

A Blockchain Platform for the Supportive Exchange of Data, Goods and Services

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ABSTRACT

Universal access to information and knowledge is the basic condition for improving the quality of life in developing countries.

Nowadays the sharing of information is made easier by the evolution and diffusion of Information and Communication Technologies (ICTs).

In this framework a web-based platform, the World Food Security E-Center (WFSEC), was developed by the University of Milan with the goal of fighting food emergencies by transferring competences and adequate solutions to rural communities.

In addition, we designed a blockchain structure for the WFSEC in order to allow a controlled exchange of the IoT data and to obtain a self-financing network by the exchange of tickets as electronic money.

Keywords

Teleconsulting, agrifood, cooperation, IoT, blockchain.

1. INTRODUCTION

The global connectivity and the cell/smartphone large diffusion allows to offer better life conditions for disadvantaged people and communities [1].

Driven by the urgent humanitarian needs highlighted by the OCCAM Observatory of Digital Communications and the Infopoverty Program (<http://occam.org>), the University of Milan realized the World Food Security E-Center, devoted to assist developing countries on rural development and urban nutrition, sharing knowledge and adequate solutions.

The software platform exists also as a Telemedicine service in the frame of the Program "Milan in the fight against hunger, malnutrition and related diseases" supported by the Municipality of Milan, serving as a consulting tool and health information exchange [2][3]. Telemedicine can be added in the future as further service of the integrated platform [4][5].

2. THE TELECONSULTING PLATFORM

The platform can be accessed after registration by Service Users (SU) and Service Providers (SP). The SU is the subject located in the developing country that collects data, images, signals manually or through IoT sensors located on the territory.

The SP is usually a University, research center or specialized laboratory that offers consultancies addressing the problems raised by SU (Figure 1).

The whole platform is coordinated by the WFSEC Hub manager, that can control the correct addressing and finalization of all the information transactions (Figure 2).

In particular, all the SU and the SP have the possibility to:

- view the global, personal and group activity stream, post directly their questions or sending a short message to other users;
- request or provide information, submit files or view the published ones [6] (Figure 3);
- provide courses uploading documents, images and links to videos, and attend them [7] (Figure 4);
- get or add contact infos of the SU or SP subscribed to the platform (Figure 5);
- manage or join a real time multiuser VOIP videoconference [8] (Figure 6);
- connect to a suitable channel for transmission of the Internet of Things signals coming from suitable sensors installed in the developing countries, yielding useful real time data (Figure 7);
- query the data repository to access all the data and the published information, and create reports and statistics [9][10] (Figure 8).

The online platform, as well as all the generated documents, can be accessed from PCs as well as from mobile phones, both on-line and off-line, providing a synchronous and asynchronous information exchange.

After the necessary testing phase and the involvement of a group of experts and laboratories, the platform is ready to be immediately available to all the users in the need of remote assistance.

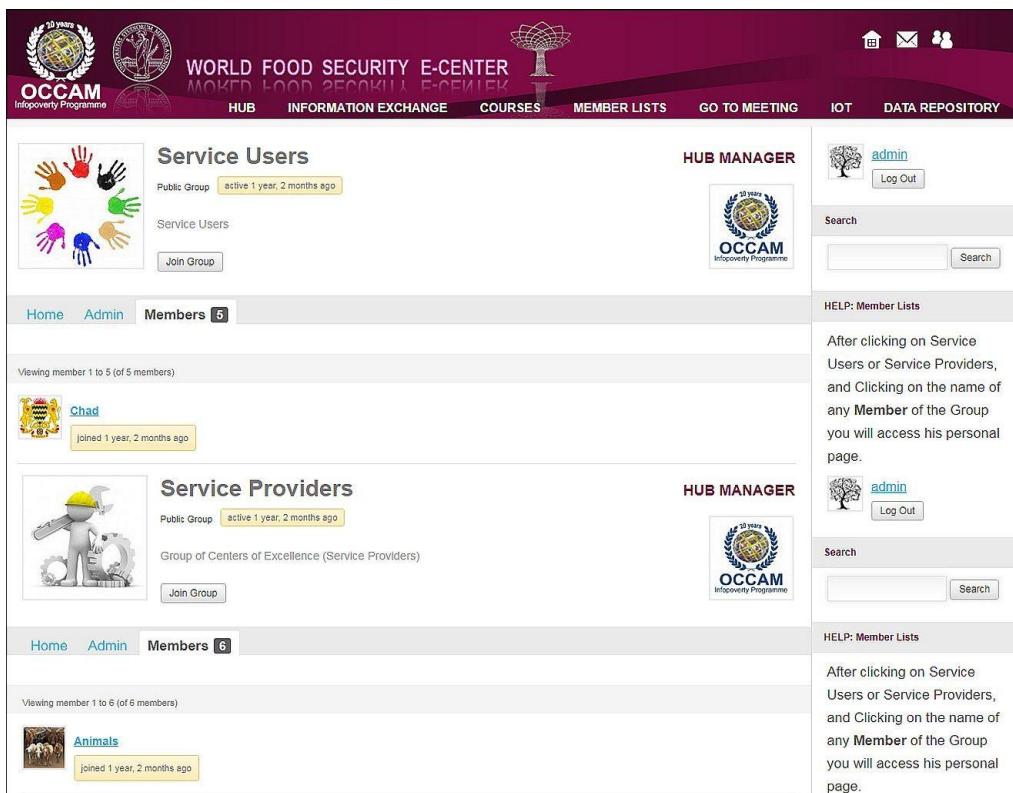
3. IoT / BLOCKCHAIN EVOLUTION OF THE PLATFORM

