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Recent Trends in Embedded System in Electronic and Communication

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ABSTRACT

The embedded systems industry was born with the invention of microcontrollers and since then it has evolved into various forms, from primarily being designed for machine control applications to various other new verticals with the convergence of communication.Various classes of embedded systems such as home media systems, portable players, smart phones, embedded medical devices and sensors, automotive embedded systems have surrounded us and with continued convergence of communication and computing functions within these devices, embedded systems are transforming themselves into really complex systems, thus creating newer opportunities and challenges to develop and market more powerful, energy efficient processors, peripherals and other accessories

KEYWORDS Embedded systems, Consumer Electronics, ruggedness

An embedded system is a computer system with a dedicated function within a larger mechanical or electrical system, often with real-time computing constraints. It is embedded as part of a complete device often including hardware and mechanical parts. Embedded systems control many devices in common use today. Ninety-eight percent of all microprocessors are manufactured as components of embedded systems.

Modern embedded systems are often based on microcontrollers (i.e. CPUs with integrated memory or peripheral interfaces), but ordinary microprocessors (using external chips for memory and peripheral interface circuits) are also common, especially in more-complex systems. In either case, the processor(s) used may be types ranging from general purpose to those specialized in certain class of computations, or even custom designed for the application at hand. A common standard class of dedicated processors is the digital signal processor (DSP).

Since the embedded system is dedicated to specific tasks, design engineers can optimize it to reduce the size and cost of the product and increase the reliability and performance. Some embedded systems are mass-produced, benefiting from economies of scale.

Embedded systems range from portable devices such as digital watches and MP3 players, to large stationary installations like traffic lights, factory controllers, and largely complex systems like hybrid vehicles, MRI, and avionics. Complexity varies from low, with a single microcontroller chip, to very high with multiple units,peripherals and networks mounted inside a large chassis or enclosure.

Varieties

- Embedded Computer Sub-Assembly for Accupoll Electronic Voting Machine.
- Embedded systems are commonly found in consumer, cooking, industrial, automotive, medical, commercial and military applications.
- Telecommunications systems employ numerous embedded systems from telephone switches for the network to cell phonesat the end user. Computer networking uses dedicated routers and network bridges to route data.
- Consumer electronics include personal digital assistants (PDAs), mp3 players, mobile phones, videogame consoles, digital cameras, DVD players, GPS receivers, and printers. Household appliances, such as microwave ovens, washing machines and dishwashers, include embedded systems to provide flexibility, efficiency and features. Advanced HVAC systems use networked thermostats to more accurately and efficiently control temperature that can change by time of day and season. Home automation uses wired- and wireless-networking that can be used to control lights, climate, security, audio/visual, surveillance, etc., all of which use embedded devices for sensing and controlling.
- Transportation systems from flight to automobiles increasingly use embedded systems. New airplanes contain advanced avionics such as inertial guidance systems and GPS receivers that also have considerable safety requirements. Various electric motors — brushless DC motors, induction motors and DC motors — use electric/electronic motor controllers. Automobiles, electric vehicles, and hybrid vehicles increasingly use embedded systems to maximize efficiency and reduce pollution. Other automotive safety systems include anti-lock braking system (ABS), Electronic Stability Control (ESC/ESP), traction control (TCS) and automatic four-wheel drive.
- Medical equipment uses embedded systems for vital signs monitoring, electronic stethoscopes for amplifying sounds, and various medical imaging (PET, SPECT,CT, MRI) for non-invasive internal inspections. Embedded systems within medical equipment are often powered by industrial computers.
- Embedded systems are used in transportation, fire safety, safety and security, medical applications and life critical systems, as these systems can be isolated from hacking and thus, be more reliable. For fire safety, the systems can be designed to have greater ability to handle higher temperatures and continue to operate. In dealing with security, the embedded systems can be self-sufficient and be able to deal with cut electrical and communication systems.
- A new class of miniature wireless devices called motes are networked wireless sensors. Wireless sensor networking, WSN, makes use of miniaturization made possible by advanced IC design to couple full wireless subsystems to sophisticated sensors, enabling people and companies to measure a myriad of things in the physical world and act on this information through IT monitoring and control systems. These motes are completely self-contained, and will typically run off a battery source for years before the batteries need to be changed or charged.

- Embedded Wi-Fi modules provide a simple means of wirelessly enabling any device which communicates via a serial port.

Characteristics

- Embedded systems are designed to do some specific task, rather than be a general-purpose computer for multiple tasks.
- Some also have real-time performance constraints that must be met, for reasons such as safety and usability; others may have low or no performance requirements, allowing the system hardware to be simplified to reduce costs.
- Embedded systems are not always standalone devices. Many embedded systems consist of small parts within a larger device that serves a more general purpose.
- For example, the Gibson Robot Guitar features an embedded system for tuning the strings, but the overall purpose of the Robot Guitar is, of course, to play music.
- Similarly, an embedded system in an automobile provides a specific function as a subsystem of the car itself.

