RoboNotts “Happy” : Power System Redesign

Electronic Engineering Team:

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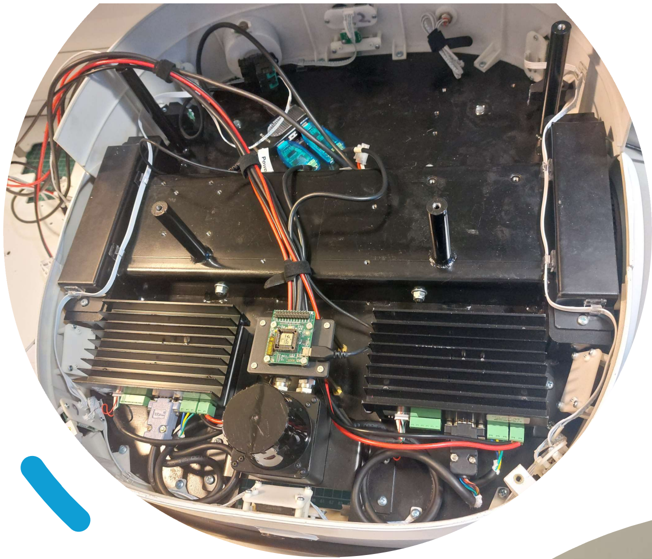
Week 1 Update - 18/01/2025

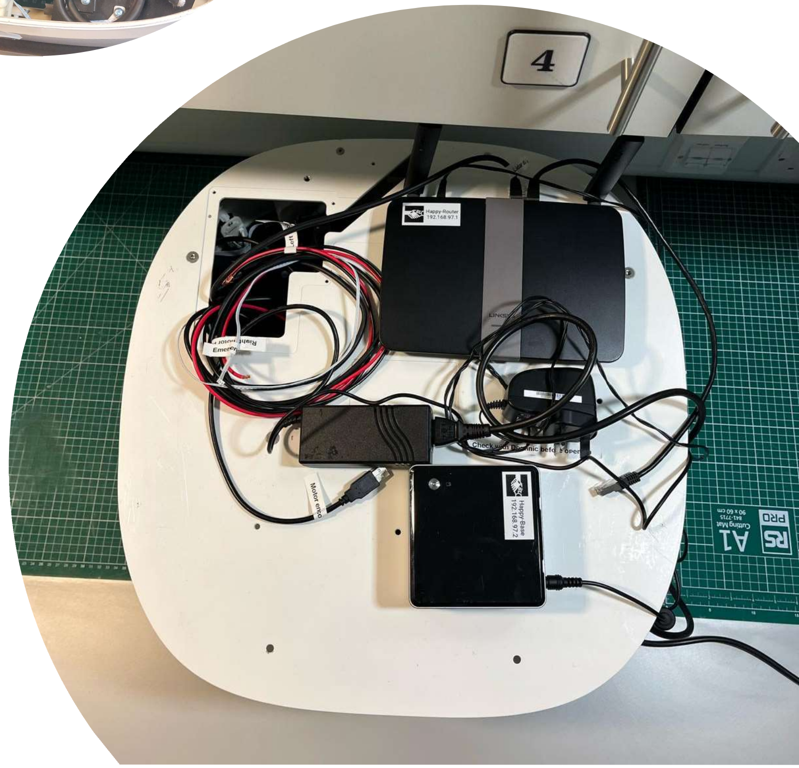
Project Overview

- "Happy" is an assistive robot platform being developed by the RoboNotts team.
- It's built on an AMY-M2-W1 disinfection robot chassis.
- The robot is designed to be modular and flexible.
- We're using ROS2 (Humble) as the software framework.
- Our long-term goal is to create a platform for research and competition (e.g., RoboCup@Home).

The Challenge: Power System Redesign

- **The existing power system has failed.**
  - The cause of the failure is currently unknown.
  - The original system was designed for a disinfection robot, not our specific needs.
- ***Our task*: Design and build a *new*, safe, reliable, and efficient power system.**

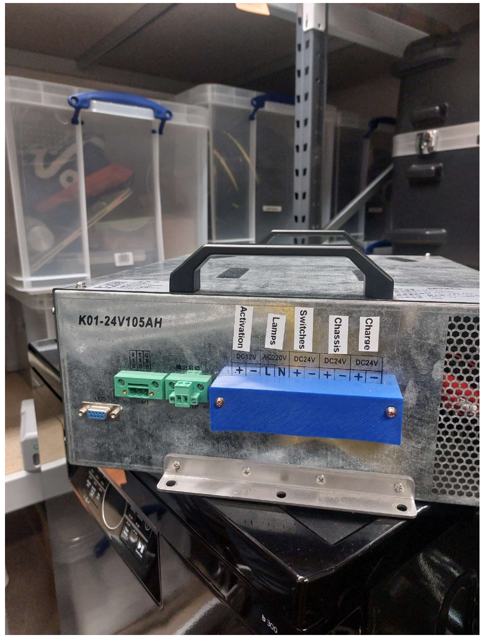


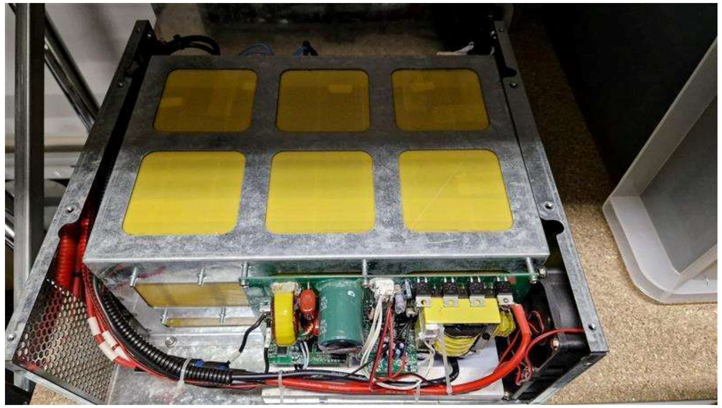


Deconstructing the Original Power System

- The original unit (K01-24V105AH) was a combined battery, charger, and inverter.
- It provided 220V AC and 24V DC.
- It was designed for high-power disinfection lamps.

