

CHAPERONE: REAL- TIME LOCKING AND LOSS PREVENTION FOR SMARTPHONES

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SMARTPHONE LOSS

- With the current generation of smartphones being so compact, According to the 2020 Uber Lost and found index they happen to be at the top of the list for items left behind.
- Whilst having the ability to do many things and store a lot of data it is a big inconvenience for people who loose their devices and poses problems with regards to breach of data which results in a lot of privacy issues

PROBLEMS WITH THE CURRENTLY AVAILABLE SOLUTIONS

- Can be easily Bypassed
- Post loss solution
- My not work be effective if user realizes that they have lost the device after a while
- We currently need a Solution which does not require any additional hardware and helps to prevent loss (primary objective) and then have the ability to help post loss (Secondary)



Find My Device

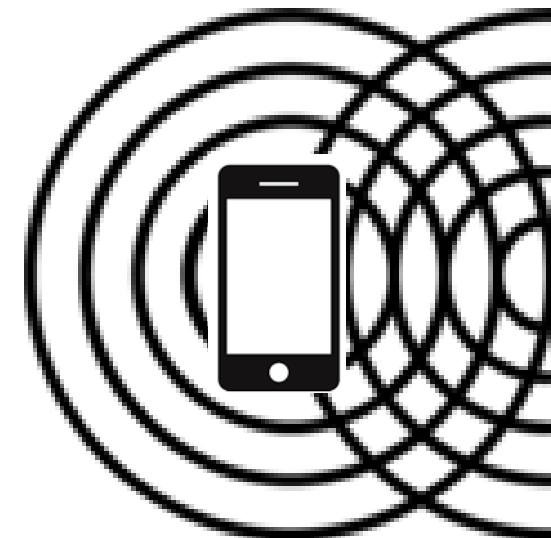
by Google Play Protect



ACTIVE ACOUSTIC SENSING

As all smartphones have at least one speaker and a microphone a solution using active Acoustic sensing can be proposed

- This means that a phone can send out an acoustic signal through the speaker and then estimate the distance between an object (the owner of the phone in this case) and the phone by the amount of time the signal took to bounce back (echo)
- Using iLock this can ensure that if the distance between the object and the phone crosses a certain limit the phone will automatically get locked
- There are many factors to consider like environmental factors (ambient noise levels) which may hinder the effectiveness of the process

