PROCESSING AND VISUALIZATION OF DIAGNOSTIC DATA FROM A BIONIC UPPER LIMB PROSTHESIS

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Motivation

Having a limb amputated is a life-changing event with consequences more significant than most of us imagine. In Germany alone, approximately 65 upper limb amputations are performed as a result of a traumatic injury every year. In the United States, in 2005, an estimated 550,000 Americans were living with upper extremity amputations. [4]

Bionic prostheses are commonly used to help patients perform everyday tasks more easily. They incorporate various methods to obtain input from the user, such as myo signal monitoring, which controls fingers using electric motors. Unfortunately, despite considerable technological advancements in the last decade, bionic prostheses still have very low acceptance rates, averaging at 44%. [1]

Figure 1: Patient with a Z-Arm prosthesis

Z-Arm Prosthesis

Z-Bionics Z-Arm (visible on the picture to the left) is an upper limb bionic prosthesis. It measures activity in residual muscles and uses it as input to control fingers. Each finger has its motor and can have up to two additional motors for the wrist and elbow, depending on the amputation type.

One way Z-Bionics tackles the low acceptance rate is by logging diagnostic data. Unfortunately, being able to access the diagnostics only during a patient visit is not sufficient. Therefore a way of remotely obtaining the data needed to be designed and implemented.

Proposed Solution

A mobile application utilizing Bluetooth to communicate with the prosthesis and featuring additional capabilities, such as prosthesis configuration, has been selected. An API and web front-end extension for prosthesis management and diagnostic data collection and visualization accompanies it together with a second database dedicated for storage of diagnostics (time-series).

