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Guardian of the Line of Control

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Abstract: ***Border security is very risky work to maintain the peace in the country and to prevent the enemies from entering the country illegally by crossing the border. This paper elaborates the solution by which the border security strength can be increased and the lives of the soldiers can be saved. This robot is based on the Raspberry Pi with different sensors for detection purpose and the camera is mounted on the robot for capturing the image of the suspect. Based on the input sensor the robot will move in that direction and will capture the image. After capturing the image , it will be attached to the message which will alert the control room nearby.***

Keywords: ***sensor, camera, image capturing and processing, robot design, alert message.***

I. INTRODUCTION

Border security is always important to keep the country safe and save the people lives from the enemies. It is very dangerous for the soldiers to do patrolling near the border irrespective of the environmental conditions, surrounding conditions.In that condition also, they have to keep the border safe from the enemies. During past years, there are many instances are happened where the safety of the country and the lives of people living near to the border was in danger. In one of the instance, during patrolling near the border the soldiers were attacked by the terrorist group and in that attack, one soldier lost his life. So, it is very important to save the lives of soldiers and to detect the hidden terrorists near the border. But now technology is improving every day. Every day some research and innovation is happening around the world. So, this is the right time to adopt that technology and to use this technology to increase the border security strength.

One of the technologies is Robot technology. Robots can be used for the improvement security and thus there are chances of increasing the border security. Robots can replace the soldiers. The multifunctional robots can be placed near the border for patrolling purpose and to detect the culprits near the border. Many countries have adopted this and started to use the robots in their force.

The proposed method is alternative method for security purpose which can be implemented near the line of control. The robot consists of different sensors such as a smoke sensor, metal detector, PIR sensor and ultrasonic sensor. These sensors can be used to sense the smoke, metal, and movement along the border. Also, the camera is fixed on the robot which can capture the image of the culprit after detection. The main advantage of this project is its very unique design. The robot can move on the circular ring pipe which makes it different from the other robots.

II. RESEARCH BACKGROUND

Currently, many solutions are available for improvement of border security using robots and embedded system. Some robots consist of different sensors with an embedded technology for detection purposes. Some robots are moving robots and some are stationary robots. Moving robots can move on the surface for detection purpose and stationary robots are mounted on walls or anything for security purposes.

S. Sudhakr has proposed a multi-access robot for the security of the border. The proposed robot is interfaced with different sensors for motion detection purpose. But the accuracy of this robot is very less [1] and also it does not detect explosive materials as well as cannot capture the image of the detected object.

Intelligent Surveillance and Security robot system is another solution given by Kyunghoon Kim and his team [2]. The paper suggests two different robots for security purpose. One is the stationary robot which can be mounted on the pillars near the border which can be used for continuous monitoring purpose. Another robot suggested by his team is moving robot which can move around the line of control for patrolling purpose. This robot consists of different cameras for capturing the image of the threat. It does not consist of any sensors which can decrease the chances of improving the security. Due to use of many cameras the cost may be high.

The mines or the metals explosives can be detected from the special sensors [3] which are hidden near the border. But the cost of such explosive detectors is very high. So, the small prototype is used in the project for metal detection purpose.

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The four-wheeled unmanned mobile controlled robot is alternate solution based on Arduino controller [4]. But the efficiency of this robot is very poor and the range of the communication is also minimum. Even if it is less costly, the accuracy is also less.
Considering the above, there are many solutions are available to increase the border security but every solution has different disadvantages like less number of sensors[1], no camera[3] for capturing the image, multiple robots[2] and many more. There are chances to improve the technology and thus we are providing one more robot which is consisting of different sensors for obstacle detection, for metal detection , for smoke detection and after that to capture the image with wireless network communication.

III. SYSTEM ARCHITECTURE

A. Block Diagram

The Fig.1 shows the block diagram of the project. The PIR sensor, Ultrasonic sensor, Smoke sensor and metal detector act as an input to Raspberry Pi module. The camera captures the image of threat. The Raspberry Pi is the main controller of the project. The threat is detected by any one of the sensors and given as the input to the controller. The controller will process the input and will generate the alerting message and send it to the control room.

