



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



The 19th International Conference on Mobile Systems and Pervasive Computing (MobiSPC)
August 9-12, 2022, Niagara Falls, Ontario, Canada

Designing a Tool to Address the Depression of Children During Online Education

Asma Alwadei and Reem Alnanih*

*Department of Computer Science, Faculty of Computing and Information Technology
King Abdulaziz University, Jeddah, Saudi Arabia*

Abstract

Advances in communication and information technology have changed the way humans interact. During the COVID-19 pandemic, the technology for communication has caused depression and anxiety, including among children and teens. Depression among children and teens may go unrecognized and untreated, as parents and teachers may have difficulty recognizing the symptoms. COVID-19 has changed traditional learning methods, forcing children to stay home and connect through online education. Although some children may function reasonably well in less-structured environments, many children with significant depression suffer a noticeable change in social activities, loss of interest in an online school, poor online academic performance, or changes in appearance. Home quarantine has affected children's mental health, and it has become challenging for school counselors to predict depression in many children participating in online education. This study aims to design and develop a tool for predicting depression among children aged 7 to 9 years old by recording students' online classes and sending a note to the child's academic file. The idea of needing this tool arose as an output for applying the design thinking approach to the online education website during COVID-19. This inspired the authors to combine the lecture recordings and the prediction of depression into one tool. Image processing techniques are applied to generate the results predicted by the model on the collected videos. The overall accuracy for classifying depressed and not depressed videos is 89%.

© 2022 The Authors. Published by Elsevier B.V.

This is an open access article under the CC BY-NC-ND license (<https://creativecommons.org/licenses/by-nc-nd/4.0>)
Peer-review under responsibility of the Conference Program Chairs.

Keywords: Child depression; online education; recording a lecture; design thinking; image processing

1. Introduction

Throughout recent history, it has been observed that computer-assisted programs and software solutions are very important, especially in ensuring continuous improvements and innovative alternatives to cater to customers and service providers' needs simultaneously. The design has an excellent opportunity to have value and meaning at the

* Corresponding author. Tel.: +966-6952000 Ext. 27326
E-mail address: ralnanih@kau.edu.sa

heart of the services, co-produced and defined as good examples of the new value co-creation model [1]. Before designing any new intervention system in any sector, the needs of all the stakeholders are not always considered, which results in many software products remaining unused for decades. As such, design thinking is a systematic process for applying human-centered techniques in solving problems via innovation in various fields such as healthcare, education, company services, etc., to ensure need-oriented intervention development [2]. The primary benefit of design thinking approach is that it is a systematic process for prioritizing users' requirements and desires. It meets their challenges and needs by analyzing issues and presenting more effective and comprehensive solutions [3].

Advances in the field of image processing, such as facial detection, have led to the development of effective systems, which prove capable of predicting and detecting emotions from facial images in a simpler way. Image processing is one of the essential domains used in various applications and is mainly employed in medical and detection-related applications. Image processing contains different techniques including feature selection, feature extraction, and classification. The images are captured from the experimental setup, and then features are extracted to aid in decision making [4].

Nowadays, children, especially online-school-age children, are overwhelmingly exposed to psychological problems. Child health studies during COVID-19 showed that the prevalence of depression, anxiety, sleep disorders, and posttraumatic stress symptoms was 29% [5]. The COVID-19 pandemic has affected all age groups due to the spread of the disease and the mutation capabilities of the CoV-SARS virus. Depression, anxiety, and mental illness can be seen more often in individuals during pandemic lockdown times. Similar emotional changes can be felt among school-age children; however, it is important to continue children's education through the use of various remote learning mechanisms. Nevertheless, online learning in the present situation may cause severe damage to students' behaviors, moods, and habits that may lead to acute depression [6].

Depression, anxiety, and frustration are becoming more prevalent among today's youth due to online education. This is substantiated in individuals aged 5 to 24 who account for roughly 13.4 of all comorbid internal health diseases in the USA [7]. Still, because stress has a delayed effect on one's health, it is critical for counsellors and internal health specialists to be able to detect depression and anxiety among school-age children. Studies in Saudi Arabia have demonstrated that anxiety or depression was present among 6.7% of those aged 14 to 25, and 11.3% of children aged 7 to 9 [8]. Although healthcare professionals have the desire to help, many families not pursue treatment for children demonstrating internal difficulties.

