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# Border Security using Raspberry Pi

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***Abstract-***Border Security is one of the major concerns for any country. Issues like political and economic instability in neighboring countries and border distribution demand a good border management and security system. The terrorist attacks that have been taking place over several years have increased the need of an improvised and high level security system. Hence, border infiltration monitoring and prevention is a system built to provide security at the borders. The device is based on the concepts of image capturing, cloud, and wireless data communication. Image processing concepts of noise removal, RGB to gray conversion, background subtraction and histogram of oriented gradients (HOG) are used to detect intrusion. Cloud is used to store the images of the intruder and retrieval at a farther place. Wireless data communication is used to send alert messages from the primary base station to the secondary base station. Further reactions are taken by handling manual robot for fire focusing to the enemy object by targeting and shooting and moving the robot towards enemy with robot detecting metals along its path for safety checking of any bomb present along its way.

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## I. INTROUCTION

The international border running between India and other country demarcates the Indian states and provinces of other country. The border runs from the Line of Control (LOC), Border Security is one of the major concerns for any country. TheBorder security systems detect intruders crossing the border and reports information of intruders to a base station and a border patrol. [1]The project finds its application in the field of defense helping to monitor the India and border known as the Line of Control (LOC). The system is designed to prevent the intrusion of people by illegal means. The device is based on Embedded System and concepts of Image Processing have been employed. The Infiltration or crossing the border of a country illegally and secretly to avoid the consequences of the law is an issue and great concern for India. The size of infiltration units may vary from an individual to small units of up to 300 personnel. The steps taken to encounter any such event i.e. an illegal force attempting to cross the border are termed as border security operations. The function of determining if the infiltration attempt took place or can possible take place is known as detection. Detection is followed by the process of prevention. Prevention is rendering the enemy personnel or material incapable or inefficient in their operation or mission. Hence, border infiltration monitoring and prevention is an automated system using a camera and image capturing, cloud computation and wireless communication to achieve the goal. The system can work efficiently in presence of direct sunlight, rain and during the night time.

## II. LITERATURE SURVEY

Computer controlled Intrusion-detector and automatic ring unit for border Security system was built by Vital et al [3] which mainly includes, a novel computer-controlled intrusion-detector and automatic ring unit, which may be used for the surveillance of borders, either of a country, or of areas requiring high security, especially in regions of extreme climatic conditions, where it is difficult to deploy personnel. This system not only detects intrusion but also provides a video-coverage of the suspicious area, for remote vigilance, via a satellite based communication system. It is also provided with automatic ring mechanisms which can be used to automatically locate the target. Thus, several kilometers of the borders, which would have otherwise required several hundred personnel, can be effortlessly monitored with this system, with only a few personnel. Since, the actual _ring occurs only after an authoritative personnel has doubly confirmed the presence of an intruder, chances of firing at innocent people are completely ruled out. Wave-Type Barrier Coverage for Border Security in Wireless Sensor Networks method of border security was attempted by Takuya Suzuki et al [4] which consists of a network construction method of sensor nodes for border security systems. Border security systems generally monitor intruders by using sensor nodes with communication function. Those systems require the detection of some intruders and the long-term operation. More over those systems have a serious problem of power consumption. Next generation of the broadband network for sustainable development of border security system method was to introduce awareness about the new threats that are posed near the borders was developed by Cristina Cica et al [5].

## III. SYSTEM ARCHITECTURE

The camera module section is responsible for capturing the images from a height of approximately 45-50 feet, when an intrusion occurs through the border.

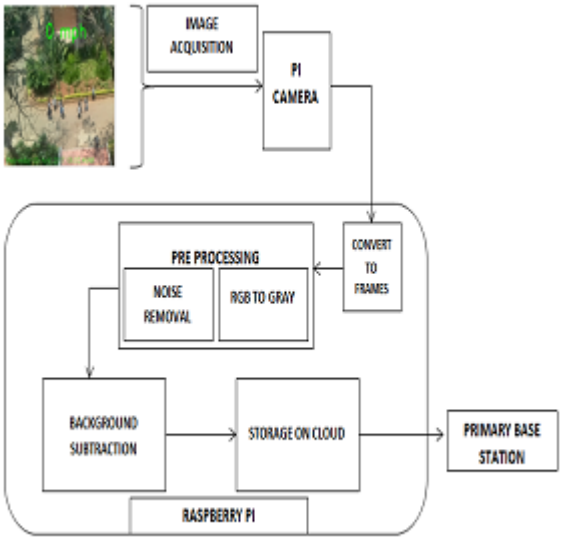


Figure 3.1.System overview at the camera module.

