What's New in I²C GPIO Devices

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General-purpose input-output (GPIO) peripherals solve many of design problems and free up valuable processor resources. The latest generation of GPIOs includes new features such as input latching, interrupt masking, and voltage level translation. They also operate over wider voltage supplies.

Introduction

From handheld or wearable mobile electronics to gigantic server farms supporting today's cloud storage, general-purpose input-out devices deliver important benefits to both small- and large-scale products. These GPIO integrated circuits manage multiple control lines while using just two signal pins on the system's controller, perhaps a CPU, MCU, or SOC. The expanded ports are very flexible; they drive LEDs, collect data from sensors, monitor alarms and receive data from the user's controls.

In a cloud server application, adding a GPIO device can simplify hardware by eliminating long, multi-wire cables and connectors. Large servers, by necessity, are arrays of HDD or SSD storage drives, each requiring careful monitoring through sensors. Real-time data collection helps control operation and reduce maintenance, while protecting the end-user's valuable data. This data collection also reduces hardware clutter and system costs. Each rack may have numerous sensors to monitor, but just one GPIO device can support these and other needs. A GPIO device can also operate maintenance controls such as cooling fans or LED status lights.

On a much smaller scale, updating mobile phone designs or creating wearable devices with the latest features often requires adding new hardware from simple buttons or LEDs to new NFC subsystems. Finding extra I/O pins on the system controller, typically an SOC, is always a challenge in this already crowded environment. A small GPIO expander chip makes adding these new control tasks a snap.

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GPIO devices talk to the system's controller, whether small- or large-scale, over the popular I²C bus. New system chips such as the latest CPU or SOC often require lower power supply and signal voltages. For portable devices that depend on battery power, designs expect lower operating current and very small package size.

General Purpose Input Output (GPIO) devices deliver important benefits to both small and large-scale products; from handheld or wearable mobile electronics to gigantic server farms supporting today's cloud storage.

Agile GPIO: Reinventing Essentials

NXP invented GPIO technology and now we've made it even better with Agile features that speed product development from inception to market while reducing development cost. The new, low-voltage Agile GPIO device families also provide the flexibility to quickly add new features and functionality as designs mature. Do more using smaller components while reducing part counts and processor overhead.

The Agile GPIO part families implement all the industry-standard functions, but new features in smarter parts reduce the burden on the processor while making integration with other parts simpler. Across the 8-, 16- and 24-bit device families, similar pinouts aid PC board layout.

Low-voltage GPIO device families operate at 1.65 volts to 5.5 volts compared to the legacy industry standard of 2.3 volts to 5.5 volts. Voltage translation integrates components that operate in different power domains or take inputs from real-world signals.

Functionality usually implemented by firmware allows Agile GPIO devices to reduce firmware development, while internal components such as pullup or pulldown resistors save board space.

Backward compatibility with legacy components eases implementation into existing designs. Designers can implement the parts without making changes to the existing board or software and add only the features required.

New Agile Features

Latched inputs remove the need for external latches and preserve the state of an input without software intervention. Changes on an input are preserved until the interrupt is serviced to allow reduced sampling rate and a load reduction on the microprocessor. Internal pullup/pulldown resistors are selectable via software, saving board space and reducing the bill of materials.

Interrupt masking reduces the load on the microprocessor while improving its response to new interrupts. The mask determines which GPIO pins can generate an interrupt. The interrupt register stores and reports the line that generated the interrupt, reducing software complexity and external logic.

Selectable output drive types and current levels increase flexibility. Drive currents of 25%, 50%, 75% or 100% are selectable via software. Choosing the drive current allows the designer to modify the output to reduce system noise or tailor output current to device requirements.

Agile GPIO Features Improve Design Flexibility				
Agile Outputs	Software selectable drive current level of 25, 50, 75 or 100%	Select Push-Pull or Open-Drain for each output	Reduce noise and match impedance	Tailor outputs to reduce the need for multiple GPIO components
Agile Inputs	Latching saves transitions until processed	Selectable pullup or pulldown resistors	No external latches simplify software	Eliminate external resistors and reduce BOM
Agile Interrupts	Mask inputs from triggering interrupts	Identify which input triggered an interrupt	Reduce processor interrupt traffic and improve service response	Reduce and simplify external logic and software

Table 1: Agile GPIO Features Improve Design Flexibility

Agile for Large and Small Applications

From small wearables and mobile devices to the largest cloud server applications, NXP Agile GPIO families provide the features necessary for a successful design.

Tiny wearables and mobile devices are, by design, reliant on battery power. Processor manufacturers are lowering operating voltages to reduce battery drain and lengthen the time between necessary battery charging. Other components lag behind the power curve with higher operating voltages.

In a large-scale cloud storage implementation, battery drain isn't a concern. Energy-efficient, low-voltage processors and components such as NXP's LV Agile GPIO families reduce heat along with the energy costs associated with environmental control systems. Agile GPIO provides multiple avenues for control and data collection.

Agile features such as input latching improve reliability while reducing processor load. Legacy GPIO components allowed inputs to change before they were processed. Events were lost if the processor was busy or when multiple events occurred at the same time.

For example, a busy processor might miss a button press, whether it's on a small wearable device or the front of a cabinet on a cloud storage array. Latched inputs capture the event and store it until the processor has time to act upon it and the input is cleared to record the next event. Input latching also reduces polling frequency without sacrificing reliability and reduces or eliminates the software to control external latches.

NXP LV GPIO Applications	Wearables and Mobile	Large-Scale Cloud Installations
Low Power Consumption	Extends battery life and improves user satisfaction	Reduces heat and improves energy efficiency
Voltage Translation	Legacy component integration across multiple power domains	Collect real-world data and digital inputs
Agile Features • Tailor outputs as required • Configure inputs • Control/identity interrupts	Reduce component counts while increasing functionality and reducing power consumption	Improve reliability and reduce software overhead

Table 2: Benefits and Features of Agile LV GPIO in Large- and Small-Scale Applications

Speed Product Development with Agile GPIO

The Agile GPIO component families from NXP improve product development cycles, reduce system overhead, and provide features such as low energy consumption that improve end user experience or reduce energy costs.

The reinvented components offer features that simplify the design process and provide options and flexibility that reduce part counts, save processor resources, and increase flexibility by providing built-in controls that previously required complex software and hardware.

NXP offers tools such as their I²C demonstration board to aid evaluation and development projects. The demo boards are populated with I²C devices and connect via a USB cable to desktop or laptop computers running Windows® via open-source software.

Find out more about utilizing **NXP's GPIO expanders** on your I²C bus and how they can speed product development.

Additional Resources

http://www.nxp.com/documents/selection_guide/75017443.pdf

http://www.nxp.com/documents/white_paper/Mobile_Microsite_WhitePaper_D2lowres.pdf

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