Development of an Unmanned Aerial Vehicle Platform Using Multisensor Navigation Technology

Never Stand Still

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Overview

- Motivation
- Introduction to the UAV platform
- Applications
- Concluding remarks

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Why?

- Because it can be done easily...
- Resources are available...
- Facilitates a range of navigation projects...

Requirements of a UAV nav board platform

Significant processing capability on-board.

Control and monitor UAV:

- Interfacing to sensors and other hardware
- Digital signal processing and system control in real-time
- Manipulating flight control surfaces of aircraft
- Process commands from ground control station

Perform other functions:

- Extend capability to support different applications, such as imaging missions

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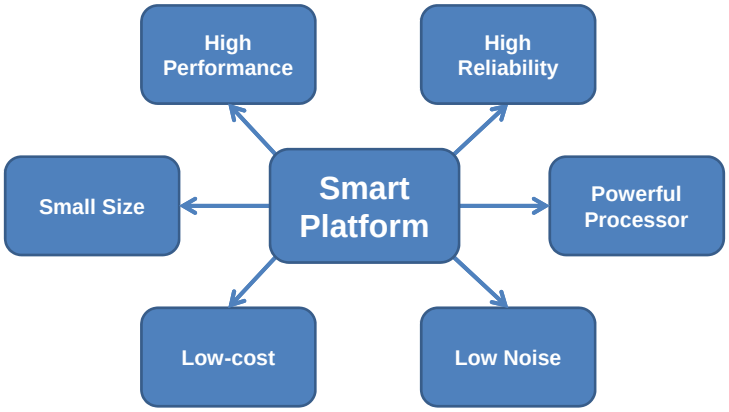
Our requirements are…



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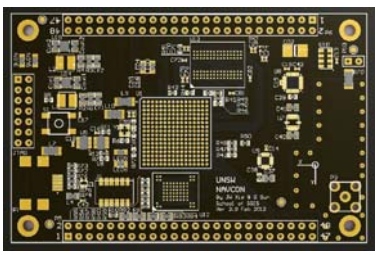
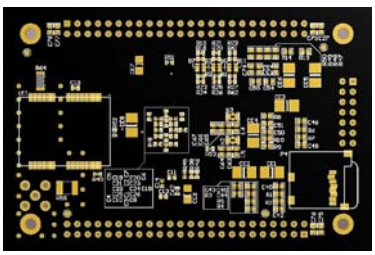
UAV nav board platform

NAVCON:

- multisensor navigation technology
- small size: 85mm×55mm×15mm
- 8 layers PCB board



Front



Back

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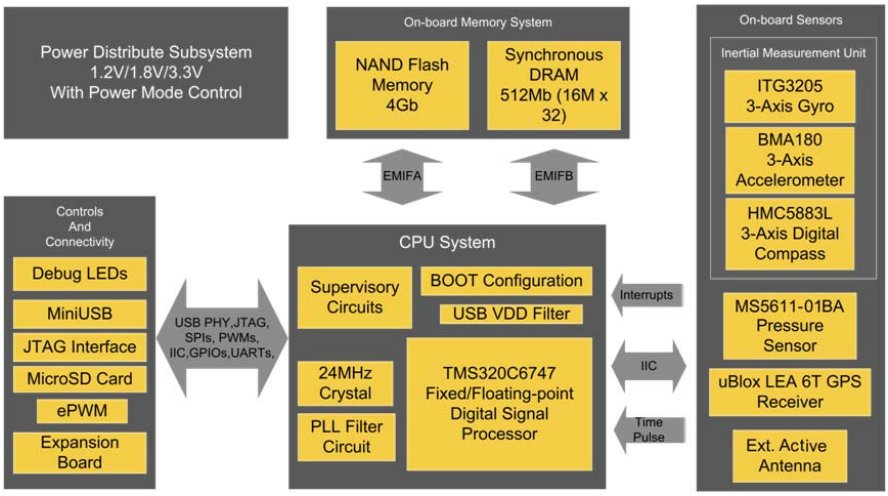
Hardware...



