

# Customizing Papyrus-RT to Facilitate Model-Driven Development of Rover Software

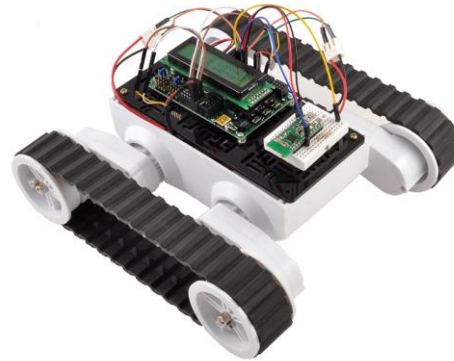
Supervised By: Dr. Juergen Dingel

**Sudharshan Gopikrishnan, Nicolas Hili**  
**Queen's School of Computing**

# Rover !!



# Rover !!

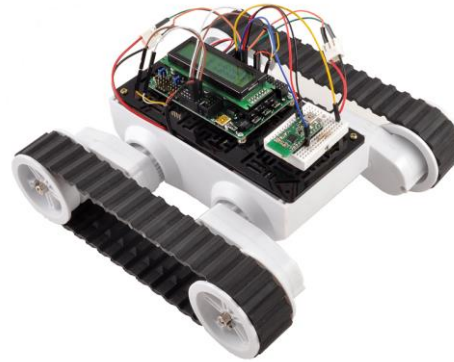


Rover A

# Rover !!



Rover B



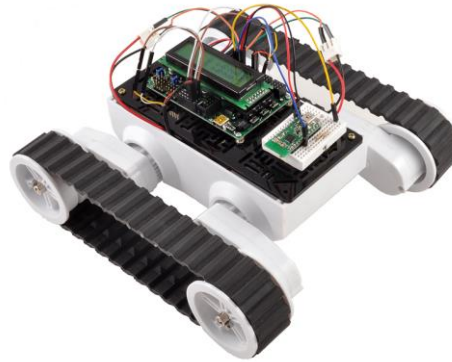
Rover A



# Rover !!



Rover B



Rover A

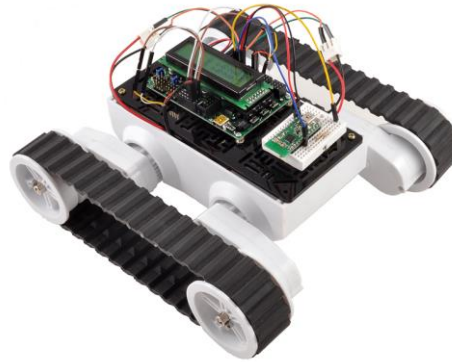


Rover C

# Rover !!



Rover B

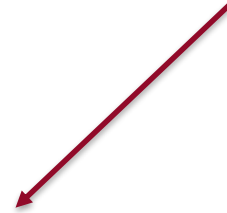
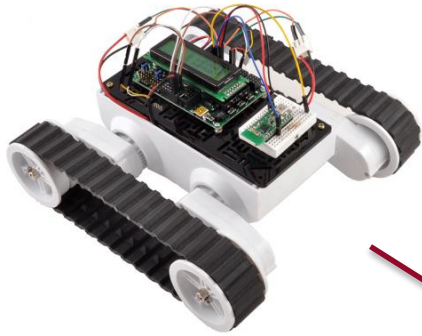


Rover A

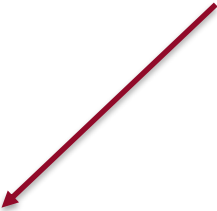
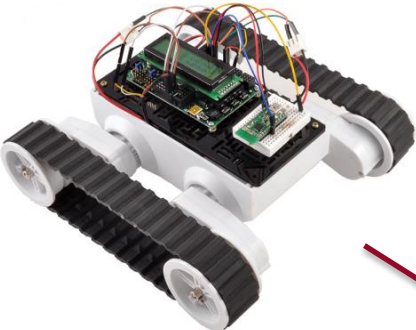