RECENT TRENDS IN EMBEDDED SYSTEMS

An embedded system is more than the electronics as most people perceive it. It has electronics – both digital and analog, special purpose sensors and actuators, software, mechanical items etc., and with design challenges of space, weight, cost and power consumption. Its important characteristics are low-power, real-time responsiveness, low thermal dissipation, small physical form factor/footprint, low radiation/emission, ruggedness in design and impervious to external radiations etc.

In order to achieve key requirements, generally embedded systems are restricted to limited resources in terms of computing, memory, display size etc. With continued convergence of other technologies a lot more functionalities are being pushed into embedded devices which were once part of traditional computing platforms. This further adds a major "decision challenge" for architects and product managers on selection of processors, operating systems, standards of usage etc., as demands on functionality increase with time to market decreases.

Patterns insight from the applications of embedded systems in real life

Embedded systems are more than part of human life. For instance, one cannot imagine life without mobile phones for personal communication. Its presence is virtually unavoidable in almost all facets of human endeavor. While we search on patterns in each of these application spaces, we can clearly identify the trend as to where the future of embedded systems is heading.

Multicore in embedded

With a lot functionalities being added, the need for high performance in embedded systems has become inevitable and so developers are increasingly leaning towards multicore processors in their systems design decision. While this range of new applications also demands low thermals in small form factor setting, the mechanicals and packaging is also becoming a sub specialization of its own.

Embedded operating systems

Traditionally embedded systems did away with an operating system (OS), it had lightweight control program/monitor to offer limited I/O and memory services, however, as the systems became complex, it was inevitable to have OS which offered low latency real-time response, low foot print both in time and space and give all traditional functionality such as memory protection, error checking/report and transparent interprocess communication, which can be applied to communications, consumer electronics, industry controls, automotive electronics and aerospace/national defense.

Emerging multi core also needs multi mission, multithread, multi process, multiprocessor, multi board debugging and has to operate on open source tool chains such as eclipse etc., most of the new designs today are moving away from proprietary OS and tool chains and are more and more opting for open source platforms both of development and deployment as the key market differentiator for them is cost.

Embedded digital security and surveillance

In the ever increasing interconnected world, Digital embedded security is no more an option but a necessity as it is very critical for more transactions happening over embedded devices as front ends. Due to constrained resources on systems, embedded systems have challenges in implementation on full fledged security systems therefore the concept of 'embedded security' offers a new differentiator for embedded product marketing.

Convergence embedded systems and applications

The retail segment is one of the fastest growing segments in emerging markets and the trend in retail markets is moving towards improving the user experience, which is most certainly setting trend towards increased performance, connectivity and rich graphics.

A point-of-sale terminal (PoS) is a great example of this - the latest PoS devices incorporate dual-display for advertising, complex accounting applications and are increasingly connected to a central server for remote management.

Healthcare

Electronic medical device and other technological innovations with the convergence of biotech, nanotech, manufacturing tech, communication tech and device, sensor technologies are making breathtaking transformations in healthcare delivery and creating new health care paradigms.

Bio med devices tech is being applied into wide variety of analytical problems including medicine, surgery and drug discovery, these devices are portable diagnostic imaging and home monitoring such as cholesterol monitors, blood glucose meters and with recent innovations paving way for miniaturization of devices, replacement organs and tissues, earlier use of more accurate diagnostics, and advances in information technology, became available thru Silicon Chip revolution.

Automotive

With drive across the world to improve on emission controls and bring in efficiency in usage of fossil fuels, the automotive segment is challenged by various factors and embedded systems are clearly the ways and means of achieving multiple objectives in this segment taking it from infotainment systems, engine control unit, Car-area-network, fuel management, safety systems all need embedded to be in it.

Traffic management and prediction systems are being developed for large cities across the world today and the critical systems that has to support this is M2M or V2V communication networks that, form adhoc networks, seamlessly gather information from multiple sources, fuse and make decision that not only help the car users but also city traffic managers.

Entertainment

Mobiles, handhelds, ipods etc., have changed the landscape of the personal entertainment in the world in the recent past, the emerging trend is adding more intelligence in the personal entertainment, communication devices by converging the social networks, city information, location based services and choices and profile of the users. All these are going to be delivered through the continuous gathering of intelligence, choices and users and recent transactions.

Localization and internationalization

For all these devices to be sold in world-wide markets, they need to be supported both locally and internationally. The access to global markets can happen only with localization/personalization of features in the device with multi-language sup-

port and also backend support offices that offer customized localized services.

Conclusion

The future of embedded lies in how faster people adapt to the changes offered by convergence – communications, nano, manufacturing and develop "super" applications that advance the society and human needs, let's hope that our future is also embedded into it.