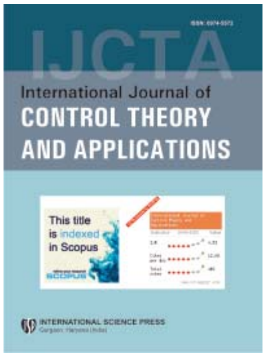

International Journal of Control Theory and Applications

ISSN : 0974–5572

Volume 9 • Number 42 • 2016

Intelligent Detection of Explosives using Wireless Sensor Network and Internet of Things (IOT)

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Abstract: This research paper focuses on the major threat of the people caused by explosives which are placed in the public area like parks, railway stations, airports, etc which are the main infrastructure resources. The existing methods in operation for the explosives detection and deactivation are more expensive and not reliable in time. For knowing where the explosives are placed and deactivate them it takes time. The proposed idea creates an area under study in which any explosives and IEDs present are detected and deactivated. This area is monitored by the MACs and these MACs are studied in real time by security officials in BMS stations. The MACs itself will take the responsibility of deactivation of the explosives and IEDs based on the database and software installed. The MACs with the nano robots will deactivate the explosives and IEDs which are controlled wireless by the MACs based on the software in it. Sometimes necessary steps will be taken by the security officials for the deactivation of the explosives and IEDs present in the area.

Keywords: *MAC Unit, BMS Station, IED, Nano Robots, Paper Sensors.*

1. INTRODUCTION

In today's world bomb explosion is the main threat to the human beings and the environment. So for that reason lot of methods and instrumentations were been developed for the detection of the explosives. Thousands of people lost their lives and several others were injured even today in the world. Thousands of people are chosen as targets in Public infrastructural areas like airports, railway stations, under grounded railways, parks, bus stands and shopping malls. Improvised Explosive Devices (IED) [14] [15] uses wireless controllers where we can find new ideas in bomb attacks which are more sophisticated and dangerous. Detection systems with real time detection efficiency are used in broad range of IEDs [15] is the major problem using mobile phones. Contemporary explosive detection methods are bulk in size and always require manual attention. Intruder can detour the detection systems easily using another avenue for the clear public visibility of the detection systems. A sensor network connected to controller consists of a number of autonomous sensors to coordinately monitor the area under study to find the presence of explosives [1]. The whole method consists of base monitoring stations, MACs and wireless transmission and reception equipments. The MAC [12] which is an embedded system comprises controller interfaced by the sensor networks, wireless systems and a few other components to transmit the information about the presence of the explosive to the base monitoring station and it also collects the information from the base monitoring station for emergency steps to deactivate the explosion by using nano robots.

In order to allow WSN [4] [9] to become an intrinsic part of the IoT [10] in a secure way, several security challenges must be considered. As aforementioned, in this paper we focus on the connectivity at the network level. Nevertheless, there are additional security challenges that, even if they are not studied in this paper, must be highlighted to guide future work. These challenges are tightly related to WSN [16] , but also can be applicable to other relevant technologies of the IoT.

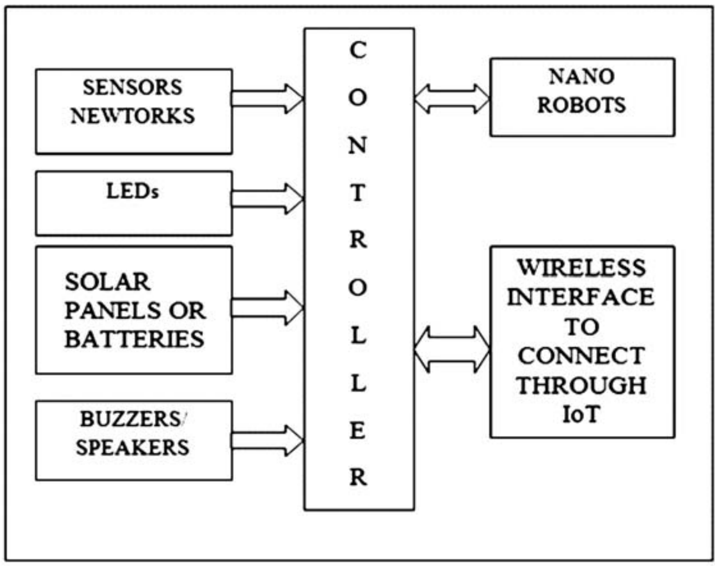

Figure 1: System Block diagram

2. EXISTING METHODS

The most commonly used explosives detection [1] [2] technique is Ion mobility spectrometry (IMS). These systems are used for commercial applications of trace. They operate under ambient conditions and are priced moderately. In IMS instruments the main disadvantage is it normally has a small amount of radioactive material as an ionizing source which poses health risk to the operator.

