Project Kirov Overview

# Description

This project is an open-sourced autonomous vehicle for the Sparkfun Autonomous Vehicle Competition1. It utilizes a Zedboard ([www.zedboard.org](http://www.zedboard.org)) as the central processing/control unit. The goal of this project is a technology demonstration and proof-of-concept for hobbyists. Since it is open-sourced, any and all files related to the project will be released.

# Tracking

Since the project is open-sourced, it was decided that the project will be open to the public to watch work being completed and collaborate. At the time of this writing, only 3 people are working on Project Kirov.

## Trello - <https://trello.com/b/uMJCYQJK>

Trello is used for project management due to simplistic interfacing and a better “overall” conceptual way of assign tasks and determining scope of the project as well as deadlines.

## Github - <https://github.com/stiggy87/Project_Kirov>

Github is used to host all project data: documentation, design files, code files, etc. There are separate “internal” branches for each section: documentation, software, hardware. Forking requests of the Github is limited to collaborators only. The reason for this is to control coding style and make sure no extra bugs are introduced.

# Concept

The concept of Kirov came years ago when Renesas ([www.renesas.com](http://www.renesas.com)) hosted a contest with their microcontroller RX62N development board. The idea was to do a proof-of-concept autonomous blimp/zeppelin with video capabilities. Generally, the applications for the project ranged from military to civilian search and rescue purposes. Since the project fell through due to not qualifying for later phases in the contest and it was shelved until further notice.

Since the contest, Xilinx Inc. ([www.xilinx.com](http://www.xilinx.com)) has released the Zynq-7000 series ([www.xilinx.com/zynq](http://www.xilinx.com/zynq)). This chip is the combination of an ARM Cortex-A9 with an FPGA with a full range of processing applications and seemed like the perfect fit to resurrect the project.

# Subsystems

## GPS & Guidance

The initial GPS subsystem will be utilizing a San Jose Navigation 5Hz GPS sold by Sparkfun Electronics ([www.sparkfun.com](http://www.sparkfun.com)). Generally, GPS has induced error, which this GPS can correct to an extent. It uses UART for communication and supports warm-startup. Since Zynq has built-in UART to the ARM processor, this seems perfect to send to ARM for processing.

## Propulsion

The propulsion subsystem is going to be high CFM fans with variable RPM capabilities. Since the vehicle is a blimp, fans will be used to keep it at a specific low altitude, as well drive it forward. Each fan will have a feedback signal to tell the Zedboard of conditions. The obvious solution looks to be using FPGA fabric to control these fans and let the ARM dictate thrust and direction from GPS coordinates. Since the blimp research was shelved to focus on subsystems, this is no finalized.

## Collision Avoidance

Air collisions for a blimp are usually a death sentence to the device and cost. To avoid poles, trees, buildings, cars, etc. the blimp will be equipped with a few sonar sensors. These senors will most likely go to a central microcontroller for ADC and then send a digital signal to the Zedboard. Since collisions must be avoided at all costs, there will be no specific IRQ interrupt to the Zynq chip, but instead go straight to the FPGA fabric and adjust inputs to the motors directions/thrust as necessary while maintaining its course.

## Video Streaming

One of the systems that Zynq has done well to demonstrate is video streaming capabilities. Utilizing the FPGA fabric for processing and then send the data to ARM for distribution via WiFi/RC. Since the ARM can support being a web server, by designing an ad-hoc network, users at events that are within range could theoretically connect using their smartphones and see what the blimp sees. This is an optional subsystem and might not make the final design due to complexity.

## Other

Other subsystems that are being considered are:

* WiFi/Bluetooth control of the blimp. This allows anyone who is paired with it to fly it
* Basestation feedback. This was an original subsystem to the original concept, but has been removed due to complexity in radio frequency laws and basestation building/design. The idea was to have everything transfer over the 900MHz frequency to a central basestation and let a user control it and add waypoint commands as well receive feedback via video.
* 24/7 flight. The original concept was to have a battery pack designed to run at night, and during the day have solar panels covering the blimp to charge the battery and power the systems. This is not feasible due to costs