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Pilot 2 - Status Report

August 29th 2022

Outline

Background

1. **Introduction:** Context, Objectives and Roadmap
2. **Selected scenario:** “The book coupon scenario”

Pilot 2

1. **The proposed system:** Flow & Processes, Back-end, and Front-end
2. **Final Pilots:** Execution, Results, and Feedbacks and improvements
3. **Conclusion and next steps:** takeaways and further improvements.

1. EmFi Context and Objectives

- The EmFi project is aimed at studying the use of new decentralized systems and digital programmable currencies (also called tokens). The general application context is that of Emergency Finance, where public authorities deliver specific financial interventions, such as the distribution of public resources to possibly specific layer of population or economic sectors, with a view of transparency and effectiveness.
- EmFi explores a specific use in collaboration with the Milano Council as a test-bed scenario: the distribution of book coupon for students in primary education.
- EmFi exploits distinguished technical features of the Algorand blockchain. Particularly, the delivered use-case, tested with a live pilot, allows both the generation of financial circuits subject to specific laws (validated by Algorand smart contracts); and extends the set of users, including - under reasonably trust assumptions - those that are not or cannot be internet-connected (by means of Algorand logic signatures).

Goal And EMFI Consortium

GOALS

Goals of the project include the design of a suitable framework and the execution of a pilot use case to validate the approach in collaboration with the Council of Milano.

This project will provide Algorand Foundation with a first use case, based on DLT and digital money, on the actual distribution of aids to final users, able to be also used in context like crisis scenario or unbunker.

The reference technological context is in a strongly developing phase worldwide, and in Europe, with a large number of studies in the context of digital money.

THE PROJECT CONSORTIUM

The Politecnico di Milano, project coordinator, focuses on financial technology and legal aspects. The University of Stirling is responsible for the design of the technological infrastructure and the definition of efficient and accountable procedures for the management of beneficiaries, resources and aims of interventions through programmable digital money. Cefriel is responsible for the development of the EmFi framework and the execution of the pilot, and the technical coordination. The Council of Milano is partner of the project, contributing to the definition of use cases (support to pupils in primary schools) and financial circuits, within a synergic approach with their other projects currently running

EMFI ROADMAP

	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Quarter 5	Quarter 6	Quarter 7
Activities	March '21-Jun 21	Jul 21-Sept 21	Oct 21-Dic 21	Jan 21-Mar 22	Apr 22-Jun 22	Jul 22-Sept 22	Oct 22-Dec 22
Set Up & Study of Algorand Technology/Framework					▲ EMFI Framework		
Collect Requirements, Use Case Definition and EMFI Definition		▲ Book coupon Process & Re Req + EMFI Spec.					
EMFI Design & Development			▲ EMFI Wallet			▲ EMFI core	
Pilots Design & Deploy			▲ Pilot 1 Mobile App			▲ Pilot 2 with Comune and Bookseller	
Project Management & Communication	▲ Partners Joint Comm		▲ Scotland Fintech Festival & Salone dei Pagamenti			▲ Algorand Comm	▲ Final Demo & Closure

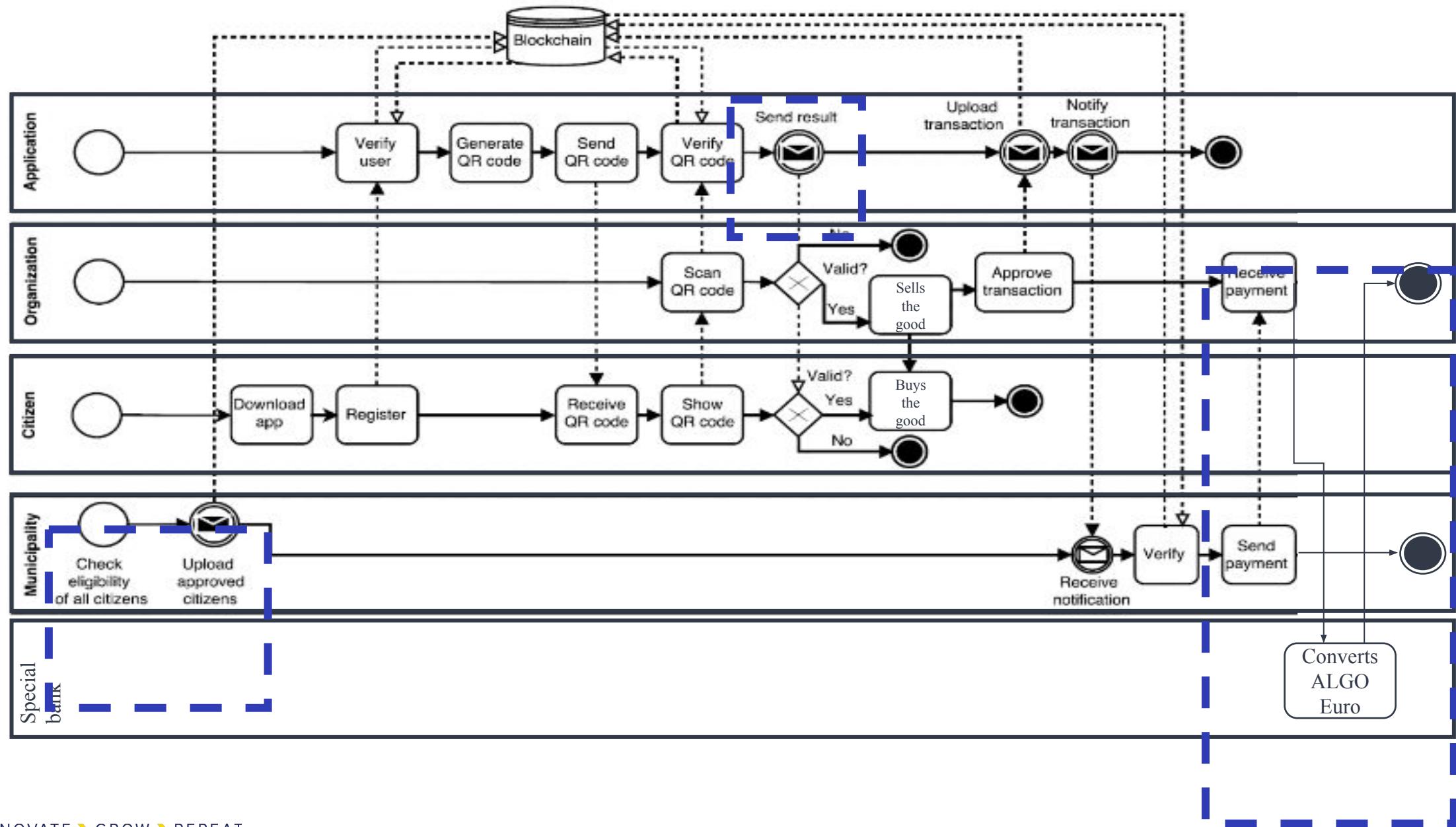
2. Selected Scenario: Primary School Book Coupon Scenario

- The **objectives** of the pilot book coupons are three:
 - The institution will have transparency on the digital coupon process: from the exchange of the coupon between the family and the bookseller to the reconciliation and liquidation of public funds;
 - The process will be faster and more efficient, with less human intervention: the bookseller will be able to see the liquidated funds more quickly;
 - Families will not be impacted by the process change
- The research includes
 - a **study phase of a significant use case** and
 - a pilot phase in the field.
In the following, we will show the output of the study phase, and our proposal for the digitization of coupons
- Two experimentation took place
 - **First pilot 1** to test the EMFI App was conducted in October 2021 at the Politecnico di Milano
 - **Second pilot 2** to test the EMFI circuit and the book coupon real process in June 2022.

2. Interest for the sperimentation and requirements

- Chief Digital Officer at the Municipality of Milan with whom we talked about the current process of the book coupons (in italian, Cedola Libraria) and the automation project they have designed.
- With respect to the "as is" process, although he is not the owner, he clarified the existence of a DB ANASCO (ANAgafe SCOlistica) managed by the Municipality which is used to record attendance in compulsory school.
- This DB contains information about schools, classes and pupils
- In particular, the idea of using a **QR code to transmit the digital token / coupon** between the parent and the bookseller is considered to be preferable. In particular, in the test phase, the QR code could be printed on paper and subsequently integrated into the apps of the Municipality of Milan.

