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A Review on a Facial and Vocal Expression Based Machine Learning Framework for Real-Time Student Stress Monitoring in an IoT-Fog-Cloud Environment

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ABSTRACT: Everybody encounters demands and challenges from time to time, and the body's natural response to these is stress. Although short-term stress usually has no negative effects on health, persistent stress can cause considerable negative physiological and behavioural consequences. It can be difficult to deal with the impacts of stress, and in this situation, stress evaluation is crucial to avoiding negative long-term effects. The widespread acceptance of Internet of Things (IoT) connected wearables, in order to forecast student stress index in a specific situation, the research provides a unique, IoT-aware architecture for real-time alarm generation and student-centric stress monitoring. Bidirectional Long Short Term and Extended VGG16, respectively, were used in the elaboration. To create the scores of emotions from student facial expressions, speech pitch, and content at the cloud layer, memory network (Bi-LSTM), and Multinomial Nave Bayes algorithms were used. According to the overall emotion of the students' physiological data readings, the model specifically seeks to categorise stress situations as normal or abnormal. When negative emotions like tension, anxiety, sadness, and disgust reach higher levels, the abnormal event is activated, and the student, coordinators, and caregivers are given a severe warning. In the end, the suggested framework will be a fantastic tool for assisting educational institutions, students, and their parents and guardians in receiving real-time alerts on students' overall moods. The student's prior understanding of the stress that has built up in their minds will aid in conquering the key issues of student dropout, decreased academic performance, and the stress condition that could result in a suicide attempt.

KEYWORDS: Internet of Things (IoT), Real-Time Alert, Emotion Analysis, Facial Emotions, Vocal Emotions, Machine Learning.

I. INTRODUCTION

The development of ICT (Information, Communication, and Technology) and other related fields around the world has a direct impact on education. The new educational connotation known as "education technology" has been created as a result of the technology's integration with pedagogy, learning, and teaching in education. It has been noted that in the present era of technology, both teachers and students have over-relied on it to achieve their objectives for successful learning. Additionally, the adoption of modern teaching pedagogies like blended learning and flipped learning (classrooms) in the field of education has demonstrated convincing evidence of forward-thinking innovations in that field.

It is impossible to dispute the existence of negative outcomes and their formation as a result of numerous extrinsic and intrinsic causes given the testimonies of educational teaching and learning evolution and development. The overabundance of stress (and other adverse emotions) among those involved in educational activities is one of the key problems that has arisen with the ongoing improvement of education and its methodology [14]. The physical and mental health of the students is negatively affected in a variety of ways by stress (or other unpleasant emotions). It leads to problems such as depression, anxiety, eating disorders, sleeplessness, poor academic performance, scenarios involving dropouts, or even suicidal thoughts, especially among students. By observing physiological and physical changes in a person, such as changes in heart rate, voice attenuation, and body temperature, stress can be assessed using computer-based non-invasive techniques.

Health care, automation systems, transportation services, and other industries are all benefiting from the recent improvement in IoT-based applications. Fog computing's assistance with IoT makes it a potent tool for quick and efficient response paradigms, particularly in the case of emergency services. Low latency, location awareness, quality of service assurance, real-time analysis, and alarm generating are just a few benefits of fog computing. As shown, the IoT-Fog computing framework is composed of three layers. The IoT layer makes it possible for end users to retrieve data from physical objects. In our instance, the main data sources would be cameras, smartphones, and microphones.

II. RELATED WORK

B. Bruggeman, J. Tondeur, K. Struyven, B. Pynoo, A. Garone, and S. Vanslambrouck, "Experts speaking: Crucial teacher attributes for implementing blended learning in higher education," *Internet Higher Educ.*, vol. 48, Jan. 2021, Art. no. 100772.

Even while satisfying students' requirements for flexibility is one of the reasons blended learning in higher education is valued, putting it into practise is still a difficult task. Since teachers are at the centre of any process for transforming education, the current qualitative study examines critical teacher characteristics from the viewpoint of experts in order to implement blended learning.

R. A. Rasheed, A. Kamsin, and N. A. Abdullah, "Challenges in the online component of blended learning: A systematic review," *Comput. Educ.*, vol. 144, Jan. 2020, Art. no. 103701.

This study includes a methodical literature analysis that reveals the current difficulties in the online component of blended learning from the perspectives of students, teachers, and institutions. Despite the depth of our research base, it is very difficult to pinpoint every issue because of the quick progress of technical breakthroughs and the complexity of human behaviour. We talked about the idea of blended learning and its advantages over other similar teaching strategies.

M. Bond, "Facilitating student engagement through the flipped learning approach in K-12: A systematic review," *Comput. Educ.*, vol. 151, Jul. 2020, Art. no. 103819.

According to this review, the vast majority of studies found evidence of at least one positive engagement factor, with the use of social learning management systems and collaborative tools like Google Docs having a positive impact on peer learning and teaching, learning enjoyment, and peer and student-teacher relationships (e.g. Google Classroom and Edmodo).

A.-J. Moreno-Guerrero, R. Soler-Costa, J.-A. Marín-Marín, and J. López-Belmonte, "Flipped learning and good teaching practices in secondary education," *Comunicar*, vol. 29, no. 68, pp. 107–117, Jul. 2021.

In summary, 43.48 percent of CSE teachers have received the necessary training to establish effective teaching methods involving the use of flipped learning in teaching and learning processes. Additionally, a variety of variables, including age, the use of ICTs in education, the number of devices available, ICT usage time, and teaching experience, are observed to have an impact on the development of good practise in staff. Additionally, a linear link between IS, TSE, TB, and TS was seen for the establishment of effective flipped learning in CSE teaching staff, which is why they are regarded as conditioning elements for its didactic application.

