Application Brief

Application of Low-Cost MSPM0 Series in Coffee Machines

Lillian Lu, Zoey Wei

Introduction

In recent years, the global coffee machine market has shown strong growth, with a surge in consumer demand for high-quality coffee and the popularization of *coffee culture* in home settings. Coffee machine products are becoming increasingly diversified, with drip and capsule coffee machines being the most common in home settings. Drip coffee machines are marketed for simplicity and low power consumption, targeting everyday home use. Capsule coffee machines are favored by urban white-collar workers for the convenience of one-button brewing and intelligent capsule recognition features.

As the *brain* of the coffee machine, the importance of MCUs is becoming more pronounced. This application brief introduces how to use the Arm® Cortex®-M0+ microcontroller (MCU) MSPM0 product series to design control modules for drip and capsule coffee machines.

Figure 1. Coffee Machine

Why Consider Using MSPM0 in Coffee Machine Applications?

The MSPM0 MCU from TI features an Arm® 32-bit Cortex-M0+ core, with a maximum CPU speed of 24MHz, 32MHz, or 80MHz. The products spans flash memory sizes from 8KB to 512KB and offers a rich and scalable set of integrated analog peripherals. MSPM0 provides extensive digital, analog, and interface integration to deliver high-performance and reliable options for the control modules of coffee machines offering various package sizes at low cost, simple to use standardized software, high-performance low-power peripherals, and comprehensive pin-to-pin scalability.

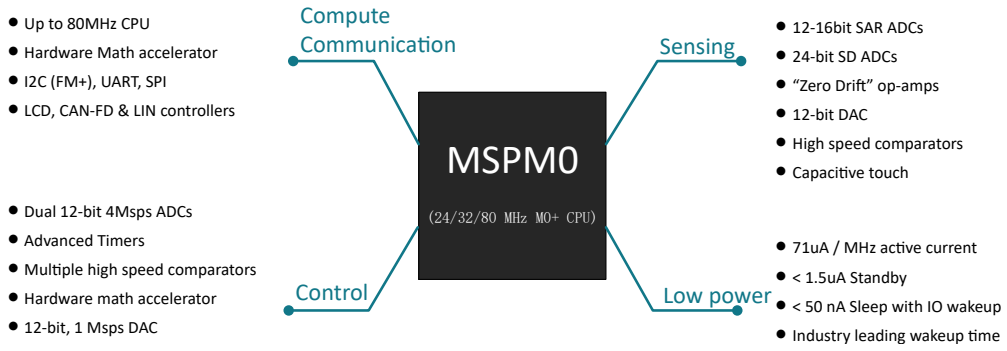

Figure 2. MSPM0 Overview

MSPM0 in Drip Coffee Machines

A drip coffee machine is a common household coffee brewing device that drips water from the hot tub into the filter with ground coffee and eventually into the coffee maker underneath the device. The core features are simple to operate, one-click start, no complex setup, low cost, and a simple design structure.

In this type of coffee machine, the main features of the main MCU require:

- Simple functions, and there is not much requirement for MCU memory.
- To use a multichannel ADC for the acquisition of analog signals such as temperature sensors and flow sensors.
- To use GPIO for key control, LED light control, and so on.
- Low cost, low standby power requirements for certain categories such as portable drip coffee machines.

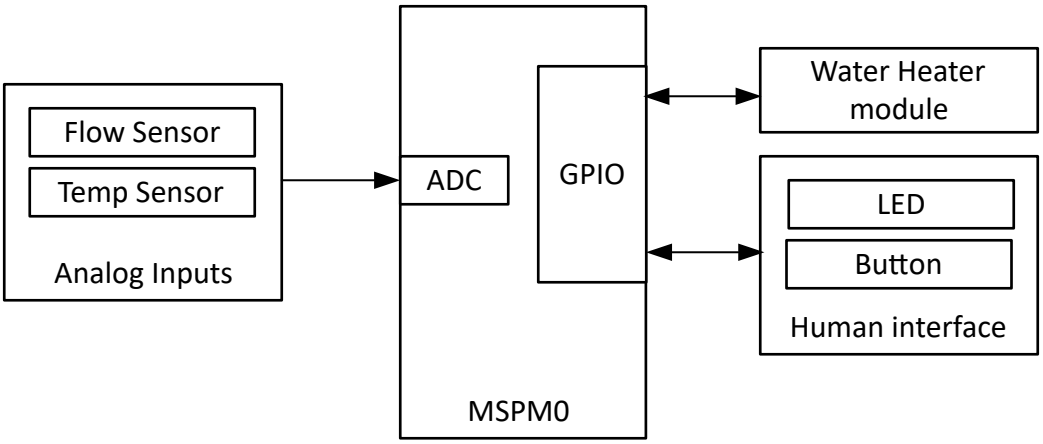

Figure 3. Typical Application of MSPM0 in a Drip Coffee Machine

Therefore, the MSPM0C110x family is preferred for hosting such drip coffee machines with the following features and benefits:

