Focus 1: Biodiversity Research

amatech

Biodiversity Research

Soft Robotics

Biomass & CO2 absorption

Eco acoustics & eDNA analytics

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Imperial College London

Project 1:A Tree climbing robot for non-timber rainforest resource exploration in the upper canopy

This project aims to raise the perceived value of the rainforest compared to forestland (which could be used for large-scale farming). This will be achieved by designing a tree climbing robot, inspired by sugar gliders, that can climb to the upper canopy, and glide from tree to tree to explore the surrounding area. It will look to sense/ take samples of non-timber forest resources and map their location (through the internet of things).

Project 2: Drone-based forest biomass and soil analysis using machine learning techniques

Continuous monitoring of forests is possible—up to a point—using remote sensing from satellites, but satellite-based technologies typically cannot pierce the canopy cover to get more details about factors such as soil health and understory complexity. These can only be estimated by on-the-ground measurements.

However, such measurements are both expensive and difficult to obtain, especially in tropical rainforests which sequester much of the world's carbon and have the highest levels of biodiversity. We believe that the availability of drones might change this picture.
Specifically, the goal of this project is to increase the quality and volume of field plot data by using drones equipped withone or more cameras and a hyperspectral sensor to create rich datasets of the forest area.
It would then be possible to use machine learning approaches such as partial least squares or Random Forest to analysethe resultant data. For example, it may be possible to work out which particular wavebands have reflectancesthat predict the underlying soil properties

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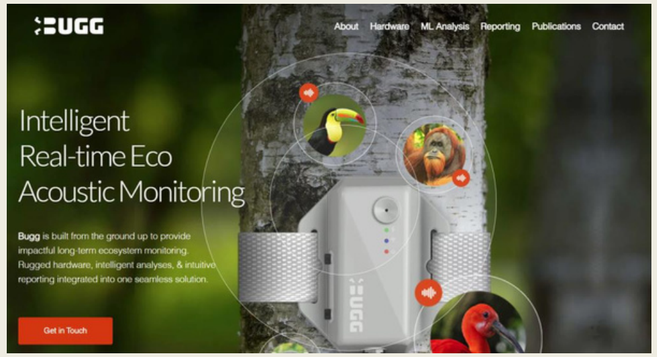

Project 3: Eco-acoustics and Environmental DNA systems development

This project will combine existing eco-acoustic Machine Learning Algorithms with low energy, biodegradable sensors and cutting-edge eDNA techniques to build a digital twin of the fauna of the forest.

Deploying such sensors e.g., from a drone would allow us to collect high-resolution data from even the most difficult to reach areas in a fully autonomous and sustainable manner. The current Bugg devices record, compress, and upload audio recorded from a mono MEMS microphone to a cloudapp that have been set up on Google Cloud Services. The devices consumes ~1-3W, can be powered by a DC voltage between 5-36V, and uses a mobile internet (3G/4G) connection to upload data remotely. The ability to record data from an external mono microphone so the device can be used more flexibly (e.g., underwater or with higher sensitivity microphones), is in advanced development.

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Project 4: Eco-acoustics and Environmental DNA analysis biodiversity monitoring pilot project

RFCxand NatureMetricswill collaborate with Amatechto build a comprehensive characterization of biodiversity using acoustic monitoring and eDNA in RPDS Amazon Rio. By combining the data sources from the two technological approaches we hope to provide a complete assessment of the local wildlife.

Using passive acoustic sensors, the RFCxscience team will be able to determine a preliminary species list, estimate species richness of birds, characterize bird species composition, create species-specific models for multiple species and understand patterns of species occupancy.

The project will have the following foci:
1. Species-specific monitoring to understand patterns of species richness, composition and occupancy 2. Ecosystem monitoring to understand how environmental factors influences the ecosystem as a whole

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Project 5 : Deforestation analysis using satellite imagery

This project will include an analysis, measurement and provision of evidence to show the positive sustainable impact of the creation of the ManicoreReserve from 2010 to present. It will aid the verification of the value of the assets in the reserve, to contribute to a Natural Capital assessment.

With the use of Geospatial and Earth Observation technologies combined with Machine Learning and data analytics 4EI will, forthe given area of interest, perform a historical analysis of deforestation (and afforestation) through time. The key time periods to review are:

- 2010-2012
- 2015-2017
- 2020-2022

The following key metrics will be provided:

- Habitat Mapping
- Biodiversity indicators
- Carbon sequestration modelling
- A conservation index indicating external pressure on the area of interest (e.g., impacts of infrastructure, urban development, mining, livestock, timber activity).
- Trend analysis of deforestation (and afforestation) from 2010 to present day.
- Yield modelling of non-timber crops (e.g., brazilnuts, acai).

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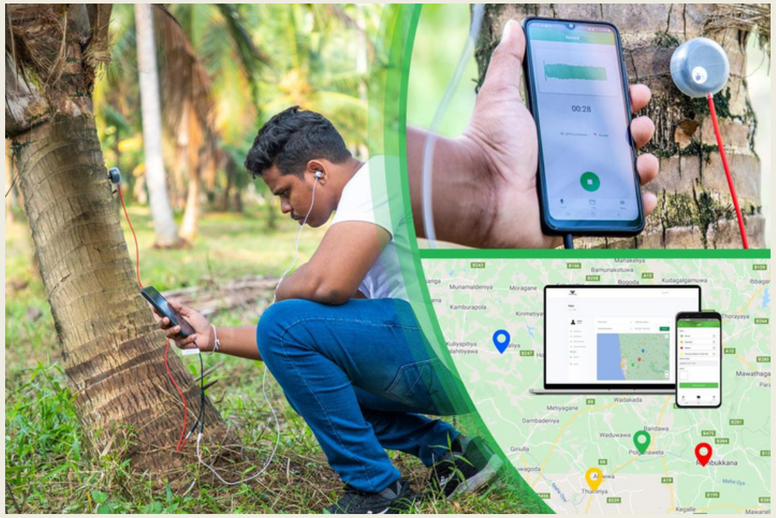
Permia Sensing

Imperial College London

Project 6 : Remote detection of boring insects in fruit and nut bearing trees



Permia Sensing offers a field-testing service to detect Red Palm Weevil (RPW) larvae growing in coconut palm trees. This insect is known to damage an estimated 10% of the coconut yield in the World, which is around £450 million per year. The World Food and Agriculture Organization (UN FAO) has declared RPW as a global threat to the food industry because it has attacked about 40 palm species in 60 countries.

This project will develop the Permia Sensing software and app to identify and locate boring insects inside the trunks and branches of trees bearing non-timber forest products that are harvesting by the local communities. As the technology is also capable of making audible the flow of water inside trees, it might also serve as an additional acoustic data source for the Metamazonia environment.

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