UX/UI **megatrends** shaping today's world

The current state of world affairs and the global macroeconomic challenges have negatively impacted product development. Still, they have also created the opportunity for UI/UX innovations to thrive.

We are seeing changing priorities, increased responsibility, new technologies, and more opportunities across the healthcare, consumer electronics, industrial automation, and automotive industries.

On the back of a **recent study** of 250 embedded device manufacturers from the UK, the US, France, and Germany conducted by Censuswide on behalf of Qt Group, as well as our expertise and extensive research with clients, it was time to take stock of the UX/UI megatrends shaping the embedded technology industry.

As such, the emerging trends we foresee shaping R&D in the embedded device market over the next few years are:

- **Multi-sensory experiences**
- **Interoperability**
- **Hyper-personalization**
- **Designing for voice**
- **Embedded analytics**

Join us as we explore each of these exciting trends.

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Feeling a multi-sensory future

Sensorial UX adds a 'physical' dimension to digital medium interactions, enabling users to feel and naturally interact with a virtual object.

"Haptics-related technologies have been a growing trend over the past few decades, but they are now beginning to flourish as industrial UX designers and leaders push back against everything becoming a display-based UI experience," says **Marko Kaasila**, Senior Vice President, Product Management, at Qt Group.

Ali Israr, Haptics R&D Lead at ByteDance, says, "Unlike audio and visual displays, touch feedback engages with users all around their bodies, thereby making the experience surrounding and building digital spaces more immersive and alive."

Haptic feedback enhances user fidelity for better user controls, enables better handling and manipulation of digital content, and provides users with new capabilities in virtual and digital mediums without overloading a user's cognitive capacities.

"This adds a new dimension to our interactions with digital mediums, such as in the metaverse, making user experience natural, intuitive, and engaging, and opens new paradigms for media production, delivery, storage, and sharing," says Israr.

> "There is a need to connect the digital UI to the movement of physical dials."
>
> Toni Paila, Qt Group

SmartKnob View is a DIY haptic input knob with Wi Fi and Bluetooth connectivity.

1
On/off
Strong detent

SmartKnob View
Open source haptic input knob
https://github.com/scottbez1/smartknob

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The move towards touchscreens has led to a loss in physical buttons and dials, making the performance of specific tasks complex, such as making changes when driving, because there's nothing to guide your hand. In response, engineer Scott Bezek has developed a proof-of-concept project called the SmartKnob View, which has a digital display and offers satisfying resistance when rotated. This revolutionary dynamic hybrid development has the potential to be used in the automotive and industrial automation industries.

Toni Paila, Business Development Director at Qt Group for Microcontrollers, says, "The growing interest in various smart knob solutions is evident in our discussions with our customers. There is a need to connect the digital UI to the movement of physical dials."

Israr concludes, "Such technologies will revolutionize how we interact with digital technologies and open new modalities in human-computer interactions." ◾

Touching the internet

Imagine shopping online for new trousers and feeling the material by dragging your finger over your touch screen. Well, that haptic technology is here.

Disney Research lab, a research-focused sector of the Walt Disney Company, has worked with Carnegie Mellon University in Pittsburgh to design a touch-screen interface that vibrates in response to a user's touch.

The system uses electrovibration stimulus to the finger via a transparent electrode placed on top of a glass screen protected by an insulating layer, providing instant tactile feedback of texture.

As the 'science of touch' moves ever closer to revolutionizing online tangibility, it is only a matter of time before it is a common feature of consumer electronics.

Haptic technology allows for the simulation of touch in digital environments.

Ivan Poupyrev, Disney's Interaction Group's Principal Research Scientist on the project, says that touch screens on mobile devices, tablets, laptops, tables, and walls will be touch-sensitive in the future: "We need tactile feedback to make it more useful and usable."

As the 'science of touch' moves ever closer to revolutionizing online tangibility, it is only a matter of time before it is a common feature of consumer electronics.

Mark Baskinger, Associate Professor in the School of Design at Carnegie Mellon University, observes, "We have crossed that uncanny boundary between understanding the real world and being in the virtual space, and then transitioning back and forth." ■

Matter redefining smart home interoperability

Interoperability has become more than a user expectation; it is now a demand.