Rover C

# Common Factor ??



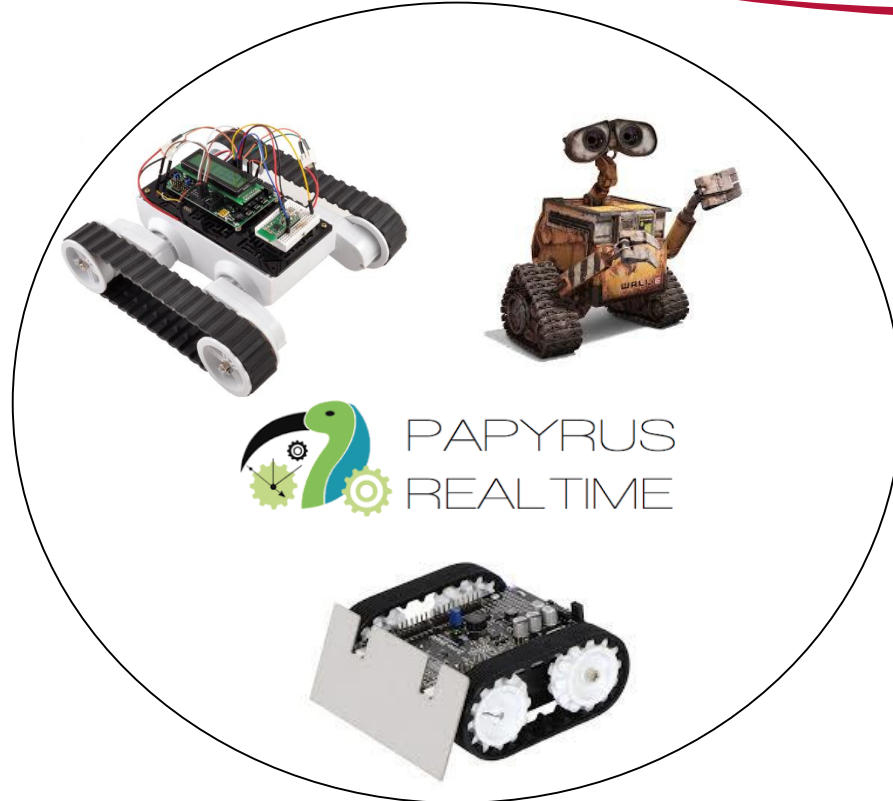
# Common Factor - Papyrus-RT



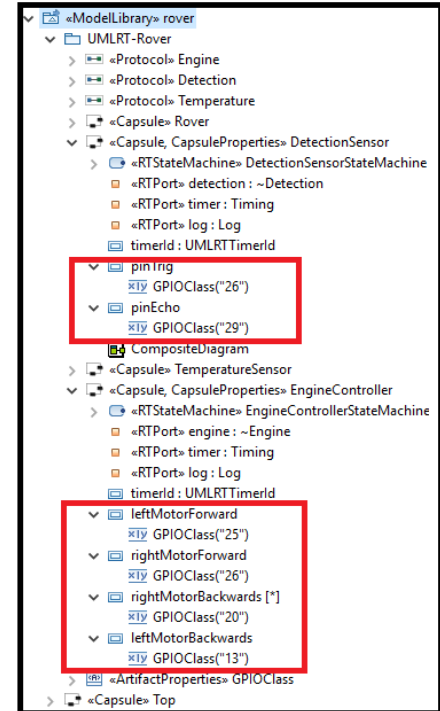
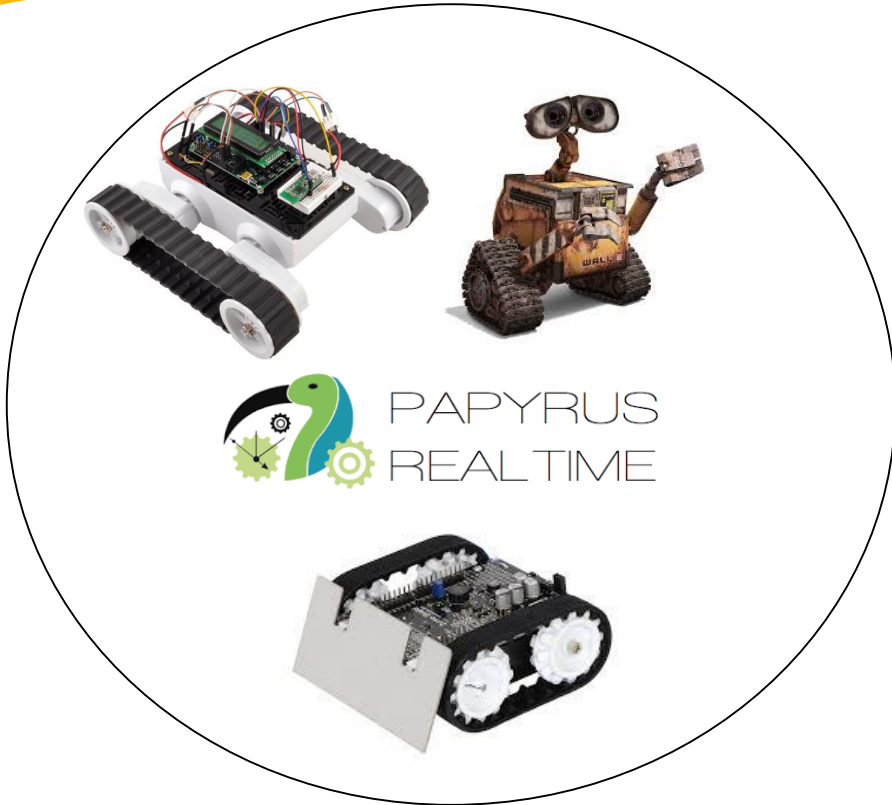
PAPYRUS  
REAL TIME



