ARCHITECTURE BUSINESS CYCLE FOR AN EMBEDDED SYSTEM

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ABSTRACT
Architecture Business Cycle (ABC) is description of a system, used to represent relationship among structures/ components of the system to the environment in which the system is developed and implemented. In this paper ABC for an embedded system is described to identify the influences to and from the architecture of the embedded system.

INTRODUCTION

Architecture of a program / system is used to represent the components / structures and its relationship. The description of component types refers to the architectural system and data transferring among components referred to the pattern (Cusumano et al., 1997). Architecture is considered as the overall structure of the system. Architecture is the result of a set of business and technical decisions which are related to the working environment of a system. ABC represents the relationship between components of the system to the technical environment in which system is constructed and worked (Len Bass *et al.,* 1996 ; AT&T 1993). The general description of ABC for a system is shown in figure-1.

The customer stakeholders pay for development of a system and specify the requirements, whereas end users use this system. The non functional requirements from customer side are usability, availability and reliability (http://en.wikipedia....) Like customers developing organizations may or may not be the same. Immediate businesses, long term businesses and organizational structures are three influences that come from developing organization changes with the division of functionality in the architecture.
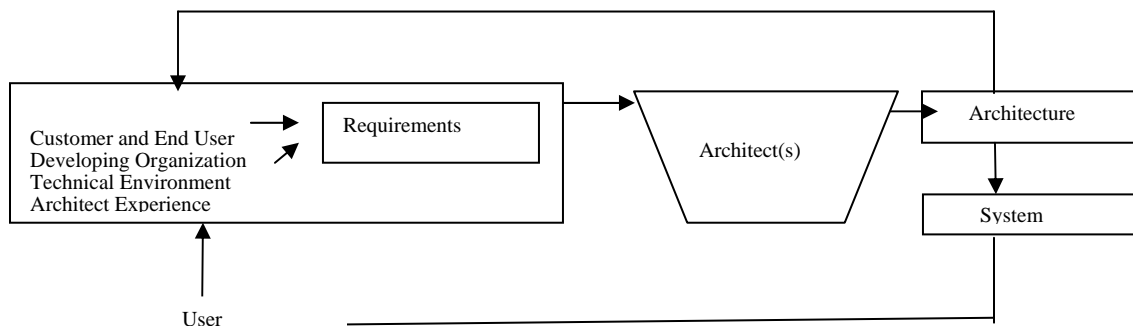

**Figure 1 General diagram of an ABC**

MACHINE CONTROL AND EMBEDDED SYSTEM
A machine control and physical structure of machine build up the controlled machines, also called embedded system. Main structure, actuators and sensors are main sub systems of a physical machine. Actuators and sensors of the machine are used to send or receive information through I/O interfaces (Mortal *et al.,* 2008). The machine control System can be divided into five functional sub systems shown in Figure-2.
1. To regulate the actuators at different positions.
2. To detect noise, error and faults.
3. To plan. Schedule and dispatching of components.

4. To process, store and manipulate gathered data.

5. To interact with a user through user interface.
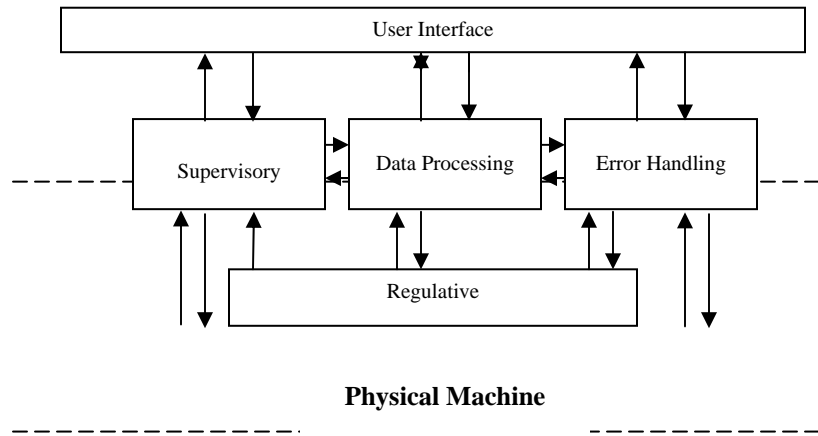
Figure 2 Machine Control Subsystems

The result of architecture will be good due to good past experience of architect. Technical environment of a system is used to reflect the backgrounds and experience of an architect technical environment of an architecture influences performance of the system. The term embedded system used for a wide range of applications and devices (Winkler *et al.,* 2006). The main characteristics of an embedded system as mentioned in (Boasson 1996) are:

1. Restricted memory usage and space requirement.
2. Specific interface.
3. Restricted power consumption.
4. Environment adjusts the processing time of system.
5. Embedded system uses the digital signal processors.
6. High level of non functional requirements such as correction, reliability and availability are required (Tilman 2006).

