Wright State University High Altitude Balloon Team: Software Defined Radio

Team Radiohead
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April 22, 2011
Outline

- Goal
- Progress
  - SDR – Digital Video Broadcast
  - Stand alone device
  - Balloon Teams
- Future Work
- Conclusion
Goal

- Provide Wright State University High Altitude Balloon team with a stand alone software defined radio communication system.
- Researched the feasibility of an FPGA based system or a computer on module system.
- Implement system.
Digital Video Broadcast

- Successfully transmitted digital video (winter 2011)
- Prototype Testing
  - Laptops connected to USRP1
- Test Results
  - Great Resolution: 1280 x 1024
  - Acceptable Framerate
  - Familiarized with DVB software
Progress: SDR

Software Defined Radio

The DVB system

Transmitter

Receiver
Progress: SDR
Progress: Standalone Device

- FPGA Design Feasibility
  - Implementation methods
    - Linux
      - Linux operating system
    - IP Cores – Informational Property Core
      - Build Individual logic units to process the data
        - Encoding
        - Signal Processing
        - Device Control
Progress: Standalone Device

- Roadblocks to FPGA
  - Hardware – expensive ($900 - $6000)
  - Software
    - Compatibility issues
    - Steep learning curve

- Outcome
  - Due to cost and time constraints, pursue Computer on Module design
Beagleboard

- **Computer on Module**
  - A type of single board computer (embedded system)
  - Concept lies between a full-up computer and a microcontroller in nature
  - Small in size: 3in x 3in

- **Specifications**
  - Reasons for selection

- **Procedure**
Beagleboard

Specifications

- OMAP 3530 Processor
  - OpenGL 2D/3D graphics accelerator capable of rendering 10 million polygons per second
- TMS320C64x+ DSP
  - HD video capable
  - 430 MHz
- Runs on 5 V
- Completely open source design
Beagleboard

- Procedure
  - Runs linux
    - Ubuntu Netbook Edition
  - Install SDR software
  - Mimic DVB laptop setup
  - Garmin 15L GPS (RS232)
DVB Transistion

- Digital video transmission
  - Achieved and tested Digital Video Broadcast last quarter
  - Linux compatible OMAP processor simplifies duplication of system on new architecture
GPS Integration

- GPS data transmission
  - Garmin 15L
  - Researching methods to interface between GPS and Beagleboard
    - Develop device driver using free RS232 port
Progress: Balloon Teams

- Working closely with mechanical engineering team ‘Chutes and Giggles’
  - Team Leader: Edward McGovern

- Tasks Completed:
  - Target launch date: 04/30/2011
  - Developed flight procedure
  - Designed electrical system
  - Initial wiring and testing

- Tasks Remaining:
  - Cable fabrication
  - Final wiring and device mounting
Flight Procedure

- Launch Date: 4/30/2011

Diagram:

1. Balloon
2. Zero Tension Release (Mechanical Device)
3. Command Package
4. Mechanical Engineering Team Ballute
Flight Procedure

- 30,000 Feet

Nichrome Burn 1: ZTR Safety
Flight Procedure

- 85,000 Feet
Flight Procedure

- Ballute at 65,000 Feet
Flight Procedure

- Approximately 100,000 Feet

Balloon Burst → [Diagram]

ZTR Activation → [Diagram]
Flight Procedure

- Approximately 100,000 Feet
Ballute Payload Wiring

Ballute

Nichrome Housing
Future Work

- Finish transitioning to Beagleboard
- Develop GPS device driver
- Prepare for Balloon Launch
  - Install devices
  - Complete wiring
  - Launch balloon
Questions?

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