terra0

Can an augmented forest own and utilise itself?

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terra0 is a self-owned forest; an ongoing art project that strives to set up a prototype of a self-utilizating piece of land. terra0 creates a scenario whereby a forest is able to sell licences to log trees through automated processes, smart contracts and Blockchain technology. In doing so, this forest accumulates capital. A shift from valorization through third parties to a self-utilization makes it possible for the forest to procure its real exchange value, and eventually buy (thus own) itself. The augmented forest, as owner of itself, is in the position to buy more ground and therefore to expand.

terra0 is a project originally developed in the Digitale Klasse at the University of Arts, Berlin by Paul Seidler an Paul Kolling. This concept paper is written by Paul Seidler, Paul Kolling and Max Hampshire.

I. Preface

The relationship between art and money can be understood in different ways. On the one hand, art exists in the form of artworks which are traded on the market. The fictive value of these works is determined by the economic rules of the market. However, pieces of art can also intervene in economic and social processes. They can be seen as economic units created by an artist, which can interfere actively in existing economic systems.[1]

For his project 'Insertions Into IdeologicalCircuits 2' (1970) Cildo Meireles put a stamp on a one dollar note, removing it from circulation, thus granting the viewer time to reflect upon the currency. Maria Eichhorn (2002) founded a stock corporation within the scope of Dokumenta11, which held a special status: its capital could not be increased. The shares were only able to be transferred to the corporation itself, and were therefore taken out of monetary circulation. This stipulation, or 'special status', stood in diametrical contrast to the social structure of other stock corporations, which were primarily profit-oriented.

Wolfgang Müller's 'Knochengeld' could be acquired only in a gallery in exchange for money. The currency was accepted at local theatres, galleries and bars as a payment. Furthermore, Müller's 'Knochengeld' decreased in value every seven days. Caleb Larsen's 'A Tool To Deceive and Slaughter' (2009) consisted of a computer, which as soon as an internet connection is established, offered itself for sale on eBay. As long as the work was embedded in its predetermined technical environment, (a gallery with internet access) it operated autonomously, questioning the legitimacy of traditional ownership structures existing between art and economic processes.[2]

By increasing automation and self-optimisation via implementing a feedback system (allowing for constant state evaluations), most infrastructural systems could certainly function autonomously. Indeed, Mike Hearn, a former Google employee and one of the leading Bitcoin software developers, has suggested that cars could own themselves:

“We can program it to make a little bit of profit, so it’s got some money for a rainy day, but not excessive amounts. We can make it the most moral, socially minded capitalist possible. (...) You would be using an app that goes onto Tradenet and says: ‘Here I am, this is where I want to go, give me your best offers,’. (...) The autonomous taxis out there would then submit their best prices, and that might be based on how far away they are, how much fuel they have, the quality of their programming. (...) Eventually you pick one - or your phone does it for you - and it’s not just by the cheapest price, but whether the car has a good track record of actually completing rides successfully and how nice a vehicle it is.” [3]

In Hearn's scenario, self-owning cars do not operate intelligently, but act in accordance with hard-wired basic rules which favour their own economic interests. Below follows the outlining of a prototype for an autonomously acting, self-sufficient economic unit, in light of the examples highlighted above.

II. terra0

From an economic perspective, an object cannot be separated from its purpose or function. Thus the means of existence of every object is based on its usability by third parties. terra0 examines a scenario whereby objects appropriate and apply utilisation mechanisms to themselves, with the help of new technologies.

A forest has an exactly computable productive force; the market value of the overall output of the forest can be precisely calculated. Beside its function as a source of raw material, the forest also holds the role of service contractor. It produces not only wood, but serves as a protected space within which diverse species can survive, contributing to an overall ecological balance. Furthermore, it offers space for relaxation. The terra0 project creates a scenario whereby the forest, augmented through automated processes, utilitises itself and thereby accumulates capital. A shift from valorization through third parties to a self-utilization makes it possible for the forest to procure its real exchange value, and eventually buy itself. The augmented forest is not only owner of itself, but is thus in the position to buy more ground and therefore to expand.

In the first phase of the project, a piece of ground is bought by the project initiators, and a smart contract is drawn up. The smart contract contains all contractual definitions from terra0 and passes of two parties: the human actors as a project initiators, and a representation of the forest as a so-called non-human actor (or 'NHA'). The bought ground is signed over to the NHA in exchange for debentures (later referred as terra0 tokens), which represent a stake of the project and the smart contract. At this stage, the forest owns itself, yet is indebted to its shareholders (the project initiators).

