

Border Security Using Wireless Integrated Network Sensors

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ABSTRACT: Border security using wireless integrated network sensors describes WINS sensors that monitor temperature, humidity, and water level and have decision-making capabilities. This system operates on a small, low-power system. Wireless Sensor Network (WSN) technology can capture real-time data and transmit it to other communication devices for processing [2]. Many applications have made use of WSN, including disaster management, precision agriculture, health care, intelligent traffic control, and military surveillance [3]. WSN technology eliminates the need for humans to collect data and monitor dangerous environments in real time. WSN's small size and low cost enable the deployment of a large number of sensor nodes in surveillance areas. Gateway nodes are used by multiple sensors to transmit and receive data. WSN technology can be used in a variety of military-related applications, including intruder footstep detection using a geophone sensor, intruder movement detection using IR sensors, and efficient surveillance using high-quality camera sensors. Researchers are also concentrating on intruder detection using microphone sensors and underwater intrusion using acoustic sensors such as hydrophones. Wireless sensor networks are thus an effective solution for monitoring intruder movements and providing early warning.

KEYWORDS: WSN ,Border , Sensor , Border Security , Signals, Wireless Integrated Network Sensors

I. INTRODUCTION

They are an integrated network that combines sensors, signal processing, decision capability, and a wireless network in a low power system embedded that is commonly used in the battlefield. DARPA was the first to initiate it in 1993. They are used in a variety of defence and security applications. These devices have sensors all over the place, such as in air, water, and air itself. They are all linked to a wireless network at base camp, where they sit and monitor the situation. They are linked at a speed of 100kbps and have a range of more than 1 km. [1]

WIND microsensors: they use infrared, seismic, and other sensors). These sensors detect the noise made by any user who enters the prohibited area, and the signals are converted into PSD values and then compared to the user-specified reference value. There are various types of hardware used, such as the mica network node, mica sensor board, mica power, and TWE-ISM-002.

Border surveillance is the most critical task in national defence and security. To maintain peace and ensure the safety of a country's people, its borders must be monitored 24 hours a day, seven days a week. Particularly in these times, when terrorist infiltrations and the illegal movement of both living and non-living beings have become common, it is critical to strictly protect border areas against such activities. The least that can be done to prevent such incidents in border areas is to provide constant monitoring. [2]Currently, this monitoring is done manually by border security forces who are responsible for constantly keeping an eye on the borders. It takes a lot of manpower and assets because the borders are hundreds of miles long and have extreme terrain and climatic conditions. As a result, the need of the hour is to design an automated border surveillance system that can perform the surveillance task without the need for human intervention. It can eliminate the need for humans to be deployed in hostile environments at all times. Furthermore, if the system detects something suspicious, it must be able to make the necessary decisions and thus actions, as well as issue alert messages to the human controllers. The central control rooms can be located away from the border area.

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When the human controller becomes aware of the intrusion, he must decide what to do next. [3] Such systems, if successfully deployed, can not only save resources but also significantly reduce the risk to human life. However, due to safety concerns, complete automation of border surveillance is not yet feasible; however, such systems can provide assistance and collaborate with defence forces to secure the country's borders.

As wireless sensor technology advances, an increasing number of organisations are deploying it for a variety of applications. After Bluetooth, ZigBee technology is a new wireless personal area standard. Following the introduction of this technology, a new wireless meter-reading system based on the ZigBee protocol emerged. This system, which consists of a ZigBee network and a database management system, has numerous advantages, including low cost, low power consumption, and a low data rate. A wireless sensor network based on ZigBee technology is a wireless network composed of many nodes of ZigBeeRF chip, sensor, and MCU, which is especially suitable for remote monitoring systems in flammable and explosive environments. [4] RFID and Zigbee fusion is also possible, which could be beneficial to wireless sensor network technology.

Detection of Intruder Using WSN

WSN detects intruders in previously uncharted territory. Intruders are discovered and investigated. WSN used a hierarchical structure for learning and communication. Each network model can monitor the local area and then communicate with the other nodes via wireless channels to produce a high-level representation of the state of the environment collaboratively. These networks can be used to monitor large areas at low cost. The system can use mobile robots to make the detection process more autonomous and flexible. The WSN sensor nodes use the ART neural network to learn the model of the environment, and then the changes are compared to the normal model and reflected as anomalies caused by potential intruders. [5]

