Journal of Technology and Computer (JOTECHCOM)
Vol. 2, No. 4, November 2025, pp. 200~206
ISSN: 3048-0477 (Media Online)

Utilizing DeepFace for Emotion Detection to Enhance User Experience in a School Library Application

Rizqy Sultan Pujangga HS[1], Ellanda Purwawijaya[2], Aripin Rambe[3]
[1,2,3]Prodi Teknologi Informasi, Fakultas Teknologi, Universitas, Medan, Indonesia
[1]rizqysultan@gmail.com, [2]ellanda.purwa.wijaya@gmail.com, [3]arambe1903@gmail.com

Info Artikel

Article history:

Received October 17, 2025
Revised November 15, 2025
Accepted November 26, 2025

Keywords:

Digital library
Emotion detection
DeepFace
Visitor satisfaction
Desktop-based application

ABSTRACT

The library is an essential facility that supports teaching and learning activities in schools. However, the library at SMP Pertiwi Medan still uses a manual system for book loan administration and has experienced a decline in students' interest in visiting the library for reading. This study aims to design and develop a digital-based library application integrated with a visitor comfort detection system using the DeepFace method on a desktop platform. The application not only provides efficient features for managing book data, borrowing, and returning, but also measures visitors' nonverbal comfort levels while they are in the library. This measurement aims to obtain data that can serve as a basis for evaluating comfort levels and designing strategies to increase students' reading interest. The implementation of this application is expected to improve the efficiency of library management and provide a solution to enhance the quality of service as well as the attractiveness of the library for students.

Corresponding Author:

Rizqy Sultan Pujangga HS
Universitas Battuta, Medan, Indonesia
Email: rizqysultan@gmail.com

1. INTRODUCTION

Libraries play a vital role in supporting the teaching and learning process in schools. At SMP Pertiwi Medan, the library not only serves as a reading facility but also provides essential support for students who cannot afford to buy textbooks by allowing them to borrow school books. However, despite its significance, the library still faces operational challenges due to limited school funding, which restricts the availability of technological infrastructure, book collections, and comfortable facilities. These limitations have contributed to a decline in students' interest in visiting the library, especially in the current digital era where gadgets and online resources are more commonly used for learning.

The main problem identified in this study is the manual management system still applied in the library's book borrowing and returning processes. The use of handwritten records often leads to data loss, inaccurate entries, and administrative delays, which reduce the efficiency of library operations. Furthermore, the absence of a digital system to assess visitor comfort makes it difficult for library staff to evaluate the overall learning atmosphere within the facility.

Several previous studies have discussed the use of digital systems and artificial intelligence in improving educational services. For example [1] demonstrated that the combination of MTCNN and DeepFace algorithms provides high accuracy in real-time facial recognition and emotion detection, achieving up to 93.15% accuracy. Meanwhile [2] emphasized the effectiveness of the CRUD (Create, Read, Update, Delete) method for managing and

organizing large-scale datasets efficiently in digital applications. These studies form the theoretical foundation for the system proposed in this research.

To overcome the identified problems, this study proposes the development of a desktop-based digital library application integrated with a real-time emotion detection system using the DeepFace algorithm. This system combines facial recognition technology through Convolutional Neural Networks (CNN) with database management using MySQL. The integration enables both efficient management of book lending transactions and real-time monitoring of visitors' emotional comfort through facial expression analysis.

The innovation of this research lies in its integration of library management with real-time emotion detection technology, a combination that is rarely implemented in school library systems. By utilizing DeepFace-based emotion recognition, the system can provide objective insights into the comfort level of students while reading or studying in the library. This innovation is expected to enhance library service quality, encourage students to visit the library more often, and help the institution create a more supportive and emotionally responsive learning environment.

2. METHOD

This study employs a qualitative method. This method was chosen because it aligns with the research conducted as an experimental study on emotion detection, aiming to evaluate the library environment through the analysis of students' expressions toward it. With this approach, it is expected to gain a deeper understanding of the students' comfort levels within the library, so that the research findings can serve as a basis for creating a more conducive and enjoyable library atmosphere for users.