The images acquired are converted to frames and undergo pre-processing techniques namely, conversion from colored to grayscale image and removal of noise. In order to detect intrusion, background subtraction is done. These images are stored on the cloud to be retrieved at the primary base station for processing and detection as shown in Figure 3.1. Therefore, the camera module section is linked to the primary base station through cloud which works with the internet. The speed at which the images are retrieved at the primary base station depends upon the speed of the internet.

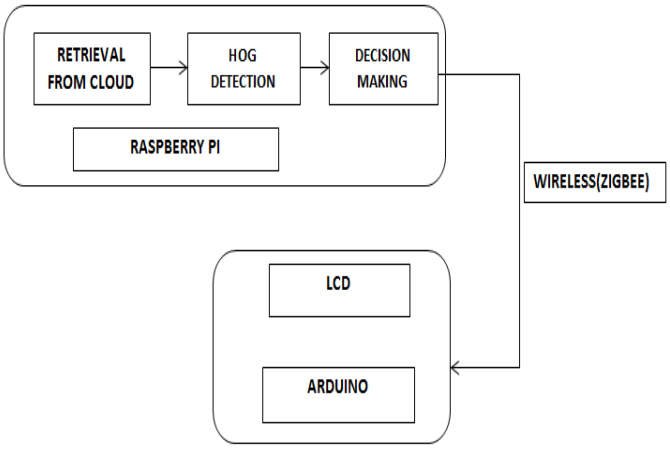


Figure 3.2. System overview at primary and secondary base stations.

The images stored on the cloud are retrieved at the primary base station where it undergoes histogram of oriented gradients detection (HOG detection) for detection. Based on the results of the detection, a decision is made whether an alert message is to be sent to the secondary base station. If a human, vehicle or an animal is detected, an alert message is sent through the zigbee module to the secondary base station which is displayed on the LCD as shown in Figure 3.2. The system can workefficiently for the following conditions:

1. When a single person crosses the border.
2. When two or more people cross the border.
3. When a vehicle passes through the border.
4. When an animal crosses the border.
5. When the camera is under the influence of direct sunlight.
6. When the device is operated in rain.
7. When the device is operated during the night.

However, the accuracy of the system depends on the height at which the camera has been placed.

## IV. IMPLEMENTATION

Firstly, the device is initialized and the executed by authorization process. If the authorization code is correct, the camera is turned on and a reference frame is captured. Later, when an intrusion occurs, the reference frame is used for background subtraction. The image of the intrusion is stored onto the cloud.

In Pre-processing Techniques: RGB to gray conversion: RGB image is composed of three color components namely Red, Green and Blue. It contains detailed color information which requires a lot of processing. Hence, conversion of RGB to gray is done to reduce the processing time which helps the system in being real time. The process involves removal of a noise from an image. All recording devices, both analog and digital, have traits that make them susceptible to noise. Images taken with both digital cameras and conventional cameras will pick up noise from a variety of sources. Gaussian blur algorithm has been used for noise removal. Mathematically, applying Gaussian blur to an image is same as convolving the image with a Gaussian function. It is a low pass filter.

The technique of background subtraction has been used to detect intrusion. Initially, when the camera is turned on, a reference frame is captured. When anyone crosses the border, the corresponding image frame is subtracted from the reference frame after converting it to grayscale image and removing the noise. If any difference is obtained, it is implied that an intrusion has occurred. Like the camera module the device is initialized and authorization is done. If the valid authorization code is entered, the image is retrieved from the cloud and detection occurs using histogram of oriented gradients technique (HOG).

## V. RESULTS AND DISCUSSION

This includes the conditions under which the device has been tested and their corresponding results. The camera from the first part of the device was placed at a height of 45

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feet facing towards the ground. An image area of 70 to 76 feet is covered. Figure5.1 shows the Line of Control

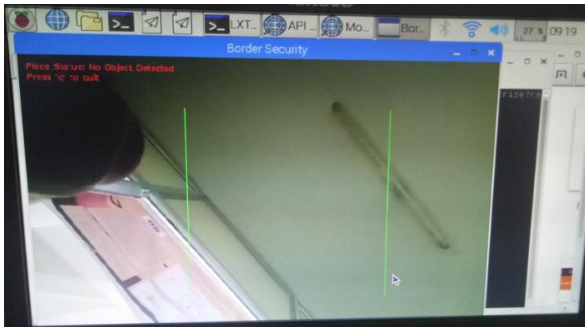


Figure 5.1. Line of control (LOC) as assumed.

(LOC) as assumed and drawn to demonstrate the project under various conditions. Initially the virtual LOC is drawn where, if any intruder crosses this LOC a notification arrives to the base station along with the speed.