Sensor architecture design

Sensor nodes are typically assigned to a sensor area. Each of these distributed nodes has the ability to acquire data and route it back to the sink and the give up customers. Records are routed back to the give up consumer via the sink via a multichip infrastructure less architecture. The protocol stack integrates power and routing attention, integrates data with networking protocols, and successfully communicates power over the wireless medium. The protocol stack is made up of the software, delivery, community, data link, physical layer, power management plane, mobility management plane, and project management plane. Depending on the sensing project, different types of application software can be built and used on the software layer. If the sensor networks utility requires it, the delivery layer can maintain the glide of statistics. [6] The network layer is in charge of routing the records received from the delivery layer. Because the environment is noisy and sensor nodes can be cells, the MAC protocol must be power conscious and capable of reducing collisions with neighbouring broadcasts. The physical layer addresses the requirements of the simple but powerful modulation, transmission, and receiving techniques. Furthermore, the energy, mobility, and venture management planes reveal the sensor nodes' power, movement, and challenge distribution. These planes help sensor nodes coordinate sensing assignments and reduce overall power consumption. [7]

II. REVIEW OF LITERATURE

Although border security has been an important aspect of national security since the establishment of US Border Control in 1942, it remains a hazy area of study with scant literature within International Relations. Overall, the border security logistics system lacked coordination, information sharing, and synchronisation (Nieto-Gomez, 2011)[8]. Furthermore, policies have historically been inefficient due to a lack of consensus among policymakers and law enforcement agencies. There is very little literature on the actual level of effectiveness in comparison to the growing list of challenges.

In 2011, the Migration Policy Institute published a report on the challenges of effective border control in the United States. This report emphasises one of the major issues with border security by stating that 30-40% of unauthorised

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immigrants in the United States entered legally but overstayed their visas due to inadequate monitoring (Koslowski, 2011). Another issue is practicality; border control objects are not static (Koslowski, 2011)[9].

Although research on the activities of individuals and organisations involved in problem solving and policy implementation at borders is limited, a recent study describing the efforts of the New Mexico Air Basin (the JAC) to improve air quality in the Paso del Norte Region suggests that they may be similar to individuals and organisations in cross-organizational relationships in other policy contexts (Cresswell et al., 2009)[10].

The framework's final component is an Integrated Data Infrastructure, which is frequently associated with the concept of interoperability. Interoperability is defined as "the combination of policy, management, and technological capabilities (e.g., governance, decision making, resource management, standard setting, collaboration, and Information and Communication Technologies such as software, systems, and networks) required for an organization's network to function effectively" (Pardo et al., 2008)[11].

Jin, Xin, et al. [12] present a feature extraction method in which wavelet coefficients derived from sensor time series are extracted using symbolic dynamic modelling and converted into statistical patterns that are then used for target detection and classification. By selecting the appropriate wavelet basis and range of scale, the wavelet transformed signal can be denoised into the original signal in time domain. The characteristics of the signal with proper reconstruction are provided by the symbolic images obtained from wavelet coefficients rather than the characteristics obtained directly from the original time domain signal.

Human intruders in border areas can be detected by integrating passive infrared (PIR) sensors and MICAz and providing information to the central base station about the directional movement and speed of the human intruder, according to JishaR.C, Maneesha V. Ramesh, et al., [13]. This paper describes the tracking of human intruders in border areas using a new system architecture that employs a passive infrared (PIR) sensor and MICAz to report the average speed and direction of the intruder to the central base station. The placement of PIR sensors is determined by the network topology, which follows a line topology. These sensors must be placed directly in the line of sight for detection. This PIR sensor detects human intrusion and transmits information to the central monitoring station such as the intruder's average speed and directional movement. The proposed system architecture is divided into four major components: object monitoring, catching, movement tracing, and node communication.

Bhaskar, Harish, et al. [14] represent the integrated system by taking some image frames from real-time sequences at each stage of the surveillance process. It combines detection and tracking techniques to detect faces by paying more attention to human targets. The detection of moving targets is the first step in the problem of concurrent identification and tracking of targets. The technique is effective at distinguishing between foreground and background regions, but it is frequently affected by noise, camera movement, and lighting variations. The contour tracing Blob Detection method is used to identify and mark the regions of each component, filtering out these noises. Target detection is followed by an identification procedure that is triggered by using face recognition. If the detection of the target's face fails, the tracking process for the target should be continued without increasing the target's identity to its signature of appearance.

Objectives

- To study system architecture for footstep detection
- To study border security system architecture
- To study underwater sensor network
- To study wireless integrating network sensor

Research Methodology

A research methodology is a universal approach to addressing a study subject through data collection, data evaluation, and study results. A research technique is a strategy for conducting a research study. Research is the systematic

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gathering and analysis of facts and information for the advancement of knowledge in any field. The study's goal is to use systematic techniques to solve intellectual and practical problems. The current study is descriptive in nature and is based on secondary data gathered from a variety of sources such as books, education, and development, journals, scholarly articles, government publications, and printed and online reference materials.

