

An exoskeleton for supporting lower limb in brush cutting (clearing) / Developing an Exoskeleton for Forestry Work

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Network to Innovate: New Innovative
Technologies in Forestry
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Shortly about me

Principal Research Scientist, HAMK Tech

Research Areas:

- Wearable Robotics
- Technostress

Background:

- Social Robotics
- Exoskeletons
- Biomechanics
- Occupational Health and Health Economics

Education:

- B.Eng. (Civil Engineering)
- M.Sc. (Quality and Environmental Management)
- M.Sc. (Biomechanics)
- EMBA (International Business)
- Ph.D. (Occupational Health)



Background

- Forestry activities are strenuous, involve risks, and are time-sensitive tasks that cannot be postponed
- Concerning manual forestry work there is a huge forest area which should be handled
- Pre-commercial thinning, early cleaning, and pre-harvest clearing are done **95 percent by hand**
- Manual clearing of forest stands requires endurance and productivity should be improved
- There is a need for specialized exoskeletons designed for forestry
- Exoskeletons for forestry are not yet commercially available

Shortly about Exo Forest project

- Aim to develop modular, affordable, easy wearable and effective lower body exoskeleton for forestry
- To make use of existing technology and build a working device, not a showpiece
- The device must assist movement in demanding forest terrain and must not hinder the use of a clearing saw.
- Exoskeletons are expected to increase productivity and prevent occupational accidents.
- Professional loggers are willing to pay approximately 1.500 to 2.000 EUR for a functional exoskeleton
- Finland has over 600.000 private forest owners with an average age of 61. They represent a significant potential user group for exoskeletons
- <https://www.hamk.fi/en/projects/exo-forest/>

Our modular design

- **Design Philosophy:** Based on available technology and components, re-designed and adapted for forestry use.
- **Modular Architecture:**
 - **Active exoskeleton:** For leg and lower-body assistance (Hypershell)
 - **Passive technology:** Integrated knee braces for joint support.
 - **Brushcutter vest:** Features an elastic element to support the back and shoulders.

Meets forestry safety standards



Design Constraints

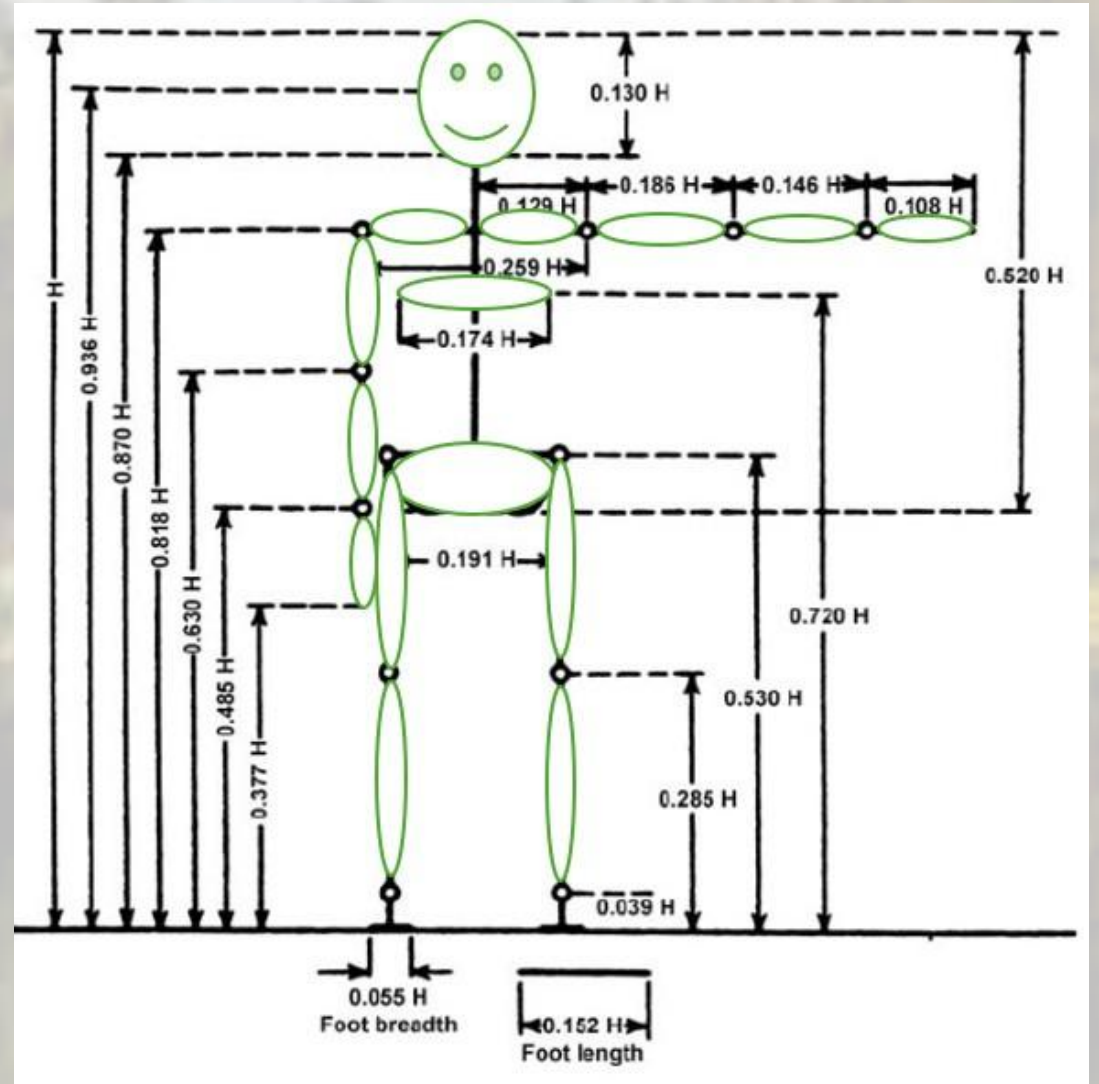
- **Time to market:** Achieve the fastest possible launch to market.
- **Target price:** Maintain a retail price between **1,500 and 2,000 EUR**.
- **Maintainability:** Ensure the device is easy to service and maintain.
- **Adjustability:** Design for high adjustability to fit different users.
- **Weather resistance:** Built to withstand variable and harsh weather conditions.
- **Battery life / Runtime:** Deliver a minimum continuous operating time of **6 hours**.