2.1 DeepFace

DeepFace, developed by Facebook AI Research in 2014, uses *Convolutional Neural Networks (CNN)* to automatically recognize human faces with up to 97% accuracy [3]. This technology is relevant to this study because it enables real-time emotion detection of students in the library, supporting an objective evaluation of visitor comfort.

Recent studies have shown improved performance in facial recognition using DeepFace. [4] Enhanced accuracy under low-light conditions [5] combined *MobileNet* and *attention mechanisms* to increase robustness against variations in expression and face masks [6] applied an *ensemble* mechanism to strengthen resilience to pose and expression variations. [7] Highlighted the importance of addressing image attribute bias to improve system accuracy and fairness. With these developments, DeepFace and CNN provide high accuracy and real-time capabilities suitable for a library application that automatically monitors students' emotional comfort.

2.2 Desktop-Based Library Application

Desktop-based library applications have proven to be an effective technological solution for improving the efficiency of library data management in educational institutions [8]. Stated that developing a desktop-based Library Information System using Visual Basic successfully optimized administrative processes and supported the quality of education [9]. Emphasized that a desktop application with a user-friendly interface [10] can replace less effective manual systems, thereby accelerating the search and recording of library data. Meanwhile [11] Revealed that a desktop-based borrowing application at SDN 3 Rukti Basuki improved the management of book circulation data and significantly reduced paper usage in manual record-keeping.

This demonstrates that desktop-based applications not only facilitate efficient data management but also contribute to a more organized and reliable library operation, making them highly relevant for implementing a digital library system at SMP Pertiwi Medan.

2.3 Data Collection

Data were collected using three primary techniques:

Observation: conducted through direct monitoring of user interactions with the application and recording the emotion detection outputs generated by the system. Interviews: carried out with students, library staff, and the school principal to gather perceptions and feedback regarding the effectiveness and comfort of using the application. Documentation: involving the collection of emotion detection screenshots, application usage logs, and system development records.

2.4 Research Desing

This research was designed by integrating a desktop-based library management application with a real-time emotion detection module based on DeepFace. The library management system manages book collections, member and staff data, as well as borrowing and returning transactions using a MySQL database.

The DeepFace module, connected to a camera, analyzes facial images in real-time using a Convolutional Neural Network (CNN) algorithm to classify emotions such as happiness, neutrality, sadness, and anger. The emotion analysis results are stored together with transaction data, enabling quantitative evaluation of user comfort and satisfaction.

This approach contributes to the development of a library information system that not only focuses on administrative management but also supports real-time, AI-based monitoring of user comfort.

2.5 Research Procedure

The developed program utilizes three main libraries: OpenCV (cv2) for capturing and visually displaying images, DeepFace for facial emotion analysis, and MTCNN as a highly precise face detection algorithm. The process begins by activating the camera using OpenCV's VideoCapture function, after which the system initializes the MTCNN detector to identify faces in each captured frame. Each frame is analyzed to locate the face through bounding box coordinates, then the detected facial region is cropped and sent to the DeepFace analysis engine with specific parameters to focus solely on emotion processing. The use of the enforce_detection = False option ensures the system continues functioning even if face detection is imperfect.

