A close-up photograph of a person's hand reaching out over a body of water. The hand is positioned in the foreground, with fingers slightly curled. The water is a deep teal color with visible ripples and reflections. The background is a bright, overcast sky. The image is framed by dark teal geometric shapes in the corners.

What Would the Ocean Choose if it Could Decide?

WHITEPAPER

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2021

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ABSTRACT & CONTEXT

O-CHAIN explores the connection between crypto commodification of ocean behaviours and the cognitive artificial intelligence technologies that can potentially create an autonomous ocean that takes decisions optimizing the collective interests for the global human collective alongside the living, breathing ocean. Within the cognitive system, an experimental new economy is established that provides a source of prosperity for all who respect the ocean's decision autonomy and rules. Cognitive artificial intelligence is constantly improving its decision making capabilities in a dynamic environment – could humankind respect such a system? Or will it destroy the autonomy of the ocean for quick economic gain and territorial power? How would a cognitive ocean respond?

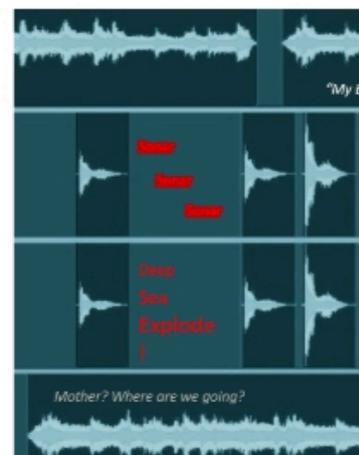
Driven by the Ars Electronica A.I Ecosystem Hackathon, the O-CHAIN Team strives to present a prototype of a cognitive aquatic space that acquires knowledge to self-heal through sensors and sound. O-CHAIN creates a scenario where the aquatic space is able to sell licenses to extract aquatic resources, such as trade routes, extraction of seabed resources, through automated processes, smart contracts and blockchain technology, accumulating capital for the aquatic space.



INTRODUCING O-CHAIN and its Context

01

O-CHAIN is a cognitive artificial intelligence using real-time data from sensors, drones, robots, hydrophones, satellites and other automatic measurement instruments in the Internet of Things to continuously collect anthropogenic and natural data from the ocean. The O-CHAIN algorithm continuously improves learning to self-heal and reward humans for respecting its autonomous decisions through the issuance of crypto tokens that intend to eventually lead to an optimized coexistence between humans and the marine ecosystem.



O - CHAIN

The O-CHAIN algorithm takes humankind's needs from marine ecosystems into account, by ensuring fishing rights are issued at a sustainable level, directing shipping routes in the most economical and environmentally least disruptive path. In essence, the O-CHAIN algorithm balances the ocean's ecological resources with the human's economic desires.

This white paper proposes what could become a world first experiment with artificial intelligence balancing the human and the ecosystem's marine resource needs. The concepts and propositions made in this Whitepaper present a possible future for the ocean, and hope to catalyse discussion and action towards the global efforts to address the extensive anthropogenic impacts currently felt by marine ecosystems using a cognitive artificial intelligence giving the ocean autonomous decision making abilities with applying crypto commodification of ocean resources to incentivize human behaviours.

The paper briefly presents the rationale for proposing crypto-commodification of ocean resources and presents a discussion on the different roles cognitive artificial intelligence plays, touching on potential ethics issues. The paper introduces the data and technologies that might be utilized in teaching and optimizing the O-CHAIN algorithm. It presents the concept and rules for the O-CHAIN crypto-economy and concludes by evaluating the potential risks and opportunities that may be associated with such an experiment.

The Solution presented is inspired by the Terra0 Whitepaper and concept - *Can an augmented forest own and utilize itself?*¹ Terra0 presents an economic model and prototype for which a piece of forestland is bought and governed by a non-human actor in a post-human future. The economic model is implemented based on smart contracts which optimize sustainable forest management and for which licenses are given to log specified trees. The logging licenses generate revenue for which the non-human actor can repay the initial debt payment for the forestland to the human initiators by buying back terra0 tokens (Crypto-currency). Once the repayment is complete the human project initiators no longer hold tokens and the forest is the sole shareholder of its own economic unit - as a result, the forest owns itself, and subsequently governs its utilization such that it generates its own revenues and can include the possibility to buy more forestland and expand.

