Averting Human-Elephant Conflict Using Machine Learning on Elephant Vocalizations

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Asian elephants are an endangered species and human-elephant conflict poses a grave threat to their existence. Human-elephant conflict refers to the negative interactions between humans and elephants such as in electrocutions and crop-raiding. Every year, more than 500 humans and 100 elephants are killed due to human-elephant conflict. A method using bio-acoustics and machine learning is proposed to build an early warning system to determine the proximity and behavior of elephants by classifying elephant vocalizations. An early warning system indicating the presence of elephants in the proximity as well as whether they are likely to raid would help curtail human-elephant conflict and prevent casualties. This system uses machine learning to detect when an elephant vocalizes and to identify the type of vocalization - Chirp, Roar, Rumble, or Trumpet. Data from recordings of 147 vocalizations were annotated and pre-processed. A unique approach was taken to train machine learning models to classify this data. Two levels of CNNs were trained hierarchically. The first level contains a CNN that classifies vocalizations into three categories - none, high frequency, and low frequency. The second level contains two CNNs that further sub-classify the vocalizations. Uniquely modified mel-scale filter banks were extracted from the vocalizations and used to train multiple CNN models. This two-level ensemble learning with hierarchical-model approach achieved an accuracy of 96.88% for the first level and 98.00% and 75.13% for the second level models. The CNN models run in real-time on a Raspberry Pi along with a uni-directional microphone and an alarm system. This early warning system raises an alarm and sends a telegram message with further information when elephants are identified.

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