Honest.io: Automation system for a market with multiple vendors based on ESP8266

Pedro Henrique de Albuquerque Gomes
Departamento de Eletrônica e Sistemas
Universidade Federal de Pernambuco
Recife, Brasil
pedro.hagomes@ufpe.br

Aline Victória Cavalcanti Pereira
Departamento de Eletrônica e Sistemas
Universidade Federal de Pernambuco
Recife, Brasil
aline.cavalcantipereira@ufpe.br

Andrea Maria Nogueira Cavalcanti Ribeiro
Departamento de Eletrônica e Sistemas
Universidade Federal de Pernambuco
Recife, Brasil
andrea.marianogueira@ufpe.br

João Marcelo Teixeira
Departamento de Eletrônica e Sistemas
Universidade Federal de Pernambuco
Recife, Brasil
joao.teixe@ufpe.br

***Abstract*—With the popularization of the internet, business has become increasingly globalized, and nowadays it is common to buy products from sellers in other states and even countries. This whole process has exponentially accelerated what we call marketplace, a type of company that connects supply and demand. This market niche was essential during the pandemic, as it is a great option for companies to enter their products in the digital market, at a very low financial and intellectual cost. Another important concept that has been widespread is the autonomous market, a type of business that uses customer confidence to reduce infrastructure costs through technology, such as self-service boxes in super markets. This work brings a disruptive view of the market, merging the concepts of an autonomous market and a physical marketplace, developing an automation system for the market, in which small sellers can register their products and outsource their face-to-face sales. A sales system is proposed with products and instructions being displayed on an LCD screen, managed by an Arduino and connected to the internet through a Wemos, in which it performs the entire process of monitoring and transferring payments to the respective sellers, using a gateway of payment via HTTPS.**

***Index Terms*—ESP8266, HTTPS, Arduino, Autonomous market, IoT.**

I. Introduction

The Covid-19 pandemic had a significant impact on the growth of e-commerce. According to the Brazilian Association of Electronic Commerce (ABComm), there was a 68% increase in 2020, reaching R$ 126.3 billion and 11% market share. Marketplaces have been the main beneficiaries of this growth, especially for small businesses that were not yet selling online. This scenario resulted in a large number of new sellers on online channels. Currently, the modality occupies 78% of B2C (Business-to-Consumer) e-commerce according to Ebit—Nielsen [1].

A marketplace is a digital platform that connects buyers and sellers of products or services, allowing them to conduct commercial transactions in a single location [2]. Generally, the marketplace offers a wide variety of products from different sellers and, in some cases, can also offer services.

Sellers in a marketplace benefit from the visibility and digital space provided by third parties, enabling them to make good deals and profit. In return, they pay commissions and contribute to keeping the marketplace running [2]. However, this relationship has more profit potential and less risk than if the seller chose to invest all their resources in their own e-commerce.

Just like marketplaces, the accelerated development of technologies and payment methods opens the market for what is called autonomous markets, which arise from the need for convenience and practicality for users who follow new consumer behaviors, acquired during the pandemic with the extensive use of the digital market [3]. Normally, it is possible to achieve better prices and margins compared to a regular market, as using user-focused payment technologies reduces the human capital needed to maintain the environment, consequently reducing operating and product costs.

It is also interesting to highlight the growth of honest markets, a branch of autonomous markets that uses trust to further reduce operating costs. This type of business began to grow within condominiums and companies, starting to emerge in Brazil before the pandemic, gaining momentum in 2020, and now consolidating. Entrepreneurs in the sector believe there is still significant growth potential and predict triple-digit growth and million-dollar revenue for the coming years [4].

In Recife, we can observe a rise in the implementation of honest markets, such as Minha Quintandinha[1], which is already established in condominiums and companies.

[1] www.minhaquitandinha.com.br

Honest markets today are not collaborative, typically managed by a single company or individual who controls the inventory and sales system, preventing the sale of external products and excluding local traders, which reduces competition. Additionally, the locations hosting these markets often gain no financial benefit.

This justifies a system that implements an honest market with products from various sellers, combining the concepts of marketplace and honest market, concepts that are growing rapidly in the country, providing convenience for buyers and offering advantageous sales options for small businesses that previously did not reach these environments. Additionally, the system transfers the task of supplying products at sales locations to the sellers, focusing only on managing the points and improving the user experience, with the main source of income being a share of the sellers' profits.