# Modelling Using Papyrus-RT



# Modelling Using Papyrus-RT



# Problem Statement



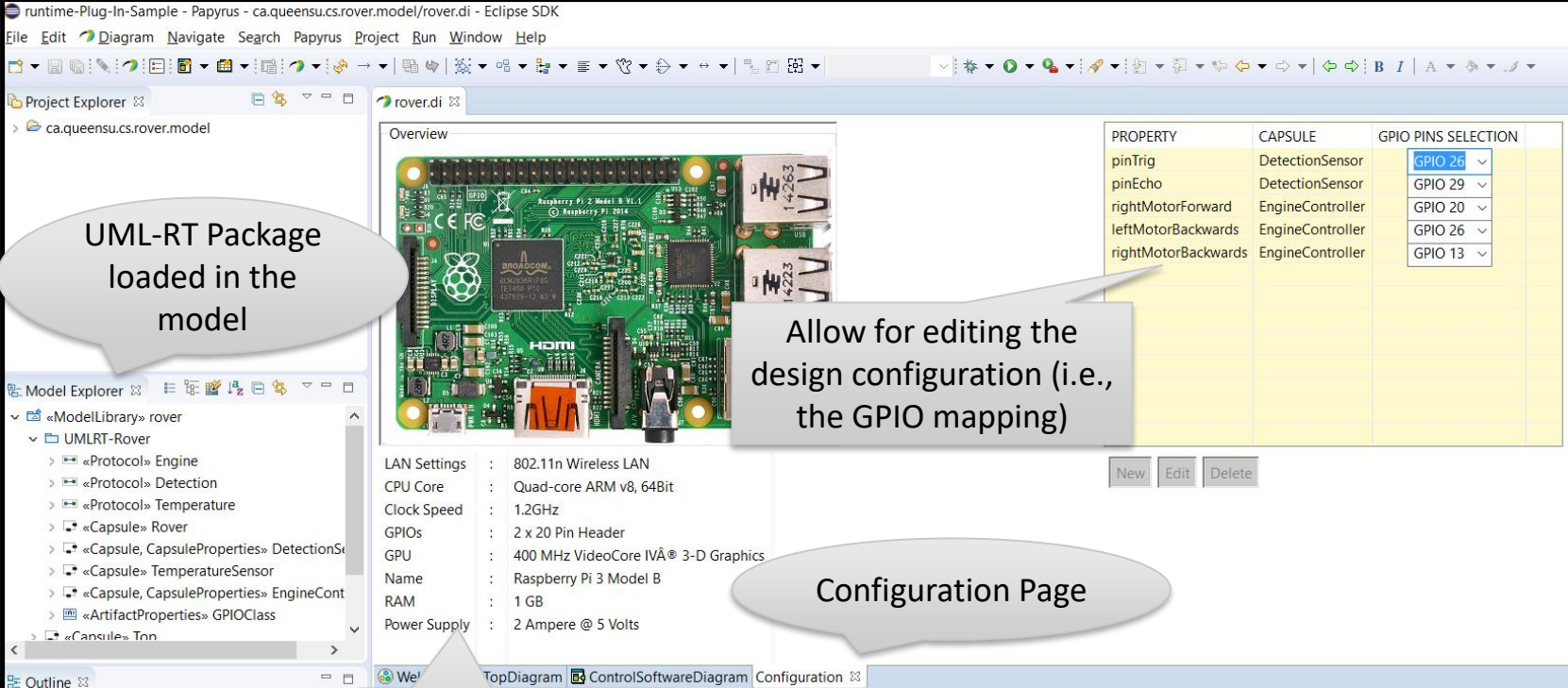


How to change the design configuration without having to modify the Rover Library ?