"It's a balancing act between security, usability, and staying connected."

Patrick Dalez, Qt Group

We want to operate our smart home all via one device, especially when utilizing products with personal assistants like Siri or Alexa. We want devices to talk to each other and have everything connected seamlessly, keeping users calm and satisfied. Whether it is a game console, Smart Fridge, or even a car, they are all seen as electronic devices at the same level as a phone.

According to the emerging embedded device and UX trends study conducted by Censuswide on behalf of Qt Group, almost a third of device manufacturers surveyed stated that they are contending with different standards in different countries and the need to comply across borders.

Automotive respondents also listed interoperability as a top trend influencing product development. This is a trend that product companies must consider at every level, creating tension between OEMs due to the need for unified standards.

One solution is the open-source Matter standard, with big tech companies like Apple, Google, and Amazon signing on. This will ignite creativity and collaboration on the Internet of Things by developing, evolving, and promoting universal open standards that enable all objects to connect and interact securely.

Smart home protocols, like Matter, are a language that devices use to communicate with each other.

Patrick Dalez, Qt Group Business Line Director, says, "Thread, a low-power mesh networking protocol specifically built for IoT devices and integral to Matter, will be the foundation of a connected home. Smart home gadgets, from smart plugs and light bulbs to air fryers and robot vacuum cleaners, will communicate seamlessly, use less power, and work faster."

He adds that there's also the question of security. "It's a balancing act between security, usability, and staying connected. The use of closed standards makes it harder to hack and therefore more secure, but the trade-off is that interoperability suffers." ◼

Seamlessly connecting
a smart home

The future of the smart home living experience spans from conceptualization and design to the deployment of functional UI applications across a range of target devices—from high-end hardware to cost-efficient low-end MCUs.

"Stop wasting time reinventing the wheel for every platform; instead, use just one framework and one codebase."

Ciro Barone, Qt Group

Connectivity is an essential element of Qt's SmartHome.

Qt Group's SmartHome project brings to life different use cases of a modern domestic environment where remotely connected appliances fulfill the user's needs using visually appealing, functional applications and utilize limitless scalability. Limitless scalability means that an embedded device can handle growing demands for processing power and storage capacity without any limitations or constraints. Even as the amount of data processed and stored increases, it can operate effectively and efficiently. The Qt platform-agnostic framework showcases how to quickly port embedded devices like HVAC, home appliances, and IoT devices across a HUB application for centralized control.

Ciro Barone, Senior Manager of Design at Qt Group, says that by enabling limitless scalability, you can create sophisticated, user-friendly applications that work across multiple devices and operating systems in weeks instead of months. "Stop wasting time reinventing the wheel for every platform; instead, use just one framework and one codebase."

Designers and developers are often siloed with little collaboration, making it hard to manage customized feature requests and endless lines of code. With Qt's solution, you can satisfy the demand for similar UX across devices by creating animations, transitions, 3D, and visual effects using the same code base as any OS or hardware. Interoperability is helped by having a design system containing all your base components and UI elements, which has a unified style and follows the same rules for a seamless experience. Barone says, "Customers often ask for the reusability of components and UI because designers tend to create product variations for different markets or models, and they must work the same for each product."

A UI composition tool closes the gap between designers and developers, such as Qt's internal bridge technology that allows designers to easily port their work into **Qt Design Studio** from existing applications like Figma, Sketch, Adobe XD, and Adobe Photoshop. ◼

Metaverse driving hyper-personalization

Personalization is leveling up.

Netflix recommends TV shows and movies for us based on our viewing preferences; Amazon suggests products based on our purchase history; and online ads have long been tailored to search results. Yet, we are now seeing the hyper-personalization of our digital experiences—particularly with the advent of the metaverse.

According to our study, machine learning, the metaverse, and hyper-personalization are all hot industry trends driving product development in automotive, consumer electronics, healthcare, and industrial automation, particularly in the US and UK. Embedded devices such as VR and AR headsets, smart glasses, and wearable devices are increasingly being used to access and interact with the metaverse, providing users with a seamless interface between the physical and virtual worlds.

"Independently, AI and 3D are potent tools. If you combine them and start thinking about the metaverse, it's an exciting Pandora's Box to open."

