



# **Automation Studio Demo Project**

## **B&R Coffee Machine**

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## I Versions

Version	Date	Comment	Edited by
1.0	Nov 05, 2007	First Edition	B&R

Table 1: Versions

## II Distribution

Name	Company, Department	Amount	Remarks

Table 2: Distribution

## III Safety Notices

Safety notices in this document are organized as follows:

Safety notice	Description
Danger!	Disregarding the safety regulations and guidelines can be life-threatening.
Warning!	Disregarding the safety regulations and guidelines can result in severe injury or heavy damage to material.
Caution!	Disregarding the safety regulations and guidelines can result in injury or damage to material.
Information:	Important information used to prevent errors.

Table 3: Safety notices

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## 1 What's it all about?

In order to improve first contact experience of users with Automation Studio a demo project was created.

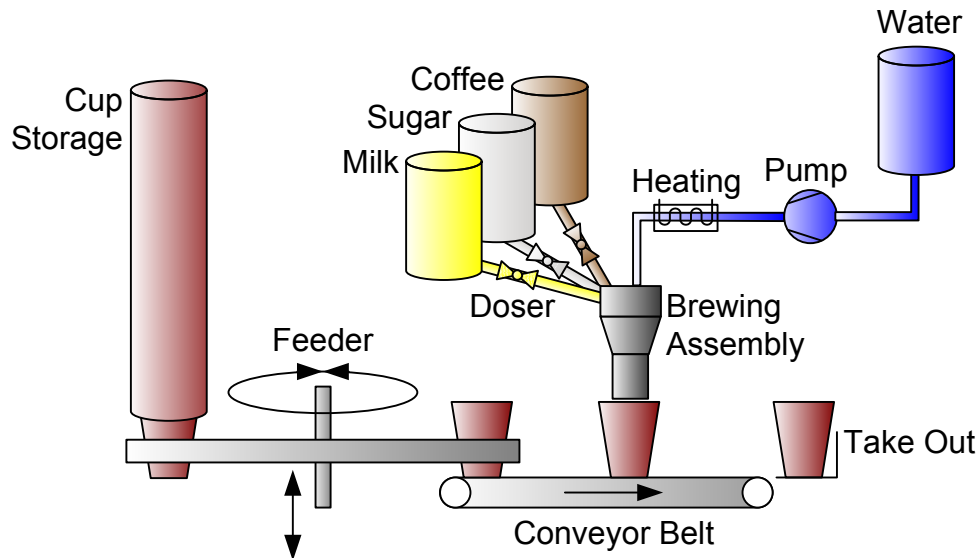
This demo project has to full fill the following requirements:

- Covering all major aspects of Automation Studio (such as Project Management, Programming, Motion Control, Diagnostics, Receipe Handling and Visualization)
- Easy to understand
- Usable during presentations
- Usable for trainings
- Well documented source code in order to allow users to extend the project

## 2 Introduction

A coffee machine was chosen.

