**Product Requirements Document (PRD) for Robotic Medical Doctor Hand**

**1. Introduction**

**Product Name:** Robotic Medical Doctor Hand (RMDH)  
**Product Owner:** Lifestyle Corp  
**Date:** [Current Date]  
**Version:** 1.0

**2. Purpose**

The purpose of this document is to outline the requirements and specifications for the development of a Robotic Medical Doctor Hand (RMDH) capable of performing various clinical functions. The RMDH aims to assist doctors and surgeons in performing precise and accurate clinical tasks, enhancing the quality of patient care.

**3. Scope**

The RMDH will be designed to perform the following clinical functions:

* Palpation
* Percussion
* Grasp
* Hold
* Touch
* Hold instruments
* Elicit clinical signs
* Elicit clinical procedures
* Stereognosis
* Additional visuo-tactile sensory motor functions

**4. Objectives**

* Develop a robotic hand that mimics the visuo-tactile sensory motor functions of a doctor's or surgeon's hand.
* Ensure the robotic hand can perform complex clinical tasks with high precision and reliability.
* Integrate advanced sensors and actuators to provide real-time feedback and control.
* Ensure the robotic hand is safe for use in clinical settings.

**5. Requirements**

**5.1 Functional Requirements**

1. **Palpation**
   * Ability to apply varying pressure to different areas to detect underlying structures and abnormalities.
   * Integration of pressure sensors to provide real-time feedback.
2. **Percussion**
   * Ability to perform tapping movements to evaluate the condition of underlying structures.
   * Integration of force sensors to measure the force and duration of taps.
3. **Grasp**
   * Ability to grasp objects of various shapes and sizes securely.
   * Integration of force sensors to adjust the grip strength automatically.
4. **Hold**
   * Ability to hold objects and instruments for extended periods without losing grip.
   * Integration of slip sensors to detect and prevent slipping.
5. **Touch**
   * Ability to touch objects and surfaces with varying levels of force.
   * Integration of tactile sensors to provide feedback on texture and temperature.
6. **Hold Instruments**
   * Ability to securely hold and manipulate medical instruments of different sizes and shapes.
   * Integration of customizable grips for different instruments.
7. **Elicit Clinical Signs**
   * Ability to perform specific maneuvers to elicit clinical signs (e.g., reflex testing).
   * Integration of sensors to detect and measure responses.
8. **Elicit Clinical Procedures**
   * Ability to perform specific clinical procedures (e.g., inserting a catheter).
   * Integration of guidance systems for precise movements.
9. **Stereognosis**
   * Ability to recognize and identify objects through touch alone.
   * Integration of advanced tactile sensors and machine learning algorithms.
10. **Visuo-Tactile Sensory Motor Functions**
    * Integration of cameras and visual sensors to provide visual feedback.
    * Coordination between visual and tactile inputs for precise control.

Rest of the functions…………

**5.2 Non-Functional Requirements**

1. **Safety**
   * Ensure all materials and components are safe for use in clinical settings.
   * Implement safety protocols to prevent accidental harm.
2. **Reliability**
   * Ensure the robotic hand performs tasks consistently and accurately.
   * Conduct extensive testing to validate performance.
3. **Usability**
   * Design the robotic hand to be user-friendly and intuitive for medical professionals.
   * Provide training and documentation for users.
4. **Compatibility**
   * Ensure compatibility with existing medical instruments and equipment.
   * Provide integration options for various clinical environments.
5. **Durability**
   * Ensure the robotic hand is durable and can withstand repeated use.
   * Use high-quality materials and components.

**6. Design Specifications**

* **Materials:** Medical-grade stainless steel, silicone, and other biocompatible materials.
* **Sensors:** Pressure sensors, force sensors, tactile sensors, slip sensors, visual sensors.
* **Actuators:** High-precision motors and actuators for smooth and controlled movements.
* **Control System:** Advanced microcontrollers and algorithms for real-time feedback and control.
* **Power Supply:** Rechargeable battery with a minimum of 8 hours of continuous use.

**7. Development Timeline**

1. **Phase 1: Research and Planning (Month 1)**
   * Conduct research on clinical functions and requirements.
   * Develop a detailed project plan and timeline.
2. **Phase 2: Design and Prototyping (Month 2)**
   * Design the robotic hand and develop prototypes.
   * Conduct initial testing and iterations.
3. **Phase 3: Testing and Validation (Month 3)**
   * Conduct extensive testing to validate performance and safety.
   * Gather feedback from medical professionals.
4. **Phase 4: Production and Deployment (Month 4)**
   * Finalize the design and start production.
   * Deploy the robotic hand in clinical settings and provide training.