Collaboration with stakeholders



Challenge 1: Human body

- There is no “universal” standard human; body dimensions vary.
- An exoskeleton must be adjustable. For example, each individual walks differently.
- There are differences in muscle activation, as well as in joint function and range of motion (e.g., in older adults).
- Users prefer modular and adjustable exoskeletons



Challenge 2: Available technology “can we modify it”

WiRobotics WIM



<https://builtin.com/robotics/exoskeleton-suit>

Centaur, InteSpring B.V



<https://exocentaur.com/>

HAL, Cyberdyne



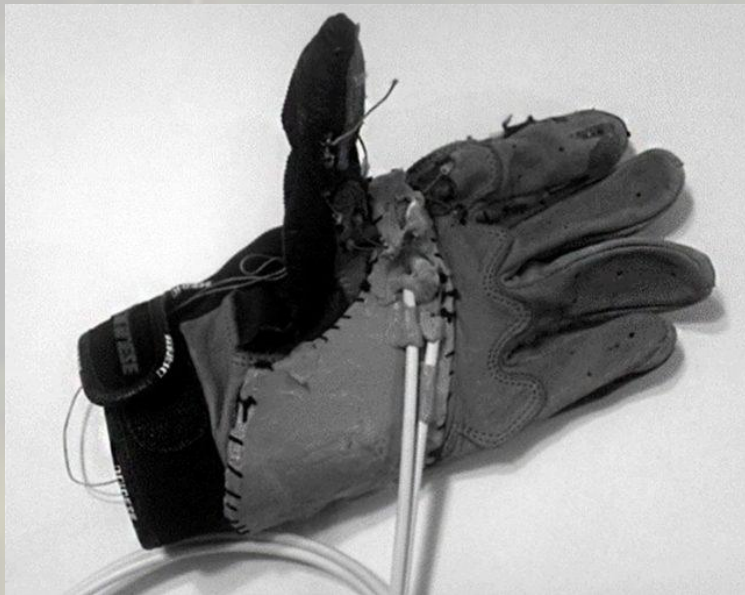
<https://www.dailymail.co.uk/sciencetech/article-2384930>

Hypershell



Challenge 3: Pipeline from prototype to product

- We have not yet identified a manufacturer capable of integrating all components into the final product.
- We need: Strategic Partnerships for collaborating with experts in system integration and mass manufacturing as well as funding for preparing the product for the market.
- Limiting factors in the sector: Skepticism over maintenance and reliability and requiring environment



First prototype 2006

<https://www.bioservo.com/corporate/our-story>



Product 2022



<https://biz.chosun.com/en/en-science/2025/08/08/D2S2N4WJTRAVVFDK734U4B753M/>

Future

Evaluating future trends

- From mechanical exos to active, functional clothes (exosuit)
- From pre-programmed reactive movements to AI-driven predictive assistance.
- From niche industrial and medical use to mainstream consumer outdoor mobility.

Monitor technological evolution and emerging products.



<https://textiletechsource.com/2019/05/20/soft-robotics-presentation/>

<https://therighttrousers.com>

Thank you!

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