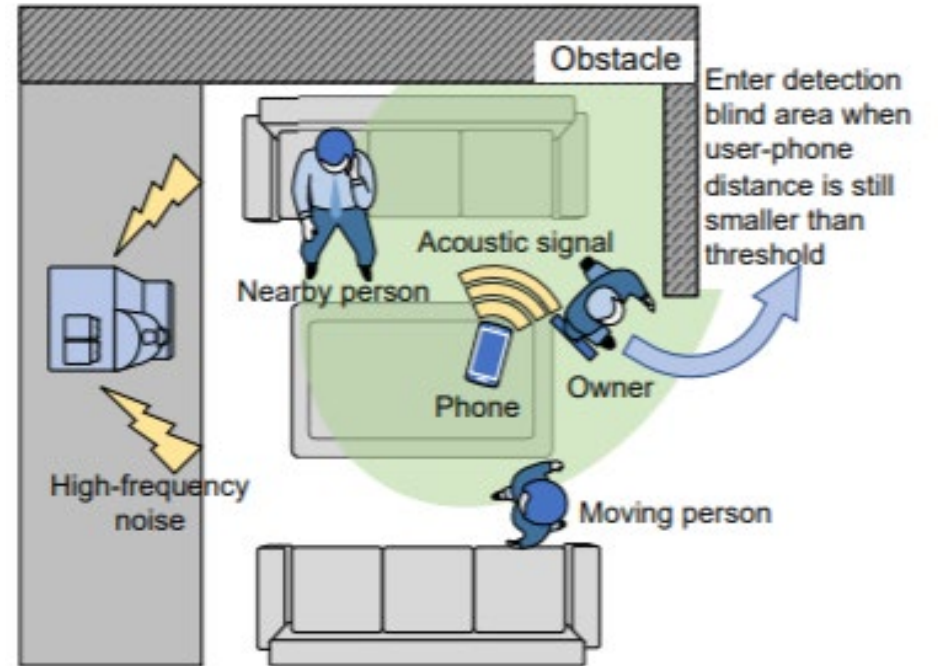


SOLUTION: CHAPERONE

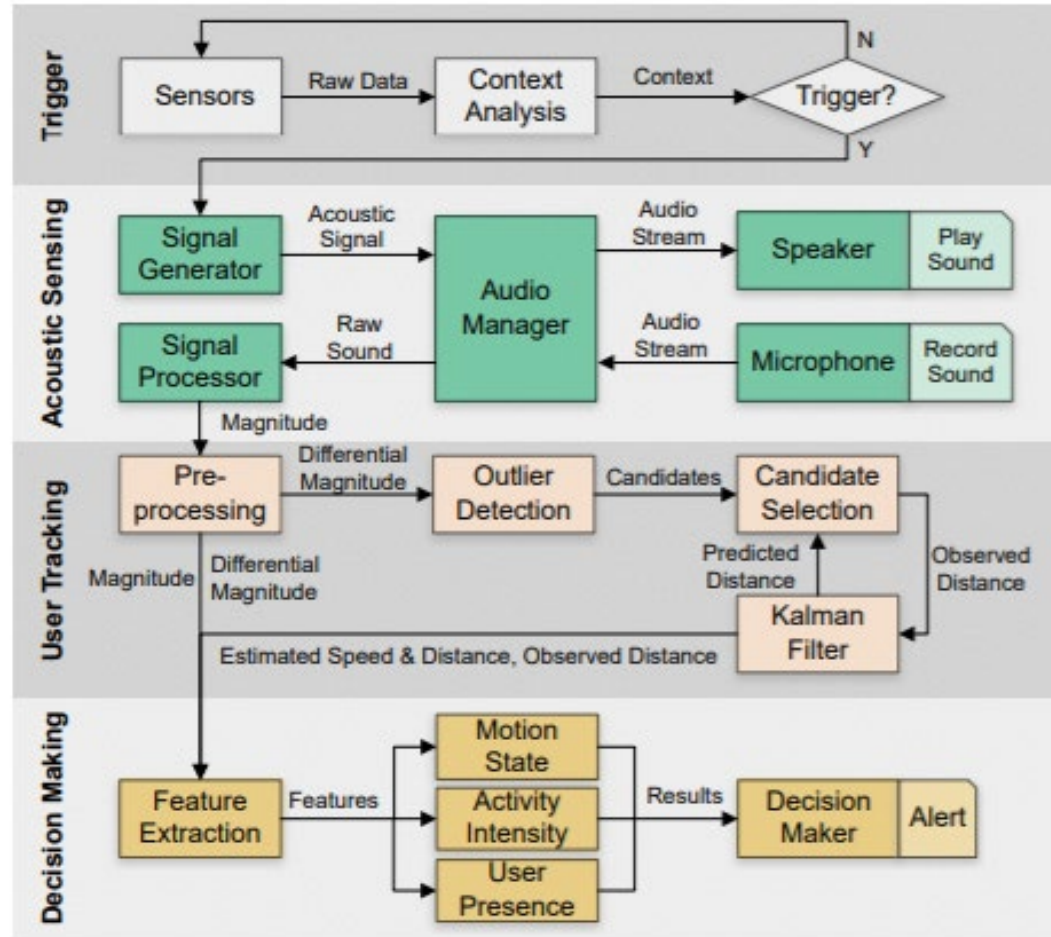
- A Real time Loss prevention solution which uses Active acoustic sensing to track the departure patterns of the owner of the device in order to prevent smartphone loss
- This solution has the ability to filter out any irrelevant noise caused by environmental factors
- This has been proven and tested with high rates of success in over 1345 experiments in different environments

CHALLENGES FACED

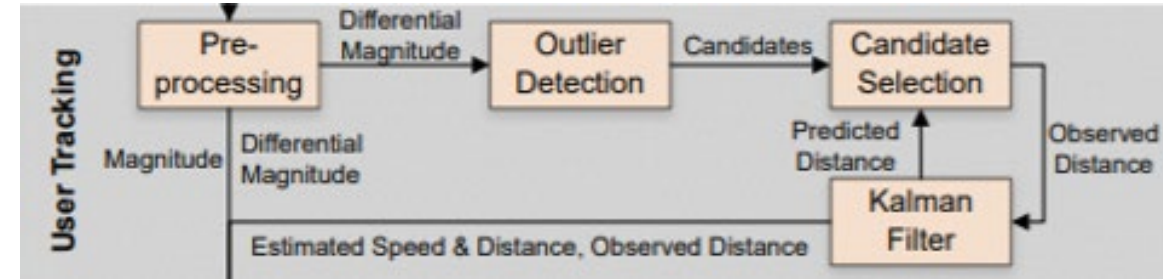
- Nearby people
- Obstacles
- High Frequency noises which are on similar bands of the inaudible sounds used during Acoustic sensing



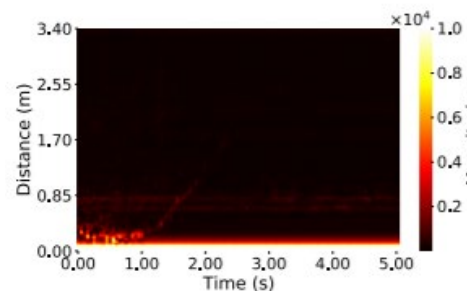
HOW DOES CHAPERONE WORK?



