International Journal of Engineering & Technology, 7 (3.6) (2018) 298-301

International Journal of Engineering & Technology

Website: www.sciencepubco.com/index.php/IJET

Research paper

AAGC-Autonomous Armed Guard Companion

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Abstract

Technology has revolutionized human world over the past centuries. The world has started to move towards the autonomous world. However, in terms of security and safety of humans from antisocial threat person, technology has not achieved its peak in providing autonomous system. Places such as airport, railways stations, and malls are well secured either by metal detectors or by manual scrutiny. Moreover, the current scenario demands a very high security in common places such as hospital, schools, and community halls where manual security checks might not be possible. In this work an autonomous system is developed to detect and track concealed weapons with potential to stop the threat person before causing any harm or danger. The system achieves its task by carrying out three main functions in a sequential order. A microwave sensor and metal detector together detects the concealed weapon by means of the Doppler shift in the radiation and eddy currents induced in the metal respectively. Secondly, the output voltage from the microwave senor is processed by a microcontroller. Lastly, a DC motor attached with a laser pointer, receives input from microcontroller such that rotates in a direction pointing the concealed weapon.

Keywords: *Arduino UNO, doppler shift, metal detector, microwave sensor, GSM, weapon detection, weapon tracking.*

1. Introduction

Over the past centuries their been an exponential growth in technology but the same has not seen in human nature. Extreme outburst of emotions such as rage, anger and hate which leads severe consequence on the society. This has lead to abomination of the society. Many advanced technologies has been developed to detect concealed weapons to provide safety to public and public assets such as airport, railways, shopping malls etc .Still the security and safety of humans is at risk especially in common places like schools, church, super markets and at homes etc, where each day most of the people spend their time. Various techniques have been developed for concealed weapon detection such as Image Processing, Active and Passive millimeter-wave sensors, Phased Antenna array, and explosives detection through Signal Processing and Pattern Recognition .However all these techniques needs a high cost installation and a manual operation to detect the weapon. Although these techniques produce good results they always relay on human need and donot have the potential to stop the danger caused by the threat person on their own. Moreover it would alert the dangerous one and helps him to escape. Thus the motivation of the proposed system came from the incidents which recently occurred, where a person committed a mass murder of 26 innocent's life in a church [6]. Various incidents like this occur each day in this world thus to prevent these incidents and to prevent loss of human life this system has been developed based on the idea to provide a low cost, high effective security system for the betterment of the society.

2. Related Work

Bhavna Khajone.et.al [1] implemented a technique for detecting weapon using IR image processing. The Image Processing technique is based on infrared radiation emitted by the concealed weapon and it follows a sequence of algorithm in which initially the color image (RGB) and infrared (IR) image of an object has been taken. The IR image has been complemented and combined with the RGB image. Further DWT fusion is applied to the obtained image to get binary image of the object in which the clear image of the weapon get contour. If a person is clothed loosely then the emitted infrared radiation will be spread over clothing area which decreases the ability to image a weapon. From the difference in thermal emissivity the hidden object can be detected but due to black image formed for background in the image, weapons cannot be detected accurately.

Helmut Essen1.et al.[2] has researched the mechanism of weapon detection using Passive mm-wave imaging with or without artificial illumination by an incoherent noise source. Due to the incoherent illumination, no polarizing effects on the surface or in the clothing material occurs. Passive millimeter wave (MMW) sensor measure the apparent temperature through the energy that is emitted and reflected by sources. The sensor output is based on the function of emissivity of the object in MMW spectrum as measured by the receiver. With the help of MMW sensors it is possible to detect concealed weapon by penetrating clothing due to the property of low emissivity and reflectivity of object like metallic gun.

S.W.Harmer.et al[3] has discussed a new technique which involves Broadband illumination of an object with microwave frequency radiation (range 0.3–3 GHz especially for handgun

sized objects) which produces excitation in low order complex natural resonance (CNR) frequency along with late time response (LTR) being located using phased array imaging techniques. Stepped frequency continuous wave (SFCW) is used to detect metallic objects. It determines the characteristics of the object, if it is get matched with their resonant frequencies then it indicates the presence of object such as weapon beneath the layer of cloths.

