Embedded Platform for Automation of Medical Devices

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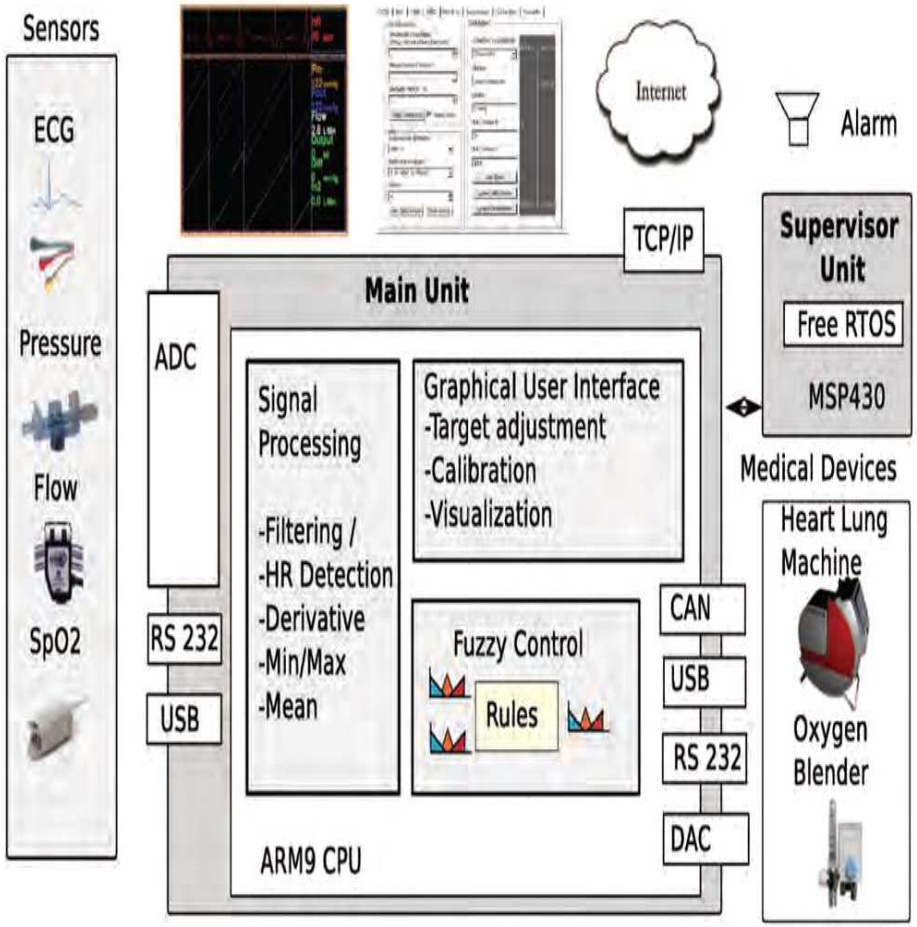
Introduction

- Small potable device
- General purpose Reconfigurable Platform
- Uses control logic to adjust parameters and adjusts them depending on what is sensed from patient
- Components required for specific applications are assembled with configuration files
- No need of compilation
- Individual component testing is possible

System Description

- Vital signals from sensors
- ADC, serial ports,ethernet
- Sensor calibration
- System configuration and control
- Logging information
- Remote access
- Reliablity
- Battery powered

