

WHITEPAPER 0.5

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1 Abstract

Our healthcare models are based on paradigms that are no longer valid. Social security in Europe was created after the Second World War when the population was almost one third of what it is now. The demographic shift toward an aging population and more patients with chronic disease burden is putting pressures on the health care systems. We have a major challenge ahead: to provide universal and good quality healthcare to an increasing amount of patients in the context of financial and human resource constraints.

In the last 5 years we have worked (first at Glue Digital and later at Hearthy) for several health and insurance organizations (SERGAS, Ginemed Telemedica, Medipremium, AXA) to help in their digital transformation processes with mixed outcomes. We have created great projects, some of them have been used by millions of users(2) but we see that the main problems are not being solved: digital health products tend to raise health care costs and adoption rates are slow. Most importantly, these innovations serve as luxuries for rich countries with the exception of India. Meanwhile most developing countries around the globe are struggling just to create sustainable 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 the 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(3). The actual social security models are more and more expensive every year as more people are getting older and the number of taxpayers to maintain them is decreasing. There are considerable efforts being made to maintain the model as the political price to pay for dismantling these services is huge. The situation is unsustainable in the medium term. A new approach to health care is urgently needed.

Looking at the USA the situation is even worse with approximately 10% of population uninsured even after the implementation of the Affordable Care Act (4). The model could potentially be sustainable in time, but it is not enough to address the myriad of policy and technology needs required to make

healthcare affordable for everyone. As the richest nation in the world, the USA is still unable to deliver universal health care to its citizens.

Developing countries are in a worse 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 (for example, Seguro Popular in Mexico, where 55 million previously uninsured people were provided with insurance in the process lasting 15 years), but there are not enough resources to reach the level of their more developed counterparts. The necessity of a new approach to health care is needed here as well.



3 The product, a blockchain based health ecosystem

Diverse health standards have been deployed in the market, both proprietary and open source, but none of them have created enough traction to create a defacto standard, assuming that in 1996 a consortium created HL7 for messaging between different HDOs . 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, if a patient just move from one province to other he might not be able to purchase his medication.

The ecosystem proposed in this paper basically has the goal to create a transactional layer bound to healthcare that fixes the most common problems that stand in the way of frictionless transactions or interoperability. Hearthy proposes use an open source PHR, integrated on a blockchain. We have the goal of scaling it so so that public and private providers and developers could contribute to it in the same way as browsers, providers and developers did with TCP/IP in the 1990s.

