Protective holster for firearms

I D Kotilevets and I A Ivanova
KB-4 Department «Intelligent information security systems», MIREA – Russian Technological University. 78 Vernadsky Avenue, Russia, Moscow, 119454

E-mail: ikotilevets@gmail.com

Abstract. At the moment, the information development of modern society is increasingly associated with the expansion of the influence of the Internet of Things, however, there are quite specific areas that require special attention. One of these areas is firearms. In this area, there is a problem of monitoring and controlling the circulation and use of weapons. This article discusses examples of Informatization of firearms. The article also suggests the development of a software and hardware complex in the form of a prototype holster for firearms.

1. Introduction
The issue of firearm control is critical, since the use of weapons is often associated with criminal situations that can lead to human casualties. It is quite difficult in the realities of the modern world to track and control the use of weapons, when and by whom the shots were fired from the weapon that the crime was committed, who the owner is, whether the weapon was stolen, whether it is legally owned. This is relevant both for specialized departments that use weapons in their activities, and for civilians who own weapons.

Crimes involving the use of weapons that have resulted in serious consequences, including death, are widely known. In view of this, as well as the impossibility of a total ban on weapons, the topic of firearm control requires special attention, both from the point of view of the distribution and use of weapons among citizens and specialized services [1].

There are results in the field of methods of arms control and so-called intelligent and innovative weapons [2]. For now, however, these are isolated cases that improve and help locally private gun owners.

This article describes current developments in the field of control and monitoring of firearms, as well as proposed prototypes of holsters for firearms that protect against unauthorized or illegal use. Prototypes also allow you to collect various data on the use of weapons, such as the time and place of removing the weapon from the holster.

The purpose of the article is to show one of the possible ways to digitalize weapons, which will make it possible to protect society and reduce the criminogenic situation.

The main contributions are the development of a secure holster that allows you to transfer data about the user, place, and time of unlocking a firearm.

2. Analysis of problems
One of the most serious problems of the issue of weapons is criminogenic. Several facts can be identified at once
• illegality of the use of the weapon by the person who used it;
• use of weapons in the wrong place;
• violation of the rules of shooting;
• illegal possession of weapons.

The laws of various countries provide for a number of measures designed to minimize the risks of accidents with firearms. For example, to obtain a smoothbore weapon, you must have a license to purchase it, as well as purchase ammunition for it.

To obtain a license in Russia, you must obtain the following documents [3]:
1. Medical report on the absence of contraindications to the possession of weapons.
2. Document on passing training and testing of knowledge and skills of safe handling of weapons.
3. Document confirming the status of the applicant, who is undergoing appropriate training and verification of knowledge of the rules of safe handling of weapons.

Weapons, depending on the purpose of their use, are divided into several different types. In this article, special attention is paid to civilian and service weapons.

2.1 Civilian weapons
"Civilian weapons include weapons intended for use by citizens in self-defense, for sports and hunting, as well as for cultural and educational purposes [4]."

To store weapons by law, civilians must purchase a specialized safe. However, today it is not uncommon for intruders, outsiders, and relatives who do not have the right to own weapons to illegally gain access to weapons due to unreliable methods of storing keys or passwords from the gun safe. It is necessary to find alternative ways to safely store weapons that will correlate with current legislation. Due to informatization, for example, the introduction of biometrics and the transfer of data on unlocking a safe to Supervisory authorities, it is possible to prevent or at least reduce the percentage of illegal possession or use of civilian firearms.

2.2 Service weapon
"Service weapons include weapons intended for use by officials and legal entities who are allowed to carry, store and use weapons for self-defense purposes or to perform their duties assigned by law to protect the life and health of citizens, property, nature and natural resources, valuable and dangerous goods, and special correspondence [5]."

For example, a police officer may use firearms: "...to fire a warning shot, give an alarm or call for help by firing a shot up or in another safe direction without endangering citizens [5]."

Thus, the introduction of information technologies in service weapons will allow you to better control the criminal situation in districts and districts of cities, analyze the activity of using weapons, which will allow you to better and faster distribute employees to different sections depending on the current situation, and also reduce the response time to offenses. With the further introduction of information technologies, it becomes possible to create various automated systems for responding to crimes.

3. Analysis of existing arms systems
At the moment, both the army and private security companies, as well as ordinary citizens, are interested in intelligent weapons. All of the above are interested both in improving the effectiveness of shooting, and in controlling the weapons themselves. Some existing developments meet these conditions, for example, eLog [6] - a system designed to digitize the capabilities of regular small arms, as well as weapons of larger caliber. However, this system is used only in army.

Such a system should increase the durability of weapons and, at the same time, reduce the cost of operation. This is achieved through effective maintenance and maintenance techniques, selected by software based on the readings of sensors integrated into the weapon.

Such a system can reduce the deployment of faulty weapons systems. Failure of weapons systems is a big problem, because it can cost soldiers their lives during operations and combat encounters, such as close combat in urban areas.
The main components of the system are a module integrated inside the firearm, a portable reader of the module, and a control system.

The data collected and saved is the number of shots fired and the service history. The modules also record the movement of weapons to help deter theft and find weapons lost from the Arsenal. In addition to tracking the status of weapons, eLog also tracks the location of each unit.

All of the above will reduce the number of crimes where weapons will be used with the integrated eLog system, as well as provide various information to quickly resolve criminal situations.

Another weapon control system is the Axon Taser – a long-range electric shock device equipped with the function of automatically calling the police when the trigger is triggered [7].

The operation of an electroshock device is as follows: when activated, the power source supplies an electric charge, which, passing through the conversion unit, enters the electrodes, through which the discharge is transmitted from the device to the enemy, causing strong muscle contractions. They cause you to lose your balance and prevent you from making conscious movements. The muscle mass of the person against whom the device is used will play against them in this case. The device looks like a gun, except for the lack of a clip - in its place are batteries.

