Low Cost Tablet Design: Technical Challenges

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The advent of iPad has created the category of devices called Tablets. Tablets are becoming the fourth screen at home, after the TV, the PC and the Smartphone. Tablets are used for browsing, email, games and many innovative applications enabled by the App marketplace. Some of the key advantages of tablets compared to traditional PCs are: instant-on access, portability, many hours of battery back-up and downloadable applications. Tablets' price points range from $700 for a 3G enabled high end version with near 10" screen such as the latest iPad to the sub $100 version with a 7" screen. In this article we are going to focus on the low cost tablet market and the technical challenges of building such a device.

Low cost tablet market

Let's define low cost tablets as the ones with a retail price of less than $100. This means the screen size needs to be 7"and not 10". So far these low cost tablets can only sport a resistive touchscreen instead of a capacitive one due to pricing pressures. The CPU & memory choices also reflect the pricing pressure: All low cost tablets use a single core ARM based CPU and not a multi-core one; the RAM capacity also cannot exceed 256MB. These restrictions have meant that the consumer experience of a sub $100 tablet is not on par with his or her expectations. This has posed a major hurdle to the mass adoption of these devices by end consumers.

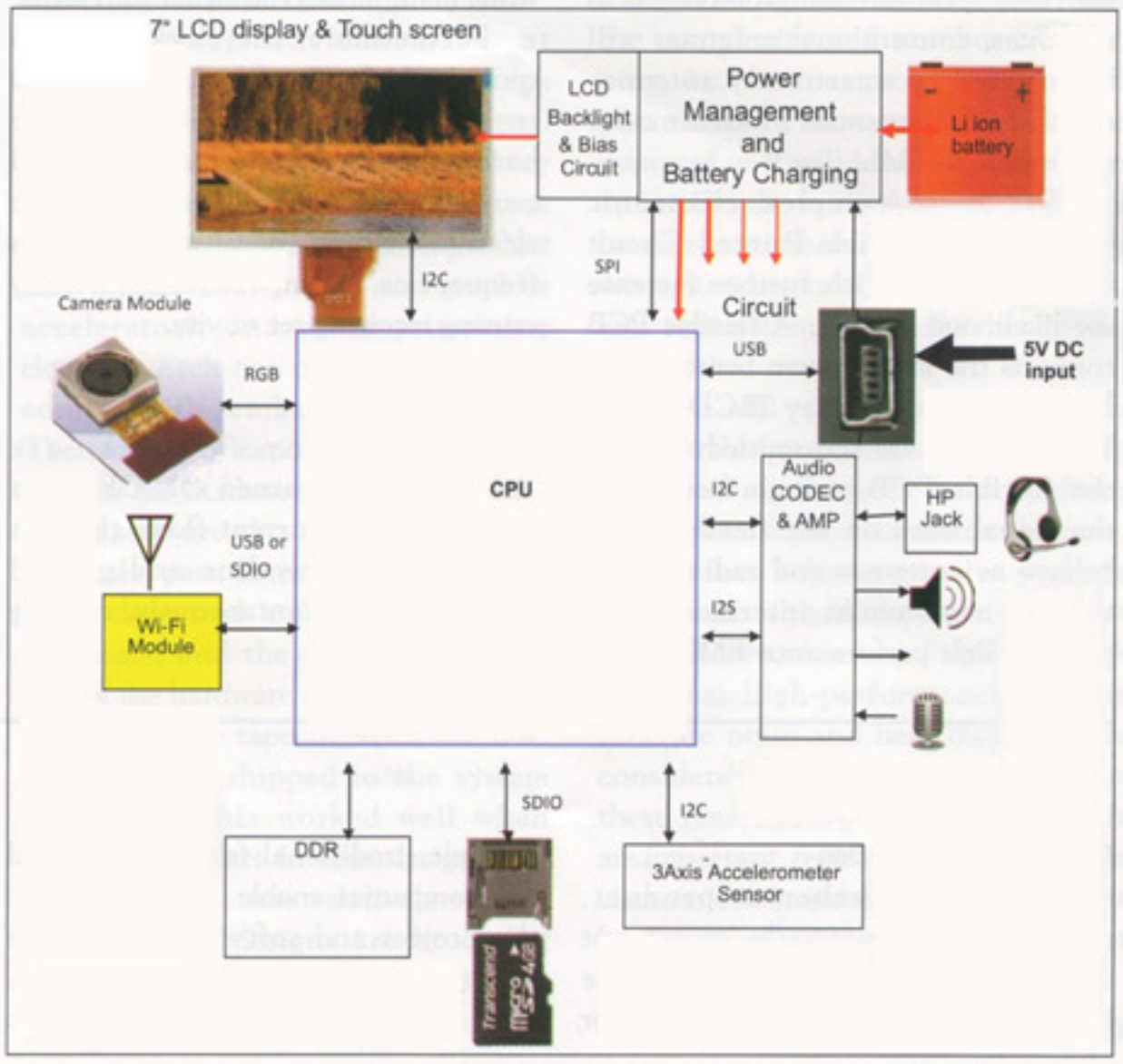
However, there are many uses for a device with 7" touch screen running the Android OS outside the consumer market: it can be a data entry device such as for census taking and logistics purposes; it can provide a terminal for online test centres with their multiple choice type questions; it can be a portable terminal for medical practitioners in hospitals for entry & instant retrieval of patient data. These B2B markets' price / performance expectations are met by the low cost tablets, and thereby these markets provide a fertile ground for low cost tablets to succeed.