Decentralized Coupons and Vouchers procedure: standard paradigm



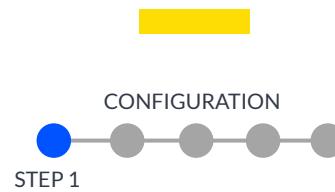
Video Pitch



3. The proposed system: Flow & Processes, Back-end, and Front-end

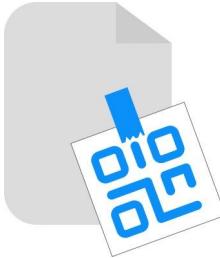
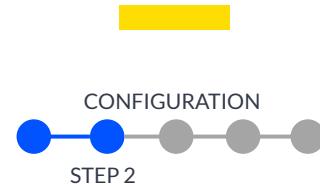


Account Creation



- The booksellers and the municipality must have their own wallet which will be used to receive and send the digital currency.
- It will not be necessary to create an account by the school and families.
- The information necessary to proceed with a correct parameterization of the platform are:
 - The anonymized list of students
 - The value of each coupon per student
 - The identification code of the accounts of the booksellers who can receive the coupons

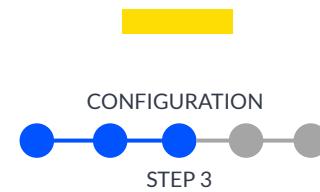
QR codes issuing code and school delivery



Creazione dei QR Code e consegna con le cedole

- Each coupon will be accompanied (or, in the future, replaced) by a QR code which contains:
 - Coupon information, such as the total coupon value
 - A series of computer controls, run by a smart contract on the Algorand blockchain, that will allow the bookseller's app to exchange digital currency in total safety
- The QR codes shall be delivered in paper format or sent electronically (for example, via e-mail)

Configuraion and App delivery



Configurazione e
consegna della app

- The bookseller must be provided with an account and a wallet plus an EMFI application (in the first pilot was mobile, in the second web)
- When the bookseller logs into the app, they will see their account and will know how much digital currency they have received following the coupon exchange with the families (as described in the following slide)

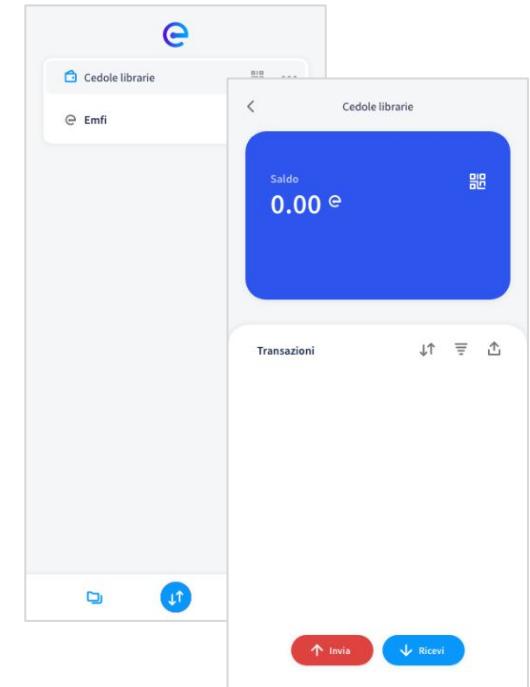
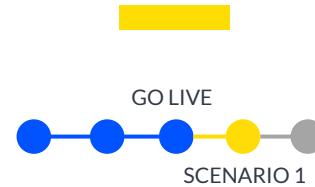


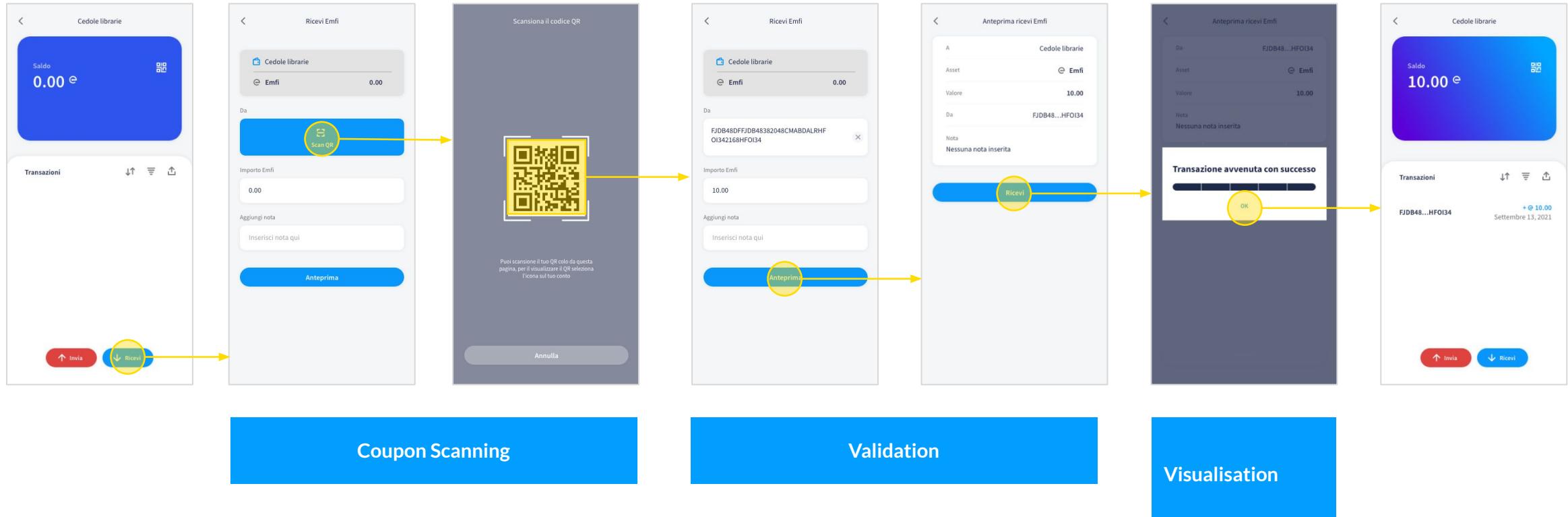
Fig. Front-End (mobile app or Desktop)

Exchange of the coupon between the family and bookseller



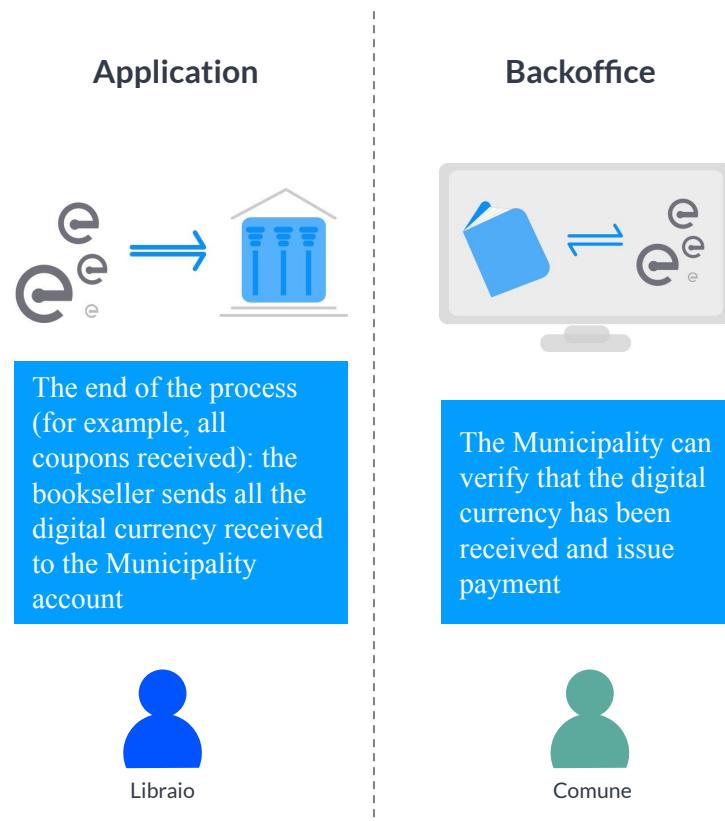
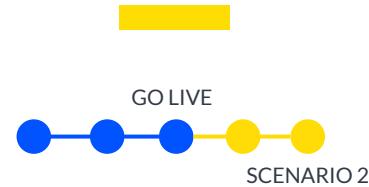
- The coupon exchange procedure will then follow the following steps:
 - The family receives the printed QR code and can go to the affiliated bookseller
 - The bookseller scans the coupon QR code through his application (Pilot App)
 - Through the application, the system acquires the QR code, verifies its authenticity and records an amount of digital currency up to the value of the coupon.
 - The successful acquisition appears on the display at the end of the process
- In a first phase of experimentation, the family delivers the paper coupon to the bookseller in line with the traditional process

