v. 3, n. 4, 2022

International Journal of Human Sciences Research

AUTOMATED SAFE FOR FIREARMS STORAGE: AN EFFECTIVE SOLUTION FOR SECURITY COMPANIES

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Abstract: With the growing articulation of organized crime and the increase in violence, manual methods become insufficient to effectively control firearms by companies, requiring the use of multiple technologies to guarantee a higher level of security in the custody of this material. The present work describes a firearm control system characterized by locking the firearm in the safe in an automated way, making it impossible to remove it without prior authorization. The purpose of this system is to prevent human error and lack of security from allowing the diversion of stored firearms. Additionally, this work aims to research patents for similar inventions in order to verify the potential of this system. The applied methodology consists of a steel safe with an electromagnetic pin lock that passes through the trigger key and the trigger guard of the firearm. The removal and storage control of the weapon in the safe is performed by a PLC (Programmable Logic Controller) in communication with a computer that opens the safe and unlocks the weapon lock. The results of this work were compared with similar patents already registered and showed an innovative character, a totality of functions and a higher level of security.
Keywords: Public security; Anti theft; Patent; Programmable logical controller.

INTRODUCTION

Brazil, nowadays, is experiencing a crisis of insecurity. In this scenario, the number of firearms being diverted from companies specializing in private security is worrying. According to a Federal Police report, at least 17,662 were diverted or stolen from surveillance companies and ended up in the hands of criminals in the last ten years. (Werneck, 2016). This type of controlled material, when used by criminals, in addition to causing financial loss to the company, causes non-stop damage to public order and irreparable damage to society.

Data presented by the National Federation of Companies for Security and Transport of Values show that the private security market in Brazil has approximately 3,551 companies specialized in the private security sector, which have 582,133 weapons and 122,022,722 ammunition (Fenavist, 2015).

Private security activities are regulated, authorized and supervised by the Federal Police Department - DPF, governed by art. 4, paragraph V, item d, Ordinance No. 3.233/2012-DG/DPF, of December 10, 2012 which disciplines in CHAPTER III, Section I, Subsection I, which provides that for a company to have authorization from the DPF to act as a specialist in the private security sector, it must meet the following requirements, among others: have a safe and adequate place to store weapons and ammunition, built in masonry, under slab, with a single access, with iron or reinforced wooden door with iron grid, equipped with a special lock, in addition to a fire-fighting system near the access door (Federal Public Service MJ Federal Police Department, 2012).

With the advancement of technology these days, it is totally incomprehensible that many companies still use purely manual methods to carry out stock control and firearm management. The use of more advanced methods, such as, for example, industrial automation technologies are capable of guaranteeing a higher level of security in the storage of this material.

The present work describes a firearm storage system composed of a security safe with automated opening control, which will allow a more robust management of war material stored by private security companies.

DEVELOPMENT

The project of the automated safe for firearms is composed of a steel safe that makes

it possible to store the firearm safely, a PLC (Programmable Logic Controller) responsible for executing all the interlocking logic for opening the door and releasing the weapon, a computer containing the safe's operation and configuration interface and a theft alarm system. The four main components of the system are illustrated in Figure 1 and will be detailed below.

SAFETY DEPOSIT BOX AND SECURITY DEVICES

The safe is where the firearm is stored, therefore, it must have an effective security system capable of preventing loss. To this end, a system was proposed consisting of a safe in high mechanical strength steel with a double security lock, in order to create redundancy in breaking into the safe. Additionally, two sensors used in triggering the theft signaling alarm were inserted. The locks on the door are electro-mechanical pins that pass through the walls of the safe, while the one on the weapon is made up of a single electro-mechanical pin that passes through the trigger button and the trigger guard of the firearm. The open door sensor is located near the hinge and is activated every time the door is open. The firearm presence sensor, on the other hand, is located close to the weapon and is activated every time it is in the safe box.

The safe was designed in a modular way to store each firearm individually, its complete composition is made from the number of weapons that are intended to be stored. The locks and sensors of each module of the safe are individually identified and connected to the inputs and outputs of the PLC (Programmable Logic Controller). A wiring trough allows these connections to be made flush inside the safe. The activation of the locks and the reading of the sensors is carried out by the logic of the program contained in the PLC. Figure 2 illustrates the interior of the safe and the security devices.

