Loetronic: from the Garage up to Industrial Production

By **Moritz Schwarz**, Loetronic

A long, long time ago... in this or similar ways, many stories start not only in films, but on occasion, company histories too. The Loetronic company from Aachen and its founding phase dates back to the year 2005, when it was established as a garage business by Moritz Schwarz, still a student at the Fachhochschule (FH, University of Applied Sciences) in Aachen.

Figure 1: The Loetronic-developed MP3 Player with various storage options.

Initially, the idea was to develop an MP3 player and make it available to private enthusiasts. However, this soon resulted in applications for commercial and industrial applications, and Loetronic was founded.

Soon the core competency was clear: the development, the production and the distribution of digital audio modules, mostly on MP3 and Flashcards basis for the integration into customer-specific electronics. Over the years, Loetronic's modules got installed wherever voice announcements or music content have to be played. The audio modules were constantly developed out. Initially, hard disks and CD-ROMS were focussed on as storage media, later these memory forms were replaced by flash memory, first CF, then SD card storage. Every now and then it was also demanded that the audio content could be played over LAN and WLAN interfaces in real-time (streaming). The

LOETRONIC

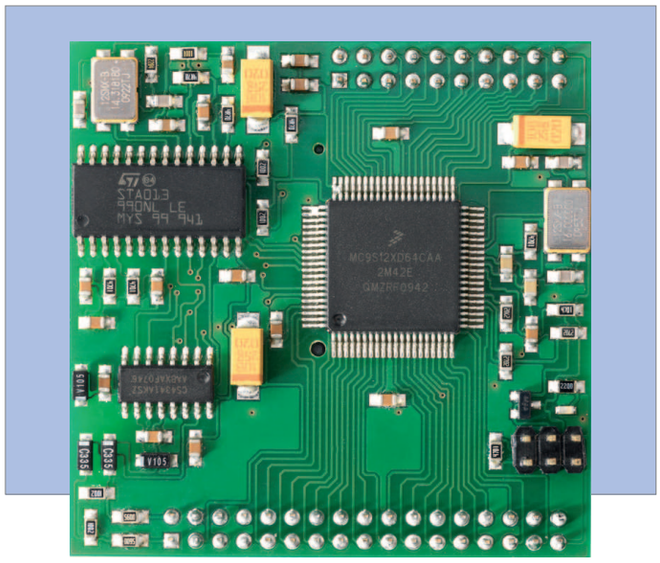
Essential technical components of a checkout lane system in terms of microcontroller and interface technology used

The centrepiece of the checkout lane opening system is a central control unit, which also accommodates the ULTRA MP3 module, monitors all processes at the cash desks and informs the customers and employees of all statuses audiovisually. Via so-called tableau units at the cash desks the employees can log on and off their own or other checkouts and select other functions. Corresponding lamps, mostly LED-based, display their status at the cash desks. Additional peripheral devices or systems can be connected to the system via additional interfaces, e.g. bakery product dispensers and bottle deposit machines, sensors for automatic customer recognition at the cahier stations or certain sales areas, as well as monitors for further visualization of sales information.

The central controller unit, like the ULTRA MP3 module, is based on a 16-bit microcontroller from Freescale (NXP). Via a serial interface, it communicates with the MP3 module and initiates voice announcements. A second serial interface is used to communicate via a proprietary RS485 bus. This bus interface was developed in close collaboration with Rickert Systemtechnik in order to be able to connect its own interface extensions even over a great distance to the system. In addition, it is also possible to interconnect several central controller units via the

external control possibilities were developed similarly. In the beginning control was limited to pushbuttons, but later RS232, RS485, LAN and WLAN interfaces were added, as well as the use of barcode and RFID readers, motion detectors and various customer-specific controls.

The following list gives a rough overview of the applications in which the MP3 modules (**Figure 1**) have been used and are still being used:



- listening stations in museums;
- audio info terminals in public or tourist places;
- listening station for music, audio books and advertising at point of sale (POS);
- automatic voice announcements in elevators;
- a player for sound and special effects;
- multichannel audio player in theme parks;
- emergency announcement devices (German: ELA);
- station and vehicle position announcements in buses, trains and ships.

More electronics

In addition to the audio modules, Loetronic was also increasingly required to develop specific electronics for customers. At the same time, the acquired know-how around the audio modules and thus microcontrollers and various interface technology was exploited. The development of customer specific adapter boards for use between the audio modules and the customer electronics as well as completely new developments for the customers were implemented in this way. Ten years after the founding of the company, Loetronic commands a wide range of development possibilities:

Figure 2: The universal MP3 Module fulfils many tasks, and is aptly called ULTRA.

RS485 bus, in order to connect multiple cash registers. A third serial interface of the microcontroller can be connected to a LAN module (Lantronix XPort) to enable the controller unit to have a direct LAN interface. A USB interface was connected via an FTDI chip via I^2C.

The LED lamps are either directly controlled by the microcontroller or via port expansion modules in the case of insufficient digital outputs.

The tableau units themselves are not controlled via a bus interface, but via an SPI interface with RS232 level. Due to the RS232 level, as well as the RS485 interface, considerable distances can be bridged, and a variable number of input and output signals can be queried and adjusted by the selection of the SPI interface.

This is important in this respect as different tableau units can be used at the cash desks, and depending on the stores, different cash desks must be controlled by a tableau unit. Besides the use of buttons on this unit, other external signals can also be addressed through this unit. The outputs to the panel unit control LEDs on the panel or other cash-related external devices.

