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# HYBRID BORDER SURVEILLANCE COMBAT VEHICLE

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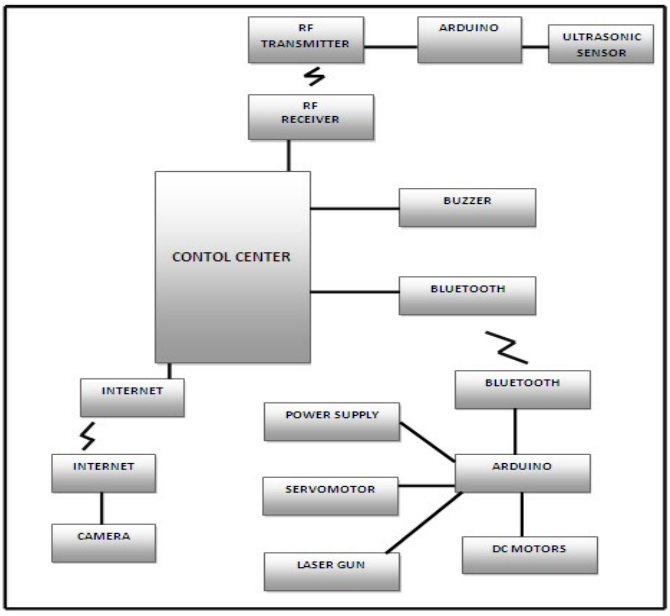
## Abstract
In this paper we propose a cost-effective surveillance robot that is used for border surveillance and at the same time prevent terrorist infiltration. The robot consists of two modules: surveillance unit and arm unit. The robot will patrol predefined paths along the border. Intruder detection is done using ultrasonic sensor and if any intruder is detected then the information is transmitted to the operator via RF Transmitter. To capture and archive the real time video from the robot, the inbuilt camera of the phone is utilized. The robot can be controlled using Bluetooth technology from the same smart phone. The camera keeps on sending live video feed to the operator in the control room. When an intruder is detected, the operator takes the robot near to the intruder for gathering more information and the threat is eliminated using weapon.

**Index terms**: ultrasonic sensor

## 1. Introduction
Despite the obvious advantages, the use of robotics is still not very popular with the Indian armed forces. Apart from certain explosive ordnance detection applications, remotely operated vehicles are not so much of a winning concept in the Indian context. Today, the new technology in robotics can be used in various other operations. Since modern warfare is increasingly depending on the digital, the use of robots in gathering information, and even performing tasks on the ground during a combat, can be very advantageous. The Indian military and the paramilitary force, however, use these remotely operated vehicles only in very few operations, mainly related to explosive detection tasks. The impact and advantages of military robot use are often “lifesaving”. The first major advantage and importance of robots is that they are capable of performing duties similar to human duties without the actual danger to human lives. These robots are easily replaceable at a cost, unlike human life. Robots can also endure damage done by bombs or other types of weaponry that would otherwise destroy the human body. Another advantage of robots is that they come in various sizes. Some robots are able to fit into spaces that are not easily accessible for humans. Tight, dark spaces are common and robots are a perfect fit for the task. Other advantages of using robots include not only to disarm bombs and weapons, but to hold and fire. Robots need not be motivated by self-preservation, anger, revenge, hunger, fatigue, or resentment. With more-extensive and more-capable sensors, they could make faster decisions and respond to changing conditions more quickly than humans. But autonomous weapons may lack empathy. We cannot use autonomous robots until we can show that we have exceeded human-level performance from an ethical perspective. In recent times, surveillance technology has become an area of great research interest. However, building a small robot for testing and research purposes proves to be extremely expensive, because primarily a security robot would require certain components such as a GPS module (Global Positioning System), High resolution cameras, radios for satellite connectivity, etc. Each of these components are quite expensive and piecing them together for the purpose of a robot is a very costly and time consuming affair. Moreover, a lot of time is wasted in writing driver code to interface all these components. The solution to this dilemma is quite simple. In the last few years, feature-rich smartphones have become popular. These phones come equipped with the required features such as a GPS module, a high resolution camera and internet connectivity. Also, the operating system on these smartphones provide Application Programmer Interfaces (APIs) for using the various sensors with ease. By using the APIs provided, we can easily write apps in a high-level language like Java, without the complication of writing driver code. In our system, we have used a smartphone running the Android Operating System, which is one of the most popular mobile operating systems today. Thus, it is our aim to build a fully-featured surveillance robot using an easily available Android phone, which can be remotely controlled.