This study aims to design and develop a tool for predicting depression among children aged 7 to 9 years old, accompanied by sending a note to the child's academic file for early recognition and better follow-up. In addition, students' classes will be recorded while attending online lectures. We would like to point out that becoming aware of students' need for the proposed tool occurred after applying the design thinking approach to the current online education website used during COVID-19 in Saudi Arabia, which inspired the authors to combine into one tool the recording of lectures and the prediction of depression. The proposed tool was validated and the accuracy result for prediction of depression was satisfactory with 89% accuracy.

The rest of the paper is structured as follows: section 2 highlights the related work; section 3 presents the approach of research designing the tool; sections 4 and 5 present the design and development of the proposed tool, respectively; section 6 displays the result and discussion; and section 7 is the conclusion and future direction.

2. Literature Review

The literature presents the related work from two views: design thinking in mental health and facial expression attributes.

2.1. Design Thinking in Mental Health

One of the most fundamental elements of the design thinking approach is that the design solutions will be produced with the full participation and consideration of the users. Design thinking is applied to healthcare challenges and how the systems utilize this proven and easy problem-solving process. Design thinking has shown new

approaches to complex and continuous healthcare problems through human-centered research, teamwork, and rapid prototyping [9]. The research and experience have confirmed the need to establish a connected health innovation framework using design thinking principles to support software developers with healthcare requirements and extend and enrich traditional software requirements gathering techniques [10]. Mental health service building design was developed by integrating feedback from mental health service users relative to what aspects of the built environments of their care would enhance their service outcomes and experiences, encourage them to avail themselves of services to reduce their willingness to avail themselves of services [11]. In [11] the authors proposed an E-pharmacy described as an online pharmacy service guided by design thinking that aims to enable healthcare professionals to prescribe medications for patients through digital technologies.

2.2. Facial Expression Attributes

Many studies have been conducted to identify the precise facial expressions related to depression. In [12], the authors aimed to determine parents' ability to recognize their children's expressed emotions by accurately observing their facial expressions. The results of that study showed that parents mostly recognize their children's emotions of fear, anger, surprise, disgust, happiness, and sadness, with fear being the best recognized [12]. The study in [13] looked at the coding of fundamental emotions by schoolchildren (happy, surprise, sorrow, and fear) from the perspective of humanistic psychology. The coding competence was investigated in circumstances of "peer communication" in children's groups, in which each preschool child was observed by a peer and interpreted the peer's facial expression. In [13], the emotion recognition system was based on tracking face triangulation points in real-time. Neutral, surprise, anger, happiness, sadness, fear, and disgust facial expressions have been classified and an overall 93% success rate has been obtained when the proposed system is applied on the CAFE set, and 80% during the real-time experiments.

3. Research Study

Design thinking is a methodology that provides a solution-based approach to solving real problems [14]. It consists of five steps: 1) understanding the problem through empathy, 2) defining and clarifying the problem, 3) proposing the best idea to solve the problem, 4) proposing the prototype, and 5) testing the prototype.

First, the researchers conducted a questionnaire distributed to 350 participants. This questionnaire aims to understand the limitations of the existing education platform and extract the need to add features to support online education. The authors received a response from 74.3% of parents of children aged 7 to 9 and 25.7% of teachers on an online education platform. The most needed features are the "record class feature," with about 64% of the parents and 18.6% of the teachers prefer it. Adding the "mental health feature," which aims to help parents and teachers follow up on students' mental state, was preferred by 82% of the parents and teachers. The authors confirmed that adding both features to the online education platform is essential for this output. Second, the following subsections present the requirements and support needed for proposing a tool to record and predict depression for children in an online school.

3.1. Data Collection

The authors performed a questionnaire consisting of three parts to compare the children before and after online studying, with the relationship between depression and studying format, the family factors that affect depression, and the depression prediction levels. Because of the researchers' ease of access in 2021, the sample population was chosen from the Saudi Arabian regions of Asir and Riyadh. Parents of small children in grades 1 and 2 were the intended consumers (7-9 years old). The three sections of the questionnaire were as follows:

Part 1: General information.

Part 2: Child depression related to physical education.

Part 3: Child depression related to online education.

A test questionnaire was reviewed with expert users prior to distribution to ensure that the items were comprehensible. The questionnaire was sent out to family and friends over the internet, and results from the two target regions were gathered. The researchers obtained 843 responses from the Asir and Riyadh regions, and 595 of the participants had children aged 7-9 years; this was the sample taken into account.