This system was named Honest.io, inspired by its relation to the honest market. The ".io"' suffix is popularly used in technology corporation domains, such as Opensea.io, the largest virtual NFT marketplace[2], and was used to express the technological and disruptive bias of the solution.

II. Related Works

In this work, the creation of a prototype involving Arduino and ESP8266 was proposed, leading to the need to research projects that used these types of microcontrollers and the mechanisms they used to move from ideation to implementation.

A. Automatic shopping trolley using IOT [5]

This project develop an automatic shopping trolley that uses an RFID sensor. The main aim of this smart trolley is to reduce the time wasted at the time of billing of the product so that the customers get more benefit.

The work is done with the help of RFID technology with the help of an EM-18 reader, an RFID card and Node MCU. It can be implemented where a huge amount of the rush in the mall by replacing the normal trolley with the smart trolley, which takes less time in this world of automation.

Items that are put in a shopping cart read the RFID tag one by one and the bill is generated and displayed on the LCD display of the trolley and on the website as well. After the total bill is generated, the customer of the shopping mall usually pays their bills by using their net-banking or by using UPI.

B. Alert System for Water Consumption Control by Domestic Services [6]

This research project aimed to design and build a prototype of a control system that would allow measuring and monitoring water levels in domestic tanks. Technologies such as ESP8266, HTTP, and MQTT BROKER were used for this purpose.

Furthermore, the investigations presented respond to observations made in homes in Trujillo, Peru, which currently have physical water consumption measurement systems that are manually and periodically performed, informing users every 25 or 30 days.

With the implementation of the alert system, users receive notifications on their cell phones about the filling and emptying processes of liquids in the tanks, thereby generating lower production costs [6].

This project is quite interesting and provides a wealth of relevant information about the HTTP communication process using the ESP8266.

III. Proposed Solution

The hardware application developed aims to manage sales in an honest market featuring products from various sellers. It includes a display showcasing products and checkout screens for payments. After each purchase, the system automatically transfers payment to the respective seller, charging a maintenance fee that goes to the company or individual providing the venue.

The prototype is divided into two main parts: the application running on the Open-Smart R3 Air, nicknamed the graphical *interface*, which is responsible for storing seller data and displaying products for sale, and the application running on the Wemos, nicknamed the payment *gateway*, responsible for payment authentication and forwarding a portion of the amount to the seller. The two parts communicate with each other via Serial.

The prototype of the solution, named Honest.io, presents the functional idea of the project, without focusing on visual aspects, as shown in Figure 1.

The code developed for this project, as well as a series of instructions for parameter modifications, are maintained on GitHub [3] to manage versions and enable contributions from other developers to the project.

A. Graphical Interface

It consists of an Open-Smart R3 board connected to a 3.5-inch TFT Touch Screen LCD and a microSD shield. The system functions as a sales application, which can be navigated through simple touches on the screen.

The main screen displays the registered products, and after selecting a product, the user is redirected to the payment screen.

For each product selection, the seller's PIX key, the type of key, and the product price are sent via Serial to the payment *gateway*.

The data sent is in the format "value,key(key_type)", allowing the seller to use any personal account with a registered PIX key. Key types accepted include CPF, CNPJ, email, phone number, and random key.

After identifying the payment (a message received via Serial from the *gateway* to the *interface*), the user is redirected to a thank you screen and then returned to the main screen after a few seconds.

[2]https://superdominios.org/por-que-os-entusiastas-da-tecnologia-adoram-usar-o-dominio-io

