SYMBIOTIC ASSOCIATIONS

a research on digital soil remediation

1.Problem

Land pollutions refers to degradation or destruction of earth's surface and soil, directly or indirectly as a result of human activities.

Soil consists of a mixture of unconsolidated mineral and rock fragments (gravel, sand, silt, and clay) formed from natural weathering processes. Gravel and sand formations are porous and permeable, allowing the free flow of water through the pores or spaces between the particles.

Land Pollution has led, in fact, to a series of issues that we have come to realize in recent times, after decades of neglect. The increasing numbers of barren land plots and the decreasing numbers of forest cover is at an alarming ratio.

The dominant types of land degradation across the dry lands are water and wind erosion – often the result of overgrazing, unsustainable agricultural and water management practices, and the over-exploitation of vegetative cover.

In turn, these are driven by rapid population growth, urbanization and poverty, which force rural communities to adopt non-sustainable land use practices. Climate change is making it even harder to cope, increasing vulnerability to crop failures and poor livestock productivity.

Land fills and reclamations are being planned and executed to meet the increased demand of lands. This leads to further deterioration of land, and pollution caused by the land fill contents. Also due to the lack of green cover, the land gets affected in several ways like soil erosion occurs washing away the fertile portions of the land.

2.Research Questions

In agriculture, toxic levels of various elements pollute the groundwater as a result of excessive fertilizer application (e.g., nitrates and phosphates), and through leaching of naturally occurring trace elements in the soil after irrigation (e.g., selenium). Pollution of both water and soil poses a significant hazard to human health.

Finding suitable treatment technologies to clean up contaminated water and soil is not easy. Many technologies that are available are usually very expensive. Because the need for practical and cost-effective procedures for cleaning up contaminated water and soil is so

great, researchers in this group have dedicated themselves to achieving this goal through the study of process involved in soil pollution and analyze the best solution to apply.

Essential contribution is devoted to the right selection of strategies to recover contaminated soil. The choice is based of knowledge of basic principles of soil characteristics and analysis of pollutants speciation and bioavailability.

In this research we question the possibility of designing and predicting soil remediation by digitally exploring and experimenting several processes of soil decontaminations.
Contemporary tools allow, in fact, to study, through hardware and software instruments, biological behaviours based on the extraction and interpretation of real time data.
This research is meant to explore the possible implementation of physical computing, computational design and digital fabrication techniques in the design and optimization of the most efficient soil remediation strategy.

3.Hypothesis

Mycoremediation is a form of bioremediation, the process of using fungi to degrade or sequester contaminants in the environment. Stimulating microbial and enzyme activity, mycelium reduces toxins in-situ. Some fungi are hyperaccumulators, capable of absorbing and concentrating heavy metals in the mushroom fruit bodies. One of the primary roles of fungi in the ecosystem is decomposition, which is performed by the mycelium. The mycelium secretes extracellular enzymes and acids that break down lignin and cellulose, the two main building blocks of plant fiber. These are organic compounds composed of long chains of carbon and hydrogen, structurally similar to many organic pollutants.[1] The key to mycoremediation is determining the right fungal species to target a specific pollutant.

Recent studies also suggests that **protein absorbents** related to the beta-lactamase from Chromohalobacter might be designed using the techniques of **synthetic biology**, the most likely approach being to engineer a native protein to make the affinity site described by the team. The genes for such an agent might then be engineered into new b vbreeds of plant that could be grown on the site [1].

This research will be structured on the data collect from a single or a family of **apparatus**.
An apparatus consist in any equipment used during data collection (such as computers or eye-tracking devices). Materials include scripts, surveys, or software used for data collection (not data analysis).
Our hypothesis is that using those information we'll be able to introduce additional methods to perform programmed soil decontamination, mixing digital fabrication and rapid prototyping techniques.

4.Operational Terms

4.1_A description of the experimental design and how participants were assigned conditions.

The experiments will be performed through a collection of tests where will be monitor how fungi grow and how fast the process of mycoremediation is working in terms of extraction and absorption of pollutants from the soil.
Those test tubes will be sottoposti to real time data evaluation using physical computing techniques. The data will be then analyzed and visualized using computational design methods which will be adopt to define patterns for mycoremediation.

4.1a_Possible pollutants to work with:

causes:
beta-esaclorocicloesano
β-hexachlorocyclohexane (β-HCH) is an organochloride which is one of the isomers of hexachlorocyclohexane (HCH).[1] It is a byproduct of the production of the insecticide lindane (γ-HCH). It is typically constitutes 5-14% of technical grade lindane,[2]
In March 2005, the Italian National Monitoring System on Chemical Residuals in Food of Animal Origin detected levels of the pesticide beta-hexachlorocyclohexane (ß-HCH) that were 20 times higher than the legal limit of 0.003 mg/kg in bulk milk from a dairy farm in the Sacco River valley. ß-HCH, a lindane isomer and possible human carcinogen, was subsequently found in milk from several neighboring farms. A study was therefore undertaken to evaluate the extent and risk factors for contamination.

effects:
tumore della pleura

4.1b_MAURO WRITE HERE:

Early Inquiry
The main goal of this project is to define a new methodology for monitoring what happens in a polluted soil when a mycelium is applied, using the technology opportunities that Digital Fabrication can offer, in terms of manufacturing customization, electronics and data sharing.
As both the soil conditions and the pollutant agents may vary enormously, requiring an infinite range of scenarios and quality of fungi to apply, it is mandatory to start with a simplified condition, in terms of soil characterization and contaminants.
Typical (and common) pollutants are Hydrocarbons and Heavy Metals as Cd, Cu, Zn, As and Pb (As not directly generated by Human activity).
Main steps should be:

1) Defining contaminants to use and one or more soil conditions (Hydrocarbons and Pb?)
2) Define the Data to monitor and the sensors to use

3) Build the Apparatus
4) Build the Electronics with different probes: general info (Humidity, Temperature, PH, ORP, Salinity, Nitrates) and specific info (depending on contaminant)
5) Create web based GUI for data sharing
6) Acquisition of Fungi (Pleorotus Ostreatus) and start application.
7) Data and Visual (Time-lapse?) recording

4.2_Identification of your independent variable(s) (IV), dependent variable(s) (DV), and control variables. Give your variables clear, meaningful names so that your readers are not confused.
Important instructions to participants.

Will be specify after meeting with biologist and mycologist

4.3_A step-by-step listing in chronological order of what participants did during the experiment.

Will be specify after meeting with biologist and mycologist

Research Team

Project coordination: Noumena
Prototype and tests: Noumena (Pavel Aguilara)
Computational designers: Noumena
Physical Computing expert: Italian Makers (Mauro Jannone)
Biology expert: Marc Montlleo
Mycologist: _____ (MAURO FILL IT)

Operative links

https://docs.google.com/spreadsheets/d/1_0sn0M4-quwtNGtGdr3ubSP1yF1mjChBT7sFX-y_Y4k/edit#gid=617559058

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precedences

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apparatus

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mycelium

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pollutants

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