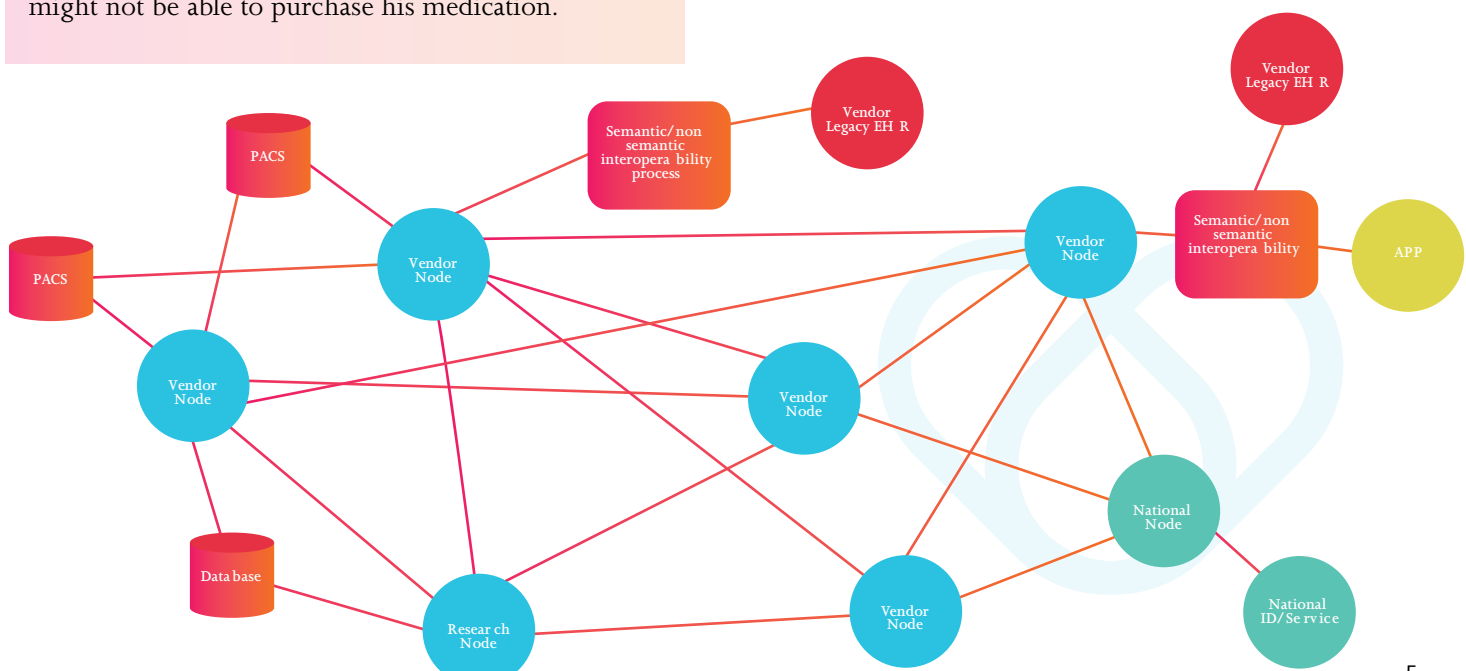


Figure 1. Example of a network based on Hearthy

3 The product, a blockchain based PHR

What problems we solve with Hearthy?

1) Reduced healthcare costs

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.



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.



3 The product, a blockchain based PHR

What problems we solve with **Hearthy**?

4) 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 and population health apps. Our repository will be open to everyone and every individual can grant access to their anonymized data if they want just by telling the user why they want the data, who they are and what they will be using the data for. Users can also be rewarded for sharing their medical data (as described in economy design).

5) Interoperability

Interoperability between healthcare systems is one of the most vexing problems in healthcare, with Hearthy will create a LEGACY SEMANTIC AND NON SEMANTIC interoperability system that facilitates legacy organizations to continue using their existing systems while also enabling efficient data exchange between systems. This is a very long term aim of the project and will need a vast amount of resources.



4 How this project is articulated

This project is articulated in two separated organizations:

Hearthy Foundation:

The hearthy foundation is the core of the system and also the seed of an open, global and health outcome oriented jurisdiction. Hearthy Foundation is aimed to be a DAO at some time, as for now it will remain as a human-operated foundation. After a certain time token holders will vote on that, when the most of the users state that Hearthy Foundation must be a DAO that process will start.

Hearthy Foundation will fund:

- The development of the protocol and the PHT, the coin and all the infrastructure needed so other organizations can benefit from the hearthy ecosystem.
- Any organization or developer who plan to use Hearthy ecosystem and to create a health outcome oriented app.

Hearthy Foundation will fund itself with transaction

Hearthy Foundation will fund itself with transaction fees, these transaction fees might be lowered to organizations with better health outcomes.

How will Hearthy Foundation will select the best projects?

Every year Hearthy Foundation will have a budget for developers based on his liquidity, the foundation will be opened for call for about 1 month, stating the problems they want to address.

Every project sent to the foundation between the deadline will be sent to a peer review, every project is sent to at least 5 peers that will set a score the project, peers are always token holders. The projects with biggest scoring just get funded, organizations and developers can also fund themselves partially. When a project is funded a project controller is set, this project controller will be the responsible of controlling milestones and trigger funding. Every project is funded in steps and just when reaching certain milestones.

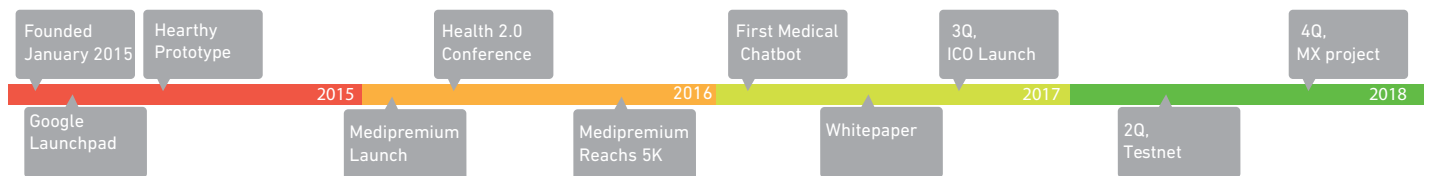
The foundation has another important mission, maintain the value of the token stable, **The foundation must protect the token-holder interests**, making the token value raising over time.



4 How this project is articulated

Hearthy Co.:

Hearthy Co. works as a startup, defining a manageable problem and trying to solve it with defined milestones and small tranches of funding. Hearthy Co will be funded by Hearthy Foundation as it reaches its milestones. Hearthy Co. Milestones are stated above:



Hearthy Co is as now a established company, registered in Spain as (JBTHOMAS SL) and merged with Glue Digital, Hearthy, as Glue Digital, has remained unfunded, we were able to grow without external funding.

Hearthy CO. actually has two projects in production, Hearthyapp, that had powered telemedicine projects such as Medipremium, and Whitecloud. a EHR for dermatologists. We have been also been working on medical chatbots, having a working prototype as for now. Actually Hearthy is also proposing for 2 pilots in Europe (Código100 and Emppatics).