- Low Power Consumption: Power performance in both operational and standby modes.
- Low Cost: Low cost Arm Cortex-M0+ MCU with in-system programmable flash memory, Flash is available from 8kB to 64kB.
- Integrated Analog: 12-bit ADC with up to 1.6Msps sampling rate and up to 27 channels.
- GPIO: Up to 45 GPIOs in a 48-pin package.

MSPM0 in Capsule Coffee Machines

The capsule machine is a smart device that makes coffee quickly with pre-packaged coffee capsules. The features and benefits are simple to operate, simple to clean and are available with standardized flavors. In this type of coffee machine, the main features of the main MCU require:

- A multichannel ADC for the acquisition of analog signals such as temperature sensors, flow sensors, and so on.
- The I2C/SPI/UART interface to connect with the HMI module.
- GPIO connection capsule module, heating module, water pump module, and so on to make controls such as key controls and LEDs.
- Low power consumption.

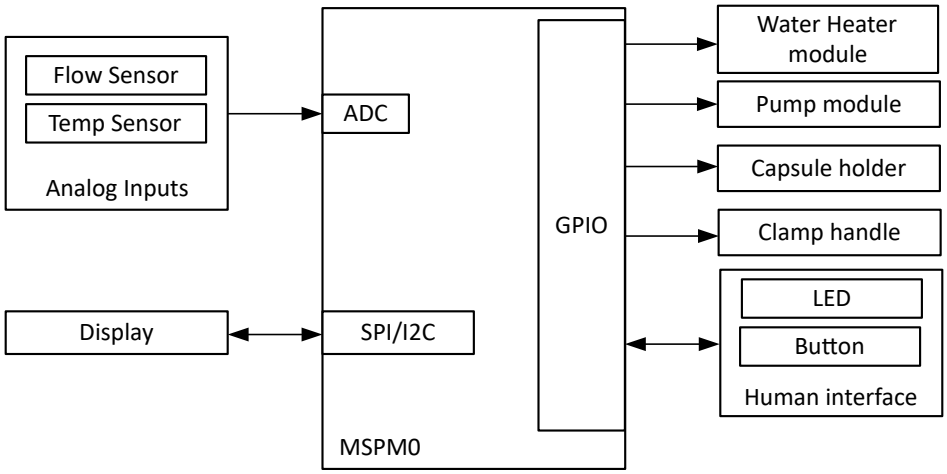

Figure 4. Typical Application of MSPM0 in a Capsule Coffee Machine

Therefore, the MSPM0L110x family is preferred for hosting such drip coffee machines with the following features and benefits:

- Low Power Consumption: Excellent power consumption performance in both run and standby modes, with current as low as 71µA/MHz in run mode. Current can be as low as 1µA in standby mode.
- Integrated Analog: 12-bit ADC with up to 1.68MSPS sample rate and 10 channels.
- Sufficient Interfaces: SPI, I2C, UART for simple connection of the various modules of the coffee machine.
- GPIO: Up to 28 GPIOs in a 32-pin package.

Summary

This application brief describes how to design control modules for drip coffee machines and capsule coffee machines using Arm® Cortex® -M0+ microcontrollers MSPM0 series. By explaining the special requirements of the main MCU for different types of coffee machines, this deepens the understanding of the coffee machine system for the user, and facilitates the selection of the main MCU.

Start Using MSPM0 MCU

Select a low-cost MSPM0 LaunchPad™ development kit today to begin evaluating the device for the coffee machine control module. MSP Academy provides simple MSPM0 code samples and interactive online training. Use the following links for related resources.

- MSPM0 Overview Page
- MSPM0 Software Development Kit
- MSPM0 Academy
- MSPM0C1104 LaunchPad
- MSPM0C1106 LaunchPad
- MSPM0L1306 LaunchPad

Trademarks

LaunchPad™ is a trademark of Texas Instruments.
Arm® and Cortex® are registered trademarks of Arm Limited.
All trademarks are the property of their respective owners.

IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATA SHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES “AS IS” AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, regulatory or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI’s products are provided subject to TI’s Terms of Sale or other applicable terms available either on ti.com or provided in conjunction with such TI products. TI’s provision of these resources does not expand or otherwise alter TI’s applicable warranties or warranty disclaimers for TI products.

TI objects to and rejects any additional or different terms you may have proposed.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265