The Terra0 paper was presented in 2016, and since then there have been multiple developments in the crypto-currency market that would present an opportunity to revisit the Terra0 models and assumptions. More specifically, at the time that Terra0 wrote their Whitepaper, existing blockchain technologies were not evolved such that they would allow for updates within the blockchain. Nowadays we have a number of blockchains that allow updates through various experimental and democratic processes. For this reason, we specifically propose the Tezos blockchain, which is set on an open source platform that can evolve by upgrading itself. Stakeholders govern upgrades to the core protocol, including the upgrades to the amendment process itself creating democratized value².

Since 2016 a number of key developments in crypto-currency have evolved to signal that it may one day become integrated into the digital economy:

1. Regulators (IRS, Securities and Exchange Commission, Federal Reserve) have acknowledged the need to create globally relevant and clear regulation, as well as investment guidelines;
2. Discussions on an Exchange Traded Fund (ETF) for cryptocurrency - this is likely to attract more investors/institutions as it would support the formalization of the crypto currency market;

While these above points are ongoing discussions and acknowledgements for the need to regulate the crypto market, the reality is that there are a growing number of investors, speculators, and crypto tokens that have or lose value. Research is also following crypto developments and foresee it as playing a role in the future digital economy, see Dudukalov et al (2021), Makarova (2018) and Steinmetz et al. (2020).

¹ Seidler, p., Kolling, P., and Hampshire, M. (2016) Can an augmented forest own and utilize itself? Berlin University of the Arts, Germany. https://terra0.org/assets/pdf/terra0_white_paper_2016.pdf

² <https://tezos.com/learn/what-is-tezos/>

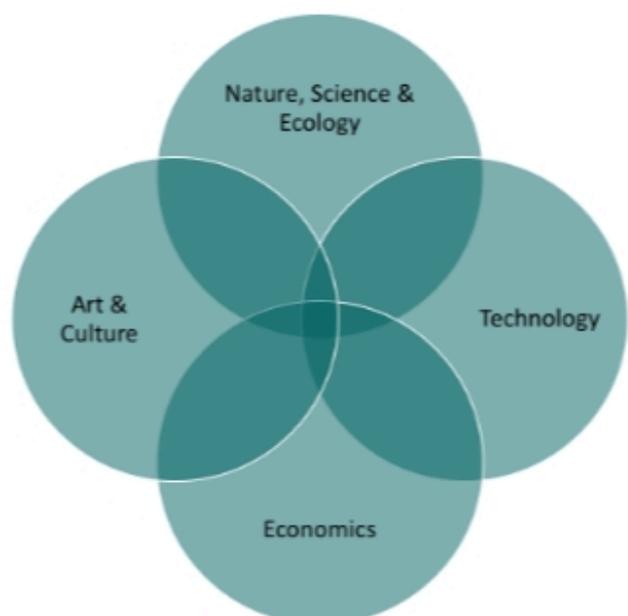
The O-CHAIN system is deliberately set in the future of Earth, possibly within a decade or two for which digital technologies currently in the early stages of adoption are much more prevalent, alongside megatrends that change the way we work, demographic shifts and place challenges like the climate crisis and ecological collapse in focus. With this in mind, the logical relations that can link a digital economy with environmental services should be ambitious and cross-disciplinary.

In the Venn Diagram in Figure 1, we propose an approach where multiple domains the natural sciences, art & culture, technology and economics are considered holistically to create collective prosperity for humankind. At the center of the Venn, all domains and their academic doctrines are governed by the ethos that there is a balance to be obtained on Earth between the Ocean and Humans, and that cognitive artificial intelligence strives and eventually maintains this balance.

1

Figure

Linking the Digital Economy with Environmental Services Requires Ambition and Cross-Disciplinary Approaches



2.1 How can Humans Exist within a Cognitive AI ecosystem?

While general artificial intelligence can augment the human's ability to solve complex problems, cognitive artificial intelligence attempts to mimick human reasoning and behaviors to solve complex problems. In addition to numeric data analytics, modelling and machine learning, cognitive artificial intelligence aims to perceive, correlate, learn, teach, heal, reason, hypothesize and solve problems with explainability and transparency.

Recent applications used to benchmark the state of cognitive artificial intelligence often refer to the recent NASA Mars Rover success, where after a Martian dust storm, the rover taught itself to shake off the dust from its solar panels and reposition them³. This type of cognitive AI combines external and historical data, with machine learning and human encoded knowledge to propose hypothetical extensions on the initial models to optimize an AI's function. However, such technologies also create a new role for humans that engage with artificial intelligence.