GoLive: Book coupon exchange



PROCESS

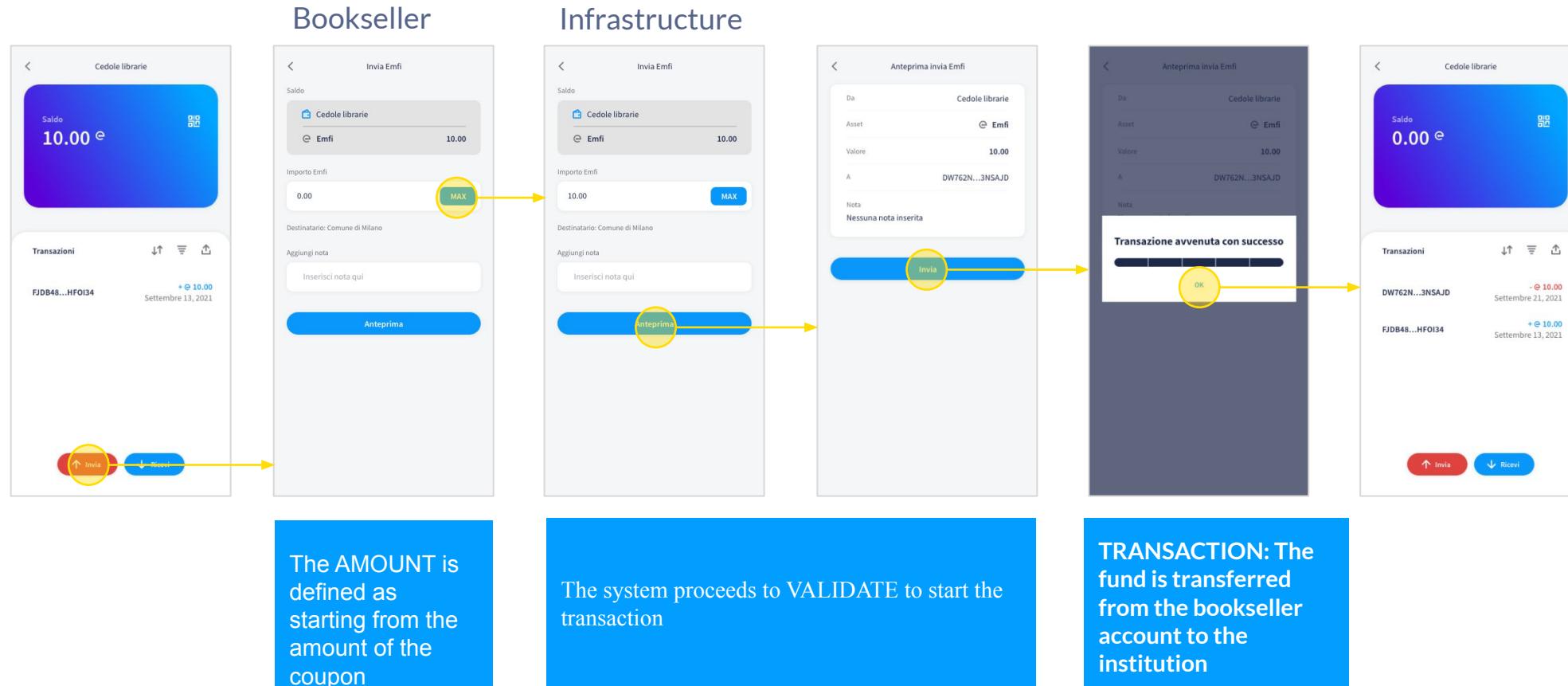
Liquidation



The liquidation process will also take place on the bookseller side on the app:

- The bookseller uses the app (Pilot App) to send all or part of the tokens acquired to the Municipality.
- In particular, he can press a "max" button and the total amount of tokens collected will be automatically entered by the app and transmitted.
- The Municipality will have access to digitally certified information - via blockchain cryptography - for the validation and reporting of the process.
- The Municipality will be able to liquidate the bookseller in the face of certified information, in the most appropriate ways. The whole process could be integrated and automated

GoLive: Liquidation



Display of the steps of the prototype, on the front-end application side, for the liquidation process of the bookseller's funds

4. Final Pilots: Execution, Results, Feedbacks and improvements

Pilot 2: testing plan

Application tests:

- Spending two times the same QR
- Paying an unlisted bookseller
- Paying two different booksellers with same qr
- Paying two different booksellers with different qr
- Reverse engineering QR
- Spend entire coupon
- Spend smaller amount
- Spend larger amount

students' codes

Pilot Tests:

- Day 1
 - 634299 - buy all books
 - 1223679 - buy "SUSSIDIARIO"
 - 626146 – buy RELIGION (Book 1) & INGLESE (Book 2)
 - 715716 - buy all books
- Day 2
 - 634299 - buy SUSSIDIARIO -> **Error** - not enough funds [has already bought all the books]
 - 1223679 - buy RELIGION and INGLESE
 - 626146 - buy SUSSIDIARIO
 - 728021 - buy RELIGIONE
- Day 3
 - 728021 - buy SUSSIDIARIO
 - 636184 - buy all books
 - 123456 - buy RELIGIONE -> **Error** - the QR code is invalid [scam]
- Day 4
 - 728021 - buy RELIGIONE and SUSSIDIARIO -> **Error** - not enough funds [has already bought the SUSSIDIARIO]
 - 636184 - buy all books -> **Error** - not enough funds [has already bought all books]

EMFI Pilot 2 Deploy

- During the week of June 27th-July 2^{sy}, **the final pilot of EMFI** has been conducted by the Team at the library "**Il Passalibro**" in **Sesto San Giovanni**, involving end-users (two library operators), aimed at testing the feasibility of using **Algorand chain and tokens** to implement the book coupon scenario.
- The scenario of "**book coupons for primary school**" was tested accordingly to the national process.
- The feasibility results and issues will be included in the final report of the Project.

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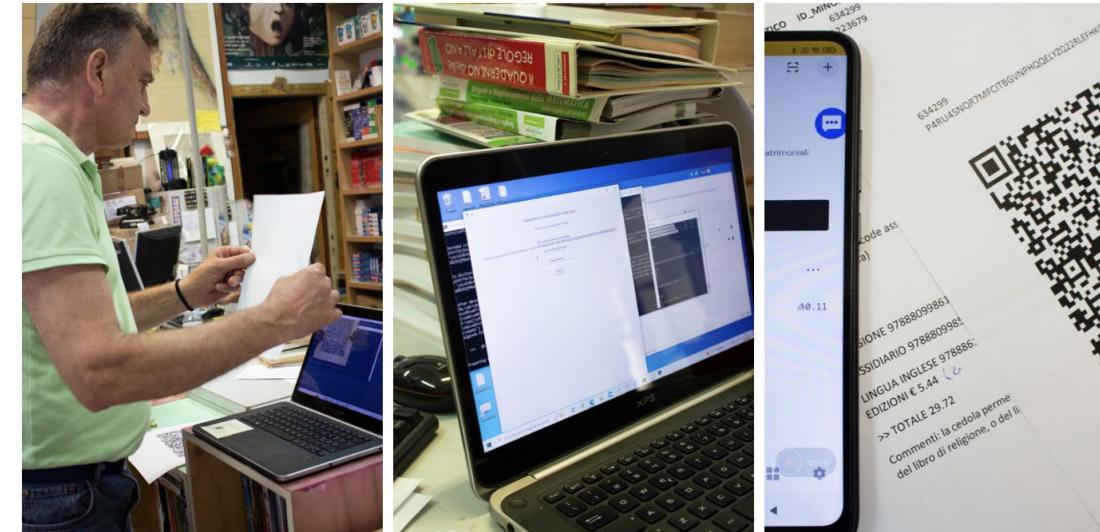
EMFI Smart Payment – Pilot 2

July 19, 2022 Uncategorized

During the week of June 27th-July 2^{sy}, a second pilot of EMFI has been conducted by the Team at the library "Il Passalibro" in Sesto San Giovanni, involving end-users (two library operators), aimed at testing the feasibility of using Algorand chain and tokens to implement the book voucher scenario.

The scenario of "book vouchers for primary school" was tested accordingly to the national process.

The feasibility results and issues will be included in the final report of the Project.



<https://www.qfinlab.polimi.it/emfi-smart-payment-pilot-2/>

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Final Pilot - Back end operations for accounts and QR code preparation (Step one)

- The EMFI Core is the part of the software that is able to create an address for every student that has the right to a Cedola.
- Also it creates (the first time) an address for every bookshop that is in the list.
- Procedure:
 - The Comune address sends the correct amount fo the cedula to every student (38.88 + fees in the pilot) and some algos to the lybrarian.
 - When the addresses are created the QR code, containing the smart signature, and the Teal contract are created by the core.
 - Lastly, the core checks if everything is correct by doing a little transaction.

