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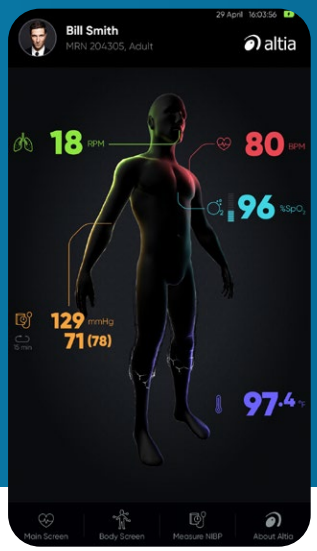
A Roadmap for Designing and Deploying Medical Device GUIs



How the Touchscreen GUI is Reshaping Modern Medicine

Touchscreen GUIs are becoming increasingly commonplace in medical settings as both PC displays and handheld devices. These touch screen GUIs offer a range of benefits to health care professionals and patients alike. A vast majority of the population is accustomed to interacting with smart phones and tablets. Lending this familiar mode of interaction to medical devices is a natural and necessary next step in the improvement and advancement of medical care. The advantages these medical touchscreen devices bring are many, and their importance should not be overlooked.

Improved Organization

Medical facilities are often in a state of chaos—even if it's organized chaos. The sheer volume of patients served in a single office on any given day can be overwhelming. The quantity of data that must be processed to adequately document and deliver quality patient care is vast. The introduction of touchscreen GUIs, however, as part of a medical device or a larger network, helps to combat that disorganization. Streamlining processes and giving access to information makes staying focused easy. Users are also afforded the ability to update information at the touch of a button and quickly share that information with other members of a healthcare team.

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Protected, Easily Accessible Data

With the use of a touchscreen GUI, patients or medical professionals have easy access to a whole range of data stored by the device, via a simple interaction with the screen. For example, instead of having to wade through three decades' worth of medical notes, a physician can simply find the appropriate application and enter a specific date or keyword; the device returns the appropriate search results. Additionally, with a paperless system and proper data security protocols in place, sensitive patient information is safer.

Secure patient data opens new opportunities for healthcare workers to serve patients remotely as well using telecommunications technology. Telehealth[1], or telemedicine, gives doctors and nurses the capability to treat patients to access medical expertise quickly, efficiently and without travel. These virtual visits are accomplished using a computer, tablet or smart phone and, sometimes, by sending and receiving messages over a secure messaging app or file exchange. Patients collect their own medical data via an easy-to-use medical device, often including a touchscreen, and then transmit this data via the Internet to their health care provider who can monitor progress remotely.

[1] "What is telehealth?", Health Resources & Services Administration, https://telehealth.hhs.gov/patients/understanding-telehealth

The advantages[2] offered by telehealth are tremendous. Patients in remote areas are granted better access to healthcare—and, regardless of patient location, the opportunity to work with specialists outside a local area is now available. Patients save time and money by eliminating commutes from office to office. They can be diagnosed and treated faster, improving outcomes and decreasing overall healthcare costs. Telehealth also provides an important alternative to urgent care and emergency room visits, which was particularly necessary[3] during the COVID-19 pandemic.

Lower Cognitive Load and Reduction in Human Error

When using a well-designed touchscreen graphical user interface, access to all critical functionality is laid out in front of the user—whether that be a doctor or patient. It's incredibly easy to enter data or to retrieve information; it's even possible to set reminders on some devices to take the next test or dose. The ease of use and multiple functions reduces the required cognitive load, ensuring that users have more available mental processing capacity to focus on more important or complex tasks. By reducing the necessary cognitive load and increasing ease of use, touchscreen GUIs help to reduce human error. For example, those applications with "required fields" refuse to let users complete a task or move off the current display without giving an appropriate response. Additionally, many high-quality GUIs ask for confirmation of an action, making users pause briefly to consider whether this is the appropriate approach.

Case in Point: The t:slim Insulin Pump

Just how much difference does the right user interface make? Consider the t:slim® Insulin Pump from Tandem Diabetes Care. The t:slim Insulin Pump[4] is a prime example of a cutting-edge touchscreen GUI medical device that empowers patients. The device makes monitoring blood sugar levels and delivering insulin super simple, while ensuring the risk of human error is negligible. It boasts a state-of-the-art shatter-resistant touchscreen that provides easy navigation and simple reporting, allowing users to quickly find and view complete insulin delivery histories. To reduce the chance of human error, the interface has several safety features including a lock screen and confirmation screens that require user input before setting changes or beginning insulin delivery.

