**BE : Project Abstract 24 July 2017**

**Group Number:** 23

**Priority:** 3

**Project Title:** High Precision Ultrasonic Positioning Using a Robust Optimization Approach

**Group Members:** Janam Sarmalkar

Mohid Shaikh

Shivam Samaleti

**Abstract of Project:**

In this paper we present a mobile application and solution for accurate smart indoor positioning. Some interesting applications include medical professionals and patients tracking inside the complex environment of hospitals, tourist navigation inside museums to offer adaptive personal tracking guide depending on user behaviour, augmented or virtual reality, gaming, in-building guidance or support for ambient assisted living. Encoded ultrasonic signals and TDMA protocol are used to obtain fine-grained distance measurements. Signals are emitted from a set of low cost ultrasonic local positioning systems. An acquisition module, based on a MEMs microphone and a microcontroller, digitizes the incoming signals and sends them over an USB protocol to the mobile device for their processing. An Android Application will compute the Time Difference of Arrival (TDOA) to estimate the current position and display it in the mobile screen.  Several users can compute their positions autonomously and user privacy is protected. The application can be configured for different encoding techniques and modulation schemes according to the environment requirements. Absolute error less than 5 cm is achieved in a 5×6m complex environment in 85% of the cases for an average position refresh period of 200ms.

1. **Motivation:** People spend 80%-90% of their time in indoor environments, on the other hand, majority of people own a smartphone or a tablet. This has triggered the research in indoor positioning so as to overcome the GPS limitations inside buildings and offer an extended variety of Location Based Services (LBS) to users.
2. **Problem Statement**: Current systems in place use electromagnetic waves to find the position of objects. GPS satellites are the most commonly used. However, in short range these systems are an overkill, requiring high power systems and complex architectures. This Ultrasonic positioning system is both highly accurate and requires less power and complexity. Also, foreign object interference is less and accuracy for indoor positioning is greater.
3. **Approach:** Encoded ultrasonic signals and TDMA protocol are used to obtain fine-grained distance measurements. Signals are emitted from a set of low cost ultrasonic local positioning systems. An acquisition module, based on a MEMs microphone and a microcontroller, digitizes the incoming signals and sends them over an USB protocol to the mobile device for their processing. An Android Application will compute the Time Difference of Arrival (TDOA) to estimate the current position and display it in the mobile screen.

# Reference papers:

# Ultrasonic indoor positioning for smart environments: A mobile application

# Authors: E. Díaz

# M. C. Pérez

# [D. Gualda](http://ieeexplore.ieee.org/search/searchresult.jsp?searchWithin=%22Authors%22:.QT.D.%20Gualda.QT.&newsearch=true)

# [J. M. Villadangos](http://ieeexplore.ieee.org/search/searchresult.jsp?searchWithin=%22Authors%22:.QT.J.%20M.%20Villadangos.QT.&newsearch=true)

# [J. Ureña](http://ieeexplore.ieee.org/search/searchresult.jsp?searchWithin=%22Authors%22:.QT.J.%20Ure%C3%B1a.QT.&newsearch=true)

# [J. J. García](http://ieeexplore.ieee.org/search/searchresult.jsp?searchWithin=%22Authors%22:.QT.J.%20J.%20Garc%C3%ADa.QT.&newsearch=true)