HANDOUT
GREEN WALL ROBOT

green wall
robot

Fraunhofer
IPA

Automation
and green facades

CONTENTS

Fraunhofer-Institute for Manufacturing Engineering and Automation IPA
Department Robot and Assistive Systems

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Figure 1 State of the art green wall, Museum of Modern Art, San Francisco
Design: David Brenner, Installation: Habitat Horticulture, Photography: Garry Belinsky

HANDOUT
GREEN WALL ROBOT

Project Description

Modern urban areas face the unavoidable necessity for significant reduction of air pollutants. Main sources of pollution are traffic, industry and other combustion-related processes. Nitrogen oxides, carbon monoxides, ozone and particulates (and other volatile organic compounds) have exceeded the official nonhazardous limits for years in cities like Stuttgart and Paris, and are still increasing. Politicians in Europe and Asia try to handle the problem with new urban infrastructure models such as electric drives, ban of diesel-engined cars in city centers or incentives for public traffic without significant positive impact to date.

A promising approach for reduction of hazardous pollution are green facades that are able to support cities with natural air filters, noise dampers, humidifiers and enhance the aesthetic values of the objects they are installed on. Main reason for the rare installation of green facades is the high costs of maintenance. These costs vary between 5 % to 10 % of the initial investment per year and thus hinder green facades from conquering the vertical space in urban areas.

With years of experience in robotic applications in industries and as well as in resource efficiency in production, researchers of Fraunhofer IPA focus all the technical knowledge needed for the development of ground breaking new technologies in that context. With a new approach of facade robots new green urban areas will be opened up.

The **Green Wall Robot** concept developed by researchers of Fraunhofer IPA is a first and significant step towards economically maintainable green facades. It is able to work completely autonomous and combines a huge spectrum of applications due to its modular design. The following illustrations present possible implementations of the green wall robot. They are supposed to be understood as conceptual illustrations. The implemented solution will differ in asthetics, its appearance and technical detail depending on the use case specific requirements.

