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BORDER SECURITY ALERT USING LONG RANGE

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Abstract - *The idea behind protecting our nation is to build up an implanted intruder identification framework in the border using LoRa (long range). LoRa is used for long range, low power and secure data transmission. It operates in the 920 to 923 MHz band of frequency. It is known that in the border there are numerous circumstances which may occur, so every second our soldiers can't watch the border, thus providing an opportunity for intruders to enter our border unknowingly to commence an attack. At this point, when an unknown person or any object is recognized in the scope of that camera, it immediately sends the flag to raspberry Pi and the camera starts capturing the images. After capturing the images, it will compare with the database and if humans are detected, an alert signal will be sent from Raspberry pi to Arduino uno via LoRa. A vibration sensor is connected in the transmitter side to monitor if the device is damaged by the intruder or under natural calamities. At that point, the operation will be quick in identifying the people who are entering unknowingly. The main purpose is to reduce the manpower resources utilized in the border areas. Even beyond this, the system is even capable to act as a trap to neutralize the enemy completely.*

***Key Words*: LoRa, Surveillance, Image Processing, Automation, Border Security.**

1. INTRODUCTION

Border monitoring is the high hazard undertaking among all cross border operations which prompts higher operational expenses and loss of lives. Numerous nations began dealing with an all-encompassing arrangement called Inclusive Border Management System (IBMS). It works under the mechanism of security. IBMS proposed to have another radar system being introduced in the border areas which will transfer a 180-degree perspective of the area to the control room. Once the control room gets any data around an invasion endeavor, the particular cameras at the border will naturally set itself as indicated by accessible directions to catch images of activists attempting to sneak in. Border security alerting system using LoRa [3] is the state-of-the-art solution for the effective monitoring and control of national borders. The proposed system consisting of LoRa based entrapment sensors with alarm which activates after any minute movement in the border areas that makes it sensitive enough to check every possible infiltration bid by the militant or enemy army or mechanized force. Border controls are put in place to control both the inflow as well as outflow of people, animals and goods. Specialized government agencies are usually created to perform border controls. Ensuring the integrity of land, sea and air borders is critical to the countering of national security threats and cross-border organized crime.

2. LITERATURE REVIEW

Devkar.A.R. et al. (2016) designed an advanced electronic security system by using small PIR (Passive Infrared) and IR (Infrared) sensors built around the arduino controller. PIR and IR sensors sense the presence of intruder and the controller reads the signal from sensors. If an intruder is detected it turns on the buzzer and the lights in the room. A call is also made to a predefined number through a GSM (Global System for Mobile communication) modem. At the same time controller also turns on camera to capture the image of intruder [2].

Chindhia.P. et al. (2018) developed a next generation wireless sensor networks called as Smart dust networks. Smartdust is a hypothetical system of many tiny Micro Electro Mechanical Systems (MEMS) such as sensors, robots, or other devices, that can detect, for example, light, temperature, vibration, magnetism or chemicals; are usually networked wirelessly; and are distributed over some area to perform tasks for defense industry and homeland security applications. The smart dust wireless sensor mote detects and classifies into vehicles, individuals and groups [1].

Naveen kumar.M. et al. (2014) used a system of tracking the location of the boat using DGPS (Differential Global Positioning System) and to trigger an alarm which consists of a Piezo-buzzer, when the border is approached or crossed. Also , in addition, the DGPS information is sent to control room where it is read and then through a GSM device, information is sent to the family at regular time intervals who are in anticipation about their family member's safety. The

paper aims at providing a system that will alert the fishermen well in advance and ensure maximum safety and peace at the borders and also notify the family members [5].

Pampapathi.B.S. et al. (2016) a detecting system by means of PIR nodes to monitor outdoor targets more than 20 meters away from the PIR detectors. Furthermore, because of velocity difference, by extracting time domain amplitude, signal length, maximum frequency and corresponding frequency amplitude as features; people, wheeled vehicle and tracked vehicle in the unattended wild ground environment are successfully classified. The detecting and classifying results confirm the average accuracy is 85.67% and 82.67% when PIR detectors are deployed 20 meters and 30 meters away from the Area of Interest (AoI), respectively [6].

Sathiskumar.M. et al. (2015) used a security system which is based on the embedded system along with GSM and sensor networks. The human movement is detected using the PIR sensors. In this time, the system triggers an alarm detecting the presence of person in a specific interval of time and simultaneously sends the how many persons are intruder via message to the SMS through GSM Modem. When the security system is activated, the CCTV (Closed Circuit Television) camera is activated. This highly reactive approach has low computational requirement. Therefore it is well suited for home surveillance system. This surveillance security system implemented using PIC (Peripheral Interface Controller) micro controller, camera, GSM and sensors [7].

