

Investigation of Auto Emotional Detection of Health Professionals Based on Bio Information Data Analytics

Ashish Kumar¹

¹Professor, Computer Science and Engineering,
ITS Engineering College, Greater Noida, India
ashishcse29@gmail.com

Melanie Elizabeth Lourens²

²Deputy Dean Faculty of Management Sciences Durban University of Technology, South Africa.
Melaniel@dut.ac.za

Nitin Tiwari^{3*}

³Assistant Professor, Community Medicine Affiliation- ASMC, Uttar Pradesh, India
doctor4unitin@gmail.com
<https://orcid.org/0000-0002-7321-243X>

Pranav Dass⁴,

⁴Associate Professor and Head, Department of Computer Science and Engineering,
Bharati Vidyapeeth's College of Engineering, Paschim Vihar, Delhi, India
pranav.dass@bharatividyaapeeth.edu

M V Suresh Kumar⁵

⁵Research Scholar Koneru lakshmaiah Education foundation Guntur
advocatesuresh69@gmail.com

Khairul Hafezad Abdullah⁶

⁶Senior Science Officer, Science Laboratory Unit, Department of Academic Affairs, Universiti Teknologi MARA, Perlis Branch, Arau Campus, Malaysia
khairul085@uitm.edu.my
Orcid:0000-0003-3759-6541

Abstract- Emotion detection is an important aspect in healthcare industries. Effective analysis of emotion detection helps in analyses patient's mental state, psychological state, disease progression rate etcetera. Emotion detection is also required for healthcare professionals (doctors and nurses). Automatic emotion detection is usually done with different technologies such as AI technology, multimodal system, pattern recognition, signal analysis, audio-visual analysis etcetera. The present research analyses the most effective technology for auto-emotion detection among all the technologies. The survey-based statistical analysis has been done in this research with 53 participants from different healthcare sectors of the United Kingdom. The data shows that AI-based multimodal system and Pattern recognition using Electrocardiogram and Electroencephalogram are the most effective technologies for automatic-emotion detection. The analysis also showed that emotion-detection is necessary for healthcare professionals and this analysis helps in enhancing patient's recovery rate by analysing their mental state.

Keywords: AI-Based multimodal system, Pattern recognition, Automatic emotion detection, Electrocardiogram, Electroencephalogram

I. INTRODUCTION

Emotions recognition are essential in any work field, especially in the healthcare industry where emotions play a key role in assessing the psychological conditions of patients and medical professionals. Feelings and emotions are the two main keys that control an individual's "state of mind". Maintaining psychological wellbeing is necessary for health workers as their interpersonal emotional distress can worsen the patient's condition. According to Azam and other researchers, emotional distress can be seen in patients with specific diseases such as HIV, coronavirus, malaria, dengue etcetera [1]. Emotional distress sometimes deteriorates the

patient's condition by promoting negative psychological thoughts. Machine learning (ML), neural networks can be used to analyse the emotional change in patients. This is done by implementing different ML models such as "Multinomial naive Bayes or MNB", "MultiLayer perceptron or MLP" etcetera. MLP analysis also helps in achieving optimal accuracy of emotions detection. Automatic recognition of a patient's emotions can also be done through "audio-visual" analysis [2]. Different 2 dimensional and 3 dimensional "convolutional neural network" models are used for the audio-visual analysis.

Emotions detection not only helps healthcare professionals in determining the patient condition, it also helps the stakeholders of the healthcare industry in analysing the level of "patient satisfaction". As per the viewpoint of Wang and Zheng, effective analysis of emotional changes promotes wellbeing and rehabilitation therapy [3]. The

electrooculography signals and expression changes of patients are collected to analyse the emotional distress in patients. In healthcare, it is important to maintain stable emotions to reduce the impact of the disease.

