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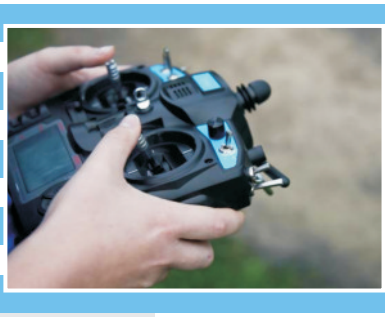
Designing Drone Electronics using Nano SOM


Overview

The arena of Unmanned Aerial Vehicles (UAVs) has for many years been dominated by the defence sector. The primary reason being their complexity, cost for designing, and the construction & operation of these vehicles. However, in recent years drones have evolved from simple, radio-controlled toy aircrafts into sophisticated, feature-rich systems that can perform a myriad of functions. They cater to a range of applications like photography, sports, media, traffic monitoring, security and surveillance, inspections, farming and logistics. High-quality image/video capture is one of the key requirements for these applications and to address this image/video capture and media streaming requirement, a compact, small form factor, light-weight yet powerful hardware is required.

The i.MX6 Nano SOM from Mistral is a small form factor System-on-Module built around the powerful 800MHz i.MX6 Dual/Quad Core, ARM Cortex A9 SoC from NXP (earlier Freescale). Based on a complete “System-on-Module” architecture, the Nano SOM consists of the SoC, PMIC, LPDDR2, eMMC, wireless connectivity and provides high processing power. Designed using a micro-BGA (0.4mm Pitch 12mm x 12mm) i.MX6Q/D SoC using PoP (Package on Package) memory assembly to ensure compact package and with a PCB size of just 44mm x 26mm, this is one of the smallest SOMs available in the market currently.

This application note gives a technical perspective on how the i.MX6 Nano SOM can be adapted to meet the technical and functional requirements for designing drone electronics and ground station electronics.

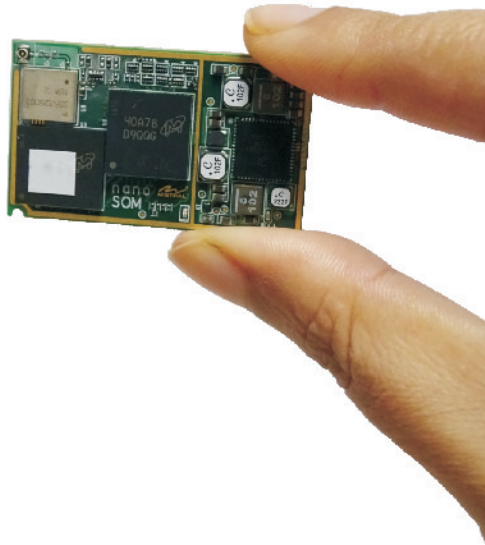
Basic Configuration of the Nano SOM

The Nano SOM from Mistral is a small form factor, high-performance, low cost, ready-to-use System on Module (SOM) built around the powerful 800MHz Quad/Dual Core i.MX6 SoC from NXP. The i.MX6 offers extensive integration capability such as dual camera, LCD, PCIe, HDMI output, NOR flash, Ethernet, Audio and easily deployable architecture that favours fast time-to-market.

Features

Hardware

- i.MX6D/Q800MHz ARM Cortex A9 processor
- 1GB LPDDR2 PoP memory
- Wi-Fi + BT 4.0 Module
- 8GB eMMC
- Can be operated by powering up from a battery
- Weighs < 8 Grams