Sameer Singh.et al.[4] has discussed about X-ray screening method to detect concealed weapon. The X-ray screening technique scans the material and provides the object density d and effective Atomic number Z to check the elements present inside the luggage. The atomic cross-section, the attenuation obtained in a location in the transmission image provides the total X-ray interactive cross-section obtained as the sum of photoelectric and scattering cross section. The absorbed energy depends upon the density of the material. More energy is absorbed by the object which has high density and it creates a darker image. Object such as metal or weapons appear very dark in the transmission image. Areas of heavy metals are dark whereas areas of light elements absorb energy in low amount.

Wixian Tan.et al.[5] has researched Range Stacking Technique for Three-Dimensional Microwave Imaging to detect concealed weapon.3D range stacking algorithm deals with the compensation of losses due to propagation, reconstruction of wave front, and aliasing mitigating and no occurance of interpolations. The algorithm is based on the multiplication of the reference signal spectrum at each specific range bin, headed by the coherent summation for the whole frequency band. The results produce a very high resolution and good image fidelity of the proposed algorithm.

3. Proposed Method

In this modern era many inventions have been developed for various purposes but still human safety is in critical danger. New technologies have been developed to detect concealed weapon. However they are not designed to operate without manual aid. Thus this paper proposes a system which can detect, recognize, track and take down a person having concealed weapon.

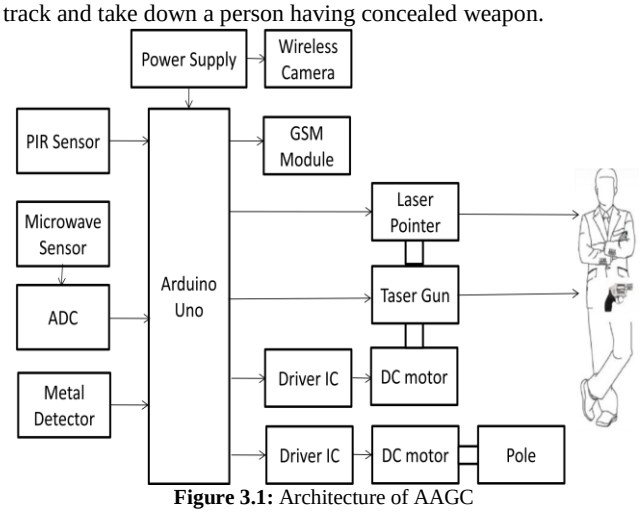

Figure 3.1: Architecture of AAGC

The figure.3.1 and figure.3.4 provides a schematic representation of the system.

The Hobby metal detector works under the principle of electromagnetic induction. Metal detectors contain one or more inductor coils that are used to interact with metallic elements on the ground. The simplest form of a metal detector consists of an oscillator producing an alternating current that passes through a coil producing an alternating magnetic field. If a piece of electrically conductive metal is close to the coil, eddy currents will be induced in the metal, and this produces a magnetic field of its own. If another coil is used to measure the magnetic field, the change in the magnetic field due to the metallic object can be detected. In this system the metal detector is placed at the sides of the door to detect weapons which are having base composition as metals such as knives, metallic guns etc. If weapon is detected then the buzzer is turned on.

The HB-100 microwave sensor is a mini radar motion sensor module based on the Doppler microwave induction technology. The Doppler Effect produce velocity data about objects at a distance. The figure 3.2 provides the circuit designed to interface HB100 microwave sensor with arduino using analog to digital converter (ADC).

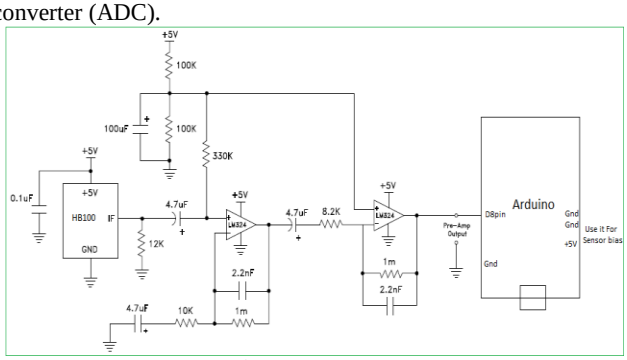

Figure 3.2: Circuit to interface HB100 microwave sensor with arduino

The figure.3.3 describes the principle of occurrence of Doppler Effect due to Scattering of microwave radiation from the human body. It process takes place by bouncing a microwave signal off a desired target and analyzing how the object's motion has altered the frequency of the returned signal. This variation gives direct and highly accurate measurements of the radial component of a target's velocity relative to the microwave sensor position. It produces high level TTL (Transistor Transistor Logic) output signal when there is motion. It operates over the range 4-28V and provides a convenient 3.3V output to drive microcontroller.