Proper emotional detection helps an individual in determining the mental condition of an individual in absence of proper communication. Emotion recognition is also essential in healthcare professionals as improper analysis of emotional changes can enhance the negative effects of the disease in patients. "Artificial intelligence (AI)" also recognises the emotional changes through analysing the "body language", "gesture" and "voice tone" of patients. According to the studies of Marechal and colleagues, an effective "AI-based multimodal system" can be used to analyse the emotional changes of patients [4]. These can be

done through analysing "texts", "sounds", "emojis", "dialogues" and "videos".

As per the viewpoint of Egger and colleagues, emotional recognition is essential in specific patients who are suffering from psychological distress (such as depression, anxiety and other neurological disorders). Effective emotional recognition can influence their cognitive memories and can boost their well-being. Proper "facial recognition", "speech recognition" and body gesture can be analysed through "electroencephalography", "electromyography" and "bio-signal analysis" [5]. A multimodal system is effective in analysing emotional changes. Bio-information can be analysed through "neural networking", "AI-based multimodal", "CNN", "image recognition", "signal analysis" and "audio-visual analysis". The present research analyses the most effective method from the above-mentioned methods. Survey-based statistical data analysis has been done in this report to describe the importance of these methods in recognising "emotional changes".

II. LITERATURE REVIEW

Neural Networking

Neural networking is essential in analysing the changes in an individual's emotions. Azam and other researchers have used MLP and MLB level neural networking to describe the emotional changes in patients. Their research has been done by collecting bio-information from patients suffering from dengue, malaria, diabetes, cancer, HIV and other diseases.

TABLE I. EMOTION CLASS AND OVERALL DISTRIBUTION

(SOURCE: [5])

Number	Classification	Total count
1	Angry	1542
2	Fear	740
3	Happy	530
4	Excited	1230
5	Sad	350

According to the above data, the number of "Angry" and "excited" emotions have been seen in maximum quantities in these patients. This suggests that the anger and emotional distress have made the patient's condition even worse. Comparatively the number of "Happy" and "sad" emotion classes is low. This describes that extreme emotional distress can reduce the effects of normal emotions such as being happy or being sad.

As per the studies of Hossain and Muhammad, "Edge-cloud based" automation can effectively analyse the expression changes of individuals [6]. This method has been extensively used by healthcare professionals to analyse their facial expressions and emotional changes. "Internet of Things" or IoT is used in these methods to gather patient information. Convolutional Neural Networks can also be used with specific databases such as the "RML database" and the "eNTERFACE'05 database". These databases can effectively capture the "change in emotion" through facial expression, body gestures and eye movements.

AI-Based Multimodal system

These systems are effective in detecting multiple levels of emotions and are more effective than conventional unimodal systems. According to the studies of Abdullah and colleagues, different algorithms such as CNN, DCCN,

LSTM can be used to analyse the expression change and emotional changes [7].

According to the studies of Abdullah and colleagues, different types of algorithms are used in neural networking to analyse emotional change. Their research shows that maximum accuracy can be seen in the "DCCN" database and the accuracy level is approximately 80.5%. In the case of the "ID CNN" database, nearly 1.9% improvement has been observed. This describes that patients have responded to these therapeutic treatments of emotional recognition. Thus neural networking can act as an effective treatment procedure for patients with psychological disorders.

Signal Analysis

This is another method that is used for effective emotion analysis. Signals are usually analysed through body language, posture patterns, different expression levels, facial patterns, verbal language and eye movements. Signals are gathered using "Electroencephalogram", "electrocardiogram", "electromyogram", "rate of respiration" and "skin response" [8]. The body temperature of patients is also analysed to observe the rate of emotional change and physiological change. Multimodal, emotions space model etcetera is effective in analysing the rate of change of emotions of different patients and healthcare professionals. Electroencephalography is an effective method to record the signals generated from patients. The signals from patients are analysed through different graphical formats [9].