[2] Holland, Kimberly. "How Does Telemedicine Work, and What Are the Benefits?", Healthline.com, https://www.healthline.com/health/telemedicine

[3] "CARES Act: AMA COVID-19 pandemic telehealth fact sheet", American Medical Association, April 27, 2020, https://www.ama-assn.org/delivering-care/public-health/cares-act-ama-covid-19-pandemic-telehealth-fact-sheet

[4] "Introducing the t:slim® Insulin Pump", Tandem Diabetes Care, http://www.tandemdiabetes.com/Products/t-slim-Insulin-Pump/

Delivering a GUI that is Simple, Safe and Certifiable

It's clear that a touchscreen GUI has multiple advantages that make it an attractive decision. However, there are numerous pitfalls. We've all experienced the GUI that was confusing or slow or buggy. In a medical setting, these flaws can be life-threatening.

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For medical device manufacturers, it's not enough that they provide a device that works. With an increased number of devices that are used by patients only—outside the hospital or doctor's office—that device's GUI must be straightforward and simple, without requiring extensive user training. Software quality and a clear focus on usability are paramount.

When it comes to software development, medical device developers have it harder than developers of any other consumer device. While consumer devices can update their software functionality and even their GUI on the fly, sometimes without users even knowing it, government regulations require that medical devices have a longer route toward creating a touch screen user interface.

Medical device developers attacking their first GUI might approach the project from a mobile phone perspective, attempting to mimic the look and feel of a smart phone since that is what their users know and expect.

This isn't the best approach, however. With a smart phone app, developers are often tempted to start with an open-source library of software. And why not? They have all the power and memory space that modern mobile phones have to offer. They are comfortable trading code bloat for saving time with programming.

Many first-time medical device developers who consider this approach fail to realize that starting with an open-source kit often pulls in megabytes of potentially unnecessary libraries and a rat's nest of dependencies. After all, the purpose of the kit is to save a very wide swath of GUI developers from having to write code by hand. Trying to serve the needs of the many leads to a non-optimal solution.

Moreover, the UI is going to be one of the most frequently changing sections of programming—leading to even more inscrutable spaghetti code. In the medical space, device manufacturers often need to trace back to every line of code that's ever been written that will go into a device. They must know and document where that came from and why it was written. So, it's often best to start development with a blank sheet of paper.

Medical devices need more than just advanced features. Every aspect of the interface must be fine-tuned to optimize usability and safety. Learn more in this medical UI/UX trends report.

The challenge for device makers is to define what a device user does and also the thousands of things they might do. Medical device software is regulated under ISO 62304[5], so it's critical that device software meets those criteria. Using open-source technology for touch screen medical GUIs is a risky option.