The screenshot shows a terminal window titled "Prompt dei comandi - python core2.py". The output of the script is displayed, detailing the process of sending money from a master account to bookshops, performing minimum balance transfers for bookshops, sending funding to students, and generating logic signatures and QR codes for students. The terminal also indicates successful transactions and a timeout for waiting for a transaction ID.

```
>>> Send money from master to bookshops
Successfully sent transaction with txID: Y546MR40DDZXDSWW23F6AA7LPH0QTAZKR2Q5F6E456NMZMSEOBHQ
Wait for transaction id Y546MR40DDZXDSWW23F6AA7LPH0QTAZKR2Q5F6E456NMZMSEOBHQ timed out
!!!! Stopping ...

>>> END min balance transfers for bookshops

>>>> Sending funding to students
['A4BLNUNKQMFUKHPIXWG2DE6SFZUS2QTIB5C23RTAAUH5QQEVJHCAMWIS6M', 'VUAYMJOG7YON35LUOA2JM5G2GYCDOMR63ACELLWEESZA50NU33FGU30J
JA', '6HHZ2MZ3VDOC3XHUCWKRTJ4DU4YXU47HRZB5W2542PPK6BD7PBOFRGOMKU', '56IJFXSTTFD2DKGCWXTX44S6V3UNUHYIV4XULZHS6AB7QZEJ47E3
RAGESA', '5ICZOSRBA573BZGJIS20MW2BB5EDWONNROKTU3Y4XW3UBT76QLG3X2VD4Y', '42U3N235R2RLCQVSYGQ6FCSCVWV74PLEHBVOBV2TTFGAEW2H
BHAZQCAYCE']
[38880000, 38880000, 38880000, 38880000, 38880000]
{'A4BLNUNKQMFUKHPIXWG2DE6SFZUS2QTIB5C23RTAAUH5QQEVJHCAMWIS6M': '38880000', 'VUAYMJOG7YON35LUOA2JM5G2GYCDOMR63ACELLWEESZA
50NU33FGU30JJA': '38880000', '6HHZ2MZ3VDOC3XHUCWKRTJ4DU4YXU47HRZB5W2542PPK6BD7PBOFRGOMKU': '38880000', '56IJFXSTTFD2DKGC
WXTX44S6V3UNUHYIV4XULZHS6AB7QZEJ47E3RAGESA': '38880000', '5ICZOSRBA573BZGJIS20MW2BB5EDWONNROKTU3Y4XW3UBT76QLG3X2VD4Y': '38880000
', '42U3N235R2RLCQVSYGQ6FCSCVWV74PLEHBVOBV2TTFGAEW2HBAZQCAYCE': '38880000'}
38880000
Successfully sent transaction with txID: 62YQBTUMGWMZ6VSZJLDX4L6X2Q0MJFVAIBJBV2IVRWLH3HKCAIIA
Wait for transaction id 62YQBTUMGWMZ6VSZJLDX4L6X2Q0MJFVAIBJBV2IVRWLH3HKCAIIA timed out
!!!! Stopping ...

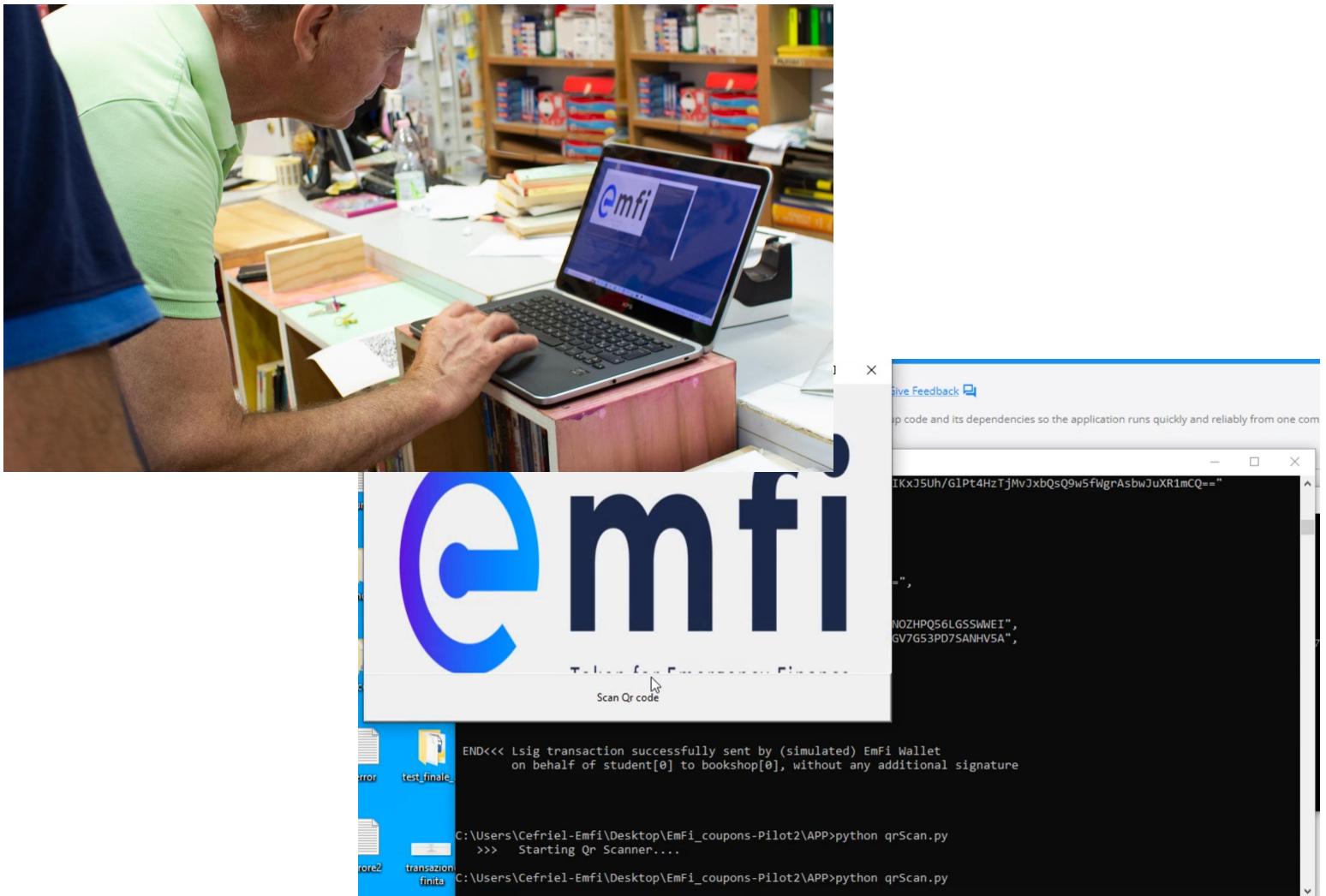
Funding transfers to students completed successfully

Begin generating Logic Signatures and QR codes for students
```

The Core is the part of the software that is able to create an address for every student that has the right to a Coupon (Cedola Libraria).

Final Pilot - Step 2 Bookseller operations (Step 2)

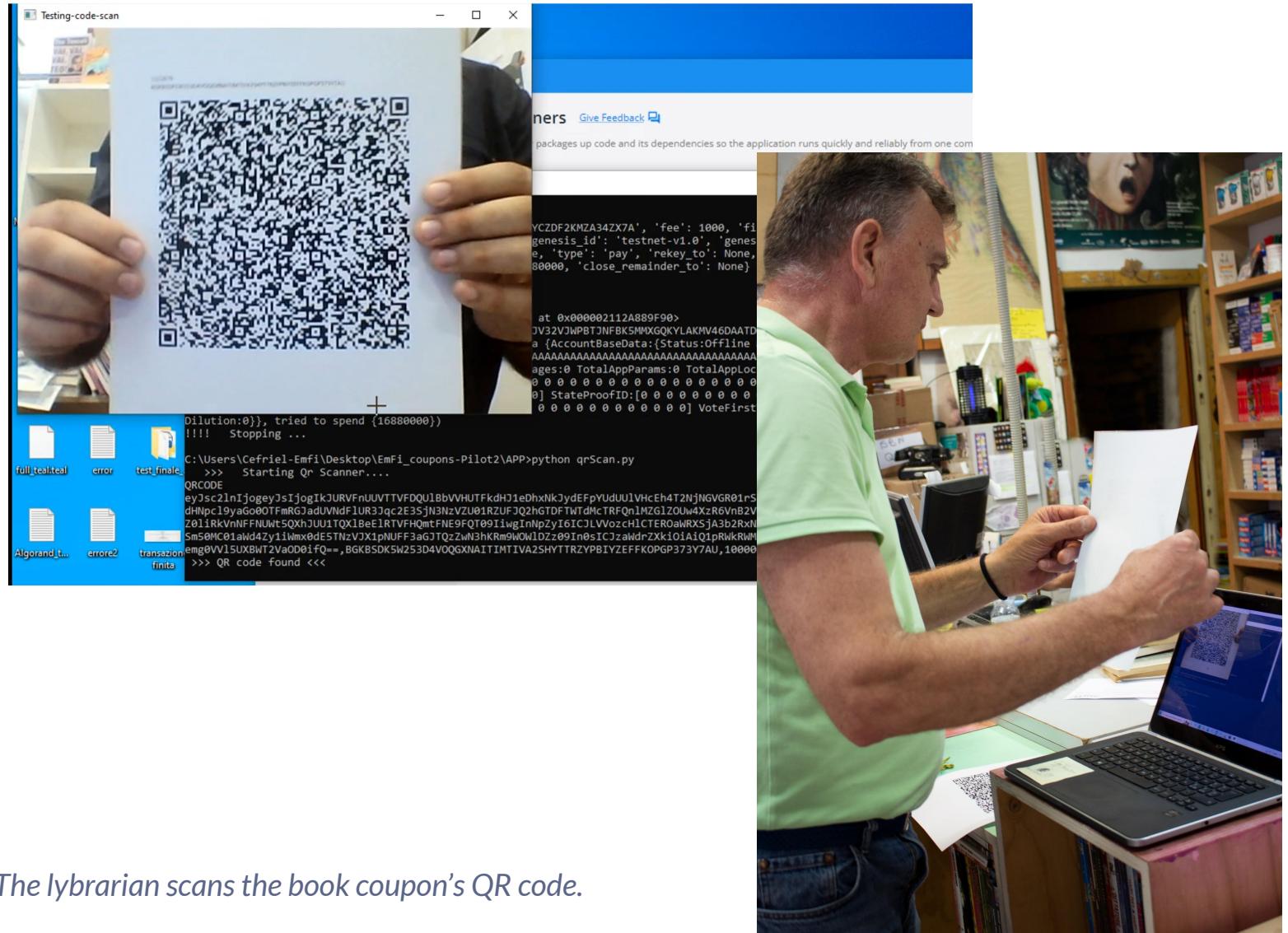
- Bookseller needs to run the qrScan.py program that opens a little UI showed in the figure.
- The functionality is very simple. The only thing that can be done is to press the button to open the camera and scan the QR code.