PROGRAMMABLE LOGICAL CONTROLLER

The PLC (Programmable Logic Controller) is digital electronic equipment with hardware and software compatible with industrial applications, being responsible for automating the opening of the safe and unlocking the gun lock, as well as activating the theft alarm, in case there is any attempt to break into the safe.

The PLC's programming logic allows opening and closing of the safe and release of the weapon lock whenever the operator, from the computer interface, requests the removal or storage of the firearm. Figure 3 presents the programming logic flowchart for this purpose.

COMPUTER

The computer has software that communicates with the PLC, whose main function is to control access to the automated safe. The system operator uses the software to open and close the safe to remove and store the weapon, as well as to register new users authorized to use the firearms and information about the weapons. All users who can retrieve a weapon must be previously registered in the system, in the same way, all firearms must contain a record informing the technical data and the storage position in the safe. Each weapon is individually monitored by a presence sensor, which is linked to an identification code. For a withdrawal or storage request to be carried out, a careful identification process is required to guarantee the security of the system. All operations carried out in the software are stored in a data history for future queries and analysis. Figure 4 presents the simplified structure of the system's functionalities.

ALARM

The alarm system has the function of

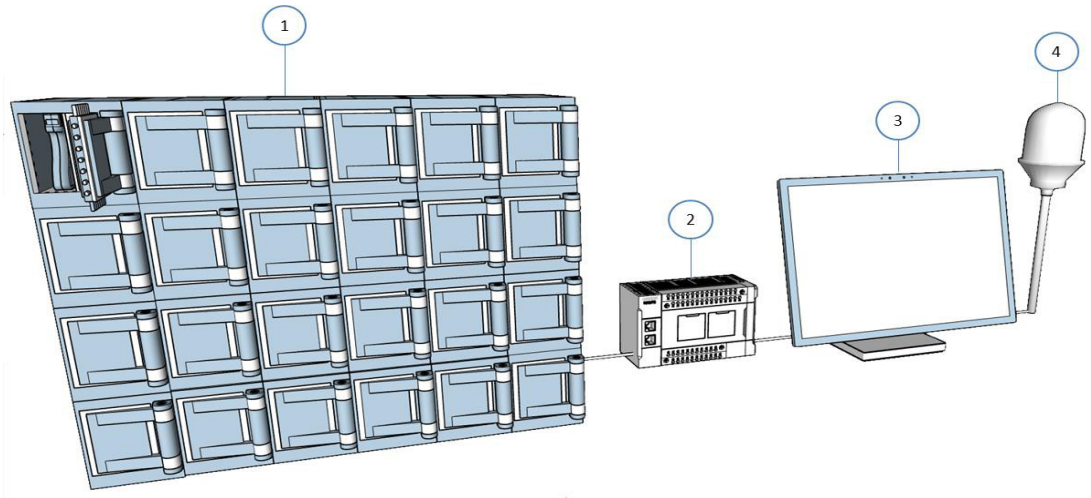

Figure 1 - Automated safe for firearm storage (1- Safe; 2- PLC; 3- Computer; 4- Alarm)

