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The significance of UI/UX on IoT

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Abbreviations

UI/UX	User Interface/User Experience
I/O	Input Out
NFC	Near Field Communication
RFID	Radio Frequency Identification

Introduction

IoT devices are unconventional devices that can wirelessly connect to a network and transmit data. They allow internet connectivity beyond traditional devices, such as smartphones, laptops, tablets, desktops, etc. Assimilating technology into these devices allows communication and dialogue over the network for remote monitoring and control.

Currently, IoT devices are experiencing enormous growth in demand and consumption. This boom is expected to continue. The development of IoT devices has accelerated since the first IoT device came up in 1990. Every second, 127 new IoT devices are used. This means that the IoT industry will explode over the next few years and decades and the universe is expected to use more IoT apps than ever.

What does future hold?

The future of the IoT looks very promising. By 2025, the number of IoT devices is expected to reach over 75 billion internet-connected IoT devices. This paves the way for a global IoT device market worth about $ 1.1 trillion, supplying devices to almost every industry.

IoT trends show smaller and more powerful IoT technologies, which enable smarter, unobtrusive wearable devices like smart glasses that look like standard glasses. This also means that IoT sensor devices can be used in industries where current-generation IoT devices are too large to perform the required functions.

Improved IoT technology will greatly benefit the medical and industrial manufacturing industries as devices become small and powerful enough to be more widely used in surgery and internal diagnostics. Industrial production plants will feature more sensors and finer tuning to maximize production, enabling companies to create entirely new products.

This makes the IoT the best market to enter now and in the future. Today, many IoT products outnumber people on this planet.

Some of the essential features of IoT devices are as follows:

- **Perception:** A device that observes the environment with respect to temperature, movement, the appearance of objects and so on.
- **Sending and receiving data:** IoT devices can send and receive data through network connections.
- **Analysis:** Devices can analyze data received from other devices over the Internet network.
- **Control:** IoT devices can also be controlled from some endpoints. Otherwise, the IoT devices will communicate endlessly with each other and system failure will occur.

Advantages of using IoT devices:

- Facilitates device-to-device interactions, known as machine-to-machine interactions
- Provide excellent automation and control
- Incorporate additional technical information for easier usability
- Offer robust monitoring features
- Assist in saving time and money by reducing manual tasks, leading to increased efficiency.
- Automation of tasks in daily life ensures proper monitoring of the device
- Ensures quality of life

How does IoT UX differ from regular UX?

As UX designers, we all know the standard path, formats, processes and techniques to create an engaging experience for a product. On the contrary, UX for IoT is not about just designing for user actions, but it is much more than this.

We need to design minimalist and futuristic products that enable users to personalize them and integrate them with other IoT devices. As the name suggests, IoT relies entirely on the Internet. This means that if the connection is lost, the device might not respond or could experience a delay.

In general, when a user presses a button in an app, there is a visible interaction. However, in the case of apps using IoT, remote controls play a central role. It's important to notify users and confirm that their intended action was successfully completed. Without this feedback, users may repeatedly tap the button, leading to frustration when they do not see the expected results.

In fact, we can say that the IoT shares some similarities with UX design; however, IoT design requires a different approach. This is primarily because IoT is not a one-size-fits-all solution. There are several guidelines that define an IoT product—it can consist of a network of devices, but it is more than just a screen. When designing your IoT product, consider various functionalities while ensuring a consistent experience throughout the entire system.

Types of IoT devices

The IoT devices are of three types: Home, enterprise and industrial.

1. IoT home devices

- **Google Home Voice Controller:** This is a smart IoT device that lets users control features such as media, alarms, lights, thermostats and volume with just their voice.

- **Amazon Echo Plus Voice Controller:** This is a trendy and reliable IoT device. It allows you to play songs, make phone calls, set timers and alarms, ask questions, provide information, check the weather, manage to-do and shopping lists and play instruments in your home.

- **August Doorbell Cam:** This handy IoT device allows you to open the door remotely. It also helps safeguard your house from intruders and tracks changes in the movement of your front door.

- **August Smart Lock:** This utility IoT device enables you to easily manage a residence's doors from even a remote location. In addition, this device helps keep thieves away from your home.

2. IoT enterprise devices

Some of the popular IoT enterprise devices are as follows:

- **ABB – Smart robotics:**
  One of the most well-known companies that uses predictive maintenance is the power and robotics company ABB. It uses linked sensors to track the maintenance requirements of its robots across five continents and to initiate repairs before parts fail. The business' collaborative robots are also connected to IoT. They're the YuMi model, created to work in tandem with people. They can accept input over Ethernet and use commercial protocols like Profibus and DeviceNet.