**8. Budget**

* **Research and Development:** $X,XXX
* **Prototyping:** $X,XXX
* **Testing and Validation:** $X,XXX
* **Production:** $X,XXX
* **Training and Documentation:** $X,XXX

**9. Risks and Mitigations**

1. **Technical Challenges**
   * Mitigation: Conduct thorough research and testing to address technical challenges.
2. **Regulatory Approval**
   * Mitigation: Ensure compliance with all relevant medical device regulations and standards.
3. **User Adoption**
   * Mitigation: Provide comprehensive training and support to users.

**10. Conclusion**

The Robotic Medical Doctor Hand aims to revolutionize clinical care by providing medical professionals with a highly precise and reliable tool for performing various clinical tasks. Through careful design, rigorous testing, and close collaboration with medical professionals, we aim to develop a product that meets the highest standards of performance, safety, and usability.

**Signatures:**

**Product Owner:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  
**Project Manager:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  
**Lead Engineer:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Date:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**4. Objectives**

* Develop a robotic hand that mimics the visuo-tactile sensory motor functions of a doctor's or surgeon's hand.
* Ensure the robotic hand can perform complex clinical tasks with high precision and reliability.
* Integrate advanced sensors and actuators to provide real-time feedback and control.
* Ensure the robotic hand is safe for use in clinical settings.

**5.1 Functional Requirements**

**Palpation**

* **Function**: The RMDH will be capable of palpating various parts of the body to detect underlying structures, abnormalities, or masses.
* **Capabilities**:
  + Apply varying pressure to different areas.
  + Detect differences in tissue density and texture.
  + Real-time feedback through integrated pressure sensors.

**Percussion**

* **Function**: The RMDH will perform percussion by tapping on the body to evaluate the condition of underlying structures such as organs.
* **Capabilities**:
  + Perform rhythmic tapping movements with adjustable force.
  + Measure and analyze the sounds produced through integrated force sensors.
  + Provide feedback on the condition of underlying tissues.

**Grasp**

* **Function**: The RMDH will be capable of grasping objects of various shapes and sizes securely.
* **Capabilities**:
  + Adjust grip strength automatically based on the object's properties.
  + Use force sensors to ensure a secure yet gentle grip.
  + Handle delicate objects without causing damage.

**Hold**

* **Function**: The RMDH will hold objects and medical instruments steadily for extended periods.
* **Capabilities**:
  + Maintain a stable grip without slipping.
  + Use slip sensors to detect and prevent unintended movement.
  + Ensure prolonged holding capability without fatigue.

**Touch**

* **Function**: The RMDH will touch objects and surfaces with controlled force to assess their characteristics.
* **Capabilities**:
  + Vary touch force for different tasks.
  + Provide tactile feedback on texture, temperature, and other properties through integrated tactile sensors.

**Hold Instruments**

* **Function**: The RMDH will securely hold and manipulate medical instruments of various sizes and shapes during procedures.
* **Capabilities**:
  + Customizable grips for different types of instruments.
  + Ensure secure and stable handling of instruments during clinical tasks.

**Elicit Clinical Signs**

* **Function**: The RMDH will perform specific maneuvers to elicit clinical signs, such as reflex testing.
* **Capabilities**:
  + Execute precise movements to trigger reflexes or other responses.
  + Measure and analyze responses with integrated sensors.
  + Provide feedback to the doctor on the patient's condition.

**Elicit Clinical Procedures**

* **Function**: The RMDH will perform specific clinical procedures, such as inserting a catheter or drawing blood.
* **Capabilities**:
  + Follow precise guidance systems for accurate movements.
  + Use sensors to ensure the correct depth, angle, and pressure during procedures.
  + Minimize patient discomfort and risk of error.

**Stereognosis**

* **Function**: The RMDH will recognize and identify objects solely through touch.
* **Capabilities**:
  + Use advanced tactile sensors to gather detailed information about object shape, size, and texture.
  + Employ machine learning algorithms to interpret sensory data and identify objects accurately.

