Detection of Explosives Using Wireless Sensor Networks

Avinash.Vanimireddy[1],D.Aruna Kumari[2]

[1]M.Tech,ECM Department,KL University,Vaddeswaram,A.P,India

[2]Associate Professor,ECM Department,KL University,Vaddeswaram,A.P,India

***Abstract*: Automatic detection of explosives using wireless sensor networks monitors and tracks the IEDs that are placed by terrorists at public environments.The area under study is monitored in real time,collect data by the sensor and send to the processor which process the data and compares with the database and if there is a match the processor enables the buzzer which provides early warning to the people in that area.current system in operation uses sensors which are very expensive and not very sensitive and also uses a good deal of power.The paper sensors is coated with chemical compounds that are frequently used in explosives so that it will be easy for the sensor to know the type of IED used.These sensors has inbuilt communication unit which can be used to communicate to the nearby nodes . The sensor uses very little power, which makes it suitable for running off of thin-film batteries or solar cells and the cost of these sensors are very much less compared to sensors used in current system.**

***Keywords*:ExplosiveDetection,Papersensor,Wireless sensors,Automatic explosive detection system,less cost**

I.Introduction

Nowadays a lot of attention is being paid to the development of methods and instrumentation for the detection of explosives.Initiated explosives have already killed thousands of people and injured several tens of thousands.Infrastructural facilities, like railwaystations,airports,undergrounded railways are preferred targets involving up to thousands of people. New forms of bomb attacks are more sophisticated, more dangerous, using remote control of Improvised Explosive Devices (IED). Initiation by mobile phones permits terrorists to initiate a bomb immediately. Therefore, detection systems with a reliable detection efficiency used in broad range of IEDs are an important problem.

Traditional explosive detection systems are bulkier in size, expensive, and always require manual attention. Because of its public visibility intruder can easily bypass the system using another route. A wireless sensor network consists of several types of autonomous sensors to co-coordinately monitor a particular activity. The system consists of a processor, a sensor and wireless transceiver equipment. The system collect the sensor data, perform local processing and transmit the required information to the security officials

II.Related work

Ion mobility spectrometry (IMS) is the most common technique used for commercial applications of trace explosives detection. IMS systems operate under ambient conditions and are priced moderately[7]. The main disadvantage of the IMS instruments is it normally contain a small quantity of radioactive material as an ionizing source which poses health risk to the operator.

Another method in explosive detection is Chemiluminescence.The principle of this method is the produced IR light is directly proportional to the amount of NO present, which is related to the amount of the original nitrogen-containing explosive material that was present[8]. A significant drawback of CL systems is their inability to detect explosives that are not nitro-based.

In surface acoustic wave(SAW) method detection of explosives materials is based on frequency changes that occur when materials are deposited on the SAW crystal surface[9].Advantage of this method is it does not use radio active material so it will not impose any health risks. The SAW is nonspecific and the presence of other chemicals may make explosives detection more difficult. Additionally, a gas container is necessary for operating the instrument

The other method is mass spectrometry (MS) which uses an explosive material's molecular weight and fragmentation patterns for identification[3]. MS is a powerful laboratory technique and now fieldable MS systems are available for field applications. The disadvantages of using this MS systems is it require a gas supply or vacuum pump and the sample analysis time can be relatively long.

In dual energy x-ray techniques a single broad x-ray beam and a dual detector arrangement, or low-energy X rays and high-energy X rays to image materials[11]. X-ray data are obtained at both x-ray energies. The two independent images are computer-processed to compare low-energy to high-energy x-ray absorption. The displayed results characterize and identify the various materials by their shape, and artificial colors are assigned to different Z-numbered materials.

The disadvantages of dual-energy x-ray systems are:It can be difficult to separate objects from one another in an image, especially when the object does not strongly interact with X rays.

The dual-energy technique does not determine a material's thickness therefore, it cannot unambiguously determine the Z number of a material.