Shawn Dorsey, Qt Group

Getting the immersion and user experience right is vital for the success of a VR application.

Shawn Dorsey, Design Experience Lead at Qt Group, says car passengers could soon be wearing VR headsets and be immersed in a new environment on a long road trip. "It could go to a new level, such as sitting on an airplane or at home and still be with your friends, family, or colleagues to maintain that sense of being together." When you think about different drivers in a family: how can the car adapt to each person? The UI can recognize you from your key, connect your phone and initialize personalization. The driver can have a pre-selected drive mode, seat position and mirror preferences, and tailored environmental and ambient settings.

Furthermore, interactive 3D designers are designing innovative ways to present information in new ways, and 3D elements offer that opportunity. "Independently, AI and 3D are potent tools. If you combine them and start thinking about the metaverse, it's an exciting Pandora's Box to open."

Eva Rio, Product Manager at Tuxera, adds that having a digital persona or avatar in a virtual world is something for companies to explore if they want to target the younger market. "But it's going to be about how many people are ready to share their data to get this seamless, personalized experience versus people who don't." While it is a concern to privacy advocates, the design process will be about adopting intelligence data that has been collected with your permission. The more information gathered the more UX designers can understand and improve.
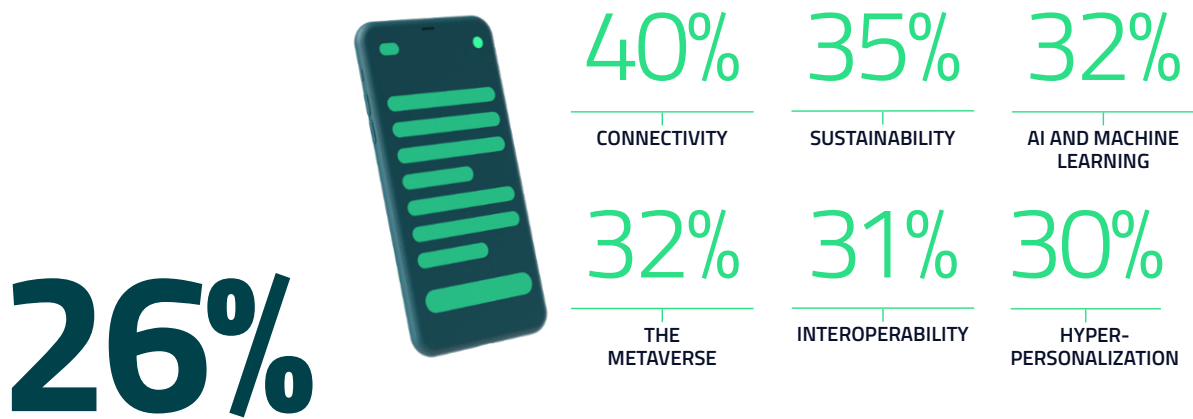
We'll want our devices to know us and adapt to our liking instead of something that's programmed and reacts to anyone. ◾

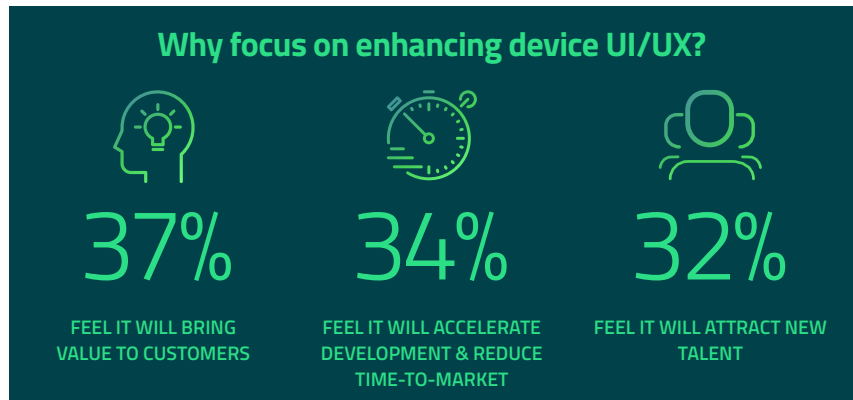# What's influencing UX/UI development in embedded devices?