3.2. Data Analysis

Regarding the general information part, 53.9% of the 595 parents were between the ages of 31 and 50, 25.4% were between the ages of 41 and 50, 17.5% were between the ages of 20 and 30, and 2.7% were over 50 years old. In terms of region, 60.8% of the 595 participants came from Asir, while 39.2% came from Riyadh. The majority of responders said their children went to kindergarten or preschool, while 16.8% said they did not. Before COVID-19, 33% of participants said their children utilized computer-based activities to supplement their schooling "occasionally," 7.8% said "generally," and 5.9% said "often." However, 23.8% of parents said their children "never" used computer-based activities to supplement their learning.

Regarding parts 2 and 3, child depression in physical and online education is detected through an "Adaptive PHQ-9 International Stander Test [15]. The PHQ-9 test is found to be the standard criteria matching our search requirements with Arab understanding and online learning. Before distributing the questionnaire, a face test was conducted with an expert user to ensure the clarity of the survey. A lot of feedback was received and addressed. Then, the survey was distributed online to family and friends and the responses were extracted and belong to the two regions mentioned above. Table 1 shows the descriptive analysis percentage result for the nine items in physical and online education. The depression scale was designed according to four possible responses [not at all (scale 0), several days (scale 1), more than half the days (scale 2), and nearly every day (scale 3)].

Table 1. Descriptive Percentage of Depression Items Scale for the Physical and Online Education

Items	Physical education scale				Online education scale			
	0	1	2	3	0	1	2	3
1-Your child has little interest in doing their school homework.	21.2 %	43.0 %	18.8 %	17.0 %	27.6 %	44.4 %	15.3 %	12.8 %
2-Your child has trouble falling asleep during school weekdays.	56.5 %	28.9 %	7.2% %	7.4% %	58.3 %	26.4 %	6.9% %	8.4 %
3-Your child feels tired or has low energy while preparing for school.	33.1 %	42.9 %	14.3 %	9.7% %	40.0 %	39.5 %	11.9 %	8.6 %
4-Your child feels a failure in the school environment.	68.9 %	22.2 %	5.9% %	3.0% %	67.1 %	22.4 %	6.1% %	4.5 %
5-Your child's teacher informs you that your child has trouble concentrating on class lessons.	69.6 %	20.5 %	6.9% %	3.0% %	41.5 %	35.6 %	12.9 %	9.9 %
6-Your child thinks of hurting themselves when they meet a problem at his school.	95.0 %	2.9% %	1.3% %	0.8% %	90.9 %	5.2% %	2.4% %	1.5 %
7-Your child feels down when attending school classes.	62.4 %	26.9 %	5.5% %	5.2% %	59.0 %	27.7 %	8.1% %	5.2 %
8-Your child feels bad about their learning on school days.	74.5 %	18.3 %	4.0% %	3.2% %	70.9 %	18.7 %	6.1% %	4.4 %
9-Your child's teacher informed you that your child moves around more than usual during class.	53.3 %	31.1 %	8.1% %	7.6% %	30.1 %	32.9 %	16.0 %	21.0 %

Since the depression scale consists of nine items and four scales, the degrees of depression will range between 0 to 27 degrees, and these degrees have been classified into three levels as follows: no depression (scale ≤ 4), moderate depression ($>5-14$), and severe depression (scale >15) based on Tönnies et al. [16]. Table 2 shows the results of children depression classification levels in physical and online education.

Table 2. Children’s Depression Levels in Physical and Online Education

Level of Depression	Physical education scale		Online education scale	
	Frequency	Percent	Frequency	Percent
No depression.	299	50.3%	253	42.5%
Moderate depression.	264	44.4%	288	48.4%
Severe depression.	32	5.4%	54	9.1%
Total	595	100 %	595	100 %

According to depression level, 50.3% of students between the ages of 7 and 9 do not suffer from depression when they are studying physically by attending school. That same percentage goes down to 42.5% when they attend online school, which clearly shows that while participating in online school, more students have depression in comparison to when physically attending school. It can also be explained in a reverse manner that 57.5% (100-42.5) students are suffering from moderate or severe depression during online learning, however, in physical school, the value is 49.7% for moderate or severely depressed students.

The results clearly show that child depression is higher when attending online virtual school than when studying in physical school. Therefore, it is accurate to say that the percentage of depressed students increases for online school for moderately and severely depressed students. The numeric values are: 48.4% students feel moderate depression during online schooling in comparison to a lower value of 44.4% for physically attending the school, and 9.1% students are suffering from severe depression from online schooling while physical schooling has only 5.4% of severely depressed students.