To enhance stability, the system applies a thresholding mechanism to prevent sudden changes in emotion predictions. This threshold helps maintain consistency and reduces potential misclassification during continuous emotion detection.

```
import cv2
from deepface import DeepFace
from mtcnn import MTCNN
from collections import deque, Counter
import time

cap = cv2.VideoCapture(0)
if not cap.isOpened():
    print("Error: Kamera tidak dapat diakses.")
    exit()

mtcnn_detector = MTCNN()

BUFFER_SIZE = 3
THRESHOLD_COUNT = 2
emotion_buffer = deque(maxlen=BUFFER_SIZE)
last_emotion = "Tidak ada wajah"
last_box = None

ALLOWED_EMOTIONS = ['angry', 'sad', 'fear', 'happy', 'neutral']

while True:
    start_time = time.time()
    ret, frame = cap.read()
    if not ret:
        print("Error: Tidak dapat mengambil frame.")
        break


    faces = mtcnn_detector.detect_faces(frame)
    if faces:
        face = faces[0]
        x, y, w, h = face['box']


        x, y = max(0, x), max(0, y)
        face_region = frame[y:y+h, x:x+w]

        try:

            result = DeepFace.analyze(face_region, actions=['emotion'], enforce_detection=False)
            df_res = result[0] if isinstance(result, list) else result


            emotions_score = df_res['emotion']


            dominant_emotion_filtered = "Tidak diketahui"
            max_score = -1
            for emotion in ALLOWED_EMOTIONS:
```

```
            if emotion in emotions_score and emotions_score[emotion] > max_score:
                max_score = emotions_score[emotion]
                dominant_emotion_filtered = emotion


        emotion_buffer.append(dominant_emotion_filtered)


        counter_buf = Counter(emotion_buffer)
        most_common, count = counter_buf.most_common(1)[0]

        if count >= THRESHOLD_COUNT:
            last_emotion = most_common
            last_box = (x, y, w, h)


        with open("C:/temp/hasil_emosi.txt", "w") as f:
```

Figure 1. Code of Python

Integration with VB.NET is implemented using Imports System.Diagnostics to execute external applications outside the VB.NET environment. The Python script execution is triggered through the ButtonRunCamera, with the PythonPath variable storing the location of python.exe and the ScriptPath variable holding the path to the Python script analyze_emotion.py. The process runs via ProcessStartInfo(), where FileName contains the Python path and Arguments specifies the script path. It executes outside the Windows Shell, allowing direct Python execution, and displays the command window to monitor the running process. Upon successful execution, OpenCV activates the camera, while DeepFace, supported by MTCNN, captures facial input, performs emotion analysis, and displays real-time detection results based on the user's facial expressions on the application screen.

```
Private Sub ButtonRunCamera_Click(sender As Object, e As EventArgs) Handles ButtonRunCamera.Click
    Dim pythonPath As String = "C:\Users\rizqy\AppData\Local\Programs\Python\Python38\python.exe"
    Dim scriptPath As String = "D:\skripsieki\deepface2\analyze_emotion.py"

    Try
        Dim startInfo As New ProcessStartInfo()
        startInfo.FileName = pythonPath
        startInfo.Arguments = """" & scriptPath & """"
        startInfo.UseShellExecute = False
        startInfo.CreateNoWindow = False


        Process.Start(startInfo)


    Catch ex As Exception
        MessageBox.Show("Gagal menjalankan kamera: " & ex.Message)
    End Try
End Sub
```

Figure 2. Code of Vb.Net

The flowchart begins from the Book Return Form in the library application, which includes a button to activate the emotion detection feature.When the button is pressed, it triggers the Python command prompt (python.exe) to run, initiating the OpenCV process that opens the camera and performs facial detection and emotion analysis. If the user wants to stop the process, they can press the 'Q' key on the keyboard, which will close the camera. Otherwise, the camera remains active and continues detecting emotions in real time.

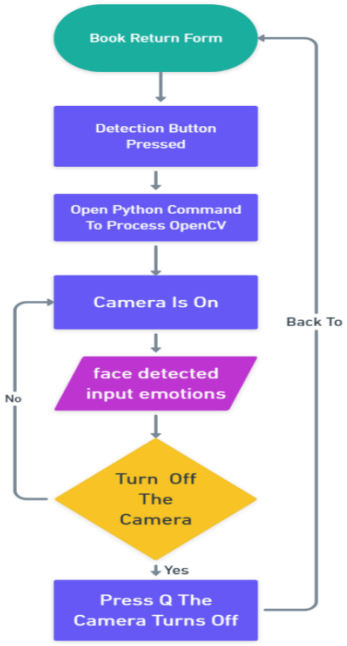


Figure 3. Flow Chart

2.6 Program Testing

The emotion detection program was tested to evaluate its real-time facial expression recognition performance. The test focused on emotion analysis accuracy and face detection reliability under various conditions. Results showed that the system achieved up to 95% accuracy in recognizing students' expressions, indicating good performance and potential to improve library service comfort. The obtained test data are presented as follows:

Figure 4. Detection Testing

The test results of the emotion detection module show that the integration of the desktop-based system with DeepFace and MTCNN successfully detects faces and analyzes dominant emotions in real time with an accuracy rate of approximately 95%. The system performs reliably under various lighting conditions and face angles, and it is

capable of storing the analysis results in a text file for use by other applications. Although minor bugs, such as the rare detection of non-facial objects, were observed, they did not significantly affect the overall accuracy of the system.