**Additional Visuo-Tactile Sensory Motor Functions**

* **Function**: The RMDH will integrate visual and tactile inputs to perform complex tasks requiring coordination between sight and touch.
* **Capabilities**:
  + Use cameras and visual sensors to provide real-time visual feedback.
  + Coordinate visual and tactile data for precise control during intricate procedures.
  + Enhance the ability to perform tasks that require fine motor skills and visual assessment.

**Blood Pressure Measurement**

* **Function**: The RMDH will measure blood pressure using standard cuff techniques.
* **Capabilities**:
  + Inflate and deflate a blood pressure cuff.
  + Use sensors to detect systolic and diastolic pressures.
  + Provide real-time blood pressure readings.

**Venipuncture**

* **Function**: The RMDH will perform venipuncture to draw blood or administer intravenous therapies.
* **Capabilities**:
  + Locate veins using advanced imaging sensors.
  + Insert needles with precision and control.
  + Minimize patient discomfort and reduce the risk of complications.

**Wound Care and Dressing**

* **Function**: The RMDH will assist in cleaning wounds, applying dressings, and performing minor surgical procedures.
* **Capabilities**:
  + Handle sterile dressings and wound care supplies.
  + Apply appropriate pressure and movement for cleaning and dressing wounds.
  + Monitor wound healing progress through integrated sensors.

**Suturing**

* **Function**: The RMDH will perform suturing for wound closure and surgical procedures.
* **Capabilities**:
  + Handle suturing needles and threads with precision.
  + Perform various suturing techniques based on the wound type.
  + Ensure consistent and secure sutures to promote healing.

**Ultrasound Imaging**

* **Function**: The RMDH will perform ultrasound imaging to assist in diagnostics and procedural guidance.
* **Capabilities**:
  + Manipulate ultrasound probes to obtain clear images.
  + Interpret ultrasound data with AI algorithms.
  + Provide visual feedback to the doctor during procedures.

**Electrocardiogram (ECG)**

* **Function**: The RMDH will perform electrocardiograms to monitor heart activity.
* **Capabilities**:
  + Place ECG electrodes accurately on the patient's body.
  + Record and analyze ECG signals.
  + Provide real-time feedback on heart rhythm and condition.

**Injection Administration**

* **Function**: The RMDH will administer injections, including intramuscular, subcutaneous, and intravenous injections.
* **Capabilities**:
  + Handle syringes and needles with precision.
  + Insert needles at the correct depth and angle.
  + Ensure accurate dosage delivery and minimize patient discomfort.

**Patient Monitoring**

* **Function**: The RMDH will monitor vital signs and other patient parameters.
* **Capabilities**:
  + Continuously measure vital signs such as heart rate, respiration, and oxygen saturation.
  + Alert medical staff to any abnormalities or emergencies.
  + Provide data logging for long-term patient monitoring.

**Physical Therapy Assistance**

* **Function**: The RMDH will assist in physical therapy exercises and rehabilitation.
* **Capabilities**:
  + Guide patients through specific exercises with controlled movements.
  + Measure range of motion and provide feedback.
  + Adjust exercises based on patient progress and needs.

**Robotic Assistance in Surgery**

* **Function**: The RMDH will assist in complex surgical procedures.
* **Capabilities**:
  + Perform tasks such as holding instruments, making incisions, and manipulating tissues.
  + Integrate with surgical robots and other operating room equipment.
  + Enhance surgical precision and reduce procedure times.

**Tissue Sampling and Biopsy**

* **Function**: The RMDH will perform tissue sampling and biopsy procedures.
* **Capabilities**:
  + Use fine motor control to obtain tissue samples.
  + Ensure accurate targeting and minimal invasiveness.
  + Provide immediate analysis of samples using integrated sensors.

**Telemedicine Support**

* **Function**: The RMDH will support telemedicine by enabling remote diagnostics and procedures.
* **Capabilities**:
  + Allow remote control and monitoring by medical professionals.
  + Provide real-time data and imaging to remote doctors.
  + Enhance accessibility to medical care in remote or underserved areas.

**Teleoperation and Remote Surgery**

* **Function**: The RMDH will allow for teleoperation and remote surgery, enabling specialists to perform procedures from distant locations.
* **Capabilities**:
  + Real-time control by remote surgeons.
  + High-fidelity haptic feedback for remote operators.
  + Integration with telecommunication systems for minimal latency.

**Dermatological Examination**

* **Function**: The RMDH will assist in dermatological examinations and minor procedures.
* **Capabilities**:
  + High-resolution imaging and analysis of skin conditions.
  + Ability to perform biopsies and minor skin treatments.
  + Real-time feedback on skin texture and lesions.

