

# Bridging Technology and Ecology: A Comprehensive Analysis of Environmental Robotics

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**Abstract:** *Nowadays, new robotics technologies are emerging. Robots are used in different fields. Environmental Robotics is one of them. The purpose of Environmental robotics is to study the environment with the help of robots. This branch of robotics also deals with problems of the environment. Robots can play an important role to save our environment. There is already a variety of robots are being developed to fight against different environmental issues such as to stop wildfires, clean water bodies, to control climate change effect, to stop soil erosion, etc. Besides so many benefits, certain concerns also rise due to the unethical use of these robots. Some of the major concerns are misuse of their collected data, disturbance in the food chain, etc. Their possible solutions are also mentioned in this paper. This paper aims to provide you with all aspects of environmental robotics.*

**Keywords:** Robotics, Environmental robotics, eco bots, roboethics

## 1. Introduction

Robots have been primarily developed for warfare, but we can use them to solve the modern world's problems. Nowadays, the usage of robotics is increased in various industries and research. Scientists and engineers are also using robots for environmental research purposes and to minimize environmental, climate, and biodiversity changes. Though there are many benefits of robots in environmental science, we cannot ignore their harms such as UAV (Unmanned Aerial Vehicle) and drones are used to send in inaccessible areas to gather data but they are also used in war. There are very few papers on concerns of unethical usage of environmental robots.

In this paper, we will discuss how robots can help solve environmental problems, what are practical, ethical, and socio-political concerns, and their possible solutions like guidelines and policies and the future scope of environmental robots.

## 2. Environmental Robots

We take into account environmental robotics to be the area that studies all robots that resource in environmental remediation, engineering, research, and protection. Herein, we consciousness particularly on the types of robots which can be used and/or designed to carry out capabilities inside the service of environmental studies, engineering, and safety with some diploma of autonomy. [1] This area also consists of robots that might be impacting the surroundings like agriculture robots, river cleaning robots (ro - boat) [2], etc.

There are particularly 3 types of environmental robots:

- 1) Robots in ecology
- 2) Robots for ecology
- 3) Ecobots (Ecologically functional robots)

These classes are not completely distinct and admit overlap.

They are primarily based on in - use functionality. Yet they are full - size and beneficial to manual and map ethical problems of the surroundings. [3]

Ecobots are specially made for environmental purposes. Their primary function is to serve them the environment. (e. g., to clean rivers, beaches, etc.) Robots for ecology are designed to carry out environmental research tasks such as drones and UAVs for monitoring forests, wildlife, etc. Robots in ecology are more general which means general robots which are used in environmental research applications. [3]

Some Ecobots are made by non - profit institutes like COTSbot made by Queensland University researcher Matt Dunababin. It is a specialized AUV (autonomous underwater vehicle) to control the amount of COTS fish (Crown of throne starfish) by injecting toxins into their body. Researchers of Harvard's Wyss Institute also developed 'Programmable robotic swarms - Kilobots'. In near future, robotic swarms may repair environmental damages. Harvard's Wyss institute had developed a robot to stop soil erosion. Los Angeles Fire department deploys a human - controlled fire fighting machine called "Robotics System 3". Mark Stewart's Company had designed a planting tree robot - Growbot. The company has developed more than 4000 robots to restore forest trees.

Robots for ecology are designed to work in environmental research. Some examples of this class are Treebot [4], bio mimicking robots such as The Octobot from Harvard University, Snakebot, etc.

