

SYSTEM AND METHOD TO DETECT ONE OR MORE CONCEALED WEAPONS**TECHNICAL FIELD**

5 **[0001]** The present invention relates to metro security system, in particular to system and method to detect one or more concealed weapons carrying by commuters in real time.

BACKGROUND

10 **[0002]** Conventional scanning systems for security purposes include devices such as metal detectors and X-ray units. The metal detectors are used to detect metal objects such as knives and handguns and cannot discriminate between innocuous items such as glasses, belt buckles, keys, etc. and are essentially useless in detecting modern threats posed by plastics, ceramic handguns, knives and even more dangerous items such as plastic and liquid explosives. Additionally, in light of the increased threat of terrorism, a greater need
15 for an accurate and efficient concealed weapon detection systems and methods for use at security access points, such as the systems and methods located at transportation hubs such metro station, airports, railway station, is urgently needed.

20 **[0003]** US patent number 9,332,624 B2 filed by Morton discloses gantry scanner systems which can be used as cargo scanners. The gantry scanner system disclosed in Morton reference includes a radiation source, detectors, and support frame to support the detectors. The support frame includes an elongate support member arranged to support the detectors. The gantry scanner system disclosed in Morton reference further includes a gantry scanning system, a control system, and rechargeable power storage means mounted on the gantry. The power storage is connected to a power supply so that it can be recharged. However,

the gantry scanning system disclosed in Morton reference is a complex and huge scanner that scans backward and forwards under computer control around a stationary load under inspection. Such system large in size and it is not suitable for commuters' daily access.

[0004] Airport typically adapts X-ray technology in conjunction with CT scanner for scanning bags, and separately, flight passengers are required to walk through a metal door frame sized detectors for detecting metals. Such system typically uses millimetres wave or backscatter x-ray scanner for metal detections, and if any metal is detected, the flight passengers are required to stand aside for a secondary scan perform by human operator with a handheld metal detectors. Such work flow is time consuming and not suitable for large crowd of commuters passing through metro gantry daily.

[0005] This present invention recognizes that the scanner devices should be compact and interoperable to configure in any existing gantry systems for metro or subway or rail transport. It is desired to provide gantry , and it is a challenge to integrate the portable screening devices in the existing gantry system to detect the concealed weapons.

SUMMARY

[0006] The present invention provides a system and method to detect concealed weapons in real time. The metro security system having a gantry for detecting one or more concealed weapons carried by commuters passing therethrough. The gantry comprises a radar screening device adapted to scan commuters in real time to detect the concealed weapon and produces an image signal pertaining to the detected concealed weapon; an image processor connected to the radar screening device to receive signals from the radar screening device to render images based on the detected signals; and a communication module connected to the image processor to transmit the images to a computing unit over a communication network for analysis.

[0007] In one embodiment, the received signals are affirmative signal, or the negative signal depicting a plurality of parameters pertaining to the detected the concealed weapon.

[0008] In another embodiment, the processing unit depicts the plurality of parameters through a display module configured with the computing unit.

[0009] In an alternative embodiment, the plurality of parameters comprising a dimension of the concealed weapons, type of the concealed weapons, and model of the concealed weapons.

[0010] In a further embodiment, the radar screening device receives one or more control instructions from the computing unit.

[0011] In another aspect, there is provide a method for detecting one or more concealed weapons carrying by commuters. The method comprises deploying a gantry having a radar scanning device; scanning commuters to detect the concealed weapon and produces an

image signal pertaining to the detected concealed weapon through the radar screening device; receiving the image signal and processes the image signal to produce at least one of an affirmative signal, and a negative signal through an image processor; and communicating the produced affirmative signal, or the negative signal to a computing unit
5 over a communication network for analysis through a communication module.

[0012] In one embodiment, further comprises processing the received affirmative signal, or the negative signal and depicting a plurality of parameters pertaining to the detected concealed weapon through a processing unit.

[0013] In an alternative embodiment, the processing unit depicts the plurality of
10 parameters through a display module configured with the computing unit.

[0014] In yet another embodiment, the plurality of parameters comprising a dimension of the concealed weapons, type of the concealed weapons, and model of the concealed weapons.

[0015] Further the radar screening device receives one or more control instructions
15 from the computing unit.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] In the figures, similar components and/or features may have the same reference label. Further, various components of the same type may be distinguished by following the reference label with a second label that distinguishes among the similar components. If
20 only the first reference label is used in the specification, the description applies to any one of the similar components having the same first reference label irrespective of the second reference label.