We also studied a blockchain framework that applied to the WFSEC would be able to allow both the controlled and supportive management of the supplied data (especially IoT data) and the self-sustainability of the platform.

Blockchain is a network protocol that uses various technologies to create a chain of linked blocks. This chain is owned by all the nodes of the network and acts as a distributed database that allows the shared control of all transactions on an equal basis [11].

As for the above described platform configuration, we have so far two types of subjects: the SU and the SP.

At the core of this structure we have the Hub, central body that acts as guarantor for the whole network.



The screenshot shows the 'Service Users' section with a group of diverse hand icons. It includes a 'Join Group' button and a 'Public Group' status message. Below it, the 'Service Providers' section features a stick figure icon with a wrench and gear, along with a 'Group of Centers of Excellence (Service Providers)' message and a 'Join Group' button. A sidebar on the right provides administrative help for member lists.

Service Users
 Public Group active 1 year, 2 months ago
 Service Users
 Join Group

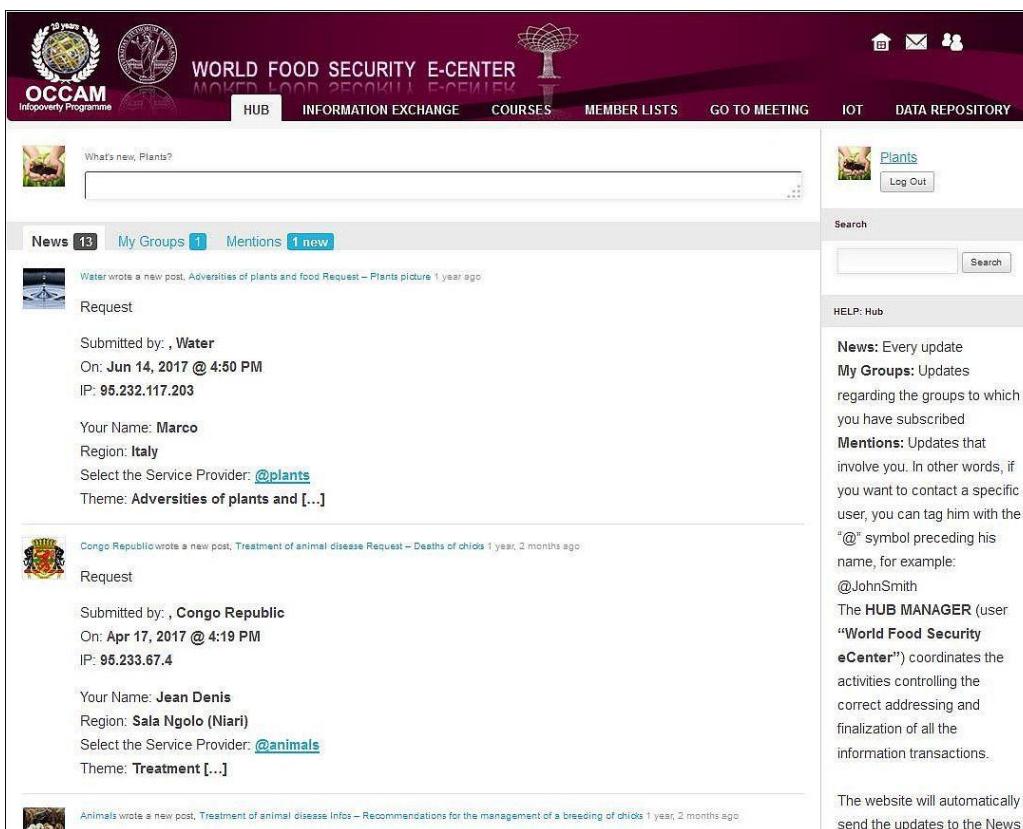
Service Providers
 Public Group active 1 year, 2 months ago
 Group of Centers of Excellence (Service Providers)
 Join Group

