eating properly or eating at all and functioning routinely and normal way, then these are matter of concerns for you as possible sign of depression [1].

Particularly, if you have felt this way for at least 2 weeks, you may have symptom and sign of depression, a serious but treatable mood disorder.

Being lonely and keeping isolated from your sounding, not only is not a good idea, yet enhances progress toward a possible existence and an indication of depression that you need to start paying attention to.

As part of our mental health and wellness, we need to be socialized and mingle with all friends, family and our sounding, so we can feel as part of society we live in.

To maintain a healthy and metal wellness, you need to continue to look out for yourselves and each other.

Experts say social isolation can create feelings of fear, anxiety and depression. For example, the chaos of the novel coronavirus or that is known to expert and public as COVID-19 global pandemic disease was unknown to everyone or anyone globally, since December of 2019. Many have come to fear the virus, creating feelings of insecurity and uncertainty of their future due to adverse ecumenical impact of this virous.

Shelter in Place or Stay at Home order or Social Distancing is driving folks into loneliness and helplessness in particular among single individuals that are living by themselves.

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However, bear in your mind that again, physical distancing that comes along as part of adverse side effect of this virous does not mean social isolation—thus you need to look for ways to stay mentally and emotionally healthy during this trying time imposed by federal and local governments authorities around the nation and worldwide.

Social isolation, loneliness is a sign of depression in particular in youngsters during their adulthood time period and requires immediate attention by that individual or her/his family member by referring the young to a professional for consultation and treatment.

After first appearing in Wuhan, China, the novel coronavirus has spread to at least 177 countries and territories.

According to data compiled by the U.S.-based Johns Hopkins University, nearly 684,700 cases have been reported worldwide, with the death toll above 32,100, and 145,696 recoveries.

Moreover, events like the COVID-19 that conceive lockdown and enforceable social distancing, are not an isolating case that took place since December 219 and continues up to now. In future there might be events like this that may take place in future and no one can really predict or forecast such thing, but the lesson that we can learn from it is that, how to deal with isolation and loneliness driven depression.

By definition, medical term "#Menoumespiti", which means "Staying at Home", became a slogan on social media groups created for people to share views and feelings about the situation.

Experts believe that any kind of interaction is crucial in such times. Clinical psychologist and psychotherapist Thomas Maliaroudakis said that this can help as it creates bonding and comforts people that share similar issues [2].

"Maliaroudakis explained that human beings are social creatures and social isolation is something unfamiliar and new, therefore a significant amount of the population will find it difficult to adjust to this new situation due to the loss of control".

"He added that a sense of helplessness will be felt. This helplessness as a result can have a serious impact on people's mental health and it can be very overwhelming." [3].

Furthermore, isolation and loneliness or shelter in place, mean that there is no easy access to day-to-day necessities as a routine procedure under normal conditions such as going to grocery shopping or visiting a doctor and easy access to needed medication or even buying stuff off the shelves such as hand sanitizer etc.

In cases such as COVID-19, "A deterioration of the general health of the population is expected", expert Gonidakis states that [3].

He even claims that "long periods of isolation can create a state of chronic stress".

This stress can contribute to the manifestation of anxiety disorders such as panic disorder, generalized anxiety disorder and phobias. In addition, people who are already suffering from bipolar disorders, psychosis, OCD (obsessive-compulsive disorder) and eating disorders may have a higher rate of relapsing, he explained [3].

Note that: OCD is a brain and behavior disorder categorized as an anxiety disorder in the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV) [4]. OCD causes severe anxiety in those affected and involves both obsessions and compulsions that interfere with daily life.

Given the data and consequently information that are collected historically and continue to be collected at massive volume, how we can utilize technical and innovative capability such as AI (artificial intelligence) with its integrated functionality of ML (machine learning) and DL (deep learning) would help us.

To be able to analyze mood of a person by looking at his or her face via CR (character recognition) or IP (image processing) in real-time, thus it gives professionals to prevent any suicide attempt and manage it among the folks that not only are isolated socially but show sign of depression on their face and

their behavior.

And experts in science of data as data scientist or DL, see the opportunity and feel responsibility to contribute in this global pandemic to be stopped and collaborate with right partner by augmenting AI to prevent and be ahead of this disease apex.

AI and Healthcare: Best Practices for Better Outcomes, thus igniting the AI in healthcare community is the way to go.