- Embedding a specific configuration page with the loaded library
- Providing a unique user experience when designing the Rover Model

# Current Implementation



runtime-Plug-In-Sample - Papyrus - ca.queensu.cs.rover.model/rover.di - Eclipse SDK

File Edit Diagram Navigate Search Papyrus Project Run Window Help

Project Explorer

ca.queensu.cs.rover.model

rover.di

Overview

UML-RT Package loaded in the model

Allow for editing the design configuration (i.e., the GPIO mapping)

PROPERTY	CAPSULE	GPIO PINS SELECTION
pinTrig	DetectionSensor	GPIO 26
pinEcho	DetectionSensor	GPIO 29
rightMotorForward	EngineController	GPIO 20
leftMotorBackwards	EngineController	GPIO 26
rightMotorBackwards	EngineController	GPIO 13

Model Explorer

- «Modellibrary» rover
  - UMLRT-Rover
    - «Protocol» Engine
    - «Protocol» Detection
    - «Protocol» Temperature
    - «Capsule» Rover
      - «Capsule, CapsuleProperties» DetectionSensor
      - «Capsule» TemperatureSensor
      - «Capsule, CapsuleProperties» EngineController
      - «ArtifactProperties» GPIOClass
      - «Capsule» Top

Configuration Page

Platform Overview

LAN Settings : 802.11n Wireless LAN  
CPU Core : Quad-core ARM v8, 64Bit  
Clock Speed : 1.2GHz  
GPIOs : 2 x 20 Pin Header  
GPU : 400 MHz VideoCore IV® 3-D Graphics  
Name : Raspberry Pi 3 Model B  
RAM : 1 GB  
Power Supply : 2 Ampere @ 5 Volts

New Edit Delete

# The Change!!

Before

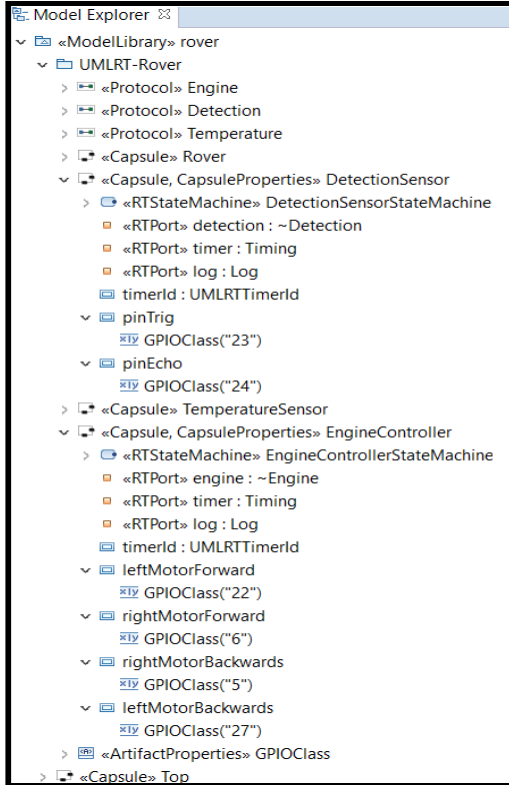


Model Explorer

- «ModelLibrary» rover
  - UMLRT-Rover
    - «Protocol» Engine
    - «Protocol» Detection
    - «Protocol» Temperature
    - «Capsule» Rover
      - «Capsule, CapsuleProperties» DetectionSensor
        - «RTStateMachine» DetectionSensorStateMachine
          - «RTPort» detection : ~Detection
          - «RTPort» timer : Timing
          - «RTPort» log : Log
          - timerId : UMLRTTimerId
        - pinTrig
          - GPIOClass("23")
        - pinEcho
          - GPIOClass("24")
        - «Capsule» TemperatureSensor
        - «Capsule, CapsuleProperties» EngineController
          - «RTStateMachine» EngineControllerStateMachine
            - «RTPort» engine : ~Engine
            - «RTPort» timer : Timing
            - «RTPort» log : Log
            - timerId : UMLRTTimerId
          - leftMotorForward
            - GPIOClass("22")
          - rightMotorForward
            - GPIOClass("6")
          - rightMotorBackwards
            - GPIOClass("5")
          - leftMotorBackwards
            - GPIOClass("27")
          - «ArtifactProperties» GPIOClass
        - «Capsule» Top

