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WHITEPAPER **0.3**

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David Conde Sayáns

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1 Abstract

Our healthcare models are based on paradigms that is not longer true. The social security was created after the second world war where the population was almost ⅓ of what it is now. The age and increase number of patients with chronic disease burden are putting extremely heavy constraints on the healthcare system. We have a huge challenge ahead: to provide universal and quality healthcare to an increasing amount of patients, with infrastructure, personnel and budget limitations.

In the last 5 years we have worked for several health and insurance organizations (SERGAS, Ginemed, Medipremium, AXA…) trying to help them in their digitalization processes with a bittersweet outcome. We have created great projects, some of them are/used by millions of users, but we see that the main problems are not being solved: the digital health products tend to raise the medical bill, there isn't enough adoption and, most importantly, they mainly serve as commodities for rich countries, with the exception of India. On the other hand most of the developing countries around the globe are struggling just to create basic health care systems.

With Hearthy, we want to create a decentralized, open and sustainable ecosystem to improve health care access to everyone, regardless of income, making health care efficient, agnostic to jurisdiction and user-centered.

Our ecosystem will consist of:
- A Protocol: an PHR that relies on distributed ledger patient can use and own.
- A coin: The 💚 (HTY), that will fuel the ecosystem.
- A suite of open source tools and applications to boost the traction of the protocol and create the first services.

2 Background

Healthcare delivery background

In developed countries population is aging fast, in some parts of Europe and Japan the average age is above 44 years, with over 33% of the population being more than 60 years old. The actual social security models are more and more expensive every year, as more people are getting older and the number of tax payers who maintain them is decreasing. There are considerable efforts being made in order to maintain the model, as the political price to pay for dismantling these services is huge, the situation is unsustainable in the mid-term. A new approach to health care is a must.

Looking at the USA the situation is even worse, about 10% of population is uninsured even after the huge effort made by the Obama administration to amplify health care. The model is sustainable in the time, health companies have great profits, but it

Being the richest nation in the world, the USA is not able to deliver universal health care to its citizens.

The developing countries are in the worst situation as their population is getting older and their health care systems are still in the process of being developed. Some of these countries had made huge efforts to expand their health care programs (like Seguro Popular in Mexico, where 55 million previously uninsured people were provided with insurance in the process lasting 15 years) but there aren't enough resources to reach the level of their more developed counterparts. The necessity of a new approach to health care is again prominent here.

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3 The product, a blockchain based PHR

Diverse standards have been deployed in the market, being HL7 the standard for PHR messaging and formatting almost every health system has developed different versions of the protocol. However, the interoperability between systems is still a big issue.

The Spanish Case

The Spanish case is paradigmatic as Spain has one of the most effective, advanced and well designed health systems in the World (with an expenditure of $2,658 per inhabitant, universal health care and a life expectancy of 83.08 years). For more than a decade the health systems in Spain have been developed regionally, even when having a central organization, in order to accord all the health development. However, not all the regions of Spain are interoperable. So, for example, a patient who moves from one region to another has no guarantee that is PHR is even readable. Why do we have to accept this ?

Our protocol basically intends to create a transactional layer bound to healthcare that fixes the most common cases which nowadays limit the health care access allowing frictionless transactions. Hearthy proposes creating an open source PHR almost from scratch based on open stand, generating enough traction so that public and private organisms could add-up to it, the same way as browsers, providers and developers did with TCP/IP.

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3 The product, a blockchain based PHR
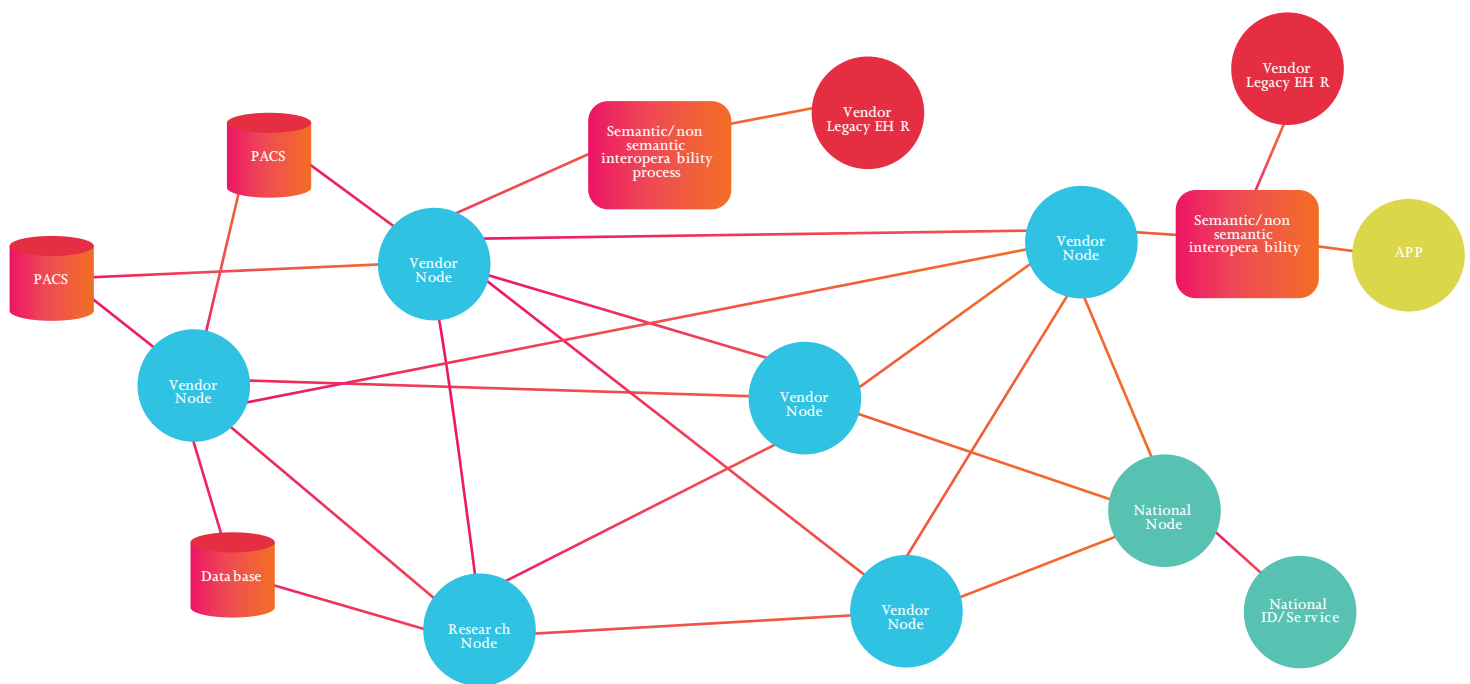
What problems we solve with **Hearthy?**