## 2. History of Informed Consent

Everyone feels sad or low sometimes, but these feelings usually pass with a little time. Depression—also called "clinical depression" or a "depressive disorder"—is a mood disorder that causes distressing symptoms that affect how you feel, think, and handle daily activities, such as sleeping, eating, exercising, or working. To be diagnosed with depression, symptoms must be present most of the day, nearly every day for at least 2 to 3 weeks [5].

Depression and anxiety are different types, when they show their signs among people, we can divide them in two different and most common forms, and they are introduced as follows.

### *2.1 Major Depression*

Major depression is having symptoms of depression most of the day, nearly every day for at least 2 weeks that interfere with your ability to work, sleep, study, eat, and enjoy life. An episode can occur only once in a person's lifetime, but more often, a person has several episodes.

### *2.2 Persistent Depression Disorder (Dysthymia)*

Persistent depression disorder is having symptoms of depression that last for at least 2 years. A person diagnosed with this form of depression may have episodes of major depression along with periods of less severe symptoms.

Some forms of depression are slightly different, or they may develop under unique circumstances for each person that may be different from the other one, such as [5]:

- Perinatal Depression: Women with perinatal depression experience full-blown major depression during pregnancy or after delivery (postpartum depression).
- SAD (seasonal affective disorder): SAD is a type of depression that comes and goes with the seasons, typically starting in the late fall and early winter and going away during the spring and summer.
- Psychotic Depression: This type of depression occurs when a person has severe depression plus some form of psychosis, such as having disturbing, false fixed beliefs (delusions) or hearing or seeing upsetting things that others cannot hear or see (hallucinations).

Other examples of depressive disorders include disruptive mood dysregulation disorder (diagnosed in children and adolescents) and premenstrual dysphoric disorder. Depression can also be one phase of bipolar disorder (formerly called manic-depression). But a person with bipolar disorder also experiences extreme high—euphoric or irritable—moods called "mania" or a less severe form called "hypomania".

You can learn more about these disorders on the National NIMH's (Institute of Mental Health) website (www.nimh.nih.gov).

## 3. What Are the Signs and Symptoms of Depression?

Sadness is only one small part of depression and some people with depression may not feel sadness at all. Different people have different symptoms. Some symptoms of depression include:

- Persistent sad, anxious, or "empty" mood;
- Feelings of hopelessness or pessimism;
- Feelings of guilt, worthlessness, or helplessness;
- Loss of interest or pleasure in hobbies or activities;
- Decreased energy, fatigue, or being "slowed down";
- Difficulty in concentrating, remembering, or making decisions;

- Difficulty in sleeping, early-morning awakening, or oversleeping;
- Appetite and/or weight changes;
- Thoughts of death or suicide or suicide attempts;
- Restlessness or irritability;
- Aches or pains, headaches, cramps, or digestive problems without a clear physical cause and/or that do not ease even with treatment.

However, depression and anxiety do not look the same in everyone and it affects different people in different ways. For example [5]:

(1) Women

Women have depression more often than men. Biological, lifecycle, and hormonal factors that are unique to women may be linked to their higher depression rate. Women with depression typically have symptoms of sadness, worthlessness, and guilt.

(2) Men

Men with depression are more likely to be very tired, irritable, and sometimes angry. They may lose interest in work or activities they once enjoyed, have sleep problems, and behave recklessly, including the misuse of drugs or alcohol. Many men do not recognize their depression and fail to seek help.

(3) Older adults

Older adults with depression may have less obvious symptoms, or they may be less likely to admit to feelings of sadness or grief. They are also more likely to have medical conditions, such as heart disease, which may cause or contribute to depression.

(4) Younger children

Younger children with depression may pretend to be sick, refuse to go to school, cling to a parent, or worry that a parent may die.

(5) Older children and teens

Older children and teens with depression may get into trouble at school, sulk, and be irritable. Teens with depression may have symptoms of other disorders, such as anxiety, eating disorders, or substance abuse.

Treatment of depression may differ from one patient to another, depending on the stage they are. In early stage some patients may be treated by means of pharmaceutical approach, which in this case one antidepressant pharma pill does not work for everyone with the same effect and each patient might be recommended different type of medication.

The other procedure or methodology that is suggested namely ECT (electroconvulsive therapy), may possibly work in case of sever or serious depression.

Either way of the above two approaches is very invasive and has their own side effect such as lapse of memory in case of ECT. However, there exist other none-invasive approaches in form of TMS (transcranial magnetic stimulation) or rTMS (repetitive-TMS) that are suggested, and a lot of information can be found on Internet or other references such as the ones by Zohuri and Zadeh [1], Zohuri and McDaniel [6], and Zohuri and Modisette [7].