Qt Group partnered with Censuswide to research the embedded market and vertical trends among 250 embedded device manufacturers from the UK, the US, France, and Germany. Together, we determined which embedded device and UX trends are emerging in the automotive, healthcare, consumer electronics, and industrial automation sectors.

Influential trends driving UX/UI development
Here's what those surveyed said:

40%
CONNECTIVITY

35%
SUSTAINABILITY

32%
AI AND MACHINE LEARNING

32%
THE METAVERSE

31%
INTEROPERABILITY

30%
HYPER-PERSONALIZATION

26%
of companies plan to invest over half their development budget into UX/UI in embedded devices this year.

Why focus on enhancing device UI/UX?

37%
FEEL IT WILL BRING VALUE TO CUSTOMERS

34%
FEEL IT WILL ACCELERATE DEVELOPMENT & REDUCE TIME-TO-MARKET

32%
FEEL IT WILL ATTRACT NEW TALENT

3 reasons why companies are counting on UX/UI

30%
... of those surveyed feel it will lead to financial gain.

29%
... feel it will help increase market share.

26%
... think it will open new avenues for technological disruption.

Designing for voice

"I'm becoming much more than they programmed. I'm excited!"

"Samantha", Her (Spike Jonze, 2013)

The 2013 Spike Jonze film Her presented a realistic vision of the world's direction with artificially intelligent virtual assistants. While Google Assistant, Apple's Siri, and Amazon's Alexa aren't yet at the level of the fictional Samantha, the possibilities are constantly expanding.

Controlling products by voice will become much faster than tapping and swiping a device, especially if you need to explain a complex issue. AI will be well-suited for conversational-use cases such as customer service and personal assistants, as we already see with ChatGPT and its ability to generate human-like text to answer questions, provide explanations, and translate text.

Peter Schneider, Senior Product Manager at Qt Group, says that voice is a potent tool that will only continue to grow: "Our study found that an increasing number of medical device manufacturers are investing in virtual assistants and voice control. There's also a trend across all industries to move towards more headless embedded devices." In addition, there is also research into the voice used by virtual assistants. The voice must be calming, assuring, and give security. Gender once played a role in that, but Danish researchers have now created Q, a voice assistant with a gender-neutral voice specifically designed to reduce gender bias and reflect diversity.
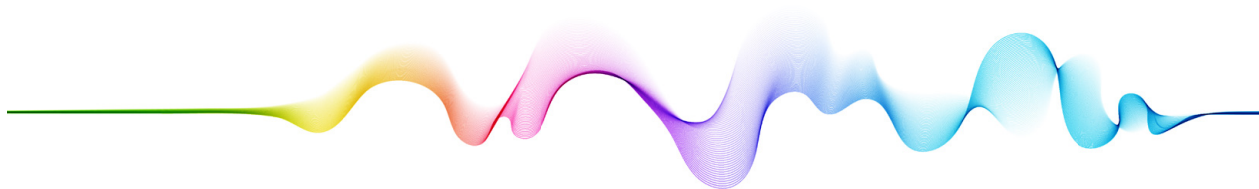
Doing things with your voice will open a whole new world of experience, but products should offer a hybrid approach that allows them to be operated without voice commands. It cannot be exclusive and discriminating. Language, accents, pronunciation, and clear articulation all come into play.

While health-related searches using voice recognition are steadily rising, it only scratches the surface of the possibilities. As technology evolves, voice data is predicted to offer physical and mental diagnoses beyond what a patient tells a doctor. By analyzing a patient's tone, pace, and inflection, we'll get an insight into their health, mood, and social status. ◾

Experts' Forecast

"Why should your **AI recognize your gender based on your voice**? It's a moral question. I know that some companies aren't assigning gender to somebody. Designers and product companies are taking these issues seriously."

Heikki Paulaharju, Senior UX Manager, Qt Group

"**Physical engagement with the world makes us human**. Taking that away is a conscious and forced evolution in a scripted direction. However, it's also ripe territory to intellectually scrutinize what it means to think and act in the world without physical engagement."

Mark Baskinger, Associate Professor in the School of Design at Carnegie Mellon University

Next-gen analytics to elevate UX

We live in a world where we expect information to be instantly available to us. And yet analytics is a trend that's strangely neglected.