3. METHODOLOGY

The overall process of the proposed system is given in the form of a block diagram (Fig 1). The IP camera [4] in the mobile captures the live feed is compared with the datasets. The data set is present in the raspbian OS which contains 450 images of humans taken under different lightings and backgrounds in grayscale format. The LoRa transmitter will send a message to the LoRa receiver, once the movement of humans is identified. Also, a vibration sensor is connected in the transmitter side to monitor if the device is damaged by the intruder or under natural circumstances. Arduino uno [8], LCD and the buzzer at the receiver side are used to alert the personnel once a message is receiver from the transmitter end. The assembled modules are given a power supply of 5V through a USB connector and are seen in Fig 2 and Fig 3.

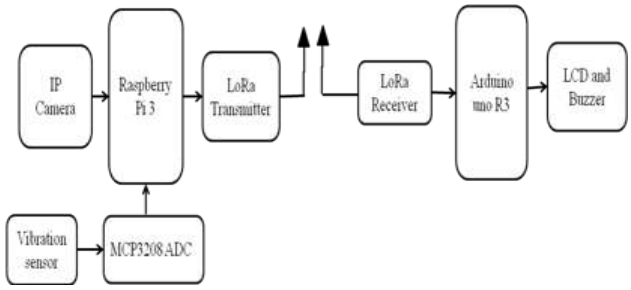

Fig -1: Block Diagram of Proposed System

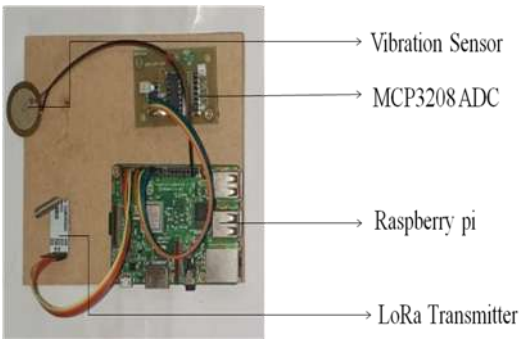

Fig -2: Transmitter Side

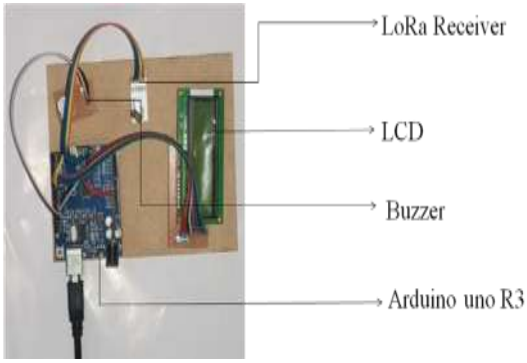

Fig -3: Receiver Side

3.1 Image Detection

The IP camera is used for surveillance and the live feed from it is simultaneously sent to the Raspberry Pi model for the process of "Real Time Object Detection". A database of images is dumped in the board for this process. These pre-trained images include pictures of human. DNN (Deep Neural Networks) algorithm (Fig 4) is used for human detection. The model is programmed to send a signal through the transmitter, once a human is detected from the comparison of the live feed and the pre-trained images.

3.2 Damage Detection

The transmitter side is fitted with a vibration sensor through an analog-to-digital convertor. The sensor is triggered when device is shaken. The pulses from the sensor are simultaneously sent to the Raspberry Pi model through an MCP3208 ADC. The ADC (Analog to Digital Converter) is used for the converting the analog pulses to digital pulses. The device is programmed such that to send a message when the pulse from the sensor is above a particular level.