1)Economic Access to health care

Reducing intermediation costs and the medical time in each visit and having an access to a more consistent PHR could provide a more economic access to health care.

Also by 2020, 40% of HDOs(Health deliver organizations) will find that their EHRs are incapable of fully meeting their digital business needs(1), the creation of an open source ecosystem will make it easier for an underdeveloped health system to join our project.

All our project is open source, and all the developments made under its umbrella will be, so onboarding by health systems will be easy.Installing actual PHR is quite expensive, some of the rising economies don't have enough resources to implement proprietary technologies which leads them to buy or create low-level non-interoperable systems.

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3 The product, a blockchain based PHR

What problems we solve with **Hearthy?**

2) Empowering patients

By own and control their clinical records and by having medical services agnostic of their jurisdiction we can empower patients, boosting self-aware and self-care, automated agents (as described later) can be a huge plus here. A Recent study (2) show that automated agents linked can have great clinical outcomes.

Other study (3) also suggest that allowing patients to record their symptoms on web based interface generate better survival rates on certain types of cancer, generating more survival rate than actual medication.

3) Ownership of data and user centric KYC

We give the owner of the data total control over his or her information. The owners can control who gets access to their data, the reason for it and what kind of data they want to obtain. Sharing data with providers and researchers can generate benefits for the users, in form of tokens or cash back in premiums. We will create a system which, by design, ensures the users that the clinical data cannot be used against them. In order to do that, we will provide a dashboard of control that not only will allow the user to control who has access to the data but why. Furthermore, we will increase health literacy among our users hence providing the right tools for them to make informed decisions about the data they share.

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3 The product, a blockchain based PHR

What problems we solve with **Hearthy?**

4)Proof of identity

We manage the third problem when it comes to PHRs. There are 1,500 million unidentified people in the World. How can we grant them the right to health care if they cannot prove their identity? With biometric and signature based protection we can create a unique ID for every user, without depending on any jurisdiction or health service, all the rest of identification will be constructed on an additional layer, or combined with other services, such as CIVIC.

Also our PHR can be exported, printed or shared just by the user. The data belong to the patient, not to an institution, a State or even us

5) Open research

Accessing health data can be tough for researchers, but it can be improved by creating an aggregated anonymized repository of medical data which can give researchers and developers tools to create predictive models, population health apps... Our repository will be open to everyone, and every individual can give access to their anonymized data if they want, just by telling the user why they want the data and who they are. Users can also be rewarded for sharing their medical data.

More economic medical app development

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4 Hearthy DB

As well as an PHR is feasible to storage on a distributed ledger files associated to an EHR (DICOM images, PDFs, reports) are almost impossible to store on a blockchain, these files can be indexed on it but Hearthy is the need of a storage system that ensure consistency, availability and partition tolerance.

We propose to provide a database with the following properties:

Database is public, each user is identified by its ID, users, professional, providers have different ID types (follow FHIR V3 implementation).

When a user makes a transaction on the db it's encrypted with his private key and signed, by the user and the medical professional and organization.

Each new records imprints the ownership of the data, when a medical professional generates a transaction (ex: uploading a DICOM image) it's signed by the professional, encrypted and owned by the user.

Just the user and the professional can decrypt that file.

Anybody can set up a Hearthy DB node, a node must have some minimum specifications. Hearthy welcomes professional and nonprofessional hosts incentivizing retrieving data and storage.

Every organization working inside the protocol can also setup its own nodes and receive incentives to do so, also any organization can let any users or certain users to storage its data.

5 EHR Architecture

The data storage will be done with an Open Source standard. We will be following the trends that big new players in this field are adopting. For example, Apple has chosen the HL7 C-CDA over FHIR. Why ? Because almost every EHR can do some CDA, almost no EHRs can do FHIR. Many open source projects have emerged since then like this one or this other one. Furthermore Apple brought HL7 CCD (a subset of C-CDA) health records to HealthKit in iOS 10.