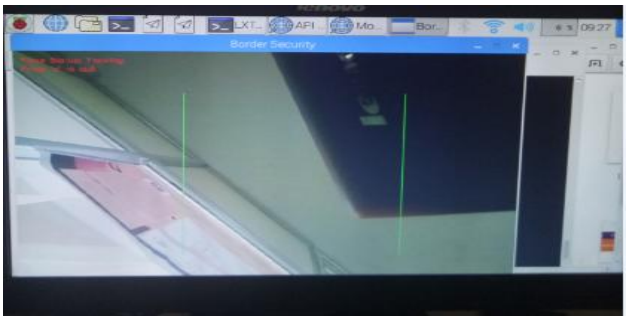


Figure 5.2: Line of control (LOC) as assumed through which an intruder crossing border.

Figure 5.2 shows where the object present nearby LOC is detected and the image is captured and then it is uploaded to the cloud.


Figure 5.3: Images retrieved from primary station

Figure 5.3 shows the images of objects or intruders that are retrieved from cloud to secondary base station.

Figure 5.4Disaster management system model.


Figure 5.5 shows two or more people crossing the border and being detected.

In Fig 5.5, the rectangular box indicates the presence of a human being crossing the border and being detected. The rectangular box indicates the presence of a human being.


Figure 5.6: Vehicle crossing the border and getting detected.


Figure 5.7: Detection of human beings when the camera is placed under the influence of direct sunlight. Shows the human beings detected when the camera is placed under direct sunlight.

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Figure 5.8: Detection of human beings during rain

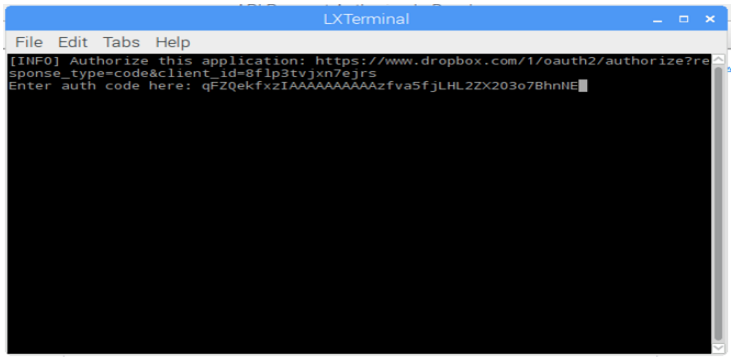

Figure 5.9: Terminal window for authorization to access images from the cloud.

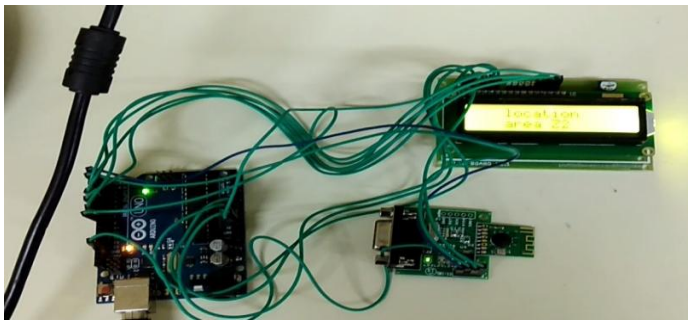
Figure 5.10: Alert message as seen at the secondary base station.

In Fig 5.10, after receiving alert message to the base station about the arrival of the intruder, then a disaster management system i.e. robot is sent to the border area to take action against the intruder attack. The moment of the robot can be controlled from the base station using android application and we can also get to know what is happening in the border through live streaming.

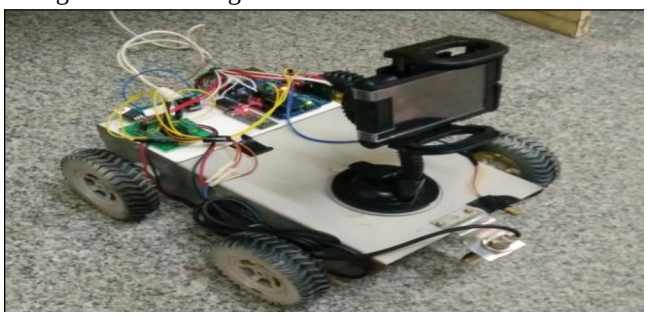
Figure 5.11:Robot moving towards right.

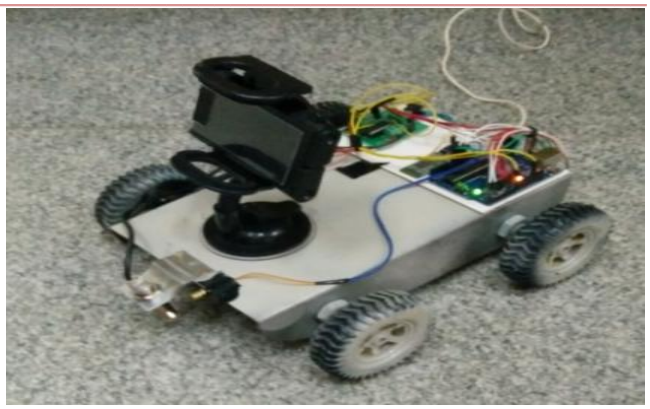
Figure 5.12:Robot moving towards left.