4. Designing the Proposed Tool

The proposed tool is designed to integrate with the existing online education platform in Saudi Arabia. One of the issues that the authors identified from the online educational website “Madrasty” is that there is no option to record classes and upload them automatically to help students return to them when needed. Also, to predict children’s depression in online education, the authors proposed a feature for mental health to support the online education statutes without affecting students’ focus. The proposed tool aims to record the classes and predict children’s depression while attending their class.

In order to access the tool, the student should create an account with their name, email, grade, and password. The account will then be created, and the student can sign into the site. The researcher at the agreement certifies to use the information only for the mentioned purposes to preserve the confidentiality of the information and to not disclose this information to any other parties or individuals who are not authorized to access it. The student agrees to record the required information only for the mentioned purposes to preserve the confidentiality of the information. Figure 1 shows the course screen that appears to the student. The student chooses one subject to start recording the video, and there is another option to upload the recording video if the tool cannot record directly (Figure 2).

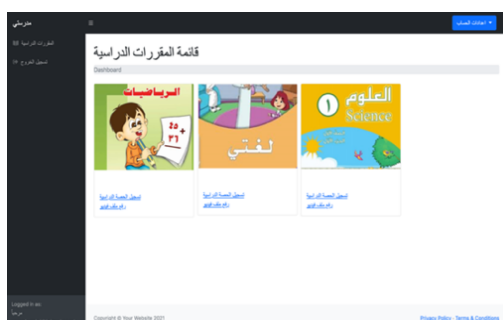


Fig. 1. Courses Screen

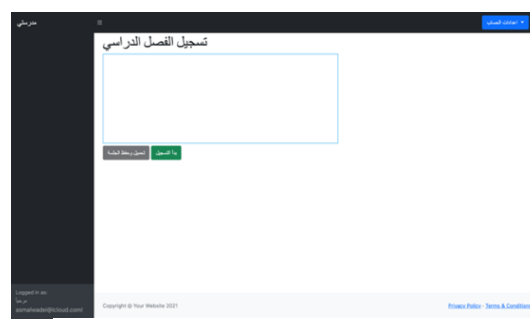


Fig. 2. Recording Screen

5. Developing the proposed Tool

In this study, we developed the dataset for the conducted research. For this purpose, a survey PHQ-9 was provided to the parents of the students involved in the online session. Parents filled out the form and gave their final verdict about the student's depression status. On the other hand, we recorded the student's facial expressions while attending online classes using the recording feature in the proposed tool. The authors received 30 videos recorded by the tool for 30 different children. Out of the 30, 11 videos have been deleted for some issues. The remaining 19 videos were used. Two excel sheets are formed. The first sheet contains the student's name and status of depression according to the PHQ-9 responses from their parents. The second sheet represents the video name and their respective class based on positive and negative emotions. For both sheets, the student with no depression is labeled as 0, the student with depression is labeled as 1, and the empty videos are assigned with a value of -1. The videos are converted into frames and applied the concept of similarity measure points to standardize the number of frames for each video according to the minimum number of frames compared to all videos [17]. Since the smallest video received consisted of 112 frames, the dataset consisted of 2128 frames for the 19 videos. The dataset used the facial expression as an input modality. Table 3 describes the characteristics of our dataset as follows:

Table 3. Characteristics of Collected Dataset

Dataset Name	Number of videos	Number of frames	Number of Participants	Input Modalities	Classification
Children Faces	19 videos	2128 frames (112 from each video)	19 children aged 7-9 years	Facial expression	Depressed Not depressed

5.1. Pre-processing

The pre-processing step can be taken in two different contexts for this research. First is the training of models for identifying a human face in a particular image and classifying it as depressed or normal. This task can be marked as pre-processing for the study as it is the primary functional requirement of the video analysis. For this purpose, the models are trained for identifying the face in the image and then classifying it as depressed or normal. During the training of the Support Vector Machine (SVM) model, normalization, resize, and histogram equalization are applied as pre-processing steps. Second, pre-processing is also applied for video processing and analysis. The primary step taken is the dataset generation for the research. The videos collected for the dataset have been of varying formats, but our proposed model only supports the .mp4 extension for the processing of frames. Therefore, all videos are converted into the desired format using various video tools. Additionally, executing every frame of the video affects the performance of the model, therefore, to reduce the complexity of the current solution, the number of frames is reduced using the technique of frame similarity measures. The frames with similar features have been removed from the analysis and classification process. Moreover, each frame is captured from the video and is converted to an equivalent NumPy array containing the RGB values for every pixel. Aside from this, the grey scaling, normalization, and resize factors are applied to convert the frame image according to the requirement of the pre-trained model.