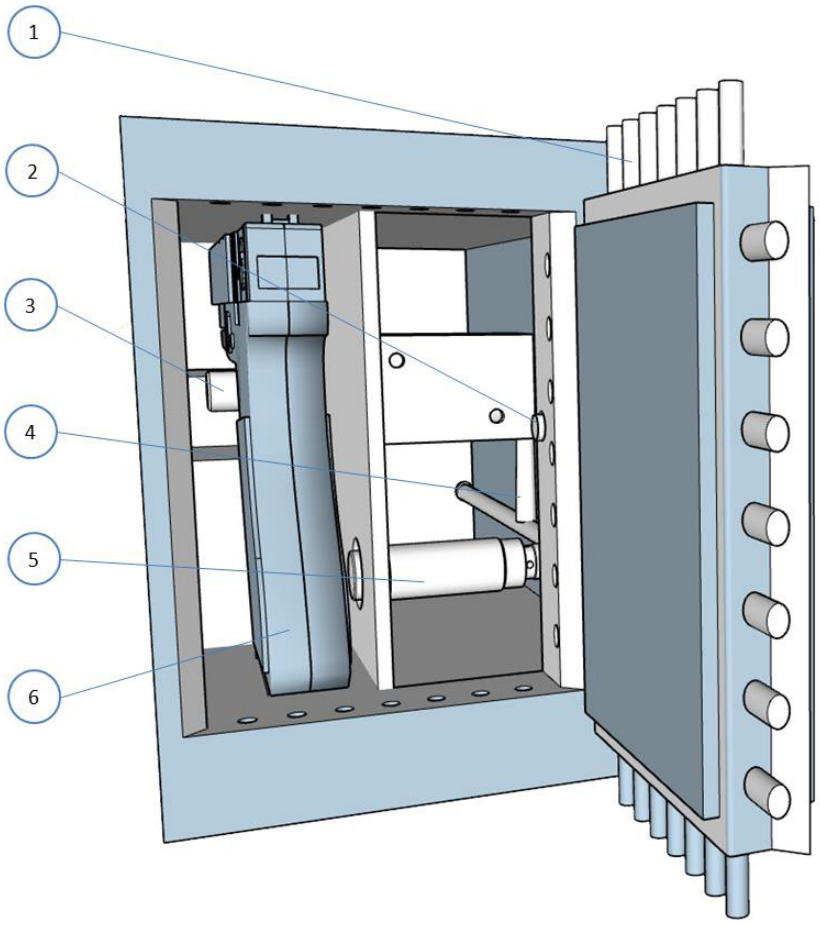

Figure 2 - Steel safe and security devices (1- Electromechanical door locks; 2- Open door sensor; 3- Electromechanical firearm lock; 4- Gutter for the electrical wiring of locks and sensors; 5- Firearm presence sensor; 6- Bin for firearm allocation)