The idea behind this is to use as leverage the work done by other players big players. This will let us focus our resources on the security layer and the user experience instead of re-inventing a new protocol on our side.

Furthermore, we will explore some ontology standards like SNOMED-CT since it increases interoperability as they provide a shared understanding of concepts used in clinical documents. This is not an easy task, this paper tries to close the gap between HL7 and SNOMED-CT.

However, it's extremely important that we try also to close this gap in order to accelerate the automatic processing of health data. Why ? Because the next step behind interoperability is the capacity to analyse the transmitted data in order to increase efficiency of the entire health system.

We don't have all the answers about the path to follow, but we know that this work has to be done in order to succeed in our endeavor of bringing cost-effective healthcare all over the world.
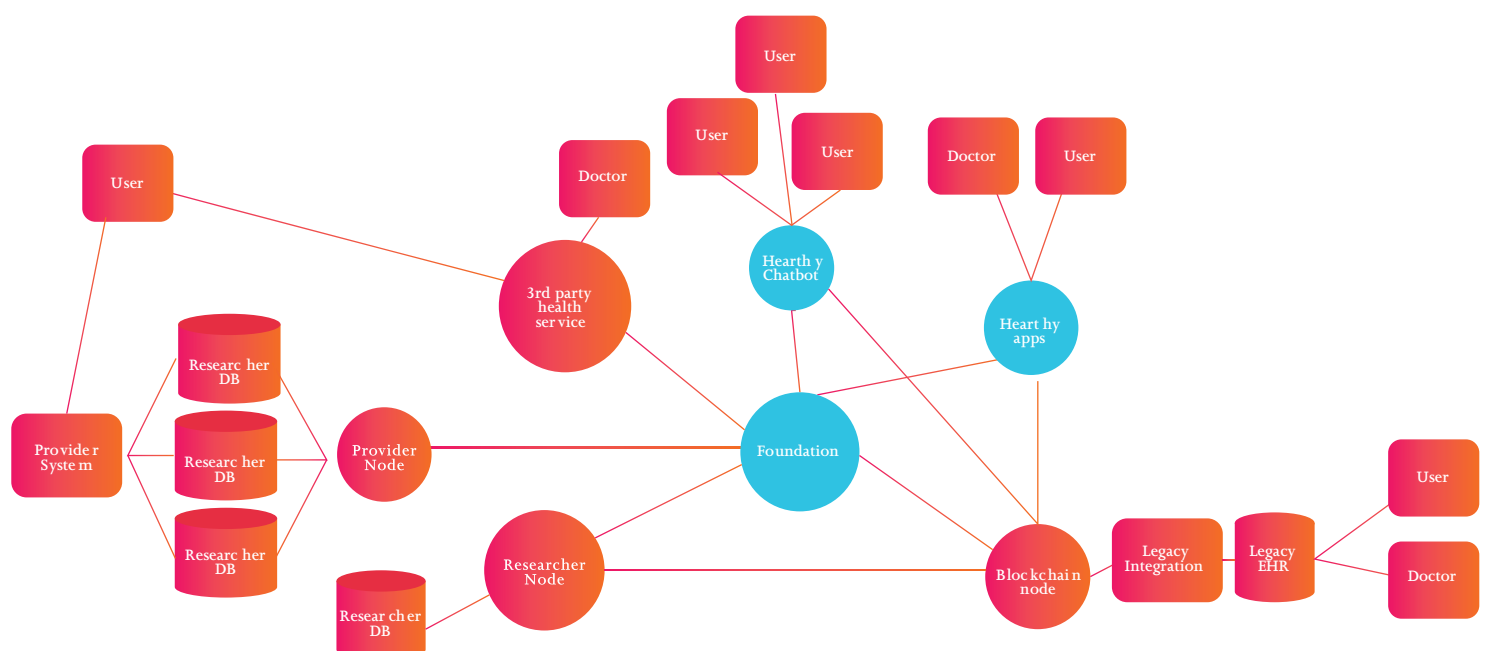
6 Distributed ledger topography

Our distributed ledger will have some typical actors, as described below:

The foundation

Amends and updates are the core of the system, so the owner of the tokens can use it to amend it. Any node and token holder will be able to propose an upgrade, with an inherent price. If the majority of the token holders finds it useful they can send some tokens to the proposer so that he could complete the upgrade with enough resources. The foundation's board itself will also propose and develop upgrades.

The Foundation board will have veto rights at least for the first 3 years after launch. After these first initial years the foundation is intended to become a full DAO, but further advances in the design of DAOs have to take place before taking this step.

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6 Distributed ledger topography

The provider

The provider is a hospital, a health care system, an insurance company… every provider buys enough tokens to maintain a node (paying fees to the foundation for each transaction on the blockchain). By creating a node the provider can ask any user for access. If the user consents to it, the provider can access some of his/her data in order to create a certain service, the provider can also send some tokens to the user to be able to access some data, or to reach them with an offer. The provider can read/write data on the user's PHR if the user agrees.

As we plan to start working with regions with uninsured/underinsured population we may be a great connect point between providers and new health care users, that will have an PHR when the provider arrive.

The user

The most important thing in this project is the user. Our users have various types of registrations, by default our registration process is done only by biometric identification, we just need a selfie and a signature. That system creates a unique user ID, that ID is recorded on the blockchain, selfie and signature are stored on the device, all the information that circulates on the internet is anonymized.

