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DRONE BASE STATION

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INTRODUCTION

The main aim of the project is to design a communication system that employs drones as a base station. The project is multi-disciplinary so, we students from the Department of Electrical& Electronics Engineering working with two students from the Department of Mechanical Engineering.

In the project, our task is to use a network by mounting a base station on a drone. To put it simply, the idea is to strap a computer and a radio on a flying platform. Then, the communication link will be established between the drone and ground by using the radio. After that, the platform will transmit to / receive from signals at the ground by using this connection. While doing this, the platform will measure telemetry data such as power consumption, altitude, vibration, then will save the data to SD Card.

To achieve these tasks, we needed a computer that drives the SDR platform and sensors. As a computer, we choose a Raspberry Pi 3a board. To handle signal issues, we will use LimeSDR. In a Ground Station, we use USRP to receive data.

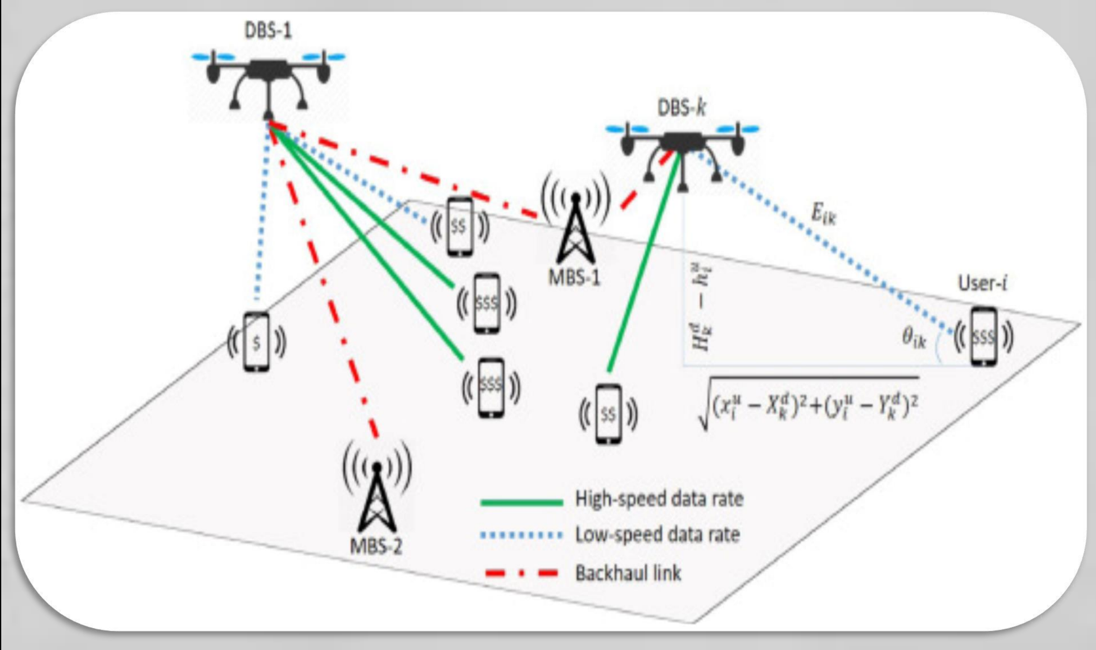

Figure 1. Simple Drone Base Station Example

Figure 2. DJI PHANTOM 3 Pro

SYSTEM DESIGN

In terms of the system mounted on the drone, we connected LimeSDR to Raspberry Pi via the USB port and we installed LimeSuite into Raspberry Pi. We will program LimeSDR with using Pothos GUI on Raspberry Pi.

On the other hand, the vibration sensor (MPU9265) will not be connected to Raspberry Pi directly because there is no analog input pin on the Raspberry Pi board. That's why we will put the Arduino Nano module between the vibration sensor and the Raspberry Pi. To measure power consumption, we will connect the power sensor between the battery and the flight controller. Then, measured data will be sent to Raspberry Pi.