The librarian opening qrScan.py and pressing the button

Final Pilot - Step 2 Bookseller operations (Step 3)

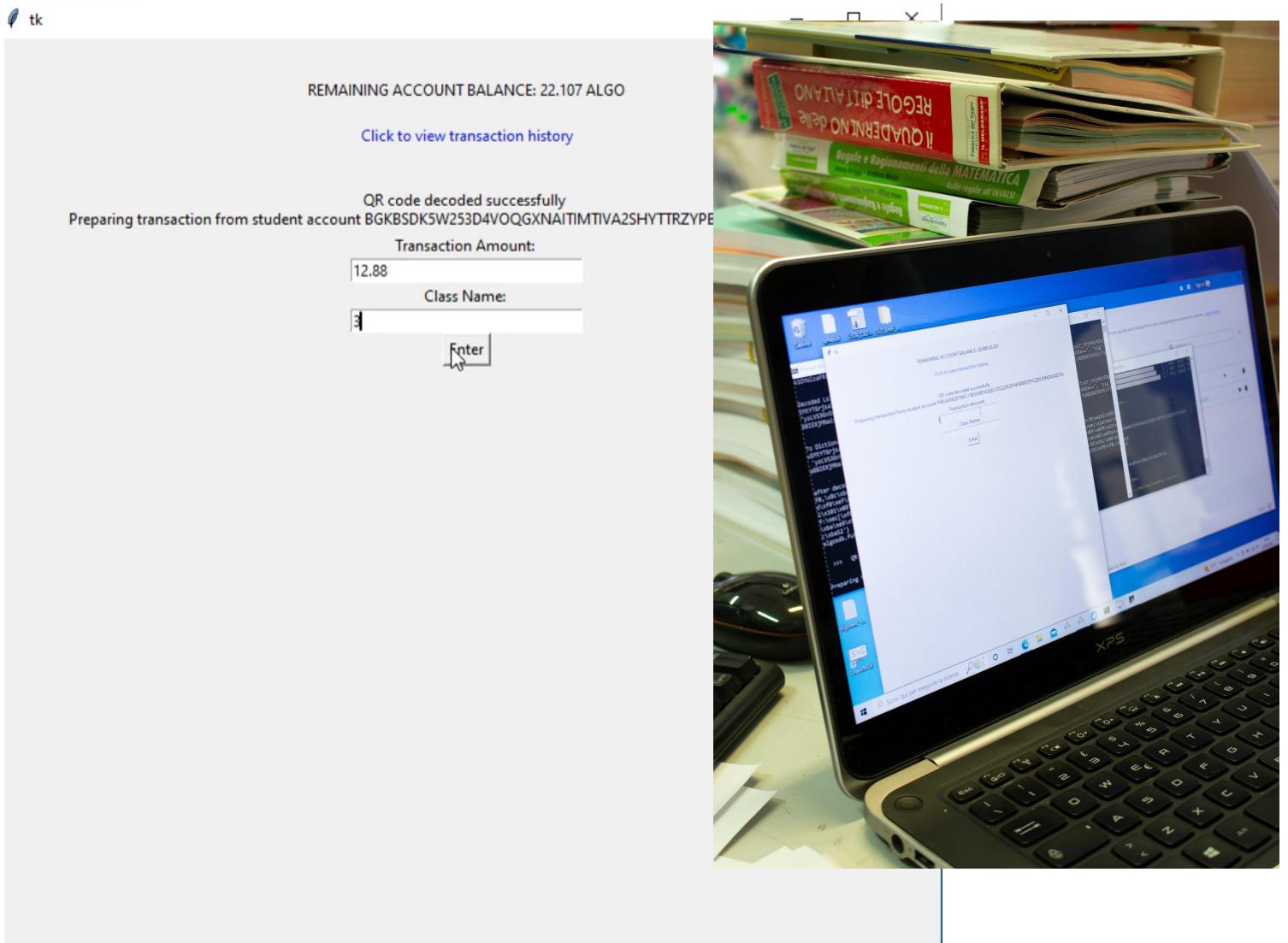
- When the camera opens up the bookseller has to scan the QR of the student.
- As it is possible to see in the picture, the program reads and prints what is read by the scanner, just to be sure that everything is fine



The librarian scans the book coupon's QR code.

Final Pilot – Book coupon utilisation and transaction (Step 4)

- When the QR read by the camera is correct the page shown in the picture appears.
- The page also shows the account of the student; if the privacy laws permits it, the desirable thing would be to be able to show the student's first and last name as well. However, that was not considered in the pilot.
- Finally, at the end of the page, there is a form that is filled out by the bookshop owner which has to write down the transaction amount and the class name.