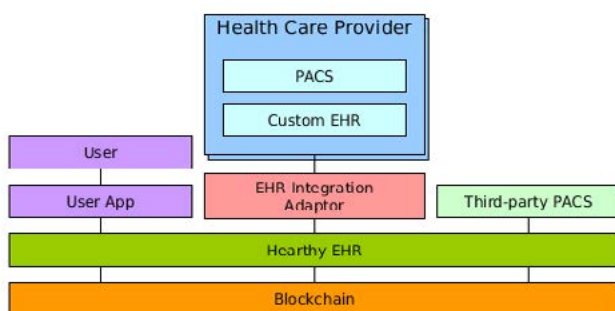
At first Hearthy Co. was not intended as Open Source Project, so our code remained private in Gitlab, as we are switching to blockchain space all our developments will go open source soon(check on website). Notice that some of them are legacy. **Notice also that we have still not started the development of the blockchain, it is a mid-term project, impossible to start without funding.**

After creating the Hearthy Core (PHR+Production Blockchain) Hearthy Co. will develop his first two projects.

- A mobile telemedicine project in México: Hearthy will create a marketplace for telemedicine service based on our ecosystem (See Use cases for more info), This will be in production in 4Q 2018
- An automated agent for depression and anxiety treatment (See use case 2) 2Q,2019

5 EHR Architecture

We will create all PHR according to FHIR standards, the latest version provided by the HL7 consortium. The PHR will be totally modular, so organizations/apps/developers can use parts of it. Basically it follows this structure.



Also The PHR will be separated in 3 layers, the first will be dedicated to Security and privacy, Conformance and terminology, the second layer is dedicated to administration, defining all the roles our ecosystem generates. And the third layer will keep all the medical data related to a medical process. (See figure next page)

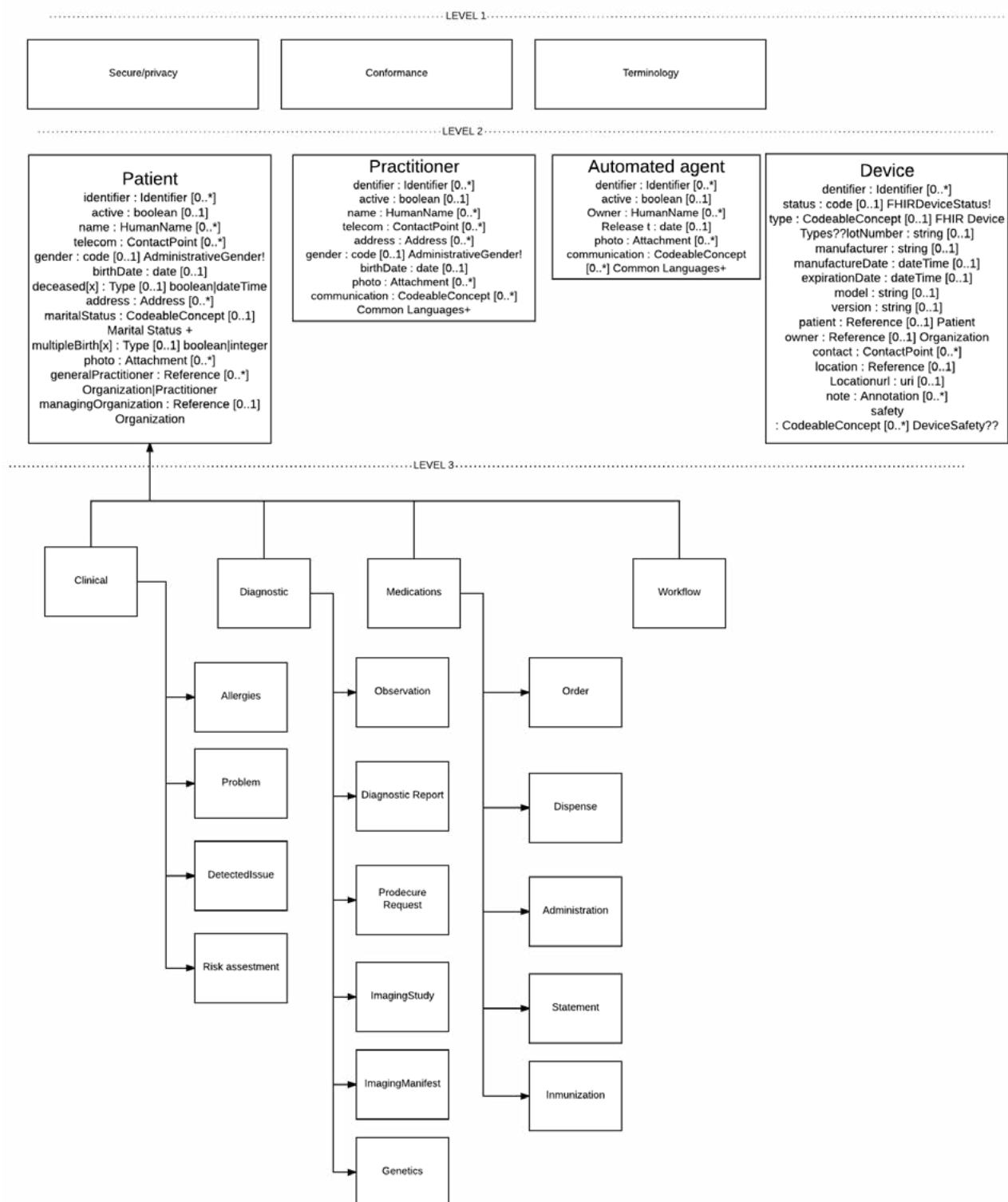
We will explore some ontology standards like ICD-10 and SNOMED-CT since it increases interoperability as it provides a shared understanding of concepts used in clinical documents. This is not an easy task, on a paper written in 2011 some researchers were trying to the gap between HL7 and SNOMED-CT.

