Development of Information System for Monitoring the Emotional State of a Student with Special Needs

Olesia Yaloveha[1], Vasyl Andrunyk[2]

Lviv Polytechnic National University, Lviv, Ukraine

olesia.yaloveha.kn.2016@lpnu.ua[1],
vasyl.a.andrunyk@lpnu.ua[2]

Abstract. This article is an overview of a practical implementation of monitoring the emotional state of a student with special needs. In this article, we present an in-depth review of current technologies for detecting human emotions. The purpose of this work is to create an AI system to help teachers and psychologists to observe children with special needs while they are learning or passing tests. The object is the methods and tools for emotion recognition. This system is designed to solve the problems of recognizing the emotional state of the student and helping him to properly respond to the emotional manifestations of other people. The subject of this system are processes of activity of this AI. We conclude the investigation by highlighting the aspects that require further research and development.

Keywords: Information System, Emotion, Recognition, Artificial Intelligence.

1   Introduction

Emotions are an important component of human communication and interaction. We often rely on them both in everyday life and in unusual situations. They can be expressed in various ways: facial expressions, posture, movements, voice, body response (heart rate, blood pressure, respiratory rate). However, the best reference is the human face [1-3]. There is a false statement that people with different nosologies are people who have an emotional deficit. As an example, many people with autism simply do not express emotions in the way that average people show them. That is, the idea that people with autism tend to lack empathy and cannot recognize their feelings is wrong [4].

The founder of the science of emotions and their recognition is the American psychologist Paul Ekman. He defined the classification of basic emotions of man, which are still guided in the 70's of the last century. This includes six emotions: anger, disgust, fear, happiness, sadness and surprise[5-6].

A global breakthrough in the development of emotion recognition technology has come not too long ago. He has created various applications and algorithms that can

184

determine the emotional state of the user. For example, the Text Analytics API is one of the Microsoft Cognitive Services, which allows developers to embed ready-made "smart" algorithms into their products. Already existing software tools often work with neural networks in real time. This allows us to apply software in various areas of our lives and thus actively influence its quality[7-8].

Today, less attention is given to identifying the emotions that children with ASD exhibit than their ability to recognize other people's facial expressions. This aspect is important for the productive and fruitful learning of children with special needs, because if interpreted emotionally correctly, it will help to modernize the learning process according to the needs of the students. The use of emotion recognition technology can make this process quite significant [9-14].

2   Description of the System

The purpose of this study is to identify the emotional state of the student as they pass lessons/tests to correct further treatment. Because inclusive classes only have a teacher and a teaching assistant, it is impossible for them to concentrate their full attention on one student, even if there are only two students. As children with special needs are very sensitive to the environment, they immediately notice changes in attitudes of adults [15]. It is also impossible to just send a few people out to track the emotional state of the students because the children simply will not allow strangers to be near them and it will take a long time to earn the trust of the children. Therefore, a system for detecting a student's condition during the lessons/tests will be perhaps the best alternative to the observation. The student will not even notice that his or her condition is being analyzed in order to further provide the collected information to the teacher and the PMPI for analysis and processing, according to which the curriculum will be adjusted individually for each student [16]. Instead, the system will teach the child to correctly recognize the emotional state of others and to respond appropriately to it. The main sections of the lessons will be the "Introduction", which includes introducing yourself and exploring yourself (self-identification), the "Main Part", in which the child will become acquainted with feelings and emotions, and the "Conclusion" in which the child can learn to distinguish friendship and love [17].

The main functionality includes:

- Introducing children to emotions: anger, disgust, fear, happiness, sadness, surprise.
- Enriching the emotional sphere, improving the emotional state of children.
- Responding to negative emotions that interfere with the proper personal growth of the child.
- Reducing anxiety, overcoming fears.
- Learning to recognize the emotional manifestations of other people on various grounds (facial expressions, voice, body movements, etc.) [18].