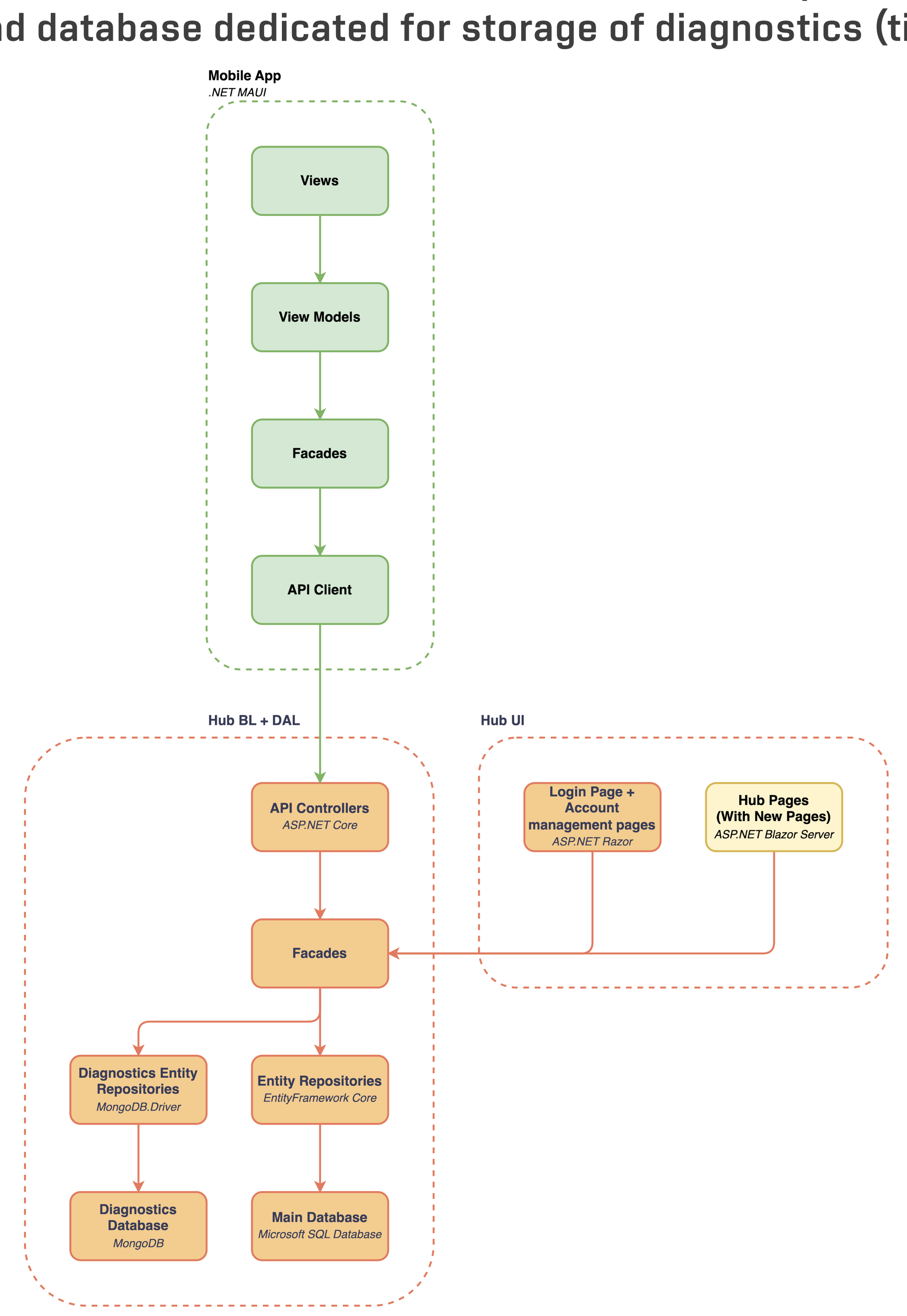

Figure 2: Simplified architecture of the proposed changes

Implementation

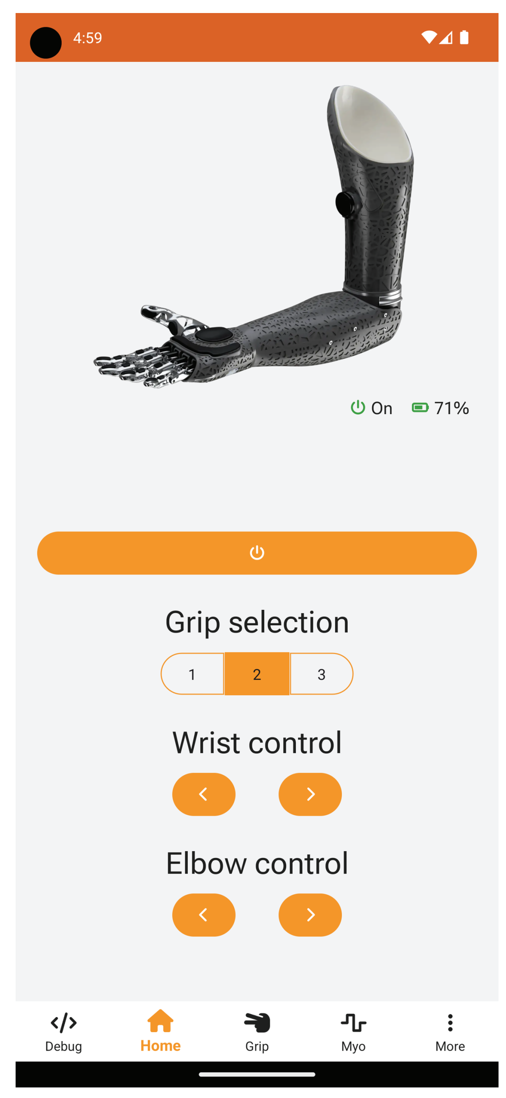

Figure 3: Application main page

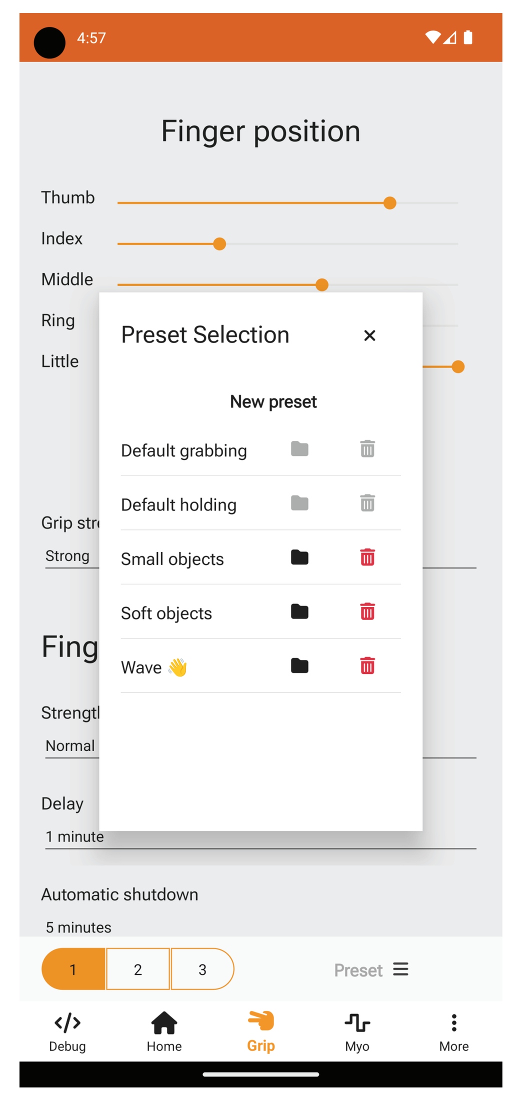

Figure 4: Application grip page with Preset selection opened