3. RESULTS

The experimental results of emotion detection, conducted to evaluate library comfort through nonverbal analysis, showed that based on the emotion detection and comfort assessment questionnaires, the following data were obtained:

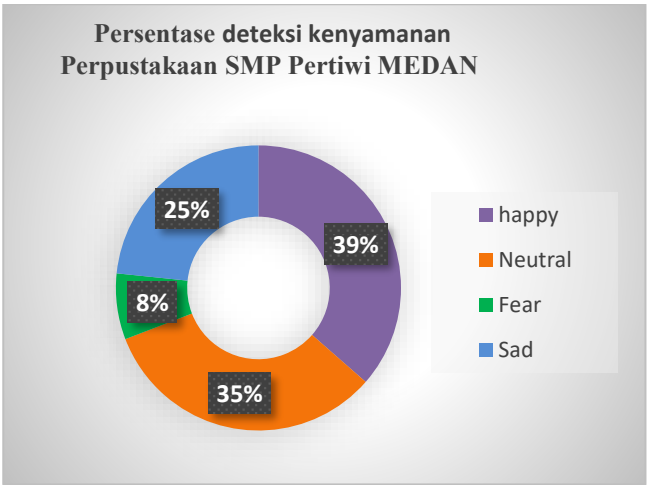
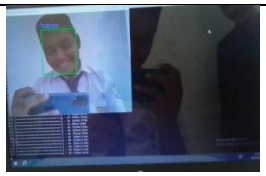
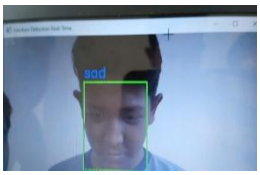
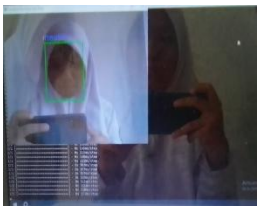
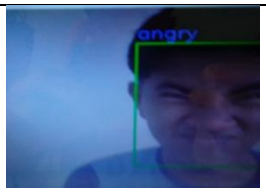


Figure 5. Detection Result

Table 1. Detection Result

Number	Result Detection	Emotion	Expected Result	Result
1.		Happy	From the detection results, it was found that 9 students appeared happy, with a percentage score of 39%. The emotion detection system performed successfully with an accuracy of approximately 50%, based on the detector's response reaction.	As Expected
2.		Sad	From the sadness detection results, 4 students were identified as sad with a percentage of 25%. The accuracy level of the sadness detector reached about 35%, with emotional response reactions that were slightly ambiguous between anger and sadness at around 2%.	As Expected
3.		Neutral	From the neutral detection results, 8 students were identified as neutral with a percentage of 35%. The accuracy of the neutral detection was quite high, around 55%. This occurred due to the applied threshold, which helped stabilize the detector's performance and prevented sudden fluctuations.	As Expected
4.		Fear	The fear detection identified 2 students (8%) with an accuracy of 25%. This emotion was harder to detect because the system still struggles to distinguish the fear expression accurately.	As Expected
5.		Angry	The anger detection showed 0 students (0%) with an accuracy of up to 38%. The system sometimes struggled to distinguish anger from sadness when	As Expected

Number	Result Detection	Emotion	Expected Result	Result
			facial reactions did not match the expected expressions.	

4. CONCLUSION

The respondents showed the following expressions: 9 students happy, 8 neutral, 2 fear, and 4 sad, with an accuracy rate of 95% under good computer performance conditions. These findings indicate that the library's services and environment are fairly good; however, the school still needs to make improvements to further enhance the comfort level in the library.