Fig 1 commercially available dual x-ray explosive detection system[11]

Computed tomography (CT) is an x-ray technique that produces two- dimensional images of cross-sectional "slices" through an object at many angles and then combines these slices to obtain a three-dimensional image[12]. Each x-ray measurement is converted into an electrical signal and computer processed. These images have a more coarse spatial resolution than conventional x-ray images. However, CT images do have improved density resolution compared to conventional x-ray images.The advantage of CT is Detects explosives-like materials and discriminates them from most other innocuous, low Z number materials. This ability is possible because CT can accurately determine the material density.The disadvantages of this method includes system complexity,high cost and low throughput

Fig 2 commercially available CT system from invision technologies

III.Current system

Current system uses wireless sensors which continuously monitors for the IED in that particular location where wireless sensor is placed.Each and every IED contains some portions of chemical compounds which releases chemical vapours in to the atmosphere which then detected by the sensors placed in that area.The sensors receive this data and forwards the same to the expert system which are placed at different locations.The expert system process this data and by using some type of algorithm the type of IED can be known.with this current system the exact location of the IED cannot be known.The sensors used in the current system are gas sensors and chemical sensors which are high cost and uses more battery power and the accuracy is low.As the atmosphere contains many chemical vapours besides the IED chemical compound vapours the false rate will be high.

IV.Proposed system

The proposed system will overcome the limitations in both the traditional and the current systems that are using for explosive detection.In this proposed system the paper sensors are used for the detection of IED.The paper sensors consists inbuilt communication system and these sensors are coated with chemical compounds that are frequently used in IEDs.These system works by detecting the traces of chemical compounds in the atmosphere and as these sensors are coated with chemical compound it directly detect the type of IED without any expert systems.The sensor sends the acquired data to the processor and memory unit which process the data and compares with the database and if there is a match it enables the buzzer The false rate of the paper sensors is very low when compared to the current explosive detection techniques.Different type of chemical compounds are integrated to the sensor so that it can detect all type of IEDs.

A. *System architecture*

The proposed explosive detection system architecture consists of solar panel,Radar unit,paper sensor and communication unit ,processor and memory unit and a buzzer

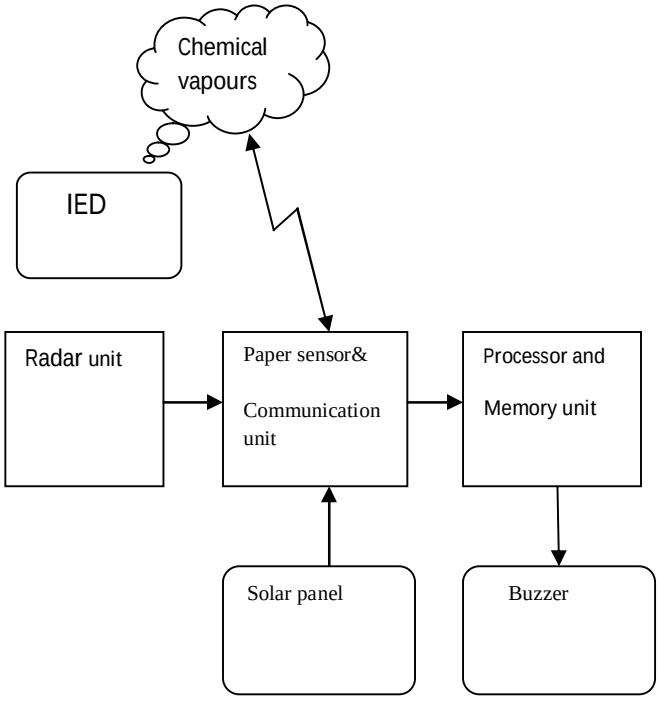

Fig 3 proposed explosive detection system architecture

B. *Operation*

This section explains the operation of modules present in the explosive detection system architecture

1) *Solar panel:*This solar panel module is the extra power supply unit besides battery which was used for increasing the life time of the system
2) *paper sensor and communication unit:*The sensor is used to trace the vapours of explosives in the atmosphere and depending on the type of chemical compounds the type of IED can be detected.The communication unit is used to communicate with the other wireless sensor nodes present in that area and it also used to send the data to the security officials[4]
3) *Processor and Memory unit*:The sensor after acquiring the data about the explosive, sends it to the processor which process it and compares with the database present in the memory.If the matching is found it enables the buzzer
4) *Radar unit***:**The Radar module is used to track the IED.When a target is found the radar will continuously tracks the the target till it moves out of its range
5) *Buzzer***:**If the target which detects by the sensor matches with the database the buzzer enables which provides early warning to the people

V.Conclusion

The proposed automatic explosive detection system automatically detects the IED without any human intervention.There are many advantages with the proposed system when compared with the traditional detection techniques.The advantages include less cost,low power consumption and less analysis time.By this proposed system the exact location of the IED can

easily located which will deactivated immediately so that many lives can be saved.

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