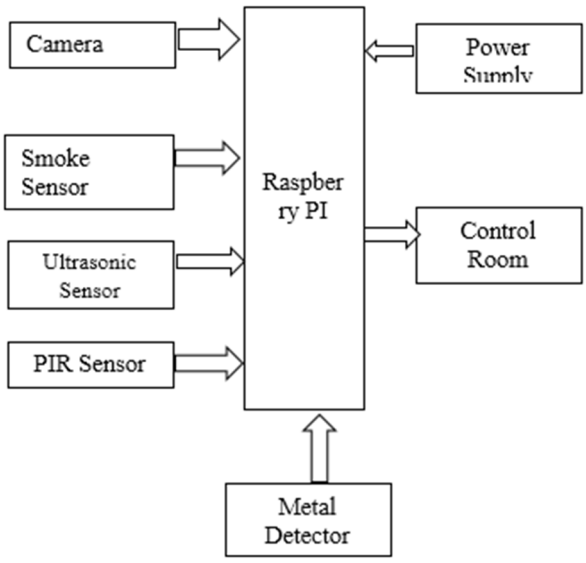

Fig.1. Block Diagram

The working of the robot is divided into three different stages-

1) *Stage 1:* This section consists of different sensors such as PIR, ultrasonic, gas and metal sensor. This sensor will detect any type of motion, gas or explosive devices. The output is given to controller.

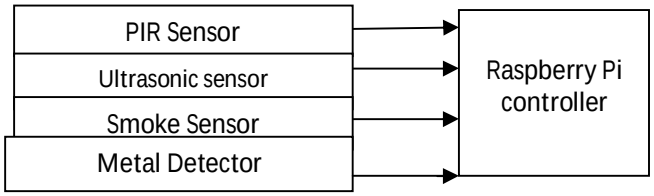

Fig.2. Stage1- Detection stage Fig.2. Input Section

2) *Stage 2:* Capturing the threat after detection using camera.

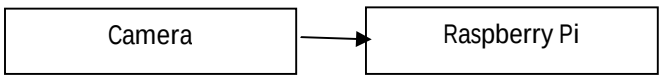

Fig.3. Capturing the image .

In ideal condition i.e. when no object is detected, the robot will be continuously moving on the pipe. At that condition, no input will be given from input section to the Raspberry Pi and hence it will not capture the image.

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Suppose during patrolling, if any one of the sensors detects the threat or any other object near to the border, that sensor will give input to the controller. So the controller will move the robot in that direction and the camera will capture the image of the threat automatically.

3) *Stage 3:* This stage includes the image capturing and e-mail sending process.

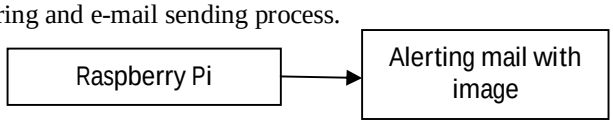

Fig.4. Sending message

After the image has been captured it will be attached to the alerting message and will be sent through e-mail to the control room. Before capturing the image by the camera, it has to be interfaced with the controller.

4) *E-mail Sending:* After capturing the image, it has to be attached to the email. Before sending the mail there are some steps to be followed and these steps are given below.-

a) Install SMTP configuration file

b) After installing the file, edit it. Include "hostname". Then include "username" and "password" from which e-mail has to be sent.

c) Then include "e-mail id" and "password" of a person to which e-mail has to be sent.

d) Then write subject of the e-mail

e) The processor will automatically attach the captured image and the message to be written in that e-mail has to be written by the user during coding

B. Software Implementation

In this system, we are going to use Raspbian Jessie Operating system as it is free operating system based on Debian optimized for Raspberry Pi hardware.

The Fig.5. Shows the operational flow of the project.