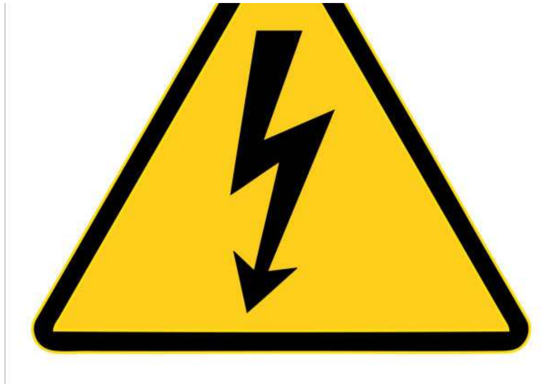
- Knowing why the old power system died would help prevent the risk repeating the same mistake.





Safety is Our Top Priority

- A recent incident with the battery highlighted the importance of safety.
- Lead-acid batteries can be dangerous if mishandled (short circuits, overheating).
- Our new design will prioritize safety through:
  - Proper wiring **and insulation**.
  - **Fuses** and **circuit breakers**.
  - A **Battery Management System (BMS).**
  - Careful testing procedures.
- Use safety equipment
  - Safety Gloves
  - Safety Glasses
  - Anti-Static Bracelet



For illustration purposes only

Power Budget (Preliminary)

- This table shows the *estimated* power requirements of the key components.
- We are initially prioritising the LiDAR, motors, controllers and potentially the NUC.
- *Peak current* values are crucial for selecting fuses, wiring, and DC-DC converter *output* capacity.
- *Typical current* values are used to estimate battery life.
- We are still gathering complete data for all components (see 'Status' column).

Component	Nominal Voltage (V)	Typical Current (A)	Peak Current (A)	Power (W)	Status
Motors (x2)	24	?	6.9	120	Needs Testing
Motor Controllers (x2)	24	?			Needs Testing
NUC	19	?	3.42	65 (Peak)	Needs Testing
LiDAR	9-36?	?	?	4	Needs Testing
Wi-Fi AP	12	?	2?	65 (Peak)?	Needs Testing
Robotic Arm	24	?		20	Needs Testing
Other sensors					
Totals				274	

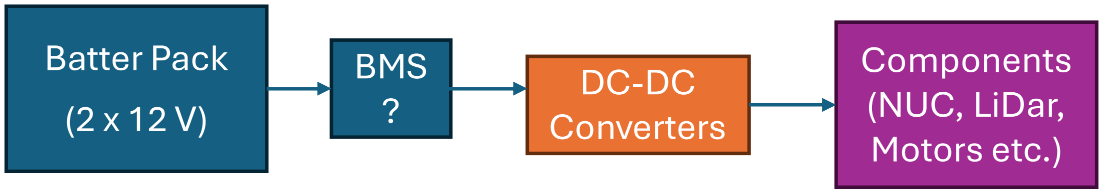
Evaluating Power System Options

- **Option 1: Basic (Direct DC + Resistors) - *FOR TESTING ONLY***
  - Direct connection from battery to components (using resistors to limit current/voltage).
  - *Extremely simple* for initial testing.
  - **HIGHLY UNSAFE** for long-term use. No battery protection.
- **Option 2: DC-AC Inverter**
  - Uses a DC-AC inverter to generate mains voltage.
  - Relies on existing AC adapters (Router, NUC, Robotic Arm).
  - *Highly inefficient* (significant power loss).
  - Not recommended.
- **Option 3: Recommended (DC-DC + BMS)**
  - Uses DC-DC converters for efficient voltage conversion.
  - Includes a BMS for safety and battery health.
  - Modular and expandable.
  - Our recommended approach.

Feature	Option 1 (Resistors)	Option 2 (Inverter)	Option 3 (DC-DC + BMS)
Efficiency	Very Low	Low	High
Safety	Very Low	Medium	High
Complexity	Very Low	Low	Medium
Voltage Regulation	Very Poor	Good	Good

Proposed Solution: Efficient DC-DC Power

- We will use a DC-DC converter-based system for maximum efficiency.
- This avoids the power loss associated with DC-AC-DC conversion.
- We will use a 24V battery system (two 12V lead-acid batteries in series).
- DC-DC converters will provide the required voltages (19V, 12V, etc.).



Note: This is an oversimplified block diagram. Detailed wiring diagram to be created featuring fuses, bus bar, circuit breaker, power switch etc. as per requirement.

Battery Management System (BMS)

- Protects the battery from over-discharge, over-current, and short circuits.
- Balances the cells in series-connected batteries.
- Provides information about battery health and state of charge.
- Essential for safety and battery longevity.

Our Next Steps (2 week plan)

- Finalise the power budget table
- Select specific DC-DC converter models.
- Select a BMS.
- Create a detailed wiring diagram.
- Release first draft of *shopping list* (components to buy – we'll need a list of suppliers the CMS uses)
- Design and simulate the circuit
- Collaborate with the mechanical team on battery and power system placement.
- Potentially begin testing basic resistor circuit