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A Survey on Border Security System Using Cognitive Sensors (BSSCS)

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ABSTRACT: The sensor should have learning capability and act accordingly (to identify the expected usage of the detected signal and raise alarms on predefined and/or learned events). It is required to realize and deploy an integrated sensor infrastructure with learning capabilities to provide comprehensive surveillance on the Indian borders and perimeters of security sensitive installations, formations and movements. The sensor should have self-power generation and management capability to provide solution in unmanned area for long duration. It should have threat computing, wireless networking and routing capability to appropriately communicate the sensing information to stake holders. Safety and security including self-deactivation/destruction are mandatory features to be considered in the proposal.

KEYWORDS: self-alert, self-charge, self-learn, self-destruct, thermal imaging surveillance, object detection, wireless sensor network, infrared radiation sensor.

I. INTRODUCTION

Number of countries like Bangladesh, China, Pakistan, Nepal, Bhutan and Myanmar. India shares it's border with these countries. The lives and lifestyle of all the countries is separated by borders of each and every country and also separated by geographical barriers like mountain ranges and rivers where exchange of things is done from every beginning.

Indian border consist of so many variety of geography such as deserts, land, fertile, tropical evergreen jungles and etc. By keeping in mind the current geopolitical situation and scenario of Indian border, management becomes the must part for focus. The border which is considered as the pain part of focus is India-Pakistan border which is spread across extreme climatic conditions that follows from hot Thar deserts in Rajasthan to the cold Himalayas in Jammu and Kashmir.

Considering today's situation of modern digital India still there are some places on borders where the situation is bad like sand storm's in desert and cold storm's in northern part where it is very difficult for soldiers to give security check and some times it becomes impossible. Such conditions put the life of soldiers in huge risk where life of soldiers is directly proportional to the Border security and due to such situations on Indian border loopholes get automatically generated. Today if there is an era of making digital India then why can't we focus on making digital borders as well using various types of technologies like artificial intelligence and machine learning which will help the Indian defence efficiently.

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II. RELATED WORK

Survey

This survey deals with Preliminary Survey which authors have carried out using various observations and interviews and also based on some literatures.

2.1 Survey of unstable Indian borders:

2.1.1 India-Pakistan border:

India-Pakistan border is widely spread across having extreme climatic conditions that contain hot Thar deserts in Rajasthan and the cold Himalayas in Jammu and Kashmir. The double-row fencing installed by Indian defence helps preventing smugglers, terrorists and other intruders out of the boundaries of the country. To talk more about the fence is electrified connected with landmines. Although a fence is installed, smuggling of heroin and other drugs is quite often because some villages on both sides of the border are in support for such activities. Not only drugs but various other goods and weapons are smuggled on the border side.

2.1.2 India-Bangladesh border:

West Bengal, Assam, Meghalaya, Tripura and Mizoram share border with Bangladesh. The entire border area is composed of river and hills with less obstacles. Border has much population and civilization is carried out till the every end point of the border. Illegal immigration and smuggling of cattle and drugs is an issue with this border.

2.2 Summary of Preliminary survey:

Table 1 shows summary of various preliminary surveys carried out by authors.

Table1: Summary of Survey work

TYPE	NAME	DETAILS
Zee news feed	News channel	Study about Uri attack that what were the vulnerabilities due to which the attack was done.
Power management	RishabGogad Sir (E- solar solutions)	Feasibility of different solar panels in rough weather.
Meet up	SupriyaChitre (Retired Squadron leader)	Learned to think from enemies' perspective.
Army Colonel	Name cannot be disclosed	Importance of network security in border perimeter

2.3 Research Papers Studied:

In this section literature review is summarized in the Table 2.

Table 2: Glance of related work

NAME OF RESEARCH PAPER	AUTHOR NAME	DATE OF PUBLISH	WORK
A constant current triboelectric nanogenerator arising from electrostatic breakdown (TENG).	Di Liu, Xing Yin.Hengyu Guo, Linglin Zhou, Xinyuan Li, Chunlei Zhang Jie Wang, Zhong Lin Wang	April 2019	Working of TENG and its principles.
Object Detection and pattern tracing using TensorFlow.	Rasika Phadnis, Jaya Mishra, Shruti Bendale	April 2018	Specify how TensorFlow is better than other frameworks.
The infrared universe (for thermal imaging).	Dr. Mamta Patel Nagaraja,NASA	May 2019	Detailed information about infrared imaging.

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Wireless sensor network formation: Approaches and techniques.	Miria Carlos-Marncilla,Ernesto Lopez-Mellado and Mario Siller	February 2016	Present WSN and different working approaches.

III.PROPOSED WORK

Modules in the proposed Border Security System

This section describes the various modules used in BSSCS.