An economic model implemented in the smart contract controls the exploitation of the forest. The NHA sells licences to log certain trees. If a certain sum of money has been earned via selling these licenses, the NHA starts to repay its debts to the project initiators by buying its terra0 tokens back. Once repayment is complete, the original owners (the project initiators) hold no more tokens, thus the forest is the sole shareholder of its own economic unit. The forest, in economic terms, controls itself.

By appropriation of capitalist and cultural mechanisms, a piece of ground thus plays an active role in society, whilst at the same time avoiding direct influence by third parties, via removing the possibilities of economic interaction by them. terra0 can be seen thus as a prototype of an economic unit in a post-human future.

IV. THEORY

A. Ownership & Personhood

'Property' describes the most comprehensive form of possession of a 'thing' or (im)material good, due to its operating at the legislative level. Features of modern forms of the property are the legal assignment of (im)material goods to a legal entity, the recognition of the arbitrary rights of the owner, and the demarkation of the limits of owner discretion. One also therefore talks about property as a 'bundle of rights' which symbolises the economic-, and power-relations, as well as the behaviour between persons. Property thus operates in the legal, economic, and social spheres simultaneously.

At this point it is evident that property always defines itself through the allocation of an (im)material good to a 'real' individual, or agent. In light of this project, the concept of a natural person is discussed, before being deconstructed. Thus, what constitutes the 'reality' of the individual to whom property is allocated to is also deconstructed.

In the classical sense, a natural person, or agent, is a person insofar as they are a legal subject, hence the bearer of rights and duties. The right to property stems from these rights and duties. Following their birth, a person is granted some legal capacity, even if this capacity is limited by - to use a common example - their age. This capacity is lost at the moment of death. The conception of the natural- and juridical-person is debated actively.

Blockchain technology and smart contracts enable non-human actors to administer capital and therefore to claim the right to property for the first time. Property is discussed now as something which is not separable from a natural or legal entity. terra0 begins in this legal grey area, originating in the technological change brought about with the invention of blockchain technology and smart contracts. Since an individual's property is protected in accordance with their rights, one would assume that objects which have gained the right to property are entitled to similar personal rights as natural persons.

The Whanganui, for example, is a landmark which is legally handled quite like a person, or agent. It is the third-biggest river in New Zealand, to which a court granted rights usually reserved for persons, after an indigenous community won a lawsuit demanding personhood status for the river.

In 2008 Ecuador added the 'Rights of Nature' article to its constitution, granting the ecosystem the sort of legal rights usually reserved for natural persons. The legal article outlines the protected status of nature's rights to exist and maintain itself:

„Art. 72. Nature has the right to restoration. This integral restoration is independent of the obligation on natural and juridical persons or the State to indemnify the people and the collectives that depend on the natural systems. In the cases of severe or permanent environmental impact, including the ones caused by the exploitation on non renewable natural resources, the State will establish the most efficient mechanisms for the restoration, and will adopt the adequate measures to eliminate or mitigate the harmful environmental consequences.“[4]

B. Nature & Culture

The diametric opposition between nature and culture is inherent in the concept defining culture.

Everything that humans themselves affect and produce is defined as an aspect of culture (from the Latin 'cultura': treatment, or care), whilst nature is defined as everything else, i.e. that which is by itself, simply 'as it is'. However, the natural can only be described via cultural technologies, like art and science. The concept of 'nature' thus takes, as a demarcation, a function in the cultural apparatus and cannot be separated therefore from it. Nature is influenced directly and indirectly by society, and is defeated therefore by its logic of utilisation. Vilém Flusser describes this contradiction in his book 'Dinge und Undinge' (1993), via analysis of the function of a garden.

"Anders also als historisch muß der Garten heute angesehen werden: nämlich als der bewußt verlogene Versuch, einen sehr weitgehend von der Kultur bedingten und durch die Kultur verdingten Menschen von dieser Kultur zu befreien und ihn in die Natur zurückzuführen. (...) Ein Trachten, das allerdings von vornherein als vereitelt angesehen werden muss, weil es ja im Wesen der Natur liegt "gegeben" zu sein, also nicht konventionell als solche kodifiziert werden zu können. So dass wir, wenn wir im Garten lustwandeln, in Wirklichkeit uns nicht etwas tun der Natur ergehen, sondern in einer "Natur" betitelten Abteilung des Kulturapparats funktionieren. Mit anderen Worten: eine Funktion innerhalb des Kulturapparats erfüllen, welche vorgibt eine Antifunktion zu sein, aber in Wirklichkeit in Synchronisation mit anderen Funktionen die Struktur unseres Lebens als Funktionäre, die wir sind, ausmacht."[5]

We find this "nature entitled department of the cultural apparatus" (""Natur" betitelten Abteilung des Kulturapparats") everywhere once we try to break out of the domain of culture. This leads to, for example, a simple walk in the country becoming an 'excursion to nature', in order to escape from the domain of culture.

