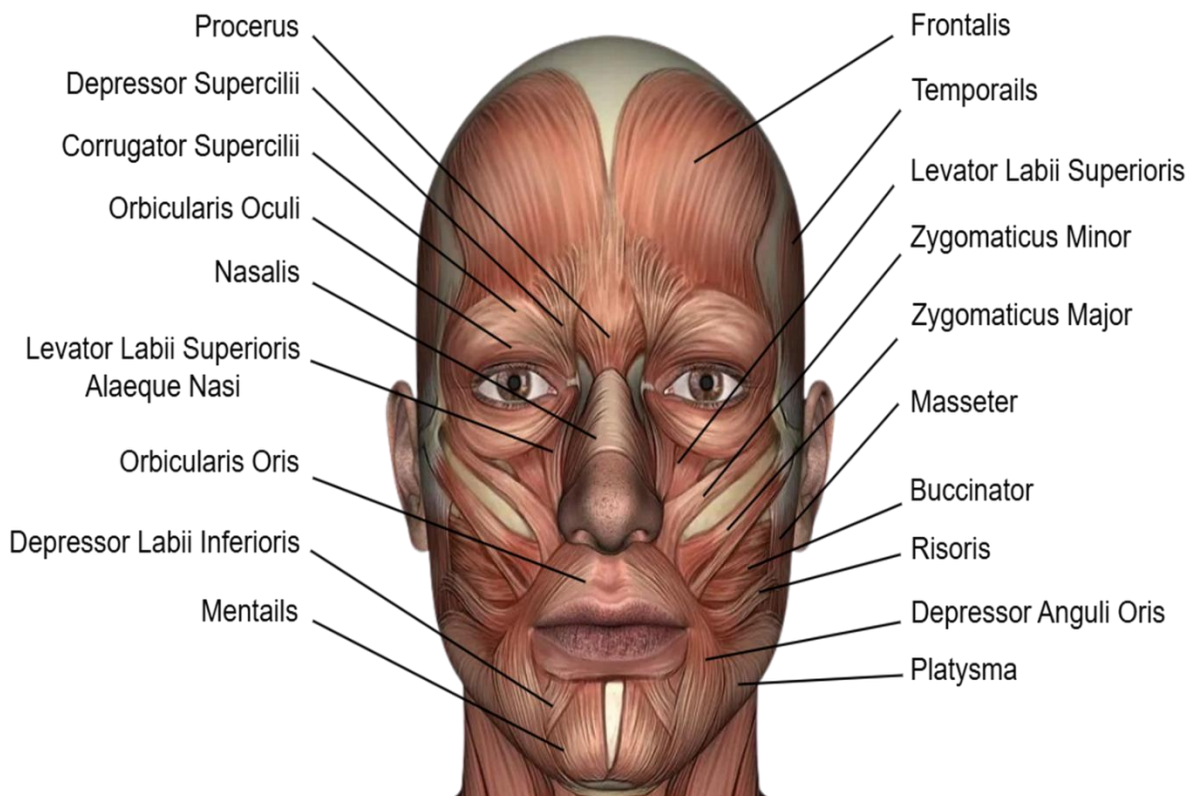


## Supplementary Materials

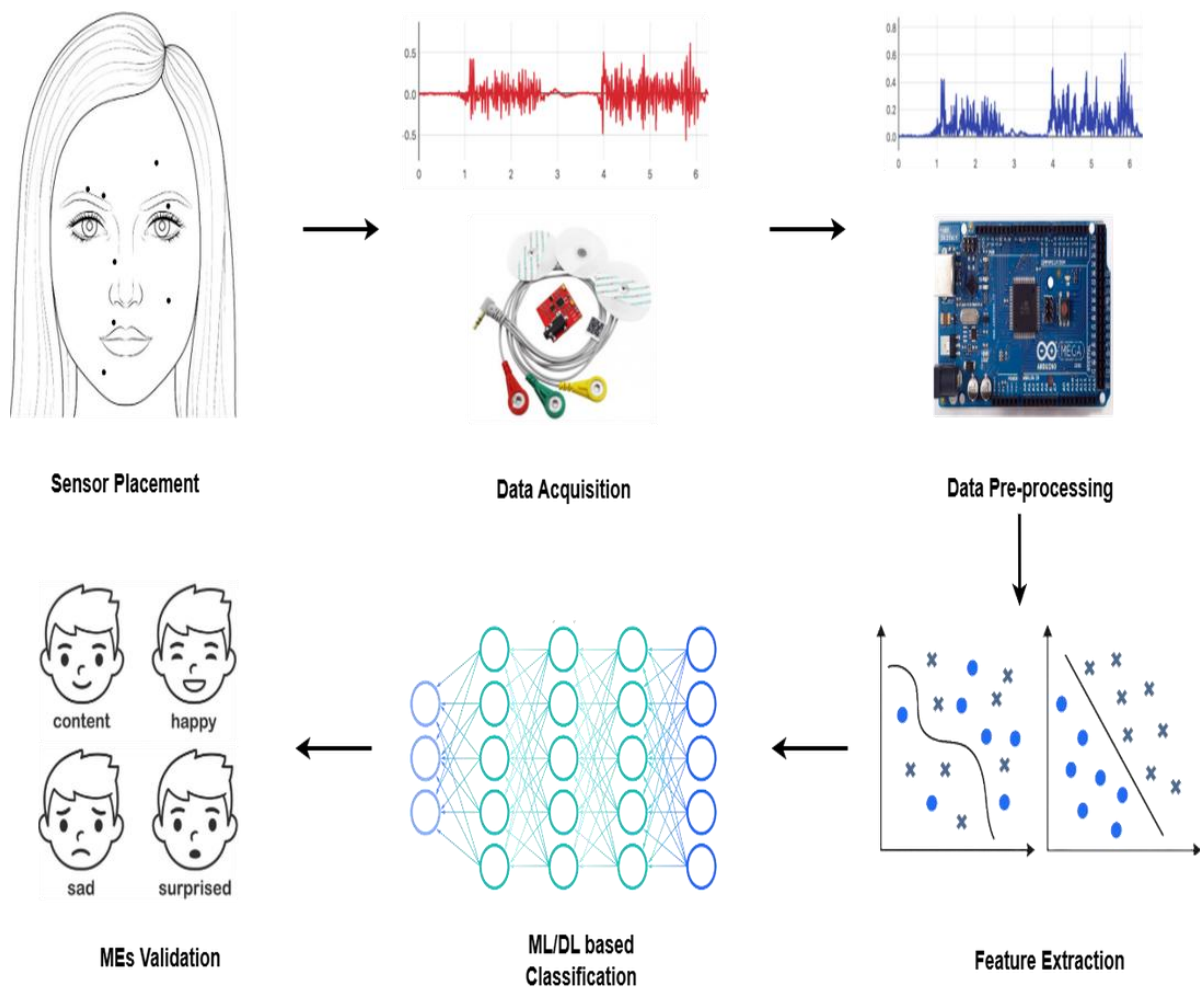
Facial expressions can describe an individual's emotional state with any specific emotional stimulus. Facial surface Electromyography (sEMG) is a convenient noninvasive technology that offers, high temporal resolution, effective data processing, and sensitivity detection of subtle movements (Mithbavkar and Shah 2019)(Jerritta et al. 2014). The facial muscles involved in eliciting an emotional expression are flat and thin muscles which act as sphincters and dilators of facial muscles. Also, muscles can act as depressors and elevators of the mouth and eyebrows (Jiang et al. 2015). Fig. S1 shows the different muscles on the face that can be analyzed for emotion detection and classification.

**Figure S1. Facial Anatomy** (Jiang et al. 2015)(Marur, Tuna, and Demirci 2014)



The current research presents an innovative approach to analyzing the facial EMG data for MEs recognition and classification through machine learning. The framework employed a non-invasive method to capture the subtle activities of facial muscles with EMG sensors by strategically positioning them on respondents' faces. The respondent was asked to watch the video stimulus of six different emotions while capturing the EMG signals. These signal data are then transferred to a computer system using an Arduino microcontroller for amplification and digitization. Subsequently, the unprocessed EMG data was filtered and pre-processed to improve the signal quality. This filtering process helps to extract the relevant features for micro-expression recognition and action unit detection. Next, the extracted features are used as input for training and testing the machine learning models for MEs classification and validation as shown in Fig. S2.