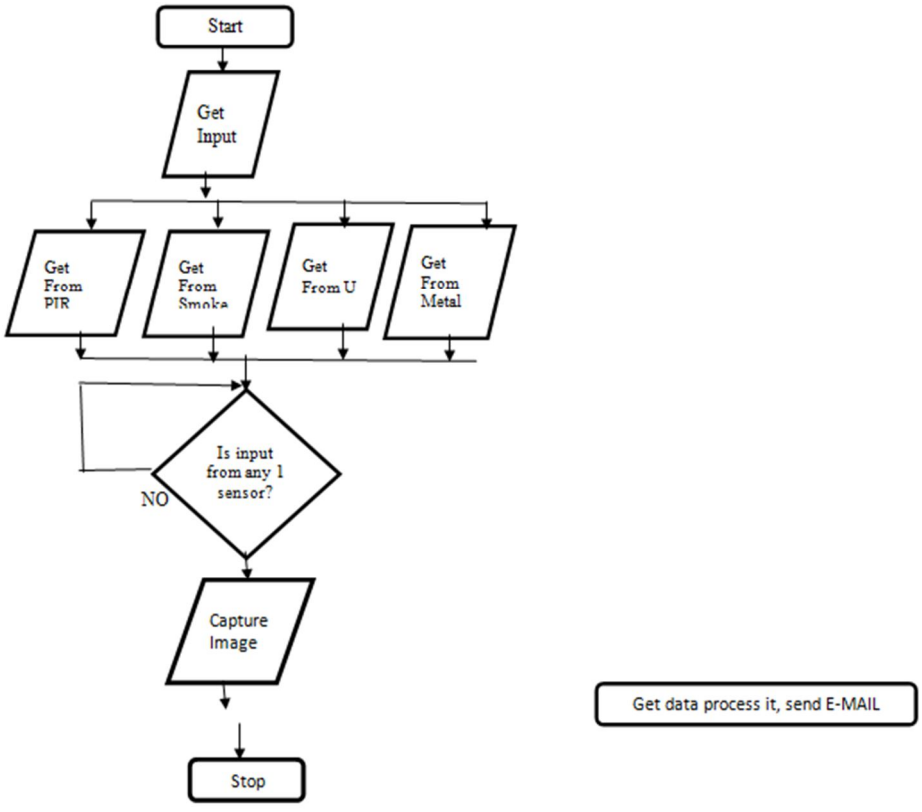

Fig.5. Flowchart

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C. Results

1) Actual hardware of the robot

Fig.6.Shows the actual robot design.

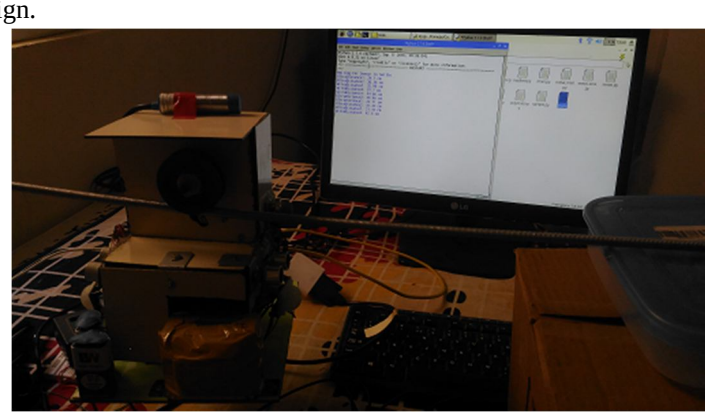

Fig.6. Actual Robot design

The robot consists of a metal detector placed above the wheel. The ultrasonic sensor and PIR sensor is connected to either side of the robot. The power supply is given from the 9v batteries to the motor which is placed inside the robot (not visible in the image).

2) PIR and Ultrasonic Detector Output: Fig.7.Shows the output of the ultrasonic sensor and PIR sensor. The ultrasonic sensor and PIR sensor is combined for detection purpose. Whenever any object is detected by this sensors it will display as 'Obstacle detected'

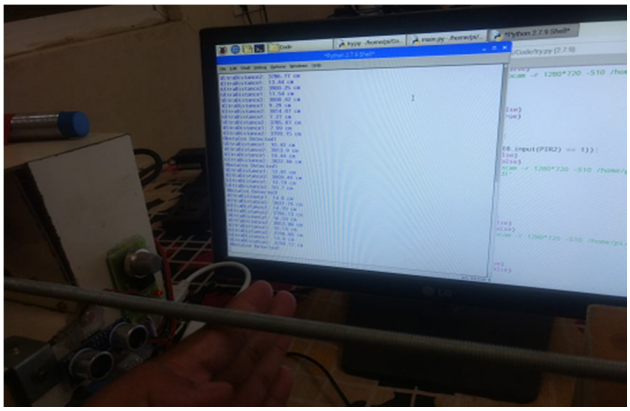

Fig.7.PIR and Ultrasonic detector and output.

