Knight Shield

"Monitoring Drone Incursions at Central Florida Airports"

Group 24

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1 Introduction

1.1 Narrative Description and Motivation

Drones pose a serious threat to aircraft and airports alike. Drone sightings have spiked in recent history and on multiple occasions have shown the potential catastrophes waiting to happen. Recent incidents at Reagan National Airport near Washington D.C. initially shutdown operations for 2 hours. In addition, in Canada a police drone in the area of a local airport caused heavy damage to a small aircraft that could've proven fatal. There is a huge need for drone prevention technologies, specifically at airports, but could also be utilized at places such as schools, prisons, and military bases.

For this project, we plan to create an Automatic Dependent Surveillance-Broadcast (ADSB) Receiver to detect both drones and aircraft in the Orlando area. This device will consist of an antenna that detects the ADS-B out signal, that then passes the received signals through the Pro Stick which filters out all frequencies besides 1090 MHz and 978 MHz. The signals provide information of the aircraft's callsign, altitude, location, heading, and velocity. This data will then be sent from the device to a cloud service where it will be processed and sent to a website for human use. This data will show the location of the aircraft in real time. Allowing for quick detection of unwanted aircraft in a protected area of the users choosing, such as an airport. A drone can easily be detected in this system because our system will provide the assigned ICAO aircraft address and when a drone's address is detected it will raise a flag and provide an alert to the user either through a website.

1.2 Project Goals

The project goals lay out the foundation of success for this project. When Knight Shield Device and website meet these goals the experiment will be a success and will provide a system that detects drone incursions in a specified area.

- Provide a safe and effective solution to drone incursion detection at airports.
- The Device will be low cost
- The Device will be low maintenance
- The Device will run without an outside power source.
- The Device will receive signals from nearby aircraft and filter the signals through the Pro Stick
- The Device will connect to the internet via WiFi
- The data from the device will be sent to the cloud to be processed
- Specific Geofence locations will be designated to solidify a 'fence' around a specific area.
- The processed data will be moved from the cloud to API and from API to custom website for viewing.

2 Requirements and Constraints

This section details the requirements that the device must satisfy in order for it to be successful. Requirement specifications must meet the needs of the customer or end user. Constraints impacts/ limits the design.

2.1 Requirements

No.	Requirement	Value	Units
1.0	The device should be no larger than 24 x 24 x 24	24 x 24 x 24	inches
1.1	The device should stay operational without intervention for at least 6 months	6	Months
1.2	Device should alert user of an active incursion within 30 seconds of incursion	30	seconds
1.3	The device should be able to receive/send at least 1.2 Megabytes a day	1.2	Megabyte
1.4	The device should transmit data at least every 15 seconds	15	seconds
1.5	The Device will weigh no more than 50 pounds	50	pounds
1.6	The Device should be able to receive signals from aircraft at a range of 0-10 miles around the device	0-10	miles
1.7	The Device should cost no more than $300	300	dollars
1.8	The Device will withstand temperatures ranging between 0-50	0-50	Celcsius
1.9	The device will withstand wind speeds of at least 60 mph	60	mph

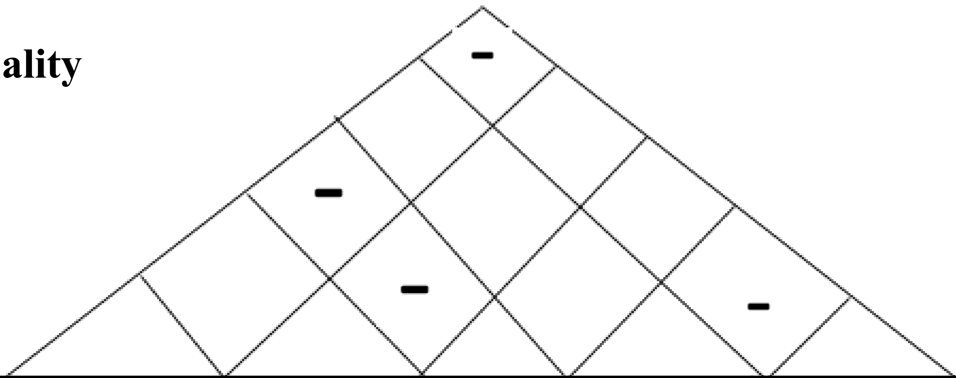
Table 1: Requirements of the device

2.2 Constraints

No.	Description
2.0	The Device must filter out frequencies other than 978 MHz and 1090 MHz.
2.1	The Device must be able to support a communication range of at least
2.2	The Device must be able to operate on less power than what one solar panel could generate in a day
2.3	GPS will be used for the positioning system.
2.4	Device must be able to withstand water from rainfall.
2.5	Wifi will be used to connect the device to the internet.
2.6	Microcontroller must have a usb 3.0 connection to connect to the pro stick.

