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Tesis

Design of a payment system in private transportation to prevent Covid-19 contagion - Huancayo

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Design of a Payment System in Private Transportation to Prevent Covid-19 Contagion - Huancayo

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ABSTRACT

The contagion of Sars-CoV-2 or Covid-19 inside the city of Huancayo is growing, with the transport sector being one of the most affected, so it was planned to reduce the rate of contagion among users of these services. This required the use of RFID-NFC technology in such a way as to prevent direct and indirect contact between passengers and drivers. Technology that is not dependent on the internet, because it was taken into account that, in that city, the technology is not very expanded so, there are places where the internet signal does not arrive. For this reason, the modules created from RFID technology are a good option to be able to slow the advance of the covid-19.

CCS CONCEPTS

• **Hardware**; • **Communication hardware, interfaces and storage**; • **Digital signal processing**; • **Displays and imagers**; • **External storage**; • **Tactile and hand-based interfaces**; • **Wireless devices**;

KEYWORDS

RFID, NFC 2, Smart City 3, Payment System 4, Payment Without Internet 5, RFID Memory 6, Time Optimization 7, Covid-19 8

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1 INTRODUCTION

Covid-19 or Sars-CoV-2, is a pandemic disease, so its great infective capacity, since the contagion can be directly, between person and person, or indirectly, through surfaces that were in contact with some carrier of this disease [1], which converts cash, into a contagion channel [2].

The current situation has obliged people to adapt to a new lifestyle, fear of contagion has changed people's routines, the way people mobilize is not the same, because one of the main pillars of contagion has been public transport, according to the " EsSalud Intelligence and Data Analysis Unit [3]. That is why in Peru there are protocols for the prevention of Sars-CoV-2 inside the transport service, provided by the public institutions of the state [4].

A contactless payment system on public transport would mitigate the capacity to contagion cash using a system based on NFC-RFID technology, which allows the collection of a certain amount of money without the need to make direct contact with some collection module [5]. Due to the social-technological context presented by the city of Huancayo, the proposed system was developed with RFID technology through cards to guarantee mass use among citizens.

2 DESCRIPTION OF THE PROBLEM

In this new sub-normal, money is a great source of contagion. Because thanks to the currencies that are used daily to obtain products and / or services, and counting that these are in direct contact with people, in times where it is not known for sure who is or is not carrier of the disease these act as a direct conduit to be able to extend the rate of contagion among people who come to manipulate those currencies. For this reason, it is search to minimize the use of money inside private transport since in this sector foreign exchange is constant. For this it is necessary to use the technology, because thanks to this we will be able to manipulate large amounts of money without having to have direct contact with it.

In several cities where technology is constantly growing, it is used to facilitate different activities, such as in Spain where a special system was implemented in a school to facilitate learning with the use of RFID tags [5]. Also in pomegranate studies were carried out on payment methods with the help of NFC technology achieving a predictive model of acceptance of 70.7% [6]. RFID technology and its applications have been growing and encompassing more and more

Table 1: Initial investment outside of administrative expenses

	System Cost for 30 cars (GR - 20 Cars per year)	Company Income	Cash Flow
Year 0	$. -1,609.95	$. 0.00	$.-1,609.95
Year 1	$. -2,646.54	$. 22,018.35	$.10,564.47
Year 2	$. -2,073.18	$. 39,633.03	$.21,706.63
Year 3	$. -3,109.78	$. 66,055.04	$.36,523.25
Year 4	$. -4,146.37	$.101,284.40	$.56,624.27

areas in the industry. As a result, a proposal was made to implement this technology in inventory control in an electronic payment facilitator, obtaining as results the knowledge of the great benefits that would be achieved if RFID technology were implemented [7].

3 METHODOLOGY

The methodology used was VDI2206 – experimental, as the prototype payment system was developed with electronic components. The problem was identified and based on that it was decided to survey a minimum of 324 to obtain a 95% reliability percentage in random simple sampling. The technology developed and applied for the prototype was the product of prior modeling and analysis, with which the first systemic functional prototype was obtained.

4 SYSTEM FUNCTIONALITY

Trying to find economical solutions with which RFID Technology can be implemented has been seen as convenient to use Arduino RFID-NFC modules as these are very economical, accessible and open code. It was also necessary to use Bluetooth modules for communication between prototypes which are implemented in the vehicle.