Chemiluminescence is another method of explosive detection. In the method the main principle of operation is the production of IR light which is directly proportional to the quantity of no present, which relates to the quantity of the original nitrogen containing explosive material that was present.

Surface acoustic wave (SAW) method of detection is frequency based and nonspecific. In this method, detection of explosives materials is based on frequency changes that undergo when materials are deposited on SAW crystal surface. Since no radioactive material is used, it will not impose any health risks, which is the main advantage of SAW over IMS. Any other chemical presence may make explosives detection more difficult. Additionally, a gas container is used for the operation of instrument.

Mass spectrometry is another method. Here we use molecular weight of explosive materials and fragmentation patterns for identification. This is a powerful laboratory technique and now a day's MS systems are available for field applications also. In MS systems, it requires a gas supply or vacuum pump and the sample analysis time that can be relatively long which makes this systems disadvantageous. Dual energy *x*-ray technique has a broad *x*-ray beam and two detectors arrangement, or low energy and high energy *x* rays to material images.

X ray data are obtained at both energy levels. The two independent images are processed through computer where these are compared at low to high energy *x*-ray absorption. The results which are displayed are characterized and detect various materials by their size and shape, and are assigned artificial colors to different Z-numbered materials. The disadvantage of this system is that separation of objects from one another in an image could be difficult when there is no strong interaction between the objects and the *x* rays. The dual energy technique determines unambiguously the Z number of materials since it does not determine the materials thickness.

Computed tomography (CT) is an *x* ray technique which generates two-dimensional images. These are cross sectionals sliced images through an object at many angles and the images are combined to form a three-dimensional image. Each measurement of *x* ray is converted into an electrical signal and processed through computer. These images have a great coarse spatial resolution. The main disadvantage of the system is its complexity and low throughput.

3. PROPOSED SYSTEM

Our system can overcome the limitations of existing explosive detection methods. In this system we create a sensor networks which detects the explosives [1] [2]. The sensors we use are the paper sensors coated with chemical compounds that are frequently used in IEDs detection. The sensors detect the presence of the trace of the chemical compounds in the area under study. The sensors networks give a good throughput as they are coated with chemical compounds it detects the type of IED [15] used without any expert system directly. The sensors acquire the data and sends to the processor and the memory unit. The received data is processed and compared to database and if there is a match it alarms the people at the base monitoring station. When compared to current explosive detection sensors the false rate of paper sensors is very low and by integrating the sensors with different type of chemical compounds they can detect all type of IEDs.