5.2. Image Acquisition from Video

Up to this stage in the research, we have a set of videos and an excel sheet representing the class for each video. Further, the task is to classify the students in each video as either depressed or normal. To achieve this, we used the concept of capturing frames from each video. Each video is uploaded from the folder and executed frame by frame using the cv2 library. Using the pre-trained models, each frame is first checked for the human image. If the human image exists in multiple frames of the video, the video is classified as non-empty and is passed along for the depression classification. For the depression classification, each frame is tested and classified as depressed or normal. The overall video is then classified based on the most occurring label, however, for the execution of such a nature of code, a

powerful system was required. It is observed that the complexity of the system is increasing due to the presence of an enormous number of frames in a single video. Therefore, to reduce the complexity, the video with the minimum number of frames is selected, and then each video is analyzed for the same number of random frames.

The reduction of frames may cause the loss of important features from the video. To avoid this issue, we have applied the concept of similarity measure points. It is observed that consecutive frames have similar features as expression changes over a span of time, therefore, the same expression is expected in neighboring frames within a threshold value. As such, it is deduced that skipping similar frames cannot cause any loss of necessary features and does not affect the overall accuracy of the model. Furthermore, the smallest video is 112 frames, so the larger videos can be reduced to this number. To extract frames of interest and ignore similar frames, a variable duplication removed was used. The duplication removed value is set to 1 for smaller videos and to 10 for videos larger than 112 frames. This technique results in frame checking of larger videos by skipping the intermediate 10 frames each. For instance, the model is applied on the first frame, then on the tenth frame, followed by the twentieth frame, and so on until the maximum number of frames is reached.

6. Results and Discussion

Each video in the set is analyzed and labeled with the same labels as in the initial excel sheet, e.g., empty is labeled as -1, depressed as 1, and not depressed as 0. All the predicted results are stored in an auto-generated excel sheet with video names and predicted results. The videos from 19 different students were taken for analysis. Each frame of every video was examined based on depression determined as depressed or not (1 or 0). Overall, 2128 frames of the videos were considered.

Table 4 presents the overall confusion matrix of the classification of the frames into depressed and not depressed. The diagonal and off-diagonal elements of the confusion matrix represent successful and unsuccessful detection of the depression. Around 336 of the set were classified as depressed and are correctly classified. On the other hand, 1568 of the sample were classified as not depressed and are correctly classified. Two hundred twenty-four frames are classified as depressed incorrectly. According to (1), It can be observed that the proposed tool was able to differentiate the depressed cases from those not depressed with an accuracy of 89.47%.

Table 4. Classification of Frames as Depressed or Not

Actual Label		Predicted Label	
		Depressed (Positive)	Not Depressed (Negative)
Depressed (True)	Depressed (True)	336	0
	Not Depressed (False)	224	1568

$$Accuracy = (TruePositive + FalseNegative) / (TruePositive + FalsePositive + FalseNegative + TrueNegative) \quad (1)$$

Table 5 represents the results for the classification of 19 videos for 19 children into depressed and not depressed. Each video/session contains 112 frames. If the video has more than the half of depressed frames it classified as depressed video. The results show that most predicted labels match the actual labels except for two videos/sessions that are not depressed but are classified as depressed. It can be observed that the proposed tool was able to differentiate the depressed videos from those not depressed with an accuracy of 89.47 % which is related to the accuracy of frames.

Table 5. Classification of Videos as Depressed or Not

Actual Label		Predicted Label	
		Depressed (Positive)	Not Depressed (Negative)
Depressed (True)	Depressed (True)	3	0
	Not Depressed (False)	2	14

7. Conclusion

The COVID-19 pandemic has caused an increased focus on individuals' mental health. Nowadays, depression, anxiety, stress, and other psychological disorders have increasing footprints among youngsters and children in their online Education. In this paper, the authors proposed a tool integrated into the online education platform as a solution to students challenges during attending online school. The proposed tool helps the counselors discover students' mental health issues from the beginning stages and inform the child's parents and instructors. The idea of integrating the tool arises from applying the design thinking approach. The benefits of the proposed tool are to predict children's depression aged 7-9 years old as a result of attending online school and add the important functions that support the online educational platform, such as recording the classes. The data set consists of 2128 frames collected from 19 videos. The accuracy result for classifying of depressed and not depressed faces is 89%.