Once a user is registered a small amount of tokens are sent as a reward, just to allow the user to create some transactions.

A user always uses an app/dapp, Hearthy Co. will develop the first apps, but the environment is as open as possible, so any organization can create his own apps/dapps. When a user uses any app more services will be available. All these services must be paid with tokens, and the user has to buy or obtain them in some way. Providers can also send tokens to certain users in order to allow them to receive medical services (by example, some insurance companies may offer some services inside the platform by buying and sending to their policy holders some quantity of tokens each month).

6 Distributed ledger topography

The user

The health information is stored in HIPPA compliant storage systems or servers compliant with health related storage information. Each time that some information is accessed (writen / read), the access information is stored in the blockchain. The access in read, needs to be granted by the user. The granted access is a contract between the user and the person or institution that wants to have access to that data.

A user will not have karma, but he can create a positive or negative review of any other agent in the blockchain.
Users can create their own Ethereum accounts or use a provider/developer account.

The researcher

The researcher needs structured data. Every time a researcher creates a node on the network, he can search on our distributed ledger for any data we storage: symptoms, diagnoses... He then creates a petition with all the data he wants to gather and sets the price he is willing to pay per user, as well as other aspects related to the users (Age, gender, location...). Then all the selected users receive a notification on their apps asking them to share their data with the researcher. If the user agrees, all the data becomes visible for the researcher, this access will have an expiration based on the smart contract associated.

Hearthy Co. will develop an dapp to make easy to any researcher to access the data.
A researcher has a karma, everytime a user accepts to share his information with them they gain karma, they lose it when more users choose not to agree to share their information. In extremely low karma states a researcher might be banned from the network. Any token holder can make a petition to a researcher to share the outcomes of his research after certain time.
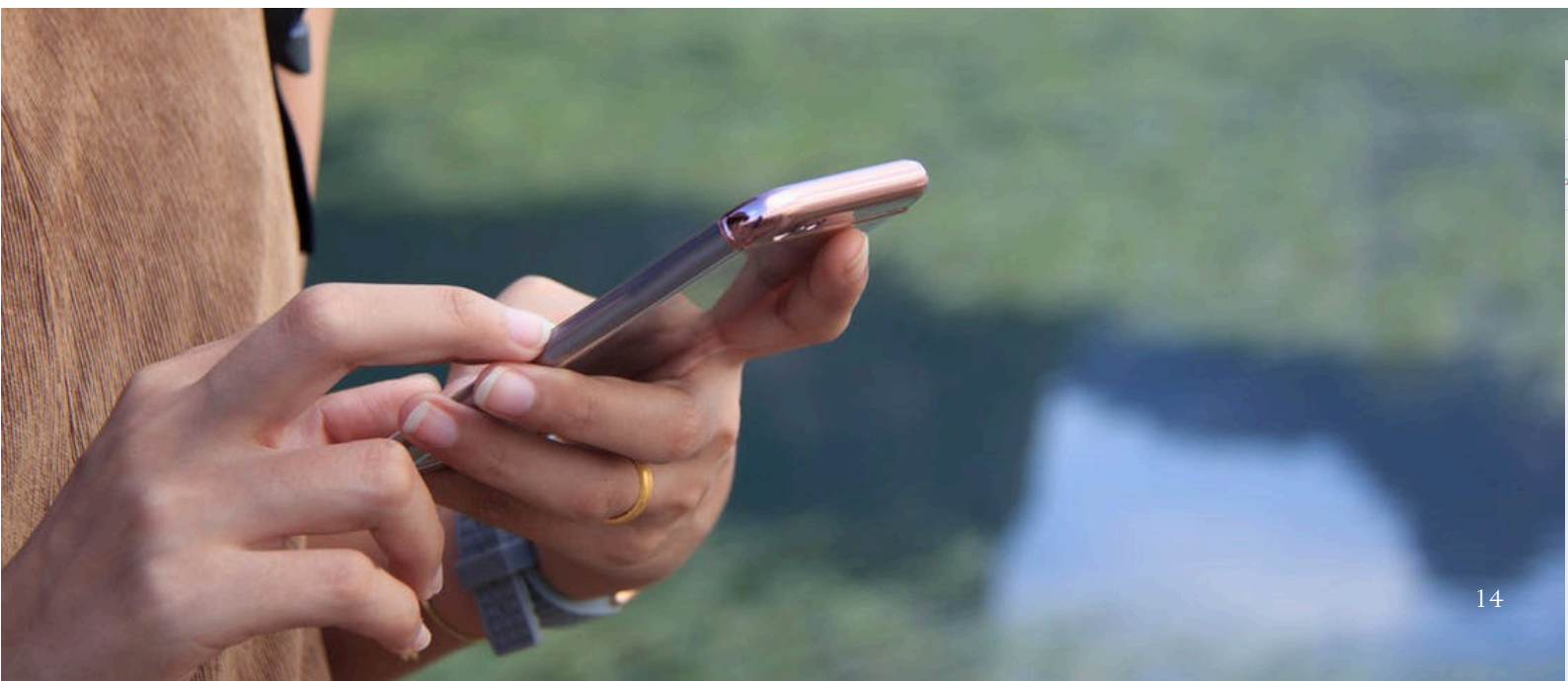
6 Distributed ledger topography

The medical professional:

Every medical professional is a user on the blockchain and also on the developer's app. The doctor delivers health care in markets created by app developers and providers, whether they are telemedicine or not. The doctor sets a price for his services or maybe makes an agreement with the provider or with the app developer.