CURRENT SITUATION

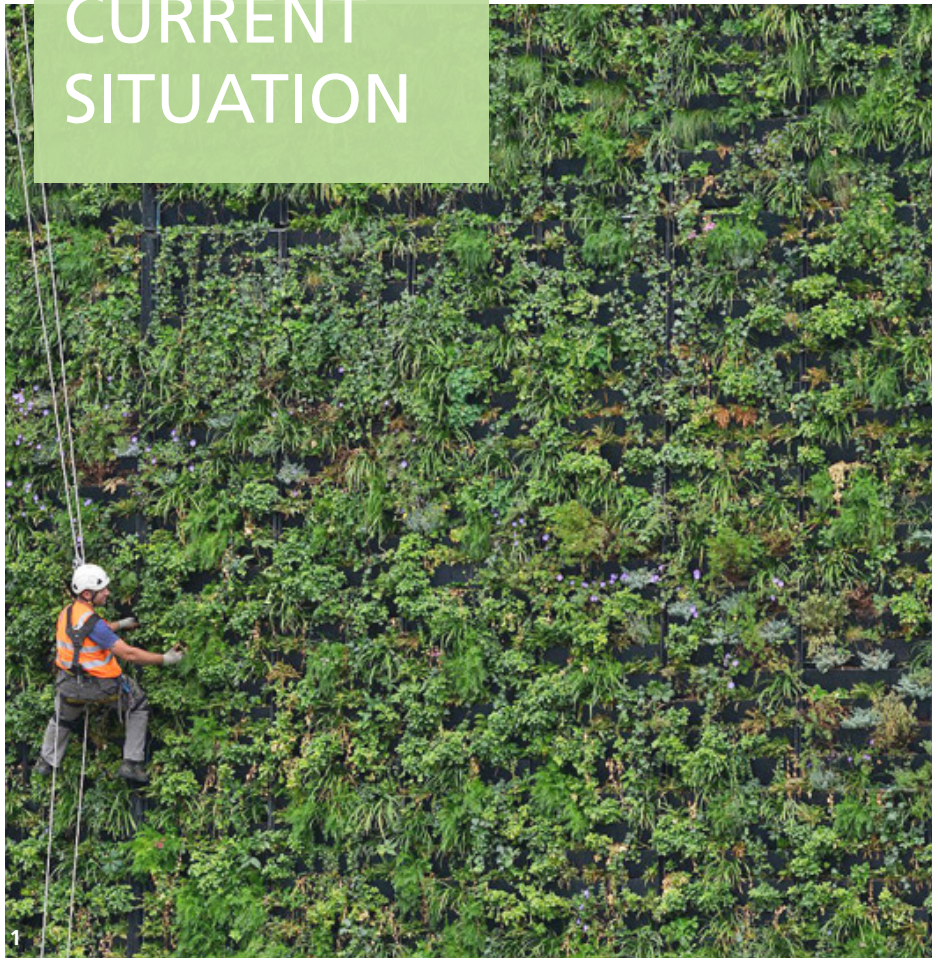

Figure 2 Example for state of the art green wall solutions
1 & 3: Rubens at the Palace Hotel, London, England | 2: Helix Pflanzen GmbH, Helix© Elata

- Green facades are costly
- Annual costs for maintenance 5-10% of initial invest
- Industrial climbers or lifting platform needed

Plants for facades are chosen according to their practicability on buildings:

- free of regular maintenance
- robust to urban environmental impact
- low variety of plant species