Taking into account that, in the city of Huancayo, Junín province, when contracting the services of a private transport unit, the price of such a service is varied. Which changes taking into account different factors, such as distance, schedule, weather and destination. For this reason, the prototype must not have a constant price of collection in the tariff. The sequence of operation of the designed prototypes is governed by the following function diagram see Figure 1

5 ECONOMIC STUDY

The economic feasibility of this project is demonstrated below in estimating the initial investment of a new company in the implementation of this system in 30 vehicles and with a growth rate of 20 additional vehicles per year, charging approximately 5 new suns for the use of this technology to its collaborating partners daily, see Table 1

The profitability of this project is endorsed by the Net Present Value and Investment Rate of Return, considering as an interest rate of 7%, this being the highest interest rate provided by a financial institution in Peru, see Table 2.

6 ELECTRONIC DESIGN

Electronic diagrams of prototypes were developed in Eagle software. In the electronic diagram of module 1, which contains a Bluetooth

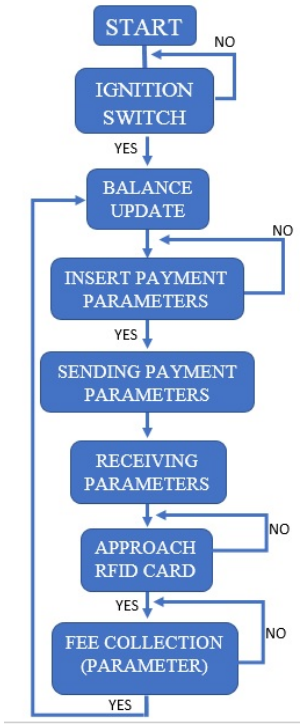

Figure 1: Function Diagram. Function Diagram that indicates the payment process of our prototype. own authorship

Table 2: Profitability calculation

Interes rate	7%
Npv	$. 100,235.03
IRR	752%

module, a matrix keyboard, an LCD display, an I2C module, and the Arduino UNO controller. In this module, Bluetooth is configured as a master, so that you will receive data from the other module. In addition, it consists of a matrix keyboard with which the collection parameters will be sent. See Figure 2

The electronic diagram of module 2, contains a Bluetooth module, an RFID reader, an LCD screen, an I2C module, and the Arduino UNO controller. In this module, Bluetooth is configured as a slave, in this way sending reading from RFID-NFC cards to module 1.