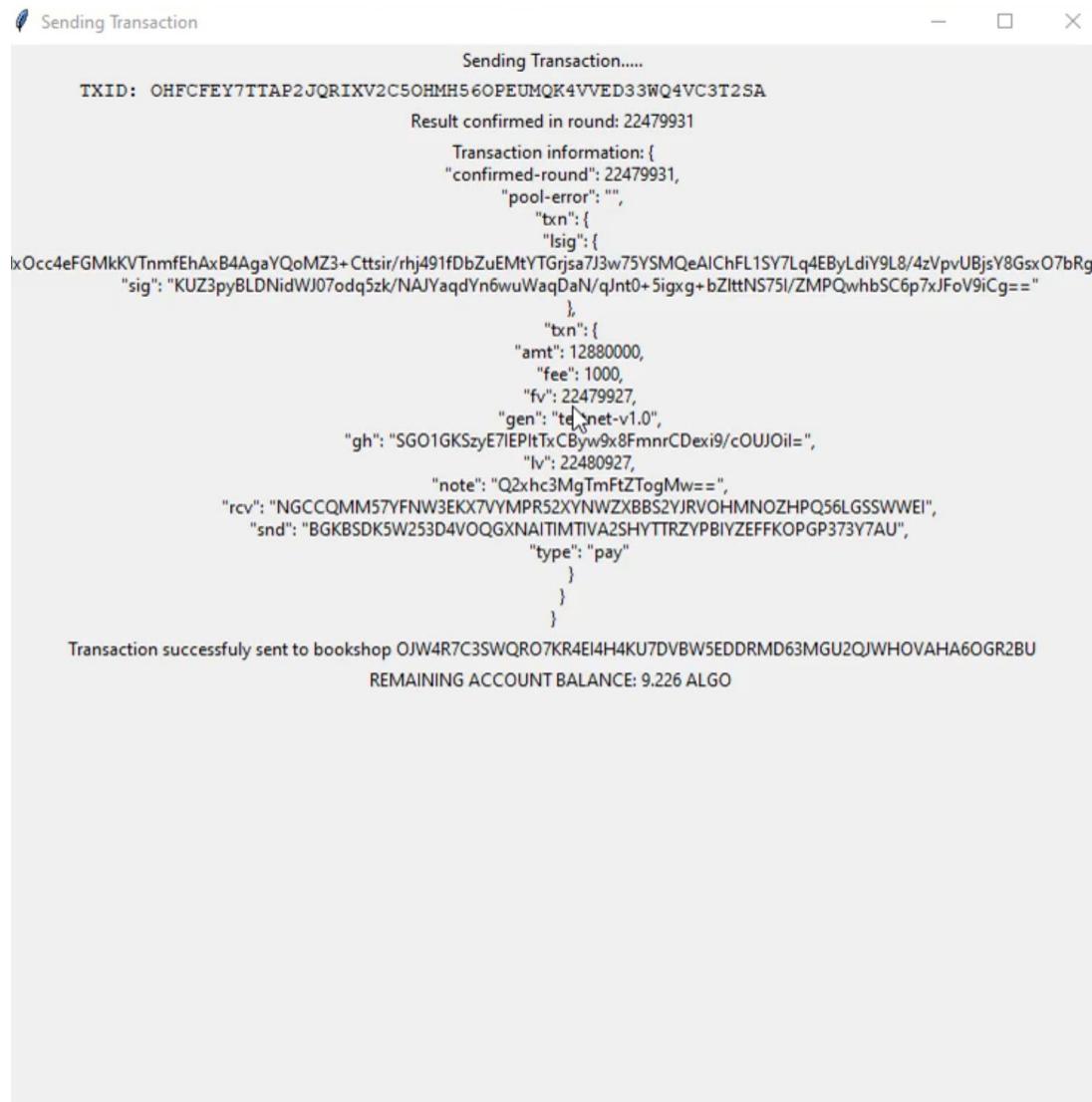


The Bookseller scans the book coupon's QR code.

Final Pilot – Book coupon utilisation and transaction (Step 5)

If the data of the transaction are correct, that is the cedula has enough amount, the addresses are correct and all the checks have been passed, the picture shows the successful transaction with all the data required, like the receiver, the sender, the confirmation round etc. etc.

Also should be noted that the remaining account balance was added, that should help the communication between the bookseller and the student

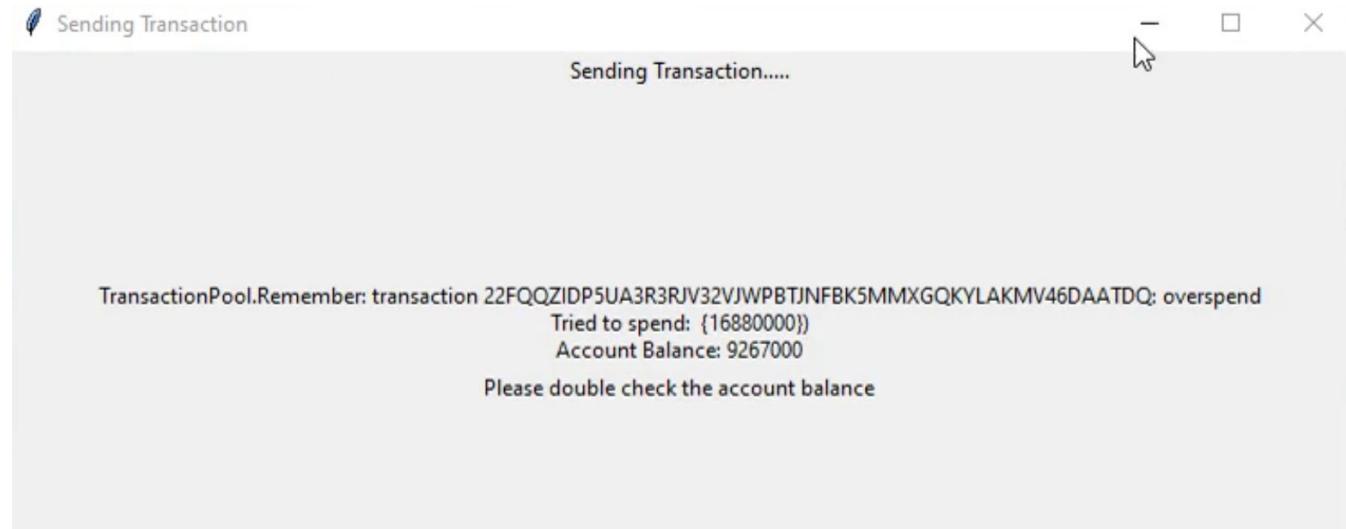


The librarian scans the book coupon's QR code.

Final Pilot – Book coupon utilisation and transaction (Step 6)

If the transaction is rejected for some reason a page like the one showed will appear.

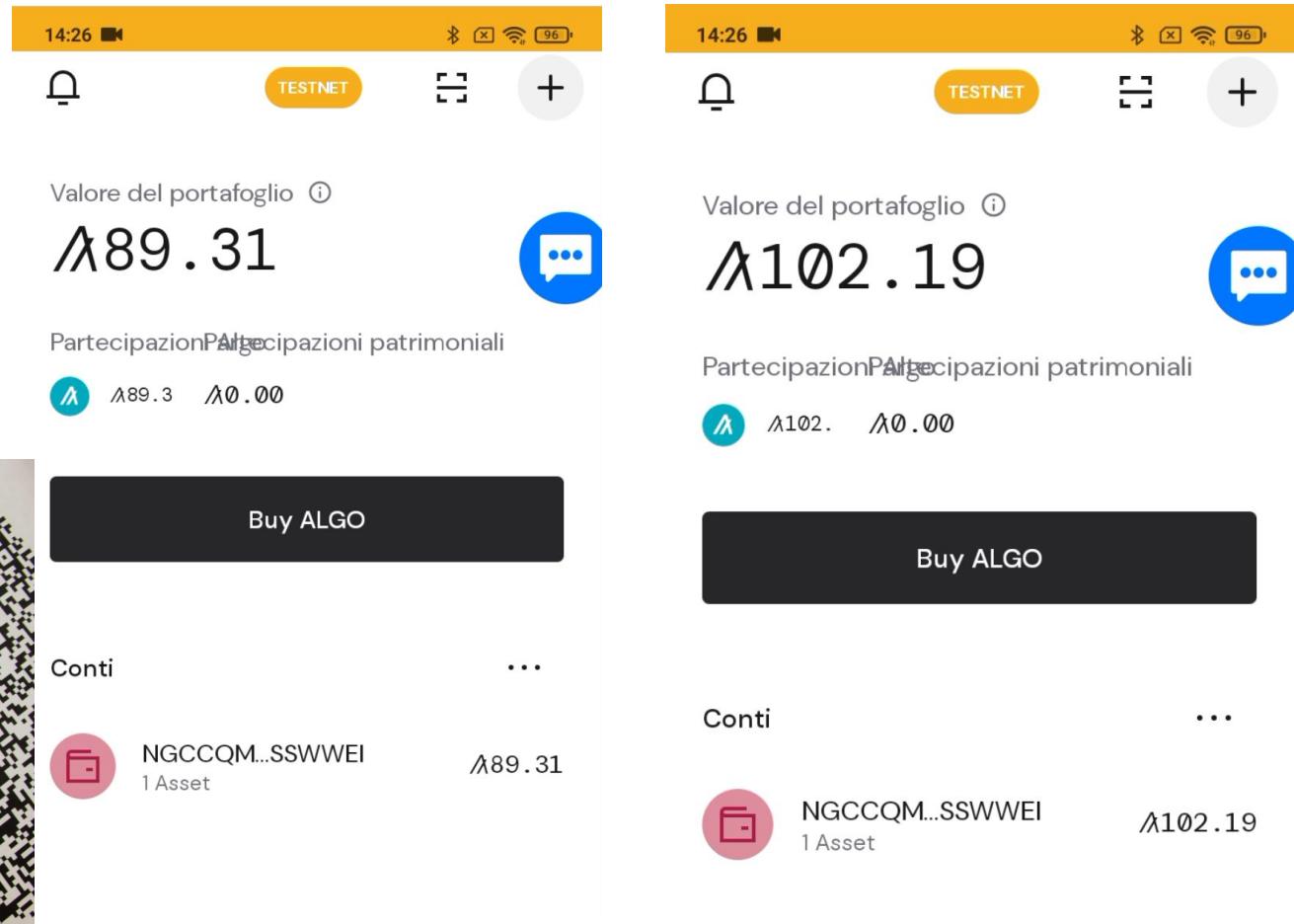
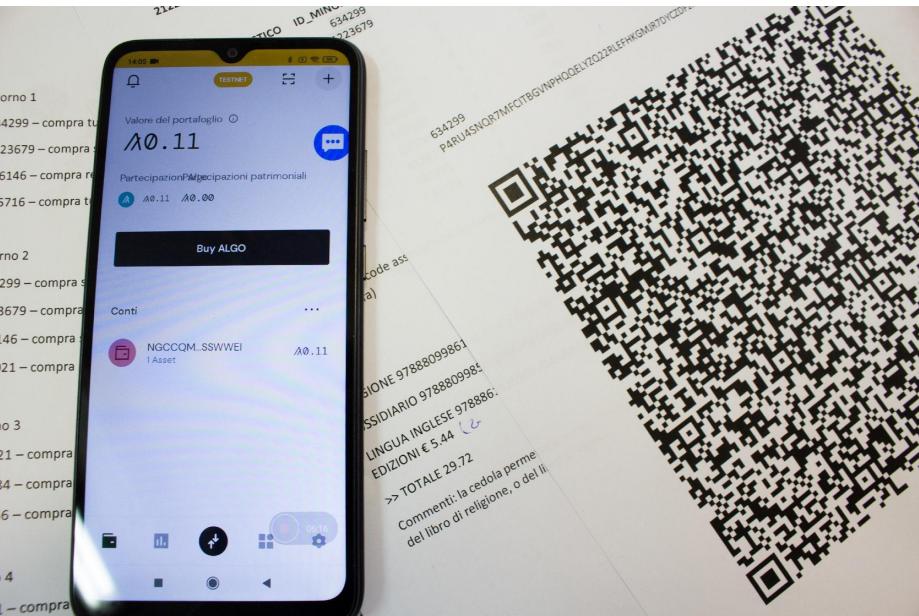
In this case the student tried to overspend by buying the book twice, but the remaining amount is lower than the price, so the transaction is correctly rejected