OUR VISION

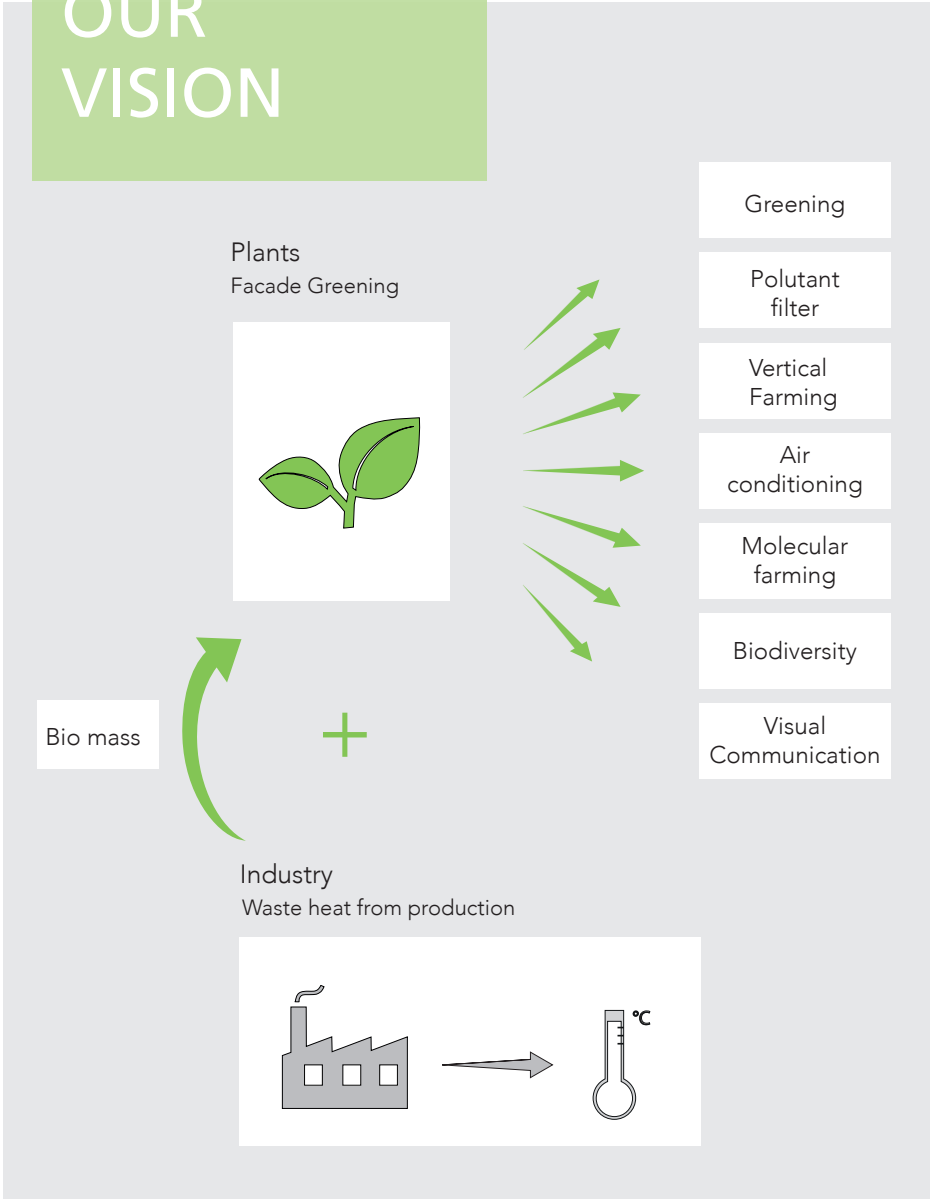

Figure 3 Facade greening on industrial and urban buildings supported by the Green Wall Robot technology with potential benefits and outcomes

Green Wall Robot

= Green Walls + Robots + Artificial Intelligence

Our Vision is, that robots and artificial intelligence enable a greener and more sustainable urban and industrial architecture.
The implementation sceanarios range from task specific assistance systems for green wall gardeners up to the fully autonomous maintained and optimized biointelligent green wall system.

Benefit for urban areas

- Air pollution control
- Depletion of particulates and NOx emissions
- Cooling effect in urban micro-climate
- Water retention for heavy precipitation
- Noise absorbing
- Ecosystem on building
  → habitat for wild bees and endangered insects

Benefit for industrial areas

- Reduction in energy consumption for air conditioning
- Heat and carbon sink
- Production of biomass
  - local food production
  - energetically usable crops
  - natural resources for industries
- Visual communication for advertising through different plant cutting structures or combinations