HUB MANAGER
 OCCAM Infopoverity Programme

admin Log Out
 Search
 HELP: Member Lists
 After clicking on Service Users or Service Providers, and Clicking on the name of any Member of the Group you will access his personal page.

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Fig 1: Service Users and Service Providers list



The screenshot displays a 'News' feed with posts from users like 'Water' and 'Congo Republic'. It shows transaction details such as date, time, IP address, and user names. A sidebar on the right explains the Hub Manager's role in managing platform transactions.

What's new, Plants?

News 13 **My Groups** 1 **Mentions** 1 new

Water wrote a new post, Adversities of plants and food Request – Plants picture 1 year ago

Request
 Submitted by: , Water
 On: Jun 14, 2017 @ 4:50 PM
 IP: 95.232.117.203
 Your Name: Marco
 Region: Italy
 Select the Service Provider: [@plants](#)
 Theme: Adversities of plants and [...]

Congo Republic wrote a new post, Treatment of animal disease Request – Deaths of chicks 1 year, 2 months ago

Request
 Submitted by: , Congo Republic
 On: Apr 17, 2017 @ 4:19 PM
 IP: 95.233.67.4
 Your Name: Jean Denis
 Region: Sala Ngolo (Niari)
 Select the Service Provider: [@animals](#)
 Theme: Treatment [...]

Animals wrote a new post, Treatment of animal disease Infos – Recommendations for the management of a breeding of chicks 1 year, 2 months ago

HUB MANAGER
 OCCAM Infopoverity Programme

admin Log Out
 Search
 HELP: Hub
News: Every update
My Groups: Updates regarding the groups to which you have subscribed
Mentions: Updates that involve you. In other words, if you want to contact a specific user, you can tag him with the "@#" symbol preceding his name, for example: @JohnSmith
 The HUB MANAGER (user "World Food Security eCenter") coordinates the activities controlling the correct addressing and finalization of all the information transactions.
 The website will automatically send the updates to the News

Fig 2: The Hub manager log allows to control the flow of all the platform transactions

Access by Service Users to post a Request

Your Name*

Region*

Select the Service Provider* @water @plants @animals @food @other

Theme*

Subject (max 90 char)* e.g. "ants photo"

Description* Write your request

Attachment Choose file selectorata.

Note The fields marked with * are mandatory.

Publish a Request
 In this section, if you are a Service User you will be able to write a request. After you submit the request, it will be filed under "Go to Requests" page.
 The selected Service Provider will be notified of the request also by email.

Go to Requests
 This section contains the list of all requests
 Click on each entry you will be able to comment, reply, and add a file to your answer. The Service User will be notified of the reply also by email.

