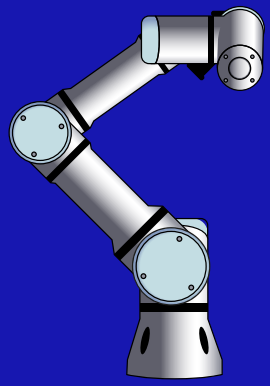
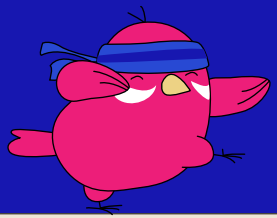


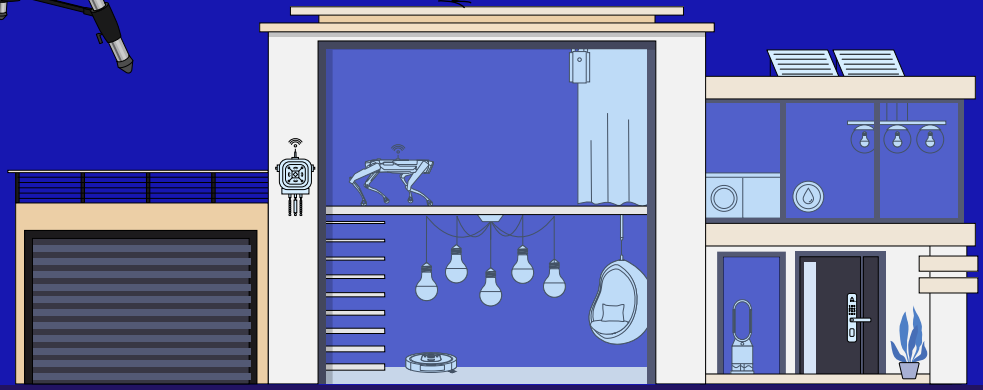
R&D

ROBONOMICS NETWORK

VOLUME #2

Cases 18-28





ROBONOMICS.NETWORK • BOOK №5 • 2022 • English version

WHAT IS ROBONOMICS?

Robonomics is an open source platform for IoT applications that implements the exchange of technical and economic information in the form of atomic transactions between user applications, IoT services and complex robotics.

The Robonomics platform provides functions for creating blockchain digital twins, machine-to-machine smart contracts for robots, software for connecting a device to a decentralized cloud, API libraries for user's IoT applications, and other solutions for industrial, commercial and domestic use.

The platform includes a wide range of tools for developing various IoT solutions. Communication between the user and the device is carried out using technologies from the Web3 world — Ethereum, Polkadot and IPFS. Thus, developers can create new, secure applications for smart cities and industrial enterprises.

ROS 2

In 2022, the focus of attention of the Robonomics team has shifted towards the development of a decentralized cloud for IoT.

Robonomics 2022 is a futuristic decentralized cloud for IoT applications that solves the problems of protecting device data, ensuring user privacy and becomes a full competitor of centralized clouds, while retaining all the useful features of cloud services for IoT: remote access, statistics and analytics.

To date, the Robonomics platform has many different use cases — already implemented, in development and potential.

#Ethereum #Polkadot #Kusama #Parachain #IPFS #substrate #ROS #robotics #IoT #web3

Check out last year's R&D projects:

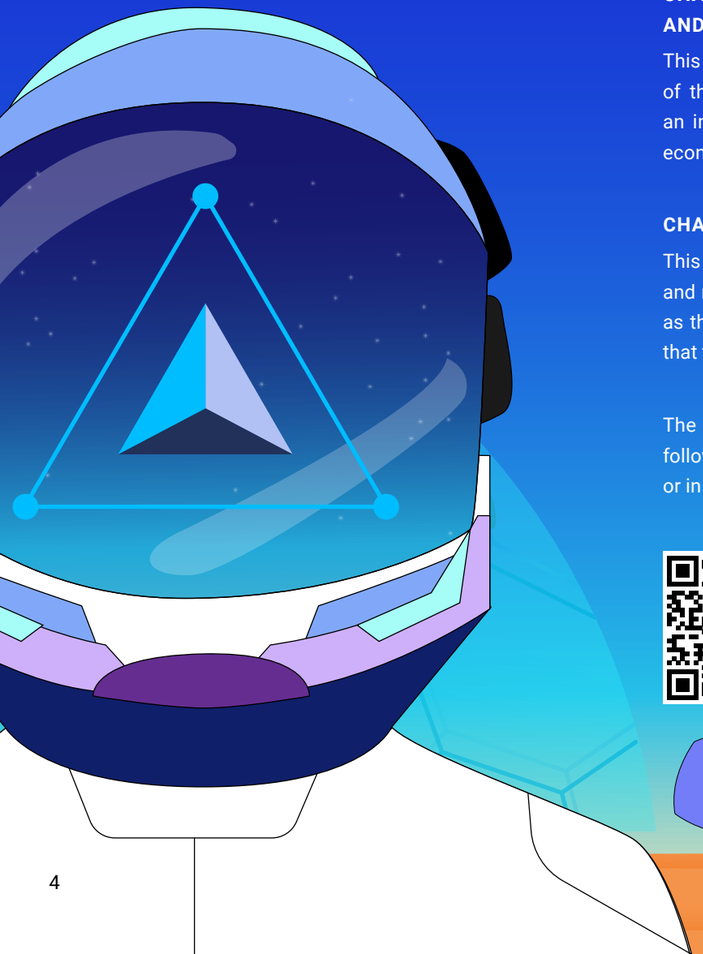
R&D Robonomics // Volume #1 (2019-2021) >>>

NOW LET'S MOVE ON TO WHAT THE ROBONOMICS R&D TEAM HAS BEEN UP TO DURING 2022.

>>>

ROBONOMICS WHITEPAPER 2022

To get a deeper understanding of the Robonomics concept and projects based on it, we would suggest that you familiarize yourself with the theory by reading the Robonomics Whitepaper 2022. Two chapters are already available on the site:



CHAPTER 1: AT THE INTERSECTION OF CYBERNETICS AND ECONOMICS

This chapter is about the relevance of the meta idea of the robot economy, which in the future may become an important part of humans' lives and shift the current economic guidelines towards fully automated services.

CHAPTER 2: ROBONOMICS ARCHITECTURE

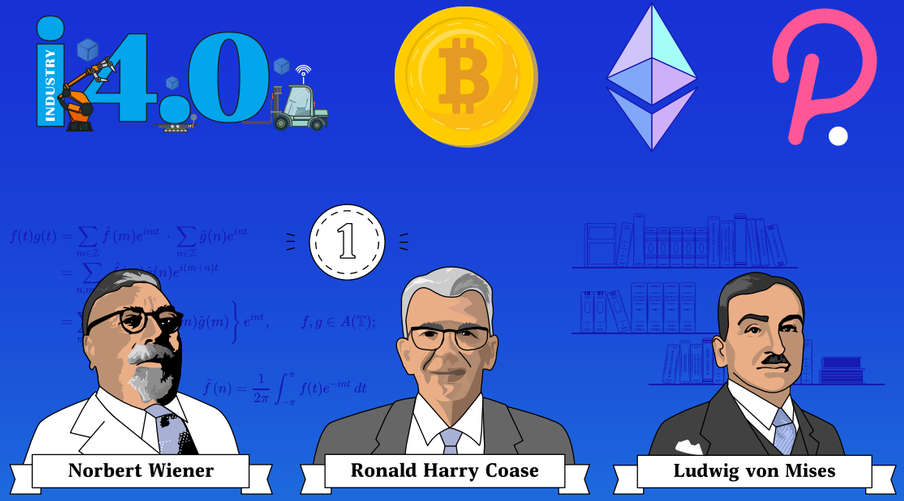
This chapter is about the interaction of humans and machines using modern Internet technologies, as well as the basics of the Internet of Things and the difficulties that the developers of IoT systems face today.