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.



5 EHR Architecture



5 EHR Architecture

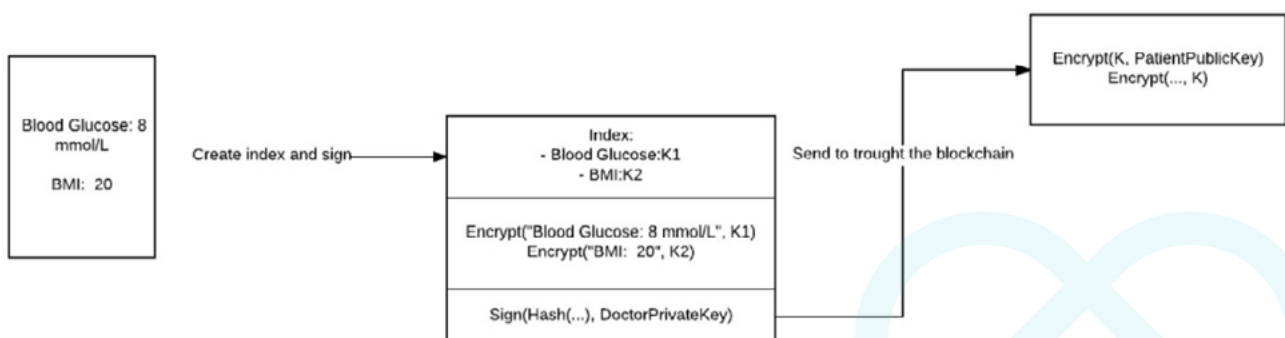
Privacy and cryptography

To provide the privacy a health system requires, we'll make use of cryptography to allow the user to give granular access to his data, keeping parts private when he chooses to. We will also allow professionals to sign their additions to the PHR, so their authenticity can be verified by those who access them.

Once any medical milestone is created (stated by a doctor, the patient or any automated agent) the system splits it on blocks, and encrypts each block with a randomly generated key. In addition, an index is generated with each block and its key

The combination of index and encrypted blocks is signed by the doctor with his private key, to ensure that nobody can tamper with the data. Finally, the whole entry is encrypted with a random entry key, and the key is sent to the user encrypted with his public key, ensuring only him can read it.

This system allows the user to give access to anyone he wants to, by sharing either the entry key, or any of the block keys, allowing decryption only of the chosen data.