Details of the Request
 Submitted by: Ched
 On: Apr 15, 2017 @ 4:31 PM
 IP: 87.77.244
 • Your Name: Marie Lucie
 • Region: Bourkou and Tibesti
 • Select the Service Provider: @plants
 • Theme: Adversities of plants and food
 • Description ID: 001 - Date palms infested by animal parasites
 • Description: In our northern regions, Bourkou and Tibesti, we have our date palms infested by animal parasites (such as white cochineal, palm acar and termites) or fungi, causing the death of plants. What are the means to combat these pests and to prevent these diseases?
 • Attachment:

Courses to share

5 responses to Courses to share

- World Food Security eCenter said on April 5, 2017
Saving women's rights in Iraq
- World Food Security eCenter said on April 5, 2017
Republic of Congo the fight against cholera
- World Food Security eCenter said on April 17, 2017
Kenya: Telemedicine and Broadband
- World Food Security eCenter said on April 17, 2017
The Sendai Framework for Disaster Risk Reduction
- World Food Security eCenter said on April 17, 2017
Changing population age structures and sustainable development

Fig 3: Posting of a Service User's requests

Fig 4: Available Courses

Infos Archive: Go to Infos

access by Service Providers to read the Infos

Treatment of animal disease Infos – Recommendations for the management of a breeding of chicks
 by Animals No Comments x

Access by Service Providers to post Infos

Your Name*

Region*

Select the Service Provider* @plants @animals @food @other

Theme*

Subject (max 90 char)* e.g. "meteo news"

Description* Write the Infos

Attachment Choose file selectorata.

Note The fields marked with * are mandatory.

Publish a Request
 In this section, if you are a Service User you will be able to write a request. After you submit the request, it will be filed under "Go to Requests" page.
 The selected Service Provider will be notified of the request also by email.

Go to Requests

Fig 5: A menu allows Service Providers to post Infos or to answer the received requests

Go to Meeting

zoom SOLUTIONS PLANS & PRICING JOIN A MEETING HOST A MEETING SIGN IN SIGN UP, IT'S FREE

Join a Meeting

Plants
 Your meeting ID is a 9, 10, or 11-digit number

Join

Auto

Fig 6: Videoconference access page

The screenshot shows the 'Internet of Things' section of the platform. At the top, there are logos for OCCAM and the World Food Security E-Center. The menu includes HUB, INFORMATION EXCHANGE, COURSES, MEMBER LISTS, GO TO MEETING, IOT (selected), and DATA REPOSITORY. On the left, there's a sidebar with a 'Plants' icon and a 'Log Out' button. The main content area displays IoT channels for four countries:

- São Tomé and Príncipe:** Shows icons for soil moisture, soil pH, and webcam.
- Congo Republic:** Shows icons for soil moisture and soil pH.
- Chad:** Shows an icon for soil moisture.
- Madagascar:** Shows an icon for soil moisture.

To the right of the country icons, there's a detailed description of the IoT feature:

When you log in, you can select one of the following sensors:

HELP: IoT

Login with the user name and password given you by the Service User IOT manager. When you log in, you can enter the number related to the chosen sensor, and you will be directly connected by our Server to the real time data coming from the device.

Fig 7: IoT channels. Data from sensors located on the Service Users territories are directly received by the platform server

The screenshot shows the 'Data Repository' section of the platform. At the top, there are logos for OCCAM and the World Food Security E-Center. The menu includes HUB, INFORMATION EXCHANGE, COURSES, MEMBER LISTS, GO TO MEETING, IOT, and DATA REPOSITORY (selected). On the left, there's a sidebar with a 'Plants' icon and a 'Log Out' button. The main content area displays a hierarchical file structure:

```

    Data Repository
    +-- Activity
    +-- Groups
        +-- Service Users
        +-- Service Providers
        +-- Images
    +-- Requests
    +-- Infos
    +-- Courses
  
```

To the right of the file structure, there's a detailed description of the Data Repository feature:

HELP: Data Repository

You can navigate through all the published data and information of the platform and have the possibility to output them, query the data repository and create reports and statistics.

Fig 8: Data repository

The new scenario prefigures a private blockchain platform in which not only data and information, but tickets that act as electronic money are exchanged [12].

The Hub has the task of verifying the correct occurrence of the exchange of tickets for the payment of the consultancies.

The novelty lies in the possibility to reach a self-financing network [13].

But it is also possible the introduction of new intermediate subjects, the Stakeholders (SH).

The infrastructure at the base of the network remains the same.

The Stakeholders (that can be also the Service Users selling their products) offer services and goods on the network, for them they require compensations. This fee is partly turned over to the Hub. The Hub then checks the amount of tickets present on the whole network and decides in which percentage to increase this number.

After which the costs paid to the relative Stakeholders are reversed, with the addition of a premium proportional to the paid tickets (Figure 9).

