Non-contact detection of hidden objects under clothes

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Abstract. The security portal is a set of technical devices united by a single software in an information environment with a common database. We design the portal for highly effective detection of the maximum number of threats: metal objects and electronic products hidden on the body and in clothes.

1. Introduction
The security portal allows to detect hidden radio-electronic devices (cell phones, bomb fuses, transmitters, miniature video cameras, listening devices). Figure 1 shows the appearance of portal.

The portal is a combination of technical devices [1]. The metal detection subsystem provides real-time positioning of single or group objects under a person’s clothing, which are made of metal or containing metal. The subsystem allows accurately control the location of a metal object on the human body. The subsystem splits the scanned space into 21 control zones. The porta controls seven zones in the vertical direction and three in the horizontal directions.

The subsystem of the radio-electronic location detects hidden radio-electronic devices such as cell phones, bomb fuses, transmitters, miniature video cameras, listening devices, metal elements on the
human body, etc. [2]. In the same time, devices could be in the off state. The sub-system controls the location of electronic objects with high accuracy on the human body. The portal controls four zones in the vertical direction and two in the horizontal. The explosives detection subsystem uses supersensitive semiconductor sensors [3], which reacts to the content of NO2 vapors in air.

The portal could enhanced with the biometrics system by installing a video camera. Figure 2 shows software interface window.

![Figure 2. Interface window.](image)

2. Device and operation
The design has two side panels. In each side panel there are seven receiving and one transmitting magnetic coils, passage sensors, and also a detector of semiconductor elements. Which is designed to search and detect electronic devices, both in active / disactive state.

We applied the eddy current method with a harmonic magnetizing field to detect metallic objects. The system of coils creates a uniform field in the control zone, which gives uniform sensitivity in the control zone. Digital processing of signals from receiving coils provides high product selectivity. The detector of semiconductor elements is based on the property of semiconductor elements to re-radiate the second and third harmonics when irradiated elements with microwaves. Maximum response from semiconductor elements of artificial origin at the second harmonic of the probing signal. Oxide films of natural origin and the accumulation of small metal fragments, which are often found in explosive elements during irradiation, give the maximum response at the third harmonic. Digital processing of the demodulated signal gives maximum sensitivity. The detector of semiconductor elements analyze responses from irradiated objects for the second and third harmonics of the probe signal, which makes it possible to identify electronic devices and natural oxide semiconductors in the same time. Also, the portal can simultaneously identify the levels of the second and third harmonics (Figure 3). The operator controls and changes the parameters of the portal with the help of a personal computer.

All subsystems combined on the software complex into the common information environment. Its designed for highly efficient detection of the maximum number of threats. The embedded software determines the type of prohibited item on the human body and shows to operators an approximate location on the human body.

Basic software features:
• Identify the type of hidden object (metal or electronic device).
• Determining the location of hidden objects on the human body.
• Sensitivity setting.
• Archiving events and photos on a remote server.
• Networking from multiple portals.
• Remote control.

Figure 3. Nonlinear object detection.

3. Comparisons with analogues
Now, there are several approaches to detecting prohibited items under clothing:

Radio-wave scanners are designed for non-contact, safe and prompt inspection of citizens in order to prevent any substances, materials and products from 3–5 mm in size to the protected area [4, 5]. They are used at checkpoints organizations and enterprises

Advantages: high resolution, human safety
Disadvantages: requires a qualified operator (with a shift every 30 minutes), the high cost of the device (about $ 200,000), low throughput (six people per minute).

X-ray scanner.

Advantages: high resolution, detection of objects (drugs) hidden inside a person.
Disadvantages: requires a qualified operator (with a shift every 30 minutes), the high cost of the device (about $ 100,000), low throughput (5 people per minute), unsafety for people in cases of frequent use.

The portal (Figure 4).

Advantages: low cost, the ability to detect a wide range of prohibited items, ease of maintenance does not require a specially trained operator, high throughput (up to 30 people per minute). Change a standard metal detector to the portal and starting to use. It is enough.
4. Area of use
- Aviation, rail, water transport.
- Government agencies and organizations, corporate headquarters.
- Objects of increased danger, including military facilities, nuclear and hydroelectric power plants.
- Industrial enterprises, including non-ferrous metallurgy and jewelry enterprises.
- Warehouse terminals, archives, storage.
- Banks, data centers.
- Health care institutions, educational institutions, universities, museums.
- Embassies and diplomatic missions.

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