Please note, although antidepressants can be effective for many people, they may present serious risks to some, especially children, teens, and young adults. Antidepressants may cause some people, especially those who become agitated when they first start taking the medication and before it begins to work, to have suicidal thoughts or make suicide attempts. Anyone taking antidepressants should be monitored closely, especially when they first start taking them. For most people, though, the risks of untreated depression far outweigh those of antidepressant medications when they are used under a doctor's careful supervision.

## 4. AI & OCR (Optical Character Recognition)

One of the capabilities that AI offers through its ML and DL functionality (Fig. 1) that integrated FER (facial expression recognition) and EM (emotion detection) capability can help us to detect human emotions by implementing them.

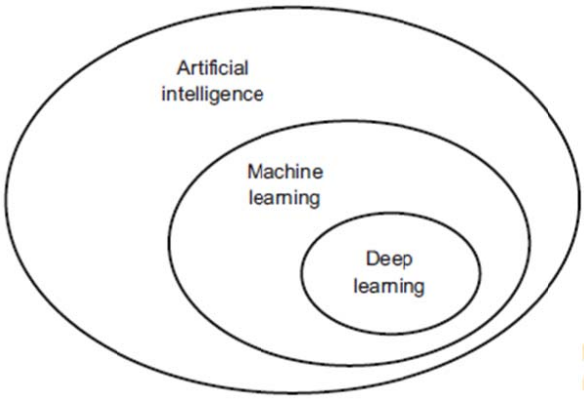


**Fig. 1 AI, ML, and DL at work.**

The feature like FER and EM via AI, ML and DL helps implement happiness meter and build a proper algorithm application for AI/ML/DL that can detect blinking and sleeping. FER detects whether the person appearing in the picture or in a video stream has her eyes open (nearly 100% recognition rate on our internal tests) or whether the person is smiling (92% recognition rate) [8].

Bear in mind that DL is a type of ML technique that teaches computers to perform what comes naturally to humans: learn by example. DL is a key technology behind driverless cars, enabling them to recognize a stop sign, or to distinguish a pedestrian from a lamppost. It is the key to voice control in consumer devices like phones, tablets, TVs, and hands-free speakers. DL is getting lots of attention lately and for good reason. It is achieving results that were not possible before.

Most DL methods use NN (neural network) architectures, which is why DL models are often referred to as DNNs (deep neural networks). This is explained in next section.

The term “deep” usually refers to the number of hidden layers in the NN. Traditional NNs only contain 2-3 hidden layers, while deep networks can have as many as 150.

DL models are trained by using large sets of labeled data and NN architectures that learn features directly from the data without the need for manual feature extraction.

As we have stated before, DL as sub-set of ML per Fig. 1 is a kind or type of ML that trains a computer to perform to certain degrees human-like tasks, such as identifying images according to IP functionality per its algorithm assigned to it or recognizing speech per its VR (voice recognition) capabilities function as well or for that matter organizing data. However, instead of organizing data to run through predefined equations, DL sets up basic parameters about the data and trains the computer to learn on its own by recognizing patterns using many layers of processing.

All the above use cases that DL is involved with are driven by the capabilities of NN augmented with DL as a sum, when NN uses its three classes of ANNs (artificial neural networks) that are recommended by the expert in the field of AI and SAI (super artificial intelligence) and you need to focus on in general. These three classes are defined in Chapter 4 of the paper by Zohuri and Modisette [7], while NN is fully described in same chapter as well.

These three classes are briefly written here, and these use cases are defined accordingly. They are:

(1) MLPs (multilayer perceptrons).

(2) CNNs (convolutional neural networks).

(3) RNNs (recurrent neural networks).

A lot of flexibilities are offered by these three classes of NN and they have proven themselves over decades to be useful and reliable in a wide range of problems. This includes as an appropriate approach driven by NN for your predictive modeling problems.

In summary, a lot of computational power is needed to solve DL problems because of the iterative nature of DL algorithms, their complexity as the number of layers increases, and the large volumes of data are needed to train the networks.

The dynamic nature of DL methods—their ability to continuously improve and adapt to changes in the underlying information pattern—presents a great opportunity to introduce more dynamic behavior into analytics.