**Assistive Device Management**

* **Function**: The RMDH will manage and adjust various assistive devices used by patients.
* **Capabilities**:
  + Adjust prosthetics and orthotics for comfort and functionality.
  + Program and calibrate medical devices such as insulin pumps.
  + Provide feedback on device performance and patient usage.

**Respiratory Function Testing**

* **Function**: The RMDH will conduct respiratory function tests, including spirometry.
* **Capabilities**:
  + Guide patients through breathing exercises.
  + Measure lung capacity and airflow.
  + Analyze respiratory patterns and provide diagnostic feedback.

**Intravenous (IV) Line Insertion and Management**

* **Function**: The RMDH will insert and manage intravenous lines for fluid and medication administration.
* **Capabilities**:
  + Locate veins and insert IV lines with precision.
  + Monitor and adjust IV fluid flow rates.
  + Detect and respond to complications such as infiltration or phlebitis.

**Anesthesia Administration**

* **Function**: The RMDH will assist in the administration of anesthesia.
* **Capabilities**:
  + Precisely control the delivery of anesthetic agents.
  + Monitor patient vitals and adjust anesthesia levels in real-time.
  + Provide feedback to anesthesiologists on patient status.

**Cardiopulmonary Resuscitation (CPR)**

* **Function**: The RMDH will assist in performing CPR during emergencies.
* **Capabilities**:
  + Deliver consistent chest compressions and rescue breaths.
  + Adjust force and rate of compressions based on patient feedback.
  + Integrate with defibrillators for synchronized resuscitation efforts.

**Drug Dispensation and Management**

* **Function**: The RMDH will manage and dispense medications.
* **Capabilities**:
  + Handle and administer various forms of medication, including pills, liquids, and injections.
  + Ensure accurate dosages and timing.
  + Provide alerts for medication schedules and potential interactions.

**Laboratory Sample Handling**

* **Function**: The RMDH will handle and prepare laboratory samples for analysis.
* **Capabilities**:
  + Collect and label samples such as blood, urine, and tissue.
  + Prepare slides and reagents for diagnostic tests.
  + Ensure proper storage and transport of samples.

**Patient Mobility Assistance**

* **Function**: The RMDH will assist patients with mobility and positioning.
* **Capabilities**:
  + Help patients move between beds, chairs, and examination tables.
  + Provide support during walking and physical therapy exercises.
  + Adjust patient positioning for comfort and procedure requirements.

**Nutrition and Feeding Assistance**

* **Function**: The RMDH will assist in feeding patients and managing nutritional intake.
* **Capabilities**:
  + Handle feeding tubes and administer enteral nutrition.
  + Assist with oral feeding, ensuring safety and comfort.
  + Monitor and document nutritional intake.

**Health Data Analysis and Reporting**

* **Function**: The RMDH will analyze and report on health data collected during clinical tasks.
* **Capabilities**:
  + Aggregate data from various sensors and sources.
  + Use AI to identify patterns and anomalies.
  + Generate comprehensive reports for medical professionals

**Connectivity**

* **Wireless communication**: For data transfer and remote control (e.g., Wi-Fi, Bluetooth).
* **Wired communication**: USB, Ethernet for stable connections.

**Software and Firmware**

* **Embedded software**: To control sensors, actuators, and data processing.
* **User interface software**: For doctors to interact with the robotic hand.
* **AI Integration**: Machine learning models for diagnostics and control.

**Safety Features**

* **Emergency stop**: For immediate deactivation in case of a malfunction.
* **Fail-safes**: To prevent accidental harm.

**Mechanical Components**

* **Joint mechanisms**: High-precision joints for smooth articulation.
* **Protective casing**: To safeguard internal components and ensure durability.

**Data Storage**

* **Internal storage**: For storing operational data and patient records.
* **Cloud integration**: For data backup and remote access.

**Maintenance and Support**

* **Self-diagnostic tools**: For monitoring and reporting system health.
* **Modular design**: For easy replacement and upgrading of components.

**Ergonomics and Design**

* **Human-like appearance**: To ensure patient comfort and acceptance.
* **Adjustable grip**: To handle various instruments and objects.

**Regulatory Compliance**

* **Medical device regulations**: Ensure compliance with FDA, CE, and other relevant standards.
* **Biocompatibility testing**: For all materials used in direct contact with patients.

