Deep Spatio-Temporal Video Based Analysis for Shoulder Pain Intensity Measurement

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Motivation

- Pain assessment and management are important across a wide range of disorders and treatment interventions.
- The standard clinical assessment of pain is limited primarily to the subjective reports (e.g., Visual Analog Scale (VAS)).
- While convenient and useful, subjective reports have several limitations (e.g., inconsistent metrics, reactivity to suggestion).
- We propose an automatic and objective pain intensity measurement using spatio-temporal changes in facial expression.

Experimental Setup

Two level 5 fold Cross Validation

Stratified distribution of data

- Dataset is split into five independent folds.
- Well distributed pain intensities per fold.
- Ensures model training is not biased due to skewed training distribution.

Experimental Results

Mean Absolute Error (MAE) in pain intensity measurement: VAS [0-10], OPI [0-5]

End-to-end Spatio-Temporal Deep Model

The CNN-RNN Model trained on spatial and temporal features

Face Registration And Warping

- 66 facial points tracked using Active Appearance Model.
- Face registration and warping using Delaney triangulation.
- Normalized facial video sequences.

For each video sequence:

- Three self-reported pain scores
  - Affective Scale (AFF)
  - Sensory Scale (SEN)
  - Visual analogue Scale (VAS)
- Offline Observer Pain Intensity Rating (OPI)

Dataset

UNBC McMaster Pain Archive

- 25 Participants with shoulder pain
- 200 video sequences

For each video sequence:

- Three self-reported pain scores
  - Affective Scale (AFF)
  - Sensory Scale (SEN)
  - Visual analogue Scale (VAS)
- Offline Observer Pain Intensity Rating (OPI)

Conclusions

- Automatic, objective, and reliable measurement of pain intensity from facial expression is feasible.
- The proposed loss function exploits the consistency between different pain intensity measures.
- Stratifying data on average improved VAS and OPI results by 13.6% and 8.9%, respectively.
- OPI offers a more objective assessment of pain intensity.

References


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