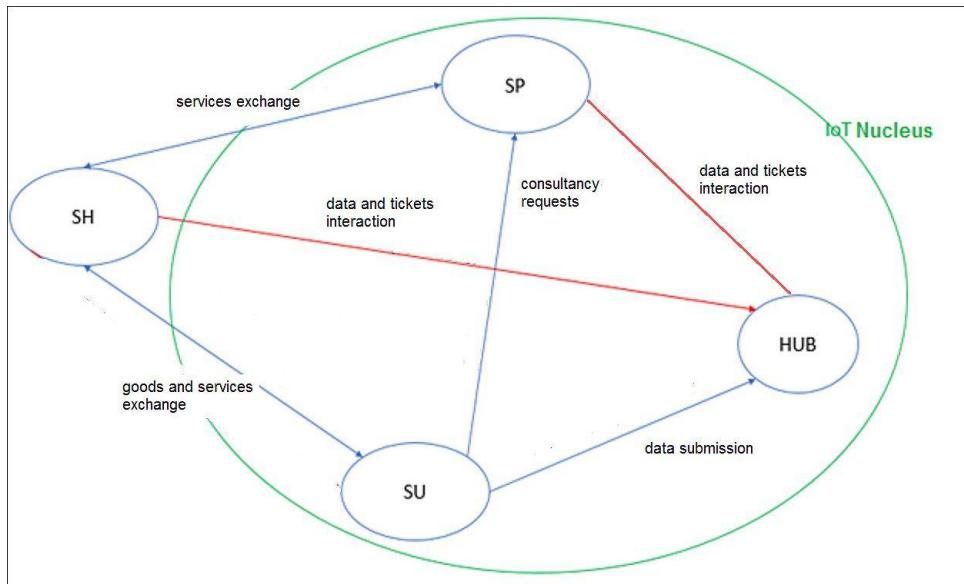


Fig 9: Evolution of the platform: Blockchain tickets exchange

These awards allow services and goods to be more accessible as costs decrease, or the provider can get the resources necessary to improve the service/good offered.

The software platform maintains the same architecture, but the request form becomes for example as in Figure 10.

Access by Stakeholders to post a Request	
Your Name or business name *	<input type="text"/>
Name or business name of the seller *	<input type="text"/>
Region *	<input type="text"/>
Select the product *	<input type="radio"/> @busticket <input type="radio"/> @animals <input type="radio"/> @hospital ticket <input type="radio"/> @food <input type="radio"/> @other
Quantity *	<input type="text"/>
Description *	<input type="text" value="Write your request"/>
Attachment	<input type="button" value="Sfoglia..."/> Nessun file selezionato.
Note	The fields marked with * are mandatory
<input type="button" value="Submit"/>	

Fig 10: New request form including exchange of good and services to be paid through Blockchain

There are other advantages offered by the blockchain framework:

- in the IoTs network, the blockchain itself allows to guarantee and authenticate the data exchanged between smart devices;
- the blockchain could also act as guarantor for the exchange of renewable energies between individuals without consulting a centralized intermediary;
- it also allows point-to-point control of donations, as the blockchain itself guarantees that the transactions reach the correct target without intermediate manipulations.

In summary the data exchange supported by the teleconsulting platform activates a self-controlled ticket movement [14]. The virtual money can be exchanged with regular currency, but

has the advantage not to face currency exchange problems among countries, allowing simpler product selling procedures.

The blockchain platform extends the application context to the whole world, allowing the exchange of any kind of good and services, included data and knowledge, by means of the exchange of tickets passing through the Hub [15]. Thus any Service User can benefit from the platform usage.

4. CONCLUSIONS

We developed a web-based platform able to support farming communities in the developing country by means of a network of experts. The knowledge can be shared and remains at disposal for future needs, increasing in time. The platform can be accessed from any device and can manage data coming from remote IoT sensors.

Blockchain technology may be applied to the web platform in such a way as to allow agrifood operators in remote countries to exchange not only knowledge but also goods and services in a supportive framework [16] [17]. A central Hub acts as a guarantor and shares awards among all the users allowing an easier access to services and goods. In the meantime, the underlying teleconsulting platform allows the agrifood operators to access high-level knowledge to improve their work [18].

The model can be easily implemented and would allow the self-sustainability of the platform.

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