[0017] FIG. 1 illustrates a block diagram of a metro security system to detect one or more concealed weapons, in accordance with one embodiment of the present invention.

[0018] FIG. 2 illustrates a flowchart of the method for detecting one or more concealed weapons, in accordance with an alternative embodiment of the present invention.

5 **[0019]** FIG. 3 illustrates a perspective view of a gantry system of metro/subway/railway transport adapted for scanning commuters for detecting concealed weapons in accordance with an alternative embodiment of the present invention.

DETAILED DESCRIPTION

[0020] The present invention is best understood with reference to the detailed figures and description set forth herein. Various embodiments have been discussed with reference to the figures. However, those skilled in the art will readily appreciate that the detailed descriptions provided herein with respect to the figures are merely for explanatory purposes, as the methods and systems may extend beyond the described embodiments. For instance, the teachings presented and the needs of a particular application may yield multiple alternative and suitable approaches to implement the functionality of any detail described herein. Therefore, any approach may extend beyond certain implementation choices in the following embodiments.

[0021] Apparatus and method are disclosed for a metro security system to detect one or more concealed weapons carrying by commuters. Embodiments of the present invention include various steps, which will be described below. Although the present invention has been described with the purpose of detecting one or more concealed weapons and communicating the detected data over a communication network, it should be appreciated that the same has been done merely to illustrate the invention in an exemplary manner and to highlight any other purpose or function for which explained structures or configurations could be used and is covered within the scope of the present invention.

[0022] FIG. 1 illustrates a block diagram of a metro security system **100** to detect one or more concealed weapons, in accordance with one embodiment of the present invention. The metro security system **100** includes a radar screening device **104**, an image processor **106**, a communication module **108**, and a processing unit **112**. The metro security system can be adapted as a standalone system that is sufficiently compact to fit into any

metro/subway/railway gantry, whereby all commuters are scanned to detect for concealed weapons in real time. The radar screening device **104** is installed within a gantry **102** of a metro to scan an individual to detect the concealed weapon and produces an image signal pertaining to the detected concealed weapon. The radar screening device **104** operably
5 send out pulses or continuous waves of electromagnetic radiation as detection signals. In an embodiment, the radar screening device **104** may utilize various algorithms for the detection of on-body concealed weapons carrying by commuters when passing through the metro gantry. The algorithms used by the radar screening device **104** provides a non-invasive full body scanning technology that is safe for human usage. In an embodiment,
10 the radar screening device **104** is having suitable pulses or waves in other suitable frequency ranges may also. The radar screening device **104** acts as a stand-off detection of on-body concealed weapons. In an embodiment, the radar screening device **104** may learn by using machine learning algorithms after deployment and adapts to a specific environment.

15 **[0023]** The image processor **106** is connected to the radar screening device **104** to receive an affirmative signal or a negative signal therefrom and process the signal to product images of target objects, such as concealed weapon. The image processor **106** may use various software such as ENVI (Environment for Visualizing Images), OpenCV library for processing the image signal. The image processor **106** may enhance the detected image of
20 the concealed weapons and may extract some useful information from it.

[0024] The communication module **108** is connected to the image processor **106** to communicate the produced affirmative signal, or the negative signal to a computing unit **110** over a communication network **116** wired or wirelessly (e.g., the Internet or a local area network) for further analysis. In an embodiment, the radar screening device **104**

receives one or more control instructions from the computing unit **110**. Examples of the computing unit **110** may include, but are not limited to a personal computer, a laptop computer, a embedded computer, server, of the like. The computing unit **110** may execute an operating system, examples of which may include but are not limited to Microsoft
5 Windows™, Android™, Redhat Linux™, or a custom operating system.

[0025] The processing unit **112** is connected to the computing unit **110** to process the received affirmative signal or the negative signal and depict a plurality of parameters pertaining to the detected concealed weapon. In an embodiment, the processing unit **112** depicts the plurality of parameters through a display module **114** configured with the
10 computing unit **110**. In an embodiment, the plurality of parameters comprising a dimension of the concealed weapons, type of the concealed weapons, and model of the concealed weapons.

[0026] FIG. 2 illustrates a flowchart **200** of the method for detecting one or more concealed weapons, in accordance with an embodiment of the present invention. The method includes
15 the step **202** of scanning an individual to detect the concealed weapon and produces an image signal pertaining to the detected concealed weapon through a radar screening device installed within a gantry. In an embodiment, the radar screening device receives one or more control instructions from the computing unit.