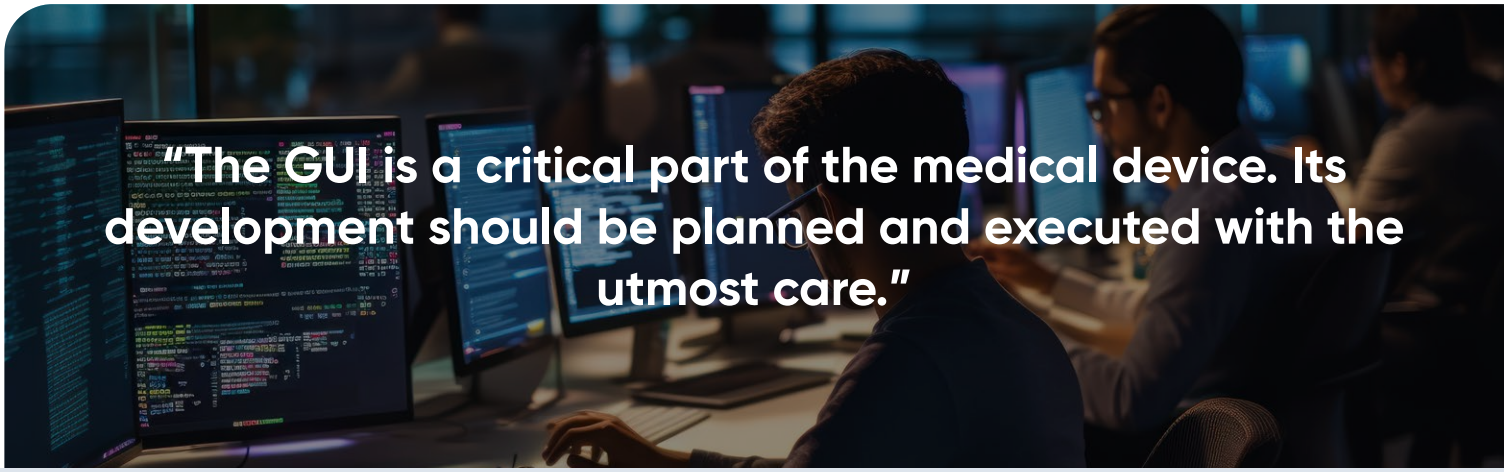
Focus on User Goals

In developing device software, manufacturers must be laser focused on the needs of whomever their device is designed for, whether it's patients, doctors, nurses or administrators. A successful approach is to address GUI development from the top down—the screen, components, how big a button is, what the color palette is—as all of these elements are regulated. Ideally, with the compilation of those elements, development teams can create a UI that can be simulated so that human factors studies can be done before software development begins. Collecting this data early is key to understanding the overall demands of their device, like the minimum hardware requirements that will be able to run the device and its components. Remember, that device must be absolutely perfect and bug free before it can be submitted for its one- or two-year-long FDA approval.

FDA approval time is not the device makers' biggest obstacle, however. There are four major mistakes seen too often in medical GUI development.

Medical GUI Mistake #1 – Underestimating the Time to Build a Good GUI

Many device makers are underestimating the time it takes to build a good GUI. In recent years, many companies had a device that didn't have a display or they had a segmented LED display. Now they have a graphical display and they assume that simply adding some GUI components to their existing interface will take only a month or two. This philosophy is flawed and will lead to a doomed product with the FDA[6] or with users. The GUI is a critical part of the medical device. Its development should be planned and executed with the utmost care.



[5] "IEC 62304:2006: Medical device software – Software life cycle processes," International Organization for Standardization, July 16, 2010, http://www.iso.org/iso/catalogue_detail.htm?csnumber=38421

[6] Story, Molly Follette, PhD, "FDA Perspectives on Human Factors in Device Development," United States Food and Drug Administration, June 7,2012, http://www.fda.gov/downloads/MedicalDevices/DeviceRegulationandGuidance/HumanFactors/UCM320905.pdf

Medical GUI Mistake #2 – Forgetting the Value of Aesthetics

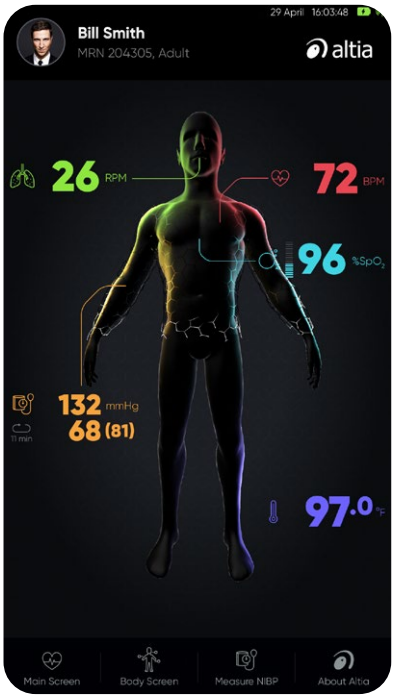
Medical device companies must take to heart the value of aesthetics—and how an attractive device GUI reflects quality perception. If their devices have a good-looking user interface, then doctors and patients feel more comfortable with the quality of the device itself.

Just as a vehicle dashboard GUI reflects upon the quality and perceived cachet of a new car, medical devices are subject to the same perception issues. Especially given the development time and the regulatory pathway, by the time a medical device hits the market it will already look four years out of date unless the GUI development team creates a really smart, forward-looking, timeless, classic design.

It is important to balance usability with a tasteful aesthetic that will make patients feel comfortable. Why? Today, consumers are becoming increasingly savvy but likewise increasingly demanding. Balancing simple functionality with great design and a beautiful GUI that matches the look and feel of the device is key to user acceptance and device success.

The balancing act is in trying to find standards but not overdoing it for the sake of compromising the brand.

And templates won't do. Medical devices are very custom and specialized. Brand image plays a part here—designers, manufacturers and customers all want the GUI to be customized.



Read about how one surgical device manufacturer saved time and resources by engaging Altia's GUI experts to provide a turnkey GUI solution.

Medical GUI Mistake #3 – Lacking Awareness of Software Development Requirements and Certifications

There are a vast number of different programming languages and options for software developers out there. One of the things that is critical for medical device developers to understand is that their code needs to be developed and validated in a language that is certifiable. While mobile apps typically use common graphic oriented languages like Java, C++ and Python, medical devices are typically programmed in C, the great grandfather of modern programming languages.