Technical challenges facing the designer

Before we analyze the key technical challenges in designing a low cost tablet, let's understand the various components of the product. The block diagram below should serve as the reference for the following discussion.

The diagram shows the key components of a low cost tablet. They are:

- CPU
- RAM - DDR memory
- Solid state storage (NAND Flash and/or SD card)
- LCD panel
- Touch screen
- WiFi
- Battery



- Power management and charging circuit
- Audio codec & amplifier
- Optional accessories (Camera, Accelerometer, 3G modem etc)

In addition, the choice of the Operating System (OS) is another key technical factor.

Let's look at technical challenges in each of these aspects.

CPU: The choice of CPU falls essentially to one of the three: ARM based, Intel, or MIPS based. The combination of price competitiveness, power efficiency and availability of multiple silicon vendors gives ARM a clear advantage in the market place. CPUs with a single ARM-Cortex A8 core running at or below 1GHz would be the preferred choice for low cost tablets in the medium term. Key additional requirements for the CPU would be internal hardware accelerators for HD video and 2D/3D graphics.

Memories: Most low cost tablets would use DDR2 or DDR3 memories. The size of the memory depends purely on the price. Minimum of 256MB is required to run the Android OS with a decent set of applications.

Solid state storage: Non-volatile solid state memory is required to store the OS, applications as well as user contents. With many modern CPUs able to boot from SD card, a single SD card which serves for both code storage and user data may suffice. If there's need for providing an externally replaceable SD card for user data, then the code storage will be NAND Flash or internal SD Card. Nand Flash is preference for internal storage as it cannot be easily removed. Typical SD card size bundled with low cost tablets ranges from 2GB to 8GB.

LCD panel: A 7" LCD with 800x480 pixels resolution is the most used choice in low cost tablets. With LCD being the costliest component of the system, LCD resolution, optical characteristics, thickness and back light brightness become compromises in the race to reduce overall cost.

Touch screen: There are mainly two types of touch screens: resistive and capacitive. Resistive screens typically need harder and pointed presses as with a stylus. Capacitive touch screens can take soft touches with human fingers. Capacitive touch screens are also available with multi-touch feature that allows the gestures such as zoom, pinch etc which are very handy for consumer usage. This makes capacitive touchscreen the preferred choice of the consumer. However, resistive screens are significantly cheaper than capacitive ones (by about $10). Ultra-low cost tablets so far have used resistive touch screens due to the cost factor. However, the cost of capacitive touch screens is falling. Along with advances in touch screen technology, this makes it possible and even likely that low cost tablets in the near future will be able to sport capacitive touch screens.

WiFi: There are two options for WiFi connectivity: USB based or SDIO based. It is typically observed that USB modules are available at a lower price compared to SDIO because the former has higher production volumes. But is the USB option consumes higher power compared to the SDIO one.

Battery: Lithium Ion batteries are most common across mobile and tablet markets. Cost of battery is determined by its capacity (mAh), additional protection features required, and physical shape. Batteries with higher capacity and thinner shape cost more.

Power management and charging: The power management IC controls the various external devices for turning on/off and putting in stand-by. It accomplishes this task in conjunction with the CPU. It also interacts with the charging circuit and battery to control when and how fast the battery gets charged. Some of the modern CPUs have built-in basic power management and charging circuit that reduce overall system cost.

Audio codec & amplifier: Audio codec can either be a separate external device or be combined with the Power Management IC or even the CPU. So, is the case with the Headphone Amplifier.

Optional features: While accelerometer can be optional, it is getting more standard with the recent low cost tablets. So is the case with the camera sensor. However, the price pressure of the low cost tablets does not allow a built-in 3G modem within the tablet device.

Choice of OS: All low cost tablets today run the Android OS. It is free, has an App store with many free applications and the Honeycomb version is designed with tablet use in mind. While higher priced tablets will likely start running Windows 8 starting the end of 2012, the possibility of any other OS replacing Android is remote in the near future in the low cost tablet market segment.

Conclusion

We discussed the multiple technical challenges facing the designer of a low cost tablet. However, the chief among them is implicit: What trade-off can be made in the decision of price Vs performance? The effect of this trade-off manifests itself in key decisions: quality of the LCD panel (resolution, optical characteristics, backlight), the choice of touchscreen (resistive or capacitive; sensitivity to touch, multi-touch), battery life (power consumption of components, battery capacity), CPU selection (MHz, video or graphics performance), memory and solid state storage size. How the engineer and the procurement specialist together address these trade-offs will make or break the product.