Bengalathon – Solution Concept Note

Attempted Challenge:
Quick Accident Response.

Challenge Description:
The solution should be able to distinguish impact sounds when vehicles ram into each other on the road. The solution needs to be real time and the nearest PCR van should be alerted so that precious lives can be saved.

Proposed Solution Name:
Automatic Impact Audition.

Brief Background of Proposed Solution:
In the recent years, video surveillance has been employed for roads monitoring in order to detect abnormal events and improve the safety procedures in case of emergency. Certain event, such as car collisions are difficult to detect when only the visual information is considered. The proposed solution offers a new dimension to this task. We consider the car collision impact sound spectral pattern to identify the accident event from background acoustic scene. Once the target event occurs, inform accordingly to the server (PCR van) for further action.

Objective:
- Real time audio is recorded to capture the acoustic event. The accident impact sound is detected by analyzing the spectral feature from real time audio data.
- Then by confirming the vehicle impact sound the associated PCR van or control room will be informed through telecommunication/internet technologies.
- As the complete process is in an automation, the successful acoustic event detection task can reduce the rescue time and mortality rate drastically.

Brief Description about the Concept:

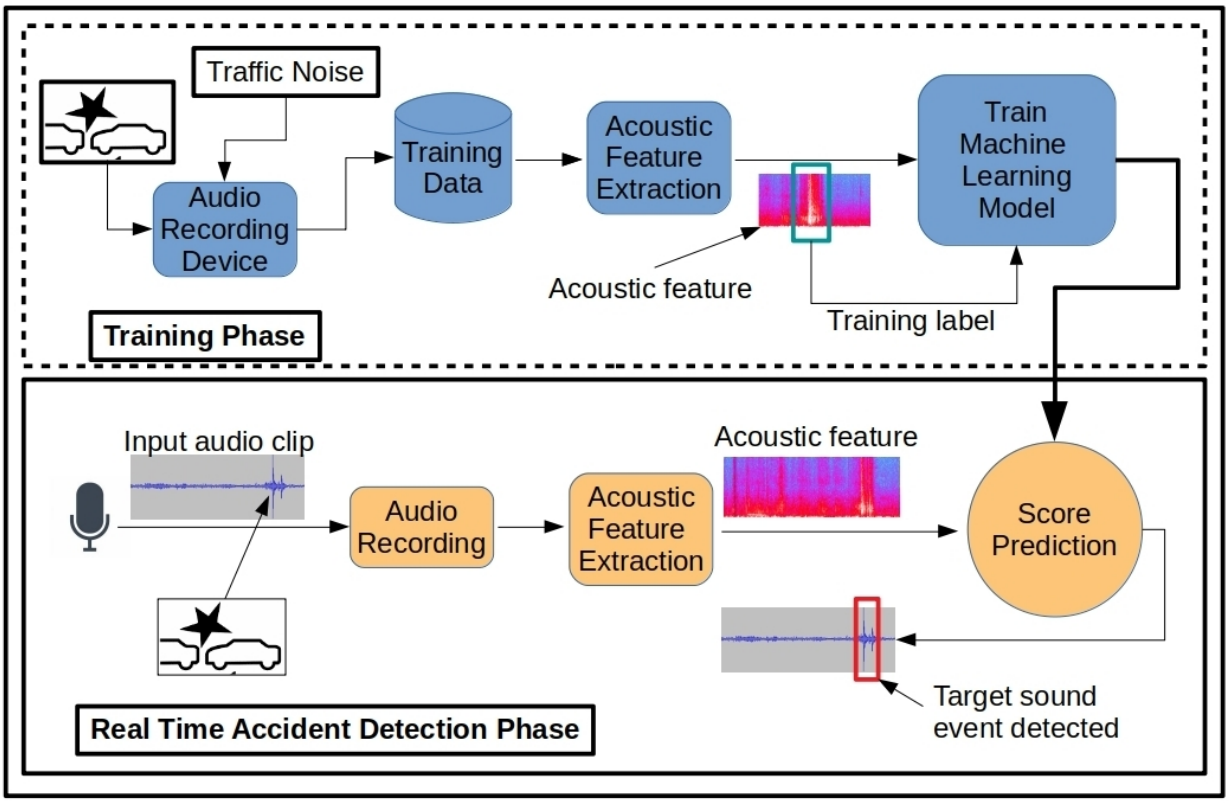

Figure. 1 Schematic representation of sensor node workflow.

Mainly there are three major sections: (a) Acoustic sensor node, (b) Server Control Unit, (c) Inter-connectivity between the sensor node and server.

The complete system implementation consists of multiple acoustic sensor node, one server control node and its inter-connection units. Each server unit has its own geographical range of control. A policy should be built to setup the server control unit that depends on few facts such as road conditions, interconnecting facility, population of vehicles etc. Acoustic sensor node are individual units which are to be placed at the road side in a safe position to capture real time audio data. On the sensor node real time data processing takes place to detect the accident event. Similar sensor nodes can be placed after at a certain distance to complete monitoring of a long distance. All the sensor nodes are inter-connected to each other and finally to server control unit. The planning is to make a real time fast data communication setup. Therefore, internet protocol will be the best solution to inter-connect the nodes and server unit. Server control unit functions as sever and all sensor nodes will act as individual clients. Each sensor node has its own ID number which is stored in

server. Therefore, sensor node will transmit the ID information to the server once accident is detection. Thus, the server can identify the location of incidence and search the nearest PCR van to inform it accordingly.

The schematic representation of each sensor node's workflow is represented in Fig. 1. Each sensor node has multiple physical interface such as:

- Microphone – to capture real time audio data
- LAN port / inter-connection port – to establish inter-connection.
- Speaker – for self-testing used in **audio-in-loop** mode.

Sensor node have its own firmware which control the actual workflow. Initially a trained model is programmed to the device to recognize the target sound activity. Several other tasks have to be prescheduled or command should be issued from server control unit as required.

In the Training Phase as mentioned in Fig. 1, at first the target acoustic features are computed from a training database. The training database consists of target sound and other possible sounds such as traffic noise etc. Then a suitable Machine Learning (ML) model is trained by the extracted features of the labeled data.

Now the trained ML model is deployed to predict the accident event from the same flow of feature extraction as shown in Fig. 1 in Real Time Accident Detection Phase. During this phase the real time audio signal spectral pattern similarity is found out by the help of trained ML model and generates an accident prediction score. The score value is compared with a predefined criterion which is set during the validation session.

In addition to this regular functionality sensor node also monitor the condition of the microphone using **audio-in-loop** test.

In this competition task we are planning to implement the concept using a toy model, which can be extended further to detect real accident event.

Expected Outcomes:

The main objective of our task is to detect the impact sound of accident. The model can be used in many practical cases. In rural areas or National highways, due to the lack of population, the information of accident event remains unknown. The proposed solution is able to detect the impact sound of accident among the traffic and surrounded noises and it automatically sends the message of disaster to the associated server control unit (proposed in our model) and nearest PCR van.

Risk and Mitigation Plan:

Microphone is the most vital device for capturing sound, must be protected from climatic adversities. Although the sensitivity of microphone may be reduced over the passage of time. Another challenge is that to distinguish between the accident sound if it is not prolonged for a long time and concurrently some anomaly sounds like firecracker, thunderstorm take place.

To mitigate this risk factor, we are planning to use audio-in-loop testing for identification of microphone sensitivity and fidelity. To tackle certain impulsive concurrent sound like thunderstorm, real time audio streaming may be employed.

Revenue Model:

- Each sensor unit cost: 4000/-
- Inter-connection cost / km: 2000/-
- Server control unit cost: 20000/-