Finally, all measured data will be transmitted to the Ground Station via LimeSDR which is connected to the Raspberry Pi. In a Ground Station, we have USRP to receive data transmitted from the drone platform with the help of GNU Radio. The block diagram of this process is shown in Figure 3.

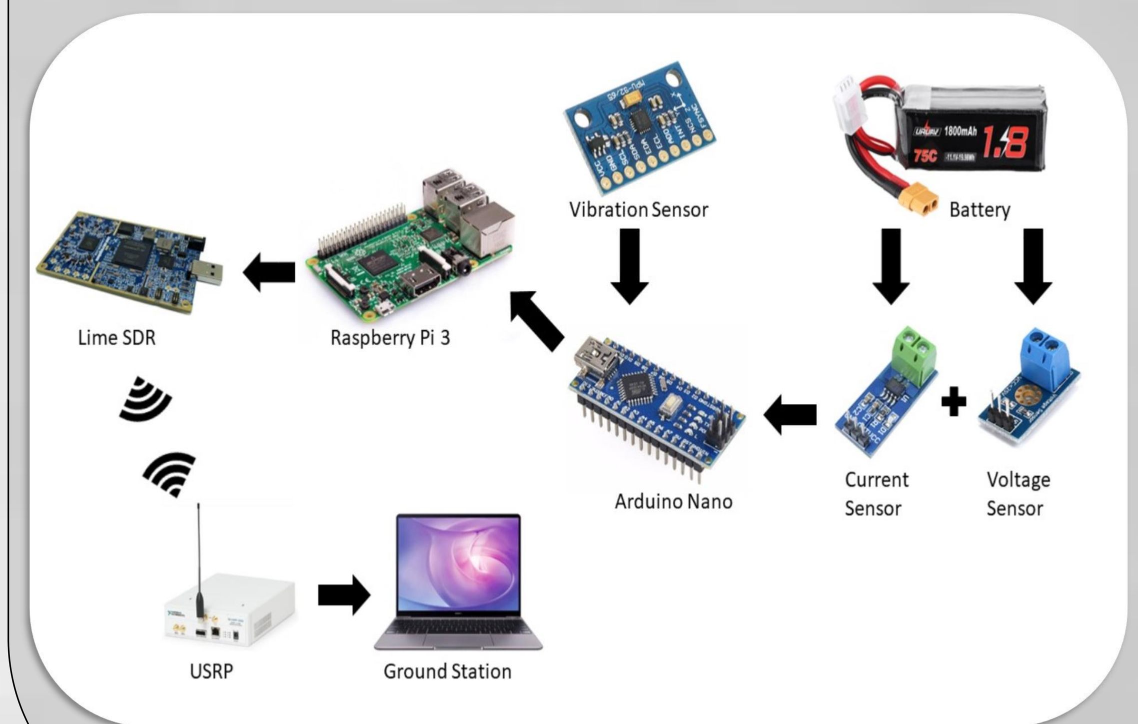

Figure 3. Block Diagram of the System

APPLICATION AREA

Unmanned aerial vehicles (known as Drones) are witnessing major development in their capabilities. They are being used in many applications such as inspection, agriculture, traffic monitoring, surveillance, and many others. One of the promising applications of drones is in the field of mobile communication. A base station mounted on a drone can reach places where normal base stations cannot be deployed due to the drone's high degree of freedom.