- **Future Factory for Airbus:**
  These crafts require millions of parts and tens of thousands of assembly procedures, where mistakes can have a significant financial impact. Airbus has started a digital manufacturing program called "Factory of the Future" to simplify operations and increase production capacity to handle the complexity. The business has added sensors to shop floor tools and equipment as well as provided wearable technology to employees, including industrial smart glasses, to lower errors and improve workplace safety. The wearables helped boost efficiency by 500% in the cabin-seat marking while eliminating mistakes.

- **Amazon – Reinventing warehousing:**
  Although the industry leader in online retail isn't frequently referred to as an IoT company, it is undoubtedly a pioneer in storage and logistics. According to MIT Technology Review, while the company's ambitions to employ drones for delivery have garnered substantial media attention, the firm's fulfillment warehouses use armies of Wi-Fi-connected Kiva robots, demonstrating how it is "pushing the frontiers of automation and human-machine collaboration." The fundamental premise of the Kiva technology, which Amazon purchased for $775 million in 2012, is that it makes more sense for robots to find product shelves and carry them to employees rather than for staff to search for things on the shelves themselves. According to Dave Clark, a senior vice president at Amazon, the robots assisted the business in cutting its operating costs by 20% in 2014.

- **Boeing- Using IoT to drive manufacturing efficiency:**
  William Boeing, a pioneer in aviation, once said that "it behooves no one to dismiss any original concept with the phrase, 'It can't be done.'" The worldwide aviation corporation established in his honor appears to adhere to that mentality. It is striving to become the most useful information provider in aviation while making its service offerings more significant than its product offerings. The firm has already seen a considerable transformation by making substantial enhancements. IoT technology has been aggressively implemented by Boeing and its subsidiary Tapestry Solutions to improve productivity in manufacturing and supply lines. Additionally, the corporation is gradually increasing the number of connected sensors that are integrated into its aircraft.

- **Bosch- Track and trace innovator:**
  In 2015, Bosch launched what would be the Industrial Internet Consortium's first test bed. The so-called Track and Trace program was primarily motivated by the fact that workers would frequently spend considerable time looking for tools. So, starting with a cordless nut driver, the company equipped its tools with sensors to enable tracking. Bosch intends to utilize the system to direct assembly operations when the tracking resolution improves.

3. IoT industrial devices

Some of the popular IoT Industrial Devices are as follows:

- **Connected vehicles:**
  A self-driving car is one of the most prolific examples of how IoT is actually working. It uses an array of connected devices to securely navigate the road in all traffic and weather conditions. The various technologies used in connected vehicles are Artificial Intelligence (AI) cameras, Motion Sensors and Onboard Computers. IoT connections also exist in standard vehicles where manufacturers install connected devices to keep an eye on the performance and manage computerized systems. Commercial fleets, such as city buses and corporate delivery trucks, are often endowed with additional IoT technologies, like a network system for keeping an eye on security problems.

- **Traffic management:**
  The road infrastructure has been ever so more connected over the last decade - sending data from cameras, sensors, traffic light controllers, parking meters and even smartphone traffic apps to evade congestion, stay away from accidents and ensure smooth travel. For example, a camera gathers data about traffic levels and sends it to a central management group. The group can analyze the information and assess whether, when and what mitigation actions need to be taken.

Traffic light sensors perceive different levels of light in the sky and adjust the signal's brightness so that it is always perceptible to the driver. You can use the connected device to detect free parking space and send this information to the kiosk or app to alert the driver.

Bridge monitors collect and send data, analyze structural health and alert authorities to maintenance requests before failures or problems occur.

- **Smart grids:**
  Energy operators are also using the IoT to make their energy grids more competent and robust. Historically, energy flows are unidirectional in nature, i.e., from the power plant to the customer or along the grid. On the other hand, connected devices have enabled two-way communication throughout the energy supply chain. Power companies are getting better with time in their ability to move and manage smart grids - from power generation to distribution to consumption. Utilities can collect and analyze real-time data transmitted by connected devices to spot power outages and forward power distribution to meet changing energy demands and loads. Smart meters, installed in individual homes and businesses - provide information on both actual usage and past usage patterns, which can further be analyzed to identify ways customers and utilities can improve efficiency.