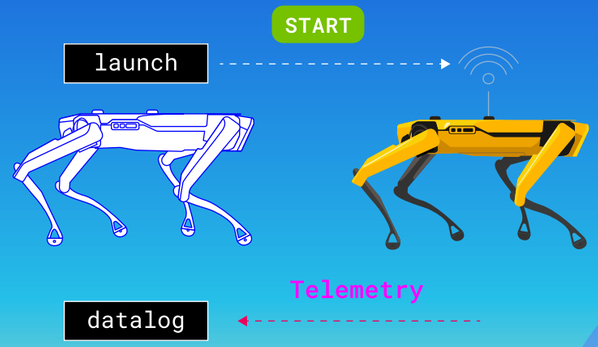
The Robonomics whitepaper continues to grow. You can follow the release of new chapters on the project website or in the community in Discord.

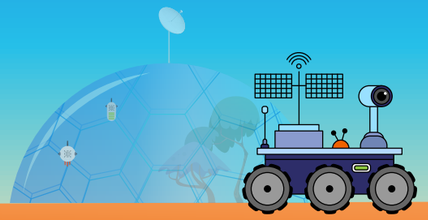
Start exploring the whitepaper right now:

<<< robonomics.network

Join the Robonomics community on Discord:
<<< Discord







DECENTRALIZED CLOUD FOR IOT

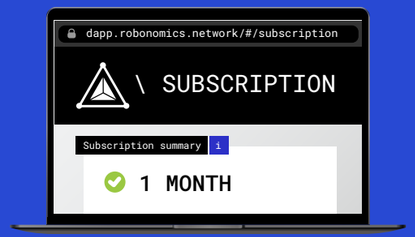
As described above, in essence, Robonomics 2022 is a decentralized cloud for IoT, so this particular R&D case is the flagship for the team, and some other use cases described in this book are based on it.

Robonomics Web Services (RWS) is a basic cloud infrastructure for robotics and the IoT. The decentralized cloud is based on distributed technologies: namely the Ethereum and Polkadot / Kusama blockchain platforms, which serve to log and protect information, and the IPFS file system as a data storage.

RWS aims to:

- control smart devices for security and global availability;
- provide users with serverless IoT applications;
- perform technical and economic transactions between humans and machines to improve service efficiency.

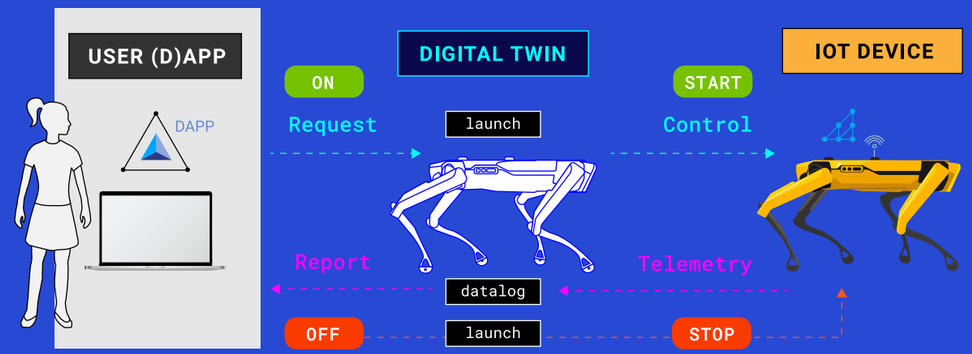
The Robonomics team has presented the IoT subscription mechanism, an important element of the Robonomics parachain as a decentralized cloud for smart devices. This mechanism makes it possible to move away from the typical transaction fee model to a monthly payment model for a package of provided services, which is more familiar to users of modern web. There are several groups of modules that provide the functionality of a decentralized cloud for IoT.



FUNCTION MODULES OF CYBER-PHYSICAL SYSTEMS

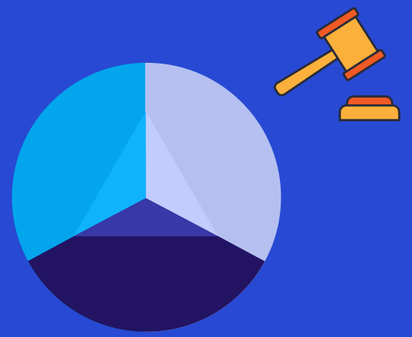
The “Cyber Physical System Functions” group contains all currently available types of interaction with devices.

- ***digitalTwin()*** — the function of creating and controlling a digital version of a real device. It is stored in the Robonomics parachain and represents a single imprint of the current state of the cyber-physical system. Structurally, it is a dictionary, where the key is the identifier of the CPS node, and the value is the address in the parachain assigned to this node.
- ***launch()*** — a device start function, which sends a launch command when executed. The function leaves no traces on the blockchain, does not change the state of a digital twin, but its execution can be verified in the list of events.
- ***datalog()*** — a telemetry sending function, which stores user data on the blockchain when executed. In conjunction with the digital twin module, it allows you to get the latest state of the device, and check the history of state changes.
- ***liability()*** — a function to start the Robot-as-a-Service cycle. It launches the execution of a certain CPS behavior model with user data as the subject of a transaction, upon execution of which this system is obliged to provide some result.



IOT SUBSCRIPTION MODULES

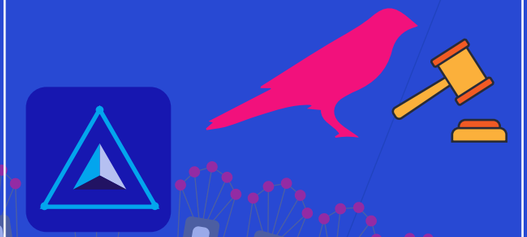
The main interface of IoT subscriptions in the Robonomics parachain is implemented as the ***rws()*** module. The module is designed for issuing and controlling IoT subscriptions. The main process of obtaining subscriptions is implemented as an auction. With the help of the ***bid()*** module, the user has the ability to offer XRT tokens to participate in the auction for activating their subscription.



AUTOMATING CROWDLOANS

The most important task for the Robonomics developers is to update the lease of the parachain slot to ensure the availability of IoT subscriptions. To do this, we can perform calculations taking into account the median value of the slot cost as the optimal parachain slot auction price, and the typical reward for crowdloan contributors based on the ideal staking rate on the Relay Chain. Holders of Relay Chain tokens have the choice to either stake their tokens or support one of the parachains during a crowdloan. Therefore, to better incentivize participation during a crowdloan, it is important to target an estimated return which is equal to, or slightly higher than the opportunity profit lost during Relay Chain token staking.

The team’s immediate plans include the implementation of a module for automating calculations and participation in parachain slot auctions.



