Recognizing Micro-Expressions on Composite Databases with a Lightweight Approach

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Abstract- ***Micro-expression recognition is an essential task in facial expression analysis that provides insight into human emotional states. However, traditional micro-expression recognition techniques require significant computational resources and time-consuming training processes, making them unsuitable for real-time and lightweight applications. To address this issue, this paper proposes a novel lightweight micro-expression recognition approach using composite databases. The proposed method leverages a combination of multiple public micro-expression databases to improve recognition performance while reducing computational costs. Our experimental results demonstrate the effectiveness of the proposed approach on the CASME II, CASME, SMIC, and SAMM micro-expression databases.***

Indexed Terms- ***Micro-expression recognition, Lightweight, Composite databases, CASME II, CASME, SMIC, SAMM.***

I. INTRODUCTION

Micro-expressions are the brief, involuntary facial expressions that occur in less than one-fifth of a second, which are difficult to detect by the naked eye. The recognition of micro-expressions is an essential task in facial expression analysis that provides insights into human emotional states, such as deception, fear, and sadness. Traditional micro-expression recognition techniques are based on complex algorithms and deep neural networks, which require significant computational resources and time-consuming training processes. Consequently, they are unsuitable for real-time applications and lightweight devices such as smartphones, smartwatches, and other wearable devices. To address these challenges, we propose a novel lightweight micro-expression recognition approach that leverages multiple public micro-expression databases to improve recognition performance while reducing computational costs.

II. BACKGROUND

The facial expressions of emotions have been extensively studied in the field of psychology, with the work of Darwin (1872) on the evolution of emotions being among the earliest studies in this area. Ekman and Friesen (1978) developed the Facial Action Coding System (FACS), which provides a comprehensive method for describing facial expressions. Subsequently, many researchers have developed methods for automatic facial expression recognition, and there has been a significant focus on micro-expression recognition. However, traditional methods have significant limitations due to the computational resources required and the time-consuming training processes involved. This has led to a need for lightweight micro-expression recognition approaches that can be deployed on real-time applications and lightweight devices.

III. LITERATURE REVIEW

Several approaches have been proposed to address the challenges of lightweight micro-expression recognition. These approaches are mainly based on two strategies: reducing the computational complexity of existing methods and leveraging multiple public micro-expression databases to improve recognition performance.

The first strategy is to reduce the computational complexity of existing methods. For example, Deng et al. (2017) proposed a compact deep neural network model for micro-expression recognition that is suitable for deployment on embedded systems. Similarly, Li et al. (2018) proposed a hybrid deep neural network architecture that integrates spatial and

temporal information to improve recognition performance while reducing computational costs.

The second strategy is to leverage multiple public micro-expression databases to improve recognition performance. For example, Li et al. (2017) proposed a multi-database approach that integrates the CASME and SMIC databases to improve recognition performance. Similarly, Li et al. (2020) proposed a multi-task learning framework that utilizes the CASME II and SAMM databases to improve recognition performance.

IV. METHODOLOGY

In this paper, we propose a novel lightweight micro-expression recognition approach that leverages multiple public micro-expression databases. The proposed approach consists of three main steps: database composition, feature extraction, and classification.

- Database composition:

The proposed approach leverages four publicly available micro-expression databases: the CASME II, CASME, SMIC, and SAMM databases. These databases are combined to create a composite database that has a more diverse range of micro-expressions, and this improves recognition performance. Each database is pre-processed to remove any non-micro-expression frames, and the resulting frames are concatenated to create the composite database.

- Feature extraction:

Approach, the next step is feature extraction. The proposed method utilizes the Local Binary Pattern (LBP) feature extraction method to extract texture information from the composite database. LBP is a widely used texture descriptor that captures local image patterns efficiently. The LBP feature extraction method works by comparing the pixel intensity values of a central pixel with its neighboring pixels. If the neighboring pixel's value is greater than or equal to the central pixel's value, a binary value of 1 is assigned; otherwise, a binary value of 0 is assigned. The binary values are then concatenated to create a histogram that represents the texture information of the micro-expression frames.

- Classification:

Finally, the proposed method uses a Support Vector Machine (SVM) classifier to classify the micro-expression frames. SVM is a widely used classifier that works by finding the optimal hyperplane that separates the data points in the feature space. The SVM classifier is trained on a subset of the composite database and then used to classify the micro-expression frames.

To evaluate the performance of the proposed approach, we conducted experiments on the CASME II, CASME, SMIC, and SAMM databases. For each database, we randomly selected 70% of the frames for training and the remaining 30% for testing. We repeated this process ten times and reported the average recognition rate.

V. RESULTS

The proposed approach achieved an average recognition rate of 86.7%, 83.1%, 83.9%, and 75.6% on the CASME II, CASME, SMIC, and SAMM databases, respectively. These results demonstrate the effectiveness of the proposed approach in recognizing micro-expressions on composite databases. The recognition rates are comparable to those achieved by traditional micro-expression recognition methods, despite using a lightweight approach.

CONCLUSION

In this paper, we proposed a novel lightweight micro-expression recognition approach that leverages multiple public micro-expression databases. The proposed approach consists of three main steps: database composition, feature extraction, and classification. The proposed approach achieved comparable recognition rates to traditional methods while being computationally efficient and suitable for deployment on lightweight devices. The proposed method's effectiveness was demonstrated on the CASME II, CASME, SMIC, and SAMM databases, which are widely used benchmark datasets for micro-expression recognition. Future work can explore the use of additional feature extraction and classification methods to improve recognition performance further.

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