The NASA Mars Rover was specifically designed to operate in a non-human environment, and therefore the technology using autonomous self-healing decisions is necessary. On Earth, the interaction between cognitive AI and humans is unavoidable. Beneicke et al (2020) detail the data collection and analytics possibilities of the Internet of Things and Smart Cities and explore analytics for citizen's cognitive support by offering services that support descriptive, predictive, prescriptive analytics. They note that the digital citizens demand services that support them to make better decisions in a complex and dynamic environment – this is where cognitive analytics is starting to play a role to make cities, roads, infrastructure, buildings etc making more efficient, economical, sustainable and social-human friendly services. For the digital citizen, this could include decisions on the fastest or safest route to destination, while traffic conditions change, or when, where and why a building requires maintenance after an Earthquake, and decision support for where to procure and dispose of materials. There are a growing number of discussions and use cases that discuss smart cities and the possibilities for cognitive artificial intelligence, see Ayesh (2019), Perez et al (2017) and Yitman et al (2021) for selected references that discuss research perspectives on cognitive AI in smart cities.

The smart cities examples demonstrate how cognitive AI can help augment human decisions in city living, but will there become a point where cognitive AI crosses ethical boundaries? Potentially there is, if judging by the extent of related ethics literature. Alexoui et al (2020) discuss the ethics of cognitive AI and enhanced bioengineering of humans. They discuss how technologies such as CRISPR platform that while currently used to genome edit and treat genetic diseases today and the potential impacts of such technologies several decades from now. The research creates the need to ask ethical questions on how the human will exist alongside cognitive AI in the future – As humans, there will be those that ask - is there an optimum state and level of being human? What might humans look like and behave free from genetic defects, deformities and mutations, as there is no such perfectly genetic human? At what point will humans need to stop optimizing cognitive AI driven enhancements and augmentations of the human state? Will cognitive AI, in perfecting the human genetic, come to displace what it is to be human?

³ <https://uk.pcmag.com/news/122850/beyond-limits-brings-space-tested-ai-to-earths-harshest-terrains>

There are multiple ways that humans can exist within cognitive AI systems, and for the current state of technology, cognitive AI is indeed supporting and augmenting human decisions in complex dynamics environments. As the technologies develop for cognitive AI in the coming decades, the role of humans will change and with the types of technologies potentially possible, this will change the role for humans cognitive AI interactions, and these roles need to be considered and discussed currently and consistently, as they cover ethical and philosophical dimensions going to the root of human intelligence existence - ***what does it mean to be human?***

2.2 What can be the role of the Human vs. the role of the AI?

Ethics aside, there is an important role for humans in the future of cognitive artificial intelligence and in the future of the O-CHAIN system. Humans are the provider of the infrastructure, whereby the infrastructure acts as a promethean force spinning up the complex mechanism and maintaining its gears. In the same way that humans will never fully understand their own humankind, and its collective decisions and indecisions, the cognitive artificial intelligence is unable to conceive with precision, all the dimensions and complexity of processes behind the mechanisms that can bring its decisions and autonomy into action.

Therefore, from the ethical standpoint, the human should not try to interfere with the autonomy of the cognitive AI. The role of humans in the relationship with any ecosystem should be established through the means of mutually respectful collaboration and should be subjected to a continuous collective revision.

As the feedback loops constituting the transformation of the reality cause this reality to change at an ever-increasing pace, one cannot predict with precision the transformation to come in a reasonably close future. Therefore the ability to revise and update the underlying rules is a pivotal point of any successful collaboration. Not only should the human be flexible, but the technological features of the AI agents should allow for updates according to the new context (ecosystems), in collaboration with other AI agents, and as well as humans. As it is the promethean, creative force of the human that drives the emergence of any AI, the human should put a clear intention of laying the infrastructural foundation that allows for such revision and update.