Case #18
SOVEREIGN SMART HOME

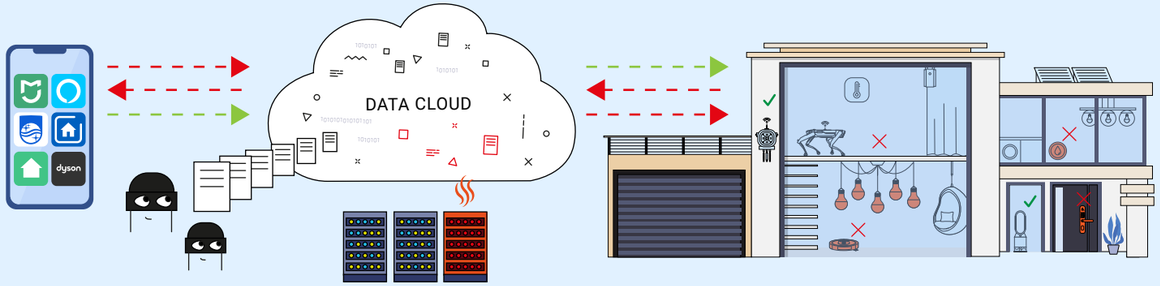
This special case perfectly demonstrates the capabilities of the platform as a decentralized cloud in practice.

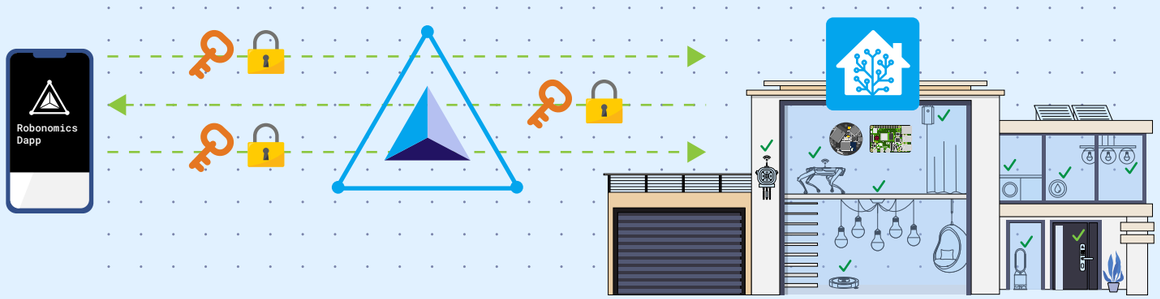
The modern IoT market provides users with a large selection of smart home solutions, but they are all tied to centralized cloud providers or expensive proprietary equipment. At the same time, a smart home cannot be truly smart without cloud statistics and analytics.

The Robonomics team sees two main problems with modern smart homes:

1. The user cannot control what data they share with the provider or any third party.
2. Smart homes are vulnerable to the shutdown of their centralized cloud servers.

Robonomics Web Services in conjunction with the Home Assistant (local control system for smart homes) can solve both of the above problems. While on vacation or on a business trip, the user can control their home from anywhere in the world with security and privacy.

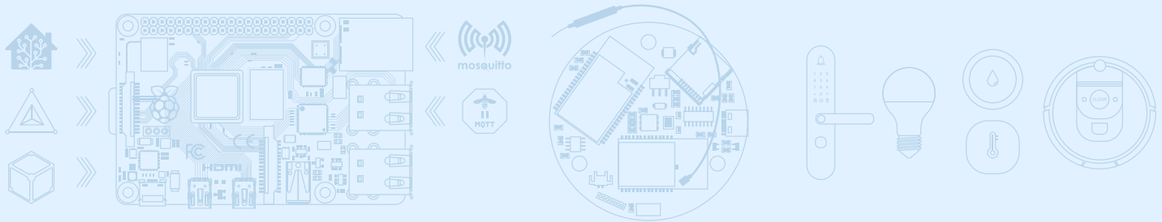




Are you a Home Assistant User?
Make your smart home sovereign today:

<<< wiki.robonomics.network

Are you a Developer?
Get free detailed course on building the sovereign smart home at Robonomics Academy:
<<< robonomics.academy



Case #19
TELESCOPE: CONNECTING THE UNIVERSE TO THE METAVERSE

The deep dark depths of outer space is fraught with many secrets and mysteries. It still remains a practically unexplored territory for humans, it is this mystery of the unknown that attracts us all. The Robonomics team adores the space theme, so we have developed a Robonomics “space” scenario that allows you to explore the observable Universe in a fun way, as well as make a beautiful NFT of deep space, which can also be used as a gift to a similarly like-minded space loving friend!

HOW DOES IT WORK?

There is a real, physical telescope that is installed in the Atacama Desert, Chile. The telescope takes photos in real time, so the app is available only from 11pm to 6am GMT-3. Anyone can connect to it and take a photo of a nebula or a cluster of stars. To use the telescope, you need to purchase special $STRGZN tokens, which can be bought with a credit card.

You can select any astronomical object from the list of the most brightly visible at the moment. After that, the telescope will start moving and in a few minutes will create an NFT using the RMRK NFT standard on the Singular platform. By releasing an NFT with astronomical objects, the user gets access to the channel of amateur astronomers in our **Discord!**

WHY?

This experiment shows the interaction of the digital and physical world: using the application, people look from the Metaverse to their own Universe!

Watch the stars with us:

<<< telescope.merklebot.com

HERE IS HOW THE WHOLE PROCESS WILL GO:

<<< Video

singular 2.0

First Beyond the Sky

IMAGE

Carina Nebula

Unlimited series

Telescope NFT collection

<<< singular.rmrk.app

Case #20
PUBLIC LAB
WITH BOSTON DYNAMICS SPOT

This year, work at the Robonomics lab in the San Francisco Bay Area continued successfully. Spot, a robot dog, from Boston Dynamics is available for developers, experienced roboticists and companies to lease remotely for a limited time. And ordinary users can take part in a demonstration of drawings by a robot!

For those interested in robotics, the team has developed a course on the Spot SDK within the Robonomics Academy, which includes the basics of programming Spot. Students will gain the necessary skills to create their own projects.

Experienced roboticists can lease a time slot on our equipment for their work goals. The lab is located in the Circuit Launch working space and is equipped with everything you need to develop and test your solutions, including access to Spot itself.

Not related to robotics, but interested in modern technologies? Here's a simple demo for you of how Spot uses its sensors and software to replicate your drawing in the browser.

Learn how to control Spot

<<< robonomics.academy

Try demo:

<<< spot.merklebot.com

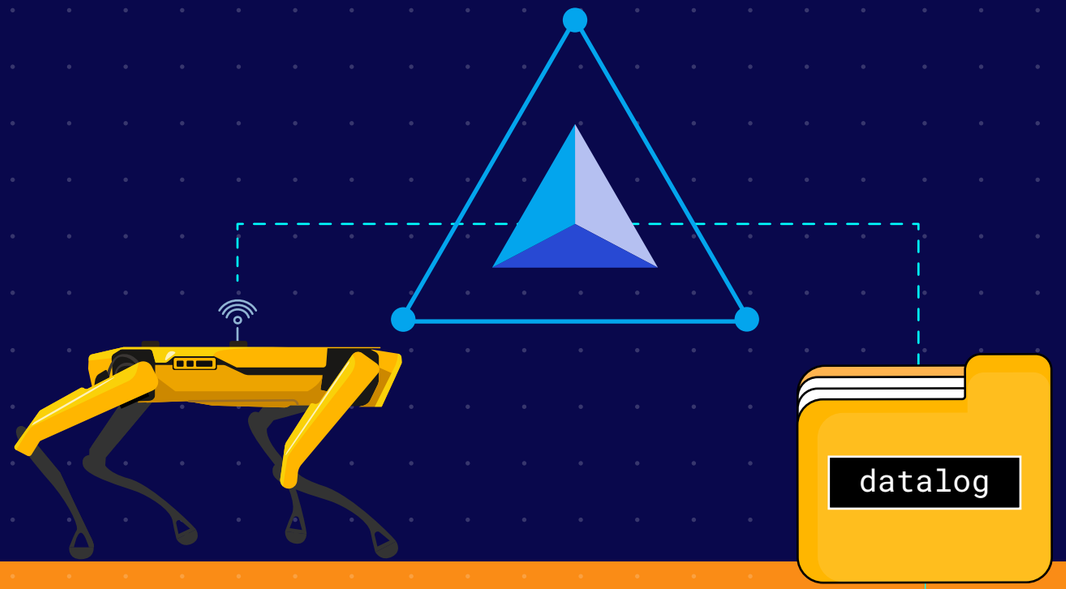
Stand-up
Trace
Sit-down

Lie down
Nod
Go
Turn around

run_spot_check
run_camera_calibration

Case #21
BACKUP AND ARCHIVING SERVICE FOR ROBOTICS COMPANIES

This year, the Robonomics team began collaborating with other parachain teams to leverage the unique strengths of the Polkadot ecosystem. Thanks to this ability, a backup and data archiving service for robotics companies was launched on the Robonomics platform. Robots generate large amounts of data, including videos, raw technical information, and logs, which can be very costly to store on a large scale.