Table 2:Constraints that will impact the design of our device

3 House of Quality



↑ - positive correlation ↓ - negative correlation + - positive polarity - - negative polarity		Battery Life	Weight	Cost	Power Consumption	Range
		+	-	-	-	+
Low Cost	-	↓	↓↓	↑↑	↓	↓
Low Maintenance	-	↑↑	↓	↓		
Reliability	+	↑		↓↓	↓↓	↑
Ease of use	+			↓		
System Accuracy	+	↓		↓	↑	
Response time	-	↓		↓	↑↑	
Wireless	+	↓	↑	↓	↑↑	↑↑
Target		**>2 days**	**< 50lbs**	**< $300**		**> 5 miles**

Figure 1: House of Quality

4 Block Diagram

The block diagram is made to show a general overview of both the high-level overview and the hardware block diagram. Each block diagram shows the designated person responsible for each section.

4.1 High-level Software Overview

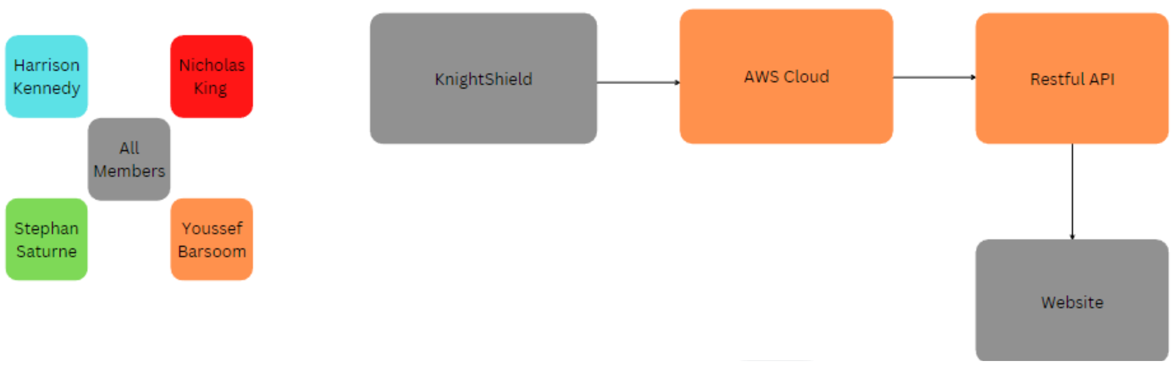


Figure 2:Software Block diagram

Module	Description	Responsibility
KnightShield	ADS-B Data receiver	All Members
Cloud service	KnightShield processes and sends the data to Cloud service. Data is archived in the Cloud service.(ETL scripts to be executed)	Youssef Barsoom
API	API is to retrieve the data from cloud service. Processing the data such that it can then be sent and displayed on the website.	Youssef Barsoom
Website	The Website will be created to present data and provide an alert to users in case of drone incursion.	All Members