3.1 Object Detection Module:

- Intelligent Recognition Imaging Surveillance is the module used for object detection using image processing.
- It identifies the object if any found in the projection of camera's wide-angle view using object detection algorithm.
- The module is integrated with camera which detects object using TensorFlow [1] (open source library, developed by Google) which will be used to classify the suspicious/non-suspicious objects.
- Infrared Radiation [2] Sensor (IR Sensor) will be used for night Surveillance instead of the night vision camera because the night vision camera fails to provide accurate surveillance at fog-like conditions.
- Thermal Imaging [2] will be embedded with camera module required for night time monitoring.

3.2 Wireless Sensor Network Module:

- Wireless Sensor Network [3] and Signalling is the module responsible for creating a wireless network of BSSCS Nodes (Camera module integrated with Different Sensors) in the border perimeter for the automated monitoring.
- The module will be comprising of various group of WSN Networks clusters having one controller each and its particular number of client nodes. Also, one of the client nodes will be acting as controller (for emergency situation) and will remain in connection with another cluster's controller.
- Controller further will be connected to control room's server for transferring the suspicious alerts and checking the activity thresholds too.
- One BSSCS Node consists of a Camera module integrated with IR Sensor, Temperature Sensor, LoRa Sensor.
- The self-organization strategy is used for sensors in the proposed system.

3.3 Power Management Module:

- The Power Management is the module responsible for generating power and providing it to whole BSSCS System.
- There are two techniques spotted for generating power for the proposed system:
  1. Solar Based 2. Using Triboelectric Nano-generator (TENG) [4]
- The system will be designed in such a way that Camouflaging materials will be generating power via TENG and Solar energy.

3.4 Camouflaging Module:

- The Camouflaging is the module responsible for hiding BSSCS System from enemies/intruders.
- The material will also be responsible for power generation in Power management Module and will be protecting the nodes from other physical phenomenon.
- Camouflaging Module assures to provide great camouflaging of system and will remain undetected in the RADAR of enemies

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BSSC System Network Architecture:

BSSC system comprises of group of sensor nodes. Every node will be communicating with every other node in that group of nodes. If any suspicious activities are detected then the sensor nodes get active and inform the control room along with other nodes. By this the team of soldiers will get an idea about the location and then the intruders can be traced out with ease. This will avoid any malpractices from occurring in the border perimeter hence preventing deadly attacks in the country.

