LUMISSIL Microsystems
A Division of ISSI

MCU & MPUs for Next Generation Refrigerators

Household refrigerators are evolving quickly due to consumer demands for new features and new energy standards from the US and EU. Therefore, the processors to run these new designs must also improve and remain cost effective. Let's look at how the market is evolving and how Lumissil's new MCUs and MPUs fit into the next generation refrigerators.

Before we get into the topic of refrigerators let's first define the difference between MPUs and MCUs. MCU – the Microcontroller Unit is a single-chip system that typically includes a microprocessor, memory, and input/output peripherals all on a single chip. MCUs are often used in embedded systems, such as in appliances like refrigerators, because they are compact, cost-effective, and require less power than larger microprocessors. MCUs are designed to handle specific tasks and are often used in applications that require real-time control.

MPUs – Microprocessor Units are more powerful than MCUs and can handle more complex tasks, such as running operating systems, applications, and software. MPUs are often used in personal computers, servers, and mobile devices, where higher processing power, advanced HMI and multitasking capabilities are required.

New features on refrigerators that require a processor:

- Smart Connectivity: Many new refrigerators come equipped with Wi-Fi connectivity and can be controlled through smartphone apps. This allows users to monitor and adjust temperature settings, receive notifications when the door is left open, and even order groceries directly from the refrigerator.
- Energy Efficiency: Energy efficiency is becoming an increasingly important consideration for consumers, and many new refrigerators are designed to be more energy-efficient than older models. Some newer models include features such as variable-speed compressors, improved insulation, and LED lighting to reduce energy consumption. The EU is expected to update the energy usage standards for refrigerators in 2024 and the US is expected to update rules soon since it has not been updated since 2014.
- Sleek modern design which means incorporating capacitive touch buttons for HMI control
- Voice Control: Some newer refrigerators feature voice control capabilities, allowing users to control the temperature and other settings with voice commands to virtual assistants like Amazon Alexa or Google Assistant.
- Advanced Cooling Technologies: Some newer refrigerators feature advanced cooling technologies, such as dual evaporators, which help to maintain optimal humidity levels and prevent food from drying out or spoiling prematurely.

The refrigerator market can be broken into 2 categories. The first is simple low/medium end appliances that do not connect to the internet, has a simple static display or do not have a display at all. The second is high end appliance that connects to the internet, has voice controls, and a color display capable of video. This is an oversimplification of the market but a useful way to think about it for this discussion.

Low end refrigerators tend to have distributed processing where multiple low end MCUs control the different functions and therefore can have one MCU as the master. See figure 1 for a typical block diagram. High end refrigerators are trending toward more centralized processing. In the high end an MPU will be used since it must perform advanced functions like cybersecurity, internet connections, AI for voice control etc. See figure 2 for a typical example.