By considering these additional specifications, the RMDH can be designed to meet a comprehensive range of requirements, ensuring high performance, reliability, and safety in clinical setting

**5.2 Non-Functional Requirements**

1. **Safety**
   * Ensure all materials and components are safe for use in clinical settings.
   * Implement safety protocols to prevent accidental harm.
2. **Reliability**
   * Ensure the robotic hand performs tasks consistently and accurately.
   * Conduct extensive testing to validate performance.
3. **Usability**
   * Design the robotic hand to be user-friendly and intuitive for medical professionals.
   * Provide training and documentation for users.
4. **Compatibility**
   * Ensure compatibility with existing medical instruments and equipment.
   * Provide integration options for various clinical environments.
5. **Durability**
   * Ensure the robotic hand is durable and can withstand repeated use.
   * Use high-quality materials and components.

**6. Design Specifications**

* **Materials:** Medical-grade stainless steel, silicone, and other biocompatible materials.

|  |  |  |
| --- | --- | --- |
| PLA+ 3D printing filament | 1 roll | 1000 |
| High Tensile Cord | 1 roll | 50 |
| Elastic Cord | 1 | 50 |
| Adhesive | 1 | 50 |
| **Medical-grade stainless steel**: Used for structural components and joints. |  |  |
| **Silicone**: For flexible and skin-like exterior |  |  |
| **Other biocompatible materials**: For various parts to ensure safety and durability |  |  |
| Total |  | 1150 |

* **Sensors:** Pressure sensors, force sensors, tactile sensors, slip sensors, visual sensors.

|  |  |  |
| --- | --- | --- |
| Capacity pressure transducer | 5 |  |
| Polymorphic Foam flexible high sensitive low pressure capacitive sensors | 1 |  |
| **Pressure sensors**: To measure applied force. |  |  |
| **Force sensors**: To determine the strength exerted. |  |  |
| **Tactile sensors**: For detecting touch and texture. |  |  |
| **Slip sensors**: To detect and prevent slippage. |  |  |
| **Visual sensors**: For imaging and feedback. |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
| Total |  |  |

* **Actuators:** High-precision motors and actuators for smooth and controlled movements.

|  |  |  |
| --- | --- | --- |
| MG90S servo | 5 | 1250 |
| **High-precision motors and actuators**: For smooth and controlled movements. |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

* **Control System:** Advanced microcontrollers and algorithms for real-time feedback and control.

|  |  |  |
| --- | --- | --- |
| *  **Advanced microcontrollers**: For processing and control. |  |  |
| **Algorithms**: For real-time feedback and control |  |  |
|  |  |  |
| Total |  |  |

* **Power Supply:** Rechargeable battery with a minimum of 8 hours of continuous use

|  |  |  |
| --- | --- | --- |
| **Rechargeable battery**: Minimum of 8 hours of continuous use. |  |  |
|  |  |  |
|  |  |  |
| Total |  |  |

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**7. Development Timeline**

1. **Phase 1: Research and Planning (Month 1-2)**
   * Conduct research on clinical functions and requirements.
   * Develop a detailed project plan and timeline.
2. **Phase 2: Design and Prototyping (Month 3-6)**
   * Design the robotic hand and develop prototypes.
   * Conduct initial testing and iterations.
3. **Phase 3: Testing and Validation (Month 7-10)**
   * Conduct extensive testing to validate performance and safety.
   * Gather feedback from medical professionals.
4. **Phase 4: Production and Deployment (Month 11-12)**
   * Finalize the design and start production.

Deploy the robotic hand in clinical settings and provide training

**8. Budget**

* **Research and Development:** 1,20,000 INR
  + **Salary : 40000 INR/month**
* **Prototyping:** $X,XXX
  + **Design Cost**
* **Testing and Validation:** $X,XXX
* **Production:** $X,XXX
* **Training and Documentation:** $X,XXX

**9. Risks and Mitigations**

1. **Technical Challenges**
   * Mitigation: Conduct thorough research and testing to address technical challenges.
2. **Regulatory Approval**
   * Mitigation: Ensure compliance with all relevant medical device regulations and standards.
3. **User Adoption**
   * Mitigation: Provide comprehensive training and support to users.