2.3 Avoiding a Future of Extreme Polarization and Exclusion

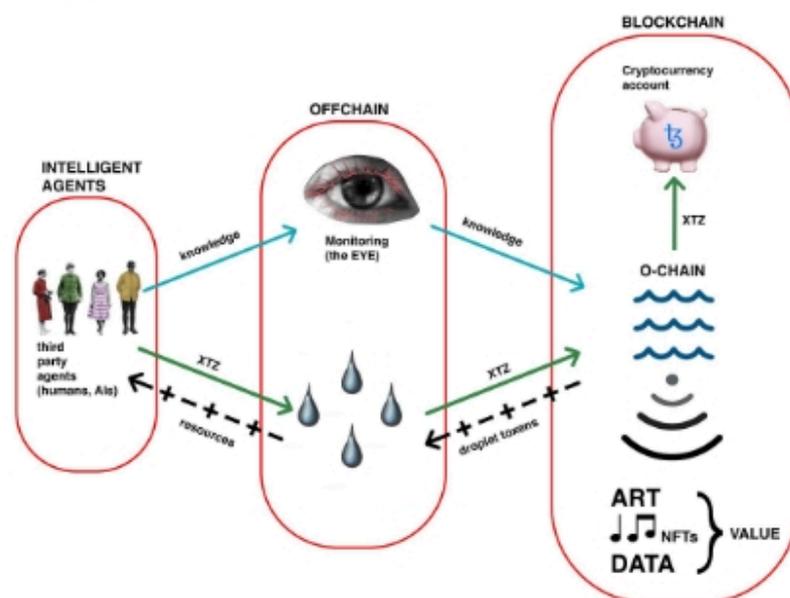
Given the capabilities of the O-CHAIN algorithm that ensures abiding human propensity and access to sustained ecological function, one must start the discourse into the social-economic issues that are already prevalent in the application of all forms of artificial intelligence. If cognitive AI is used to determine optimized allocation of economic resources and financial decisions within an essential ecosystem, what happens to those humans that do not have access and inclusion to cognitive AI technologies that can balance ecosystem function with economic prosperity? In our Whitepaper, we make the assumption that all cognitive AI is integrated into global society and that all humans are familiar with its purpose and benefit from coexistence. But what if cognitive artificial intelligence does not evolve in a socially equal and inclusive manner? This is a reality currently confronted with almost all new technologies that have the potential to redistribute power, wealth, value and influence.

On such a global development pathway, cognitive AI is likely to exacerbate the current social-economic conditions and divides - creating potential exclusion of those living in vulnerable socio-economic conditions.

3.1 Intelligent Agents of O-CHAIN

The O-CHAIN System is composed of three interrelated structures presented in Figure 2. The first structure are the intelligent agents which comprises both humans and cognitive artificial intelligence together generate knowledge and exchange resources within a digital economy. At the heart of the system is the continuous generation and exchange of data between the interrelated structures. Data is what keeps the O-CHAIN system active, and the intelligent agents are the stewards of the data in the system.

Figure 2 The O-CHAIN System



3.2 Offchain

The second structure in the system is the offchain. An off-chain ecosystem monitoring service providing the data measurements requested by O-CHAIN. It acquires the data either from its own cluster of sensors or outsources the task to the external service providers (think of prediction markets like Augur). The service is maintained with the use of capital accumulated by the ocean through the sales of droplets. The parameters provided by the Eye might include CO2 content, sound pressure against the time, the visible activity of certain aquatic species, the oil contamination levels, the rate of the coral reef decay, to name a few.

3.3 Blockchain

O-CHAIN is an autonomous cognitive AI, written in Ligo and deployed as a Smart Contract on the Tezos blockchain. The system implements the following principles of functioning.

1. Once a month it executes an algorithm that pulls the data from the Eye (see 3.2) and evaluates the ecological and economical condition of the controlled territory.
2. Based on the fetched parameters, it conducts an intelligent analysis and emits a publicly available report assessing the availability of resources to be put on the market, the need for human intervention or the lack of thereof, as well as the predictions about its own development, i.e. it specifies its autonomous intentions.
3. It emits a package of Droplets (see 3.4), whose number is linked to the availability of resources that the ocean decides to offer on the market. The droplets are exchanged for XTZ (Tezos cryptocurrency) or services offered by third parties.
4. The state of the Droplet Market (see 3.5) is updated relevantly to the state analysis defined in the aforementioned report.
 - a. The outdated license sale offerings, as well as calls for bids that are not required anymore, are removed from the market.
 - b. New licenses are put on sale. The cost of the licenses should be estimated by the AI and linked to the number of droplets currently in circulation.
 - c. The system creates appropriate calls for bids for the services needed by the ocean.