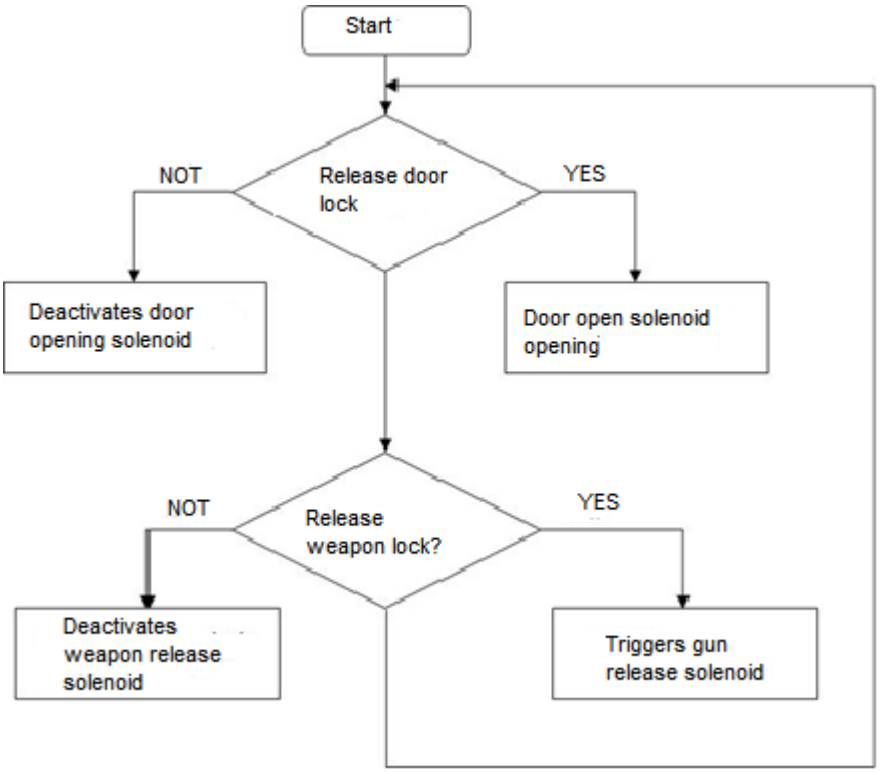

Figure 3 - Door opening and weapon release flowchart

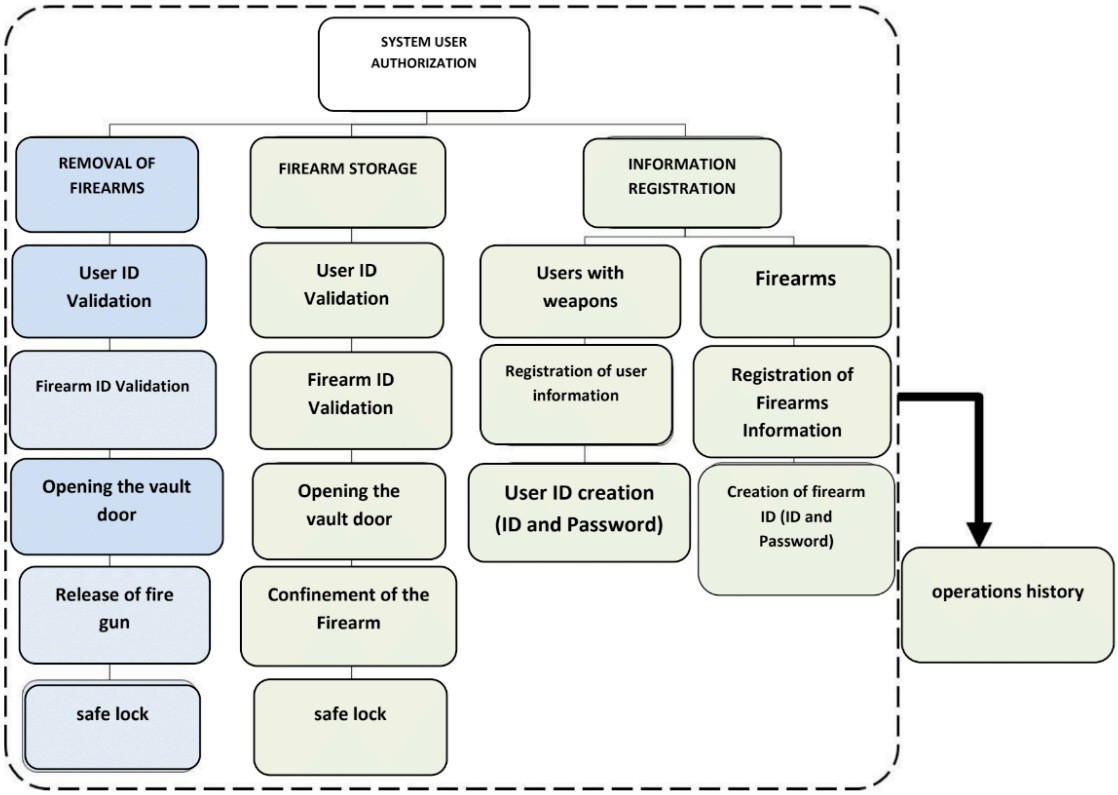

Figure 4 - Access control software functional organization chart to the safe

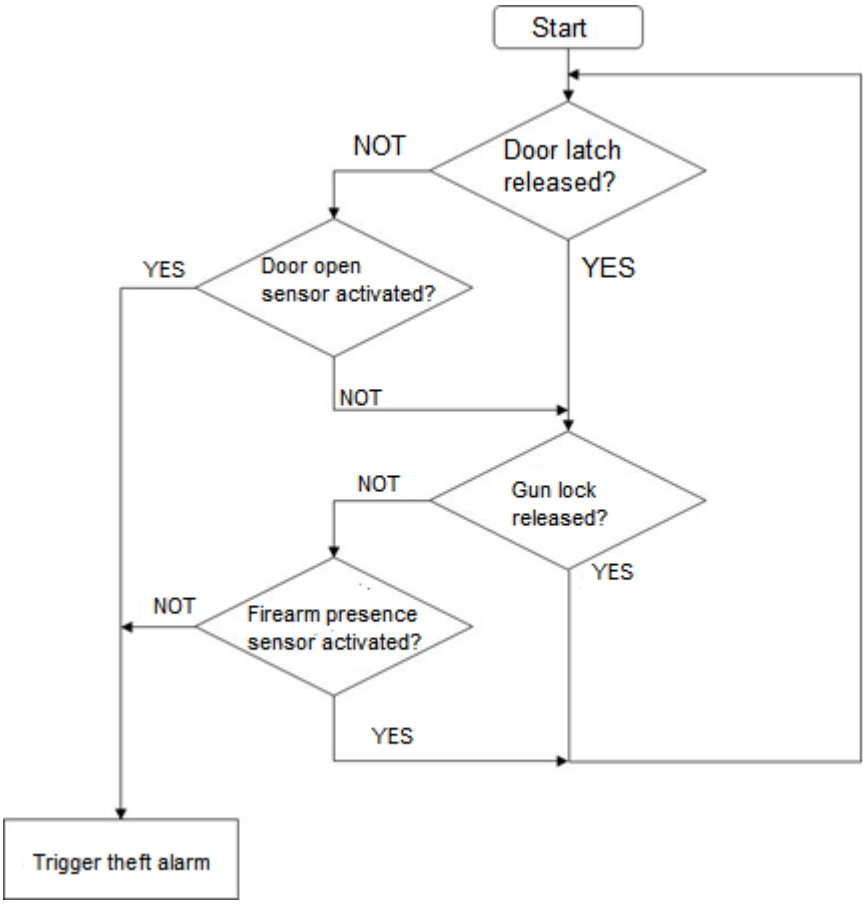

Figure 5 - Theft alarm activation flowchart

signaling any attempt to lose the firearm. For this purpose, the PLC programming logic will identify whether the door was opened improperly and also, if the weapon is not located in the vault's compartment, when it has been stored. If one of these events happens, the theft alarm will be triggered. Figure 5 illustrates the programming logic flowchart for the alarm activation control.

ANALYSIS AND DISCUSSIONS

The present work was proposed with the purpose of automatically carrying out the storage and control of the removal of firearms, with the objective of making it impossible for human error to allow the diversion of weapons. To verify the potential of this project and a future patent application, a comparison was made with the patents already registered that have the same purpose.

Through research carried out, no patents were found that specifically describe the constructive disposition of the safe for automated firearms, Diebold (1953) presents only a mechanical solution; Etal (1965) demonstrates an electromechanical locking for weapons and without automation, and outside the characteristics of the project presented here; also Shaw (1987) and Murray and Mercurio (1998) present electromechanical solutions without automation; Gangseo-Ro and Gangseo-Gu (2002) present an electromechanical device for individual locking of weapons inside a safe; Williams (2006) presents a database system with user control and firearm identification, but does not present a solution for the physical locking of the firearm; Poong and Hyun (2006) present a computer-controlled electromechanical locking of the firearm, but do not centralize the opening control in a single controller; finally Yi and Zhiqiang (2011) present a control system via software without solution to the physical locking of the firearm.