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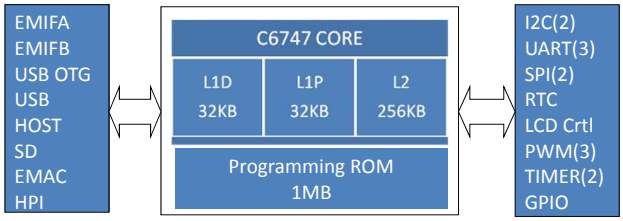
Processor

The digital signal processor:

- TMS320C6747 (from Texas Instruments)
- Runs at 300MHz (max. 375MHz) clock speed
- Superior signal processing and matrix calculation capability
- Rich on-chip resources



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Memory

SDRAM: IS42S32160B-7BL (ISSI)

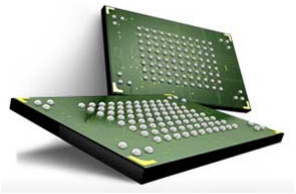
- 512Mb, 32bit, SDR SDRAM
- Support complex matrix calculations

NAND FLASH: MT29F4G08 (MICRON)

- 4Gb, 8bit, NAND FLASH
- For program and data storage

Micro SD Card

- Small size
- Real-time data logging



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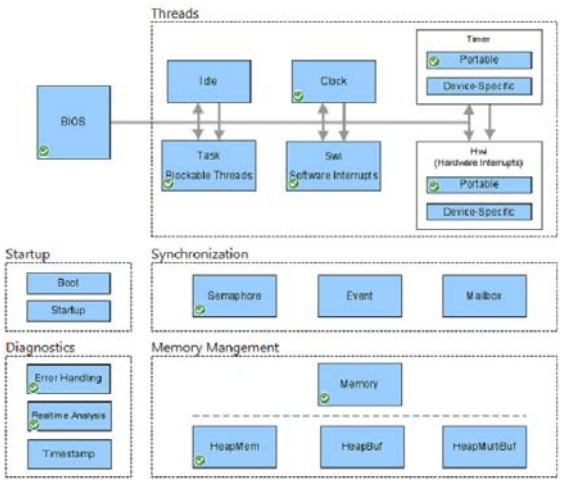
Operating system

- DSP/BIOS real-time operating system from Texas Instruments
- Development tool CCS4.x



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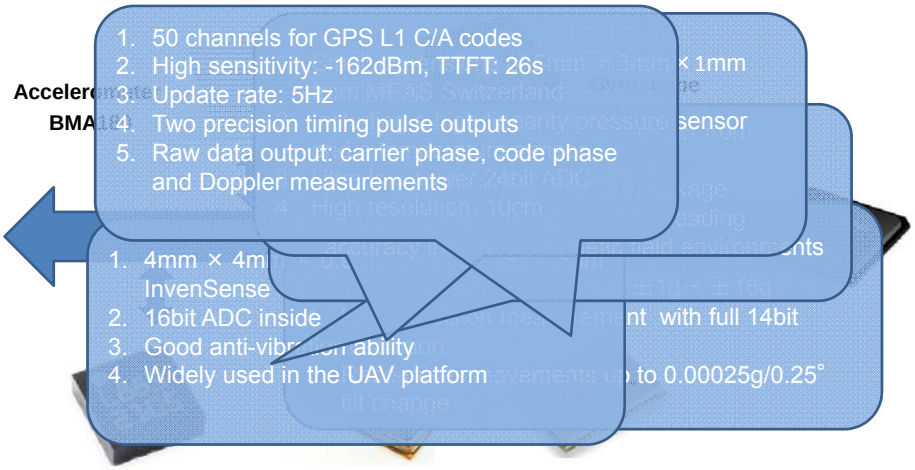
Sensors



Magnetometer HMC5883L | **Pressure Sensor MS5611-01BA03** | **GPS Receiver LEA-6T**

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Specifications...