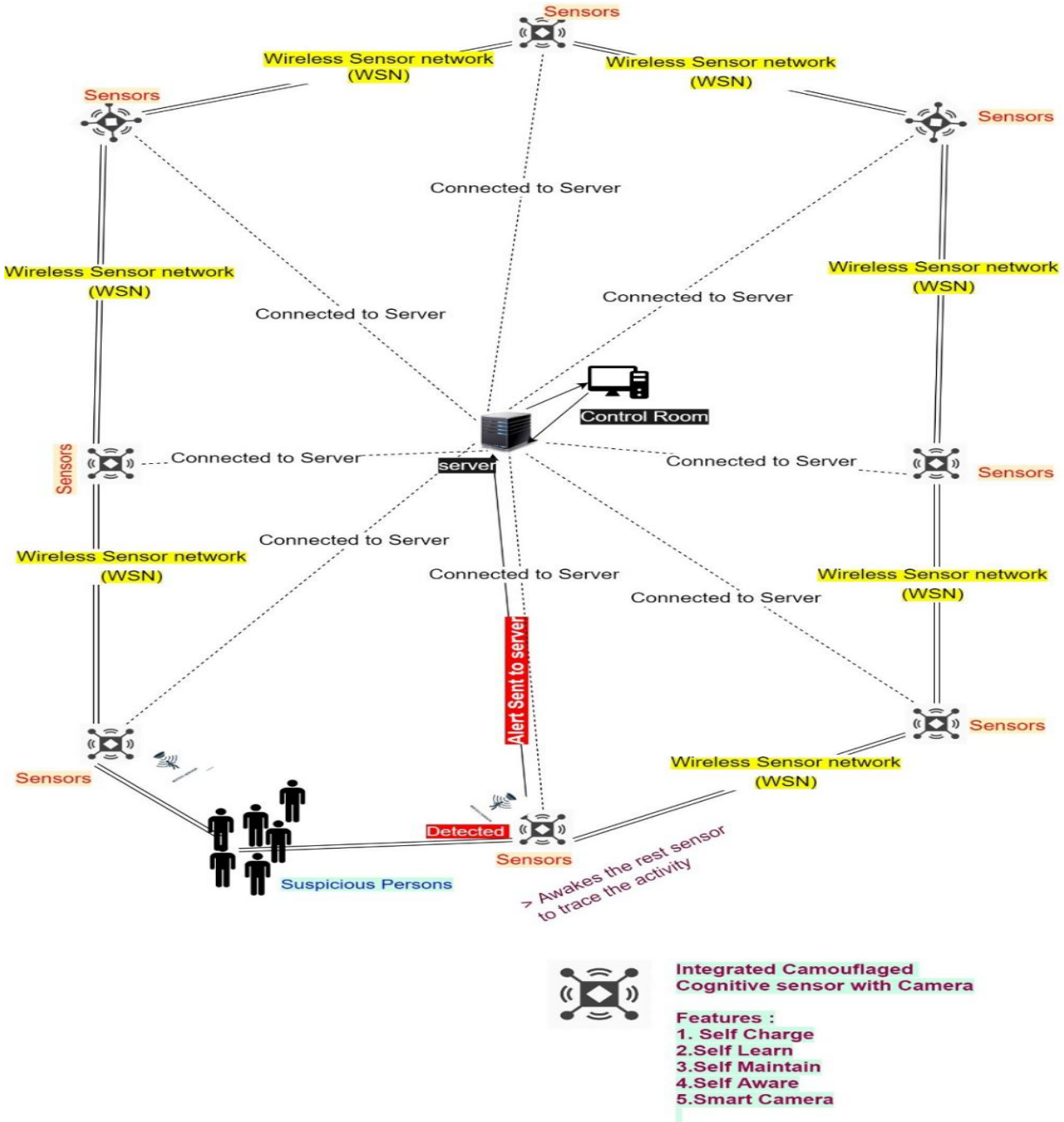

Fig. 1 BSSCS Network Architecture

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BSSC System architecture:

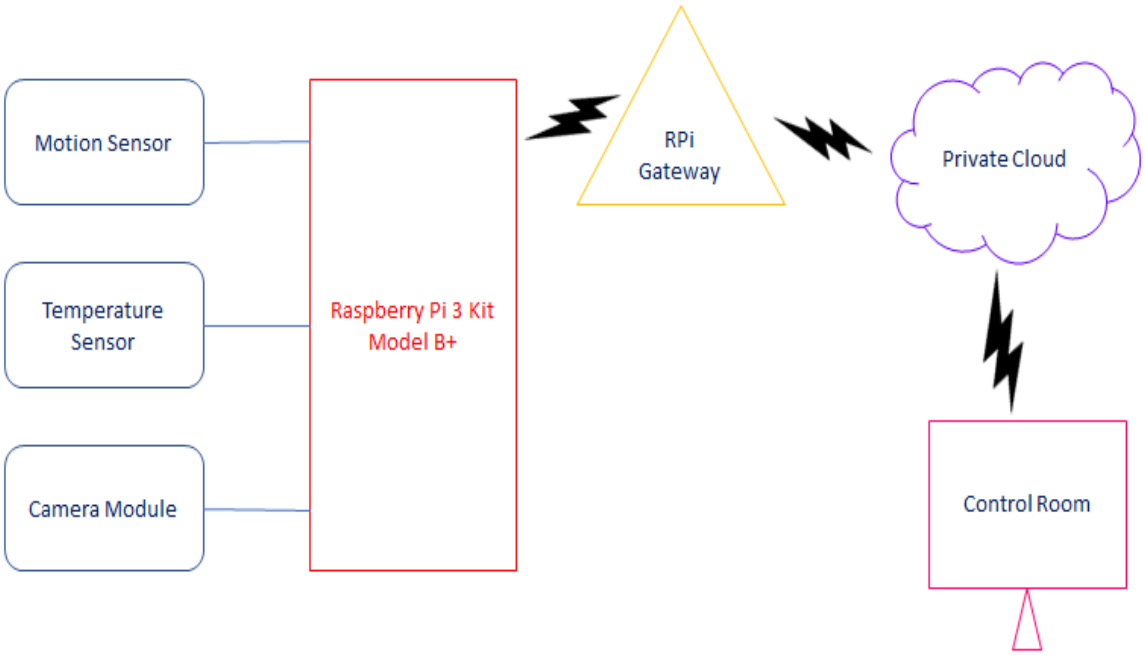

Fig. 2 BSSCS System Architecture

III. CONCLUSION

The proposed system will be helpful in avoiding illegal intrusion of terrorists which are threat to the country's peace. The Life of our soldiers can be protected from deadly attacks and India will not lose its brave soldiers and civilians.Trespassing can be detected easily.It gives automation as it reduces the manual process of patrolling the border.The system will be automated and self-communicating which will provide a smart and secured border environment.The soldiers will get the alerts before any unwanted activity takes place.

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