For a comprehensive picture of the essence of the system under study, we depict a tree of goals.
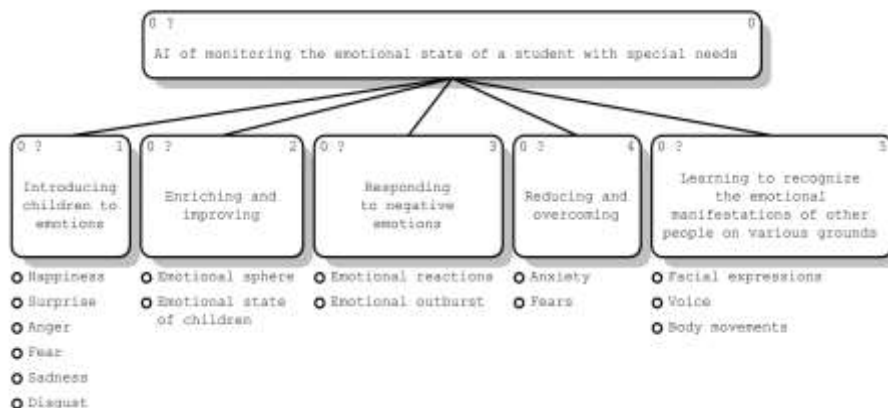
Fig. 1. Goal tree

There is a wide variety of methods for creating process diagrams. It was decided to use a data flow diagram (DFD) to describe this system, as it would be most convenient to depict the processes, relationships, and interactions between them.

The entity of "Student with special needs" - in this case, is a child with ASD who needs help in expressing emotions to facilitate the learning process.

The entity of Teacher is important for controlling the learning process. It receives definitive recommendations from the system for further work and the direction in which it is necessary to promote further learning.

The entity of "PMPI" is a psychological, medical and pedagogical institution, that is, an organization comprising specialists of medical, pedagogical and psychological profile. The main task of the commission is to identify the causes of problems in the child's education and to recommend him an educational program that he can successfully master.
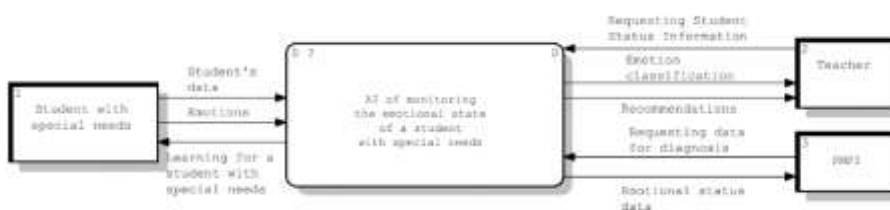

Fig. 2. Contextual diagram of data flows

In order to describe the next level of DFD, you have to decompose the main process into five others. These will include the following processes: "Download video with emotions", "Set options for learning neural network", "Analyze images using a neural network", "Get emotional statistics", "Provide guidance on learning through AI". For

186

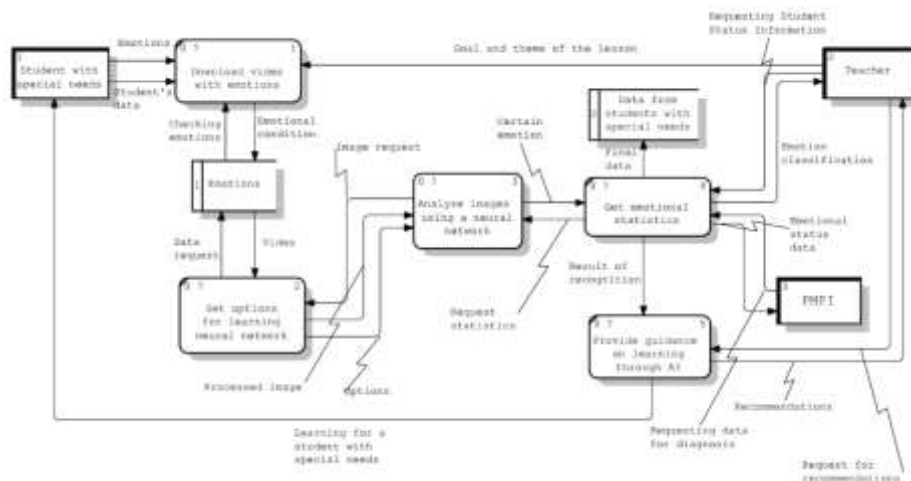reliable implementation, we also have to add two databases: "Emotions", "Data from students with special needs".