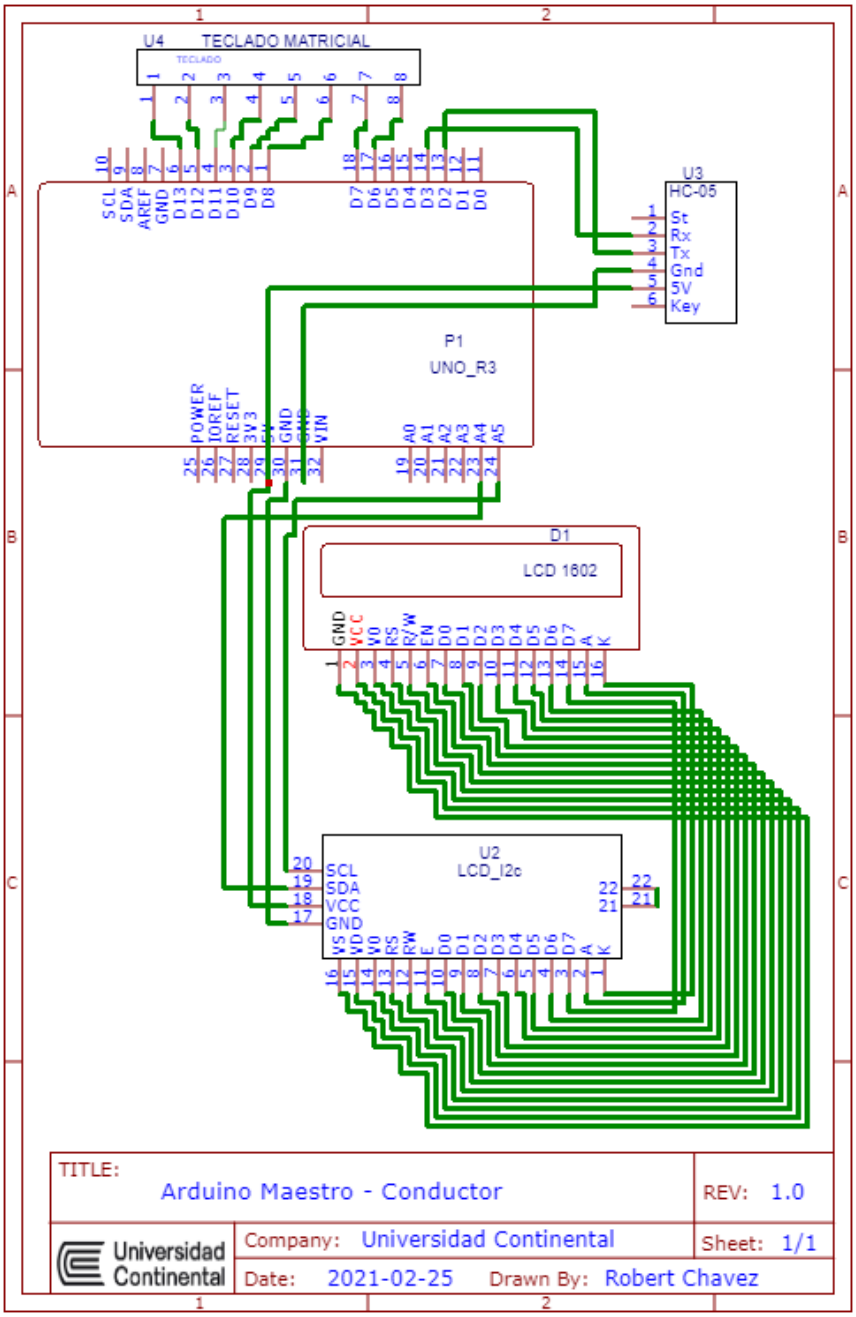

Figure 2: Electronic diagram-Electronic diagram showing prototype-1 connections - own authorship

Thanks to the reader's function, we obtain the information stored inside the RFID card and we can check the current balance and then make the due charge. See Figure 3

7 EXPERIMENTATION AND RESULTS

In the assembly of the modules was used as MDF wood material, the measurements were accurate since Autodesk Inventor software was used, after that the cut was made on a CNC machine to achieve greater accuracy and accuracy.

The modules did not present problems at the time of being tested. Fully fulfilling its stated purposes, such as running without internet signal, reading and writing RFID cards in simultaneous and mass sending of data via Bluetooth.