Table 3: Description of each module in the Software Block Diagram

4.2 Hardware Block Diagram

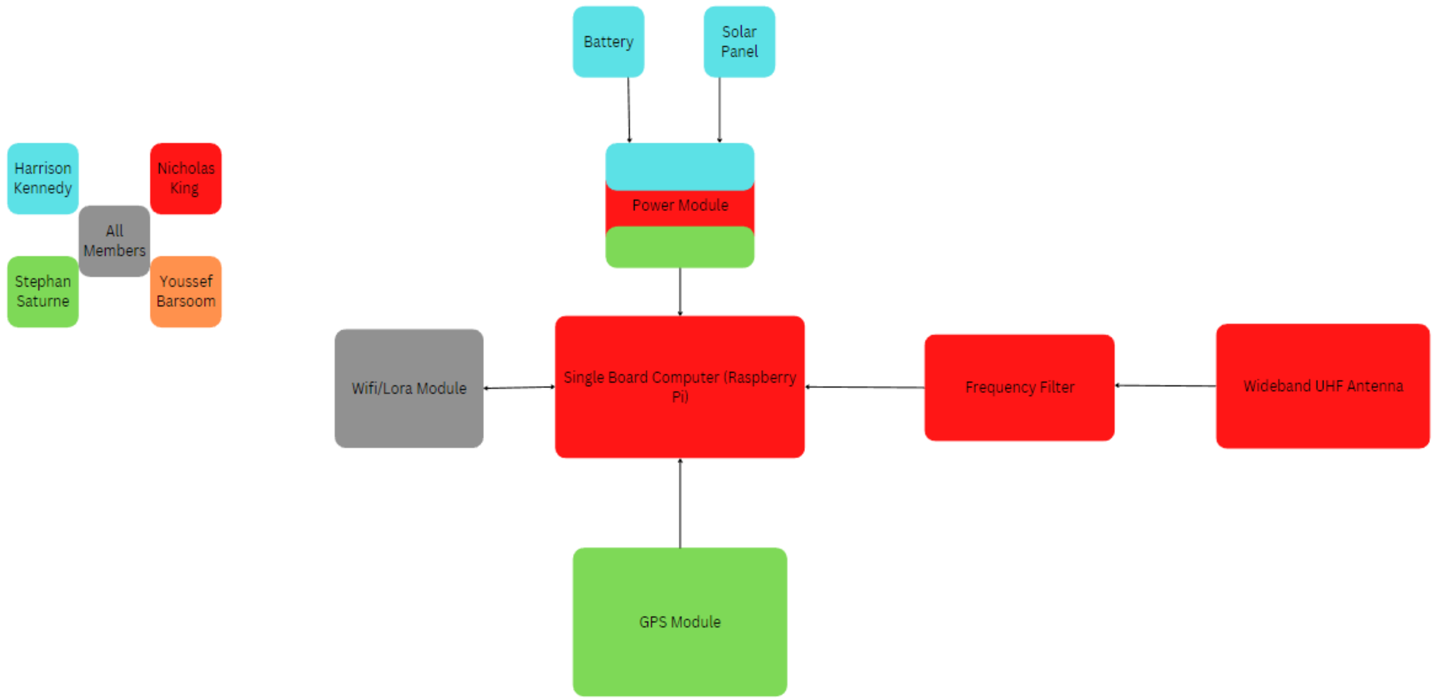


Figure 3: Hardware Block diagram

Module	Description	Responsibility	Block status
Battery	The battery will store excess energy produced by the solar panel during the day and output when the solar panel does not output enough power to run the system.	Harrison Kennedy	To be acquired
Solar Panel	The solar panel will be the main source of power for the system and will charge battery for when the solar panel is nonfunctional	Harrison Kennedy	To be acquired
Power Module	The power module will regulate the amount of voltage and ampere the single board computer receives. May also invert the DC Voltage of the solar panel to AC voltage if necessary.	Harrison Kennedy, Nicholas King, Stephan Saturne	The block is currently being researched
Single Board Computer	The single board computer will take in and process information from the frequency filter and GPS modules and send them to a cloud service using the Wifi/Lora Module.	Nicholas King	Acquired
Frequency Filter	The frequency filter will take in all frequencies collected from the wideband UHF antenna and filter them such that only 1090 MHz and 978 MHz frequencies are received.	Nicholas King	To be acquired
Wideband UHF Antenna	The wideband UHF antenna will receive frequencies and send them to the frequency filter to be filtered.	Nicholas King	To be acquired
GPS Module	The GPS module will send the location of the device to the single board computer.	Stephan Saturne	To be acquired
Wifi/LoRa Module	The Wifi/Lora module will receive data from the single board computer and send it to a cloud service.	All Members	To be acquired

Table 4: Description of each module in the Hardware Block Diagram

5 Estimated Budget

The estimated budget shows the specific cost per unit, quantity, and total cost of each component for the project. Ideally the finished product will fall in the estimated budget, yet the group is prepared for the cost to increase with the unknowns in the project.

Component	Cost per unit	Quantity	Total Cost
Prostick (Filters signal)	$36.99	1	$36.99
Dual Bandpass Filter	$20	1	$20
Microcontroller/ Raspberry Pi	$20-$50	1	$20-50
Wideband UHF Antenna	$14.00	1	$14.00
PCB (EAGLE) w/ electronic components	$10-$50	1	$10.00-$50.00
Battery	$15.00	1	$15.00
Solar Panel	$30.00	1	$30.00
Power Subsystem Components	$10.00	1	$10.00
Wifi/LoRa Module	$10.00	1	$10.00
GPS Module	$30.00	1	$30.00
Device case	$10.00	1	$10.00
Total Cost			$206-$276

Table 5: Projected Budget

6 Milestones

Task	Date	Status	Responsible
Ideas	9 - 10 - 2022	Complete	Group 24
Divide & Conquer 1	9 - 16 - 2022	Complete	Group 24
Divide & Conquer 2	9 - 30 - 2022	In progress	Group 24
60 Page submission	11 - 4 - 2022	N/A	Group 24
100 Page submission	11 - 18 - 2022	N/A	Group 24
Final Document	12 - 6 - 2022	N/A	Group 24

Table 6: Important Deadlines

Month	Progress Description
September	Begin to acquire parts. Talk of different designs and potential features of the device. Finalize plan for desired device design. Continue technology investigation to aid device design and build the foundation of the project report.
October	Begin Eagle Printed Circuit Board design of power supply. Obtain PCB and finish build of device. Begin testing components to ensure they are operating correctly. Continue working on project report (60 pages due 11/4)
November	Begin build of prototype V1 and software alpha 1.0. Finish 100 page report by 11/18.
December	Finalize final report due 12/6. Begin tests of prototype V1 and software alpha 1.0. Start planning the fixes for prototype V2 and software alpha 1.5.
January	Begin build and testing of prototype V2 and software alpha 1.5. Begin planning fixes for both prototype V3 and software alpha 2.0.
February	Begin build and testing of V2 and software alpha 1.5. Prepare fixes for final device V1.1 and software release 1.0.
March	Begin using the final device V1.1 and software release 1.0 to perform final tests and receive all needed data.
April	Any aspects of the project that have not been completed should be completed by the end of the month.
May	Present final project. Turn in the final report.

Table 7: Description of project Milestones on a per month basis