[3]https://github.com/peddrogomes/honest.io

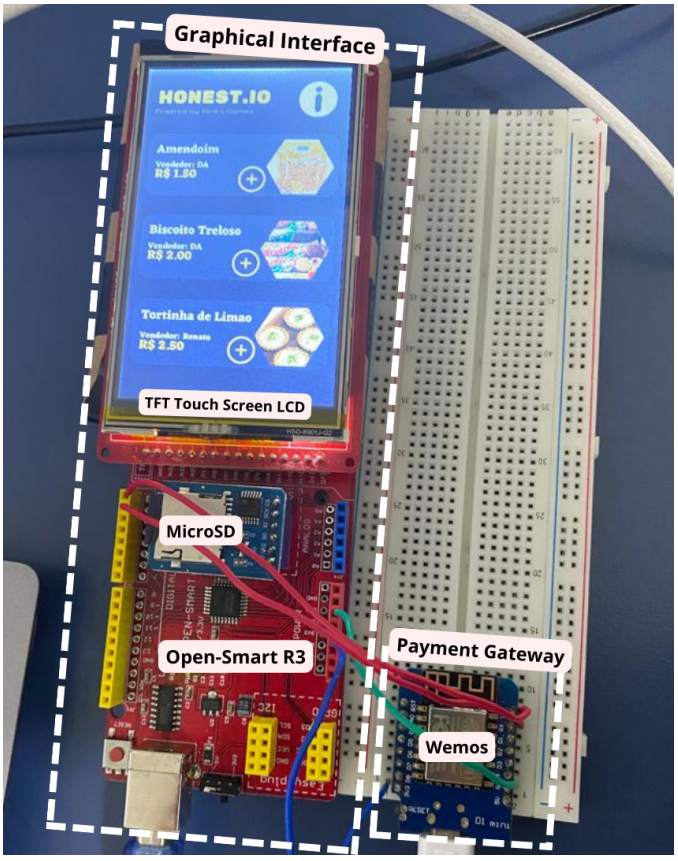

Fig. 1. Low-fidelity prototype of Honest.io

The graphical *interface* screens were produced using Canva and exported to PNG with 240x400 pixels. However, for project use, they had to be converted to 32-bit BMP images using an online converter[4].

B. Payment Gateway

Asaas[5] is a fintech that offers business automation solutions, authorized by the Central Bank, acting as the 31st payment institution in Brazil. In the project in question, the Asaas payment API was used to perform transfers via PIX and authenticate payments.

The connection to the API is made via HTTPS and requires authentication provided by an "access token" key, which is included in the request header. This key can be obtained in the digital account settings and is unique to each account.

The GET method was used to obtain the account balance, with constant comparisons between requests to monitor if there has been any capital inflow. The POST method was also used, pointing to another HTTPS address, allowing transfers from the Asaas account to any specified PIX, by sending transfer amount and PIX key information via the request body.

The *gateway* consists of a Wemos D1 Mini connected to Wi-Fi. This system makes continuous balance requests using the HTTPS GET method. The system compares the balance received in the last two requests to identify payments.

As mentioned earlier, upon accessing the payment screen in the graphical *interface*, a string specifying the product and seller data is sent via Serial from the *interface* to the *gateway*. This data is processed in the *gateway*, and the amounts to be received are updated with each product selected in the *interface*.

After identifying the payment, an HTTPS POST request is automatically made, sending 90% of the paid amount to the registered and sent seller via PIX.

IV. Tests

The two test sessions performed are described as follows.

A. First Testing Session

Before starting the first testing session, some modifications were made to the user interface, placing the prototype in a cardboard case with some usage instructions pasted next to the screen, as shown in Figure 2.

This testing session aimed to conduct a field test, allowing analysis of the prototype's behavior under the stress of continuous and daily use for a week.

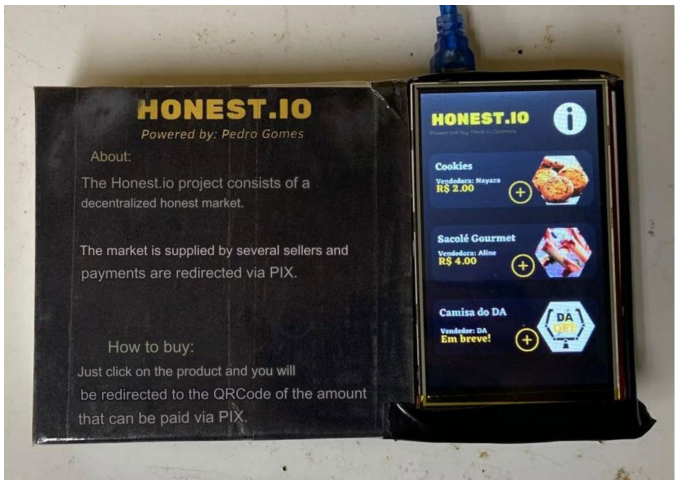

Fig. 2. High-fidelity prototype of Honest.io

The prototype was implemented in the Electrical Engineering Academic Directory (DAEE) at UFPE. Three products from different sellers were registered, and a 10% fee on the sale value was set, with this fee going to the DA (products sold by the DA are not taxed). Sales were monitored for a week, providing a sample of the daily operation of a small business of this type.

One positive aspect highlighted was that the seller receives payment via PIX and is not restricted to a specific bank, being able to use any personal account with a registered PIX key.