Final Pilot – Book coupon utilisation and transaction (Step 7)

The bookseller is able to see real-time the amount of his account.

When a transaction is made the amount updates and it is possible to see that the payment has been successfully registered



The librarian scans the book coupon's QR code.

Final Pilot – Book coupon utilisation and transaction (Step 8)

Another option is to display the chronology of the transaction made to the bookshop address



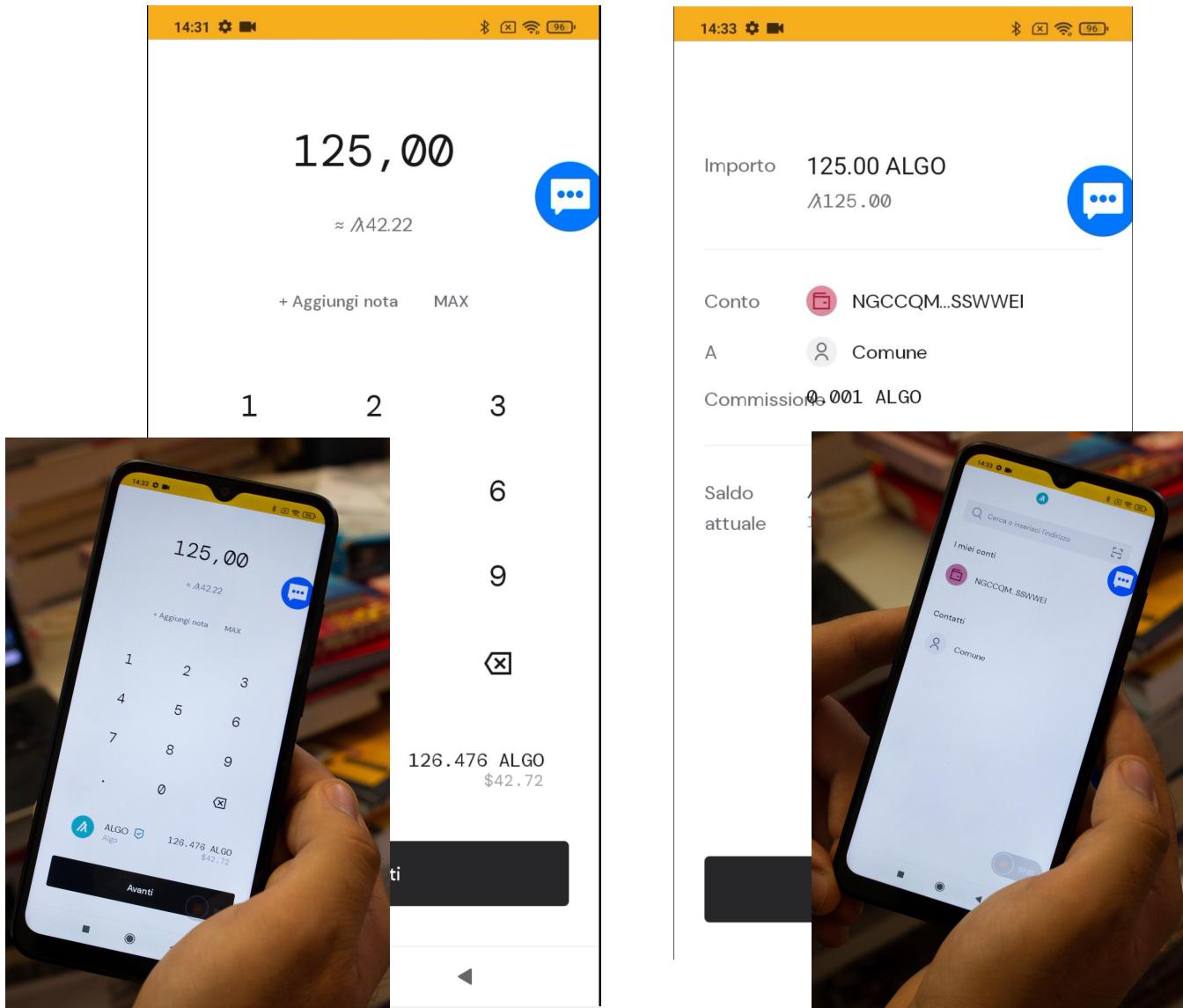
A smartphone screen displaying a transaction history. The top bar shows the time as 14:26, signal strength, battery level at 96%, and a QR code icon. Below the bar, the address 'NGCCQM...SSWWEI' is shown. A navigation bar at the top includes icons for back, home, and three dots, followed by tabs for 'Attivi', 'NFT', and 'Cronologia', with 'Cronologia' being the active tab. Below the tabs, there is a search bar with a magnifying glass icon and a blue speech bubble icon. The main content area shows a list of transactions dated 'giu 27, 2022'. Each transaction row contains the recipient's name, the amount in ALGO and USD, and a QR code icon.

Ricevi	+29.72 ALGO \$10.14
F4EADI...ANHV5A	
Ricevi	+29.72 ALGO \$10.14
P4RU4S...34ZX7A	
Ricevi	+12.88 ALGO \$4.39
2A2X5I...T6CEUQ	
Ricevi	+16.88 ALGO \$5.76
BGKBSD...73Y7AU	

The librarian scans the book coupon's QR code.

Final Pilot – Book coupon utilisation and transaction (Step 9)

- At the end of the first two days of the pilot the bookshop has to notify the Comune the amount of the transaction made.
- So he inserted all of the Algos made by scanning students' qr code to the Comune address.



The librarian scans the book coupon's QR code.

Final Pilot – Back -end

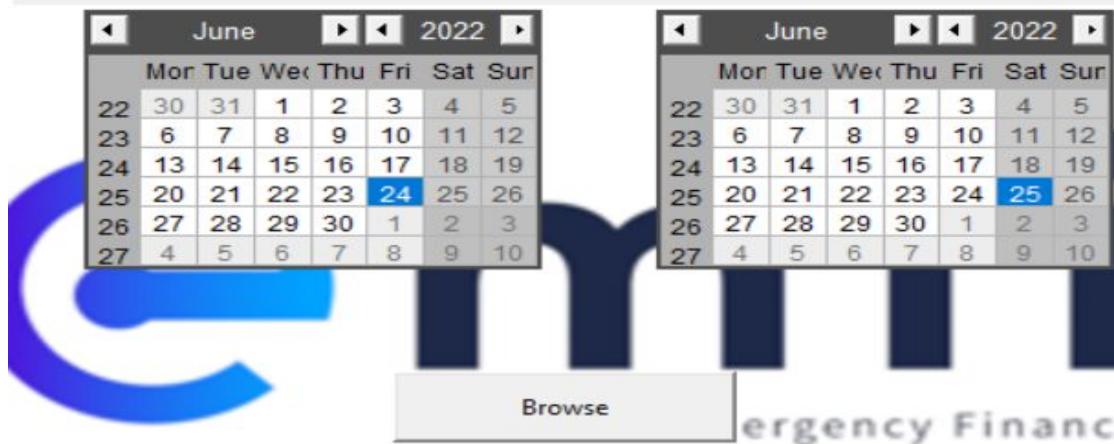
Two files are generated by the back-end. The on-chain data is retrieved using PureStake API, querying transaction data for librarian addresses over a specific time-period.

One contains a list of transactions received by the librarians with data including the librarian address, transaction amount and transaction id.

The other file contains a list of every transaction received, while also including the student id, transaction date and amount.

