International Journal of Engineering and Technical Research (IJETR)
ISSN: 2321-0869 (O) 2454-4698 (P), Volume-3, Issue-8, August 2015

Real Time Embedded System-An Overview

M. Manikandeshwar, S. Vidyashankar

***Abstract*— The main objective is to discuss and analyze the various aspects of real time application of embedded system and their scope in everyday life.**

***Index Terms*— DSKY,RealtimeEmbeddedSystem,Synthesis, switchin.**

Embedded system

Embedded systems is a special type of system that is designed to perform a specific task.Unlike a computer,an embedded system is designed to perform only a single task.It may or may not be a an integral part of a large mechanical or electrical system.The components explained below are as following: (1) Embedded system –A Historical perspective (2) Real time embedded system (3)Application of real time embedded system (4) Conclusion

I. EMBEDDED SYSTEM A HISTORICAL PERCEPTIVE

A. Initial Application and birth of the system

The first developed semi-embedded system was that of the Apollo Mission in 1960.It was designed for the Apollo Lunar vehicle Module and Command Module. It was a digital computer designed for navigation, landing and pressure containment. It was a highly dangerous mission since this was the first prototype of a semi-embedded system in a computer. The Apollo Guidance system had a 16 bit word length. It also included 15 data bits with a parity bit. Astronauts communicated through a numeric display and keypad called DSKY.

The price of embedded system began to come down after its initial introduction in the AGS.A few years later a wide range of application for embedded system was developed. Many distinguished types of system like calculators, missile guidance system etc. However these system had a few drawbacks. The calculator developed by Intel still needed an external memory. In 1978 National Engineering Manufacturers Association released a "standard" for programmable microcontrollers, including almost any computer-based controllers, such as single board computers, numerical, and event-based controllers.

The embedded system, due its cheap availability and reliability soon replaced analog systems. In 1966 the first high volume use of intergrated service was initiated.For minuteman-II,the D-17 was replaced.Prices of Quad-NAND gate ICs were reduced from 1000/each to 3$ /each commercial products feasible.In 1968 INTEL was formed.B.Noyce and G.Moore formed Intergrated Electronics.

Although Embedded system was very much in development, it did have a some major drawbacks. For example, early embedded system were not capable of surviving in harsh environment. This posed a design problem too. The other major factor that must be considered was the cost. Initial cost of the system was so exuberant that it was affordable only by a very few. Only after mass production was the cost of the system brought down. Some economic challenges are listed below.

B. ECONOMIC CHALLENGES

Embedded technologies are of strategic importance for modern economies. There are various economic challenges that must be met in order to produce a system which is successful. The various challenges that a person might come across while designing an embedded system are :the execution constrain, the environmental constrain and the computing. Apart from this there is also the problem of educating the people to use it .Thus making that too a viable constrain in the manufacturing and using of the embedded system. The execution constrain may involve problems with CPU speed, memory etc. The environmental constrain may involve problems with performance, robustness and clarity. Finally the computing part may involve a problem with the computing and algorithm. Embedded technologies are vital for systems and service developers, because they can impact their competitively and generate value. Embedded software plays an increasingly significant role with respect to hardware: software functionalities allow differentiation between products that are based on the same hardware. The initial challenge has always been the cost of the memory which is required for the programming. Next challenge was the reliability of the system as discussed above. Finally the most important challenge that scientist of that time faced was that many people were unsure of the output and never supported this type of system.

C. DEVELOPMENT IN YEAR BASES

UNIVERSAL TURING MACHINE(1936-37)

A Turing machine is one which that can simulate an arbitrary Turing machine on arbitrary input. Turing machine is said to be the father of modern day memory system since it was the first system to use stored program to execute a problem. It is also known as universal computing machine, universal machine.This system formed the basic for John Von Neumann's system in 1946. Neumann with this concept produced a Electronic computing Instrument.

The Apollo Guidance System:

M.Manikandeshwar, Department Of Electronic And Communication, Skcet, Coimbatore-641043 India
S.Vidyashankar, Department Of Electronic And Communication, Skcet, Coimbatore-641043 India

Developed by C.S Draper at MIT Instruments laboratory, a refurnished system design was used in the Apollo Guidance system to reduce the size of the circuits used in the system. The main aim in this system was to reduce the weight of the spacecraft.

Embedded System Car(1969):
The first embedded system car was formed in1969.Volkswagon 1600's used embedded system for its fuel injection. This was a breakthrough in the field of embedded system.

.

First Four bit Micro-Processor(1971)
The first four bit microprocessor was manufactured by Intel Inc. in 1971.The processor was used in calculators. The micro-processor used was Intel's 4004 series. It was a breakthrough in the field of embedded system.

Hewlett-Packard first touch screen computer (1983)
Hewlett-Packard first introduced a home computer with touch scree technology. The HP-150 was the first to have touch screen capabilities . It used a grid of infrared beams across the monitor to detect finger print.

