



# WhisperSense: Data-Driven Pest Positioning for Smart Indoor Farming

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## Problem Statement

- Indoor farming has played a major role in climate resilient agricultural systems in urban areas.
- Vertical farming involves growing crops in vertically stacked layers, often incorporating controlled-environment agriculture techniques.
- Indoor farming faces several challenges, one of them being the presence of pests, damaging the plants.



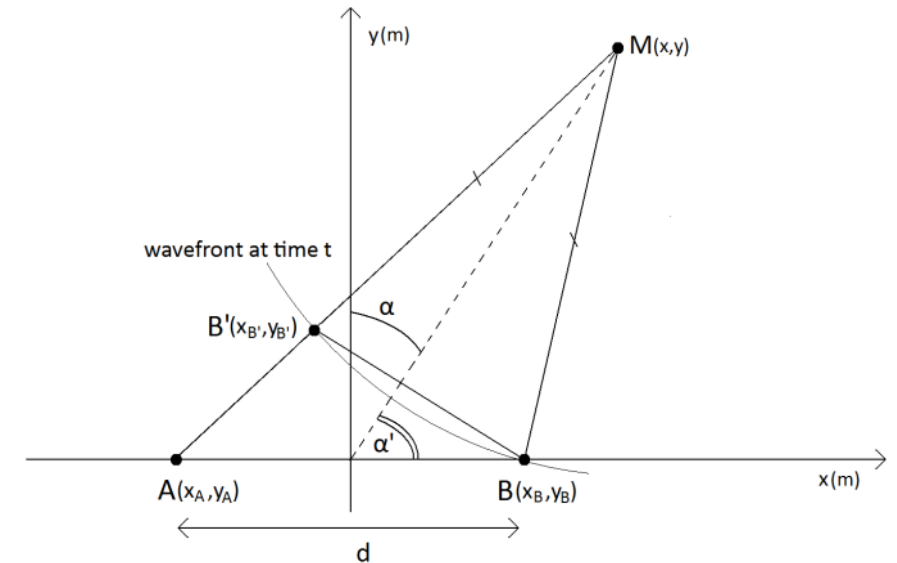
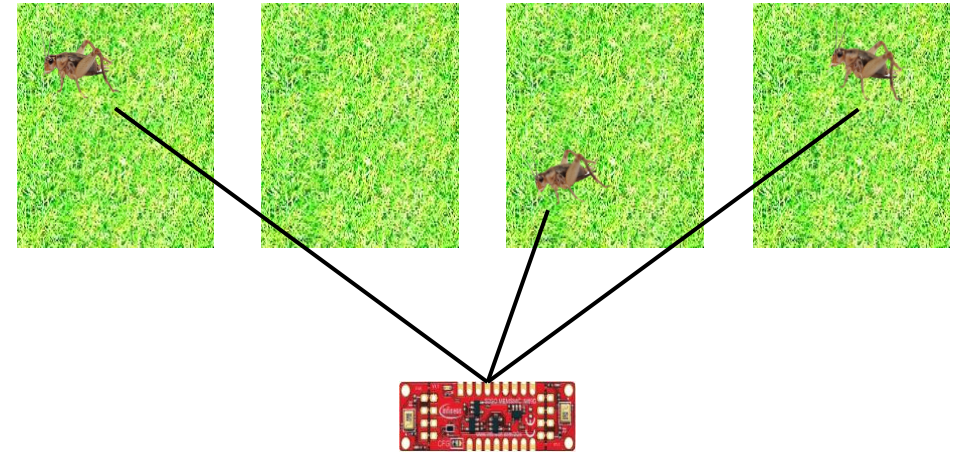
# Solution

- Due to the small size of the pests and the varying lighting conditions the use of sound-based sensors is more feasible.
- Use of 2D audio localization techniques to predict the position and angle of the pests on the plants.
- The implementation involves the following step
  - Sensor placement
  - Sound recognition
  - Real-time monitoring
  - Localization