Software

- Linux Kernel 4.1
- Android
- Yocto BSP
- u-Boot 2015.04

Design Considerations

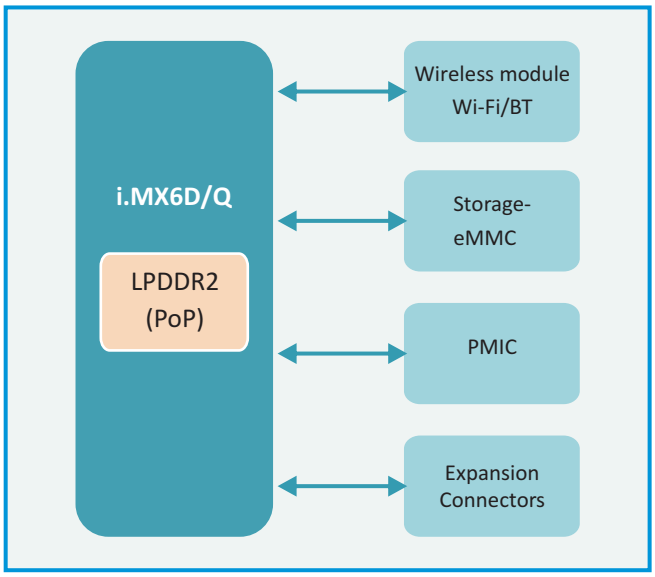
In this section, we will focus on some of the points that need to be taken into consideration while designing the electronics sub-system for a Drone and its Ground Control Unit. The electronic sub-system of a drone needs to be compact in size, light-weight, battery operated and have high processing capability. The i.MX6 Nano SOM is a high performance unit which meets the above mentioned requirements. Both the drone and the ground control unit can be designed around Nano SOM.

The Nano SOM has i.MX6D/Q core processor, which provides high processing power and Wi-Fi/BT module through which the video (1080p@30 fps) data can be streamed. The data from the drone can be sent to the Ground Control Unit through RF communication or wired communication technology, as desired. Data received from the drone can be processed and connected to LCD display that is powered by the Nano SOM.

Most of the interfaces of i.MX6D/Q are terminated onto the expansion connector of Nano SOM like HDMI, EIM, CSI, and Display, which are integral components required for the drone design to be realized. Different carrier cards can be designed for the ground control unit and the drone depending upon the interface requirements.

The development platform for the Nano SOM, called the VISE Board, consists of a carrier board along with the Nano SOM. The VISE Board provides interfaces such as camera, NOR Flash, HDMI, LVDS etc., & can be used for prototyping. The carrier board design can be modified to fit the custom interfaces as per the requirement of customer or the requirements of the product.

Nano SoM Architecture



With the VISE Board as the common development platform, one can use the same Nano SOM for both the Ground Control Unit as well as for the drone. The use of a common module reduces software porting and software compatibility overhead which in turn reduces time-to-market. A single BSP can be used in both UAV and Ground Control Unit.

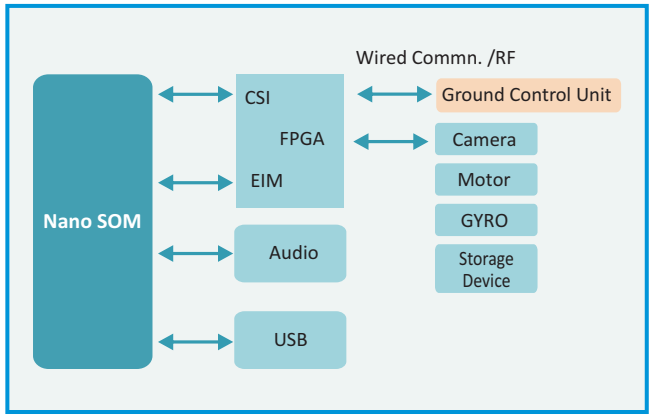
Product Implementation Approach

This section will focus on the implementation of drone and the Ground Station using the i.MX6 System-On-Module from Mistral Solutions.

Below are two block diagrams which showcase the top-level architecture for the drone and the ground control station. As discussed in the feature list, the Nano SOM already has most of the important blocks required for the UAV.

In this example, we are looking at adapting the Nano SOM to design a drone with self-navigation features. The GCS unit is for data acquisition and storage and can also override the self-navigation feature of the drone.