Handheld Technology/CE 1.0(1993/96)
In 1993 Apple introduced the first handheld touch screen technology. It released the newton PDA with handwritten technology. In 1996 Microsoft enters the embedded system market with its CE 1.0.

Computer technology: (2005)
IBM, Intel and AMD released their first multicore processors.

Iphone(2007):

In 2007Apple introduced the first all in one embedded mobile system in 2007.

II. REAL TIME EMBEDDED SYSTEM

Real-time systems are computer systems that monitor, respond to, or control an external environment. This environment is connected to the computer system through sensors, actuators, and other input-output interfaces. It may consist of physical or biological objects of any form and structure. Often humans are part of the connected external world, but a wide range of other natural and artificial objects, as well as animals, are also possible.

- Real-time systems are those systems in which the overall correctness of the system depends on both the functional correctness and the timing correctness.
- Realtime systems also have a substantial knowledge of the system it controls and the applications running on it.
- Deadline dependent.
- Predictability is important.

A. Design Challenges

Real time/reactive operation :-

Worst case design analyses without undue pessimism in the face of hardware with statistical performance characteristics (e.g., cache memory)

1. Small size, low weight :-

- Non-rectangular, non-planar geometries.
- Packaging and integration of digital, analog, and power circuits to reduce size.

2. Safe and reliable :-

- Low-cost reliability with minimal redundancy.

3. Harsh environment :-

- Accurate thermal modelling.
- De-rating components differently for each design, depending on operating environment.

4. Cost sensitivity :-

- Variable "design margin" to permit tradeoff between product robustness and aggressive cost optimization.

5. Poor design methodology:-

- Common execution constraints bound available processor speeds, power, and hardware failure rates and originate from implementation choices.
- Control theory deals with reaction constraints; computer engineering deals with execution constraints.
- The key to embedded systems design is gaining control of the interplay between computation and both kinds of constraints to meet a given set of requirements on a given implementation platform.

B. Synthesis

• HW synthesis

– Translation of CFSMs to netlist

– Standard synthesis tools

– Synthesis to FPGAs possible

• SW synthesis

– C - code from CFSMs

– application specific RTOS

• scheduler, I/O driver

• interfacing Synthesis

– external world

– HW-SW, SW-HW interface

• All these steps are automatic with some user inputs

C. Software to Software Synthesis

- For every event, RTOS maintains
- global value, local flags
- Local flags indicate to each SW-CFSM, that the event is present
- Then the SW-CFSM fetches the value from the global one

- Flag reset once the value is accessed
- Atomicity problem
- Use two copies of flags: active and frozen
- During the reaction use frozen flags

D. Hardware to Software Synthesis

- Events can be polled or drive an interrupt
- For polled event:

– allocate I/O port bits for status, value and acknowledge

– generate the polling task that acknowledgements and emits all the occurred events

- For events driving an interrupt

– Allocate I/O port bits for value

– Allocate an interrupt vector

– Create a service routine that emits the event

III. APPLICATION

Applications Areas of Embedded Systems :-

- Multimedia
- Automotive embedded systems
- Factory/Industrial Automation

A. Applications Areas of Embedded Systems in Multimedia :-

Reasons for demand :

•Personal communication

•Personal entertainment

•Personal comfort

Market characteristics:

•Large volumes

•Small profit margin (competition)

•Need for constant innovation

•Short time-to-market

•High development cost

B. Applications Areas of Embedded Systems in Automotive :-

Reasons for using ES:

- Power train – performance/efficiency
- Body – safety (anti-locking break system, active suspension)
- Telematics – navigation, personal entertainment (video,audio equipment), etc

C. Applications Areas of Embedded Systems in Industrial :-

Reasons for using ES:

•Availability and reliability

•Safety

•Survivability

•Security

•Real-time, deterministic response

•Power consumption

•Lifetime issues

D. Trends and Implications

- Multi-core Processors
- Wireless
- SoC architectures
- Power consumption
- Short range protocols

- Increased use of open source technology
- Security

- Embedded Encryption
- Elliptic Curve Cryptography
- Trusted Computing
- Authentication Techniques

- Device Convergence
- Internationalization
- Smart Devices

IV. CONCLUSION

The embedded system that we have today is far from what we are capable of exploiting the system. There are still many unexplored ways to exploit these types of system. These system will play a prominent and important role in the future technology. Currently the scope of this is enormous and it is still growing at a tremendous rate. The future generation may do many thing which we think as impractical for today .This could be achieved using this technology.

REFERENCES

[1] "A Brief History of Informatics and Embedded Systems"-www.embedded-systems-portal.com
[2] "Embedded system"-Wikipedia
[3] "Embedded system"-www.powershow.com
[4] "RTES design challenges" –http://www.dauniv.ac.in/
[5] "Emerging trends" – www.tcs.com