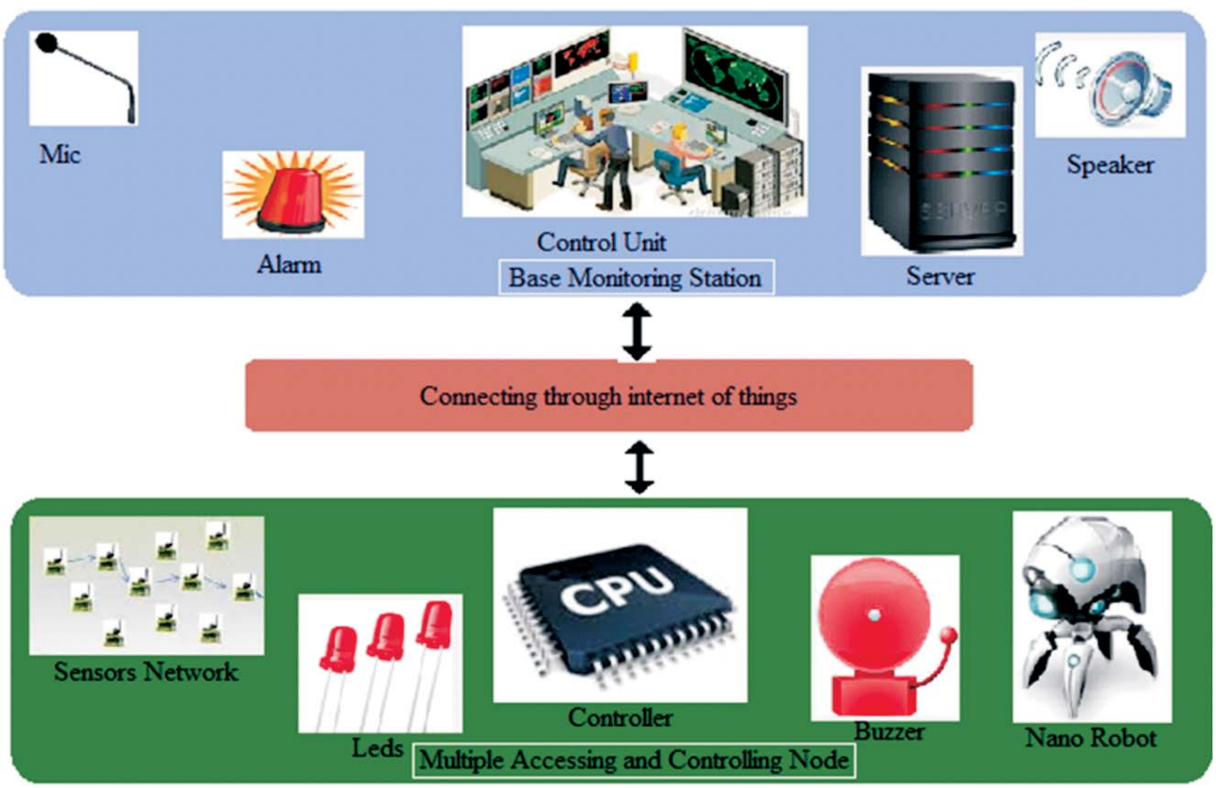

Figure 2: Architecture of System Design

3.1. Connecting through IoT

The proposed method architecture consists of Base Monitoring Station (BMS) and Multiple Accessing and Controlling nodes (MAC). The base monitoring stations have control unit, power supply for functioning and communication unit to connect to the MACs. Generally the communication unit is a wireless system so that the area can be studied from any distance place or the area under study can be a remote area. This method uses IOT concept for the connection of MACs [12] to the BMS. The IOT [17] provides reliable and effective wireless communication system to connect the system architecture. The MAC has Sensors Network, LEDs and Buzzers/ Speakers, Wireless interface, Nano Robots and Solar panels/Batters. Here each peripheral work together for the detection of the explosives and IEDs and communicate with BMS station for the deactivation.

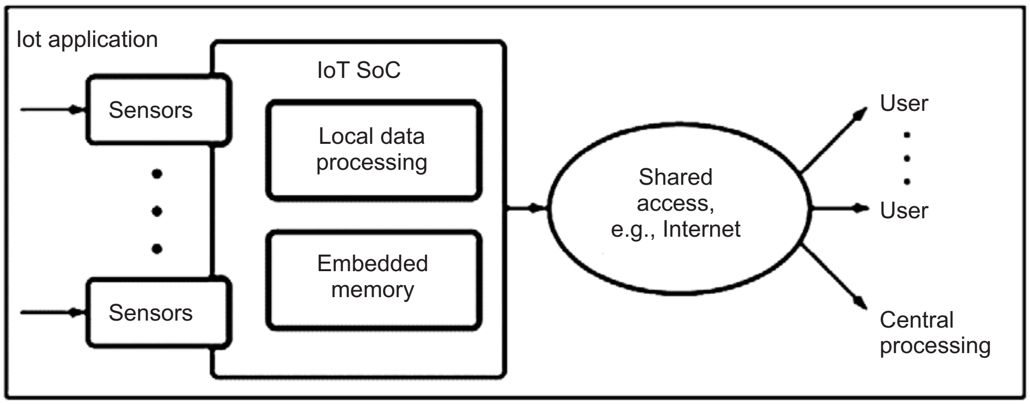

Figure 3: IoT Application

3.2. Base Monitoring station

1. **Server :** It has all the data that is required for the detection and deactivation. When the sensors sense the signals, feed to the MACs and the data is transferred to the BMS unit. And this data is compared to the data samples which are saved in the server. By this we can find the explosive or IED used. The server is also provided with the data how to deactivate the specific explosive or IED. By this the BMS work along with MAC and the nano robots are used to deactivate.