Furthermore, an optional RTC module can be installed on the controller unit in order to play timely precise announcements. The complexity of the controller unit makes it necessary to adapt the internal firmware to the respective environment via configuration parameters. In order to enable the customer to do this simply and quickly, Loetronic has programmed Windows software which communicates via the USB interface of the controller and also allows the installation of new firmware.

- development and production of electronics;
- programming of Freescale (NXP) microcontrollers in Assembler, C, Python;
- programming of Raspberry Pi single board computers;
- programming of Windows software;
- programming of Android software.

In 2009, it was necessary to develop a new MP3 module and bring it to the market. It was to be very universal and powerful, as well as very modular and easy to adapt. Designed to be manufactured in higher volumes for many years, it should replace a number of similar, but very different MP3 modules. The ULTRA MP3 module was born (**Figure 2**)!

The ULTRA MP3 module is based on a 16-bit microcontroller from Freescale (NXP) and has an SD memory card slot. An MP3 decoder chip and a high-quality D/A converter complete the main components. The module itself measures 55 x 55 mm and is plugged onto the carrier board via two sockets. The module can be controlled via pushbutton inputs, various digital inputs, two serial interfaces (with baudrates up to 115200 bps and 921600 bps). Outputs for connection to a LC display, LEDs and relays are also available. The decoded audio information can be passed in analogue (stereo) or digital (I^2S) fashion. In addition to a standard firmware for the ULTRA MP3 module, Loetronic has also created a variety of customer-specific firmware versions that utilise the MP3 module in different ways. The installation of new firmware usually takes place via the SD card, but can also be done via the serial interfaces and especially by the customers themselves.

Carrier boards

In addition to customer-specific carrier boards, standard carrier boards from Loetronic can also be used. It is then possible to connect loudspeakers or headphones directly and they fit into Loetronic's standard housings. In addition to the use of the MP3 modules as an embedded module, ready-made MP3 players can also be supplied in functional housings. The serial interfaces of the ULTRA MP3 module are expanded on the carrier boards by appropriate standardised interfaces, including USB, RS232 / RS485 or LAN.

ULTRA MP3 Module for a checkout lane system

Last but not least, this article briefly describes a system in which the ULTRA MP3 module plays an important role and Loetronic, a decisive role. Back in 2011, Rickert Systemtechnik asked Loetronic to integrate an audio module into a so-called till lane (checkout lane) opening system. The company Rickert Systemtechnik has specialized in these systems and equips warehouses with it. These systems ensure that the customer flows to the checkout desks in a targeted way, and are primarily intended to prevent the developing of queues at the cash desks. In addition to visual possibilities at the cash desks and the store, only simple bells and chimes were used in the past. The use of the ULTRA MP3 module in such a system opened many new possibilities. Now new opened check stations could also be made audible, the Store Manager could be called to the checkouts, or employees to the bakery area or bottle deposit machines.
In addition to the use of the ULTRA MP3 module in existing checkout lane opening systems, Rickert Systemtechnik was also interested in the further development of its systems and Loetronic was the ideal partner for this development. Since 2011 the checkout lane opening systems have been further developed, perfected and manufactured in various versions.

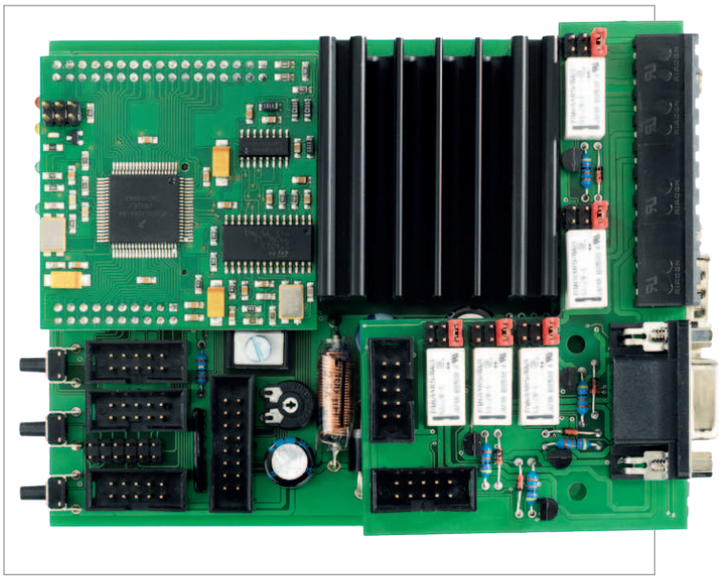


Figure 3: The mother / carrier board allows the MP3 Module to be built into Loetronic's standard enclosure.

The overall complexity of the cash register system has grown over the past few years and shows the growing know-how of Loetronic in the microcontroller and interface area. A number of customer projects have already been implemented in a similar manner, which have proved themselves over many years. ⏮

LOETRONIC

The Author

From 1998, Moritz Schwarz (1977, Aachen, Germany) studied Information Technology at RWTH Aachen, and from 1999, Electrical Engineering at Fachhochschule (Applied Sciences) also in Aachen, specializing in Engineering Informatics. Having started as a student aid at ILA (laser measurement technology) in Jülich in 1999, he founded the company Loetronic in the year 2005. In 2006 Moritz graduated with certificate at the Fachhochschule Aachen.