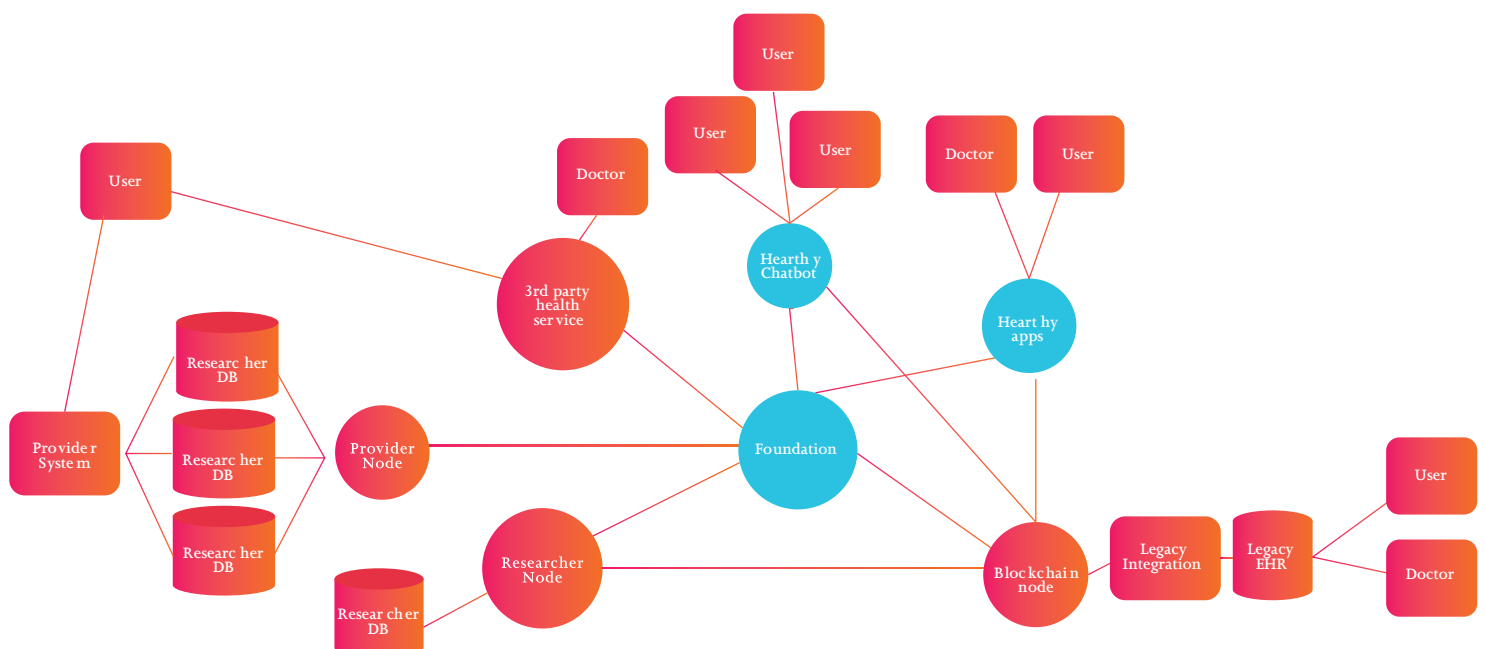


Our distributed ledger will have some typical actors, as described below:

The foundation

The foundation amends and updates are the core of the system. Any node and token holder will be able to propose an upgrade with an inherent price. If the majority of the token holders find 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 (the foundation is extensively described at a previous points).



This figure shows how all the actors are connected.

6 Distributed ledger topography

The provider

The provider is a hospital, a healthcare professional, 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 specific 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/under-insured 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 patient. Our users have various types of registrations. By default our registration process is done only by biometric identification and we just need a selfie and a signature. That system creates a unique user ID and that ID is recorded on the blockchain. The selfie and signature are stored on the device and 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 its 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. . Providers can also send tokens to certain users in order to allow them to receive medical services (for 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 that could be used for prevention services, medications, etc.).

6 Distributed ledger topography

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.

The practitioner:

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 tele-medicine 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.



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 certain tasks, medication adherence or even a complete treatment or diagnosis.

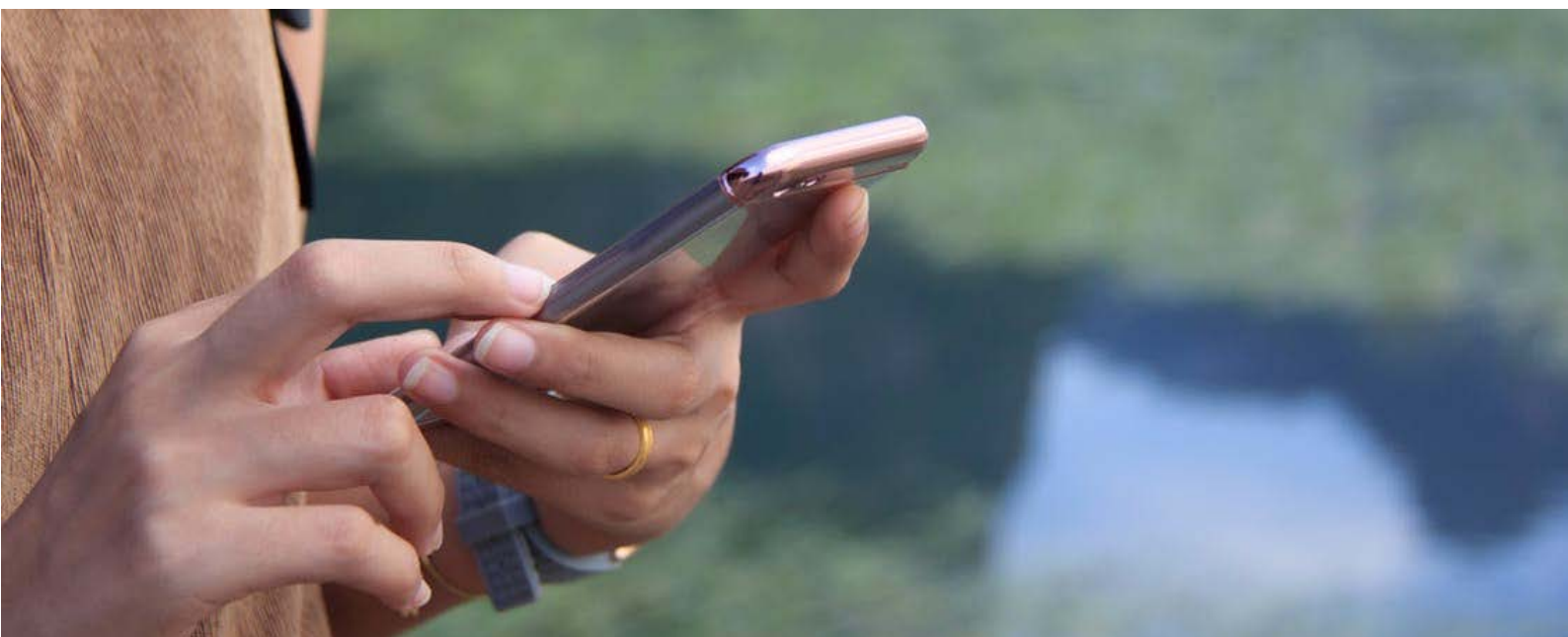
Automated apps write and read on the blockchain as any other player. The app developer must buy enough tokens to manage the node and to be able to set up a price for the service in form of tokens. Users, providers or the foundation itself can pay the fees.