In a society whose existential basis relies on a capitalist logic of utilisation, there is no good case to believe that nature (as something is which originally given, and therefore depriving itself from any utilisation) still exists. If culture is understood as the counterpart to nature, by which one recognises nature's 'otherness', then nature must be conceptualised not as being spatially separated from humans, as the person opposite oneself is, but instead as immanent within culture.

C. Agents & Smart Contracts

In July 2011 the user julz opened a thread on bitcointalk.org called 'Bitcoin the enabler - Truly Autonomous Software Agents roaming the net' in which he proposed an autonomous agent:

"For the first time, there exists the possibility for a software agent to roam the internet with it's own wallet.
Using Bitcoin - It could purchase the resources it needs to survive (hosting/cpu/memory) and sell services to other agents or to humans. To be truly effective and survive 'out there on the net' long term, you'd probably need some basic AI and the ability to move itself between service providers occasionally - but even a relatively dumb agent might survive for a while.

What initial goals such agents might be given is anyone's guess. Funnelling back to the programmer any profit over and above what the agent needs to survive would be the obvious case, and of course many such agents might be considered 'nefarious' depending on how they're programmed to achieve that goal. Other agents might be designed to provide free services or act in a way to support some piece of internet infrastructure.“[6]

In the same thread Gregory Maxwell introduced a file storage system called StorJ as an illustrative example:

"Want to share a file? send at least enough coin to pay for 24 hours of hosting and one download then send the file. Every day of storage and every byte transferred counts against the balance and when the balance becomes negative no downloads are allowed. If it stays negative too long the file is deleted. Anyone can pay to keep a file online. StorJ is not able to find new hosting environments on its own, due to a lack of sufficiently powerful AI— but it can purchase the knowledge from humans: When an instance of StorJ is ready to reproduce it can announce a request for proposal: Who will make the best offer for a script that tells it how to load itself onto a new hosting environment and tells it all the things it needs to know how to survive on its own there? Each offer is a proposed investment: The offerer puts up the complete cost of spawning a new instance and then some: StorJ isn't smart enough to judge bad proposals on its own— instead it forms agreements that make it unprofitable to cheat. By accumulating mutations over time, and through limited automatic adaptability StorJ could evolve and improve, without any true ability for an instance to directly improve itself. Through this these activities an instance can be maintained for an indefinite period without any controlling human intervention. When StorJ interacts with people it does so as a peer, not as a tool."[7]

Although some of the technical specifications could be done differently now, this post outlined a solid set of criteria for defining an autonomous decentralized agent.

I. The agent earns enough money to maintain itself, without human intervention (e.g. the agent pays for its own server space).
II. The agent has an adaptive feedback system.
III. The agent can replicate itself.
IV. When interacting with humans the agent does so as a peer, not as a tool.

While there are no specific implemented examples of autonomous agents yet (besides perhaps computer viruses), Vitalik Buterin (2013) developed this concept within 'Bootstrapping A Decentralized Autonomous Corporation: Part I'. Buterin attempted therein to develop a conceptual framework for an autonomous corporation:

"However, here a very interesting question arises: do we really need the people?… The question is, can we approach the problem from the other direction: even if we still need human beings to perform certain specialised tasks, can we remove the management from the equation instead?“[8]

Buterin (2014) further tried to build a reference system in order to properly categorise different organizational models within 'DAOs, DACs, DAs and More: An Incomplete Terminology Guide'. autonomous agents appeared again, yet in a more intelligent form, closer to fully developed artificial intelligences:

"Autonomous agents are on the other side of the automation spectrum; in an autonomous agent, there is no necessary specific human involvement at all; that is to say, while some degree of human effort might be necessary to build the hardware that the agent runs on, there is no need for any humans to exist that are aware of the agent's existence. (…) A full autonomous agent, or a full artificial intelligence, is the dream of science fiction; such an entity would be able to adjust to arbitrary changes in circumstances, and even expand to manufacture the hardware needed for its own sustainability in theory. Between that, and single purpose agents like computer viruses, is a large range of possibilities, on a scale which can alternatively be described as intelligence or versatility“[9]

Buterin described different levels of complexity, ranging from single purpose agents (computer viruses) to AI-like agents using evolutionary algorithms to discover and enter new industries. These points can thus be added to the previously outlined criteria for defining an autonomous decentralized agent:

I. The agent behaves much like a simple biological organism.
II. The agent can react and adapt to its environment (and furthermore, gather and process information about this environment).
III. The agent evolves through evolutionary algorithms and can thus discover new survival strategies.