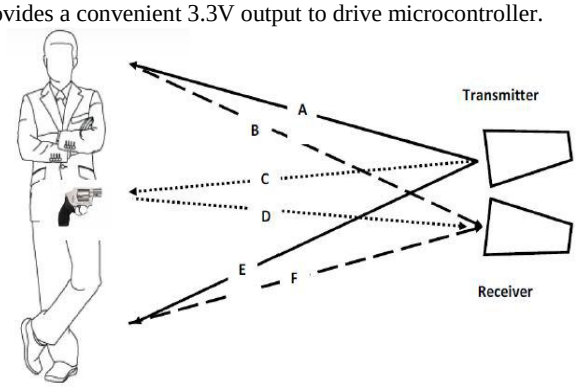

Figure 3.3: Principle of microwave sensor

Doppler effect calculations:

If ft is the transmitted frequency, fr is the reflected frequency (as measured in transmit/ receive antenna on the sensor), v is the speed of the target relative to the sensor (negative if receding, positive if advancing toward sensor), c is the speed of light and fd (fr-fd) is the Doppler shift, then:

$fr = ft\,(c + v) / (c - v)$

$fd = fr - ft = 2v\,ft / (c - v)$

If ($c << v$) then $fd \approx 2v\,ft / c$.

Assume typical human motion speed of v =1 m/s. ft=3.181GHz, c =2.998E8 m/s, then fd =10Hz.Similarly for a metal gun or other concealed weapons can be detected based upon their Doppler frequency.

PIR (Passive Infrared) sensor detects a human being moving around within approximately 10m from the sensor. The actual detection range is between 5m and 12m.PIR are fundamentally made of a pyro electric sensor, which can detect levels of infrared radiation over range 8-14µm. They are used to discover when an individual has exit or entered its coverage area. PIR sensors are incredible, they are flat control and minimal effort, have a wide lens range, and are simple to interface with Arduino microcontroller. The motion can be detected by checking for a high signal on the output. Once the sensor is initialized the output

will remain low until there is motion, at which time the output will swing high for a couple of seconds, then return low. If motion continues the output will cycle in this manner until the sensors line of sight of still again. The PIR sensor needs a warm-up time with a specific end goal to capacity fittingly. This is because of the settling time included in studying nature's domain. This could be anyplace from 10-60 seconds. Throughout this time there ought to be as little movement as could reasonably be expected in the sensors field of perspective.

The Arduino UNO receives input signal from the metal detector, microwave sensor and PIR sensor. AND logic is applied on the outputs of these sensors to confirm the presence of a person and concealed weapon in its proximity region. Once if signals received from the sensors reach above threshold levels then the microcontroller Arduino UNO transmits input signal to the DC motors through driver IC. One of the DC motor is attached with the laser pointer and Taser gun such that it is rotated in the direction in which the laser pointer is positioned to point the person having concealed weapon. Moreover the other DC motor is attached with a pole which is powered to rotate such that it blocks the path using pole attached to it. The taser gun is triggered only when the threat person tries to enter into the area.

The Taser gun is based on the principle of discharge of high voltage pulse of range greater than 9000V. It shoots two electrode needles attached to the output of the high voltage amplifier circuit such that these electrode needles penetrates through the human body skin layer. Due to high voltage pulse being transmitted to human body the threat person can be taken down without causing any danger or medical problems. The wireless camera is attached with the power supply and placed along with the motor in order to get the real time footage of the event occurring at that place.

The wireless camera attached with the DC motor to transmit the footage of the event occurring in its proximity to the central system. TV or laptop attached with TV tuner which is shown in figure.c. The wireless camera is attached with the DC motor to provide a clear image of the person who was detected with concealed weapon. The footage taken by camera is monitored through laptop using TV tuner.

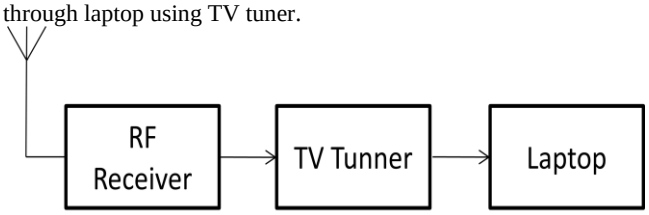

Figure 3.4: Camera Receiver set up

The GSM module is interfaced with Arduino UNO programmed to transmit a message containing information about the address of the location where the system has detected a person with concealed weapon. The Alert message is transmitted to the nearby police station and hospitals to ensure immediate health services to the victims and to arrest the threat person without eloping.