SYSTEM REQUIREMENTS

Components used to build a prototype:

UAV	DJI PHANTOM Pro
Transmitter	LimeSDR
Receiver	USRP
Computer that drives the SDR platform, USRP and sensors	Raspberry Pi 3 Laptop for Ground Station to use USRP
Sensors	Current, Voltage and Vibration sensors

EXPERIMENTAL RESULTS

The LimeSDR was then connected to a computer and calibrated through the LimeSuiteGUI. We tested the radio's loopback function and the Tx and Rx individually to ensure the Tx and Rx channels were operative. If more than one antenna is used for Tx and/or Rx, each antenna is dedicated to its channel (A or B). We started Pothos and choose a sinusoidal signal to be transmitted by the LimeSDR at the frequency of 145 MHz. The Tx signal magnitude was normalized to the value of 1. Accordingly, to receive this signal, the USRP's Rx was tuned to 145 MHz. The signal reception confirmed with the QT TimeSink of GNU Radio.

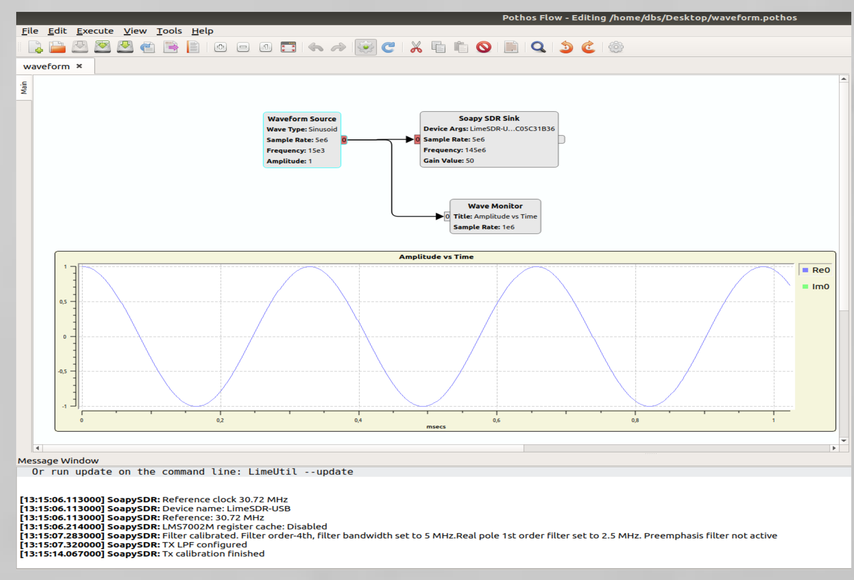

Figure 4. Transmitted Signal via LimeSDR

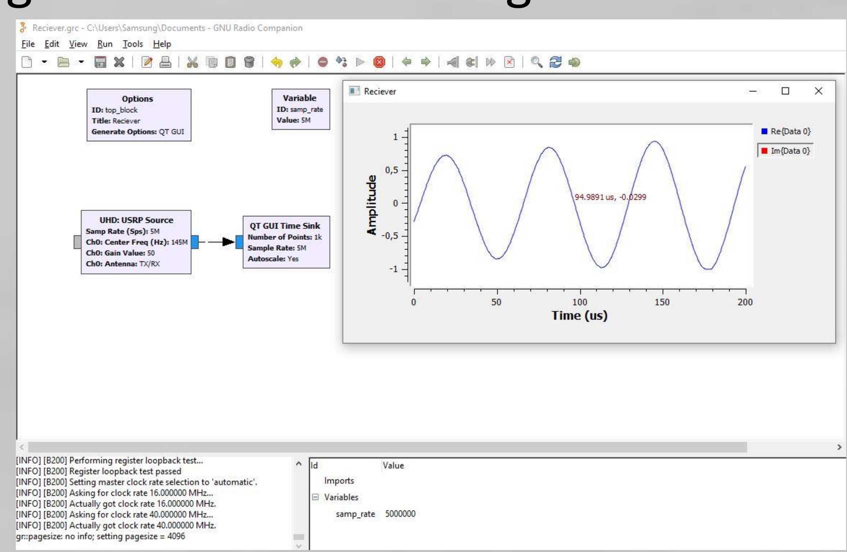

Figure 5. Received Signal via USRP

ACKNOWLEDGEMENTS

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