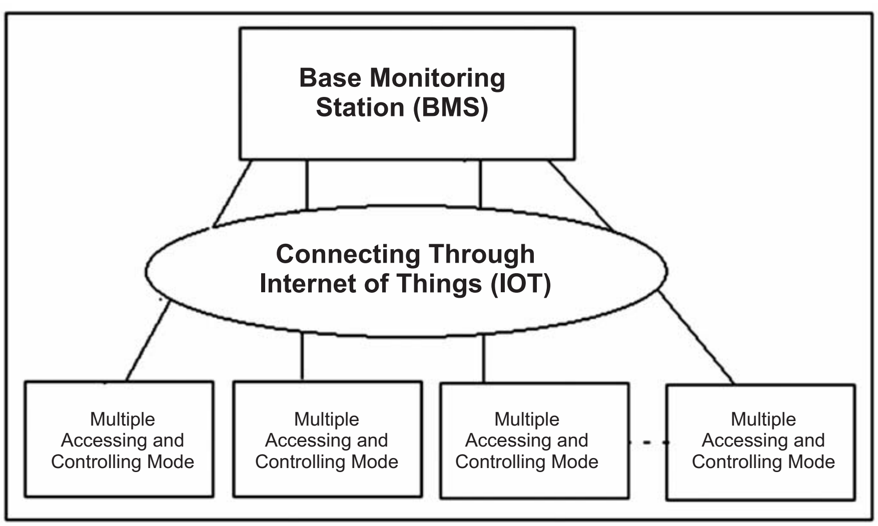

Figure 4: Connecting MAC and BMS through IoT

2. **Power supply:** It is the general unit in any system which provides power to all the modules used in the BMS station. Batteries and inverters are replaced when there is any power cut or shortage power.
3. **Wireless interface:** It has required hardware and software unit for the connection of BMS station to the MACs node. IoT technology is used for the wireless connection which provides better and reliable communication with nano robots for the explosives and IED deactivation.
4. **Display, Speakers and Alarms:** Displays are used to show the information regarding location of the explosives and also displays the operations done by the nano robots during the deactivation. Speakers/Mics are used for the communication purpose between security officials. Alarms are used to warnings.
5. **Control unit:** It is used for the controlling of the whole system in BMS stations.

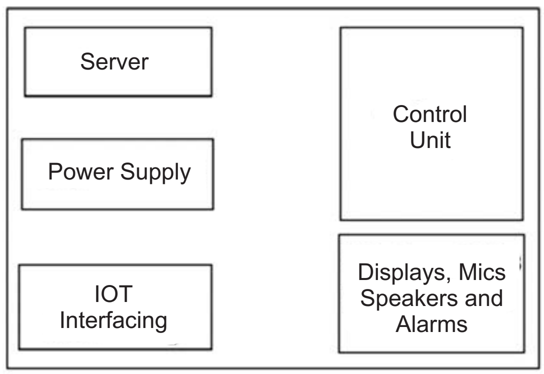

Figure 4: Base monitoring Station

3.3. Multiple Access control unit

The MAC has controllers interfaced with sensors networks, LEDs, buzzers/speakers, wireless interface, nano robots and solar panels/batters.

1. **Sensors Network :** The sensor is used to detect the presence of the explosive in the area. It traces the vapors of the explosives and the type of explosive used can be detected depending upon the chemical compounds. The communication unit deals in connections and communicates with other sensors in the network for the accuracy of data to be collected. The data is send to the BMS for the emergency services.
2. **LEDs and Buzzers/Speakers :** If it is found that there is a explosive by the system then the LEDs and Buzzers/Speakers are used to alert the people and the security officials to go for the emergency services.
3. **Wireless interface:** It has the hardware which helps in the connections of various peripherals to the controllers and also the MAC to the BMS station. It supports the sensors to connect in a desired network topology for better data reception. Generally tree topology is used in sensors network connection.
4. **Nano Robots :** The proposed system can be made advanced with the use of the nano robots. The nano robots consist of the both software and hardware which helps to deactivate the explosives from distance places or to deactivate the explosives at remote areas.
5. **Solar panels/Batteries :** Apart from general power supplies these are the extra power modules which are used in general power supply failures and also help to increase the life time of the system.