Accelerometer	Zero-g offset(fine tuning): ±5mg Zero-g offset temperature drift: ±0.5mg/K Noise density: 150 – 200ug/√Hz Nonlinearity: ±0.15 – ±0.75%FS
Gyroscope	Initial ZRO tolerance: ±40° /s Temperature nonlinearity: 0.2% Noise density: 0.03° /s/√Hz
Magnetometer	Sensitivity: 4.3mgauss/digit Compass heading accuracy: 1° ~ 2°
Pressure sensor	High resolution: 10cm Accuracy(std.): ±1.5mbar Error band: ±2.0mbar
GPS receiver	Horizontal accuracy: 2.5m Velocity accuracy: 0.1m/s Heading accuracy: 0.5° Time pulse signal accuracy: 30ns (15ns after compensation)

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Peripheral interface & expansion board

Interfaces:

- USB
- JTAG
- UARTs
- I2C
- SPI

Expansion board:

- Wi-Fi module
- Radio Frequency Identification (RFID) receiver
- FTDI
- Co-processor for radio input sampling and control of digital servos

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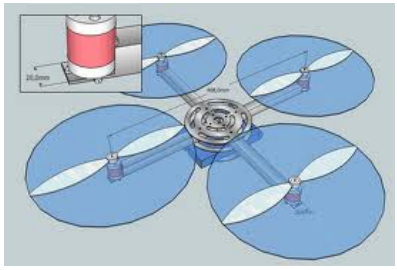
Aircraft options...

RC Helicopter

Quadrotor



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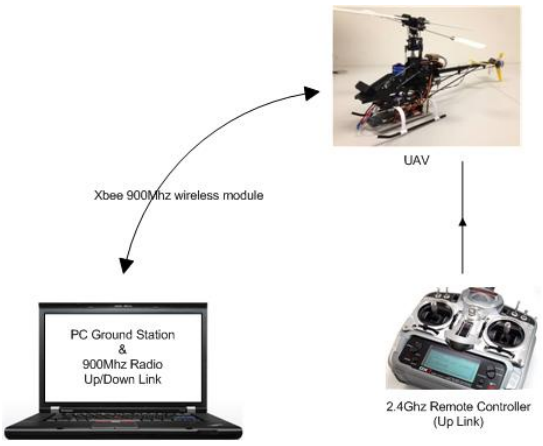
Wireless communication & ground control



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Project applications of NAVCON

1. MEMS IMU

- **Attitude measurement**
- **Ground vehicle navigation**
- **Pedestrian location and navigation**
- **Gait measurement and analysis system**

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2. Integrated GNSS/INS navigation

- **Tightly integrated navigation with LEA-6T**

- **Ultra tightly integrated navigation with NAMURU**

The processor can access the raw analogue signals, if LEA-6T replaced by UNSW's GNSS FPGA receiver "NAMURU" V3.3.

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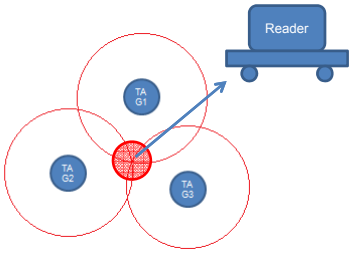
3. Indoor positioning

- **Wi-Fi module**
- **RF module**



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Concluding remarks

- Developed a new UAV platform with custom designed nav board
- Powerful processing capability and good versatility
- Extensible system architecture
- Can support a number of student project navigation-based applications
- Can be used also for non-UAV projects

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Benefits?

- Demonstrates end-to-end process and highlights individual sensor technologies...
- Multidisciplinary efforts...
- Puts robotics and control systems in hands of geospatial students and researchers...

Thank you for your attention!

Questions?

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