- **Environmental monitoring:**
  Connected devices can collect data related to IoT, including weather, air, water, soil conditions and quality, fisheries, forests and other natural habitats. You can also collect weather and other environmental data through connected devices, such as air, water, soil conditions and quality, fisheries, forests and other natural habitats. As such, the IoT not only allows access to so much real-time data about the environment anytime, anywhere but also enables organizations across multiple industries to use this data to generate actionable insights. Such information facilitates government agencies' better monitoring and forecasting of natural disasters, such as tornadoes and better managing and safeguarding of land and wildlife populations. Companies can utilize this data to limit carbon footprint emissions, document compliance with environmental regulations and plan for weather conditions that influence their business more effectively.

- **Smart buildings and smart homes:**
  Real estate owners would utilize the power of IoT to make smart buildings. Using IoT will not only make the buildings cost-effective vis-à-vis energy and comfort but also make them healthier and safer than typical buildings. The IoT ecosystem of commercial buildings may comprise HVAC infrastructure monitoring. It uses real-time data and automation technology to regularly quantify and regulate temperature for the best energy efficiency and comfort experience. On the other hand, AI-powered cameras can assist in controlling a large gathering to ensure the public's well-being at the sold-out concerts or events.

Design thinking in IoT

Design thinking is essentially the reverse of analytic thinking. You can refer to it as a process that helps us envision what is possible rather than focusing on the issues. Free from the constraints of complexity, it has proven to help us create new goals and unique solutions. It prevents us from discussing what materials should be used for the bridge and compels us to look for other ways to cross the valley. As per the top management consulting firm McKinsey's analysis, the IoT could have a major impact on our economy, going from $ 3.9 trillion to $ 11.1 trillion in three years. At the high end, this represents 11% of the world economy. Using the design thinking methodology to develop IoT solutions will help us accomplish our financial goals.

Given the ever-evolving technological and strategic potential of the IoT, it's not too hard to anticipate this level of value-add; latest standards, components, platforms, protocols etc., are coming to the fore almost every day. These options can be combined in countless ways to fulfill different use cases, such as connectivity, bandwidth, power consumption and user interaction. It applies to almost all potential applications and meets the user's needs.

However, some technical, governing and human resource challenges need to be addressed before the true value of the IoT can be realized. Perhaps the biggest test lies in the approach of IoT companies, which are investing time to understand user needs and develop solutions that deliver true value.

Certain rules are set about what makes up an IoT product; it could be a network of things, not just a screen. As you develop the UX for an IoT solution, it’s essential to consider a variety of use cases while preserving the system's consistent feel. Let's look at some of the most important characteristics of IoT design.

The Internet of Things offers a potential economic impact of $4 trillion to $11 trillion a year in 2025.

Nine settings where value may accrue	Size in 2025, $ trillion Low estimate High estimate
Factories – E.g. operations management, predictive maintenance, etc.	1.2 – 3.7
Cities – E.g. public safety and health, traffic control, resource management, etc.	0.9 – 1.7
Human – E.g. monitoring and managing illness, improving wellness, etc.	0.2 – 1.6
Retail – E.g. self-checkout, layout optimization, smart customer-relationship management, etc.	0.4 – 1.2
Outside – E.g. logistics routing, autonomous (self-driving) vehicles, navigation, etc.	0.6 – 0.9
Work sites – E.g. operations management, equipment maintenance, health and safety, etc.	0.2 – 0.9
Vehicles – E.g. condition-based maintenance, equipment maintenance, reduced insurance, etc.	0.2 – 0.7
Homes – E.g. energy management, safety and security, chore automation, etc.	0.2 – 0.3
Offices – E.g. organizational redesign and worker monitoring, augmented reality for training, etc.	0.1 – 0.2
	Total $4 trillion–$11 trillion

Numbers do not sum to the total because of rounding.

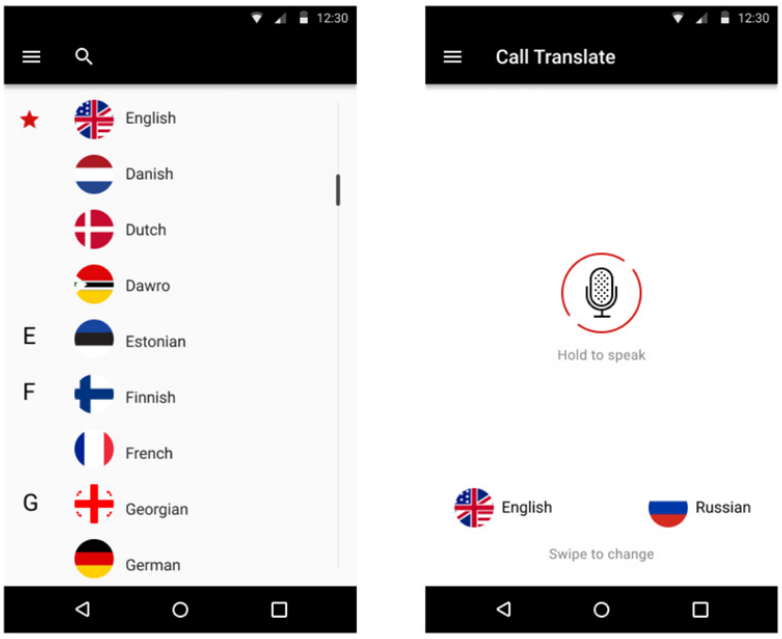
Source: Mckinsey Global Institute analysis