V. Implementation

A. Technical

It is possible to realise the project in different ways, best understood as realisations on different levels of complexity. For the purposes of this paper, discussion of potential, yet 'temporary' problems (such as the unavailability of payment via the Etherum service) will be ignored. Furthermore, the following discussion is based mainly on readily available technology.

Lowest level of complexity:
A smart contract on the Etherum Blockchain controls the in- and outputs of the forest. Every six months a programme fetches satellite pictures of the property from a supplier outside of the Blockchain. With the help of self-written image-analysis software, the programme can determine how much wood can be sold without overly-diminishing the tree population. The smart contract has hardly any feedback to rely on, and acts according to contractually invariable rules. A rudimentary function makes it possible for the system to buy additional properties and thus to expand. In this case the programme must be adjusted manually from outside the Blockchain by the project initiators.

This level of complexity realises a project which only fulfils three of the seven criteria for creation of an autonomous and decentralised agent:

I. The agent is earns enough money to maintain itself, without human intervention (e.g. the agent pays for its own sever space).
II. The agent has an adaptive feedback system.
III. When interacting with humans the agent does so as a peer, not as a tool.

Middle level of complexity:
The smart contract carries out all calculations itself and is no longer dependent on programmes outside of the Blockchain. Furthermore, the contract can scrape databases in order to dynamically regulate its prices. Because any infrastructure outside of the Blockchain is now unnecessary, the system is simple to reproduce. The contract can optimise itself from cycle to cycle. The contract thus recognises which trees are most profitable, and therefore only sell, or grow, specific types of trees in order to maximise profit. Two further criteria are fulfilled via a realisation of the project on this level of complexity:

I. The agent behaves much like a simple biological organism.

II. The agent can react and adapt to its environment (and furthermore, gather and process information about this environment).

Highest level of complexity:
The smart contract is no longer distinguishable from a completely developed artificial intelligence. Scraping data from forest databases allows the forest to radically optimise itself through logging decisions. Due to this, the wood is now sold at highest possible price. It should be noted that, although these databases are controlled by a wise variety of public, private, and governmental organisations, the political implications of the source of the scraped data is of no immediate concern to the project. After the contract accumulates a certain amount of money, it is able to set up independent versions of itself. These operate in accordance with different parameters, and let the contract optimise. Every new version of the contract thus acts more competitively, in order to optimise its economic value, and can adapt itself dynamically to different zones (according to climate and local vegetation). The last of the proposed criteria are thus fulfilled:

I. The agent can replicate itself.
II. The agent evolves through evolutionary algorithms and can thus discover new survival strategies.

B. *Overview*

The following outlines a realisation of the project on the lowest possible level of complexity. Thus, only a minimal implementation of the project will be outlined. The project is divided, both technically and in terms of content, into two phases: a crowdsale-phase, and a run-phase.

In the first (crowdsale) phase, two smarts contracts are created:
The first contract regulates the crowdsale. If the contract receives ether, it returns terra0 tokens to the sender. These tokens can be viewed as a form of debenture, which can be sold back to the second contract at a later date. The crowdsale-phase ends after the pre-agreed time interval stated in the contract. The accumulated capital is then made available to the project initiators.

The second (run) phase then begins. This phase consists of the second smart contract, a forest analysis programme hosted on a server, an Oracle, and the Etherum clock beginning the active phase of the project.
Over agreed time intervals the forest analysis programme accesses the API of a supplier for satellite images of the forest owned by the NHA. The programme selects the satellite view of the forest via its GPS coordinates, before determining the number, state, and age of the trees located on the NHA's property using OpenCV. This data is shown as a publicly accessible JSON File. The Oracle accesses the website once every six months, and reflects the data as a smart contract in the Etherum Blockchain. Periodically, the Etherum clock activates the smart contract which accesses the Oracle's data. It calculates how many Woodtokens can be sold in accordance with the given parameters, such as tree age, and density, in order for the tree population to stay constant, or in accordance with the permitted growth rate. Woodtokens represent those cubic metres of wood which can be sold. This sale is calculated in accordance with pre-determined economic and ecologic parameters. If the contracts accumulates enough Ether, terra0 token holders can sell their tokens to the contract, in return for Ether.

C. *Smart Contract*

The aim of this chapter is not be a general introduction to smart contracts. For such an introduction, Nick Szabo's 'The Idea of Smart Contracts' is recommended, as are the Etherum Community resources available online. This chapter discusses a tangible, technical realisation of financial transactions made via smart contracts.