# Implementation

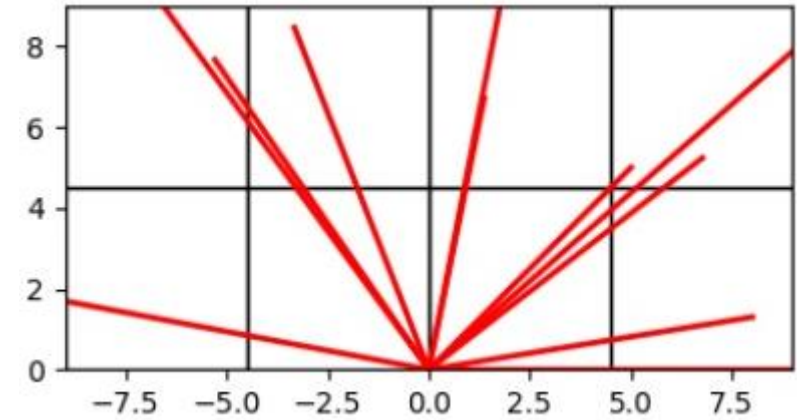
- Used I2S MEMS Microphone IM69D130 and Shield2Go Adapter for Raspberry Pi from Infineon to record audio.
- Few of the techniques used for the audio processing were Beamforming and Cross-correlation.
- Beam forming:
  - Beamforming refers to a spatial filtering technique used to estimate the location or direction of a sound source in a two-dimensional space.
- Cross-Correlation:
  - Cross-correlation is used to estimate the time differences of arrival (TDOA) of a sound signal at multiple microphone pairs.



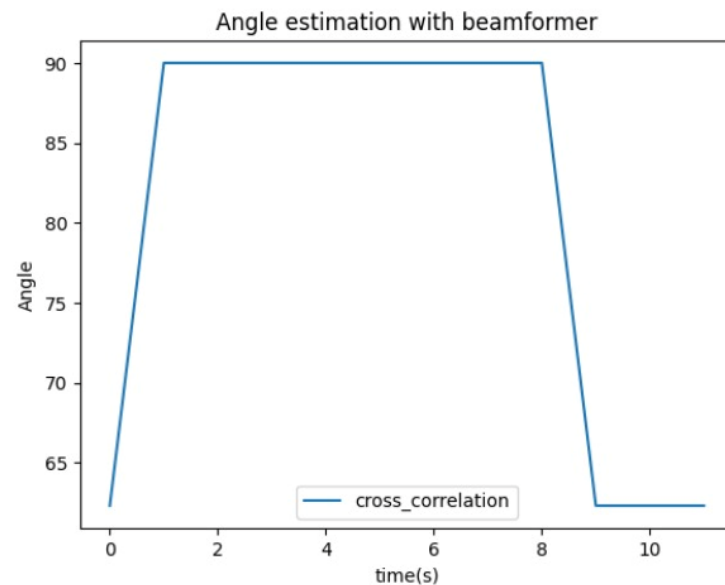


# Results

- Data was recorded for 2 pest types with varying positions and sound characteristics in .wav format.
- The Audio was processed through the algorithm and the following results were obtained.

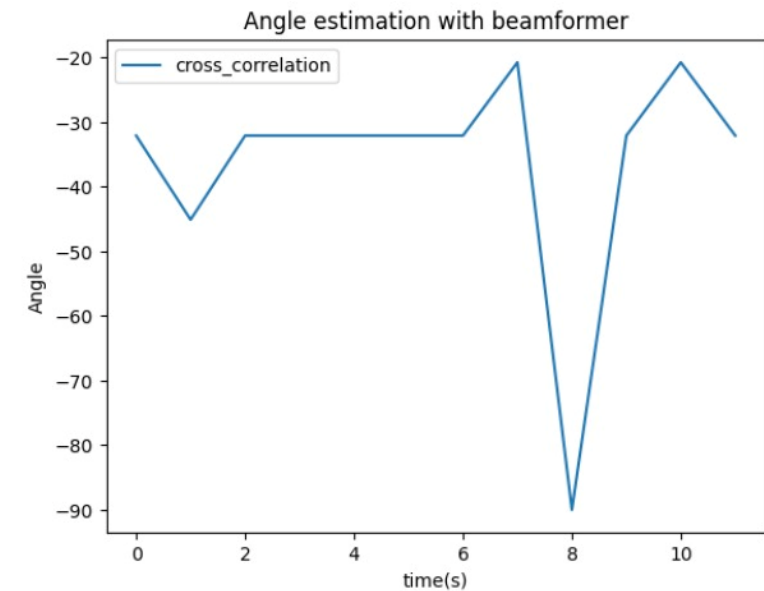


2D grid of estimated positions and angles



True Dist: 45cm  
True Angle: 90 degree

Est Dist: 40.528 cm  
Est Angle: 80.767 degree



True Dist: 90cm  
True Angle: -45 degree

Est Dist: 88.093 cm  
Est Angle: -36.108 degree



A photograph of a hydroponic greenhouse. The image shows long, parallel rows of raised beds filled with lush green leafy plants, likely lettuce. Each bed is equipped with a white PVC irrigation system featuring a red-handled valve. The beds are supported by a metal frame, and the floor is a smooth, light-colored surface. The perspective is from the end of the rows, looking down the center aisle. The text "Thank You!" is overlaid in the center in a white, sans-serif font.

Thank You!