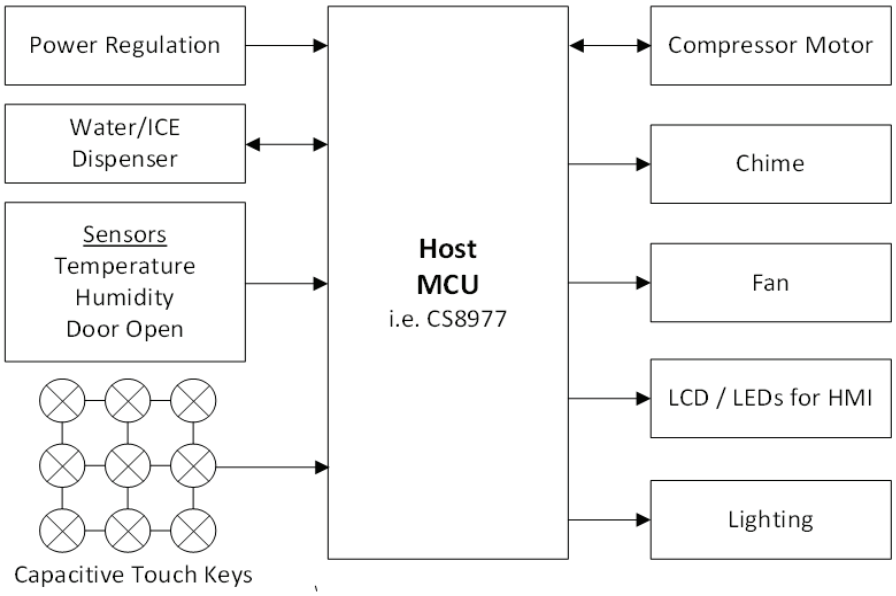

Figure 1 Typical MCU Based Refrigerator with IS31CS8977

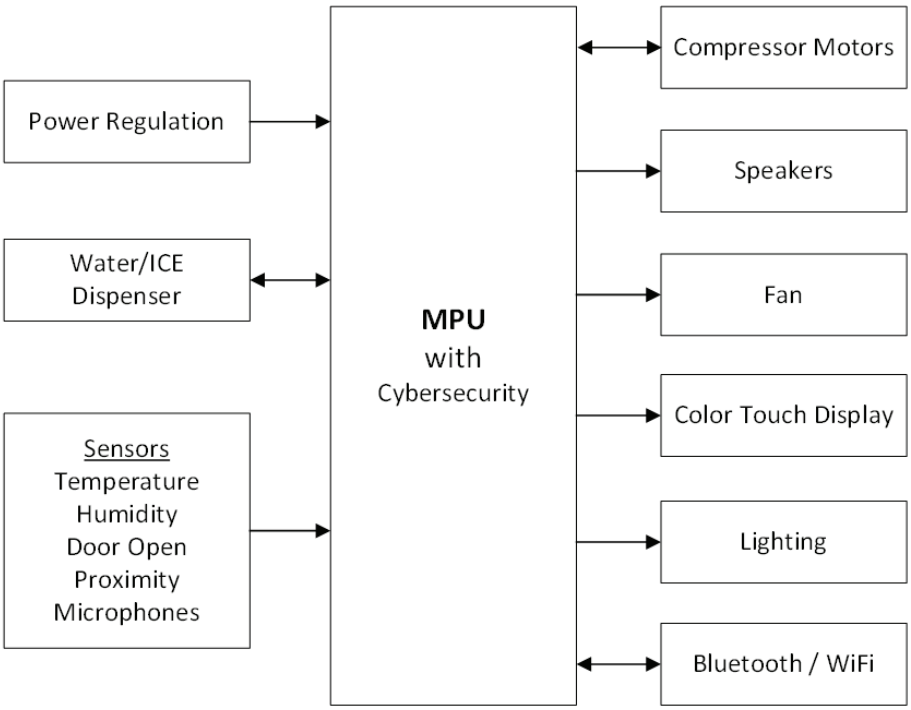

Figure 2 MPU Based Refrigerator Based on Touch Display

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Lumissil offers different levels of solutions for refrigerator control. Here are the top three solutions from simple to smart, multi-media refrigerators (and other appliances too).

Parameter	CS8977	X1600	X2000
Type	MCU	MPU	MPU
Processor	8051-1T	Xburst (MIPS32, SIMD)	Xburst2 Dual Core
Speed	32 MHz	1 GHz	1.2 Ghz
Cybersecurity	No	Yes	Yes
Real time control	Yes	Yes	Yes
Edge AI	No	No	Yes
Display interface	LCD	RGB24/SLCD	RGB24/SLCD/MIPI-DSI2D
Touch keys	27	0*	0*
Camera Input	0	1	2
SDIO/UART	No	Yes	Yes
USB	No	Yes	Yes
Video Encode	No	No	Yes
Audio input	No	No	Yes
Audio output	No	Yes	Yes

*Can be connected to Lumissil's touch key controller like IS31SE5118 to add touch keys to HMI

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