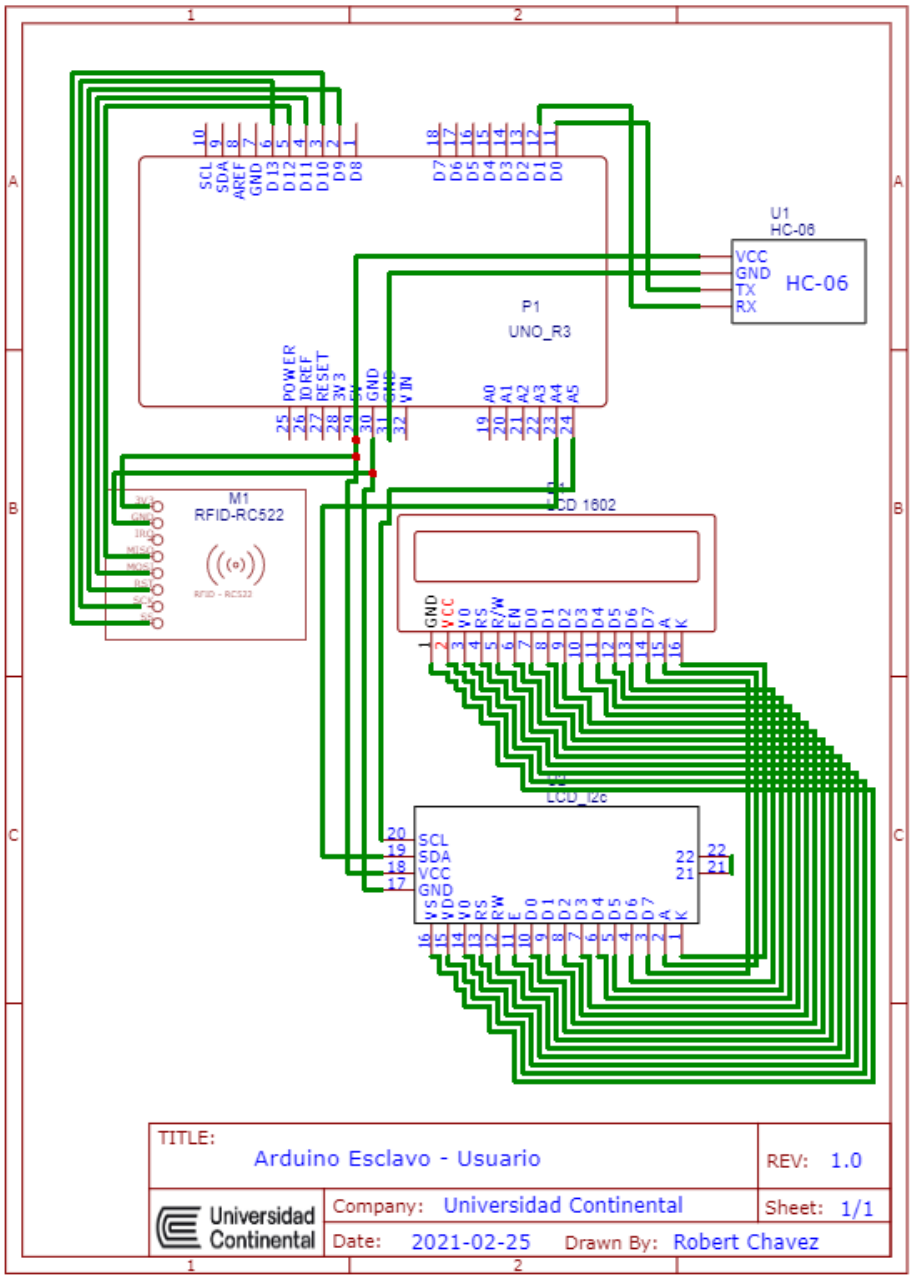

Figure 3: Electronic diagram - Electronic diagram showing prototype-2 connections - own authorship

Module 1 can be observed, where the driver will be ableto enter the faredata previously agreed with the user, as well asview the amount set and the time at which the correct payment is madethrough the LCD screen. See Figure 4

Module 2 can be observed, where the passenger will be able to make the payment with his own RFID card and limit himself from the monetary exchange, in turn he can see on the LCD the remaining balance in real time. See Figure 5

8 RECOMMENDATIONS AND CONCLUSIONES

- It is recommendable add an internal RFID card to module 1 to obtain a non-volatile database.

- It is recommendable to implement an internal battery to each module, such as secondary power, as the primary battery would be obtained from the vehicle.

Figure 4: Driver Prototype - Photograph of prototype 1 showing the amount to be charged - own authorship

Figure 5: Customer Prototype - Photograph of prototype 2 showing the remaining balance of the card - own authorship

- In short, this project uses technology to prevent indirect contagion by Covid-19 in the city of Huancayo, without the need for the application of this to prove difficult for most citizens of this city, but adapts to social-technological development, being easy to use for most potential users.

- The fact that this project can reduce the rate of contagion that is given to through to cash when making some transport payment and without the need for it to use as a means of operation and updating of data the internet, makes it a very good tool in this new normality in coexistence with the Covid-19.

9 PROGRAMMING

The programming code was developed with the following libraries, which are free to use.

#include<SoftwareSerial.h>. – This library allows us to communicate between the controllers through the Bluetooth module.

#include <Keypad.h>. – This library was used to be able to have greater control between the 16-segment matrix keyboard that has module 1.

#include <Wire.h>. – This library was necessary to be able to optimize the connections to our controller being complemented by I2C module.

#include <LiquidCrystal_I2C.h>. – The use of this library was necessary to achieve proper communication between the I2C module and the 16x2 LCD display.

#include <SPI.h>. – This library was used in order to establish one of the controllers as a slave and the other as a master, thus achieving communication between the two components.

#include <MFRC522.h>. – It was necessary to use this library to be able to make use of the RFID-NFC reader. It was said that this library executed a single function per process, which was to write or read the RFID card, so it was necessary to modify that library in order to be able to execute both functions simultaneously and thus give the effect of updating data on the RFID card. These allowed us to carry out the program for the correct implementation of the modules.

10 CITING RELATED WORK

This section cites a variety of journal [1, 6], and magazine [2, 3] articles to illustrate how they appear in the references section. It also a technical report [4], an online reference [7].

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