The fixed fee is 10%, as the main idea is to help students. On the other hand, there is no recurring maintenance cost for the prototype (the API's functionalities used are free, and the internet and electricity are provided by the university). The main purpose of the money collected by the DA is to

[4]https://online-converting.com/image/convert2bmp
[5]www.asaas.com

be reinvested in the students themselves, improving the DA's infrastructure.

B. Second Testing Session

The solution presented in this project was invited to be showcased at ArduinoDay, a global event dedicated to celebrating the Arduino platform and its community, held in Recife-PE by Cesar School on March 26, 2023[6].

This event was a great opportunity to conduct another testing session, given the high volume of sales that could be made in a single day. Thus, Honest.io was reprogrammed to sell low-value products at a normal resale price. The chosen products were paçoca (a type of peanut candy), lollipop, and mints.

The project was showcased throughout the day at Cesar School, as seen in Figure 3, resulting in 62 transactions from 32 different customers. It was observed that many customers could use Honest.io without any assistance, just following the on-screen instructions, and no products were taken without payment, even though the project operated without supervision at times.

Fig. 3. Honest.io showcased at ArduinoDay

After a significant number of 50 transactions, Asaas charged a relatively high fee for the normal operation of the presented solution. A fee of R$ 0.99 per received PIX was charged, making it unfeasible to sell very cheap products.

The fee charged is relatively low concerning the API usage; however, our transactions averaged around R$ 1.00, resulting in a 100% charge of the PIX value received, rendering the project completely unfeasible for low-value transactions.

As a suggestion, products could be priced starting at R$ 10.00, charging the seller a 20% fee, allowing for the API fee absorption and ensuring functionality even with a high number of transactions.

Regarding the total cost of the project, the Open-Smart One R3 Kit [7] costs on average R$ 100.00, and a Wemos D1 mini costs around R$ 30.00. Therefore, the final production cost of the project is R$ 130.00, which is significantly lower than the prices of smart card machines on the market, which cost around R$ 450.00 and usually only work with a monthly fee.

V. Conclusion

Technology, along with the pandemic, has changed many aspects of commercial relations worldwide, leading to the growth of the marketplace market and spreading the concept of autonomous markets. At the university, there is strong commercialization of various products by students seeking financial assistance to support their time at college.

In this context, this work aimed to develop a physical sales management system for products from different students, creating an ecosystem around it based on the concepts of autonomous markets and marketplaces.

Considering a better user experience and greater system availability, some suggestions are listed for improving this project:

- Increase the number of products and allow the purchase of several products at once;
- Establish a partnership with Asaas to reduce fees after the limit of free PIX transactions is reached or switch to an API with percentage fees;
- Implement a web-based system to directly update products online;
- Implement varied fees according to the product, allowing the sale of products by the solution maintainer (with zero fees);
- Create a layout for the board, reducing its size, and a 3D case to improve the visual aspect of the project.

References

[1] "O crescimento dos marketplaces em 2021 - e-commerce brasil." Available online at: https://www.ecommercebrasil.com.br/artigos/o-crescimento-dos-marketplaces-em-2021, last accessed on 05.23.2024.

[2] "Locaweb - marketplace: O que e e como pode transformar o seu negocio?." Available online at: https://www.locaweb.com.br/blog/temas/primeiros-passos/o-que-e-marketplace, last accessed on 05.23.2024.

[3] "Fecomerciosp - transitorio ou permanente: A pandemia e o novo comportamento do consumidor." Available online at: https://lab.fecomercio.com.br/wp-content/uploads/2020/09/ebook-transitorio_APROV_final.pdf, last accessed on 05.23.2024.

[4] "Folha de londrina - mercados autônomos entram em fase de consolidação." Available online at: https://www.folhadelondrina.com.br/economia/mercados-autonomos-entram-em-fase-de-consolidacao-3165963e.html#:~:text=Em%202021%2C%20a%20startup%20registrou,a%20mil%20em%20um%20ano., last accessed on 05.23.2024.

[5] T. Raj, Y. Cheema, V. K. Singh, A. Kumar, and S. N. Gupta, "Automatic shopping trolley using iot," *Materials Today: Proceedings*, vol. 79, pp. 362–366, 2023. International Conference on Startup ventures: Technology Developments and Future Strategies.

[6] B. Ulloa Rubio, R. Carrillo, H. Wong Aitken, J. Rodríguez, and M. Ruiz, "Alert system to control water consumption for domestic service," pp. 86–91, 07 2022.

[6] www.sympla.com.br/evento/arduino-day-recife-2023/1913069

[7] https://pt.aliexpress.com/item/32958196980.html