Customize user experience

Huge IoT systems, such as those used to monitor warehouses or run the smart grid, typically involve many users with role-based access control, permissions and even different authorization methods. In other situations, systems might not have any security constraints but provide various functionalities and access to data based on the value they offer to various users.

It is essential to customize the UX and functionality of IoT applications to meet the needs and expectations of various end-user groups during the design process. Mobile phones are termed personal gadgets for good reason.

The mobile Acouva app is an example mentioned in this section, which adapts to the UX of different user groups. One of the two mobile apps for wearable earbuds, Acouva Chat, allows users to select their preferred language and automatically translates all text and audio messages into that language. The mobile app provides two-way synchronous translation for a wide range of languages.



Activate remote control

The simplest way to give end users remote control over an IoT system may be to add a mobile app. Sometimes, it is incredible to feel that any smart home gadget, whether a smart doorbell or a sophisticated energy management system for an entire home, can be configured and controlled from a smartphone.

These specifications should be considered while developing an IoT application's user interface and user experience. Enabling proper remote control and system configuration can simplify users' lives and help them get quicker access to important services. An app's user-friendly and practical UI can greatly decrease the learning curve when installing and configuring a new device.

Image credit: luminsmart.com

Make alerts smart and push notifications

When it comes to push notifications and alerts, there is a fine line between being helpful and obnoxious. A user will turn them off entirely after a few premature pings.

This is a significant problem when creating the UI and UX for IoT applications. On the one hand, users can react briskly to certain occurrences thanks to smartphone notifications, which is a huge advantage of mobile technology. However, designers must ensure that every signal is significant; otherwise, users may begin to ignore them.

Design choices for notifications and alerts must consider context as well. Notifications from some systems can be muffled or, on the other hand, increased depending on location, time of day and personal schedule. For instance, a security camera app should ensure that the owner of the house is informed about the breach at any hour of the day, unlike an electric car app, which should not wake up an owner at night to remind them that the car is completely charged as scheduled.

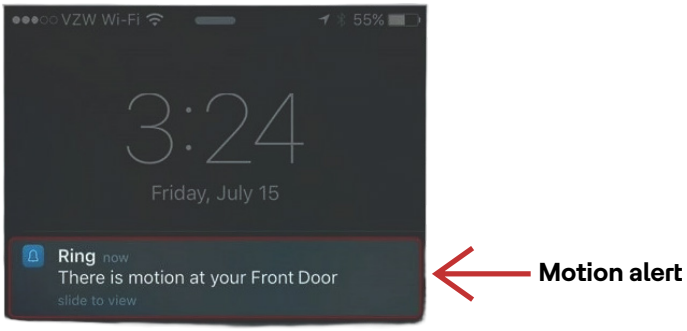


Image credit: ring.com

Make data visualization and dashboards more specific

IoT systems rely heavily on data. In reality, many mobile apps are created expressly to furnish the end users with reports and insights into graphical data. However, the restricted screen real estate on smartphones lets you make critical design decisions about how to set up dashboards and enhance IoT data visualization.

When creating a collection of relevant filters, tools to drill reports and the ability to quickly switch from one view to the next to get access to critical information instantaneously, it's crucial to consider these factors when building the UX and UI of an IoT application. Based on the system's specifics, ensure the dashboard only presents the essential information and optimizes space usage.

Image credit: solos-wearables.com

Make the most of phone features

Thanks to internal sensors and built-in functionality, modern smartphones are incredibly advanced in "sensing" and reacting to their surroundings. It's important to consider and maximize the variety of smartphone capabilities when creating a unique IoT design for mobile apps.

Designers may enhance their applications' functionality and change how apps interact with IoT devices, consumers, voice interfaces, NFC, RFID readers or location data. In addition, new benefits come with each new generation of mobile phones. For instance, some of the biggest smartphone manufacturers have already released gesture control features. When these features reach a maturity level, they help you alter how you interact with mobile devices, such as how you push buttons and swipe.