3) Smoke Detector Output: The fig.8.Shows the output of smoke sensor when it detects the smoke within its range and same is displayed on the monitor screen. In this case, the smoke is from an incense stick.

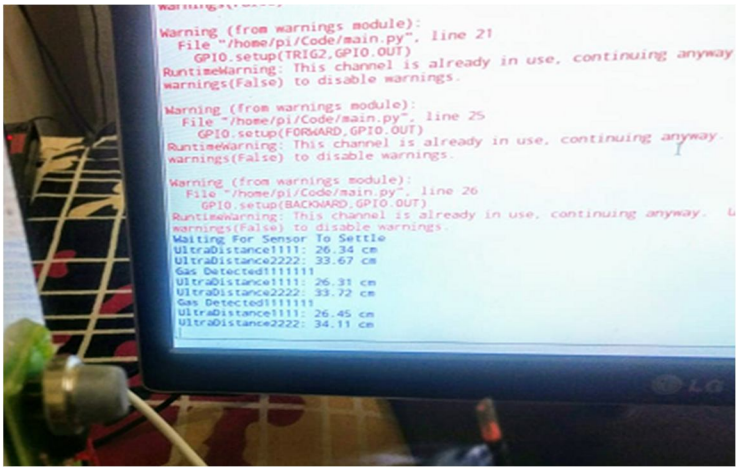

Fig.8.Smoke detector Output

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The smoke sensor is connected above the ultrasonic sensor on both sides of the robot structure.

4) Metal Detector

Fig.9. Metal Detector and Output

The metal detector is placed above the robot. fig.9 Shows the output of metal detector when any metal is detected and same is displayed on the monitor screen.

Images of project outputs-

Suppose the robot is moving and suddenly the threat is detected by any one of the sensors connected to it. So, the robot will stop and the camera will capture the image of the suspect.

5) Suspect Image: The Fig.10 shows the image captured by the camera. This image will be sent through email and same will be alerted by the message.

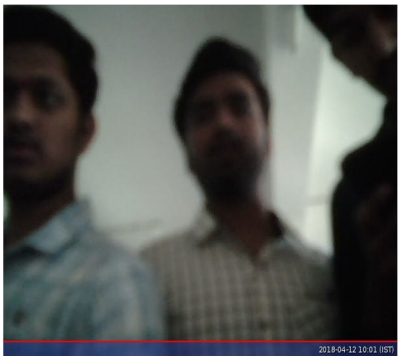

Fig.10. Image captured by the camera

6) Sending Alerting Message with Captured Image.

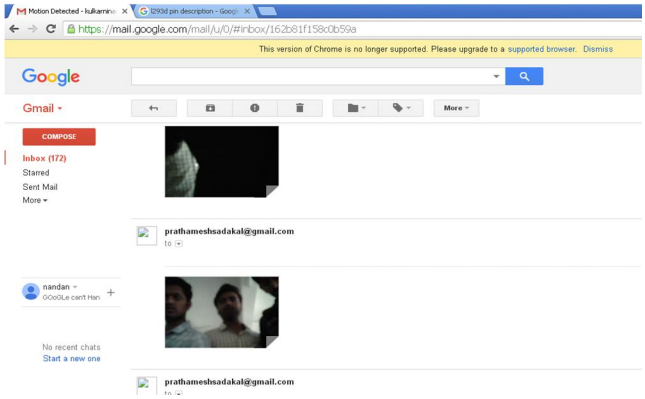

Fig.11. Suspect image sent through Email.

Now the captured image is processed by the controller and this image is attached to the registered email id to whom-ever mail has to be sent. The above Fig.11 shows the captured image of the object by the camera and successfully sent to the registered email id.

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7) Sending Message to mobile:

Suppose the email is not sent due to technical issues. So there is an alternative solution to this is that the message will be sent on mobile number from which one can come to know that some motion is detected by the robot. Fig.12.Shows the message has been successfully sent to the registered number after detection of the object

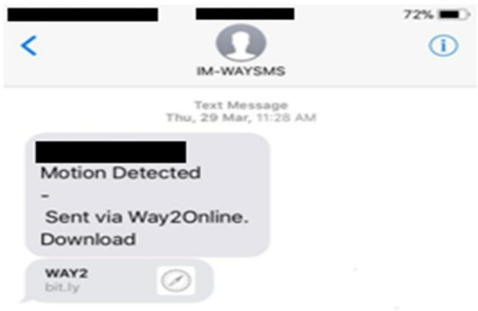

Fig.12. Message alert

IV. CONCLUSIONS

We are using robots instead of soldiers around LOC for security purpose so lives of soldiers can be saved near the line of control using robot technology.