ARCHITECTURAL STRUCTURES FOR EMBEDDED SYSTEMS

Software architecture of an embedded system is the combination of different structures. Each of these structures provides a different perspective and design. Architectural structures for an embedded system are:

Module Structure:
Architecture of an embedded system comprises on certain modules such as error handling, regulative and supervisory module. Module structure of embedded system emphasizes on static properties of a system. The embedded system module design is based on decomposition principle known as information hiding, encapsulates the system details.

Uses Structure:
Uses structure of an embedded system represent the calling procedure of modules or interaction among modules.

Process Structure: Embedded system is normally implemented on uni-process machines. The software is implemented as a set of cooperating sequential process that synchronizes with each other to use shared resources. Process structure of embedded system emphasizes on dynamic properties of a system.

Control Flow Structure:
Control flow structure of an embedded system manages the system control of concurrent events. Control flow structure uses the time and event-driven approaches to manage system control.

NON FUNCTIONAL REQUIREMENTS FOR AN EMBEDDED SYSTEM.

Besides the functional requirements commonly used, non functional requirements of an embedded system as mentioned in (http://en.wiki.......) are:

1. Availability
2. Reliability
3. Performance
4. Efficiency

ABC DESCRIPTION FOR AN EMBEDDED SYSTEM

The main components of an ABC description for an embedded system are

Customer and End User:

The customer and end user of an embedded system may be any person who uses the concerned system.

The ABC description for an embedded system is shown in Figure-3.

Developing Organization:

The developing organization of an embedded system refers to any vendors or companies who develop the system.

Architect Experience:

The experience of an architect may be of academic or past experience of developing other systems.

Technical Environment:

Technical environment of an embedded system comprises the factors information hiding, cooperating sequential process and verification of time and functional behavior.

The structures and requirements of an embedded system have been discussed in section 3 & 4 of this paper.
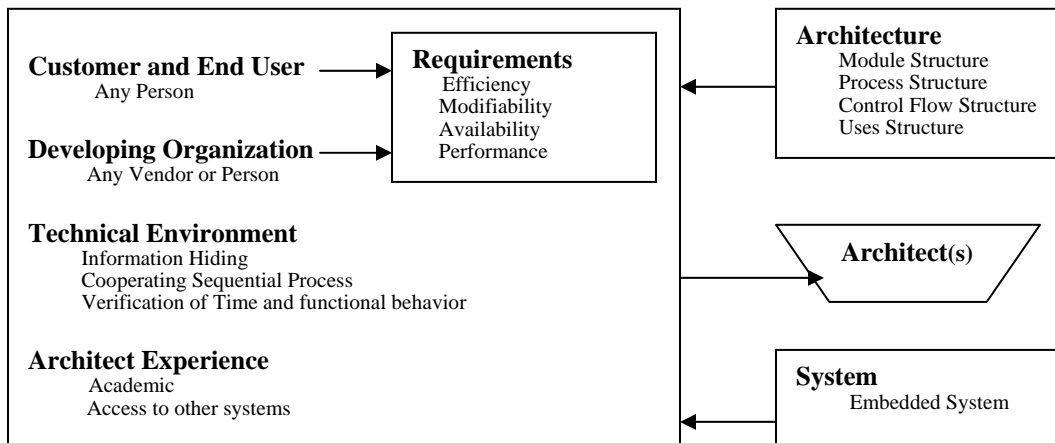
Figure 3 ABC description for an Embedded System

CONCLUSION

The ABC description of any system makes its architecture more clear and helps any architect or developer to understand the control system and functionality of that system. The main components of architecture are its structures which can be clearly described through ABC description. The ABC description for an embedded system is designed according to the functions of an embedded system and machine structures.

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