RoboImplant

For RoboImplant, Arie Meir authored most of the mechanical design and actuator electronics, and all of the embedded firmware, device communications, and Android clinical and technical application software. The system explored non-invasive lengthening of a scoliosis growing rod.

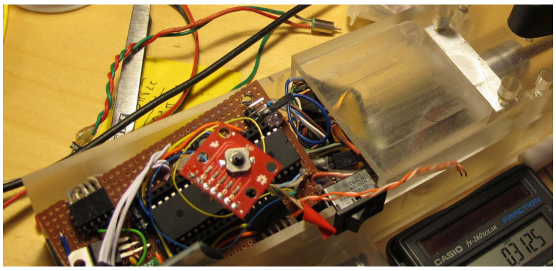
The clinical problem

Early-onset scoliosis can be treated with a telescoping rod implanted alongside the spine. As the child grows, the rod must be lengthened periodically. Conventional growing rods require repeat trips to the operating room for surgical lengthening, with repeated anaesthesia and incisions.

The approach

RoboImplant explored a non-invasive alternative: a handheld actuator placed over the implant. A drive coil couples magnetically through tissue to the implant's internal mechanism, advancing the rod in **20 micrometre increments**. Because available drive torque falls with actuator-to-implant distance, the system includes calibration routines for coupling and extension behaviour.

v1 - 3D-printed housing, acrylic top plate, brass inserts and drive coil.

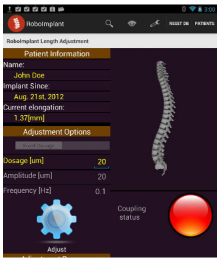


v2 - machined polycarbonate body with controller electronics integrated alongside the coil assembly.

Impact

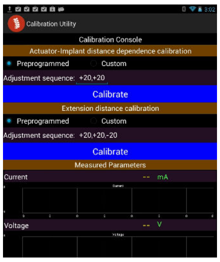
The integrated prototype **unlocked the next wave of research testing** by turning the concept into a repeatable, instrumented system for evaluating magnetic coupling, extension accuracy, backlash and clinician workflows in a research setting.

Clinician software



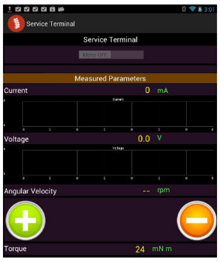
Adjustment

Dose, coupling status, cumulative elongation



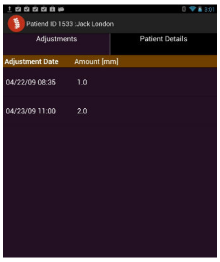
Calibration

Distance dependence + extension sequences



Service terminal

Current, voltage, angular velocity, torque



Patient record

Adjustment history per patient

Engineering architecture

Explicit device-host protocol

A defined message contract was implemented on both ends: `messageDispatcher.c` in firmware and `MessageDispatcher.java` in the console. A raw terminal remained available for direct debugging.

On-device session logging

Persistent storage used **FAT32 over SPI** with an **I2C real-time clock**, so sessions were recorded by the device even without a continuously connected tablet.

Calibration in firmware

Automated routines covered actuator-to-implant distance dependence and extension-distance characterisation, including forward/reverse motion to expose lead-screw backlash.

Reusable console architecture

Patient, telemetry, device-control and communication components were reusable; the same architecture was later applied to an irreversible electroporation treatment console.

Technical scope

Mechanical actuator + enclosure · Magnetic drive + controller electronics · Embedded control + calibration · Device-host protocol · On-device logging + RTC · Android clinician console

Design principle: make the hardware observable and independently testable - define the interface explicitly, expose useful telemetry, keep important state on the device, and preserve low-level paths for diagnosis.

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