The limited corporations to record videos from parents was one of an obstacle during this research. We hope to classify depression according to emotion type in future works and include a large sample size. Also, we hope to collect more videos for the same ages for both learning styles and test their validity in school education.

References

- [1] K. Freire and D. Sangiorgi, "Service design & healthcare innovation : from consumption to co- production and co-creation," *ServDes. 2010 Second Nord. Conf. Serv. Des. Serv. Innov.*, no. 1993, 2010.
- [2] M. Altman, T. T. K. Huang, and J. Y. Breland, "Design thinking in health care," *Prev. Chronic Dis.*, vol. 15, no. 9, 2018, doi: 10.5888/pcd15.180128.
- [3] H. Scholten and I. Granic, "Use of the principles of design thinking to address limitations of digital mental health interventions for youth: Viewpoint," *J. Med. Internet Res.*, vol. 21, no. 1, 2019, doi: 10.2196/11528.
- [4] D. Venkataraman and N. S. Parameswaran, "Extraction of Facial Features for Depression Detection among Students." [Online]. Available: <http://www.ijpam.eu>.
- [5] L. Ma et al., "Prevalence of mental health problems among children and adolescents during the COVID-19 pandemic: A systematic review and meta-analysis," *Journal of Affective Disorders*, vol. 293. 2021, doi: 10.1016/j.jad.2021.06.021.
- [6] O. Abou Abbas and F. AlBuhairan, "Predictors of adolescents' mental health problems in Saudi Arabia: Findings from the Jeeluna® national study," *Child Adolesc. Psychiatry Ment. Health*, vol. 11, no. 1, 2017, doi: 10.1186/s13034-017-0188-x.
- [7] T. Brown, "Deisign thinking," *Harv. Bus. Rev.*, vol. 86, no. 6, 2008, doi: 10.1002/med.
- [8] Q. Zhang, Q. Zhang, Y. Gan, R. Wang, and Y. A. Tan, "A Dynamic and Cross-Domain Authentication Asymmetric Group Key Agreement in Telemedicine Application," *IEEE Access*, vol. 6, 2018, doi: 10.1109/ACCESS.2018.2799007.
- [9] S. Liddicoat, "Mental health facility codesign: A new research method for integrating the service user voice in design processes using virtual reality," *Gen. Psychiatry*, vol. 32, no. 3, 2019, doi: 10.1136/gpsych-2019-100061.
- [10] N. Carroll and I. Richardson, "Aligning healthcare innovation and software requirements through design thinking," 2016, doi: 10.1145/2897683.2897687.
- [11] K. Margolis, K. Kelsay, A. Talmi, H. McMillan, M. C. Fraley, and J. F. F. Thomas, "A Multidisciplinary, Team-Based Teleconsultation Approach to Enhance Child Mental Health Services in Rural Pediatrics," *J. Educ. Psychol. Consult.*, vol. 28, no. 3, 2018, doi: 10.1080/10474412.2018.1431549.
- [12] K. Tung, P. K. Liu, Y. C. Chuang, S. H. Wang, and A. Y. Wu, "Entropy-assisted multi-modal emotion recognition framework based on physiological signals," 2019, doi: 10.1109/IECBES.2018.8626634.
- [13] S. Collishaw, "Annual research review: Secular trends in child and adolescent mental health," *J. Child Psychol. Psychiatry Allied Discip.*, vol. 56, no. 3, 2015, doi: 10.1111/jcpp.12372.
- [14] P. Newman, M. A. Ferrario, W. Simm, S. Forshaw, A. Friday, and J. Whittle, "The Role of Design Thinking and Physical Prototyping in Social Software Engineering," in *Proceedings - International Conference on Software Engineering*, 2015, vol. 2, doi: 10.1109/ICSE.2015.181.
- [15] M. L. Belfer, "Child and adolescent mental disorders: The magnitude of the problem across the globe," *J. Child Psychol. Psychiatry Allied Discip.*, vol. 49, no. 3, 2008, doi: 10.1111/j.1469-7610.2007.01855.x.
- [16] J. Tönnies et al., "Mental health specialist video consultations for patients with depression or anxiety disorders in primary care: Protocol for a randomised controlled feasibility trial," *BMJ Open*, vol. 9, no. 9, 2019, doi: 10.1136/bmjopen-2019-030003.
- [17] Y. S. Lin, J. Y. Jiang, and S. J. Lee, "A similarity measure for text classification and clustering," *IEEE Trans. Knowl. Data Eng.*, vol. 26, no. 7, 2014, doi: 10.1109/TKDE.2013.19.