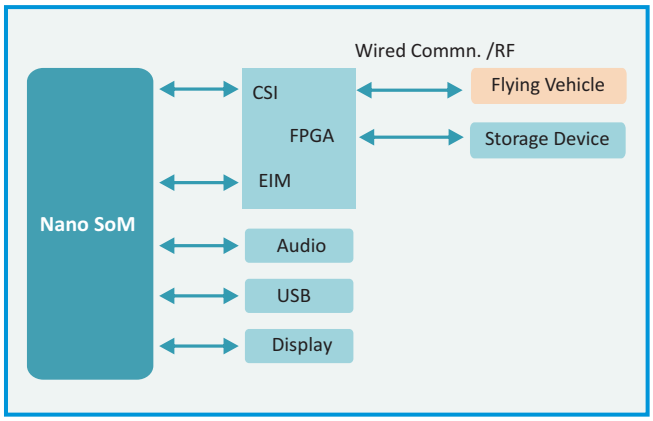
Drone Architecture



For this application, we can design a custom board for the Drone using a FPGA to implement the logic for taking in the multiple camera & sensor inputs, required for self-navigation; formatting the data and sending the same to the Nano SOM. The Audio functionality is implemented to capture and transfer the data to ground system.

The USB port is used for retrieving stored information and also to provide charge for the battery powered system based drones. The Nano SOM is utilized to capture the video stream from various cameras & packetize the video data to be sent from the Drone to the GCS.

Ground Control Architecture



We can also design a custom board for the ground control system using a FPGA to implement the logic for acquiring the streamed camera data and formatting the same to be sent to the Nano SOM camera port.

The Nano SOM here can also be configured to display the captured data to the LCD/Display interfaced on the GCS. Audio functionality can be implemented in the Ground system as an output requirement to transfer the data to the Audio system. The USB port is used for collecting and transferring stored information to a host and also to provide charge to the battery powered ground stations.

The Nano SOM modules can be validated using the Mistral VISE Board (Nano SOM + standard carrier board) which can be used for rapid prototyping before full-fledged product development.

The VISE Board comes with the following software functionalities:

- Linux Kernel with support for various interfaces like I2C, MIPI CSI, GPIO, SPI, UART, SD/MMC, Ethernet, Display Sub-system, USB Host and USB OTG
- Support for WLAN and Bluetooth Stack
- Support for 9-axis sensor
- Support for Dual camera
- Support for HDMI and LVDS output
- Support for SD and eMMC boot
- QT support for application development
- Security features which can be enabled to protect data.

Using these functionalities, the existing BSP can be customized for the drone and the GCS and the necessary middleware and application components can be developed and integrated to realize the complete functionality for the drone and the GCS.

The key advantages of the Nano SOM for implementing drone designs are:

- Powerful Quad/Dual Core ARM Cortex A9 Processor
- Comes with sufficient memory and power required for getting the OS and peripheral functionalities mapped
- Most of the interfaces needed for Drone and Ground Control Unit are terminated on expansion connectors
- It provides support for 1080p @ 30 fps video recording
- Wi-Fi IEEE802.11 a/b/g/n paves way for video streaming
- BT4.0 for short range communications
- Light-weight module.

Mistral's Expertise

Mistral offers bespoke design and development services for Drone Electronics for a wide range of applications. Mistral's expert team of engineers have helped several customers realize their drone designs with the development of smart, compact and power efficient electronics systems and the related software for the same (BSP and Apps).

Mistral's range of expertise in Drone electronics includes embedded applications, software design and development, multi-sensor integration, wireless connectivity, power and battery management, design of hardware for small form factor and multi-board designs, cloud/web application development services and FCC, CE, UL Certification.

About Mistral

Mistral is a technology design and systems engineering company providing end-to-end solutions for product design and application deployment. Mistral is focused two business domains: Product Engineering Services and Defense & Homeland Security. Mistral provides total solutions for a given requirement, which may include hardware board design, embedded software development, FPGA design, systems integration and customized turnkey solutions. Mistral's strategic partnerships with leading technology companies help provide customers with a comprehensive package of end-to-end solutions.

Mistral's Product Engineering Services are delivered through a proven development process, designed for embedded product development. Mistral's hardware and software team works together in a seamless manner providing expert product designs covering board and FPGA Designs, BSP & Firmware developments, Embedded Application developments, integration of 3rd party solutions, Verification/Validation, Product prototyping, Production coordination and Product Sustenance services.

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