K. Ratih, M. F. J. Syah, N. Nurhidayat, S. Jarin, and J. Buckworth, "Learning patterns during the disruptive situation in informal education: Parents' efforts and challenges in the adjustment of progressive learning," *Indonesian J. Learn. Adv. Educ.*, vol. 3, no. 3, pp. 180–193, 2021.

This study uses an ethnographic design and a qualitative methodology. An open observation guide was employed in the data gathering methods, and its validity was assessed using face and content validity. Data analysis strategies included site-to-site comparisons with certain analysis components for data collection, reduction, and conclusion. The research's conclusions, which take the shape of descriptions and formulations of learning patterns, point to flexible methods for providing youngsters with an effective education. In this way, students are ready for the disruptive times of the industrial revolution 4.0 and society 5.0, as well as for 21st century skills.

M. Mozafari, F. Firouzi, and B. Farahani, "Towards IoT-enabled multimodal mental stress monitoring," in *Proc. Int. Conf. Omni-layer Intell. Syst. (COINS)*, Aug. 2020, pp. 1–8.

They approach with the essential characteristics listed below: (i) Connected: utilising vigilant Internet of Things (IoT)-based wearable and sensing technologies; (ii) Data-driven: incorporating multi-modal and heterogeneous data sources from sensor readouts; and (iii) Hierarchical: made up of device/sensor, data, intelligence, and service levels. When

compared to cutting-edge approaches, experimental results based on real-world stress data sets show how accurate the suggested approach is at determining the amount of stress.

G. Li, K. Ota, M. Dong, J. Wu, and J. Li, “DeSVig: Decentralized swift vigilance against adversarial attacks in industrial artificial intelligence systems,” IEEE Trans. Ind. Informat., vol. 16, no. 5, pp. 3267–3277, May 2020.

We employ distinctively designated mobile edge computing and generative adversarial networks to address the issues on ultra-low latency brought on by dynamics in industries (GANs). The most major benefit of our work is that it can greatly lower the failure risks associated with being misled by adversarial examples, which is crucial in contexts where safety is paramount and delays are a concern.

In our experiments, numerous traditional attacking models provide adversarial examples of commercial electronic components.

In comparison to several state-of-the-art defences, experimental results show that the DeSVig is more reliable, effective, and scalable.

M. Wang and F. Hu, “The application of NLTK library for Python natural language processing in corpus research,” Theory Pract. Lang. Stud., vol. 11, no. 9, pp. 1041–1049, Sep. 2021.

Based on the Python programming language, NLTK is used extensively in natural language processing, computational linguistics, scientific computational analysis, and other areas with robust functionality. It supports a significant number of corpora. Currently, WordSmith, Antconc, Range, and other tools are frequently used in domestic research based on corpora, although NLTK of Python is rarely employed. This is because most researchers lack the Python programming knowledge necessary to fully utilise NLTK's capabilities.

T. Akter, M. H. Ali, M. I. Khan, M. S. Satu, M. J. Uddin, S. A. Alyami, S. Ali, A. Azad, and M. A. Moni, “Improved transfer-learning-based facial recognition framework to detect autistic children at an early stage,” BrainSci., vol. 11, no. 6, p. 734, May 2021.

In order to better accurately identify children with ASD in the early stages, an improved transfer-learning-based autism face recognition framework is proposed in this work. So, using a variety of machine learning, deep learning, and other transfer learning-based pre-trained models, we collected facial photos of kids with ASD from the Kaggle data pool. In comparison to the other classifiers and pre-trained models, we found that our enhanced MobileNet-V1 model exhibits the best accuracy (90.67 Percentage) and the lowest 9.33(Percentage) value for both fall-out and miss rate. Additionally, using the k-means clustering technique, this classifier is used to distinguish between various ASD groups when merely looking at autistic image data.

T. Akter, M. H. Ali, M. I. Khan, M. S. Satu, M. J. Uddin, S. A. Alyami, S. Ali, A. Azad, and M. A. Moni, “Improved transfer-learning-based facial recognition framework to detect autistic children at an early stage,” BrainSci., vol. 11, no. 6, p. 734, May 2021.

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III. EXISTING SYSTEM/OPEN ISSUES

In existing propose a non-invasive stress monitoring system with having sensor units; capable to measure temperature using Infrared Temperature Measurement (ITM), PhotoPlethysmoGram (PPG), and Inertial Measurement Units. The focus is to continuously monitor stress signs in sheep during transportation. The designed Wearable Stress Monitoring System (WSMS) showed adequate power in recording and sending detecting information on physiology and climate during transport. This study, based on noncontact and non-destructive monitoring techniques helped in minimizing the effects of stress loads on sheep.

IV. CONCLUSION

In this study, an IoT-based framework is suggested to produce real-time notifications that show the student's degree of stress as they receive psychological treatment. The goal is to foresee stress emotions at an early stage in order to prevent undesired outcomes like a loss in grades, a rise in absenteeism, and school or college dropouts. On a normalised scale from C1 to 1, the three-phase model represents the vulnerable students. The outcomes reveal how the suggested model performs when applied to the given data set and exhibit a high degree of effectiveness when compared to the testing and validation results. The model is important to use in the educational system because it will help kids, their parents, instructors, and others identify students who are prone to stress in advance.

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