An affordable and secure solution for archiving robot data is now possible thanks to the opening of an HRMP (Horizontal Relay-routed Message Passing) channel between the Robonomics and Crust Network parachains. This service is not only cost-effective, but also helps to meet the user's data management requirements. By storing data on Crust Network, the user can be sure the data is safe and it can be traced back on the blockchain at every stage of its life cycle. Data can also be encrypted with the user's or device's private key.

A web3-based backup and data archiving service is an essential tool for robotics companies looking to reduce the cost of data management and fulfill their privacy obligations.

More about
the collaboration with Crust:

<<< robonomics.network/blog

CRUST

Case #22
FEECC:
PRODUCTION MANAGEMENT SYSTEM

Feecc is a platform that allows you to create and customize your own production process control systems on the blockchain.

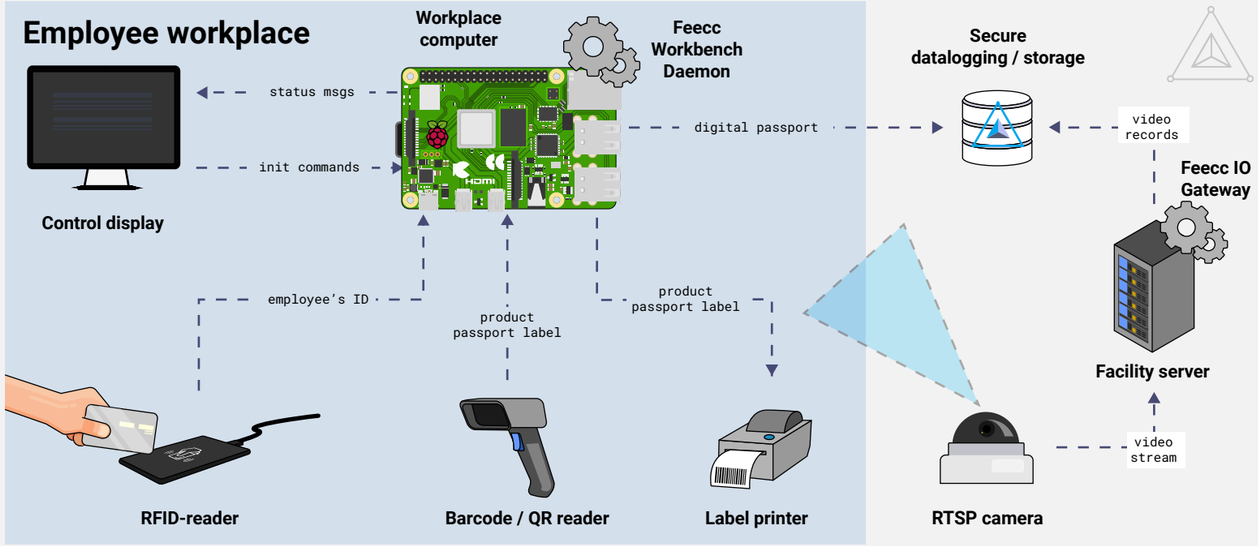
With the help of web3 technologies and a set of software modules, the platform can extract data about various workflows. Feecc uses distributed data storage, which ensures the reliability and the validity of the information collected. The platform tracks all stages of work performed, including long-term and intermittent operations. Feecc is easy to customize for any workflow using easy-to-connect hardware.

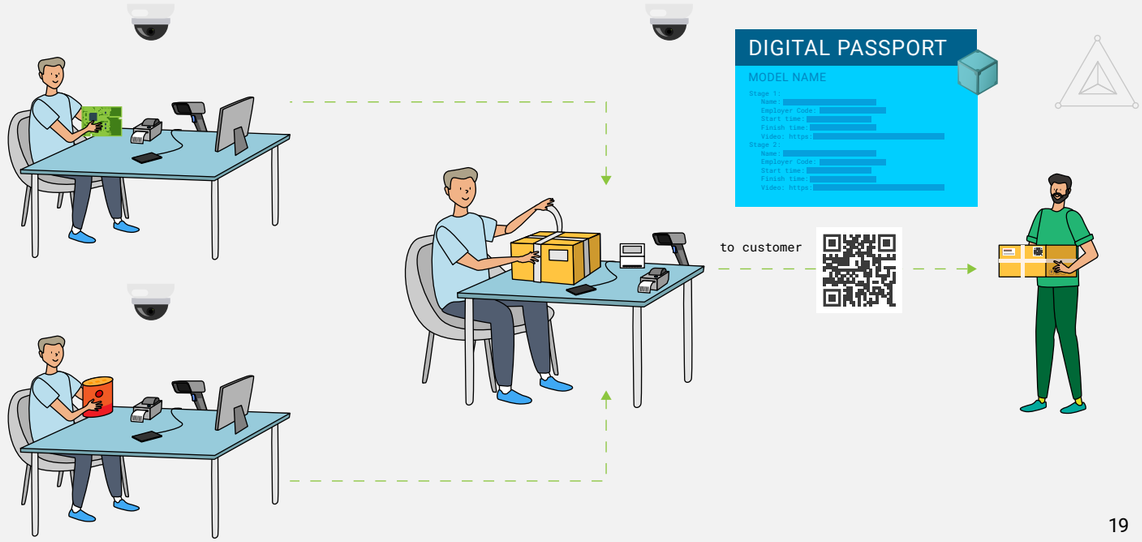
All digital traces of the actions taken are summarized in a digital product certificate with a unique identifier, which is then attached in the form of a tag. Feecc supports standard digital I/O interfaces for connecting various devices (cameras, scanners, printers, etc.)

Thanks to the Feecc platform, companies can not only digitize their production processes, but also attract the attention of new consumers to a product or service, increasing their credibility.

More about Feecc:

<<< multi-agent.io





PM10

Case #23
CIVIL AIR MONITORING NETWORK (UPDATES FOR 2022)

The problem of air pollution continues to be one of the most important, especially in large cities surrounded by many factories and industrial zones. Therefore, the Robonomics team developed the air quality monitoring initiative called “Decentralized Sensors Network”. By connecting an easy-to-use sensor, any user can start to publish air quality data about their environment. The network currently includes over 50 sensors and successfully operates in many cities around the world.

The sensors use open source software, and readily available standard components. They can recognize the presence of fine particles of PM10 and PM2.5 levels. It is these particles that are the most dangerous, since if they enter the respiratory system, they have the potential to cause serious illness. Additionally, users can add temperature and humidity sensors to their setup.

Hashes of data from sensors are recorded on the Robonomics blockchain, making the data immutable, which ensures the security and reliability of information.