Anyway every consultation a doctor makes has a fee on tokens, when on a marketplace these tokens will pass from the user's wallet to the doctor's wallet. Then the doctor can convert it into FIAT currencies.
Every doctor has a karma, so they become accountable.

Hearthy Co. plans to develop specific tools to help the doctors with diagnose and resource centers.*

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# **6** Distributed ledger topography

The automated agent:

Automations are a key factor in future health care delivery. Automated apps such as chatbots help users to manage certains tasks, medication adherence or even a complete treatment or diagnosis. Automated apps write and read on the blockchain as any other player. The app developer must buy enough tokens to manage the node and to be able to set up a price for the service in form of tokens. Users, providers or the foundation itself can pay the fees.

The foundation, by consensus, can reward some automated agents developers with tokens in order to generate new business models and to test ideas. Tokens will be released when certain milestones are achieved (this could be based on health outcomes and/or in design/development states).

Hearthy Co. will deliver the first automated apps, one for medication adherence and chatbot intended to work with depression/anxiety patients.

Automated agents will have their own wallets, the tokens on these wallets can be used for whatever the developer wants.

Automated agents have karma too.
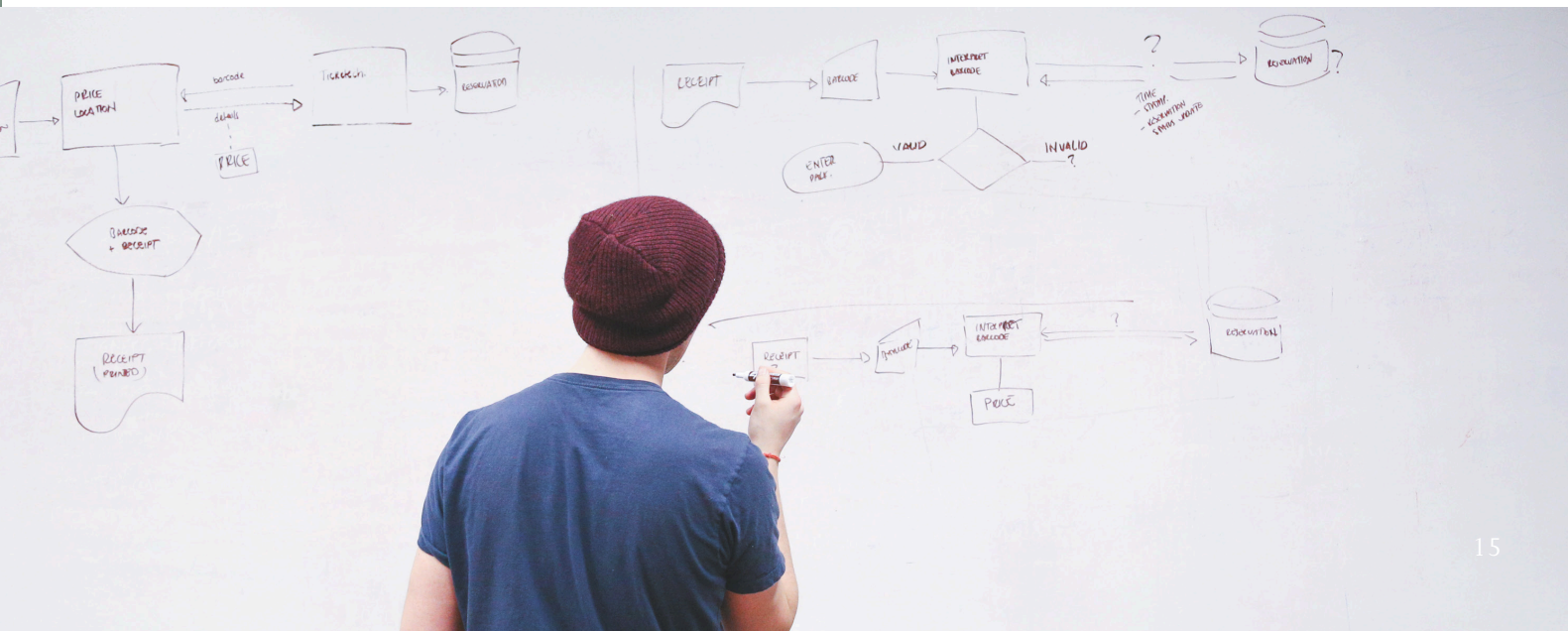
7 Economy Design

An approach to a health-oriented economy

As in other projects here at Glue Digital elegance is almost everything. When designing the first version of the economy of this project we noticed that is was pretty incomplete, as it didn't take the health outcomes into account. The organizations inside Hearthy will be successful no matter what health outcomes they achieve, that happens nowadays (eg. homeopathy) creating huge distortions and inefficiencies. A health-related token must encourage users and organizations to achieve better health outcomes. There is a necessity for incentives for organizations who generate better outcomes. Everytime we create a user, he or she has a health scoring, it always starts as 0, no matter the condition he or she entered. This scoring is only visible through a foundation smart contract. Every health metric (sugar in blood, body fat…) will generate some bonus or malus on the user health scoring. Also an organization will state the health metrics they work on, at the end of every quarter we generate an organization health scoring based on its combined user health scorings, lowering fees for the organizations that achieve better outcomes, so that the organizations that achieve better outcomes with their products could grow faster.