# The Change!!

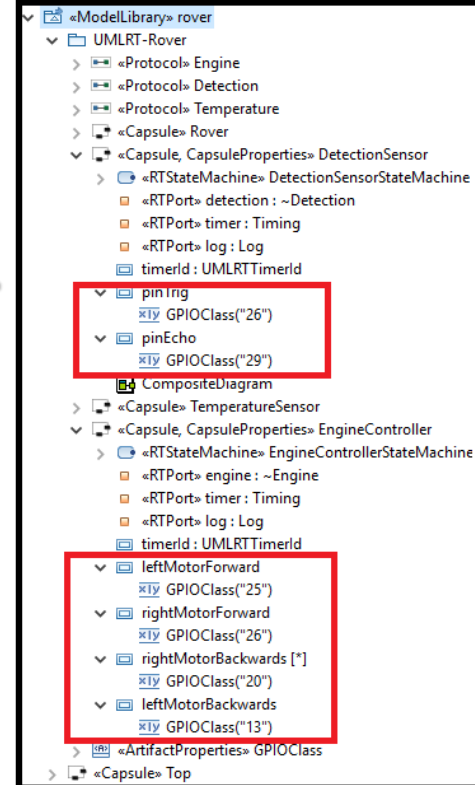
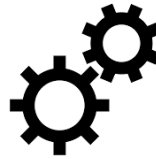
## Before



Model Explorer

- «ModelLibrary» rover
  - UMLRT-Rover
    - «Protocol» Engine
    - «Protocol» Detection
    - «Protocol» Temperature
    - «Capsule» Rover
      - «Capsule, CapsuleProperties» DetectionSensor
        - «RTStateMachine» DetectionSensorStateMachine
          - «RTPort» detection : ~Detection
          - «RTPort» timer : Timing
          - «RTPort» log : Log
          - timerId : UMLRTTimerId
      - pinTrig
        - GPIOClass("23")
      - pinEcho
        - GPIOClass("24")
    - «Capsule» TemperatureSensor
    - «Capsule, CapsuleProperties» EngineController
      - «RTStateMachine» EngineControllerStateMachine
        - «RTPort» engine : ~Engine
        - «RTPort» timer : Timing
        - «RTPort» log : Log
        - timerId : UMLRTTimerId
    - leftMotorForward
      - GPIOClass("22")
    - rightMotorForward
      - GPIOClass("6")
    - rightMotorBackwards
      - GPIOClass("5")
    - leftMotorBackwards
      - GPIOClass("27")
  - «ArtifactProperties» GPIOClass

## After



«ModelLibrary» rover

- UMLRT-Rover
  - «Protocol» Engine
  - «Protocol» Detection
  - «Protocol» Temperature
  - «Capsule» Rover
    - «Capsule, CapsuleProperties» DetectionSensor
      - «RTStateMachine» DetectionSensorStateMachine
        - «RTPort» detection : ~Detection
        - «RTPort» timer : Timing
        - «RTPort» log : Log
        - timerId : UMLRTTimerId
    - pinTrig
      - GPIOClass("26")
    - pinEcho
      - GPIOClass("29")
    - CompositeDiagram
  - «Capsule» TemperatureSensor
  - «Capsule, CapsuleProperties» EngineController
    - «RTStateMachine» EngineControllerStateMachine
      - «RTPort» engine : ~Engine
      - «RTPort» timer : Timing
      - «RTPort» log : Log
      - timerId : UMLRTTimerId
  - leftMotorForward
    - GPIOClass("25")
  - rightMotorForward
    - GPIOClass("26")
  - rightMotorBackwards [\*]
    - GPIOClass("20")
  - leftMotorBackwards
    - GPIOClass("13")
- «ArtifactProperties» GPIOClass



- Analysing hardware specification of various Rovers to further enhance the overall user experience in the context of MDD of Rover Software
- Dynamically creating & disposing new tabs within the configuration page depending on the loaded package
- Defining a software product line for Rovers

Thank You !!