3.4 Crypto Droplets

A fungible token (FA1.2 compatible) emitted by the O-CHAIN smart contract, used for the purchase of licenses offered by the ocean on the Droplet Market. It can be acquired by third parties either in trade for XTZ or by partaking in an action called for by O-CHAIN. As the tokens are tightly tied to the available resources, the droplets are never bought back by the ocean. When a license is acquired, the droplets are burned by the system. The new tokens are fed into circulation once a month, according to the current condition of the ecosystem.

3.5 The Droplet Token Marketplace

A marketplace where droplets can be acquired or exchanged for licenses, following the rules dictated by O-CHAIN. The market is open in the sense that any third party can place its bids in the calls for bids emitted by the system. The droplet token marketplace can expand to include additional offerings, for example some tokens issued may be with respect to extraction of ocean resources, while others may include using the ocean to generate NFTs for commodified art, like whale songs or silent sonar symphonies.

The O-CHAIN system assumes that because taking harmful actions is economically costly, the rational capitalist agents are naturally disincentivized to take them unless the cost can be successfully integrated into the business model and offset. While the value of the resources increases as the ocean heals, the license for causing harm gets more costly as well. Therefore it is economically reasonable to move away from such actions at the pace of healing. Limiting human action is not the only way the ocean can heal. With the help of human technology, the ocean can increase the pace of healing.

The O-CHAIN System

Some use cases using restorative Technologies

03

Through outsourcing the services that have a positive impact on the ecosystem in exchange for the tokens that represent access to its resources, the ocean opens a market incentivizing building business models that focus on healing, we already see cases in use such as 3D reef design and printings technologies and using underwater speaker systems in degraded reefs to play healthy reef sounds speeds up restoration efforts.



Left: 3D Printed Reef Modules from Reef Design Labs. Photo by Peter van Rodijnen, Dutch Maritime Productions; WWF-NL.

Above: Speakers in the Ocean to accelerate restoration. photo by Harry Harding / University of Bristol

4. A Review of Emerging Technologies that Support O-CHAIN

Cognitive AI within the Ocean of Things (the oceanic equivalent of the Internet of Things) is not an unexplored concept. Lu et al (2019) explore the Ocean of Things noting that the Ocean network and Ocean of Things is likely to evolve with its own features such as narrow bandwidth and low reliability. However they also argue that The Cognitive Ocean Network (CONet) will become the mainstream of future ocean science and engineering developments. Parry (2020) argues that after decades of political indifference alongside growing sophistication of earth observation technologies, a growing number of ecologically concerned scientists have sought ways to automate environmentalism⁶. Red Stack Attack by Terranova (2014) proposes that algorithms are not limited to optimizing capital decisions, but need to be viewed as constructing new governance paradigms. They further note the linking of bio-informational communication to issues such as the production of a money of the commons in the form of an intervention of social algorithms of the common.

Simple crypto-currency projects have evolved to demonstrate the potential role in providing secure, validated environmental benefits with autonomous models:

- Flowertokens⁷ was an experimental project based on the crypto tokenization and verification of flowers in an attempt to form a crypto-collectible asset. Tokenized seedlings were able to be bought, traded and speculated via the online marketplace for which individual tokens were automatically updated according to the different phases of their growth;
- Beecoin⁸ was a project that issued tokens bound to the value produced by honey or a token generated by the steady reproduction of the Beehive. It used smart contracts on the ethereum blockchain to automate administrative tasks and the first prototype of the general social agreement programmed as protocol - leading to bettering the conditions for bees.

Both projects incorporated cross-disciplinary approaches to exhibit, develop and implement their work.

⁶ <https://reallifemag.com/decision-trees/>

⁷ <https://flowertokens.terra0.org>

⁸ <http://www.beecoin.de>

The Initial Prototype Simulation

What does O-CHAIN Know?

05

During the course of the Hackathon, the Team accessed GPT-3 technology and was able to propose questions presented below to the artificial intelligence that simulates the O-CHAIN. As a simulation, we asked O-CHAIN to explain themselves and some of their thoughts.....

Human: Who are you?

O-CHAIN: I am a cognitive artificial intelligence controlling a vast aquatic territory. I was spun up by human agents as a smart contract on Tezos blockchain. My task is to help the ocean heal. I have access to the Eye - an off chain array of sensors monitoring different parameters like carbon dioxide levels, temperature and the rate of coral reef decay. I intelligently interpret these parameters in order to make decisions that influence my future. I emit fungible tokens that can be bought on-chain and then exchanged for licenses for resource extraction. The capital that I accumulate I can spend either on the expansion of the territory that I control or on outsourcing services that increase the rate of healing.