6

7 Economy Design

An organization with mediocre outcomes can still operate, but the one that generates more common good is incentivized.

In other order of things we want to expand our coin - the token - to the limit, so even the end-user will use it. The token must fuel all the platform and be linked to real economy. Digital currencies are on the verge of mass adoption, but, in the meantime we have lo be linked to FIAT economy.

In our economy players act in the following way:

User

The user connects to the blockchain by Hearthy Co app or by any other app, a user can buy ♥ at a market price, and spent it on services, every time the user or the doctor writes in the blockchain we also apply some transaction fees.

The doctor

(Hearthy Co. Model, other app developers can change it) When a doctor joins they create a wallet, they set a price, in ♥ or FIAT for their services, then when a visit finishes the doctor receives some ♥ in his wallet, he later can withdraw it from Hearthy Co, converting it into FIAT currencies, or transfer the funds to any other wallet.

The marketplace

The marketplace is owned by Hearthy Co. but anyone can build another one on their own, in Hearthy Co Marketplace any doctor and user can join, buy and sell services, every time a transaction is made some fees are transferred to Hearthy Co. and Hearthy Foundation in the form of ♥ .
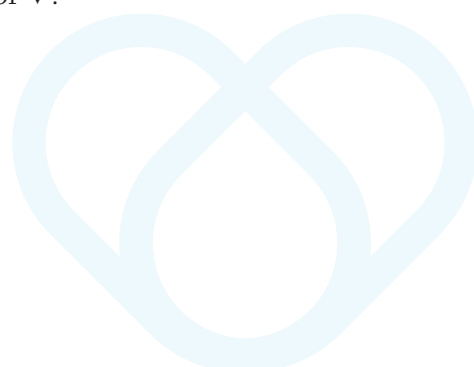
7 Economy Design

The Hearthy Foundation

The Hearthy Foundation maintains, amends and updates the blockchain, providing the governance to the project, every time a transaction is made the Foundation receives a small fee in form of ♥. The Foundation makes quarterly payouts to token holders in form of ERC20 tokens.

Hearthy Co.

Hearthy co will deliver the first telemedicine services, in order to validate the business model, attract users and encourage other companies to join the blockchain platform. The company will also employ our team, Hearthy Co will receive revenues just for its marketplace and all the services deployed using the protocol. Hearthy Co is born with the sole idea to create the initial traction to the platform.
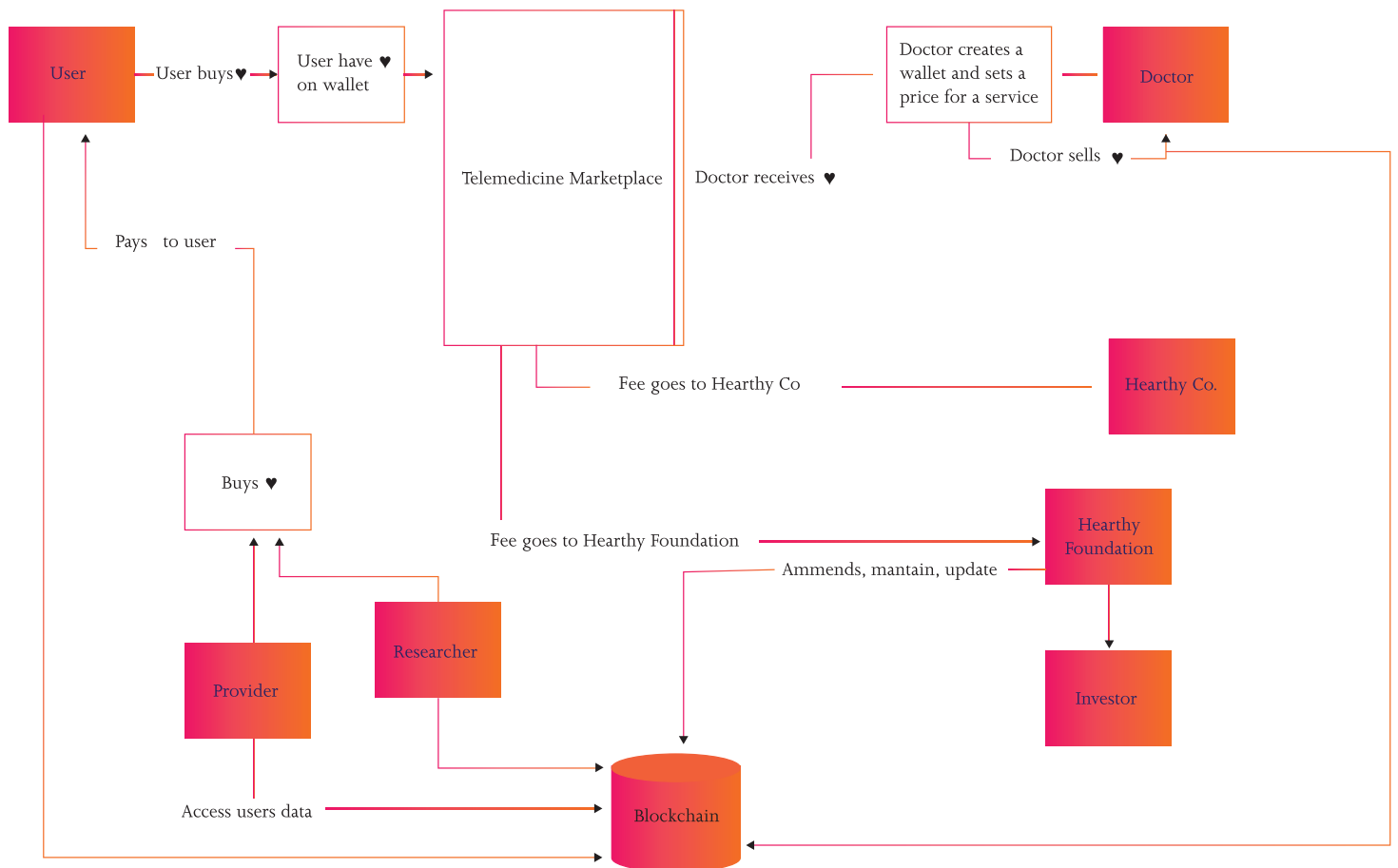
The providers

