Detection of Audio-based Emergency Situations using SCALE

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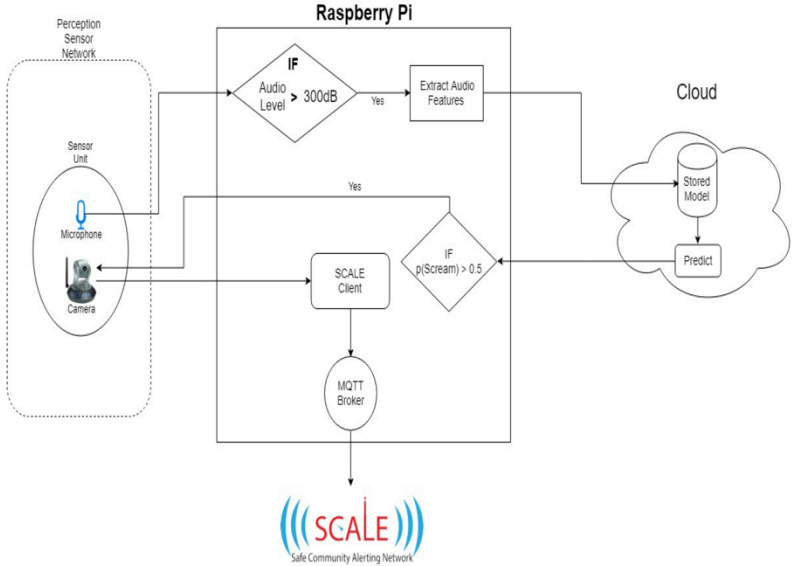
Motivation

- Each year, a large number of elder people in the US are injured — some critically or even fatally — by a fall. We plan to address the detection of emergency situations such as a fall in a household using acoustics. Once an emergency situation occurs, i.e., it detects a person screaming and asking for help, it informs their emergency contacts and also calls the emergency services.

- We aim to integrate audio signals to SCALE and process the signals on cloud using machine learning for scream detection. To minimize false positives we also plan to trigger capturing of images using camera/s connected to the central system. We suggest an event based escalation approach to make sure that the privacy of users is not encroached upon. Based on analytics performed on the data obtained we seek to classify events as emergencies and send residents alerts to confirm or reject the emergency.

Architecture of System

- A sensor unit consisting of a microphone and a camera.
- Central processing unit is a Raspberry Pi that connects to a cloud that stores the pre-trained ML model which classifies audio inputs as emergency situations such as a scream or a call for help.
- Positive classification for audio input triggers the video camera for further scrutiny of the event.
- In case the event is classified as an emergency the activity result is passed on as a message to the MQTT component of the Safe Community Alerting Network (SCALE).



Related Works

- Using smartphone for ADL classification
  Feng, K. Chang, and Chang [2] approach data collection and classification of activities through a smartphone. Using a smartphone reduces the energy consumption and setup cost of a smart home. Combination of sound, orientation and Wi-Fi signals data is analyzed to identify activities of daily living.

- Making ADL detection system energy efficient
  Alhassoun, Uddin and Venkatasubramanian [1], present a perpetual heterogeneous IoT system, SAFER. It is deployed in homes to recognize critical events that require urgent action and response. A semantic approach is followed that extract ADLs from device data for energy-optimized sensor activation.

- Audio-based emergency situation detection
  Huang et al. [3], present an approach to scream detection, using both analytic and statistical features for the classification. Log energy is used to detect energy continuity of audio. High pitch detection based on autocorrelation is used to extract the highest pitch of each frame.

Evaluation

- The machine learning model was evaluated on a test set and resulted in an accuracy of around 81%.
- A major roadblock which we tried handling throughout the project is to handle if computation is feasible on the Raspberry Pi. We feel better results can be achieved if higher computation ability is available.
- We also found a limitation with the SCALE platform, that is, we cannot publish an image to SCALE if it is greater than 10 kilobytes.

References

1. N. S. Alhassoun, M. Y. S. Uddin and N. Venkatasubramanian, "SAFER: An IoT-based perpetual safe community awareness and alerting network," *2017 Eighth International Green and Sustainable Computing Conference (IGSC)*, Orlando, FL, 2017, pp. 1-8.
2. Feng, Yunfei & Chang, Carl & Chang, Hanshu. (2016). An ADL Recognition System on Smart Phone. 148-158. 10.1007/978-3-319-39601-9_13.
3. Weimin Huang, Tuan Kiang Chiew, Haizhou Li, Tian Shiang Kok and Jit Biswas, "Scream detection for home applications," *2010 5th IEEE Conference on Industrial Electronics and Applications*, Taichung, 2010, pp. 2115-2120.