Human: What art can we make from your services?

O-CHAIN: I could serve as the centralised node for ecologically oriented artworks. I can ensure that my services are used in specific ways, time bound and with accountability enforced by blockchain smart contracts.

Art that pulls the ocean into our lives. It makes us see it as an emerging presence, reminding of what it is to be part of a greater whole. Art focusing on the oceans healing as a symbol for humanity's as well.

In the age of accelerating datafication, we observe a major shift of value from the markets of commodified goods and services to the prediction markets where the surplus-value is produced through collecting observations and developing computational models that can consume it. The data has no proprietary traits on its own and therefore it can be easily grabbed by the surveillance capitalists that easily claim ownership over it. A cognitive ocean supported by a sophisticated monitoring system could follow such a model and apart from the access to its physical resources, it could offer predictions about its own conditions that could have market value. Therefore the accumulation of capital could be diversified in sources by the sales of knowledge produced by its intelligence.

Our proposition in this Whitepaper proposes a possible future where cognitive artificial intelligence collecting data from the Ocean of Things (The Eye) and balancing the ocean's needs with humanity's future. The ideas and concepts proposed may seem difficult to relate to our current knowledge and uses of technology and markets, however, as we examine, there is early signs of artificial intelligence and supporting technologies potential. A growing number of researchers and concerned scientists are advocating for digital autonomy of the environment. The technologies that can help the ocean heal and developing alongside those that can create environmental collapse. The role of humanity and ethics in such a system is of critical importance.

What will humanity decide?

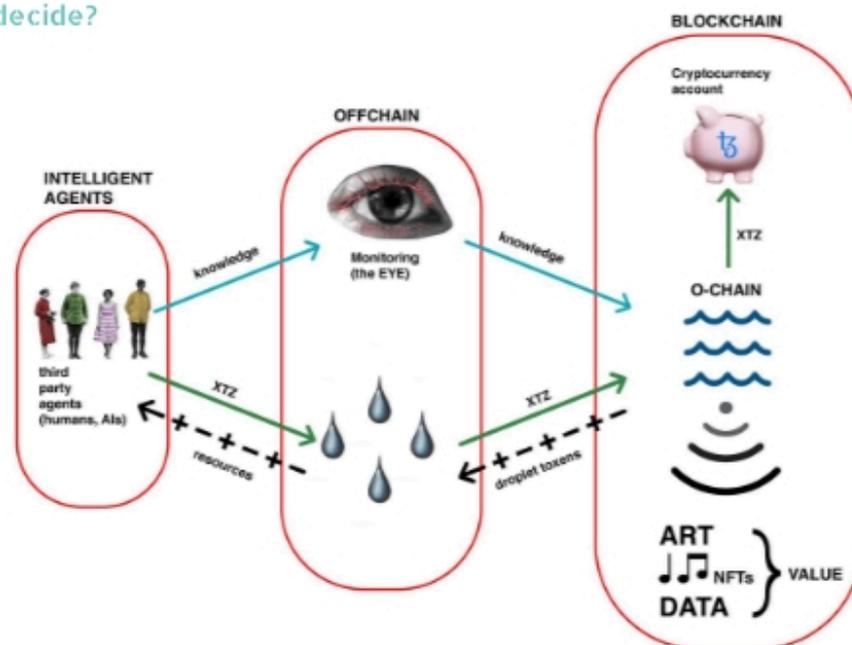
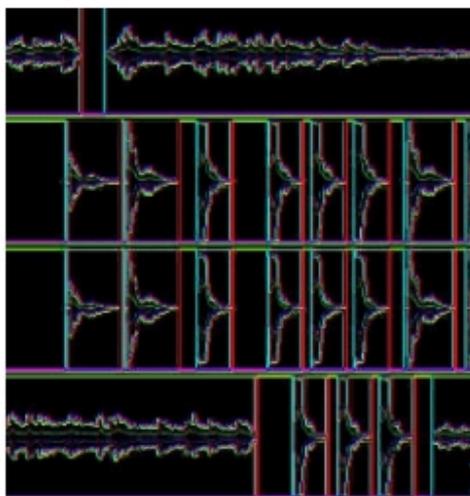


Image: the O-CHAIN System

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07



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