III. RESULT AND DISCUSSION

The Wins node architecture (fig.1) was designed to enable low-power continuous sensing, event detection, and event identification. The sensor, data converter, data buffer, and spectrum analyzer must all operate at micro power levels because the event detection process must be continuous. [15]



Fig. 1 wireless integrating network sensor

If an event is detected, the spectrum analyzer output may be triggered, and the microcontroller may issue commands for additional signal processing operations to identify the event signal. [16]

The same application of ground sensor networks for border surveillance can be used for marine surveillance and border protection. As shown in Fig 2, researchers demonstrated an underwater surveillance system to detect enemy watercraft by deploying acoustic sensor nodes in shallow water. Some challenges of underwater sensor networks include slow bandwidth, noisy channels, unreliable links, and a lack of energy efficiency.

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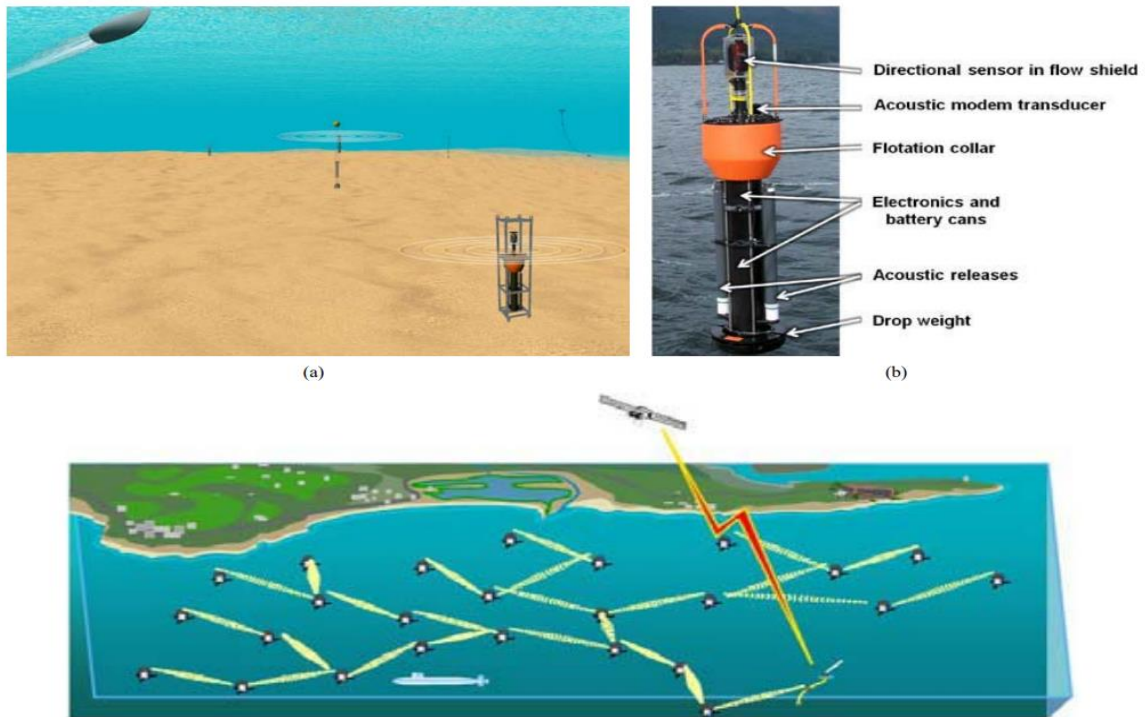
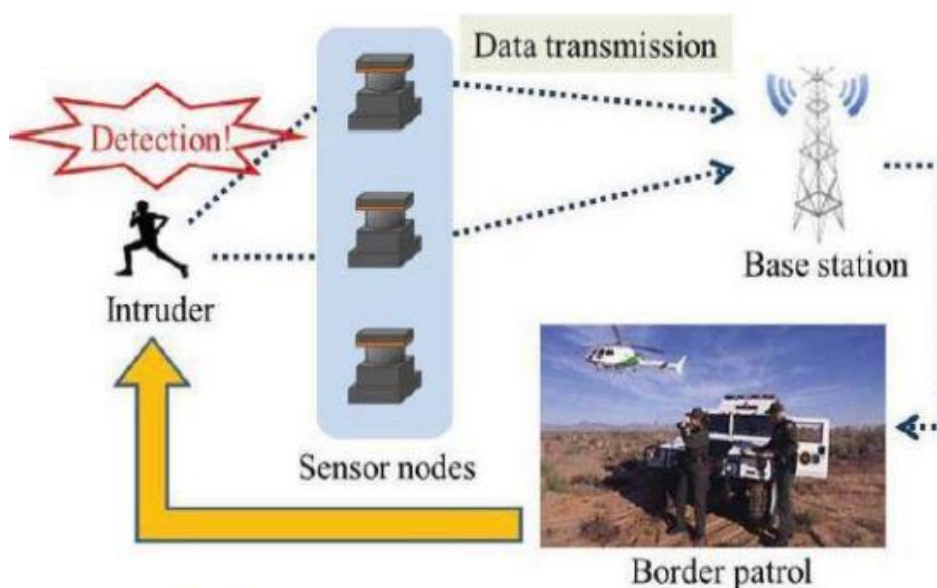