4. Experiments and Results

The PIR works at its best of detecting humans by the infrared radiations emitted by humans and it provide high output to the microcontroller Arduino UNO. The microcontroller sends high input signal to relay which turns on the appliances. Wireless camera is set to provide CCTV facility to its attached location. It is used to provide live footage and to record events occurring around. The purpose is to capture footage of threat person in case of emergency to provide evidence to submit the threat person under justice. The GSM module is interfaced with microcontroller and it sends alert message to the nearby police stations and hospitals. The alert message is predefined during installation of the system and it is set to transmit the address of the location where a threat person has been detected. The metal detector used to detect weapons having metal as its base composition and the microwave sensor is used to detect other non metallic weapons and to calculate speed of the motion of the threat person in order to track him and take down.

Based upon the average results obtained from experiments shown in table.4.1, the system is able to detect the person having concealed weapon up to the distance 5 meters.

Table 4.1: Experimental Results

RANGE	Direction OF THE WEAPON WITH RESPECT TO SENSOR POSITION	ACCURACY OF DETECTING PERSON WITH CONCEALED WEAPON	ACCURACY OF POINTING POSITION OF THE WEAPON IN A PERSON BODY
1.0METERS	LEFT	100%	95%
	RIGHT	100%	95%
1.5METERS	LEFT	100%	81%
	RIGHT	100%	81%
2.0METERS	LEFT	95%	69%
	RIGHT	95%	69%

If the distance between the weapon and the system is greater than 2.0 meters then the accuracy decreases gradually. However the system is less efficient in pointing the exact weapon position in the human body. Considering the real time operation their occurs delay in pointing the threat person continuously. Thus the processing speed of the microcontroller is less effective.

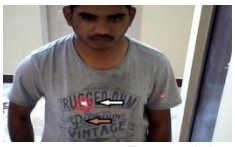

Figure 4.1

Figure 4.2

Figure 4.1 and Figure 4.2: Represents image taken by the wireless Camera

The figure.4.1 and 4.2 provides the footage provided by the wireless camera installed in the system. It shows a person having weapon, concealed underneath his clothing and exposed. In the above figure , knife is marked by white colored arrow and the LASER pointer pointing the threat person is marked using white colored arrow. The image taken by wireless camera and the message has been sent to police station and hospital. The message sent by GSM module

5. Conclusion

This paper presented a system which is developed to detect, locate and track the concealed weapon especially underneath clothing. Moreover the system is enhanced with capabilities to stop the threat person carrying weapon by using Taser gun. The Hobby metal detector and microwave sensor HB-100 together used to detect concealed weapons. The metal detector is used to detect weapons like knife, metallic gun etc. The microwave sensor is involved to detect weapons which do not have base composition as metals. The microwave sensor detects up to range 5 meters and the velocity calculations of the movement of the threat person is used to track and take down that person. The real time processing requires fast computations. Moreover accuracy of pointing the threat person in real time is discrete in nature due to the slow processing speed of the microcontroller Arduino UNO. Hence the future enhancement is to develop the system using advanced high speed processing microcontroller such as Raspberry-pi to overcome the delay and to increase efficiency of the system in real time operations.

References

[1] Khajone B & Shandilya VK, "Concealed weapon detection using image processing", *International journal of Scientific & Engineering*, Vol.3, No.6, (2012).

[2] Essen H, Fuchs H, Hagelen M, Stanko S, Notel D, Erukulla S, Huck J, Schlechtweg M & Tessmann A, "Concealed weapon

detection with active and passive millimeterwave sensors, two approaches", *German Microwave Conference*, (2006).
[3] Harmer SW, Cole SE, Bowring NJ, Rezgui ND & Andrews D, "On body concealed weapon detection using A Phased Antenna Array", *Progress Electromynetics Research*, Vol.124, (2012), pp.187-210.
[4] Singh S & Singh M, "Explosives detection systems (EDS) for aviation security", *Signal processing*, Vol.83, No.1,(2003), pp.31-55.
[5] Tan W, Huang P, Huang Z, Qi Y & Wang W, "Three-Dimensional Microwave Imaging for Concealed Weapon Detection Using Range Stacking Technique", *International Journal of Antennas and Propagation*, (2017).
[6] http://www.bbc.com/news/world-us-canada-41880511.