Figure 5.13:Robot moving backward.


Figure 5.14:Robot moving forward.

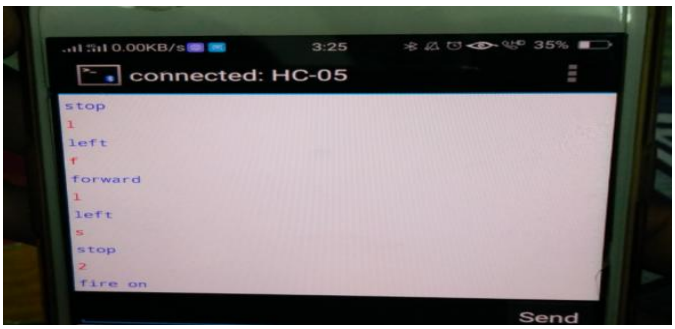

Figure 5.15:Commands to control robot.

Figure 5.16: The presence of metal is sensed and notified through the LED.

The proximity sensor are used as a metal detector which detects if any metals present or not in the robotic path. If any metals are present under the ground above 1mm distance from the metal detector, then it is sensed and LED gets on.

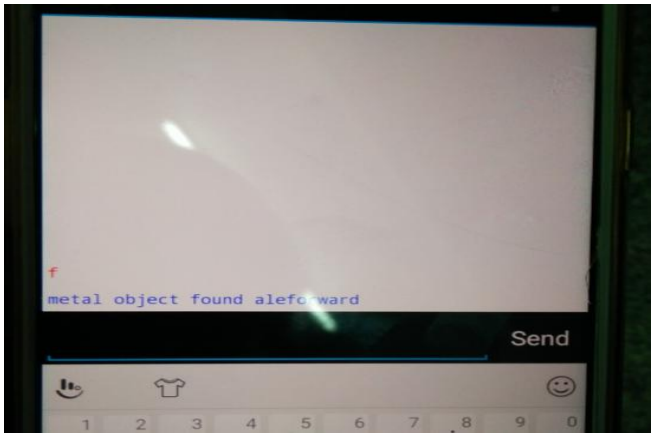


Figure 5.17:Notification to the user when the metal is detected.

If any metals are found along its path the user will get the notification as shown in the figure in the base station.

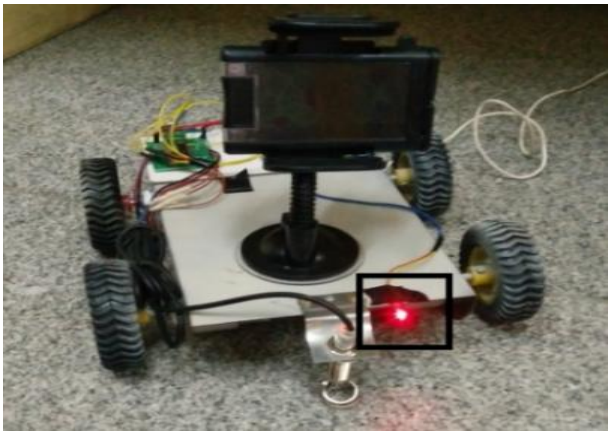

Figure 5.18:Fire focusing using LED.


Figure 5.19:Commanding and Notifying the user about fire focusing is in operation.

The device has been tested over a period of thirty minutes with the camera placed at a height of 20 and 45 feet. The results have been recorded in Table 5.1.

| Height of the camera(in feet) | No. of people crossed | No. of people detected |
|---|---|---|
| 20 | 13 | 11 |
| 45 | 17 | 10 |

Table 5.1: Device-and circuit-level implications due to changing channel doping profile for Sub-threshold operation.

## VI. CONCLUSION AND FUTURE SCOPE

Border infiltration monitoring and prevention is a system that facilitates management and security at the border of the country. It makes use of image processing, cloud and wireless transmission of data. The system is capable of working in rain, under the influence of direct sunlight and dark region. It can detect one or more people, animals and vehicles who cross the border. It can minimize the work being done manually at the borders. However, the device accuracy decreases with increase in the height at which the camera is placed. The device has a lot of scope of improvement in future. The quality of images captured can be improved by using the technique of super resolution. The system can be made completely wireless by using a wireless camera. A high resolution camera can be fixed on a satellite to cover a wider area.

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