EmoKey: An Emotion-aware Smartphone Keyboard for Mental Health Monitoring

Surjya Ghosh*, Sumit Sahu, Niloy Ganguly*, Bivas Mitra & Pradipta De#

*Department of Computer Science & Engineering, Indian Institute of Technology, Kharagpur, India
#Intellicus Technologies Pvt Ltd., India
#Department of Computer Sciences, Georgia Southern University, USA

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Introduction

- Motivation
  - Approximately 220 million people suffering from depressive disorder symptoms across the globe [1]
  - Early diagnosis and counselling can help in great extent [2]
  - Manifestations of depressive symptoms are difficult to track

- Background
  - Sensor-rich ubiquitous smartphones can unobtrusively track interaction pattern
  - Significant portion of interaction is based on text input (WhatsApp, FB Messenger)
  - Typing activity on smartphone carries emotion signature [3]
  - However, such emotion detection models mostly rely on cloud-based services, thereby suffer from
    - Privacy concern
    - Network delay
- Problem Statement
  - Can different emotions be tracked based on typing interaction on the smartphone itself with monitoring capability?

Experiment Setup

- Performed 10-fold cross-validation and measure emotion classification performance
  - a) AUCROC
  - b) F-score
  - \[ AUCROC = \sum_i \frac{|\left\{ \text{happy}, \text{sad}, \text{stressed}, \text{relaxed} \right\} \cap \text{ground truth} \cap \text{predicted} |}{\text{ground truth} \cap \text{predicted}} \]

Evaluation: Emotion Classification

- All emotions except relaxed are identified with an AUCROC greater than 75%
- Relaxed emotion is identified with highest F-score (65%)

Evaluation: Resource Overhead

- Setup
  - OnePlus X (2.3 GHz quad-core Qualcomm Snapdragon 801 3GB RAM)
  - Synthetically added training records

- Training Latency
  - Latency < 10 secs for 10K records, increases with high training volume

- Battery Consumption
  - Energy consumption < 5 joules for 10K records, increases significantly with high training volume (> 50K records)

Field Study and Dataset

- Installed EmoKey app in the smartphone of the volunteers for collecting typing details and emotion self-reports
- 22 students (20 male, 2 female, aged between 24-33 years)
- 3-week in-the-wild study

- Evaluation: Emotion Classification
  - User-wise Emotion Detection AUCROC

- Evaluation: Resource Overhead
  - Setup
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Conclusion

- Design and develop an emotion-aware smartphone keyboard, which detects four emotions (happy, sad, stressed, relaxed) based on text input interactions deploying an on-device prediction model
- It returns an average accuracy of 78%, (std dev. 10%)
- Additionally, provides an interface for mental health monitoring
- Reveals scope for devising efficient on-device models for long-term mental health monitoring

References


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