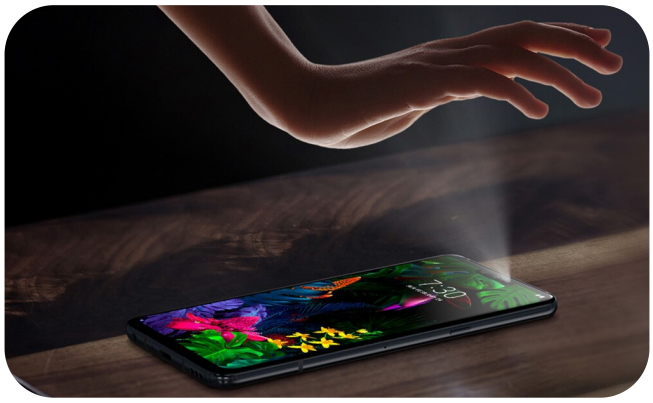


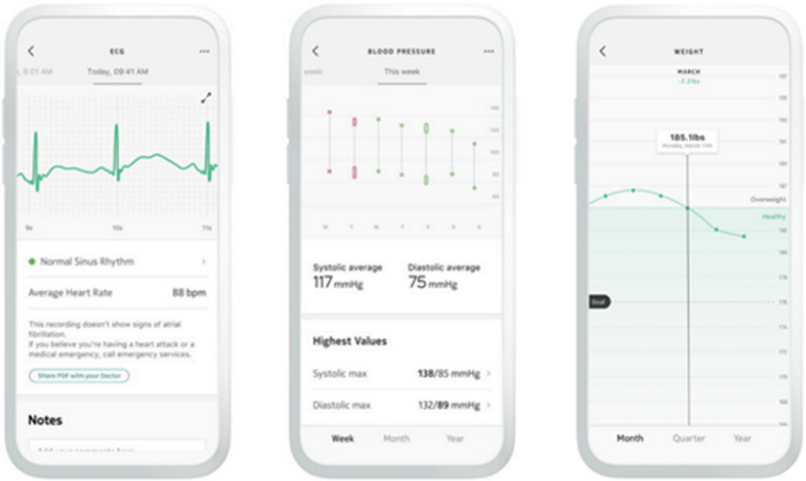
Image credit: lg.com

Consider scalability

As already discussed in this paper, IoT is a rapidly expanding and rising industry. For instance, Nest, a market leader in the smart home space owned by Google, began by selling smart thermostats. The business now provides a full range of home automation products for security, interior safety and climate management.

A business like Nest must consider how to scale up end-user tools appropriately and develop sophisticated IoT application design models for various sets of devices. Does it make sense to create a mobile application for each new device, group them or combine all the devices into one?

A handful of devices have no I/O capabilities and do not directly convey to you what you are doing. Interactions can be processed via the web or smartphone apps. Despite the different form factors, users should feel that they are using a consistent service rather than a fragmented set of user interfaces. It is important to consider interoperability as UX that is distributed across multiple devices and the ease of use of apps.



Functionality can be distributed across multiple devices with different capabilities

IoT devices have various form factors with diverse I/O capabilities. Some of the IoT devices might have a screen, like a heating control or washing machine. A few of them may have other ways to communicate with us (e.g., LEDs or blinking sounds).

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IoT is largely asynchronous

When designing for desktops, mobiles and tablets, we usually presume they are always connected. Well-designed mobile apps handle network outages properly but tend to treat them as an exception to normal functionality. We also presume that the flow of interactions will run smoothly between devices. Changes made on one device (such as deleting email) are quickly reflected on all other devices used by the same service.

Many IoT devices run on batteries and need to save power. Maintaining a network connection consumes a lot of power, so it is only connected intermittently. This means that parts of the system will be inconsistent, creating discontinuities in the UX. For example, suppose the heating is set to 19 ° C . Suppose a user sets it to 21 ° C using the heating app installed on his smartphone, but it takes a few minutes for the battery-powered heating controller to come online and see the new instructions. During this time, the phone shows 21 ° C and the controller displays 19 ° C.

Conclusion

In the IoT domain, user task flows can be spread over different devices, interaction models and usage contexts. This increases the complexity to a great extent for the designer. Users' expectations are increasing by leaps and bounds as they expect the experience of using these distinctly connected devices to be greater than the sum of their individual experiences.

The key to designing a great IoT UX is to fathom the erratic nature of IoT and add its interactions accordingly. Good user research is needed to understand users' expectations for IoT devices. The basics remain the same; apparently, the designers need to spend more time understanding how IoT works.

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