Providers will have some profits from accessing the blockchain, providers can create their own apps using our blockchain in order to create new services or to promote health, they can also cashout their users when they follow some health routines, attach to medication… Providers buy ♥ and send them to their users, who can use them inside the economy, sending it to another user or converting it to FIAT currency. Every time a transaction is made the foundation charges some transaction fees.

Researchers

When a researcher wants to access a user data they have to pay some ♥ to the user, the researcher has to buy enough ♥ to fulfill the operation.

7 Economy Design

User — User buys ♥ → User have ♥ on wallet → Telemedicine Marketplace

Doctor receives ♥

Doctor creates a wallet and sets a price for a service — Doctor

Doctor sells ♥

Pays to user

Fee goes to Hearthy Co ——— Hearthy Co.

Buys ♥

Fee goes to Hearthy Foundation ——— Hearthy Foundation

Ammends, mantain, update

Provider

Researcher

Investor

Access users data → Blockchain

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7 Economy Design

Token Anatomy

Hearthy is introducing an open source cryptographic token, named ♥ (HER) , which is envisioned as a health cryptocurrency to be used in health services. ♥ is a pure cryptocurrency of fixed supply. It is fractionally divisible and long-term deflationary by design.

♥ is intended to be bought by users and by providers and researchers, being the fuel of the transactional layer we want to create. Only the 33% of the ♥ will be liquid in the short term. Like other cryptocurrencies, units of ♥ are fungible and transferable, and they will be expected to trade on cryptocurrency exchanges.

Also the foundation rewards with quarterly payouts to token holders based on their activity, this will be inserted on each token.

Implementation:

♥ will be implemented on the public Ethereum blockchain as an ERC20 token.

The Ethereum blockchain is currently the industry standard for issuing custom digital assets and smart contracts. The ERC20 token interface allows the deployment of a standard token that is compatible with the existing infrastructure of the Ethereum ecosystem, such as development tools, wallets, and exchanges. Ethereum's ability to deploy Turing-complete trustless smart contracts enables complex issuance rules for cryptocurrencies, digital financial contracts, and automated incentive structures. These advanced features and active eco-system make Ethereum a natural fit for ♥.

7 Economy Design

Transaction **Fees**

For every transaction on the blockchain there is a transaction fee, every transactional fee is splitted into two, a percentage goes to the blockchain nodes owners (providers, data storage providers…) and another part goes directly to the foundation, which will later use this liquidity to make the ecosystem grow and generate quarterly payouts to token holders in form of ERC20 tokens.
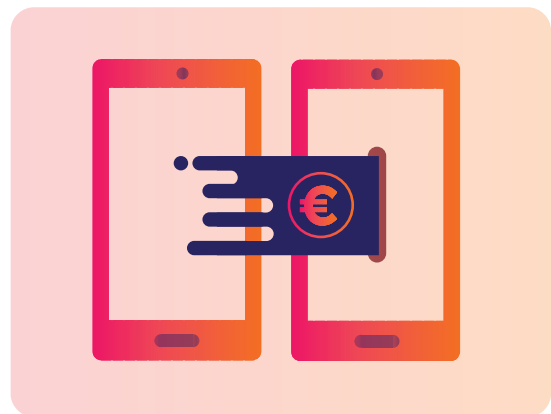
8 Misc

Onboarding **strategies:**

If we want the ecosystem and the coin to succeed we need to gain some traction with health users and health organizations. The services Hearthy Co. will develop intend to encourage other organizations to join the protocol, but that might not be enough.

We will incentivize the onboarding in various ways:

- Giving an amount of tokens to the first organizations joining after Hearthy Co: Organizations will present a health service/product associated to an invoice, if the Foundation evaluates the project positively the foundation can fund the initial development of the project, this will incentivize small startups

- Giving an amount of tokens to the first users joining Hearthy Co. services, so they access the

- Creating enough documentation and repositories to make easy to any organization to setup a project, the foundation.

- Advising small teams in UX, user experience and user onboarding

8 Misc

Fraud: Preventing, detecting and response

Fraud is always there. To prevent, detect and effectively
respond to fraud makers Hearthy will develop a series
of mechanisms in order to maintain the system
working in a fair way.