Fig. 2 (a) Simplified diagram of the underwater sensor network for detecting enemy water craft; (b) Detailed diagram of an underwater acoustic sensor node; (c) Overview of the entire underwater acoustic sensor network

Figure 3 depicts the border security system architecture proposed in Suzuki, Takuya, et al research . 's paper. The proposed system detects border intruders and reports the information to a base station and a border patrol.



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Fig. 3 Border security system architecture

Many sensor nodes are placed near the border to detect intruders. In the sensor nodes, a perception sensor with wireless communication technology is used. Because of the large monitoring area, connecting the power source and all sensor nodes with wired lines is impractical. [18-20]

Figure 4 depicts the detection of footsteps using distributed microphones. The system consists of a microphone array, sound acquisition, and event detection using an improved peak finding technique in the time domain with a coarse to fine approach. A feature vector with various feature sets is extracted, and classification is performed using SVM (Support Vector Machine).

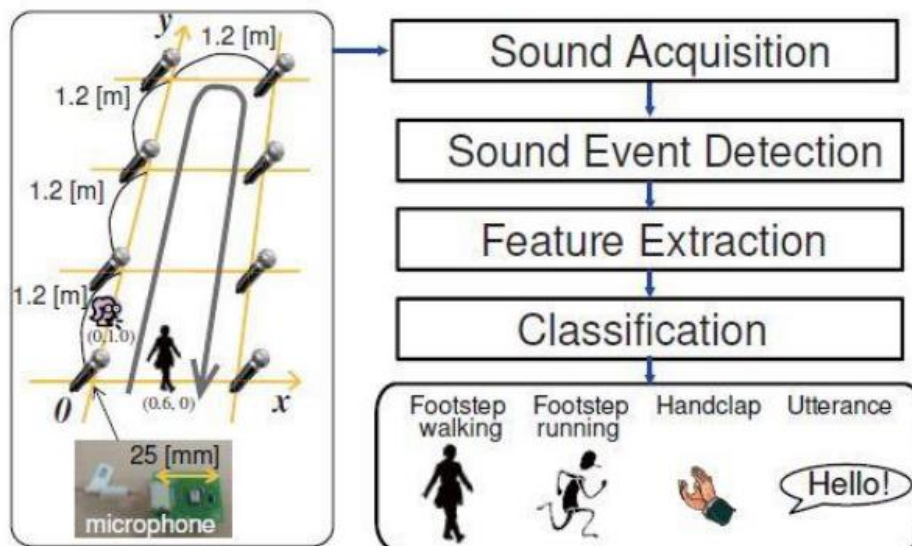


Fig. 4 Overall system architecture for footstep detection

The system employs a 2x4 grid network with eight microphones separated by 1.2 m, ensuring that at least two microphones capture the sound of footsteps with sufficient power.

IV. CONCLUSION

WSN is a new wireless technology that is being used in a variety of applications to collect data from a specific field of interest. Border surveillance and intrusion detection applications are two promising application domains. The main advantage of deploying hundreds of low-cost sensor nodes along borders is the high spatial and temporal data resolution that results. In micropowerCMOS circuits, a number of interface, signal processing, and communication systems have been implemented. To enable low-power operation of the entire WINS system, a micropower spectrum analyzer was developed. As a result, WINS require a Microwatt of power. However, it is significantly less expensive than other security systems currently in use, such as RADAR. It is even used for communication over short distances of less than one kilometre. There is less delay as a result. As a result, it's relatively faster. WINS will enable global monitoring of land, water, and air resources for environmental monitoring. Transportation systems and borders will be monitored on a national scale for efficiency, safety, and security.

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