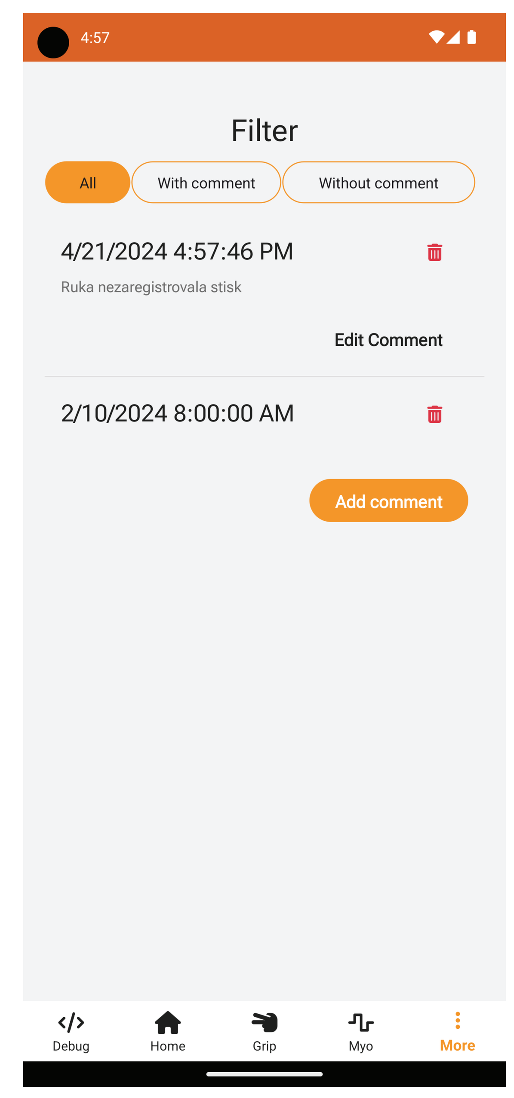

Figure 5: Application snapshots page

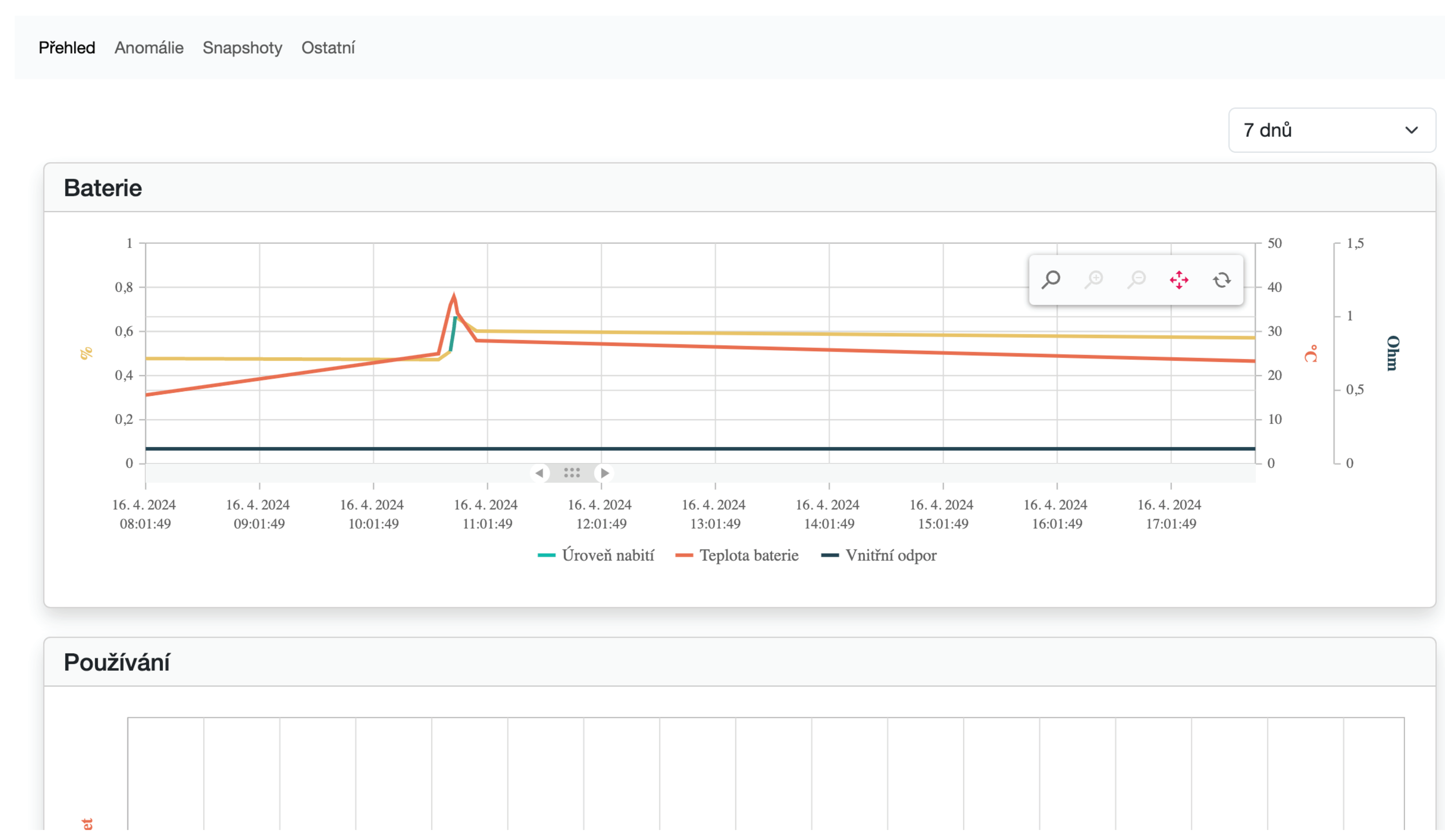

Figure 6: Diagnostics extension of the Z-Bionics Hub

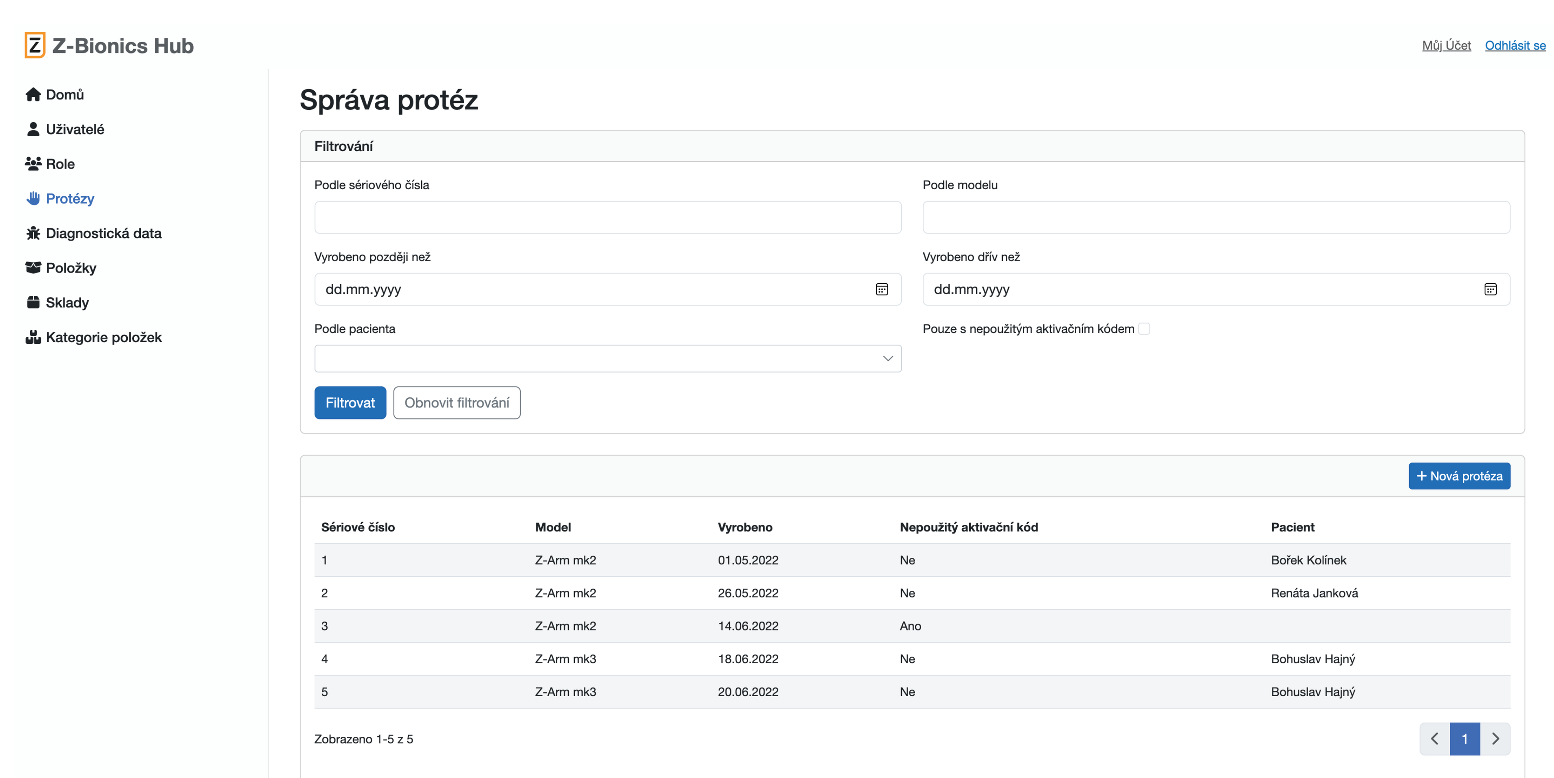

Figure 7: Prosthesis management extension of the Z-Bionics Hub

Conclusion

The result of this thesis is a reliable way of remotely accessing prosthesis diagnostic data. It provides engineers with recent diagnostics, allowing them to analyze possible issues related to the prosthesis or its usage and resolve them before they result in prosthesis rejection by the patient.

Success in lowering the rejection rate has yet to be measured; however, first impressions of both staff and patients are positive, indicating a possible improvement in the comfort of prosthesis usage.

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