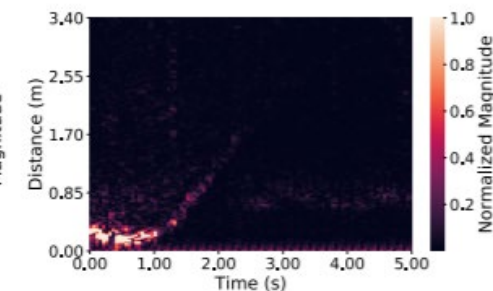
USER TRACKING MODULE



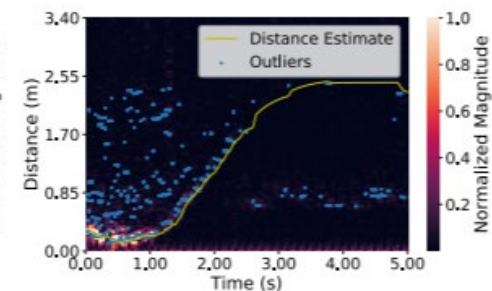
- It first generates heatmaps from echoes received in order to filter out any high frequency and static(non moving) items in order to identify the position/movements of the owner
- It then establishes a distance estimate which takes account of distances/Ranges of the items around which are used to establish records as to what constitutes as normal movement or abnormal movement.



(a) Magnitude heatmap.

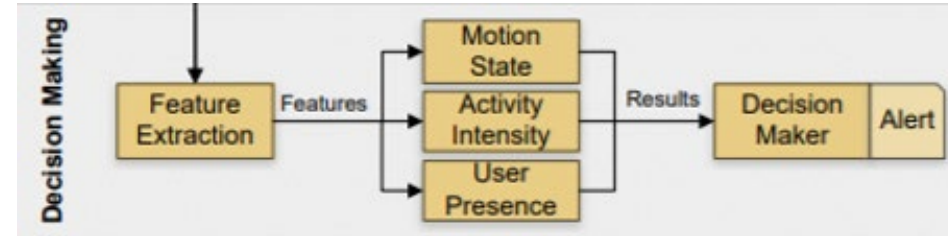


(b) Differential heatmap.

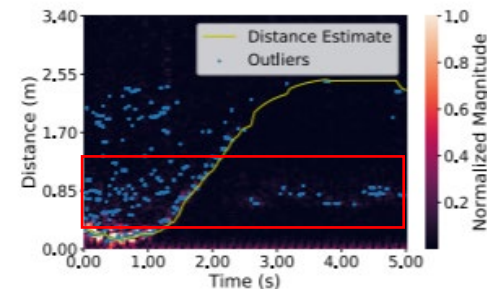


(c) Outliers and distance estimate.

DECISION MAKING MODULE



- Once the primary user has been tagged and data which constitutes as “Normal movement” is identified.
- If we consider the user standing up, turning around and walking away. Changes in echo patterns are detected during each step, this is categorised as an abnormal echo feedback which is then run by 3 filters to then ensure that the user is in range.
- The 3 filters work as follows
- Motion state defines if the owner is turning around or standing
- Activity intensity: when the owner gets up and walks away their activity intensity decreases
- This therefore determines that the user presence is lowering and then moves to the decision making vector which locks the device and alerts the user of possible device loss



(c) Outliers and distance estimate.

REAL WORLD EXPERIMENTS + USER STUDIES (CONCLUSION)

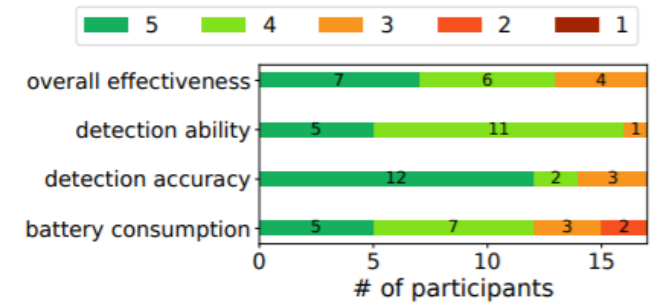


Figure 12: Participants' rating of Chaperone on a 5-point Likert scale (5: Very satisfied, 1: Not satisfied at all)

- A total of 1345 experiments were carried out in 8 different locations: Library, office, restaurants, coffee shops, lounge areas, bus stops, in-vehicle and academic venues
- Once a base was set using experiments in controlled environments it was noticed that this could detect further than 85 cm Away from the device.
- The experiments had an overall precision of 93% and recall rate of 96%
- In 95% of the successful experiments, potential losses were discovered and notified within 500 ms
- This left the users extremely satisfied with the output and proved that this is an effective solution to the problem at hand

RESOURCES

- <https://www.usenix.org/system/files/sec20-chen-jiayi.pdf>
- <https://www.uber.com/en-PK/newsroom/2020-lost-found-index/>
- <https://www.usenix.org/conference/usenixsecurity20/presentation/chen-jiayi>