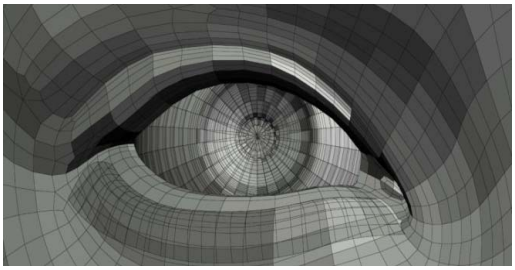

**Fig. 2 Artistic image of combining AI and OCR together.**

Greater personalization of customer analytics is one possibility. Another great opportunity is to improve accuracy and performance in applications where NNs have been used for a long time. Through better algorithms and more computing power, we can add greater depth.

While the current market focus of DL techniques is in applications of cognitive computing, there is also great potential in more traditional analytics applications, for example, time series analysis.

By having such tool in hand, we can intervene any attempt for suicide by early recognition sign of depression and take steps to treat that individual at early stage of depression and anxiety.

Capability of AI driving FER or even VR to realize if someone is happy or sad can be built into some sort of automated process. For example, it can automatically identify subject's gender based on a still image or motion stream or automatically recognize the person's age based on a single still image or a handful of frames from the video stream. Depending on source quality and lighting conditions, error rate is +/- 5 years. Age recognition can be used to track age of your subject of interest.

With a right camera or compatible webcams hand-in-hand with AI, ML and DL would allow us to conduct the IM (image manipulation). This should include a number of functions to load and manipulate images such as .bmp, .jpg, and .png, as well as memory buffers. The library can be used to resample images, rotate, crop, flip, and perform pixel-level editing. The files can be saved into the same format. These features are handy for building imaging applications even if you do not immediately require any facial recognition features.

However, these types of recognitions have to be done with computers that offer a parallel performance with possibly GPU (graphic processing unit) or TPU (tensor processing unit) on top of their normal CPU (central processing units).

In summary, optical character recognition tools (Fig. 2) are undergoing a quiet revolution as ambitious software providers combine OCR with AI. As a consequence, data capturing software is simultaneously capturing information and comprehending the content. In practice this means that AI tools can check for mistakes independent of a human-user providing streamlined fault management.

Combining AI and OCR together is proving to be a winning strategy for both data capture and management.

## 5. Conclusion

Any diversion from anybody's routine and daily life due to any traumatic events, such as natural disaster to man-made one such as war or pandemic virous as severe as COVID-19 that forces society to be locked down, can damage people's mental health. As we have witnessed these days, the CORONA pandemic virous is no difference either. So far, this pandemic virous has brought a worldwide ear of contagion and of loved ones falling sick. Economy has taken it tow in almost every society globally and has brought into even rich countries such as United States of America, United Kingdom, Germany, France etcetera to their knees.

It has created huge uncertainty about every aspect of life. And with a fifth of the world under lockdown or movement restriction, protracted isolation is also bringing loneliness, anxiety and depression.

Quarantines and "social distancing", policy measures needed to slow the spread of the novel coronavirus that causes COVID-19, are against human nature. Touch and social networks are essential for both people and non-human primates: female baboons

that have more grooming partners, or friends, exhibit lower levels of cortisol, a stress hormone [6].

"Awareness of the strain on people's mental health is growing".

Among the population of any society at large, some may be especially worried. Those who have lost their jobs, who now number in the millions, may have lost not just their income, but also their identity, routine and much of their social network, says Jan-Emmanuel De Neve, head of the Wellbeing Research Centre at Oxford University.

"Some are particularly susceptible to stress during a pandemic. Health-care workers are most exposed to the virus. The sense of camaraderie and of being part of a team that is helping people can buoy their spirits. But many doctors and nurses are being forced to isolate themselves away from their families because they may be infectious, which adds to their strains." points out Dhruv Khullar, a doctor in New York [6].

Single person who once whiled away their days with friends, or those who live separately from their partners, suddenly find themselves spending most of their time alone. Many who exercise in teams or groups—or simply enjoy spending time outside—have to do it in cramped living room and online classes.

However, as we stated at the beginning of this article, isolation and loneliness have adverse effects on people and not only create anxiety and depression with any human being, but also enhance any depression among the people who have as early stage of it, who may end up with suicide resulting in particular among youth and youngsters.

Early diagnose of depression sign by friend, family, etc., would allow early referral of the individual to expert for sooner treatment than later.

This is what we are aiming at by utilizing innovative technology such as AI with help from ML and DL elements to augment capabilities of OR (object recognition) or CR. The IR (image recognition) as part of OR and CR process allows studying facial changes to be able to diagnose any sign of any early depression so we can be head of ball.

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