Aerial Collision Avoidance System

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beagleboard -xM

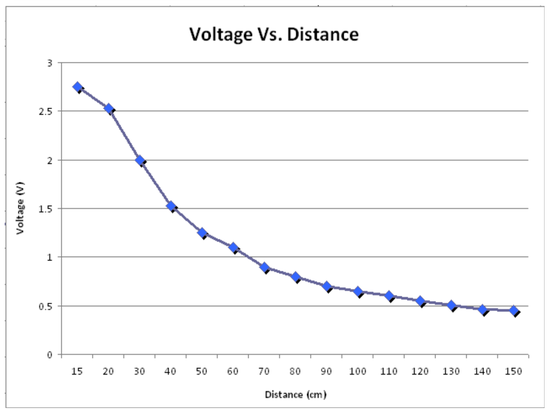
Aircraft X650

The Aerial Collision Avoidance System is designed to implement collision avoidance on a quadcopter platform using minimal sensor input. The project consists of wireless communication system, IR range-finders, a real-time Linux system, and a quadcopter aerial platform. The quadcopter is controlled by a computer connected to the system wirelessly. The Linux system minutely alters given commands to avoid obstacles based on ranging sensor inputs. The system is also designed to keep the aerial platform in place or land it safely in case of communication link breakdown.

IR Sensors

Infrared distance sensors are used to calculate distances to walls or obstacles. They are placed in the 4 cardinal directions, as well as vertical to sense the floor, ceiling, and walls around the copter.

The sensors used have the following specifications:
Effective Distance: 15-150cm
Output Voltage: 0-3V
Supply Voltage: 5V



Xenomai / Angstrom Linux

Linux – Open Source computer operating system designed around efficiency and free software.

Angstrom – Linux distribution created for embedded devices. Provides a low power desktop experience.

Xenomai – Real-time framework patches for the Linux kernel. Provide accurate timing necessary for PWM generation at specific intervals.

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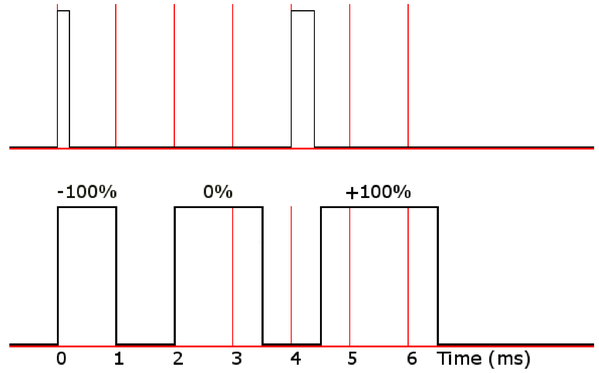
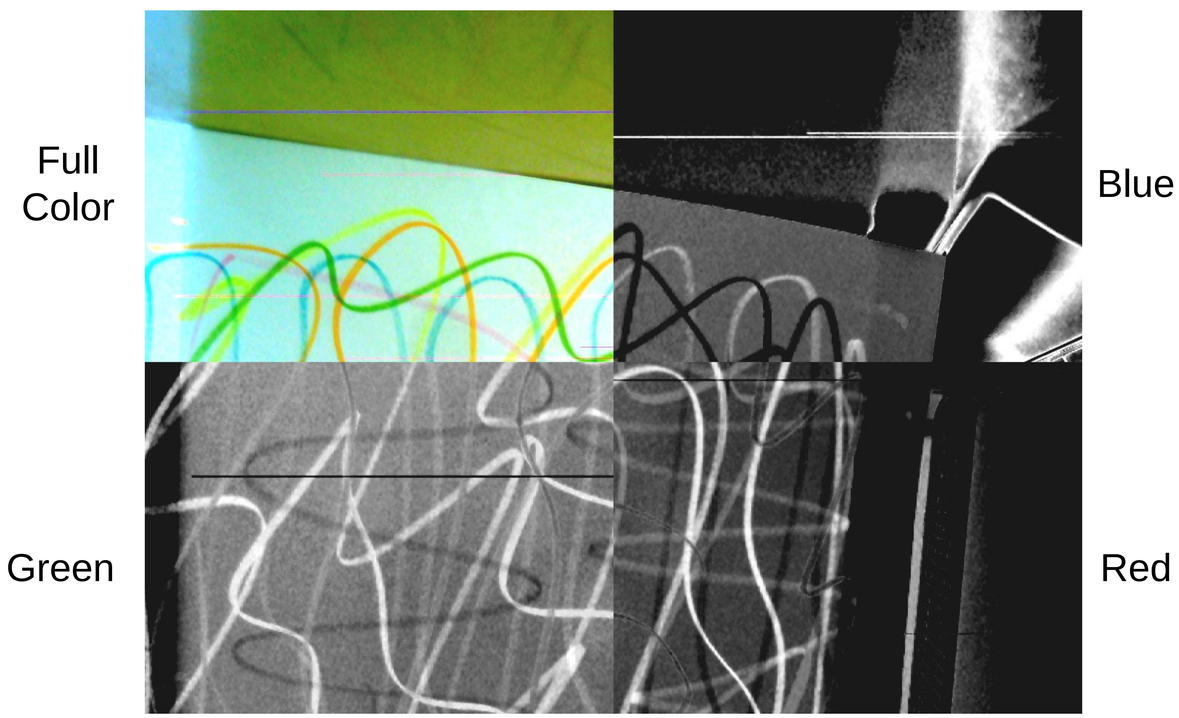
Servo Communications

The Beaglebaord xM communicates with the X650 platform flight controller via an industry standard PWM method. Pulses are created using a 50Hz frequency where the width of the pulse between 1ms and 2ms indicates a value between -100% and +100% width. The remaining time in the 20ms cycle is 0V. This is shown in the figure below.

Our copter uses four of the PWM channels for the four channel normally used by an RC transmitter/ receiver combo.





Color Distance

Imaging Processing

Image processing capabilities are demonstrated in this image using a color distance algorithm.

Color distance is used to determine how far away a pixel's color is from a given color. The images are processed in the RGB additive color domain. The equation is as follows:

Distance = 255 - Floor(Sqrt(dR*dR + dG*dG + dB*dB))
dR = Difference in Red
dG = Difference in Green
dB = Difference in Blue