



## **Touchscreen, membrane keypad, or silicone rubber keypad? - How developers find the right user interface concept**

The user interface is the central link between humans and machines. It influences not only a device's user-friendliness but also its reliability, service life, and cost-effectiveness. Accordingly, the selection of a suitable user interface concept should be incorporated into the development process at an early stage.

Modern devices today offer a wide variety of different control options. Touchscreens enable flexible user interfaces and an intuitive display of complex information. Membrane keypads impress with their robust construction and a sealed surface. Silicone rubber keypads offer a distinct tactile feel and can be individually adapted to the requirements of an application.

But which solution is the right one? The answer depends less on current technology trends than on the requirements of the specific application.

## **Define requirements early on**

The decision regarding a user interface concept should always be based on a clear analysis of the requirements. This is not just about the number of functions or the desired appearance, but above all about the device's future use.

A laboratory device with few operating functions has different requirements than a mobile control unit for outdoor use or an industrial control panel. The number of users, the frequency of use, and the importance of individual functions also play a significant role. Especially in safety-critical applications, operating errors must be ruled out as much as possible.

The more precisely the requirements are defined at the start of a project, the easier it is to select the appropriate technology and the lower the risk of costly changes in later development phases.

Developers should already answer key questions at this stage:

- Will the device be used in a stationary or mobile setting?
- Will it be operated while wearing gloves?
- Must users be able to operate the buttons reliably even without direct visual contact?
- What information should be displayed, and how frequently does it change?
- Are operating errors critical to the process or the user's safety?
- What are the requirements for cleaning, protection class, and service life?
- And last but not least: What production volumes are planned, and how do they affect the cost-effectiveness of the operating concept?

The answers to these questions provide important insights into whether a touchscreen, a membrane keypad, a silicone rubber keypad, or a combination of different technologies represents the best solution for the respective application.

## **The operating environment is a key factor**

In addition to functional requirements, the intended operating environment is one of the most important factors influencing the selection of the operating concept.

In industrial applications, user interfaces are frequently exposed to dust, moisture, temperature fluctuations, or vibrations. In medical and laboratory technology, regular cleaning and disinfection

processes are also a factor. Mobile devices must often withstand UV radiation, mechanical stress, or changing weather conditions.

While touchscreens can demonstrate their advantages in clean environments, membrane keypads and silicone rubber keypads often offer greater robustness under demanding conditions. Their sealed surfaces facilitate effective sealing and thus enable the achievement of high protection ratings.

Analysis of the operating environment should therefore always be one of the first steps in developing a user interface concept.

### **Haptics remain an important factor**

Although touchscreens are now indispensable in many areas, haptics continue to play an important role.

Physical buttons provide the user with clear feedback regarding the input. This can be particularly advantageous when operation occurs without direct visual contact or when the user is wearing gloves. Even in low-light conditions or in moving vehicles, tactile feedback can significantly improve usability.

Membrane keypads with metal domes or polydomes offer a clearly defined actuation point. Silicone rubber keypads also allow for different actuation forces and key geometries. This enables the operating feel to be specifically adapted to the respective application.

With touchscreens, this physical feedback is largely absent. While acoustic or visual signals can assist with operation, they do not always replace the advantages of a mechanical key.

### **Membrane keypad or silicone rubber keypad: What are the differences?**

Both membrane keypads and silicone rubber keypads are established technologies for industrial user interfaces. Which solution is the better choice depends on the technical requirements, the desired haptic feedback, the design, and the planned production volumes.

Membrane keypads are characterized by their flat construction, a seamless surface, and a wide range of design options. Haptic feedback is often generated by integrated metal snap discs, which provide a clearly defined actuation point. Labels, symbols, display windows, and backlighting can be integrated

directly into the user interface. Since no mold is typically required for production, membrane keypads can be manufactured cost-effectively, particularly for small and medium production runs.