The reason for such a seemingly dated approach is that C excels at the sort of control algorithms that medical devices require for functions such as insulin release for an insulin pump. C also allows programmers to find and control nasty memory leaks and other potential open-source issues that would cause regulatory and safety concerns.

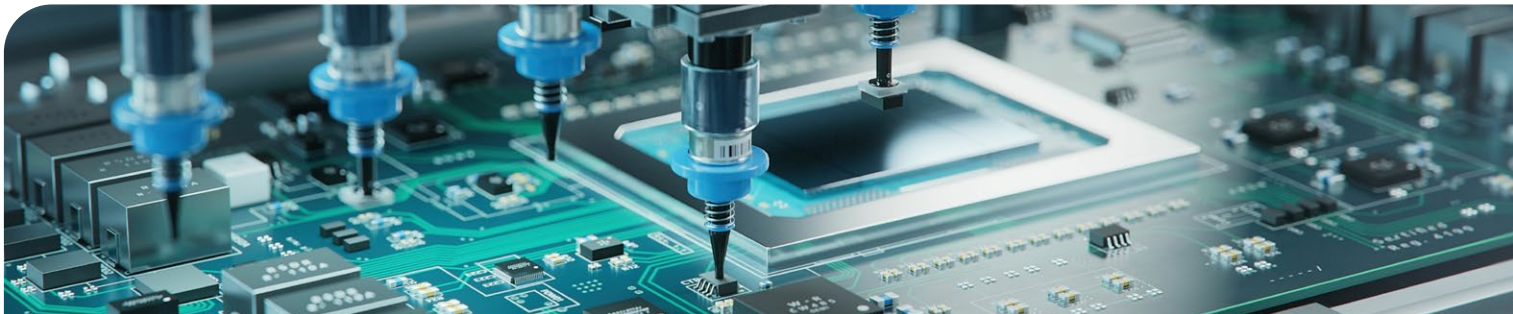
For a medical device maker, battery life and performance are big concerns—and C can be very resource friendly in comparison to other programming languages. The media player that runs YouTube videos, for example, needs 100MB of RAM just to start itself up, along with a thirty second boot time. These types of constraints are not acceptable in the medical market.

Medical GUI Mistake #4 – Selecting the Wrong Microcontroller

Starting medical GUI development with a pre-selected processor is not the best option. Device companies tend to choose hardware based on cost profile first. Only after they have designed their GUI and run it on that chip do they realize that the combination has a lot of limitations. The best practice for medical device GUI development is to start with a blank slate and define the user interface and software at a conceptual level before deciding what microcontroller or processor to use.

The powerful Intel or AMD chips that drive personal computers are too demanding and power consuming for smaller medical devices. In this arena, features like low power (long battery life) and responsiveness are critical. Chipmakers like Infineon, NXP, Renesas and STMicroelectronics provide purposeful microcontrollers geared toward the needs of the medical device industry. Combining a low-cost processor with C has become a best practice pairing because C code accommodates resource limited micros. Additionally, C has decades of testing and reliability behind it.

Leveraging a cloud-based solution to “try on” your GUI with a variety of boards before any chips are selected is a great way to determine the best board for your project. Solutions like Altia CloudWare™ can get you up and running in just minutes, saving critical time and development cost.



From Concept to Production

Touch screen GUIs enhance modern medicine by offering increased organization, securely shared data and ease of use for patients and healthcare workers alike. Developing a simple, attractive and certifiable medical device GUI is challenging—but not impossible. GUI development tools like those offered by Altia help companies empower patients with simple, straightforward embedded user interfaces that aid medical professionals in their duties and ensure the highest standards of health care.

Want to learn more about how we do this? Get in touch.

A new GUI is an entirely new way to engage customers. A well-executed, intuitive GUI can deliver the kind of experience that converts customers for the long haul.

Designing a GUI isn't simple...but with a clear focus on your user, great design and product performance, you and your team are on the right track.

How do you fast track your GUI—and your company—to market leadership? Contact Altia.

Altia-generated graphics code is driving the displays in over 100 million devices. Companies in the automotive, medical, home appliance, consumer device and industrial industries all over the world trust Altia to get first rate user interfaces into production embedded devices. Call on our team of user interface experts to discuss the goals for your next product user interface and learn how Altia can help.

Your next great GUI is waiting!

Contact Us

For more information about how Altia can help you get your next great GUI into production, visit **altia.com/contact**.

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