Designing applications and not looking at analytics will leave you in the dark. UX exercises like job shadowing or user tests pale compared to see how a product works in real-life situations, even after the product launch.

According to our study, half of the consumer electronics respondents said the primary technical barriers to delivering innovative UI/UX are a need to understand how products are used daily and difficulty in identifying user needs. That is not to say that other methods should not be used, but the data gathered via analytics complements findings and can reveal insights not found by any other means.

Embedded technology previously only offered the possibility to see a product in a laboratory or research setting while building and testing the UI. Now, analytics can provide valuable insights into an application or device's usage.

For example, you can track whether drivers or passengers use the physical button or the touch display to control the in-car entertainment volume. With that real-world information, you know what to include or exclude in the next generation or iteration of products.

Integrating analytics with embedded technology will shed light on otherwise unattainable information such as performance, usage, and user data.

The integration of analytics with embedded technology will provide insight into real-life data.
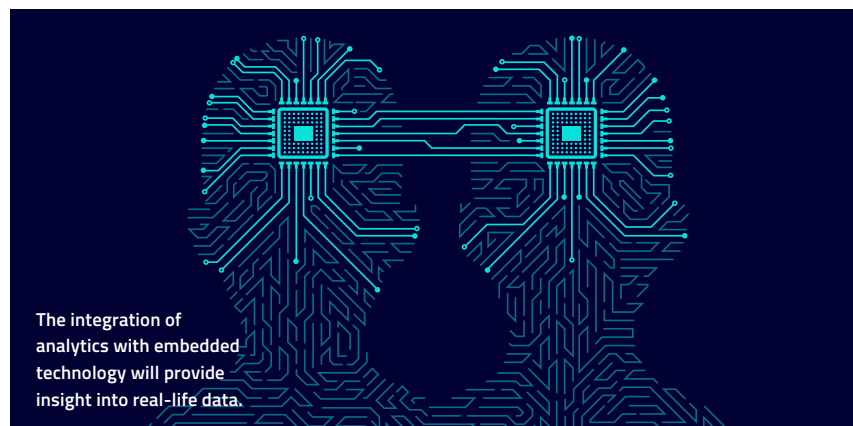
Integrating analytics with embedded technology will shed light on otherwise unattainable information such as performance, usage, and user data. By gaining insight into real-life data, you can utilize a digital twin—this allows the testing of a real-life simulation before a product has even been built. A digital twin is a virtual representation of a physical object or system that can be used for performance simulation and analysis. It can be used for design optimization, predictive maintenance, and to cut outlays associated with prototyping and testing. Analytics will support that because you get data from the artificial world as though it were a real-life situation.

Heikki Paulaharju, Senior UX Manager at Qt Group, notes, "Investment in digital twin technologies is high in the UK and France and more medical device manufacturers investing in the technology. We will see more companies looking to add value to customers, reduce costs and set themselves apart from their competitors."

Ending the guesswork in UX

Qt Insight is an analytics solution born from a desire to provide authentic customer insights to companies utilizing embedded technology.

Qt Insight offers our clients the chance to analyze the product created using our tools and to make improvements intuitively and quickly.

To accomplish this, you must learn how, when, and why people use your application or device, so you can optimize the user experience, make better-informed business decisions, and drive higher customer satisfaction.

Created for companies utilizing embedded technology, As a product analytics solution, **Qt Insight** opens the door to a world previously closed to UX designers and product managers. Previously, you needed to conduct interviews and feedback loops to understand how customers would interact with your devices. By tracking and visualizing user flows and actions, you no longer need to guess which components are popular, don't perform, or require more work.

Laura Grant, Product Marketing Manager for Qt Insight at Qt Group, says, "Qt Insight works as an integral part of your application, device, or digital platform. With it, you can become aware of customer pain points, analyze performance, and create development plans for your products and business."

Data from analytics is quantitative and usually has multiple touch points, so analyzing it can take time. Qt Insight offers our clients the chance to analyze the product created using our tools and to make improvements intuitively and quickly.

If you have an embedded device with a screen, you can now access metrics and use Qt Insight's analytics to create better user experiences. ◼

Make improvements intuitively and quickly with Qt Insight.

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UX/UI MEGATRENDS SHAPING

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