Fig. 3. DFD1

3   Conclusions

As a result of this review article, a preliminary version of a programmatic implementation of monitoring the emotional state of a student with special needs was created. After proceeding a detailed analysis, we can conclude that after successfully completing the course with this program children`s the level of anxiety, aggression and fear should significantly reduce. They would become more calm, balanced, confident in themselves, "appeasable" on the lessons of other professionals (speech therapists, teachers) and less conflict with other children. It should be noted that in similar studies, parents note a qualitative improvement in children's communication skills, their greater openness to social contact. Given the recent progress in predictive psychiatry, adequately applied AI offers the possibility of fully grasping the complexity of emotional learning assistance, with particular emphasis on spontaneous nonverbal behavior during social gatherings with the others. It is important to recognize that we are now in a time where knowledge about AI, VR, AR and MR is "in-change". Any curriculum or professional knowledge of teachers regarding the technical, social and ethical aspects of technology should be updated regularly (possibly annually) [31-32].

Reference

1. Изард, К.Э. Психология эмоций /К.Э. Изард. — Санкт-Петербург: 1999. — 464 с.

2. Лабунская, В.А. Экспрессия человека: общение и межличностное познание /В.А. Лабунская. — Ростов-на-Дону: Феникс, 1999. — 608 с.

3. Компетентность в общении : социально-психологический тренинг / Л.А. Петровская. – Москва : Издательство Московского университета, 1989. – 216 с.

4. Обратная связь в межличностном общении // Вестн. Моск. ун-та. Сер. 14. Психология. 1982. N 3. - С. 9 - 18. (В соавторстве с Л.А. Петровской).

5. Экман П. Психология лжи / Пер. с англ. Н. Исуповой, Н. Мальгиной, Н. Миронова, О. Тереховой. — СПб.: Питер, 1999). — 270 с.

6. Ecman P. Friesen W.V. Differential communication of affect by head and body cues.// Journal of personality and social psychology. 1965. Vol. 2.

7. Ecman P. Friesen W.V. Nonverbal Leakage and Clues to Deception. / Psychiatry. 1969. Vol.32. 88-106.

8. Ecman P. Friesen W.V. Detecting Deception from the Body or Face.// Journal of personality and social psychology. 1974. Vol. 29. 288-298.

9. Захаров А.И. Дневные и ночные страхи у детей. - СПб, 2010 г.

10. Заморев СИ. Игровая терапия. Совсем не детские проблемы. СПб., Речь, 2002 г.

11. Киселева М.В. Арт-терапия в работе с детьми. – СПб, 2006 г.

12. Костина М.М. Игровая терапия с тревожными детьми. СПб., Речь, 2000 г.

13. Калинина Р. Р. Тренинг развития личности дошкольника, СПб. Речь. 2001 г.

14. Кряжева И. Л. Развитие эмоционального мира детей, Ярославль, Академия развития, 1997 г.

15. Андруник, В. А., Шестакевич, Т. В., Пасічник, В. В., & Кунанець, Н. Е. (2018). Інформаційні технології навчання учнів з АСД. Вісник Національного університету Львівська політехніка. Інформаційні системи та мережі, (901), 76-88.

16. Орехова О. А. Цветовая диагностика эмоций ребенка. СПб. Речь. 2002 г.

17. González Hernández, Francisco & Zatarain Cabada, Ramón & Barron Estrada, Maria & Rodriguez Rangel, Hector. (2018). Recognition of learning-centered emotions using a convolutional neural network. Journal of Intelligent & Fuzzy Systems. 34. 3325-3336. 10.3233/JIFS-169514.

18. Мамайчук, И. И. Психокоррекционные технологии для детей с проблемами в развитии : учебное пособие для вузов / И. И. Мамайчук. — 2-е изд., испр. и доп. — Москва : Издательство Юрайт, 2019. — 318 с. — (Бакалавр. Академический курс). — ISBN 978-5-534-10042-6. — Текст : электронный // ЭБС Юрайт. — URL: https://urait.ru/bcode/429159.

19. K. Kostolányová, E-learning Form of Adaptive Instruction. Proceedings of the 9th International Scientific Conference on Distance Learning in Applied Informatics (DIVAI 2012). Nitra: Faculty of Natural Sciences Constantine the Philosopher University in Nitra, 2012, 193-201.

20. S. Anwar, M. Milanova, Real Time Face Expression Recognition of Children with Autism. Department of Computer University of Arkansas at Little Rock, Arkansas, USA. – 2016, 7 p.

21. AllFusion Process Modeler 7 (BPwin). Средство функционального моделирования бизнес-процессов. – Режим доступу: http://www.interface.ru/home.asp?artId=102.