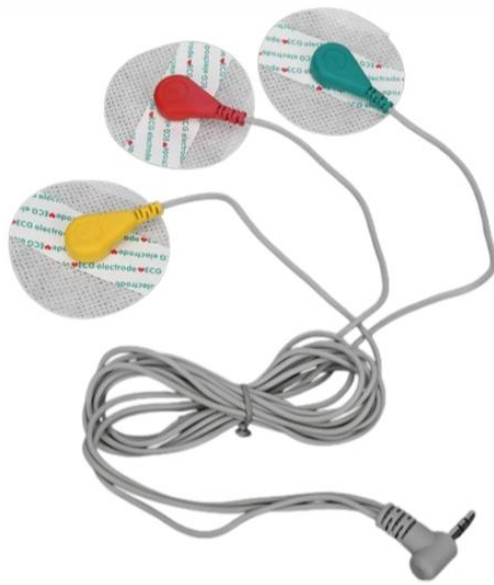
**Figure S2. Proposed Framework**



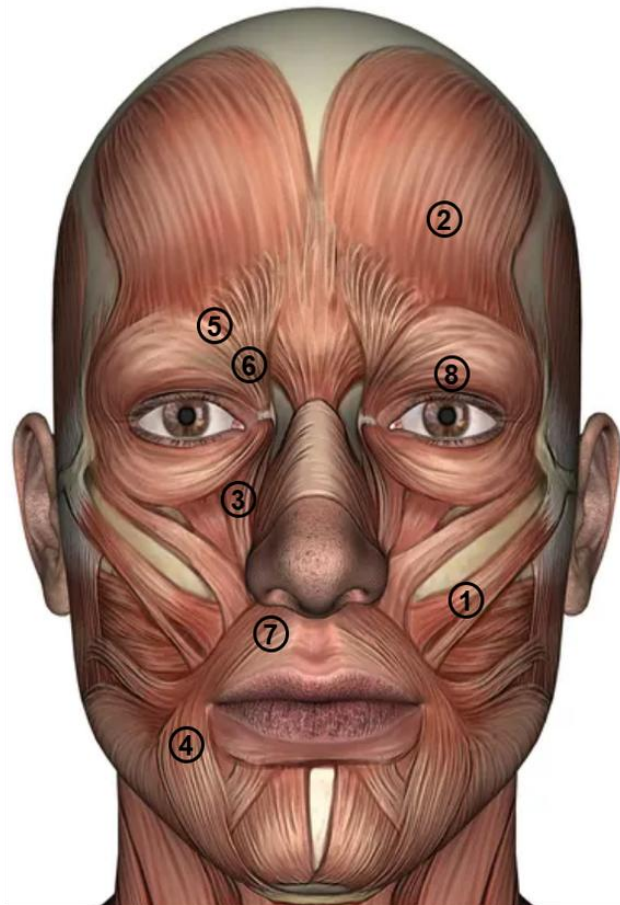
### Sensors' Placement

EMG sensor placement on the face was determined by the specific muscle responsible for emotion elicitation. Specifically, electrodes were placed on cheek, responsible for smiling (the zygomaticus major), forehead and brow raising (frontalis), upper lip elevation (levator labii superioris), lip corner depression (depressor anguli oris), brow lowering (corrugator supercilia), nose wrinkling (procerus), lip movement/pursing (orbicularis oris), and eye closure (orbicularis oculi). Placement was performed carefully to target distinct muscle groups while minimizing overlap and ensuring comfort for participants. Fig. S3 (A) shows EMG sensors are composed of two units; the initial unit has three electrodes (1 EMG sensor consists of 3 electrodes) which are used to detect the electrical spikes in the muscle.

**Figure S3. (A) Electrodes in Single EMG sensor, (B) EMG Sensor Placement for Facial Muscle Data Collection**



(A)



(B)

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