The reports are useful for accounting and reconciliation purposes.

Please choose the dates to see transactions from, and a location to save the generated files



Generate Reports						
------------------	--	--	--	--	--	--

ANNO_SCOLASTICO	ID_MINORE	CLASSE	CODICE_SCUOLA	NUMERO_TRANSAZIONE	DATA_TRANSAZIONE	IMPORTO_TRANSAZIONE
2122	636184	3	2010	UM5ZWLEZA5TN50HRVJKRUI06M7SCIQ3BA3GKV3HIM45BSWXJHA	Tue Jun 28 13:04:56 2022	29720000
2122	728021	3	2010	OFJWQGBAD3JGK3ND2VTZSBQGBXBPQFGPCXJ6YH467GC3HDIIIA	Tue Jun 28 13:04:01 2022	16880000
2122	728021	3	2010	KTBUVS5MK5CIAMAFTUMDSK6WKAGRC6DZM63GDTSM6VXUUKY34JHA	Mon Jun 27 13:31:16 2022	7400000

ANNO_SCOLASTICO	CODICE_LIBRAIO	CODICE_SCUOLA	CLASSE	IMPORTO_TRANSAZIONE	NUMERO_TRANSAZIONE
2122	NGCCQMM57YFNW3EKX7VYMPR52YNWZXBBS2YJRVOHMNOZHPQ56LGSSWWEI	2010	3	29720000	SQW4NGDP4YEJ6KILAY550V5RVXE5IY2GCING2N7S02VYBNW4ULSQ
2122	NGCCQMM57YFNW3EKX7VYMPR52YNWZXBBS2YJRVOHMNOZHPQ56LGSSWWEI	2010	3	1000	Z3ZWRG4FFD75JMYQIN3UIOVTM6XEWN5YCEEFL4VCER5NWMR5DZIA
2122	NGCCQMM57YFNW3EKX7VYMPR52YNWZXBBS2YJRVOHMNOZHPQ56LGSSWWEI	2010	3	12880000	OHFCFEY7TTAP2JQRIXV2C50MH56OPEUMQK4VVED33WQ4VC3T2SA
2122	NGCCQMM57YFNW3EKX7VYMPR52YNWZXBBS2YJRVOHMNOZHPQ56LGSSWWEI	2010	3	16880000	UYUQJ57FLDX63EKXRVMVVX73WK5DEF34G33IWBTTRSIGWVKWDSQQ

The librarian scans the book coupon's QR code.

Key aspects and enabling technology

- General framework for the creation of **trusted and programmable financial circuits**
 - Financial circuits pegged to fiat currencies (Euro in our use case)
 - Strongly **automated set-up**, seamlessly adaptable to existing processes
 - **Fast transactions, negligible overhead costs, full transparency and high level of trustworthiness**
-
- Easily **programmable value-transactions**, via **Teal stateless smart contracts** on Algorand
 - Clear **selection of beneficiaries** (e.g. via their **validated wallet addresses/other cryptography approaches** considered) ...
 - ... also **including “unconnected” ones**, via a controlled use of **Algorand Smart Signatures** and minimal trust assumptions (via **paper QR code**).
- Innovative and general use of a distinguished Algorand feature, inching towards financial inclusion and access to unbanked
- Efficient and secure accountability via blockchain-certified information (PureStake api)

5. Conclusion: takeaways and further improvements.

Librarian interview after pilots-feedbacks

Questions	Feedbacks
Is list of “ books titles ” a desirable feature?	Allowing the bookseller to see the list of the books. On the other side, it is not possible to manage book by book, given the high variability. Need to work on the amount of the Coupon or create within the application a list of books that can be selected from time to time
Is “ book reservation ” a desirable feature?	Book reservation is not an option, since the bookseller delivers only books already in possession to avoid dynamics of reservations that are difficult to manage.
What do you need for the “ invoice ” procedure?	The bookseller's reimbursement from the municipality is based on numbered receipts. A downloadable "invoice" should be generated with each submission to the municipality where you can identify the books with which it is associated.
Which support would you prefer for book coupons?	Paper is not the preferable option. Printing Coupons: today they tend not to carry coupons, it would be better to have a virtual card. Other municipalities, e.g., Cinisello Balsamo, have experimented with health cards, which cannot be split up
Is “ book coupon ” balance an option?	Yes, because in theory a book coupon can be spent in fractions. During the phase of QR scanning allows the bookseller to know in advance which books can be taken and which have already been taken. The main benefit is that in this way the value field is always filled in the correct way and the bookseller can also direct a parent to what he actually needs
Which languages do you prefer? Is multilingual a mandatory feature?	Need at least of Italian Language and Arabic

Improvements

Situational context	Improvement
The bookseller “front-end”	<ul style="list-style-type: none">Allowing the bookseller to see the list of the books (there can be up to 5 books category per class)Allowing the bookseller to have daily summary of books distributed grouped per quantities
Technical aspects	<ul style="list-style-type: none">Managing imputation error for the import for the CedolaClose the validity period of the coupon
Invoice preparation	<ul style="list-style-type: none">Allowing the bookseller to have daily summary of books distributed grouped per quantities

Emfi Partners and Contacts

Partners	Role	Team
<ul style="list-style-type: none"> QFinLab, Department of Mathematics, Politecnico di Milano (Prof. Daniele Marazzina) 	<ul style="list-style-type: none"> Project Coordination Relationship with the Stakeholders Financial Aspects 	<ul style="list-style-type: none"> Prof Emilio Barucci Prof. Daniel Marazzina Ing Davide Magno
<ul style="list-style-type: none"> University of Stirling, Department of Computing Science and Mathematic 	<ul style="list-style-type: none"> Technical Supervisor Framework and Solution Design Development of the Solution Implementation of the System for Pilots Testing & Evaluation 	<ul style="list-style-type: none"> Dr. Andrea Bracciali, PhD, Mr. Kane Lawless, MSc
<ul style="list-style-type: none"> Cefriel 	<ul style="list-style-type: none"> Service Design and Requirements for the Selected Scenario Solution Design Implementation of the systems for Pilots Development of Pilots 	<ul style="list-style-type: none"> Project Manager: Nadia Fabrizio Service Design & UX: Esther Ferruccio Development Team: Francesco Morano, Dimitar Anastasoski, Leonard Anitei

Emfi Website and toolkit: <https://www.qfinlab.polimi.it/emfi/>



EmFi – a special purpose virtual currency

Crypto and digital currencies supported by new generation Digital Ledger Technology (DLT), in the context of public financial support to citizens.

EmFi is centred on the development of a special-purpose virtual currency, backed by public institutions, for the accountable and frictionless exchange of resources, services, assets, claims and goods among institutions, citizens and companies.

[Learn more about the project](#)
[Maggiori informazioni sul progetto](#)


The Pilot

A first pilot implementation implementation of EmFi will be performed in 2022 in partnership with the City of Milan. It will consist on distributing welfare funds to purchase primary school books using digital tokens and the use of QR codes as medium of payment.

One of the main advantages of such an approach is disintermediation by means of the construction a resource supply chain, which is efficient, but also secure, low-cost and accountable.

The tokens will be exchanged on the DLT developed by Algorand who also finances the research at the foundation of EmFi.



The Partners



The project partners are a team comprising financial, economic, and technical advanced expertise, with strong experience in the development and deployment of large-scale projects. Scientific interests of proponents include financial engineering, virtual money, cryptocurrencies, and blockchain technologies.



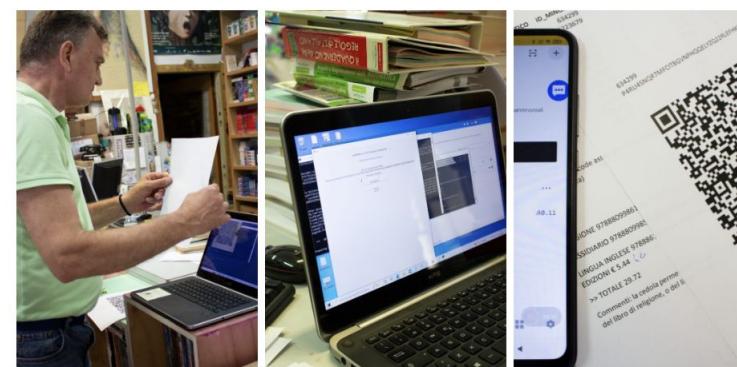
EMFI Smart Payment – Pilot 2

July 19, 2022 Uncategorized

During the week of June 27th-July 2nd, a second pilot of EMFI has been conducted by the Team at the library "Il Passalibro" in Sesto San Giovanni, involving end-users (two library operators), aimed at testing the feasibility of using **Algorand chain and tokens** to implement the book voucher scenario.

The scenario of **"book vouchers for primary school"** was tested according to the national process.

The feasibility results and issues will be included in the final report of the Project.



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