22. Y. Chen, R. Hwang, C. Wang, Development and evaluation of a web 2.0 annotation system as a learning tool in an e-learning environment, Computers and Education, 58(4), 2011, p. 1094-1105.

188

23. K. Bahreini, R. Nadolski, & W. Westera, Towards multimodal emotion recognition in e-learning environments. Interactive Learning Environments, no. Ahead-of-print, 2014, p. 1-16.

24. Feidakis, M.; Daradoumis, T.; Caballe, S. Emotion Measurement in Intelligent Tutoring Systems: What, When and How to Measure. In Proceedings of the 2011 Third International Conference on Intelligent Networking and Collaborative Systems, IEEE, Fukuoka, Japan, 30 November–2 December 2011; pp. 807–812.

25. K. Bahreini, R. Nadolski, & W. Westera, Towards multimodal emotion recognition in e-learning environments. Interactive Learning Environments, no. Ahead-of-print, 2014, p. 1-16.

26. Leo, M.; Carcagnì, P.; Distante, C.; Spagnolo, P.; Mazzeo, P.L.; Rosato, A.C.; Petrocchi, S.; Pellegrino, C.; Levante, A.; De Lumè, F.; Lecciso, F. Computational Assessment of Facial Expression Production in ASD Children. Sensors 2018, 18, 3993.

27. Csikszentmihalyi, M. Flow and the Foundations of Positive Psychology: The collected works of Mihaly Csikszentmihalyi. – Springer: Dordrecht, The Netherlands, 2014.

28. Southgate, E., Blackmore, K., Pieschl, S., Grimes, S., McGuire, J. & Smithers, K. (2018). Artificial intelligence and emerging technologies (virtual, augmented and mixed reality) in schools: A research report. Newcastle: University of Newcastle, Australia.

29. Emotion Recognition from Facial Expression Using Deep Convolutional Neural Network. D Liliana - Journal Of Physics: Conference Series - 2019

30. Kathrin Kaulard, Douglas W. Cunningham, Heinrich H. Bülthoff, Christian Wallraven. PLoS One. 2012; 7(3): e32321

31. Grossard, C., Dapogny, A., Cohen, D. et al. Children with autism spectrum disorder produce more ambiguous and less socially meaningful facial expressions: an experimental study using random forest classifiers. – Molecular Autism, 2020. – 14 p.

32. Itsquiz. "Artificial Intelligence in Special Education." Medium, Medium, 5 July 2016, medium.com / @itsquiz15 / artificial- intelligence- in- special- education- dab 27649b9b6.

33. Zdebskyi, P., Vysotska, V., Peleshchak, R., Peleshchak, I., Demchuk, A., Krylyshyn, M.: An Application Development for Recognizing of View in Order to Control the Mouse Pointer. In: CEUR Workshop Proceedings, Vol-2386, 55-74. (2019)

34. Dilai, M., Onukevych, Y., Dilay, I.: Sentiment Analysis of the US and Ukrainian Presidential Speeches. In: Computational Linguistics and Intelligent Systems, COLINS, 2, 60-70. (2018)

35. Берко, А.Ю. Intranet архітектура інтелектуальних систем електронного навчання / А.Ю. Берко, В.А. Висоцька // Інформаційні системи та мережі. Вісник Національного університету "Львівська політехніка". – Львів 2001. - № 438. – Стор.3-10.

36. Інтерактивна взаємодія та зворотній зв'язок в системі дистанційного навчання / Р.О. Голощук, В.А. Висоцька // Інформаційні системи та мережі. Вісник Національного університету "Львівська політехніка". – Львів 2002. – № 464. – Стор.44-53.

37. Висоцька, В.А. Система опрацювання структури електронного підручника / В.А. Висоцька // Інформаційні системи та мережі. Вісник Національного університету "Львівська політехніка". – Львів 2003. – № 489. – Стор.49-63.

38. Голощук, Р.О. Математичне моделювання процесів дистанційного навчання / Р.О. Голощук, В.В. Литвин, Л.В. Чирун, В.А. Висоцька // Інформаційні системи та мережі. Вісник Національного університету "Львівська політехніка". – Львів 2003. – № 489. – Стор.100-109.

39. Шаховська Н.Б. Методи та засоби дистанційної освіти для заохочення і залучення сучасної молоді до проведення самостійних наукових досліджень / Н.Б Шаховська.,

В.А. Висоцька, Л.В. Чирун // Інформаційні системи та мережі. Вісник Національного університету "Львівська політехніка". – № 832. – Львів, 2015. – Стор. 254-284.