Silicone membrane keypads, on the other hand, offer more pronounced tactile feedback and allow for three-dimensional key shapes, varying actuation forces, and custom surface textures. Additionally, sealing functions can be integrated directly into the keyboard. However, a mold is required for production, which initially incurs investment costs. As production volumes increase, these tooling costs are offset, making silicone rubber keypads economically viable, particularly for medium and high-volume production runs.

In addition to haptics and costs, factors such as protection class, cleanability, lighting concepts, and integration into the housing design also play an important role. Both technologies can be combined with displays, touch surfaces, and other control elements and can be designed to withstand several million actuations.

### **Taking a Holistic View of Cost-Effectiveness**

When selecting a control concept, the unit price is often compared first. However, this consideration alone is not sufficient for a well-founded decision.

Development costs, tooling costs, assembly effort, serviceability, and the expected service life often influence the actual total costs more significantly than the price of individual components.

Touchscreens, for example, allow different menus and functions to be displayed on a single interface. At the same time, however, the demands on software, electronics, and display integration increase. Membrane keypads and silicone rubber keypads can represent an economically attractive alternative for applications with clearly defined functions.

Therefore, the decisive factor is not the cheapest individual component, but the solution with the lowest total cost over the entire product lifecycle.

### **Consider Cleaning and Protection Class**

In many industries, user interfaces must be cleaned or disinfected regularly. High standards for hygiene and cleanability apply particularly in medical, laboratory, and food technology.

Membrane keypads feature a sealed surface with no exposed switch contacts, making them particularly easy to clean. Silicone rubber keypads can also be designed for demanding environments and offer high resistance to moisture and contamination.

For touchscreen solutions, additional aspects such as display sealing, the durability of the front surface, and potential reflections must be considered.

The required protection class should therefore be defined as early as the concept phase.

### **Focus on Service Life and Reliability**

In addition to functionality and cost, the expected service life plays an important role. Industrial devices are often in use for many years, and high demands on the reliability of the user interface are common. Depending on the design, membrane keypads and silicone rubber keypads can achieve very high switching cycles and have proven themselves in numerous applications. Industrial touchscreens also offer high reliability today, but should be evaluated early on with regard to mechanical stress, temperature range, UV resistance, and long-term component availability. Careful selection of the technology helps reduce maintenance costs and the risk of failure.

### **Hybrid solutions are gaining importance**

In many applications today, the decision is no longer between a touchscreen or a keyboard. Instead, manufacturers are increasingly turning to hybrid solutions that combine the advantages of different technologies.

In this approach, a display handles the presentation of complex information and menus, while frequently used or safety-critical functions are operated via physical buttons. This approach combines the flexibility of modern user interfaces with the benefits of clear haptic feedback.

Such concepts have proven particularly effective in industrial plants, medical devices, and mobile control systems. They enable intuitive operation while simultaneously increasing operational safety.

## **Practical Check: Finding the Right Operating Concept**

Before deciding on an operating concept, developers should answer several key questions. These include the device's operating conditions, cleaning requirements and protection class, the desired haptic feedback, and the planned service life. Equally important are the number of operating functions, the integration of displays, the planned production volumes, and the economic implications over the entire product lifecycle.

Those who consider these aspects early in the development phase lay the foundation for a technically and economically successful solution.

## **Conclusion**

Selecting the right operating concept is a strategic decision that goes far beyond choosing a single technology. Touchscreens, membrane keypads, and silicone rubber keypads each have specific strengths that may be more or less relevant depending on the application. While touchscreens offer maximum flexibility, membrane keypads and silicone rubber keypads stand out for their robustness, reliability, and clear tactile feedback. In many applications, the optimal solution even lies in a combination of different technologies.

As a development partner for custom HMI solutions, N&H Technology supports companies in selecting and implementing suitable control concepts. The range of services extends from membrane keypads and silicone rubber keypads to plastic enclosures and cable assemblies, all the way to complete HMI control units. The goal is to develop user interfaces that optimally combine technical requirements, user-friendliness, and cost-effectiveness.