The shot is fired by pressing the trigger. the device fires two electrodes that transmit an electric charge through two copper wires that remain attached to the main unit of the cartridge. The shot takes place thanks to the built-in cartridge canister with compressed nitrogen. The cartridge contains enough compressed gas to make a single shot.

The approach of calling for help when the trigger is pulled is important, since if a weapon is used in the wrong place, it is obvious that a prompt response from law enforcement agencies is needed. There are drawbacks in the systems considered:

1. Hacking sensors. The sensors do not have serious protection from the user's influence on them, and their operation can be disrupted.
2. Power supply problem. The sensors consume a certain amount of energy, and the elements that serve for over-feeding are usually either too large or do not provide the necessary operating time.
3. The problem of illegal change of ownership of weapons. Sometimes weapons are taken over by illegal actions, they should prevent this.
4. Lack of centralized control over weapons. It is not possible to track the actual use of a batch of weapons on a large scale, which does not allow accurate and timely assessment of the criminal situation and the purpose of the use of weapons.

It is precisely because of these shortcomings that the above-mentioned control systems are still in demand only in narrow areas.

4. Proposed solution

As part of this work, it is proposed the following solution:

1. Integrated into a holster for a firearm, the combination of sensors, namely:
   1) Sensor that tracks the location of weapons using the global positioning system;
   2) Biometric fingerprint sensor responsible for unlocking the holster;
   3) Radio beacon;
   4) System integrity monitoring sensor.
2. Controller that collects data, forms an encrypted block from it, and sends it to the server via a wireless channel.
3. The power element. In power consumption tests, a standard lithium-ion battery held a charge for a week. If you reduce/increase the size, and, accordingly, the power of the battery, you can increase or decrease the operating time by changing the weight of the holster.
4. Distributed ledger technology consisting of message blocks from weapon controllers stored on the servers of authorized structures.
5. Database stored on the server that contains information:
   1) about the user (it can be either a civilian or an employee of specialized services)
      • personal data of the user;
4.1 Integration into a protective holster for tracking

Due to the integration of sensors that can track the location of the holster with a weapon, it is possible to monitor the activation of the holster and the potential use of weapons. This development uses a SIM with the capabilities of a global positioning system and location tracking using cell towers. These features can significantly reduce the error in determining the location of holster owners.

The biometric sensor allows to prevent unauthorized access to firearms. Thanks to the combined use of a SIM and a biometric sensor, it is possible to monitor and analyze various criteria: when and where the protective holster was removed, who tried to unlock the case – the registered owner or an outsider. The orientation sensor will prevent false alarms of the biometric sensor.

This will help partially solve the problem of illegal change of ownership of weapons. In the case of a holster, we can track who, where and when tried to get a weapon.

However, there are situations when even a second delay can pose a threat. This is especially true for the use of a protective holster by law enforcement agencies. In this case, alternatives to the biometric sensor should be considered [10].

In which case we can resolve the problem of the lack of centralized control over weapons because we can track data of every holster. Optionally, the data can be transmitted via a closed or encrypted channel to the server. In the future, with the mass use of the holster, it becomes possible to collect geodata for further analysis, processing and creating a predicate system for calculating the criminal situation in separate areas, districts or the whole city.

4.2 Holster prototype

Based on the text above, a prototype of the holster was created (Figures 1-2), which includes sensors, an element that blocks the trigger, and a 3D-printed case.

Test mobile software was also created (Figures 3-5). A test mobile software was also created. It allows you to track the time and place of unlocking the holster, as well as the ability to link or change biometric data. At the moment, a prototype of the case for the holster is ready (Figures 6-7). Separately board layout has been developed that will be installed in the holster (Figures 8-9).

Also, a test mobile application has been developed, where a prototype of a protective holster sends data due to the temporary inability to send data to the department's servers. The prototype at this stage
performs all functions except the data is sent to servers of the departments, instead data is sent to the dedicated server and a mobile application.

**Figure 1.** Prototype of a holster with a pistol model.

**Figure 2.** Biometric sensor of the holster prototype in a 3D-printed case.

**Figure 3.** Screen example of a mobile application for a protective holster, the device user’s biometric data page.

**Figure 4.** Screen example of a mobile application for a protective holster, displaying the prototype unlock location on the map.

**Figure 5.** Screen example of a mobile application for a protective holster, the device user’s account.
5. Conclusion

Today the stage of mass integration of firearms and information technologies is just beginning. Today, intelligent systems are extensions and add-ons to the weapons themselves that facilitate their use, but only partially solve the problems of control, analysis and monitoring.

The holster proposed in the article can help improve the control and monitoring of firearms, ensure the safety of possession and use of weapons, and create platforms for monitoring and controlling firearms. In the future, with the development of technologies, it will be possible to create a platform for monitoring and analyzing the criminal situation.

Now, there are no direct analogues of such a device. The systems discussed above only partially solve the problem of digitalization of weapons. They also do not solve the problem of illegal change of ownership of weapons and cannot provide centralized control over the use of weapons. With the introduction of a protective holster for both citizens and specialized departments, we will be able to reduce the crime situation by collecting and analyzing data from each holster.

The created prototype of the holster at the current stage allows you to perform the necessary manipulations: user registration, unlocking and locking the holster, sending data to the server and phone. The police officer participating in the experiment identified several shortcomings, and work is underway to correct them.

The introduction of a protective holster in certain departments or in the civilian sector will help to reduce the crime situation both in a particular area and in the entire city by monitoring the activity of
the holster. The holster also allows you to partially avoid illegal changes of ownership of weapons and provides opportunities for centralized control of weapons.

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