LUMISSIL Microsystems

A Division of ISSI

Building Human Machine Interfaces (HMI) for White Goods Application Using the X1600 MPU

Illustrated with a Refrigerator Case Study

INTRODUCTION

This newsletter article follows up on the previous one from May 2023, titled "MCUs and MPUs for Next Generation Refrigerators."

The progress in process technologies for integrated circuit manufacturing, connectivity protocols, and consumer appliances is paving the way for the Internet of Things (IoT) in our kitchens. In a world where we've grown accustomed to the mobile internet, we now seek enhanced communication between ourselves and the once inanimate gadgets in our homes. Human Machine Interface (HMI) is increasingly emerging as a pivotal factor in the success of household appliances.

In this newsletter article, using refrigerators as a case study, we delve into the development of HMI from the perspective of Lumissil MPUs. We'll explore the key features of MPUs tailored for white goods applications, the kind of support developers can expect from Lumissil as they embark on the journey to creating user-friendly next-generation refrigerators, and ultimately, why Lumissil should be your preferred vendor for white goods applications.

1. The Framework of Electronics in the Refrigerator
   As shown in Figure 1, the electronics system in the refrigerator usually consists of 2 major parts. The Control layer takes care of actuating like turning ON or OFF the compressor while the HMI layer serves as an agent to communicate with the humans to exchange information.

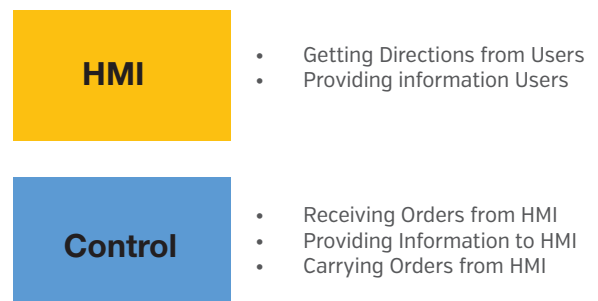| HMI	• Getting Directions from Users • Providing information Users
Control	• Receiving Orders from HMI • Providing Information to HMI • Carrying Orders from HMI

Figure 1: The Two-Layer Solution for Electronics in a Refrigerator

A more detailed version of division of functionality between HMI and Control domains is shown in Figure 2.
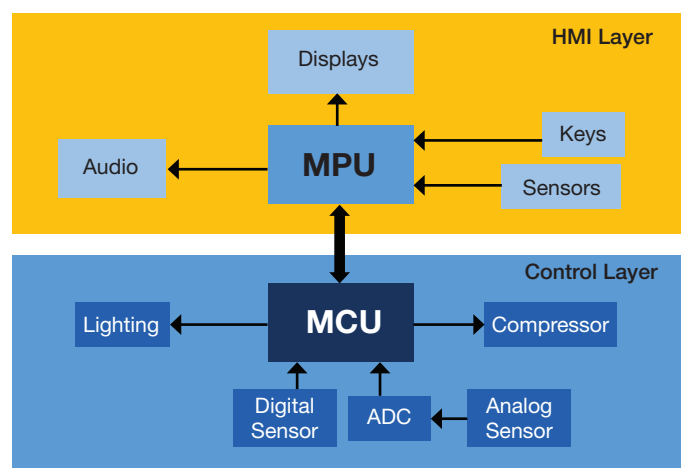
Figure 2: A Sketch of Refrigerator Electronics

2. Lumissil MPU Product oferings for HMI applications

Lumissil MPU family takes HMI as a major target application. All the key SoC products have their specific features for HMI, though thanks to their different specifications, they have different positioning in the market.

Note 1. XBurst is Lumissil CPU name. XBurst2 is more powerful than XBurst 1
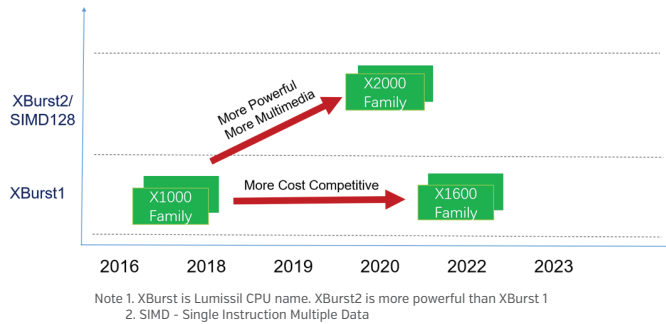2. SIMD - Single Instruction Multiple Data

Figure 3: The Roadmap of MPU Product Line

Lumissil MPU product offerings can be found in Figure 3 while features of X1600 are presented in details in the following:

3. X1600, the Choice for Simplicity

Affordable refrigerators now incorporate lightweight HMI features, with cost-effectiveness and simplicity being their primary attributes.