### 2.1 Synopsis



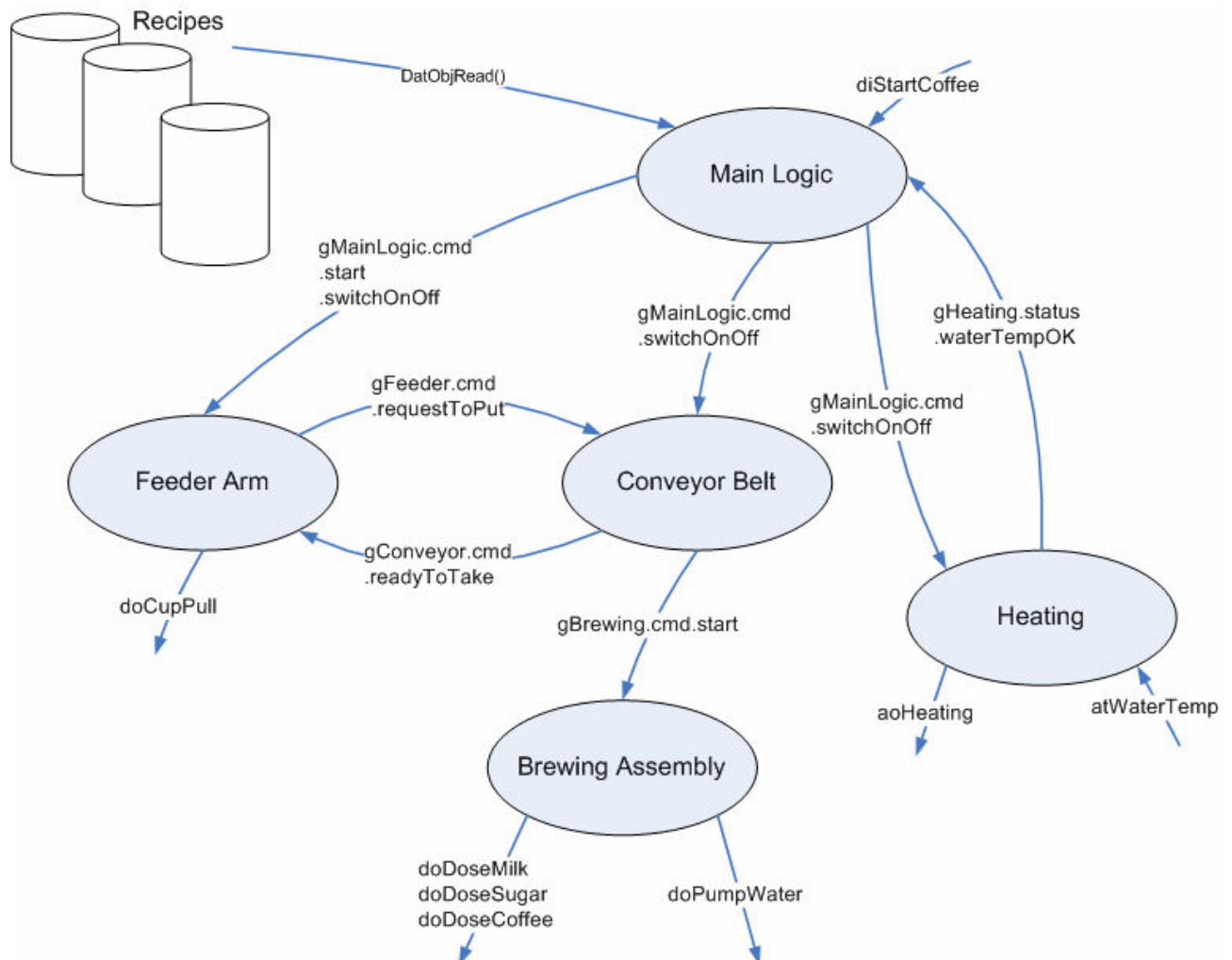
Picture 1: Synopsis

**Note:**

1. The feeder takes a cup out of the storage and places it on the conveyor belt
2. The cup will move to defined filling position
3. In the meantime dosers define – according to the recipe – the amount of milk, sugar and coffee to be fed in to the brewing assembly
4. The heating and the pump gets activated and fill the cup with
5. The conveyor belt transports the cup with coffee to the take out station

### 3 Functional Description

This describes all software components used in this project.  
Here is an overview:



Picture 2: Task Overview

**Note:**

The software structure follows basically the brewing sequence: The main logic starts the brewing. As result the feeder arm grabs a new cup and provides it to the conveyor belt using a simple handshake procedure. Once the cup is in brewing position the brewing will be started with a command to the brewing assembly. In parallel the heating control takes care about the water temperature according to the current recipe.

### 3.1 Main Logic

The main logic control takes care about global issues:

- User interactions (start handling)
- Money changer
- Recipe loading

Name	I/O Type	Variable Name	Comments
Start-Button	Digital Output	diStartCoffee	Button to start brewing coffee

Table 4: Main Logic IO

### 3.2 Feeder Arm

In order to separate a single cup from the storage the feeder arm pulls down and then rotates by 180°. As a result the cup will be placed on a conveyor belt.

Pull down movement: pneumatic; digital output to a valve manifold

Rotary movement: ACOPOS; position controlled

Name	I/O Type	Variable Name	Comments
Servo Axis	Axis	axFeeder	Feeder axis
Valve	Digital Output	doCupPull	Pulls feeder arm downwards

Table 5: Feeder IO

### 3.3 Conveyor Belt

The conveyor belt moves the cup to the filling position, which is in the halfway to the take out

Linear movement: ACOPOS; position controlled

As soon as a cup arrives at the take out position the coffee making process is finished.

Name	I/O Type	Variable Name	Comments
Servo Axis	Axis	axConveyor	Conveyor axis

Table 6: Conveyor Belt IO

### 3.4 Brewing Assembly

In the brewing assembly the ingredients get mixed together (dosing) according to a recipe. Dosing is done by an auger (one for each ingredient).

Finally the ingredients get blended with hot water and filled into the cup. The pump is switched on by digital output. The pump ensures a constant pressure suitable for coffee brewing.

Name	I/O Type	Variable Name	Comments
Auger – Cream	Digital Output	doDoseMilk	Activates auger for milk
Auger – Sugar	Digital Output	doDoseSugar	Activates auger for sugar
Auger – Coffee	Digital Output	doDoseCoffee	Activates auger for coffee
Water Pump	Digital Output	doPumpWater	Activates water pump

Table 7: Brewing Assembly IO

### 3.4.1 Flow Heater

The heating is build up as a flow heater and needs to be controlled with a maximum deviation of  $\pm 0,5^{\circ}\text{C}$ . In order to avoid additional delays caused by warm-ups, the heating starts with power-up of the system.

Name	I/O Type	Variable Name	Comments
Heater	Analog Output	aoHeating	Heating appliance
Temperature Sensor	Analog Input	atWaterTemp	Actual temperature of water

Table 8: Flow Heater IO

### 3.4.2 Recipes

A recipe stores all necessary information for brewing:

```
00.5      ; price           [€] - REAL
80.0      ; set temperature [°C] - REAL
100.0     ; milk            [ml] - REAL
30.0      ; sugar           [g] - REAL
60.0      ; coffee powder  [g] - REAL
150.0     ; water           [ml] - REAL
```



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