4. DESIGN FLOWCHART

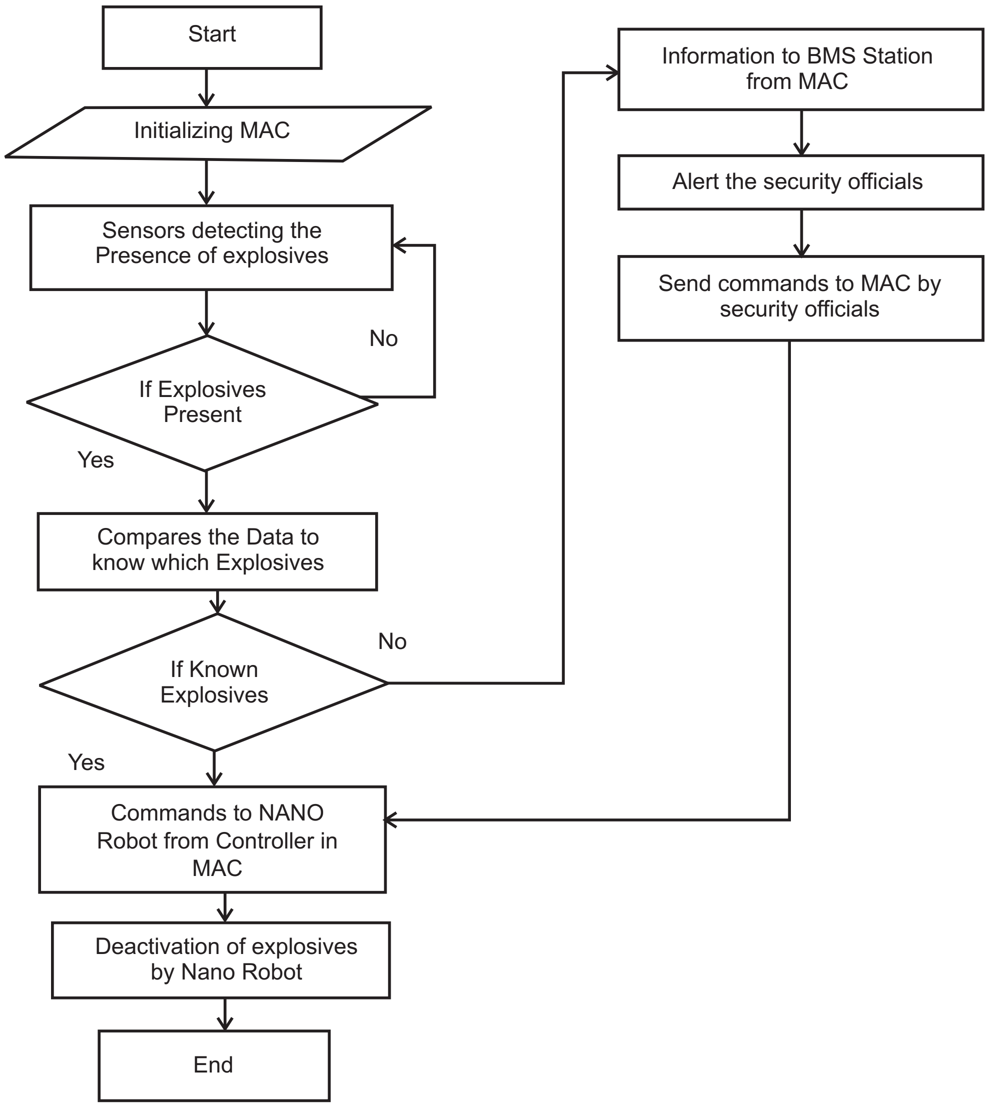

Figure 5: System design flowchart

The proposed flowchart states the detection of Explosives. First initially we initialize the MAC protocol to detect the explosives. Now the sensors present in the MAC gets activated and tells about the presence of Explosives. If the explosive is detected it starts comparing the data to know which explosive is detected and if not it again returns back to sensors. If known Explosive is detected MAC sends the command to nano robot and the robot deactivates the explosive. If unknown explosive is detected it sends the information to BMS station from MAC to alert the security officers by giving commands to them. Now the nano robot selects the explosive and deactivates the explosives to end the process.

5. CONCLUSION

The proposed system makes an area under study where it is installed. And this area can be studied from any other place. Sometimes the area under study can be a remote place, once the system is installed these areas can also be studied effectively and not only the remote places but also few other areas like where the security officials and the defense cannot go and deactivate the explosives. These are the main advantages that the proposed system can provide effectively. Since we use paper sensors with different chemical compounds, the probability of detecting the type of explosives used is more. The sensors networks helps to find the location of the explosives more pre sized in the range of few meters or sometimes in the range of few centimeters also. The keen functioning of nano robots plays key role in the deactivation of the explosives.

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