You can get a sensor and start monitoring the air condition yourself:

1. Order an assembled sensor: you just have to install it and connect the power.
2. Order parts and assemble the sensor: this will allow you to better understand its construction.

More about civil monitoring

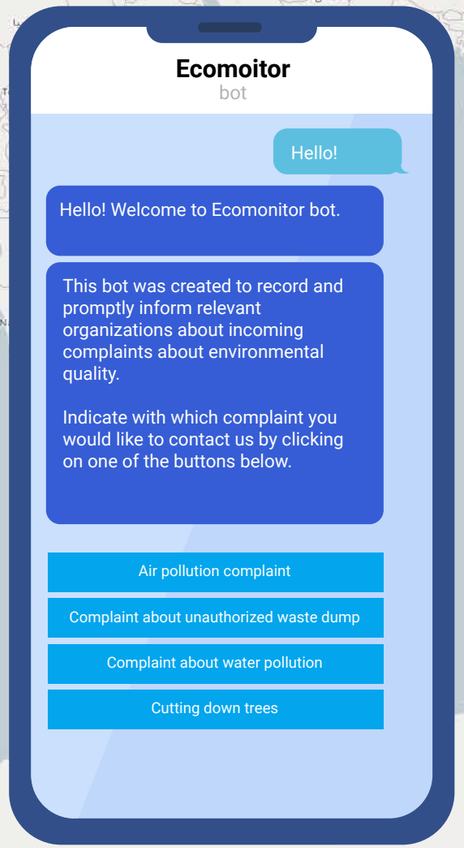
<<< airalab.org

Map of sensors connected to the blockchain

<<< sensors.robonomics.network

With the help of the project’s Telegram bot, you can report a forest fire, send a complaint about air pollution or unauthorized dumps, and much more. The bot works automatically, but if necessary, the operator will contact you to ask clarifying questions.

Air monitoring network allows all concerned citizens to protect the environment, report pollution to the relevant authorities, as well as put forward their own initiatives in this area.



28.12.2022

REAL TIME

WIND

MESSAGES

DOWNLOAD HISTORY

Case #24

WEI — WATER ENVIRONMENTAL INSPECTOR (UPDATES FOR 2022)

Maintaining water quality is as important as the previous case of air quality control. This task is challenging due to the multiple sources of contaminants, the complexity of detection, the lack of off-the-shelf technologies, and various other factors. This is what inspired our team to create the WEI project.

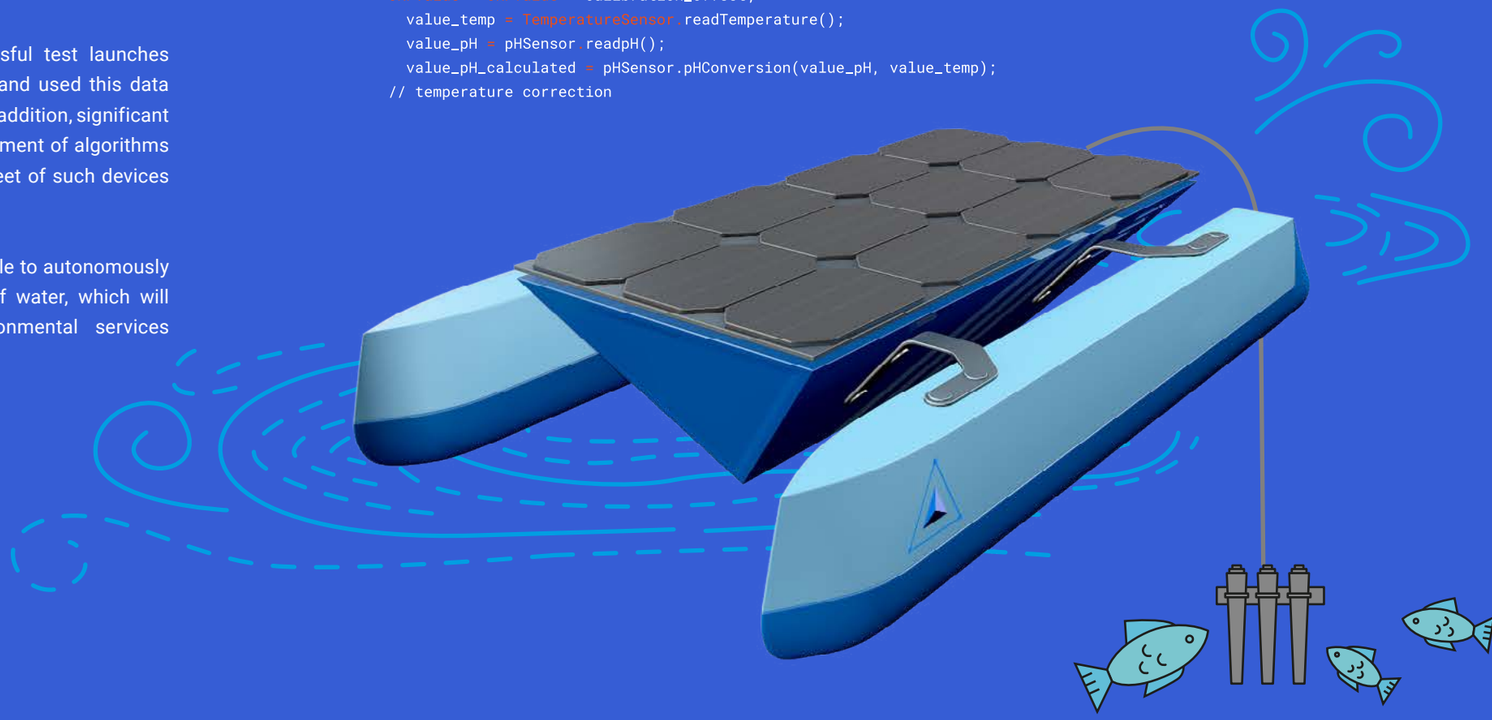
Water Environmental Inspector is an unmanned surface catamaran-type environmental monitoring vehicle that collects water quality data. The device is equipped with a compact set of sensors, on-board navigation and network connectivity, which allows it to autonomously inspect water bodies. The user can input the specific route and other desired parameters and the vehicle will begin to take measurements. The device will collect the data and provide online access as soon as it enters the network coverage area. The collected data is published on the blockchain, which guarantees its reliability and immutability.

In 2022, the team conducted successful test launches of WEI in adverse weather conditions and used this data to design a new version of the vehicle. In addition, significant progress has been made in the development of algorithms for the autonomous distribution of a fleet of such devices around pollution sources.