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 it 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.



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 to 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

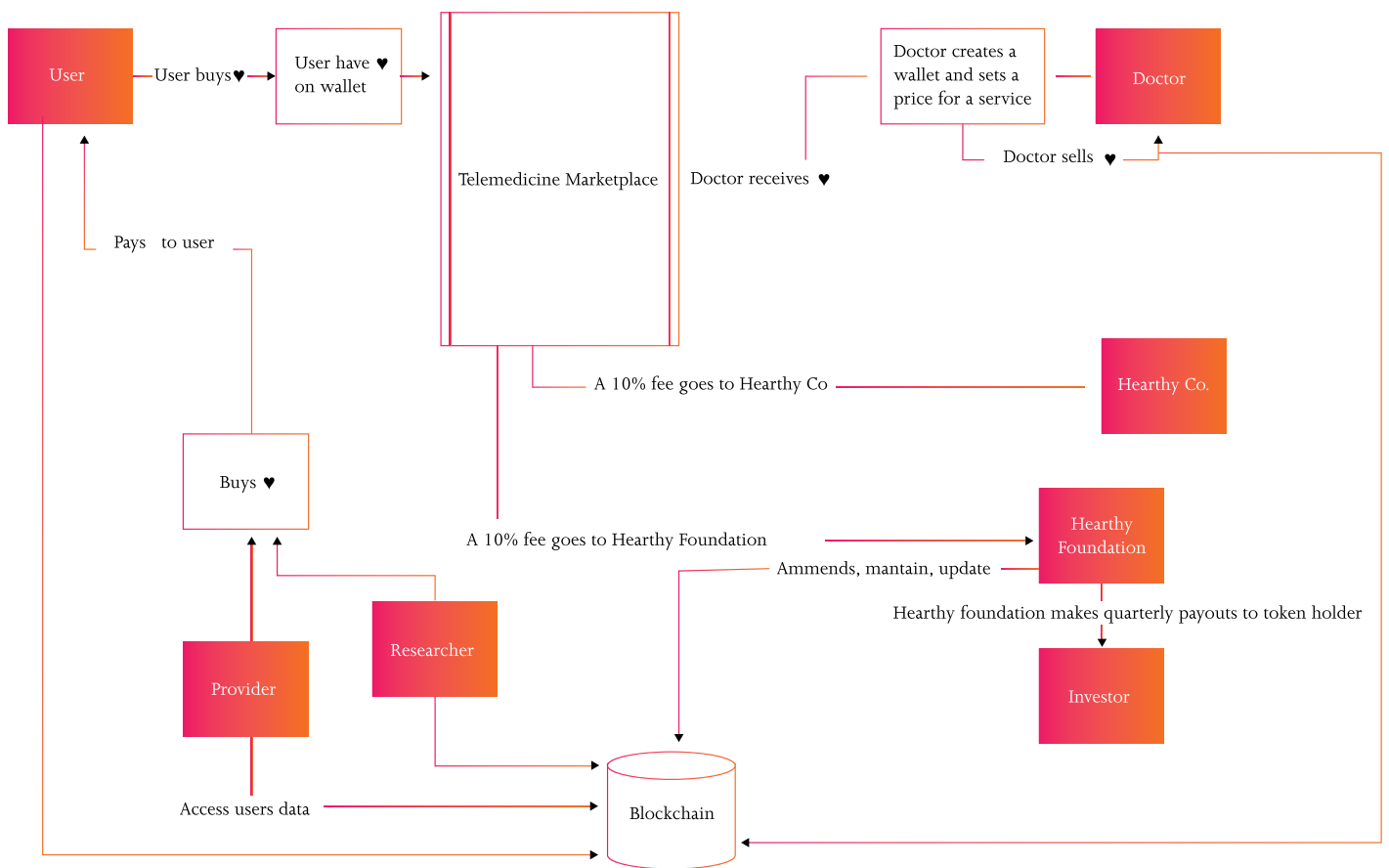
Providers will have some profits from accessing the blockchain, providers can create their own apps using our blockchain in order to create new services or to promote health, they can also cashout their users when they follow some health routines, attach to medication... Providers buy♥ and send them 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