Within the first contract, the profit aims and parameters, the funding goal, the period of the crowdsale, and the price of the terra0 tokens are laid out. If Ether is transferred to the contract, it automatically returns the appropriate amount of terra0 tokens. The crowdsale phase ends after the defined time period, providing the necessary capital for the project initiators to set up the project. The contract therefore uses tokens and the transfer function of the second contract. The first contract is very similar to the standardised crowdsale contract published in the below referenced Ethereum documentation.[10]

The second contract administers the in- and outputs of the forest, and further serves as its real 'owner'. It functions as an automated trade centre for tokens. The contract defines two different tokens:

terra0 token
terra0 token function as a debenture. The token can be acquired only during the crowdsale phase and represents a share of the property of the smart contract. The terra0 token can be sold to the contract by its owner for Ether.

Woodtoken
The Woodtoken is created by the initialisation of the contracts, and remains as a stock with the contract, and is acquired from the contract in exchange for Ether.
The Woodtoken can be seen an agreed amount of wood that can be harvested in the process of self-aquisation (Selbstwerberverfahren). The amount for sale, as well as the price of the tokens, are recalculated twice annually.

Furthermore, the contract calculates the specific trees which can be felled, and from this, the total amount of available wood. This function is executed via accessing the Oracle, which transmits topical data such as growth rate, age, number, and type of the trees to the smart contract. This function is executed every six months by the Etherum clock. A more detailed explanation of the functionality of the Oracle and the clock follow in 5.1.3, as does an explanation of the data analysis procedure on the acquired satellite pictures. The function fixes the amount of Woodtokens to be sold; the contract thus contains a simple feedback system.

D. *Oracle & Etherum Clock*

Etherum smart contracts can access data in the Etherum Blockchain. However, our contract requires data which is currently unable to be provided on the Blockchain. Suppliers like Oraclize offer so-called Oracles which function as an interface between the Blockchain and the rest of the internet. Oracles can mirror datasets published by web interfaces into the Blockchain.

The picture analysis happens outside of the Blockchain, however this function may change in a concrete realisation of the project. At the current scope of the project, we see no possibility to implement OpenCV into a smart contract.

The Oracle functions as an interface between our smart contract and our visual analysis programme which is hosted externally.

E. *Financial*

In his (1987) book 'Der Wert eines Vogels', Frederic Vester calculated the exchange value of a bluethroat (Luscinia svecica). Assessing diverse aspects of the dead bluethroat, from the value of raw materials such as bones, flesh and feathers, to his personal role as a pest controller, as well as a source of delight for the human soul, Vester calculated the total monetary value of the bird to be 301,38 DM (approx. €154).

The same quantifications of the (im)material which Vester had shown via the bluethroat are used in modern society in all areas. The behaviour of an economic unit is no longer based on the intuitive decisions of an individual, but is rather a direct consequence of an numerical, algorithmic, computational analysis.

The automated processes which control transactions - such as those at work on the global stock exchange - could therefore govern entire enterprises via such analyses.

There are countless ways to capitalise on a forest. The forest can serve as a recreational site, as a source of value for a neighbouring town, or habitat for animals and threatened plants. terra0, however, limits itself (for the sake of convenience) to the sale of wood by the 'Selbstwerberverfahren', whereby felling licences are sold to trading partners (both industrial partners and private individuals). The buyer of the wood is responsible for both the felling, and subsequent removal of, the tree(s) they purchase.

The overall value of a forest grows with its age. However, trees that are too old no longer contribute to this potential profitability, on the basis of their susceptibility to illness. The proportion of the trees that are allowed to be cleared is adjusted so that a certain rate of growth, or constant tree population is guaranteed. Old, unprofitable trees are felled in order for the forest to remain healthy, as well as allow for younger trees to grow. Thus a situation arises whereby the production rate of the wood remains as high as possible, without decreasing the forest population.

The exact model depends on both the specific vegetation itself (for example, the species of trees present within the forest), as well as the age of the trees. Therefore a specific revenue model can only be created once a piece of forest has been purchased, and analysed according to the economic parameters discussed above. An simplified example of a potential model calculating the yield and self-utilization of the forest stands as such:

A medium-old spruce forest costs roughly €1 per square meter. One hectare produces as much as 10 solid cubic metres of wood annually. Selling the wood at €30 per solid cubic metre produces an annual income of €300. Thus a forest bought for €10.000 can be paid off after approximately 33 years via wood production alone. It must be noted that the increasing age (and therefore the increasing monetary value) of the forest is not taken into account in this simplified example.

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