In the future, devices like WEI will be able to autonomously monitor the state of various bodies of water, which will greatly simplify the work of environmental services and enterprises.

```
void loop()
{
  Water.ON();
  delay(1900);
```

```
  ORPValue = ORPSensor.readORP();
  ORPValue = ORPValue - calibration_offset;
    value_temp = TemperatureSensor.readTemperature();
    value_pH = pHSensor.readpH();
    value_pH_calculated = pHSensor.pHConversion(value_pH, value_temp);
  // temperature correction
```



Case #25
ROBONOMICS COFFEE: BLOCKCHAIN-POWERED COFFEE MACHINE

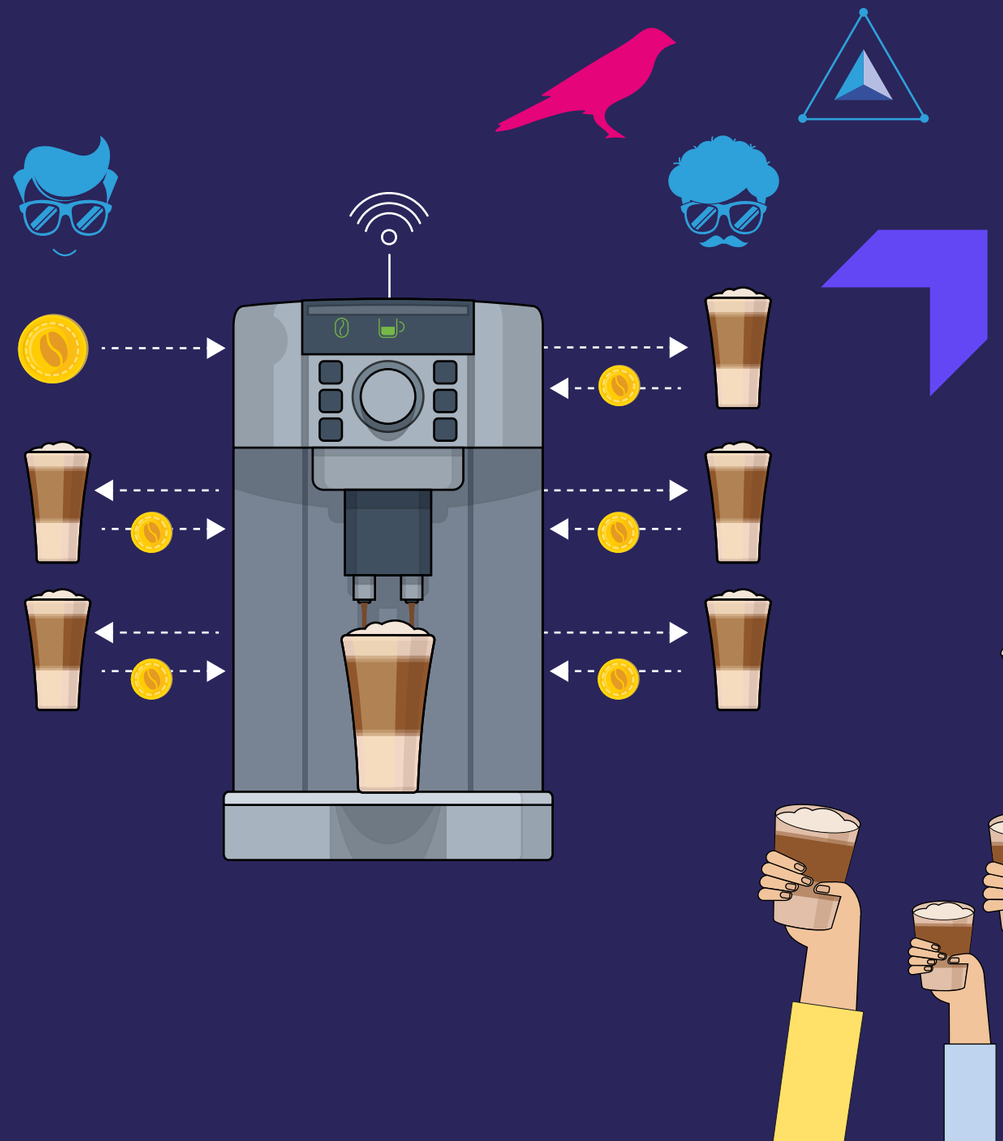
Robonomics Coffee is a smart coffee machine integrated into Robonomics Network. To start the device, the user needs to send an amount of tokens to the address of the coffee machine from the Statemine parachain, after which the machine will receive a command and... a delicious cup of coffee is ready! The project can also work on top of the Polkadot and Everscale (Free TON) networks.

To turn a coffee machine into a smart one, you first have to slightly modify its control panel by removing the printed circuit board. Then a Raspberry Pi 4 single board computer needs to be attached to the machine. It is the center of the system, providing all the control commands. It also interacts with the Robonomics and Statemine parachain.

This project not only demonstrates the potential of Robonomics in the service industry, but also shows that the application of Robonomics has no limits!

More about
smart coffee machine:

<<< Robonomics Medium blog



Case #26

EISENKOCH, THE ROBOT CHEF

In December last year, the first robot cafe opened in St. Petersburg, where the robot chef called Eisenkoch began his work. The robot is equipped with two waffle irons and can bake 6 waffles at the same time in 5-7 minutes.

Eisenkoch is based on a compact UR3e arm which has six degrees of freedom and is placed in a protective housing. It is able to perform various actions: from pouring dough into baking molds to serving baked waffles to the customer. You just need to occasionally replenish the supply of dough and waffle sticks, and the robot will do the rest. The robot chef is easy to use — you can learn how to use it in just a couple of days.

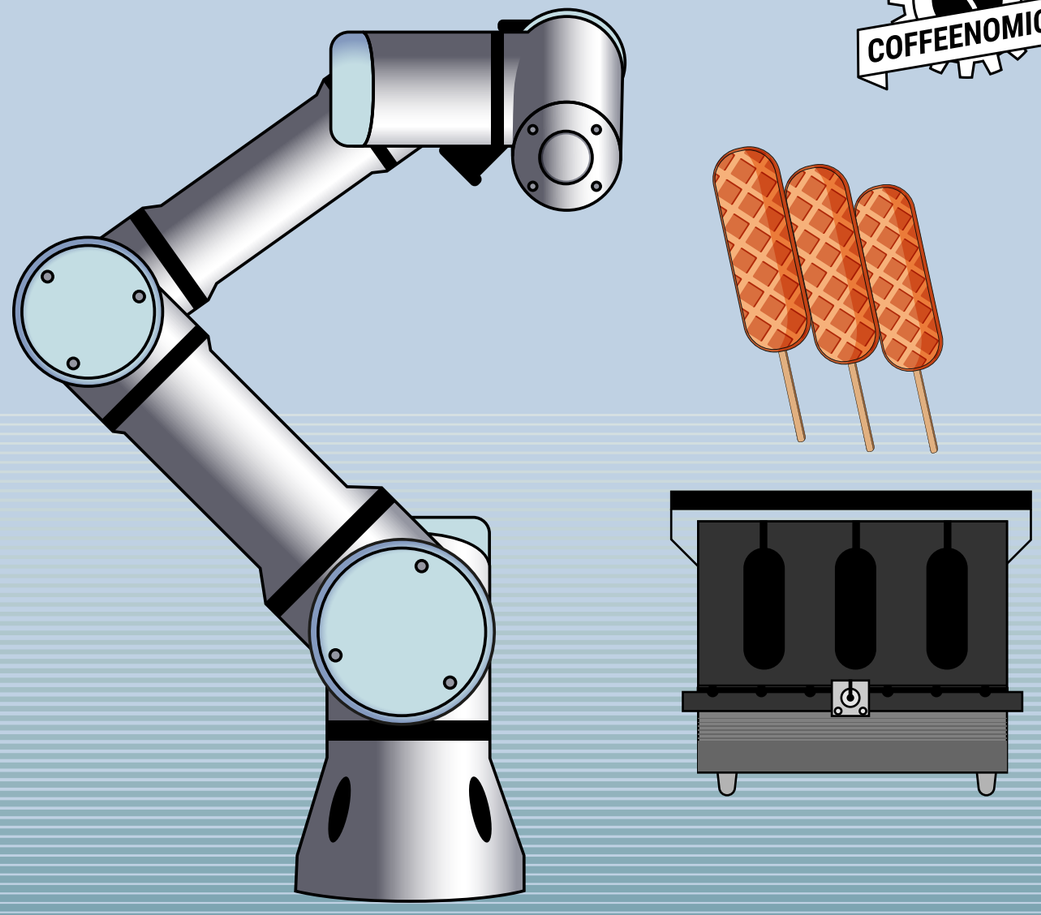
Eisenkoch does not require a lot of workplace and other expenses which are necessary to provide a comfortable working environment for human employees. Such automation is beneficial for restaurateurs: the robot takes over part of the work, which allows serving more guests. This innovation not only has great potential for practical use, but can also attract new customers to the business.