Audio-Visual Analysis

This analysis is usually done by analysing the "text", "speech", "emoticons" and "lexicons". The analysis is done by CNN, neural network, algorithm, and different databases [10]. Signal based analysis can also be done here to generate signal graphs. The neural networks, database and algorithms perform effective image recognition to generate different graphs which later are used for expression analysis. The language tone, temperature, sensitivity, speech and communication level of patients are analysed through signal generation. Any abnormal change in expression, speech, eye movement is categorised as "emotional distress". This is effective in recognising the ups and downs of emotions in patients.

The above-mentioned methods are the most effective methods of assessing emotional changes. Auto-emotion detection is an effective process that helps healthcare personnel in analysing the recovery rate of patients. The overall satisfaction level of patients can also be analysed through auto-emotion detection methods.



Fig. 1. Different types of analysis method

(Source: Self developed)

Sensory-based signal analysis

According to the studies by Ayata and colleagues, sensory analysis is another effective method that can determine the change in an individual's emotions. The "Photoplethysmography or PPG" sensor and different fingerprint analysing sensors are used in this case to determine the level of emotional change [11].

As per the viewpoint of Ali and colleagues, "electroencephalogram" is an excellent method to analyse the psychological state of "special-need" patients. The machine effectively gathers signals from the patient's "wavelet energy", "wavelet entropy" and "modified energy" and provides statistical data about the patient's psychological state [12]. Their study proves that signal based analysis is efficient in determining the emotional changes and the physiological changes that occur in accordance with it.

Pattern recognition using "Electroencephalogram" and "Electrocardiogram"

According to the studies by Tivatansakul and other researchers, pattern recognition is one of the important requirements while recognising emotional change. Human nature is prone to hiding interpersonal emotions. This often can be seen in patients with depression and anxiety [13]. Their study shows that an electrocardiogram is efficient in the successful removal of those signals from a facial expression that is false or does not correlate with a patient's internal emotional change. "Electrocardiogram" and "electroencephalogram" are effective in analysing the actual change in patient's "heart rate", "body language", "posture", "voice tone", "facial expression" and "body temperature". Abnormal signal generation from any of these indicates an effective emotional change [14]. Researchers have prioritised this signal generation for determining the emotions in "medical and healthcare professionals" and in patients. Auto emotion detection has proven to improve a patient's psychological state by boosting his or her cognitive mind. This method is highly applicable to patients who are suffering from or have a medical history of psychological disorders. Effective analysis of auto-emotions provides them with a sense of "safety" and "security" [15].

Auto-emotion detection or recognition is an effective way to describe a patient's state. The sudden change of emotion is one of the most effective superficial changes that indicate a patient's deteriorative condition [16]. Auto-emotions detection has a useful approach in healthcare as apart from expressing a patient's psychological state, it also expresses a patient's physiological state. For this reason, Auto-emotion detection has a wide application in the healthcare industry [17].

III. RESEARCH METHODOLOGY

The present research has been done with secondary data analysis by screening articles from different databases. This research paper has considered qualitative method of data collection as it helps to gather theory based information related to study. Data has been gathered from medical and healthcare backgrounds and are also considered healthcare related journals after 2017. Moreover, different keywords are used to search data from various journals. Google scholar, ProQuest and PubMed are used to access articles that are helpful to manage this research concept.

IV. DISCUSSION AND FINDINGS

It has been identified that the most effective technology for auto-emotion detection is "Neural Networking". 10 individuals responded as "AI-based multimodal systems", according to data "signal analysis" is the most effective technology. It can be stated that "AI-based multimodal system" and "Pattern recognition using "Electroencephalogram" and Electrocardiogram" is the most effective technology for auto-emotion detection [18]. Self-report and physiological measurements were taken. Social Signal Interpretation was used to record bio-signal and event data (SSI). SSI is a versatile open-source framework for extracting higher-level information in real-time using on-the-fly signal processing and pattern recognition. A wide range of devices, comprising audio-visual sensory, motion capture suits, data gloves, pressure-sensitive mats, and so on, are provided in addition to physiological sensory. The construction of multimodal database is one of SSI's main responsibilities. To this purpose, SSI allows the creation of complicated multimodal record setups that may be distributed over several workstations in a network, as well as ways to maintain collected data in sync without using time stamps. Users may build up specialised systems for recording and analysing multimodal data using a simple text-based interface that requires no programming knowledge. Hence it can be stated that AI-based multimodal systems and pattern recognition are the two most effective technologies that help in auto-emotion detection [19].