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 ecosystem 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 split into two, a percentage goes to the blockchain nodes owners as gas (providers, data storage providers, etc.) and another part goes directly to the foundation, which will later use this liquidity to make the ecosystem grow and to reward developers to amend and update the distributed ledger.

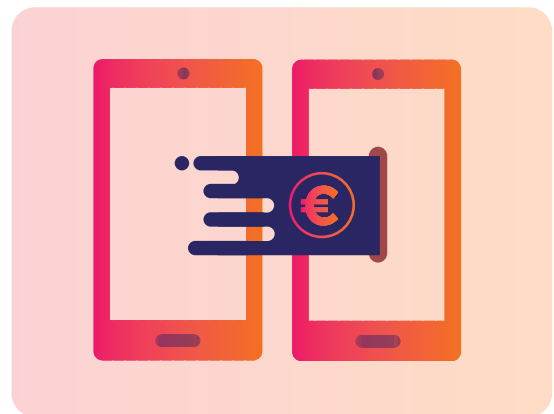
Transaction fees works in various ways:

- Incentivizing blockchain adoption by node owners.
- Redistributing wealth, in form of paying invoices to developers who create more value.
- Ensuring deflationary tendencies among time, so token earn in value over time.

Rights for token owners:

Token owners can receive medical services by using the tokens, that's its primarily use. So patients, health care organizations and doctors can use it for they daily health care-related transactions. Token holders may have right to vote on changes on the Foundation.

Quarterly the Foundation has to reward token holders with a percentage of the transaction fees received, The foundation will leverage this incentive, setting a minimum of 20%.



That reward is intended to incentivize token holders on the long term, and will only happen if the token is in the same wallet for all the ongoing quarter.

The payments will start on the quarter before the first transaction fee is received.





8 Hearthy Kickoff and ♥ insurance:

To kickstart the network, an capped number ♥ of will be sold based 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 the development of the ecosystem.

CROWDSALE DETAILS

TBD



9 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 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 or Duplostudio. 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...). 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.

Juan Sebastian Valencia CMIO

Medical doctor from Paris Descartes University with a medical thesis creating an online decision support system for healthcare professionals dealing with accidental blood exposure (ABE)

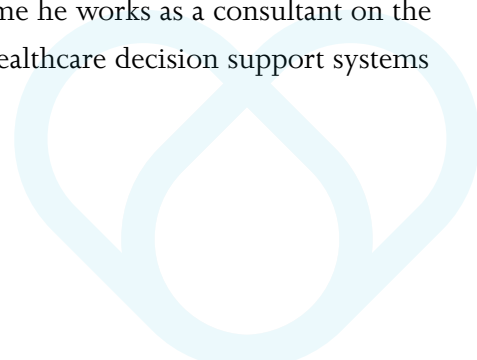
Director of MD thesis of general practice residents interested in innovative solutions applied to healthcare

Co-founder of Bress Healthcare, a french startup that created a full-web system of tele-expertise (exchange between healthcare professionals) that is used now in 6 countries of Africa and Southeast Asia to do cardiac tele-echography of pediatric patients

CMIO of Carians, a French startup that created a full web plateforme that will allow patients from all over the world to have access to the world's best medical expertise

President of the R&D Committee of France eHealthTech, an association bringing together 138 french e-health startups.

On his off time he works as a consultant on the creation of healthcare decision support systems



9 The Team

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 smart-phone app that allows users to round up their daily purchases and automatically transfer the change into a saving product.

Anxo Soto CTO

Anxo studied Computer Engineering at the University of A Coruña. He has more than 10 years of experience writing software for the web, and for the last 3 years he has been working at Glue, doing full stack development and managing a small team of talented developers.