Hardware Layer

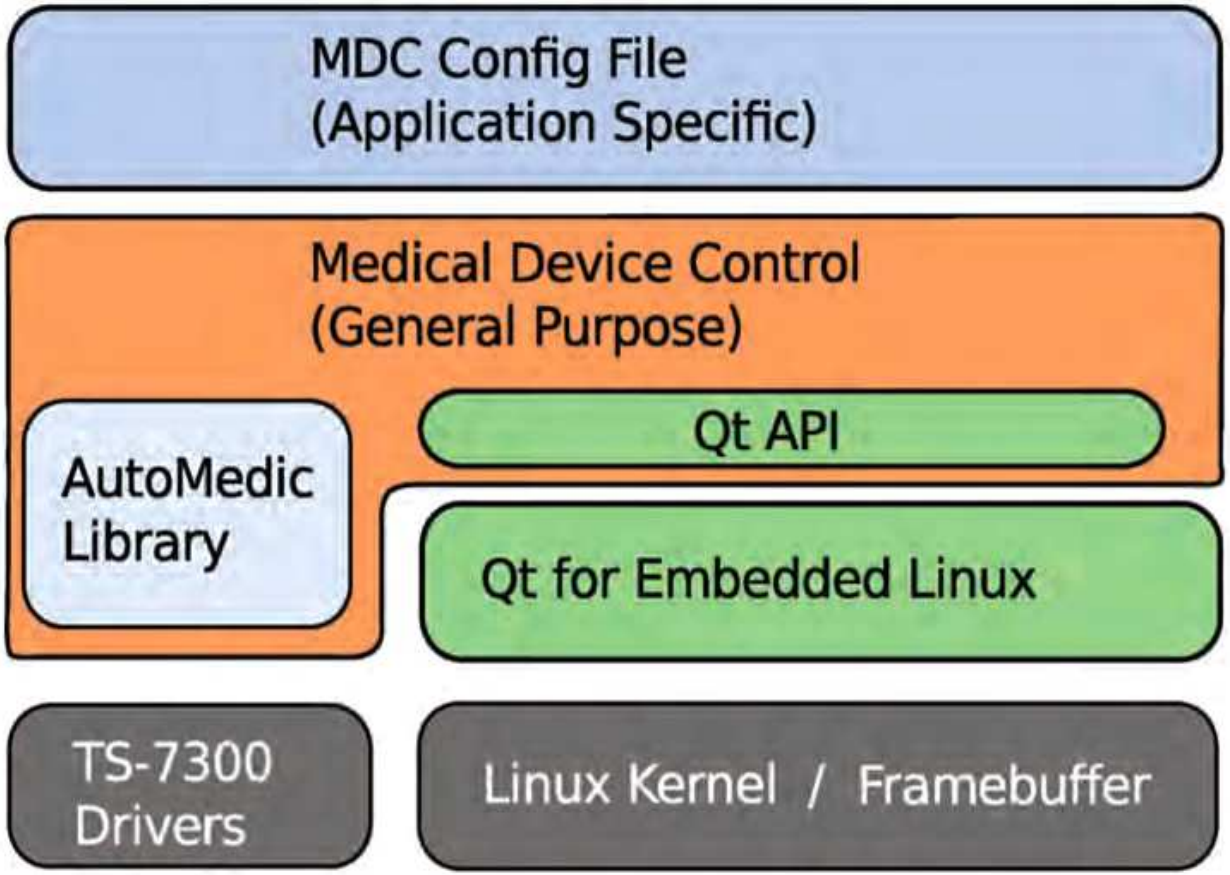


Hardware layer

TS-7300 board is used

- ARM920T processor
- Ethernet ports-2
- USB-2
- UART-2
- SD Cards-2
- PC/104 bus
- 16 adc channels
- 4 12 bit DACs

Software layer



Software Layer

- Preconfigured Linux debian based distribution
  Kernel version-2.4.26
- Ethernet configuration
- Ssh remote access
- sd read/write access
- Embedded Qt provides user interface
- Source code is downloaded and configured to be compiled for specific platform

Medical Device Control Program

- Uses Automedic Library
- BaseObject Abstract class-fundamental component
- Output port-name,value
- Connect port-Name and pointer to OutPort
- A calculate ( ) method is used
- Contains the operations required to generate the output signals

MDC Objects

Input/Output Parameters

Signal Intputs: AOC,ECG,Sp02,Network

Operators: Derivative.Sum.Gain

Saturation,Filter,Reference Model,Oelay

Control: Basic Controller,Adaptive Controller

Outputs: DAC,Scope,Network,CAN,RS232

Table 1. MOC Objects

Supervisor System

- Resposible for safety and reliability of system
- Input signals from sensors-Safety checks of critical min and maximum values are checked all times
- Control signals are checked –predefined range
- Two supervising components-
  - SMART(Smart Monitering and Rebooting Tool)-Monitors MDC program.Restarts the system in case a service stops working
  - Additional Microprocessor
- FreeRTOS is used
- Alarms are generated to inform user of system failure

Case study-Heart Lung Machine

- Ultrasonic flow probe with pressure sensors
- Uses ADC to convert the inputs
- Target values introduced by operator
- Fuzzy controllers used -2

