Medical Device Plug and Play (MD PnP)

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Background

- To reduce the possibility of errors that result from the interactions between medical devices and human operators, we need to increase interoperability among medical devices.
- Medical devices have different safety levels and different levels of reliability. As a result, interoperability of these devices is challenging.
- The context of a medical device includes its clinical environment and the human beings in that environment. Clinicians & patients must interact with the devices.
- Medical devices have real-time constraints. Failure to meet these constraints could result in patient harm or death.
- The Network-Aware Supervisory System (NASS) is a generic framework that supports interoperability among distributed medical devices, providing a development environment wherein these medical devices can be integrated into a clinical system.

Goals/Key Ideas

- Build reliable MD PnP systems in which open-loop safety is used. Open loop safety is such that a safety property can be ensured even if the controller and/or network fail.
- The FPGA needs to control its own clock information instead of relying on this information from an operating system or software program.
- Create a Java synchronization code, for the clock information, to be implemented and run on the FPGA. The synchronization of the devices and supervisory system is necessary in order to prevent cycle mismatches from occurring.

Fundamental Questions and Challenges

- How can timely medical context information be obtained and distributed consistently and correctly?
- How can the context information and real-time monitoring data be used to provide better decision support?
- “The medical workflow safety challenge”: How can a dynamically configured system be verified as safe at each stage of a complex medical procedure and safe during the transition from one stage to the next?

Research Efforts and Future Work

- Developing the linear compensation function in order to adjust the rate of the clock so that synchronization can occur.
- Deriving the appropriate parameters to be applied with the time-synchronizer.
- Developing an algorithm to ensure the safety of the time-synchronizer.
- Apply NASS framework to more medical systems using more use cases.
- Extend system to operate in a more “plug-and-play” manner.

Approach

- Program the client and server sockets because communication between the medical devices and supervisory system is critical.
- Implement Cristian’s algorithm to calculate the correct local time.
- Integrate with the FPGA and determine the state of the clock (i.e., fast or slow clock), as well as the clock offset.