## 2. System Description
Our system consists of a computer, smartphone and a robot. The robot is controlled by a user sitting at the remote computer using Bluetooth technology.




The robot consists of a smartphone running the Android operating system, an Arduino microcontroller to control the robot’s motion and other required hardware (motors, chassis, power supply, etc.). The user controls the robot by sending control signals to the Arduino board via Bluetooth which then moves the robot in the required direction. The camera on the Android smartphone is used to send video feedback to the

remote user simultaneously over the internet. This enables the user to navigate the robot remotely. Additional processing can be performed on the video feed on the remote computer.

## 3. Modules And Interfaces

We have used an Arduino Uno, a microcontroller board based on the ATmega328. The project is divided into 3 modules, each of which are explained in detail below.

A. Sensor to control center communication

We have used ultrasonic sensor connected to an Arduino. When an intruder is detected by the sensor, it transfers signal to another Arduino placed at the command centre. The signal is transferred using RF transmitter at the transmitter end and RF receiver at the receiving end. When an intruder crosses the border, the ultrasonic sensor detects and triggers the buzzer that acts as a warning to the operator controlling the robot.

B. Android to user communication

The robot has a camera enabled smart phone attached to it to record videos and take pictures. The pictures and video captured can be recorded and remotely streamed with advanced security RIJNDAEL algorithm. The smart phone uses an Android open-source operating system to facilitate support and easy usability.The camera enabled smart phone attached to the robot can be dismantled at will. Better quality of images can be acquired by using better cameras. The application is developed in the Android open source operating system. The application is very reliable and secure in a way that it uses a 32bit encryption/decryption format. The easy 128 bit encryption/decryption is further enhanced and made foolproof by making use of our own developed RIJNDAEL algorithm.

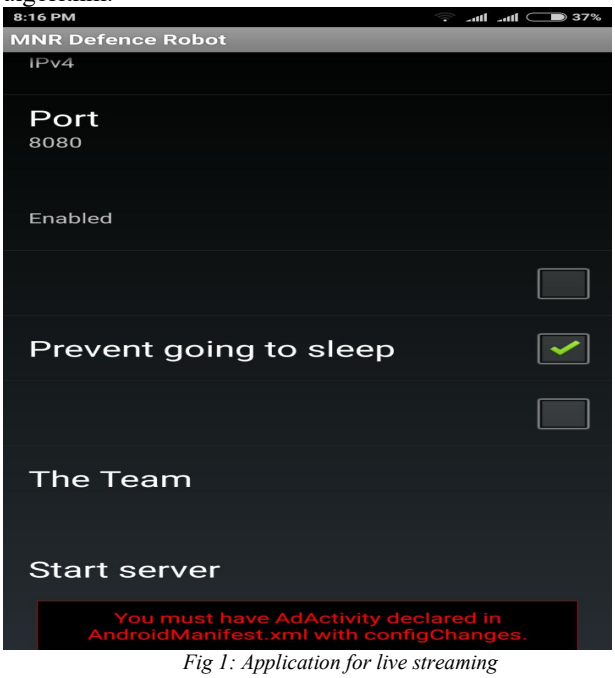



*Fig 1: Application for live streaming*

C. Android to Robot(Arduino) Communication

The Android phone is connected to the Arduino via Bluetooth module. The Arduino is powered by a 12Vrechargeable battery. The Android phone acts as a bridge for communicating between the command centre and the Arduino. For this purpose, there are two separate apps running simultaneously on the phone. One of these is for transmitting the video feed to the remote computer. For this purpose, we have used a app that streams live video and transfers it to the remote pc. The second app is responsible for transmitting control signals from the Remote User and relaying them to the Arduino microcontroller.