40. Shakhovska Natalya. Intelligent Systems Design of Distance Learning Realization for Modern Youth Promotion and Involvement in Independent Scientific Researches / Natalya Shakhovska, Victoria Vysotska, Lyubomyr Chyrun // Advances in Intelligent Systems and Computing. Advances in Intelligent Systems and Computing 512. Natalya Shakhovska Editor. Selected Papers from the International Conference on Computer Science and Information Technologies, CSIT 2016, September 6–10 Lviv, Ukraine. – ISSN 2194-5357 ISSN 2194-5365 (electronic). - ISBN 978-3-319-45990-5 ISBN 978-3-319-45991-2 (eBook). - DOI 10.1007/978-3-319-45991-2. - Library of Congress Control Number: 2016950408. - Springer International Publishing AG 2017. - PP. 175-198.. – Access mode: http://www.springer.com/us/book/9783319459905.

41. Lytvyn Vasyl. Distance Learning Method for Modern Youth Promotion and Involvement in Independent Scientific Researches / Vasyl Lytvyn, Victoria Vysotska, Liliya Chyrun, Lyubomyr Chyrun // DATA STREAM MINING & PROCESSING. Proceedings of the 2016 IEEE First International Conference on Data Stream Mining & Processing (DSMP). – August 23-27, 2016. – Lviv, Ukraine. – PP. 269-274.

42. Antonii Rzheuskyi, Orest Kutyuk, Victoria Vysotska, Yevhen Burov, Vasyl Lytvyn, Lyubomyr Chyrun. The Architecture of Distant Competencies Analyzing System for IT Recruitment // 2019 IEEE 14th International Scientific and Technical Conference on Computer Science and Information Nechnologies (CSIT'2019) : proceedings. – Volume 3. – 17-20 September 2019, Lviv, Ukraine. – PP. 254-261.

43. Shakhovska, N., Vovk, O., Hasko, R., Kryvenchuk, Y.: The method of big data processing for distance educational system. In: Advances in Intelligent Systems and Computing, 689, 461-473. (2018)

44. Rzheuskyi, A., Kutyuk, O., Voloshyn, O., Kowalska-Styczen, A., Voloshyn, V., Chyrun, L., Chyrun, S., Peleshko, D., Rak, T.: The Intellectual System Development of Distant Competencies Analyzing for IT Recruitment. In: Advances in Intelligent Systems and Computing IV, Springer, Cham, 1080, 696-720. (2020)

45. Shakhovska, N., Vysotska, V., Chyrun, L.: Features of E-Learning Realization Using Virtual Research Laboratory. In: Proceedings of the International Conference on Computer Sciences and Information Technologies, CSIT, 143–148. (2016)

46. Antonii Rzheuskyi, Orest Kutyuk, Victoria Vysotska, Yevhen Burov, Vasyl Lytvyn, Lyubomyr Chyrun. The Architecture of Distant Competencies Analyzing System for IT Recruitment // 2019 IEEE 14th International Scientific and Technical Conference on Computer Science and Information Nechnologies (CSIT'2019) : proceedings. – Volume 3. – 17-20 September 2019, Lviv, Ukraine. – PP. 254-261.

47. Chyrun L., Leshchynskyy E., Lytvyn V., Rzheuskyi A., Vysotska V., Borzov Y. Intellectual analysis of making decisions tree in information systems of screening observation for immunological patients // CEUR Workshop Proceedings. – 2019. – Vol. 2488. Proceedings of the 2nd International workshop on informatics & data-driven medicine IDDM 2019 (Lviv, Ukraine, November 11-13, 2019). Vol. 1. – P. 281–296.

48. Odrekhivskyy, M., Pasichnyk, V., Rzheuskyi, A., Andrunyk, V., Nazaruk, M., Kunanets, O., Tabachyshyn, D.: Problems of the Intelligent Virtual Learning Environment Development. In: CEUR Workshop Proceedings, Vol-2386, 359-369. (2019)

49. Golovko, V., Savitsky, Y., Laopoulos, T., Sachenko, A., Grandinetti, L.: Technique of learning rate estimation for efficient training of MLP. In: Neural Networks, IJCNN, 323-328. (2000)