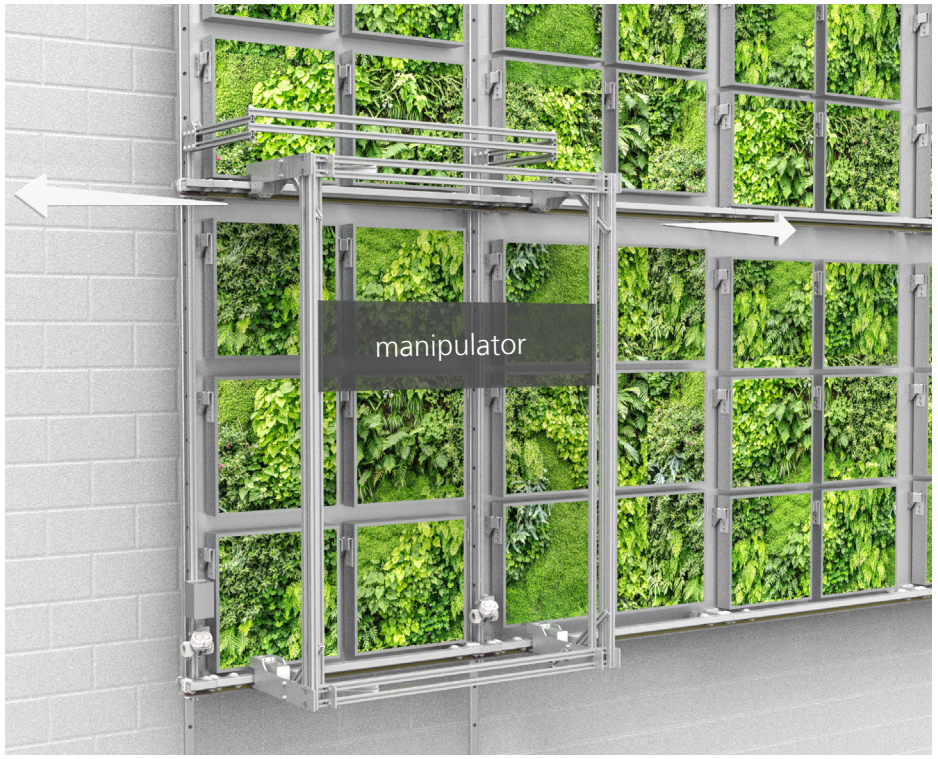

Figure 4 Visualization of a rail driven Green Wall Robot concept

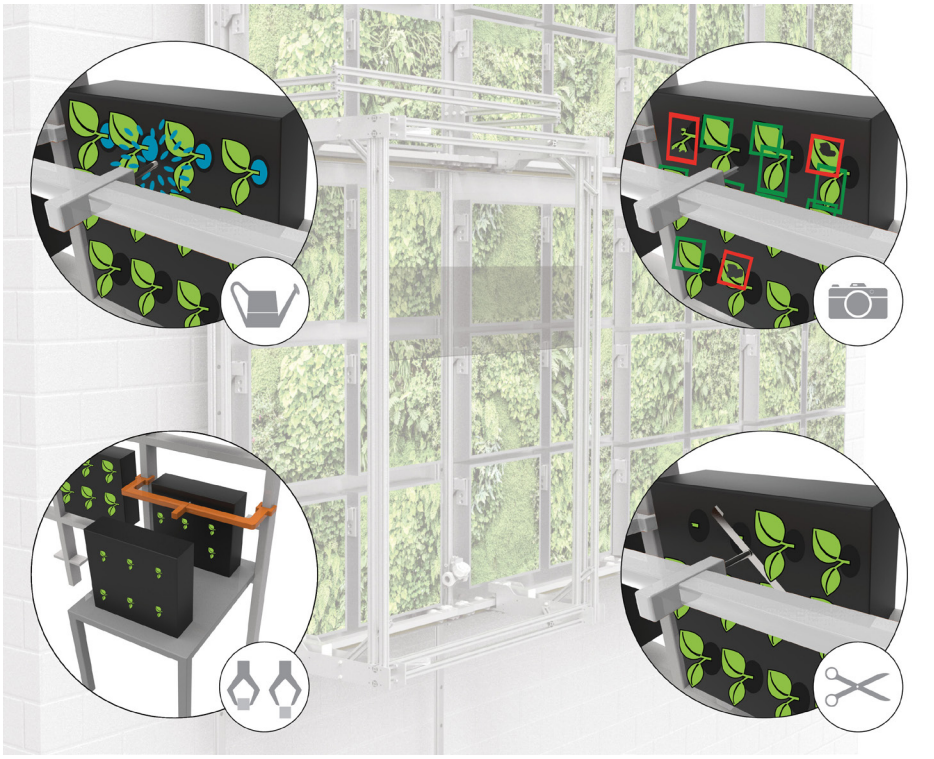

Figure 5 Possible tasks that can be conducted with the Green Wall Robot according to the context of its implementation

Concept 1

This technical concept study illustrates the idea with a focus on the modularity of a Green Wall Robot system.
The adressed use case is the intensive biomass production as an element of a vertical farming concept.

Thus the robot is able to autonomously pick modules on an entry point, in figure 5 sketched as a table at the bottom left, and place these modules at any point on the green facade layout.

Besides Pick&Place, the robot is able to perform various other tasks, such as supervision of plant health and growth process and harvesting.

It has a liquid application for conventional or biological plant protection or extra moisture control for optimal plant growth.

Figure 6 Design Study of a Green Wall Robot concept as a cable robot

Concept 2

In this design study the Green Wall Robot functions as a cable robot. It is attached to four points at the facade and moves with the held of four winches across the facade.

The robot checks plants for diseases and gives feedback to the user. Additionally, there are a cutting and a spraying tool to be plugged in.

Boxes for insects are integrated in the facade to support the variety of insects in cities.

Furthermore, the robot can be used as a learning tool. The integrated camera sends live pictures to a display underneath and gives impressions and a condition assessment of the greening and insects to interested people.

CONTACT

We are constantly looking for project partners in industry and architecture to further develop our vision of the Green Wall Robot and to find suitable application for an implementation.

In case you have questions about the technology or interest in bilateral partnerships in the application development of our technology, do not hesitate to get in contact with us at the Fraunhofer IPA.

Overview of services:
- feasability studies for innovative automation concepts
- realisation of pilot projects and scientific assistance on experiments
- bilateral partnerships for product development, market implementation

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Topics:
- Urban Production Technology
- Interface Design
- Data Science for Biointelligence

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