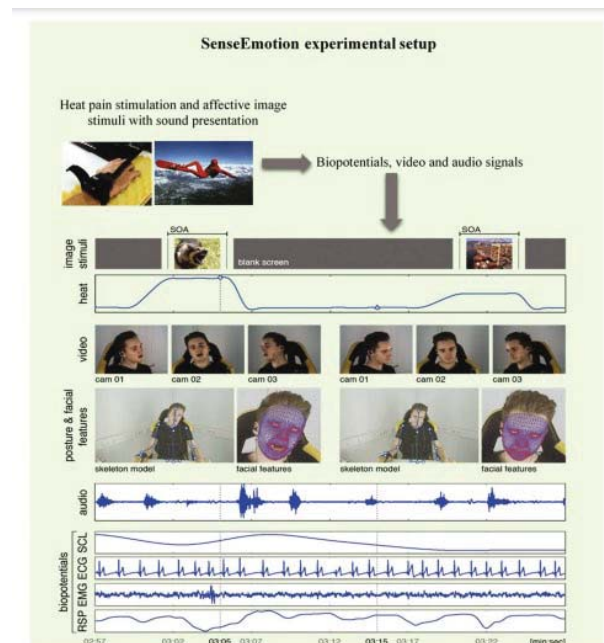


Fig. 2. The major experimental phase and the characteristics that were collected are summarised here.

(Source: [19])

Besides, it can be stated that auto-emotion detection helps patients by providing them with a sense of safety and security. This helps especially in patients with severe psychological disorders such as anxiety, depression etcetera. This "AI-based multimodal system" and "pattern recognition" is suitable as these two systems analyse a patient's temperature, "galvanic skin response", "heart rate", "language tone", speech etcetera [20]. Thus it can be proved

that auto-emotion detection enhances a patient's recovery rate by analysing their mental state [21].

Moreover, it can be stated that automatic emotion detection is necessary for healthcare professionals [22]. The mental state of Healthcare professionals (doctors and nurses) is very important as a poor emotional or mental state of healthcare professionals may negatively affect the patient's recovery [23]. Interpersonal emotional change may affect the professional integrity of healthcare professionals as they are required to analyse the patient's mental state and support them in speedy recovery [24,25,26].

V. CONCLUSION

Auto-emotion detection is necessary for the healthcare industry to maintain professional integrity, stability and patient satisfaction. The "AI-based multimodal system" and "pattern recognition" are the two most useful techniques for auto-emotion detection. These two systems analyse the internal emotional changes of a patient through the change of "heart rate", "body temperature", and "galvanic skin response" [24]. Whereas other systems such as "signal based analysis", "Neural networking", "audio-visual analysis" and "sensory-based signal analysis" do not analyse the internal changes. These systems primarily recognise a patient's mental state by analysing signals from "body language", "facial expression", "eye movement", "posture", "tone of language" and communication ability. These symptoms are effective in analysing the sudden change of emotion which can be used for determining different disease progression rates such as "malaria", "dengue", "HIV", "corona", "cancer" etcetera [25]. However, patients with severe psychological disorders can "hide" their actual superficial emotions. Thus, to analyse a proper mental state, "AI-based multimodal system" and "pattern recognition" are required. Moreover, auto-emotion detection in healthcare professionals enhances a patient's recovery rate. Thus it can be stated that "Automatic detection of emotion" should be necessary for healthcare professionals.

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