User control

As we reward users with tokens, at the beginning we have to create a scoring service
for them, in order to detect and freeze false accounts, the organization will have

Organizations control/Arbitration and metaarbitration

If a certain number of users complains about certain organization we can start a peer
review, a peer review means that other organization in Hearthy may ask the reviewed
one for some documentation, these peers review the complaints and reach a verdict. If
that verdict is a source of bad review the organization is frozen, the frozen
organization can ask the foundation for a metareview. When an organization reviews
another it is automatically rewarded with tokens.

Bug Bounties

Bugs are inherent to code, as soon as we launch we will start a permanent bug bounty
program.

9 ♥ Hearthy Kickoff and insurance:

To kickstart the network, an uncapped number of ♥♥ will be sold basing on a predetermined price function that increases over time. The funds raised from the initial sale will be transferred to the Hearthy Foundation to fund development of of the ecosystem.

Some time after the sale ends, a Community members multisig will deploy the Hearthy Network once they consider it implements its stated mission and it is secure to do so. In that moment the network will initiate and governance decisions will begin to be made by ANT token holders.

10 The Team

Javier Blanco Thomas CEO

Javier Blanco has been developing digital products for the last 11 years. He holds a degree in Audiovisual Communication in The Complutense University of Madrid as well as two masters degrees in IED and Trazos School, related to art direction and digital production . He has worked in Havas Media/MPG, and in projects with award winning studios and agencies like FarFar, Duplostudio or Waskman. Javier Blanco Founded Glue Digital in 2010, nowadays Glue Digital employs 7 people and manages about 25M users each year, working with Fortune500 clients all around the world (Carrefour, Mondelez, KFC, AXA, eBay…). Glue Digital has been awarded with some design awards and nominations, such as Awwwards, German Design Council or Laus Awards.

In the health field Javier has been working in different projects for more than 5 years, working with clients such as SERGAS, Ginemed, AXA or Medipremium. He founded Hearthy in 2015, first as a complete mhealth solution, and later as entire ecosystem, Hearthy has been featured on programs like Google Launchpad and conferences like Health2.0 and has been the core of apps like Medipremium, the first mobile health service deployed in the spanish market.

David Conde Sayans CCO

David Conde, a fintech entrepreneur, started Txstockdata in 2015 and has been its Managing director since then. With his skills for talent attracting and team leading, he has taken this project from scratch to a recognized company. Txstockdata has a multidisciplinary team of talented professionals dedicated to deliver innovative changes to the fintech industry. The Company is mainly focused on bringing more efficient solutions related to savings and investments David Conde studied Business and Administration degree in the Universidad Oberta de Cataluña and he was one of the first European Financial Planners in Spain. He also is MBA and MBA executive at IESIDE and Nebrija University. As managing director, David is leading the team behind Txstockdata's flagship product, Senseitrade. Senseitrade is a platform that turns big data from internet into trading opportunities. Recently they have launched another fintech product called Coinscrap. Coinscrap is a smartphone app that allows users to round up their daily purchases and automatically transfer the change into a saving product.

10 The Team

Juan Sebastian Valencia CMIO

Physician
Co-founder of Bress Healthcare
CMIO of Carians President of the R&D
Committee of France eHealthTech (association
with 138 french mhealth startups)
Consultant in mhealth and decision support
systems for healthcare professionals.

https://www.linkedin.com/in/juansebastian-
md/

Alejandro B. Ferrín Developer

Graduates in Design by The Antonio Failde
School of Art and Design (Ourense) and
Postgraduates Diploma in Web Project
Management and Design, degree (awarded by
Pompeu Fabra University and ELISAVA Barcelona
School of Design and Engineering).
Alejandro is a professional in the field of web
and the interface design with five years of
proven experience. During the last 4 years
Alejandro has working as a front-end developer
at Glue Digital developing the competences and
skills that make possible to design and
implement web projects, services and apps.

Diana D. Reinoso Lead Designer

Diana holds a Degree in Advertising at the Vigo
University. She has over 7 years in the design
and generation of UX projects. Diana has already
participated in diverse health-related projects.
In the last 4 years her work as designer at Glue
Digital has been awarded with some design
awards and nominations, such as Awwwards,
German Design Council or Laus Awards. Diana
is also a recognized photographer, her work has
been featured on Playground Magazine, Lamono
Magazine and exhibited on Matadero Madrid or
Bright Trade Show Berlín.

Anxo Soto CTO
TBD

César Caride Developer

TBD

(1)   Evaluate openEHR Standards for Managing Clinical Content Across the Care Continuum
https://www.gartner.com/doc/reprints?id=1-3YJ60PI&ct=170421&st=sg

(2)   Delivering Cognitive Behavior Therapy to Young Adults With Symptoms of Depression and
Anxiety Using a Fully Automated Conversational Agent (Woebot): A Randomized Con-
trolled Trialhttps://mental.jmir.org/2017/2/e19/

(3)   Overall Survival Results of a Trial Assessing Patient-Reported Outcomes for Symptom
Monitoring During Routine Cancer Treatment http://jamanetwork.com/journals/jama/
fullarticle/2630810

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Feedback

This version of the paper is inttented to change quickly, we will kindly receive and talk about the project in the following channels:

By mail
at javi@hearthy.co

By joinning our slack channel (to be opened soon)

https://hearthyco.slack.com/

By responding this survey

https://survey.enqsta.com/#/fromMail?token=DfLbtXk2kT-GDsuLT2TfkTaBLUbmdY5tpVraUUz19o5I=&sessionId=437&_k=mm0gvc