The results of this research expose the innovative character of this proposal. The cited patent documents do not present a complete solution for the control of firearms in stockpile, as they do not contemplate the physical locking of the firearm, as well as its identification in terms of location and registration of entry and exit. Among the potentialities and differentials of this project we can highlight:

- Modularity: The safe's layout can be designed according to the quantity and model of firearms to be stored. In this case, it is only necessary to adapt the safe compartment for each model of weapon and insert new input and output modules in the PLC.
- Redundant Safety Locks: The safe's locking design features dual safety locks located on the door and firearm.
- Theft alarm: a signaling alarm is triggered when there is an attempt to break into the safe door and the gun lock.
- Automated system for opening the safe and unlocking the weapon: removing and storing the weapon from the safe is only possible using the safe management software
- Access data control: all operations in the vault are recorded in a computerized way, avoiding recording errors and diversion of weapons.
- Guarding magazines and ammunition: the vault storage system also allows the storage of magazines for firearms and ammunition, as well as other war materials.

FINAL CONSIDERATIONS

This work presented an effective solution for security companies. The advantage of the proposed system is to allow the control of the

amount of firearms placed in the safe without the need for manual counting, as well as to inhibit the action of theft or diversion of any nature of firearms, as it contains constructive components that make these unfeasible. actions. In the continuation of this work it is intended to create a physical prototype of the system and a possible execution of patent registration of the proposed invention.

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