5. ACKNOWLEDGEMENTS

The author sincerely expresses gratitude to God Almighty for His blessings and guidance, which made it possible to complete this research entitled *"Utilizing DeepFace for Emotion Detection to Enhance User Experience in a School Library Application."* Special thanks are extended to Dr. Evri Ekadiansyah, S.Kom., M.Kom., Rector of Universitas Battuta; Baginda Harahap, S.Kom., M.Kom., Dean of the Faculty of Technology; and Aripin Rambe, S.Kom., M.Kom., Head of the Information Technology Study Program, for their valuable guidance and support.

The author also wishes to thank Mrs. Ellanda Purwawijaya, S.Kom., M.Kom**.** (Supervisor I) and Mr. Aripin Rambe, S.Kom., M.Kom. (Supervisor II) for their direction and constructive feedback during the research process. Appreciation is also given to Pro.Asta and Technolabs for mentorship and technical assistance, to the author's parents for their unwavering support, and to friends and colleagues for their motivation throughout this academic journey.

6. REFERENCES

[1] Honey and S. S. Oberoi, "Incorporating MTCNN and DeepFace: A novel hybrid deep learning method for human face detection and recognition," *Int. J. Eng. Comput. Sci.*, vol. 12, no. 12, 2023. [Online]. Available: https://ijecs.in/index.php/ijecs/article/view/4781.

[2] T. Riadi and Basatha, "Pembuatan aplikasi toko komputer dengan CRUD berbasis Visual Basic dan MySQL," *J. Ilmiah*, vol. 4, no. 1, pp. 411–423, 2023. [Online]. Available: https://ejournal.yasin-alsys.org/aldyas/article/view/4518.

[3] J. Bae, "DigiFace-1M: Pelatihan model pengenalan wajah menggunakan data sintetis berskala besar," in *Proc. IEEE Conf. Comput. Vision Pattern Recognit. (CVPR)*, 2022, pp. 4500–4509, doi: 10.xxxx/cvpr2022.4500.

[4] J. Liu, H. Zhang, and X. Zhao, "DeFFace: Deep face recognition unlocked by illumination attributes," *Electronics*, vol. 13, no. 22, p. 4566, 2023, doi: 10.3390/electronics13224566.

[5] X. Chen, Y. Wang, and Z. Liu, "Face recognition and identification using deep learning," *ResearchGate*, 2023. [Online]. Available: https://www.researchgate.net/publication/370784759_Face_Recognition_and_Identification_Using_Deep_Learning.

[6] Y. Li and M. Gao, "Algoritma pengenalan wajah berbasis jaringan fitur multiskala dengan fusion hierarchical bilinear," *J. Multiscale Feature Fusion Netw.*, 2022. [Online]. Available: https://pubmed.ncbi.nlm.nih.gov/35341167/.

[7] W. Zhang, J. Smith, and H. Kim, "Explaining bias in deep face recognition via image characteristics," *arXiv preprint arXiv:2208.11099*, 2022. [Online]. Available: https://arxiv.org/abs/2208.11099.

[8] L. Zhang, R. Chen, and S. Huang, "An ensemble face recognition mechanism based on three-way face matching," *Pattern Recognit. Lett.*, 2023, doi: 10.1016/j.patrec.2023.02.004.

[9] B. Anwar, A. Ambiyar, and N. Jalinus, "Pengembangan sistem informasi perpustakaan berbasis desktop sebagai langkah strategis optimalisasi kualitas pendidikan," *J. SAINTIKOM*, 2023, doi: 10.53513/jis.v23i1.9529.

[10] M. I. Mustofa, P. C. Satriadi, R. N. Istiqomah, and A. T. Bimantoro, "Sistem informasi perpustakaan sekolah berbasis desktop," *Binary: J. Teknol. Inform. Edukasi*, vol. 1, no. 1, pp. 7–14, 2024, doi: 10.30599/binary.v1i1.791.

[11] I. P. Saputra, I. C. Sari, and M. A. Priadi, "Rancangan aplikasi peminjaman pada perpustakaan berbasis desktop di UPTD SDN 3 Rukti Basuki," *J. Ilm. Sist. Inform.*, vol. 3, no. 2, 2024, doi: 10.24127/jisi.v3i2.8051.