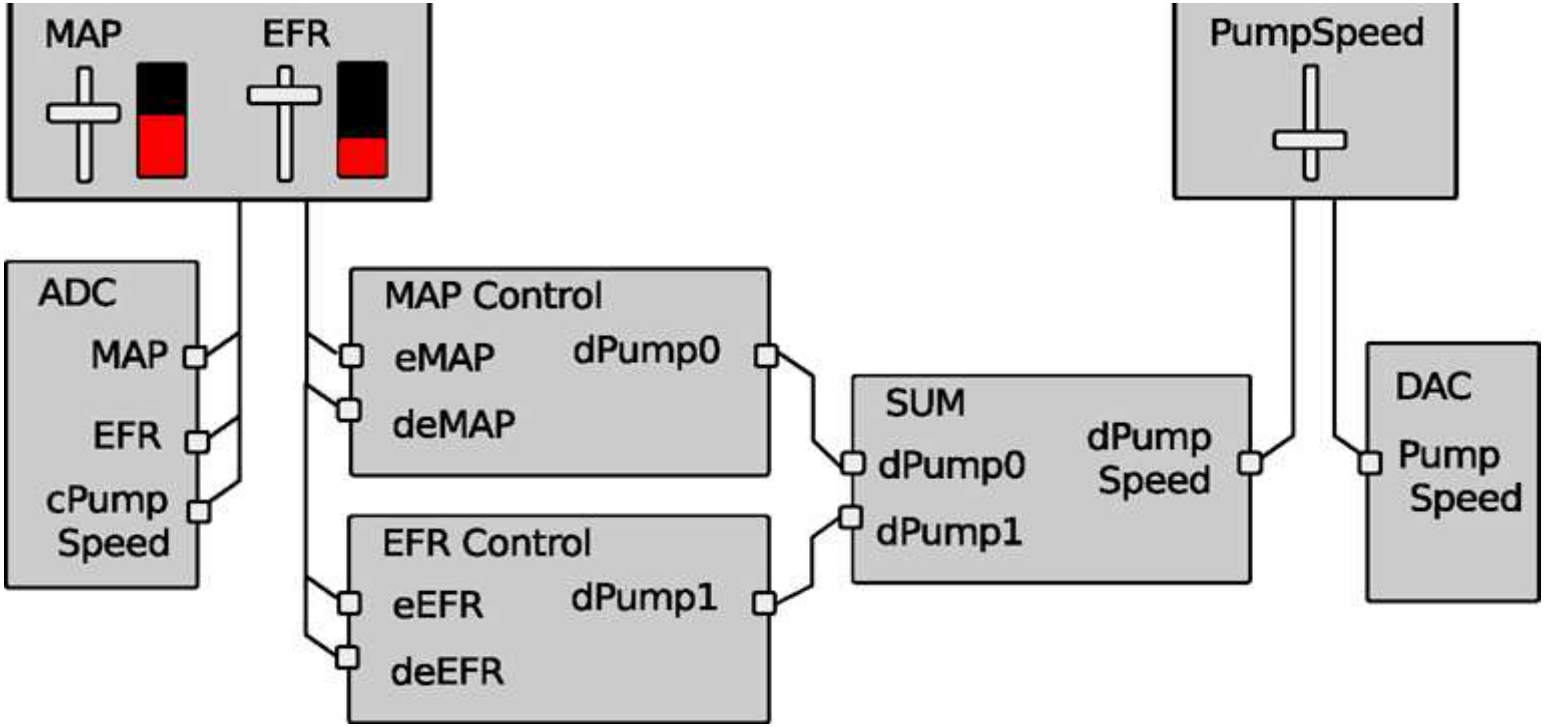
One for target MAP and second for EFR

- Output of both the controllers are added to generate one single value

Case study –Heart Lung Machine

- Two input parameters control the MAP and EFR
- Controller tries to reach the normal value of MAP and EFR by adjusting speed of centrifugal pump(PumpSpeed)
- Fuzzy controller acts as PI controller

HLM Pump Controller



Conclusion

- Possible to port software easily
- Use of same configuration files
- Adapting the required drivers
- Capable of controlling flow and pressure