It is a totally unmanned robot and have more advantages than normal human being. So it can work more effectively.

The border security strength can be improved.

Robot has different sensors and cameras for more accuracy.

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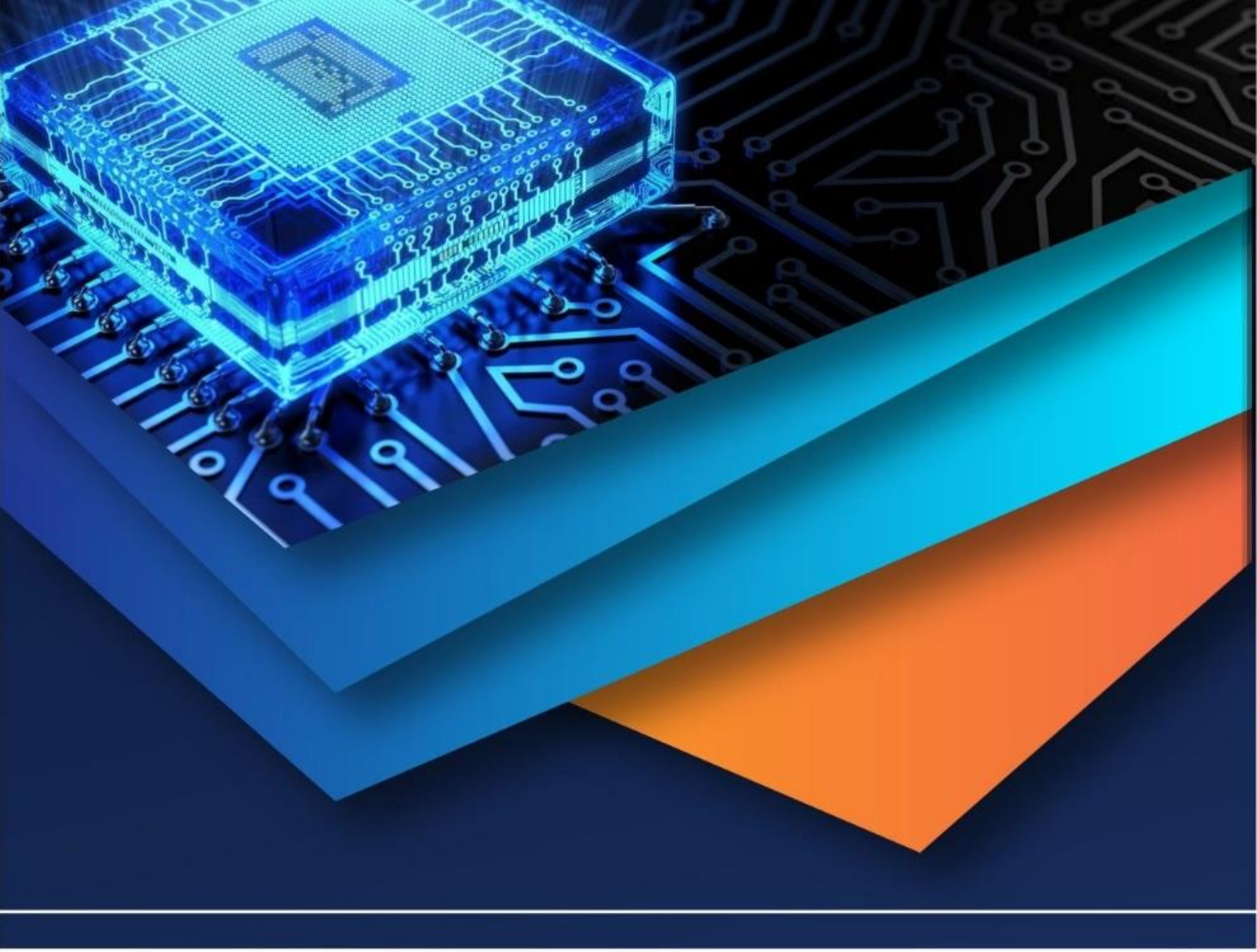

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