FAMU/FSU College of Engineering
Sponsor – Northrop Grumman

Department of Electrical and Computer Engineering

Functional Decomposition

Team # 302 – Design/Prototype a Multi-Platform Broadband Communication Payload for a Search and Rescue Operation

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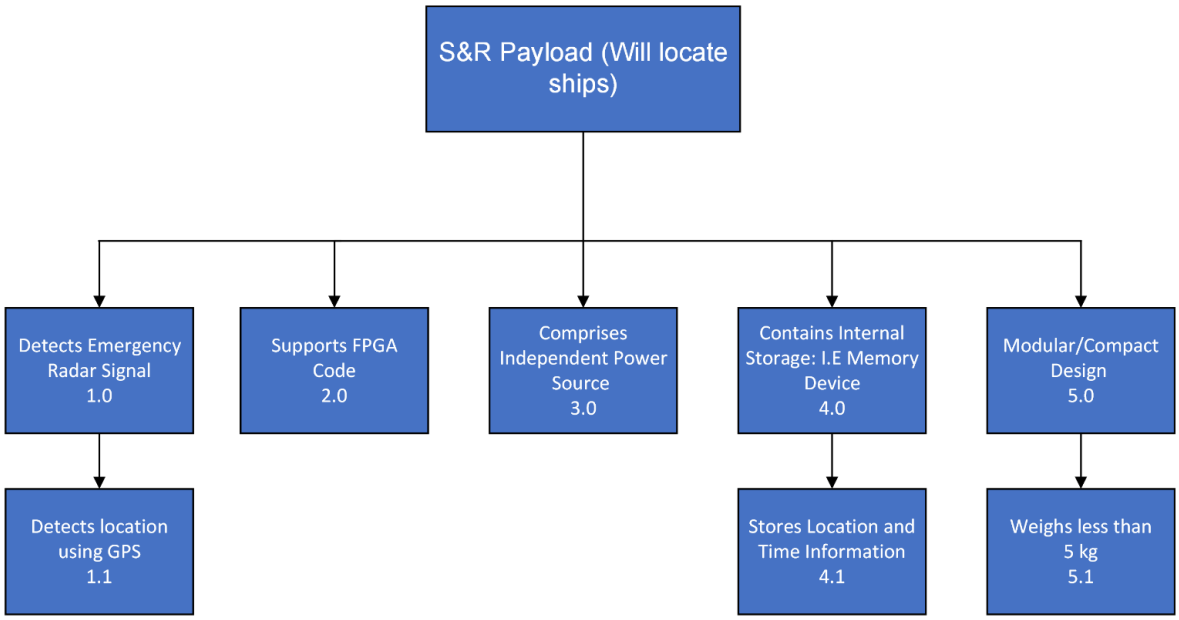
Introduction

The goal of our project is to design a multi-platform communications payload solution for a search and rescue scenario involving several commercial ships and private yachts being stranded off the coast of Los Angeles. The payload will detect the ships' emergency radar signal and store the emitted location and time stamp for later analysis by search and rescue units.

Function Tree



Discussion of Function Tree

The main overall reaching function is a payload design that will detect emergency signals from distressed boats or people at sea. The major functions of this payload consist of detecting the radar signal, supporting fpga code that deals with the signal origin, an independent power source, and a modular/compact design. Beneath these major functions are some sub functions. There are no more subfunctions because the design of the payload will consist only of COTs (commercial off the shelf parts) meaning the parts will not be designed by the team.

Cross Reference Table

Major Functions							
Minor Functions		FPGA Compatible	Detects Emergency Radar Signals	External Power	External Storage	Modular	Needs
	Light Weight		**x**	**x**	**x**	**x**	5,7,3,1
	Water Resistant	**x**		**x**			6,3

Decomposition Levels

Level 0:

S&R Payload (The Main Goal of the Project: A Search and Rescue Drone)

Level 1 Functions:

- Is FPGA Compatible
- Detects Emergency Radar Signals
- Powers Payload Externally
- Connects to External Storage
- Is Water Resistant

Level 2 Functions:

- Detects Location Using GPS
- Is Lightweight
- Stores Location and Time Information

Modules

Level 1:

Payload Power:

Input – Battery power

Output – Power to all modules

Functionality – The design will be powered by a separate power source from the drone.

FPGA Compatibility:

Input – Code from Northrop Grumman and integration code

Output – S&R data

Functionality – VHDL code is integrated onto the FPGA. This code is used to parse S&R signals that will be written onto the onboard memory.

External memory:

Input – Data from detection algorithm and integration code

Output – Whatever data is stored

Functionality – The memory will store the time and location data generated by the integration code and Northrop Grumman's detection algorithm. When the payload is returned to its "home base" the data will be downloaded by S&R teams for analysis.

Level 2:

Emergency Signal Detector:

Input – S&R signals

Output – Data that is transmitted to FPGA

Functionality – The detector's output is an input to Northrop Grumman's Detection Algorithm

GPS Locator:

Input – Power, Operation Code

Output – Location Coordinates

Functionality – The GPS output is an input to Northrop Grumman's Detection Algorithm

Northrop Grumman Detection Algorithm:

Input – GPS and Emergency Signal Detector Data

Output – Location of emitted signal

Functionality – Detects radar signals, checks if it is an emergency signal and calculates its emitted location

Integration Code:

Input – Data from radar detector

Output – Command to run Northrop Grumman algorithm

Functionality – The integration code handles the communication between hardware and software. It will get "told" when a signal is detected and then call Northrop Grumman's algorithm to run. It will then store the algorithm's output in the onboard memory.

Function Decomposition Sourcing

The function decomposition was developed based on the customer requirements. The payload design according to the customer requirements must detect and determine the location of a distress signal. The payload also must be lightweight and have a modular design if it was desired to attach it to something other than a drone. The payload design must also include its own power source according to the customer. Based on the needs a functional decomposition was created for the design.

Summary (Discussion of Functional Diagram)

The payload, physically, consists of a GPS, an external power source, an FPGA, an external storage device and a signal detector. The payload is externally powered, and this is done to not utilize the sparse amount of power the drone already has. The GPS and signal detector are both connected to the FPGA and output location data to it. The code, provided by Northrop Grumman and integrated onto the FPGA by the team, then parses the data and outputs relevant data to the external memory which is then downloaded by Search and Rescue teams for analysis.