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Envision, Enable, and Empower  
Smarter and Resilient Societies

*co-located with*

# 11<sup>th</sup> **ERDT Conference** on Semiconductor and Electronics, Information and Communications Technology and Energy

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## OBJECT FOLLOWING TECHNIQUES FOR THE AR.DRONE USING RSSI AND TDOA DISTANCE MEASUREMENTS

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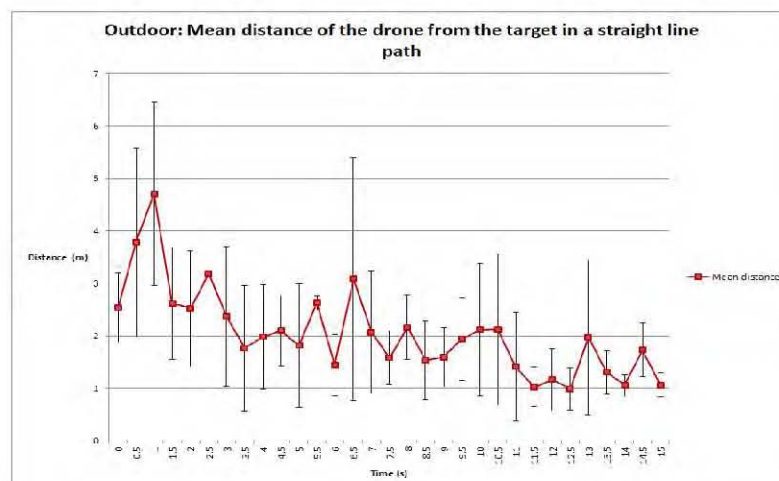
### ABSTRACT

An Unmanned Aerial Vehicle (UAV) is a type of flying machine that requires no pilot onboard. They can be either remotely controlled or programmed to be autonomously flying. UAVs, or also popularly referred to as drones, the same with other widely used technologies today, such as the Internet, are products of military research [1]. However, the advances of technology, the lowering of production costs, and their availability to the public promoted the rapid development of various researches for civilian and commercial applications. Such fields include search and rescue, wildlife monitoring, border patrol, aerial photography, mobile tracking, among others [2].

A lot of research works are being conducted on drone technology and a number of them tackle the problem of providing the drones with the capability to track and follow a target such as a person or an object. The different existing approaches in pinpointing a target's location relative to the drone are: (1) through video sensing, (2) using the Global Positioning System (GPS) technology, and (3) using Radio Frequency (RF) technologies and different sensors. Our goal is to develop an object-following drone that is simpler and not yet used in existing approaches using open hardware such as digital compass, RF transceivers, and ultrasonic sensors. The advantage of open hardware and software is that these are readily available online and usage of such technologies requires no licensing. We will take advantage of the capability of radio signals to approximate distance through Received Signal Strength Indicator (RSSI) for outdoor use and for indoors (hallways) by measuring the Time Difference of Arrival (TDOA) of ultrasonic waves and RF signals.

The outdoor implementation uses the RSSI of wireless sensors as a way of measuring the distance between the drone and the target device. A measurement of RSSI between two objects alone cannot determine the position of a target in a 2D-coordinate. A digital compass will be installed both on the target and on the drone to aid in a proper localization.

RSSI is not sufficient in indoor situations and might provide erratic data due to multipath fading and added noise and interference from other radio signals inside a building. To refine the distance measurement in the indoor environment, we used the TDOA of the sound waves given off by ultrasonic sensors and packets sent by RF transceivers..



**Figure 1.** The data shows the mean performance of the drone in terms of keeping its distance from the target in an outdoor scenario with a straight line path. The test that was replicated three times and the desired confidence interval is set to 95%.

This project demonstrates that wireless sensors can be used in applications such as an object-following drone. Most implementations existing today use the combination of video and image processing and GPS and there are not much research on using wireless sensors available online and documented. Our data shows that object-following applications using wireless sensors and without the aid of GPS and video processing is both promising and challenging. The sensors' readings are near the actual values as shown on the results assuming ideal conditions and that there are no external factors affecting the drone's flight such as the battery level, strong winds, and even magnetic disturbances.

**Keywords:** Abstract, AR.Drone, drone, RSSI, TDOA, UAV.

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