More about Eisenkoch:

<<< multi-agent.io

Eisenkoch First Run

<<< youtube



Case #27

FRONIUS SOLAR.WEB INTEGRATION FOR HOME ASSISTANT

Today, energy consumption is the largest source of anthropogenic greenhouse gas emissions that cause global warming. The demand for energy is growing every year, and with it, the burden on the environment is also increasing. The developers at Robonomics have teamed up with bbf to create a solution to address this issue.

bbf is one of the first real estate developers in the world to equip its facilities with solar panels to generate clean electricity. The panels are connected to the Fronius Solar. web system, which allows you to optimize and store excess electricity. Robonomics engineers connected report service on the generation and consumption of electricity at one of the facilities to the Solar.web system, and prepared a carbon footprint offset service if the total consumption of the house exceeds the electricity generation of solar panels. It is implemented as an integration for Home Assistant and allows you to track the daily distribution, consumption and production of solar energy.

The team hopes that this project will help create a healthy living environment in the future.

Repository of Solar.web integration for Home Assistant:
<<< github

Case #28
ROBONOMICS HELPS ENABLE RUST FOR ROS2

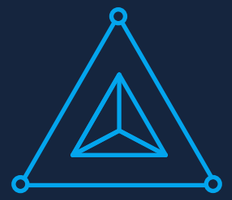
In 2021, the Robonomics team met robotics engineer Esteve Fernandez, a former member of the team that developed the second version of the Robot Operating System (ROS 2). ROS was originally created for architecturally simple robotics applications for research purposes. However, over time, ROS began to be commercialized, so the developers decided to add new features (support for multi-agent systems, embedded systems, real-time integration).

We agreed with Esteve to collaborate on the development of the ROS2 library for the Rust language, which is the main language for the Robonomics parachain. Rust has significant advantages for robotics applications, as it enables low-level, memory-safe development without runtime costs. Rust makes the development of complex and risky projects more efficient.

At the moment, ros2-rust supports message generation, publish/subscribe mechanism, clients and services, as well as support for the libp2p communication library. One of our goals in developing this case is to turn Robonomics into ROS 2 Middleware, for providing standard ROS 2 features such as discovery, serialization, and transportation. This will allow us to use Robonomics on Substrate to create an dapp that can run ROS 2 right from the browser!

More about
the ROS2 on Rust:

<<< robonomics.network/blog



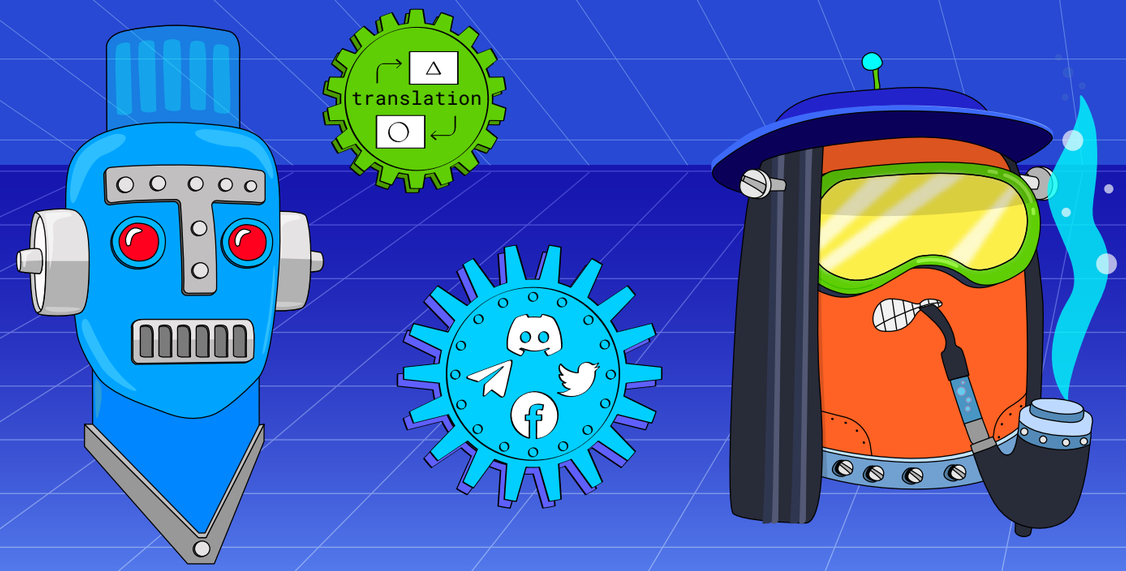
ROBONOMICS AMBASSADOR PROGRAM

Now you are a little closer to Robonomics. If you are interested in our project, our values are close to you, and you are just as passionate about new generation technologies as we are, we invite you to contribute to the development and promotion of Robonomics!

Learn, generate new ideas, talk about it, realize your talents, communicate — touch the creation of a high-tech future with us!

Become a Robonomics Ambassador:

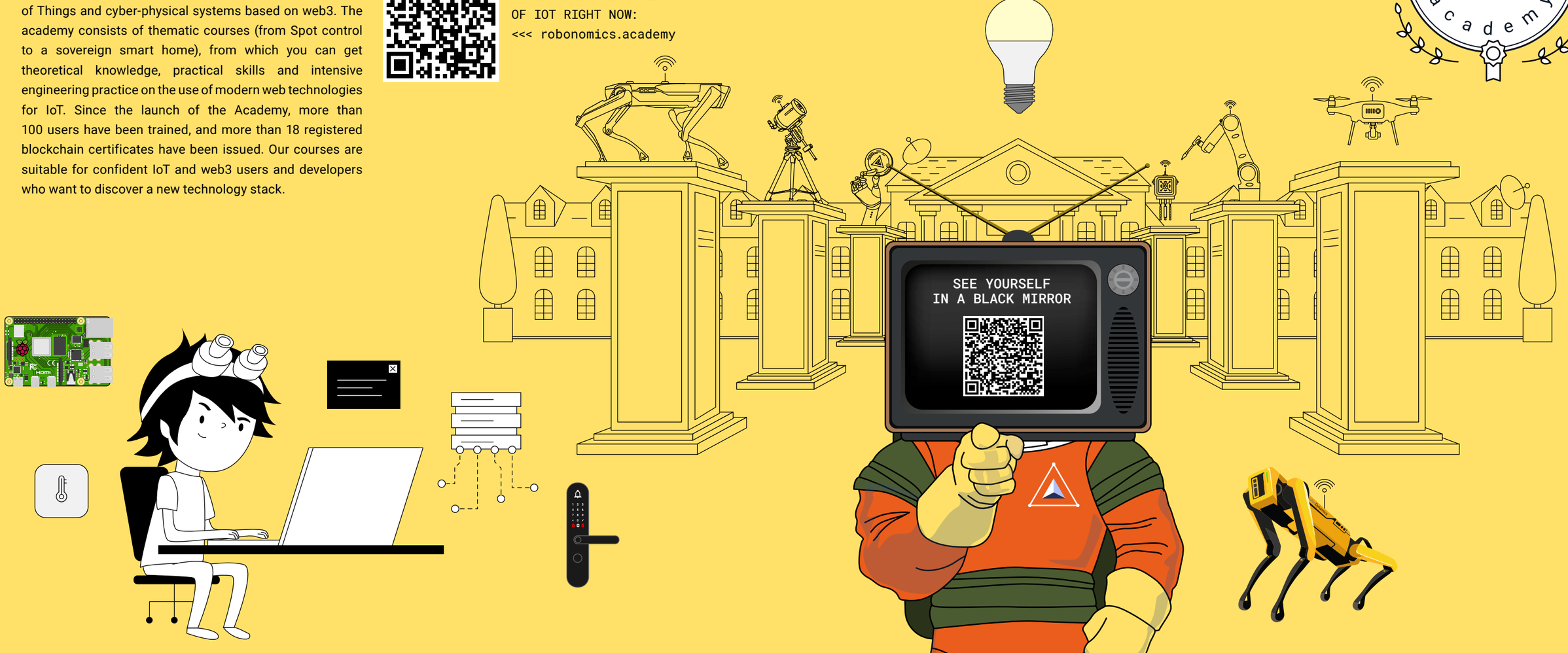
<<< robonomics.network



ROBONOMICS ACADEMY

On May 22, 2022, we launched Robonomics Academy, an educational provider to the world of the Internet of Things and cyber-physical systems based on web3. The academy consists of thematic courses (from Spot control to a sovereign smart home), from which you can get theoretical knowledge, practical skills and intensive engineering practice on the use of modern web technologies for IoT. Since the launch of the Academy, more than 100 users have been trained, and more than 18 registered blockchain certificates have been issued. Our courses are suitable for confident IoT and web3 users and developers who want to discover a new technology stack.

TAKE THE FIRST STEP
TO EXPLORE THE WORLD
OF IOT RIGHT NOW:
<<< robonomics.academy



NFT COLLECTION – ROBONOMICS CRYPTO GIRLS

We are pleased to introduce our special Robonomics Crypto Girls series of digital assets. The concept of this collection was developed by the Art&Science team: each NFT is unique and is a graphic representation of the technology used in Robonomics or a case built on Robonomics. Each girl is hand-drawn by our artists in the signature style of Robonomics. Choose what is closer to you, or collect the entire set! By the way, we plan to replenish it - do not miss the release of new cards;)

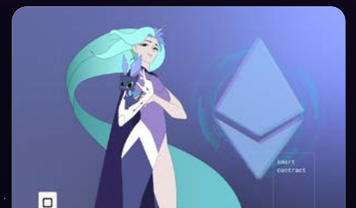
Our Crypto Girls can be not only a stylish addition to your collection, but also a way to support us - by purchasing NFT, you are helping us to continue to create and innovate in the coming year.

Do you want to see your project as a Crypto Girl?
Email us: **Discord!**

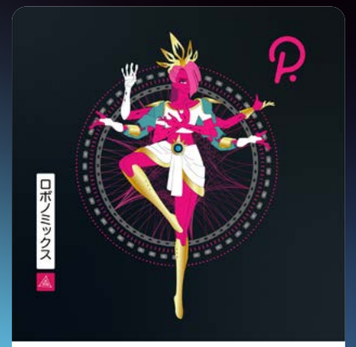
BUY NFT:

opensea.io/collection/robonomics-crypto-girls

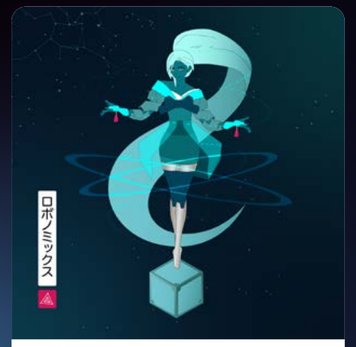
#10 Bitcoin



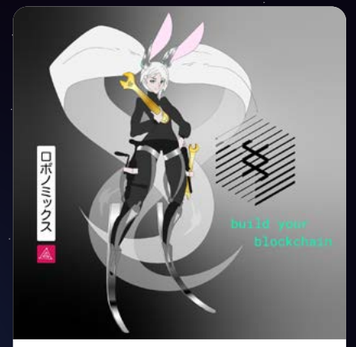
#9 Ethereum



#8 Polkadot



#7 IPFS



#6 Substrate Framework

#3 Kusama Mars colonization

SEASONAL SPOT NFT COLLECTIONS

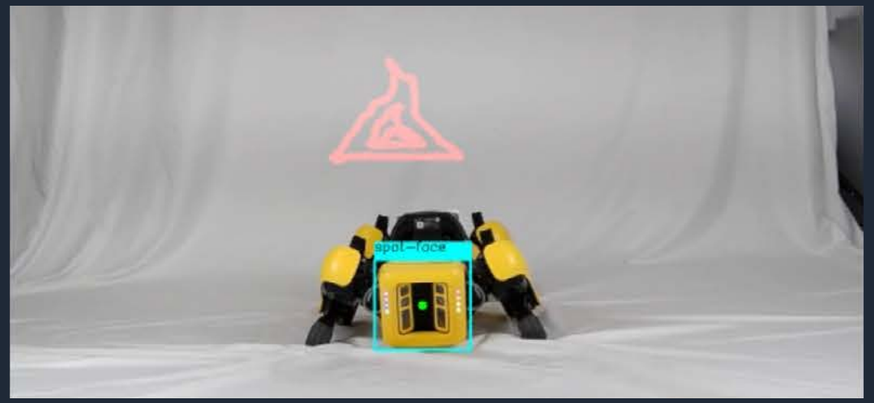
Spot NFTs are a unique service that allows users to collaborate with a Boston Dynamics Spot robot dog to create artistic NFT postcards. Our goal is to generate interest in robotics with an exciting collection of digital art created for annual international holidays. Whether you're a fan of robots or just looking for a fun and exciting activity, this service has something for everyone. From cute and cuddly Valentine's Day collections to spooky Halloween NFT cards, the Spot NFT collections are packed with designs sure to blow your mind.

The robotics industry is booming and soon we will see robots in our daily lives - try chatting with our robot right now and tell us what you think about bringing robotics to life in **Discord!**

Make you NFT with Spot:

<<< spot.merklebot.com

Hi, I'm Spot and I can paint! 🦾 🐶 👨‍🎨



Halloween with Robots!

Halloween with Robots

IMAGE Price: Not listed

Happy New Year 2023 from Spot 🎉

NY 2023 with Spot

IMAGE Price: Not listed

Polkadot Latam Day 2022 with Spot!

Polkadot Latam 22' with Spot

IMAGE Price: Not listed

St. Valentine's 2023 with Spot ❤️

St. Valentine's 2023 #9

IMAGE Price: Not listed

ROBONOMICS ART SHOP

As already mentioned, at Robonomics we are inspired by everything futuristic, in particular the theme of space. That's why we started our brand store with the «Robots on Mars» collection, which symbolizes our belief in the potential of robots to help colonize other planets!

We've fleshed out our fantasies of free-roaming and gravity on Mars, made a couple of Philip K. Dick-inspired sketches, and added a community-favorite astronaut.

Whether you're a space exploration fan, a robotics enthusiast, or just looking for a unique and stylish gift with a bold and eye-catching design, you'll find what you're looking for here.

Order merch:
<<< robonomics.network/shop/

CONNECT ROBOTICS

JOIN US

robonomics.network

robonomics discord

Check out last year's R&D projects:
R&D Robonomics // Volume #1 (2019-2021)

ROBONOMICS.NETWORK • BOOK №5 • 2022 • English version