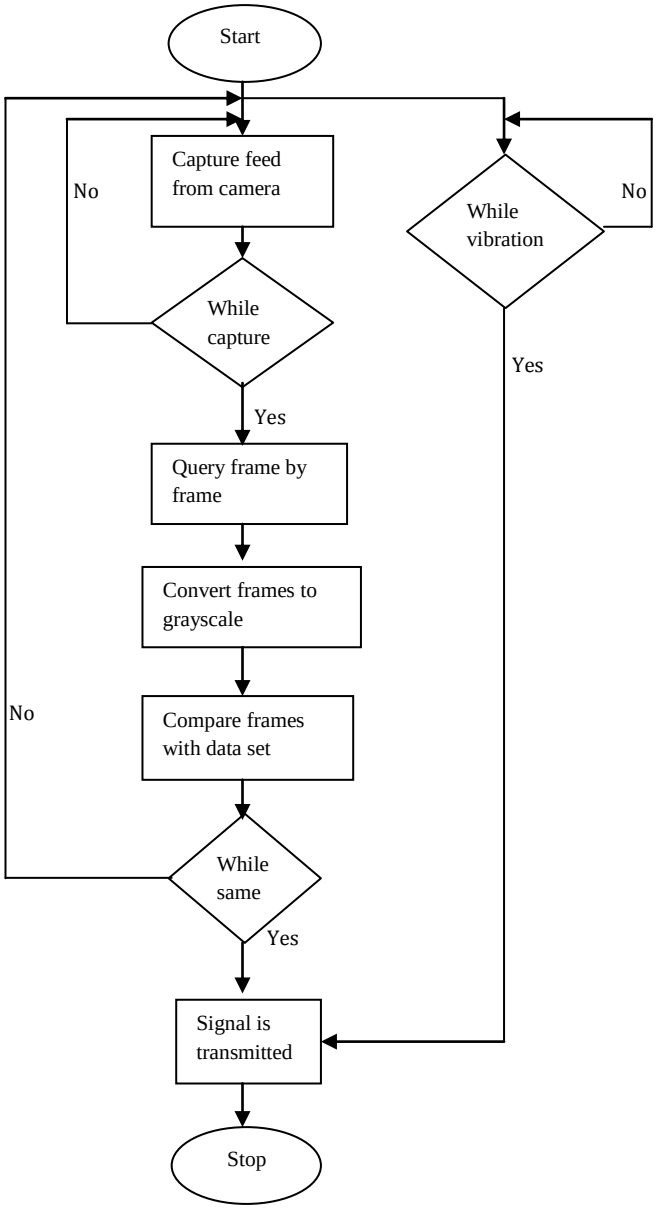

Fig -4: DNN Flowchart

3.3 Transmission and Reception

The LoRa transmitter and receiver are used for long range, low power and secure data transmission. It operates in the 920 to 923 MHz band of frequency. The LoRa transmitter is placed along with the camera and the Raspberry Pi. Then the LoRa receiver is placed at the control station. A mobile application is used to monitor the connectivity status of the IP camera, Raspberry pi and Arduino uno to the network at all times. Fig 5 shows the connectivity status of the devices.

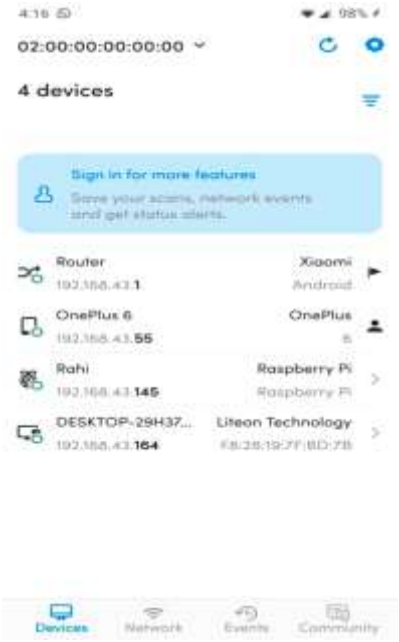

Fig -5: Connectivity Status of the devices

3.4 Alert System

The receiver system is placed at the control station where the personnel monitor the border activities. The system consists of the LoRa receiver, Arduino Uno, LCD (Liquid Crystal Display) and a buzzer. All the transmissions from transmitter are sent to the arduino uno for processing. The system is programmed to display the messages in LCD when humans or damages are detected along with the buzzer sound. The various responses collected by the system can be monitored (Fig 7).

4. RESULT AND ANALYSIS

The IP Camera is used to procure the image of the intruder (Fig 6), which is given as an input to the processor.The Raspberry is already feed with the images of humans.Vibrations on the device are given

as input to the vibration sensor (if any damage has been done to it).Once the intruder is identified, the information is communicated to the border control via LCD.The buzzer starts buzzing and LCD will display "HUMAN DETECTED"(Fig 8). Incase vibrations are detected, LCD will display "VIBRATIONS DETECTED". As an expansion in the future, Capture Cage system can be implemented, where in, the capture of the intruder is possible without the intervention of our border control. This in turn includes the addition of a steel cage which is able to activate as a trap, once the intruder has been identified as a human.

Fig-6: Image of Person detected by IP Camera

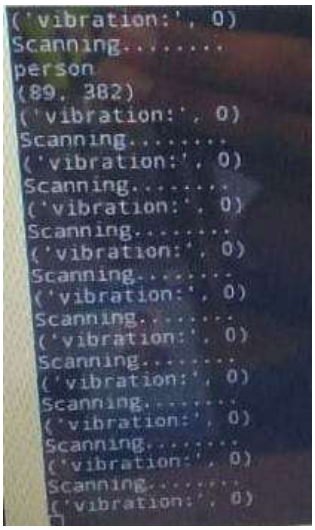

Fig -7: Recordings of various responses

Fig -8: LCD displaying alert response

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