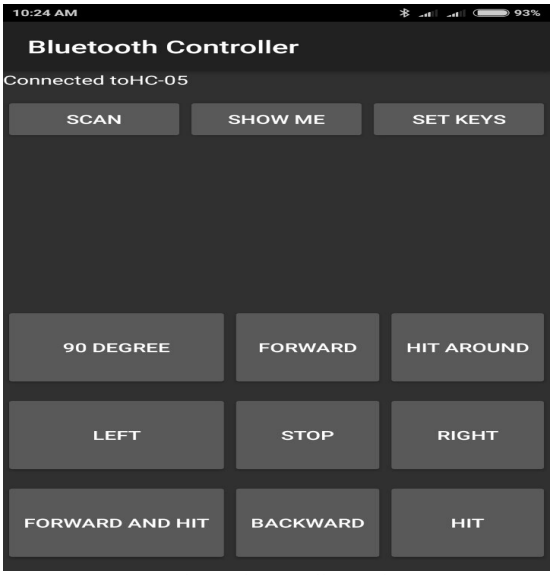



*Fig 2: Bluetooth controller application*

The Arduino project provides an integrated development environment (IDE) based on Processing, and programming is done using a language based on Wiring, which is very similar to C++. The Arduino microcontroller is configured to receive serial input from the Bluetooth module that receives string commands form the app running on the Android smartphone, and subsequently control two DC motors (1 front and 1 rear). Upon receiving the string commands from the Android phone, the Arduino generates two control signals per DC motor. For e.g., on receiving forward to indicate a forward motion, the code on the Arduino sends one HIGH and one LOW on each pair of control signals. A backward motion would involve inverting of the same, and so on. Since the Arduino cannot directly power a DC motor due to insufficient current, motor drivers, with their own power supply are used. Each motor driver is capable of controlling 2 DC motor. In our implementation, the Arduino sends the control signals to L293D motor driver powered by a 12 volt battery.

## 4. WORKING

A wheeled robot patrols along a predefined path along the border. Ultrasonic sensors are placed on the verge of the border ,which continuously sends the signals to the control room. A camera is placed on the robot which continuously sends live stream video usingan application which is developed by using RIJNDAEL algorithm. This application streams the live video to the controller which creates a static IP address. Once echo is received to ultrasonic sensor it indicates that intrusion has occurred then the signal is transmitted wirelessly to the controller using RF transmitter and RF receiver.The operator takes control over the robot and takes it to the spot of intrusion.When the intruder is found to be a threat, the laser gun which is mounted on the robot is used

to eliminate the threat. The laser gun is controlled using a servo motor. A Bluetooth controller application is created for controlling the robot and it can also be used to fire the desired target.

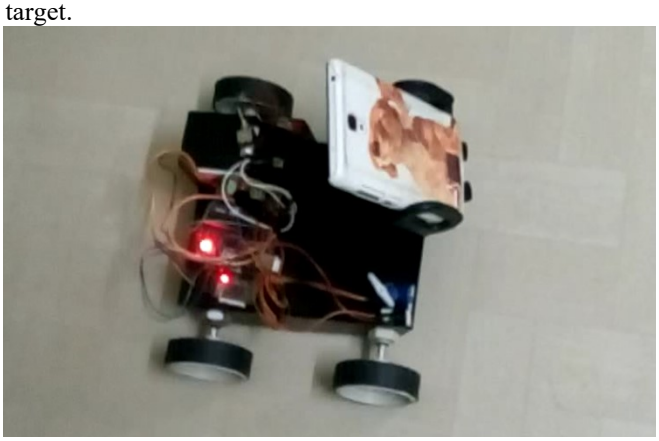


*Fig 3: Design of wheeled robot*

## 5. Future Scope And Conclusion

This project offers a lot of scope for adding newer features. If we include algorithm for on-board imageprocessing, it will help the surveillancevehicle to identify the intruders on its own. We can program the robot such that it can detect objects and reach them on its own. Thus, we can make it completely autonomous. Also, with the presence of GPS navigation and mapping software, the robot will have the capability of finding the best route possible to reach a certain location. Installation of night vision camera can enhance protection even during night. Also, by making it sturdier and giving it extra protection, we can make it an all terrain robot, which would make it ideal for a surveillance robot. The surveillance vehicle if made air-based can also be used for patrolling the water coastline of India. The possibilities are endless. This robot in its current state provides a platform for further research into improving its capabilities.

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