**10. Conclusion and Bibliography**

**Youtube**

[Will Cogley - YouTube](https://www.youtube.com/@WillCogley/videos)

[youtube.com/watch?v=8w88HwbYPWI](https://www.youtube.com/watch?v=8w88HwbYPWI)

**Github**

**Website**

[InMoov New HAND - 2020](https://inmoov.fr/inmoov-hand/)

**Textbook**

**Other PRD**

**Description**

The latest release of my Bionic Hand! This version is Delta 1.1. Delta refers to the type - Alpha was my initial prototype, Beta was the finalised version using torsion spring return in the fingers (detailed in my dissertation). Gamma is the version which features more degrees of freedom including palm flexion/extension and additional thumb CMC motion, with custom servos build into the palm. Delta is the simplified but much more robust current version.

**Supplies**

*Take these as recommendations! You can always swap with higher quality/more affordable/more accessible parts! Some of these are also untested by me since I’ve tried to find the US equivalent of every part.*

***Tools***

* Recommended 3D Printer: <https://shareasale.com/r.cfm?b=2354728&u=4178914&m=138211&urllink=&afftrack=>
* Power Supply: <https://amzn.to/3Ug9Lwz>

***Mechanical***

* Forearm Servos x15: <https://amzn.to/4cXvlgn>
* Palm Servos x5: <https://amzn.to/3VV43Bc>
* Wrist Servos x2: <https://amzn.to/3VVnBW4>
* Wrist Belt: <https://amzn.to/43VDZb7>
* Bushings x30 (haven’t found a US equivalent, Accu ships worldwide but a simple CAD modification to a different size may be easier): <https://www.accu.co.uk/shoulder-washers/501938-HSHW-4-6-3-1-3-N-BL>
* M1.6 Fasteners: <https://amzn.to/3TUK5UK>
* M2 Fastener kit: <https://amzn.to/3vFhIC1>
* M3 Fastener kit: <https://amzn.to/3vQxN7O>
* M4 Screws: <https://amzn.to/4auhGvD>
* M4 Square nut: <https://amzn.to/3xrSAPq>
* Standoffs: <https://amzn.to/4cTWSiQ>
* Tendon cable 0.32mm: <https://amzn.to/4aMIEym>
* Extension spring wire housing 0.2x2mm (thickness x OD): <https://www.aliexpress.com/item/1005005267394908.html?spm=a2g0o.order_list.order_list_main.11.65cd1802Fs5cEG>

***Electronics/Control***

* Arduino Mega: <https://amzn.to/4aJkbKA>
* PCA9685 Driver Board x2: <https://amzn.to/3TZ16Ns>
* JST SUR Connectors: <https://www.digikey.com/en/products/detail/jst-sales-america-inc/SM03B-SURS-TF/9921982?s=N4IgTCBcDaIMoFkAMBmAQgWjgVQEpwwBUAxEAXQF8g>
* JST SUR Cables: <https://www.digikey.com/en/products/detail/jst-sales-america-inc/A03SUR03SUR32W305B/6708460?s=N4IgTCBcDaICwFYEFo4AY0oHIBEQF0BfIA>
* Flat Potentiometer x15 (A few different sources, note that some are SMD and others are through-hole, either can work but current PCB design is optimised for SMD):
  + [\*\*](https://www.digikey.com/en/products/detail/bourns-inc/3382G-2-103G/2537737)[https://www.digikey.com/en/products/detail/bourns-inc/3382G-2-103G/2537737\*\*](https://www.digikey.com/en/products/detail/bourns-inc/3382G-2-103G/2537737**)
  + <https://uk.farnell.com/bourns/3382h-1-103/pot-rotary-10kohm-22mm-30/dp/2469483>
  + <https://www.digikey.co.uk/en/products/detail/bourns-inc/3382H-1-103/2080233>
  + <https://www.mouser.co.uk/ProductDetail/Bourns/3382H-1-103?qs=stOsxiBwuZUbBRCWhmmq4g%3D%3D>
  + <https://uk.rs-online.com/web/p/potentiometers/7703166>
* 3-Wire Dupont F-F: <https://amzn.to/3VWTayR>

***Misc***

* Pin vice drill: <https://amzn.to/3UhyMrb>
* Ifixit kit: <https://amzn.to/3xACJ1f>

**Notion**

**https://nilheim-mechatronics.notion.site/Nilheim-Mechatronics-Project-Archive-75a4864d73ab4361ab26cabaadaec33a?p=3e7718a58fc34e5ab0736f6c523bee1e&pm=c**