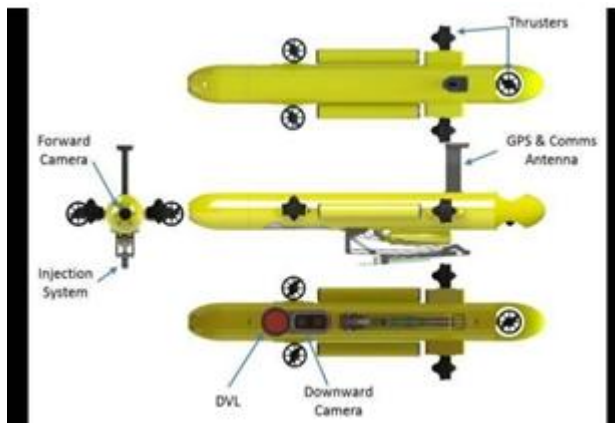


Figure 1: COTSbot

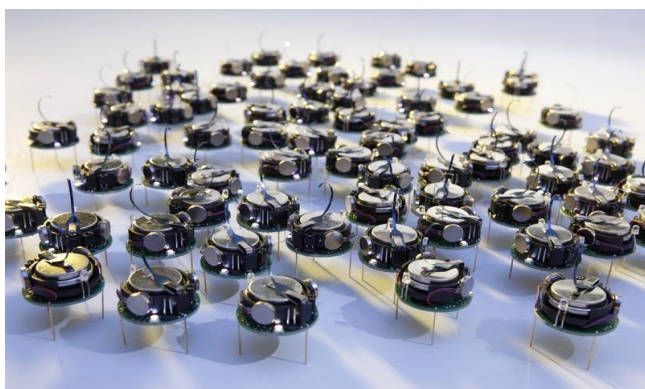


Figure 2: Kilobots



Figure 3: Environment monitoring robot



Figure 4: Aquatic predators tracking robot - Mesobot

They are also used for monitoring the biosphere. Treebot is the “World’s lightest, smallest and most flexible tree - climbing robot” as per its creators. Whereas, bio mimicking robots are used to monitor the behavior of respective species. In this section, we can also add COTSbot because every eco boat is developed for environment research but due to their multiple functionalities, we can use them for different tasks. Therefore, we can say that these sections are overlapping.

“Drones” and “Rovers” are widely used as Robots in ecology. They were not made for the purpose to solve environmental issues. Yet they can be used to get an eye on wildlife or to monitor the environment and many more things. Autonomous ground vehicles (AGVs) have enabled greater efficiency and ethical studies. For example, Le Maho et al. (2014) find that by tracking populations of endangered king penguins (*Aptenodytes patagonicus*), researchers have been in a position to seriously reduce “large and long - lasting will increase in stress hormones” related to human approaches. And as with UAV studies on sensitive and difficultly located birds, this research indicates that approaches with the aid of AGVs produce an extensively lower stress response (e. g., multiplied heart price) than techniques by way of human researchers. AUVs (Autonomous Underwater Vehicle) have enabled explorations of environments and species at excessive aquatic situations and depths. For example, they’ve enabled explorations under arctic ice sheets and have enabled more secure aquatic predator tracking (Mesobot) [5]. In these and notably many other ways, drones and rovers by themselves have shown that general robotics technology can notably increase environmental research skills in ethically most popular methods. [6]

### Concerns about Environmental Robotics

Environmental robots are very useful but we should also concern about their misuse. Therefore, we should think about guidelines or policies for their use. Let us assume that a predator - killing robot is meant to kill or monitor a certain species but either mistakenly or over aggressively kill some different species including humans. This type of mistake can rely on any type of “recognition” defect.

Bio mimicking or species control robots like COTSbot or Harvard’s Wyss institute’s “Robobees” can also affect disturbance in the food chain. These Robots are made for a specific task therefore they cannot be praying of some other species and hence novel concerns may arise.

These robots also gather data during their task and respective authority should control it otherwise it can use for different businesses and political benefits. This brings up even more concerns and questions that with whom should share data. It is also debatable that providing open access to certain kinds of data gathered by Environmental Robots may be dangerous. It is also dangerous if environmental data will be hacked. Yet these types of concerns are likely to be overlooked when we discuss environmental research and engineering. [3]

These concerns will be solved by the following things: Moral responsibilities and legal responsibilities. Moral responsibility is personal. Users of ecological robots must ensure that they are using them for the right purpose and they will not misuse their data. Whereas, the government should take charge of legal responsibilities. Government should make laws and legal policies against the unethical

use of ecological robots. [7]

### 3. Conclusion

Environmental or Ecological robotics has a great potential to understand and save our environment. Environmental robots are divided into three subcategories to ease our task. We should also consider roboethics when we use these robots. Scientists, engineers, and policymakers should work together to develop roboethics. It is essential since environmental degradation is a result of human activity. Thus, ethicists can contribute to craft policies. We have discussed different aspects of environmental robots like their types, their benefits, their practical and ethical problems, and their solutions. I sincerely hope that readers will find this paper informative and it will also encourage them to solve issues of the environment with help of robotics.

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