Figure 4: A refrigerator with Lightweight HMI

Armed with the following features, the X1600 fits perfectly in this kind of HMI applications.

Display Interfaces:

- RGB display interface with a resolution up to 720P@60fps, 24BPP (bits/pixel)
- 60/80-type MCU (SLCD) with a resolution up to 480P@60fps, 24BPP
- 3/4-wire SPI display interface

In many cases, GPIO or SSI are needed for the MPU to coordinate with touch screens. X1600 has enough of them to choose from.

Peripheral Interfaces:

- SSI Master x 2
- SSI Slave x 1
- GPIOs

Connectivity has become a mandatory function for many refrigerators, which brand themselves as IoT terminals. X1600 can support this with built-in controllers and interfaces.

Connectivity Resources:

- UART x 4
- USB 2.0 OTG (on the go)
- I2C x 2
- RMII

Voice feedback is also a regular feature requirement which X1600 meets pretty well.
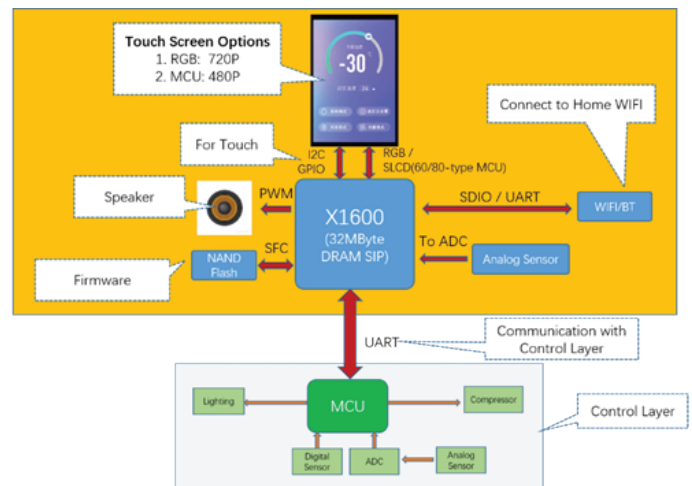
Audio Resources

- I2S
- PWM (to drive a speaker)

Figure 5: A refrigerator HMI Solution based on X1600

Additional features of X1600

- An external CODEC on the I2S can make voice interaction (microphone and speaker) possible.
- X1600E is pin-pin compatible with X1600 but has 64M-byte DRAM instead of 32M-byte. Similarly, the X1600HN comes with 128M-byte DRAM.
- Other more lightweight screens are possible using UART or 3/4-wire SPI interfaces.
- In some cases, the RMII of X1600 might be put into use for a cabled Ethernet connection.

4. System Development Support

Lumissil can support system developers with the following development packages.

Development boards and SDK packages

Halley 6 EVB for X1600 is available as well as the Board Support Packages including:

- SoC(X1600) Based HW Development Manuals
- EVB Reference Design Guide
- Linux kernel 4.4.94 and 5.10 (including both OS and Drivers)
- U-Boot
- Buildroot and third party libraries
- Compiling tool chains
- USB Flash cloner package

UI development support

- LVGL based UI development support
- AWTK based UI development support
- QT based UI development support
- HW & SW demos for baseline features in white goods

5. Choosing Lumissil, Choosing Long Term Support

Choosing Lumissil MPUs for white goods HMI applications can take advantages of world class quality chips, robust supply chain, and professional technical support.

Lumissil Microsystems is a division of ISSI specializing in analog/mixed-signal products for automotive, communications, industrial, and consumer markets. Lumissil's primary products are LED drivers for low to mid-power RGB color mixing and high-power lighting applications. Other products include audio, sensors, high-speed wire communications, optical networking and application-specific microcontrollers. ISSI and Lumissil Microsystems have worldwide offices in the US, Taiwan, Japan, Singapore, mainland China, Europe, Hong Kong, India, and Korea. Website: http://www.lumissil. com.