He participated on the latest eHealth developments at Glue Digital and Hearthy helping define the technological stack, and integrating with heterogeneous systems from our clients and providers. Anxo has extensive experience in cryptographic systems

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 Berlin.



9 The Team

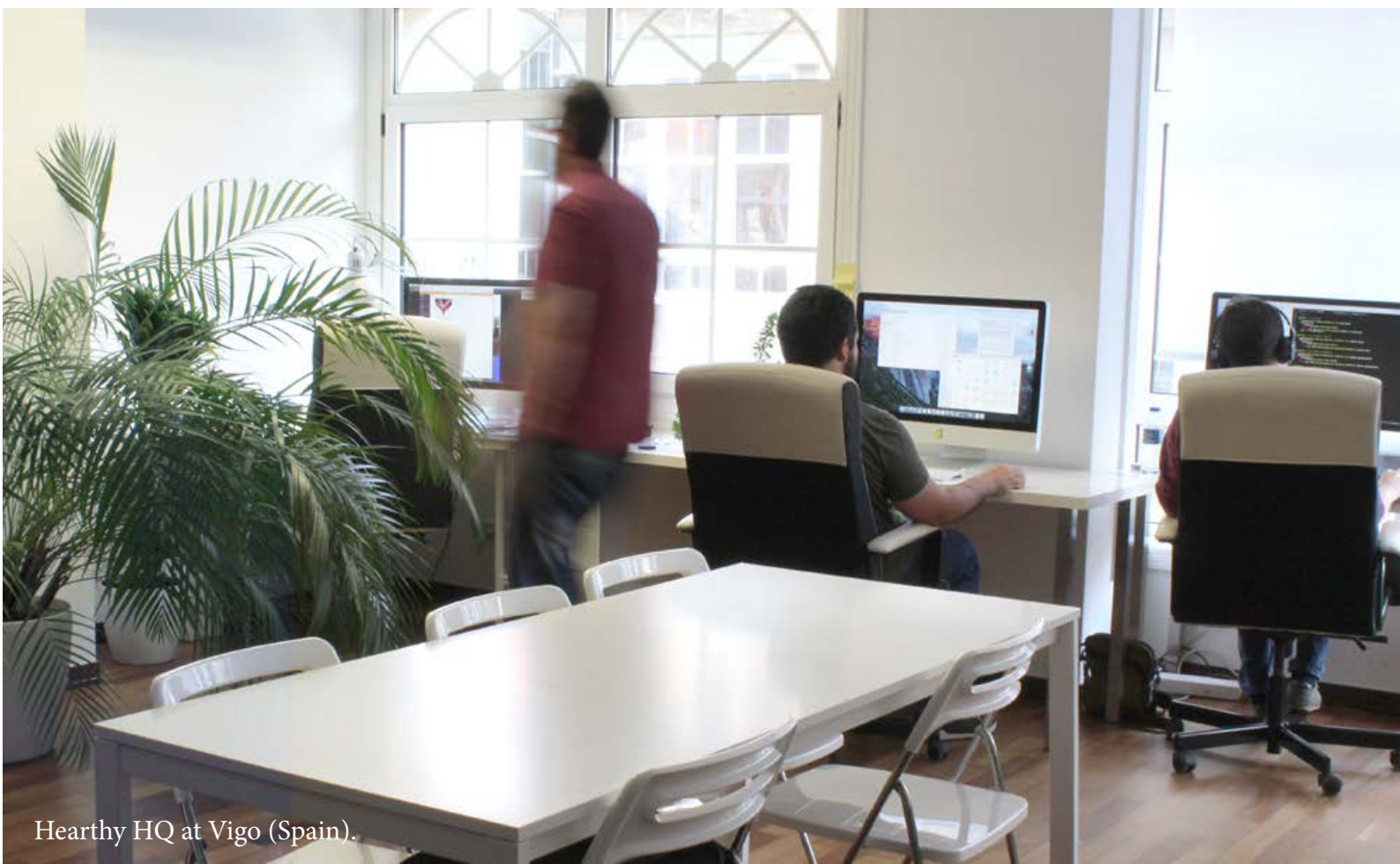
Álex B. Ferrín DEVELOPER

Graduates in Design by The Antonio Failde School of Art and Design (Ourense) and Post-graduates 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 full-stack developer at Glue Digital and Hearthy developing the competences and skills that make possible to design and implement web projects, services and apps.

César Caride DEVELOPER

César studied Computer Engineering at the University of Vigo where he also worked for a year and a half as a trainee. He worked as a developer and analyst for more than 3 years in different projects for the implementation of ERPS at IMA-TIA. For half a year he has been working in Glue Digital and Hearthy as a backend developer



Hearthy HQ at Vigo (Spain).

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

By mail

at javi@hearthly.co