[0027] The method then includes the step **204** of receiving the image signal and processes
20 the image signal to produce at least one of an affirmative signal and a negative signal through an image processor. Further, the method includes the step **206** of communicating the produced affirmative signal, or the negative signal to a computing unit over a communication network for analysis through a communication module.

[0028] The method includes the step **208** of processing the received affirmative signal, or the negative signal and depicting a plurality of parameters pertaining to the detected the concealed weapon through a processing unit. In an embodiment, the processing unit depicts the plurality of parameters through a display module configured with the computing unit.

5 In an embodiment, the plurality of parameters comprising a dimension of the concealed weapons, type of the concealed weapons, and model of the concealed weapons.

[0029] FIG. 3 illustrates a perspective view of a gantry system of metro security system for scanning commuters for detecting concealed weapons in accordance with an alternative embodiment of the present invention. In an exemplary embodiment, the radar screening
10 devices **104a**, **104b** may installed within the gantry **102**, such that any person passing through the gantry will be scanned and detected for any concealed weapon in real time. The scanned signals detected by the radar screening devices 104a, 104b are processed and analysed for detecting concealed weapon. It provides an early warning to the relevant authority to effectively deter and diminish any potential violence from occurring.

15 [0030] For metro AFC gate/gantry, the typical passenger throughput can be around 40 commuters per min or higher. It is desired that the system has sufficient throughput without holding back the passenger traffic.

[0031] In the above embodiments, only one radar screening device is installed at the front end of the gate's barrier leaf, whereby commuters are scanned before they pass through.

20 [0032] In another embodiment, the metro gate is a bi-parting gate for handling commuters bi-directionally. The metro gate is also adapted to handle different passage scenarios, such as intrusion, tailgating, piggybacking etc., which are known in the art. For bi-parting gate, it is desired that commuters are scanned before the barrier leaf opens, regardless which direction they enter. In one embodiment, one radar screening device is installed on each

side of the barrier leaf. In another embodiment, the radar screening device comprises two parallelly functioned antenna, each is deploy on each side of the barrier leaf. There may be other configuration for scanning commuters from both sides of the gates, depending on how the radar screening device is configured. The objective can be achieved by deploying
5 additional scanning means.

[0033] In a further embodiment, the screening device may be millimeter wave or the like.

[0034] In yet a further embodiment, the metro security system may include a backend system for processing the detected signal or data. The backend system may include machine learning or Artificial Intelligent (AI) capabilities for enhancing the results of the
10 data processing. The processed data can be useful for tracking commuters and alerting the authorities as required. Data processing may include video analytics and tracking, and the like.

[0035] In a further embodiment, the metro security system may store histories of the detected commuters for future analytics.

15 **[0036]** In one alternative embodiment, the metro security system is adapted with a temperature screening means for detecting body temperature of the commuters as they are progressing through the gate. In one embodiment, the gate may refuse entry if the detected body temperature is above a specific threshold. The temperature screening means may comprise a camera-based temperature screener.

20 **[0037]** Further, the metro security system may further comprise a imaging device for tracking commuters through video analytics, such that all commuters passing through the gate can be recorded. It may allow the relevant security authorities to prevent/intervene access, whenever necessary. In another embodiment, a discreet spray nozzle may be

installed to spray a chemical tracker or any invisible paint when triggered to mark specific commuter whenever necessary. Such spray may be visible through CCTV cameras and can be highlighted in the cameras automatically without video analytics. It is especially useful just in case the persons face is covered/face mask etc.

- 5 **[0038]** In yet a further embodiment, the metro security system may further comprise sensors for detecting chemical scents.

- 10 **[0039]** When any commuter is detected as a targeted suspect, the captured video or image will be broadcast to the relevant authorities. The detection may also trigger the Automated Fare Collection (AFC) system to retrieve all travel history of the suspect, so that all these locations can be searched for possible risks. If any weapon is detected carrying by the suspect, all relevant passenger information system (PIS) may be informed to evacuate station/stop, and/or trigger Operation Control Centre (OCC) to prevent trains stopping the station to prevent possible mass casualties.

- 15 **[0040]** While embodiments of the present invention have been illustrated and described, it will be clear that the invention is not limited to these embodiments only. Numerous modifications, changes, variations, substitutions, and equivalents will be apparent to those skilled in the art, without departing from the scope of the invention, as described in the claims.