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## APPLICATIONS OF AI IN AUTONOMOUS SURVEILLANCE ROBOTIC SYSTEM

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### Abstract

Nowadays, the security in the border areas is a major problem and to increase security in these areas where human surveillance is not possible, the mankind loss due to some issues like bomb blast is the major problem. The major drawback in all the existing solutions is that they will spot the enemy's drone but fails to protect its own robot and also to spot the attacking by the enemy's side it requires human intervention to defend the enemy which becomes a major issue especially when the attacker takes the next action faster than us which will lead to damaging our own robot and after this it will not be able to get the signals from rover also which becomes an advantage for the enemy side. In order to address this problem autonomous robot aims to work on the principle of PSD mechanism which is Protect, Spot and Defend. This robot also works in 3 modes of operation autonomous, Bluetooth controlled and voice controlled and can also works under any terrains (rough, smooth). This autonomous robot uses two spotting mechanism such as bomb detection and intrusions in from the sky which includes drones and missiles. The bomb detection will be done through RF detection mechanism which will detect the bomb using the RF signal. The intrusions in the sky can be detected using the special type of camera which is Mitsubishi Camera which can detect the object at range of 100m which will be trained by the ML algorithm such that it will give a positive signal to the user if the flying object is not bird or a aeroplane such that further action can be taken on the intruded object. The first mechanism is the usage of the principle of GPS Spoofers which will sends the new signal to the drone replacing their original ones with their current user and alters the GPS coordinates i.e., The drone will be spoofed in such a way that drones position can be controlled by the spoofers. Second mechanism includes High power microwave which will send a high energy signal to the drone which will destroy the electronic components of the drone and hence damaging the drone. All the above information will be updated to the user using a web application using some software like Power Bi tool.

**Keywords:** RF Detection, Machine Learning Algorithm, GPS Spoofers, Electronic Flat Panel, High Power Microwave.

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## 1. Introduction

The world's security is a complex and multi faced issue in today's scenario. Each nation faces threats that include wide range of concerns such as social threats, aggressions from a particular group, Geopolitical tensions and in terms of Global economic welfares. These threats may be direct acts of war and aggression. but they can also be subtler and harder to detect for example including espionage and election interference. In recent times The China introduced a spying balloon over U.S in stratospheric layer that consist of various sensors and cameras to gather and transmit information about the country. This leads to declination of the U.S economy to a greater extent. It is important to implement spy detection in border and confidential areas to prevent espionage and to protect their country's national security, economic interests and their citizen welfare.

Spy detection is important in borders and other confidential areas because it helps to prevent espionage and also these are the entry and exit points for intrusions making them vulnerable to infiltration by spies. This gathers all the information's about the country leading to declining of growth and economy of the country. About 27% of wars are occurring every day in the world. Over 9,00,000 – 10,00,000 causalities happen in every single war.

Monitoring device that can offer online real-time information on a patient's status has been developed. The components of the system include sensors, a data gathering device, an ESP32 microcontroller, and software. The system continuously tracks, displays, stores, and sends the patient's temperature, heart rate, ECG, blood pressure, and SPO2 to the doctor's mobile device through the application.

Gaurav Vashisht et.al (2015) [1] They have developed a Defense Surveillance Robot that is capable of detecting metals using metal detection sensor. It also contains fire detection sensor that is used to extinguish fire, IR Sensors for detecting obstacle and facilitates continuous movement. They also interfaced robotic arm that is capable of placing and diffusing explosives. It also has wireless camera that monitors the current environment and sends the data to control unit.

Zhiguo Shi et.al (2020) [2] The Proposed project has built up an acoustic based surveillance system for drones and localization of drones. They have designed a SVM based detection for detecting drones. It also has the feature extracted from the acoustic signal and background noise. An estimation of TDOA (Time Difference of Arrival) is used for the localization approaches which used Bayesian Framework.

Chandan G et.al (2018) [3]. The real time objects are detected using SSD algorithm. The main objective of SSD algorithm is to detect various objects in real time video sequence and track them in real time. It consists of features for detecting, tracking, and responding to the particular targeted objects in the video surveillance. This real time analysis has been enabling security, order and utility for any scenarios.

Sara Al-Emadi et.al (2019) [4]. The Proposed methodology was able to not only detect the drone presence but it also has the identification of the type of drone. The designed approach has shown the results of the empirical validation of drone detection. They have also supported the effectiveness of detection using deep learning techniques.

Gaurav Vashisht et.al (2015) [5] It is a Surveillance Robot based on DTMF Technology (Dual Tone and Multi Frequency). It also uses IR sensors for sensing the path and obstacles and LDR sensor for night vision. An RF remote is used for controlling the robot. One of the main features of the proposed robot is having a robotic arm of 4 degree of freedom for explosive placement and diffusion. A Wireless Camera is attached to the robot for visual monitoring.

Akshaya U Kulkarni et.al (2019) [6]. The RADAR ( Radio Detection and Ranging) based Detector consists of a transmitter that produces an electromagnetic signal which strikes any object and the reflected signal is received by the radar antenna. Later the range and location of the objects is determined by using Doppler Effect. The detected parameters are sent to the number via SMS using SIM808 module.

Here this autonomous surveillance robot will first protect itself from being caught by the enemy side intrusion in such a way that it will pay the way for

further intrusion and detection. This protecting can be done in 2 ways which is making the rover invisible by stacking a series of lens in such a way that at a particular intersection point the object will be invisible. The other way is to use the principle of electronic flat panel which will cover the entire rover such that it will become invisible to the enemy side intrusion.

After spotting the intrusion this rover aims to defend that without any human intervention using any of the two feasible mechanisms.

## 2. Hardware and Workings

### RF Signal Detector

Rf detector is used to detect certain types of bombs, landmines. This comes under the spotting mechanism of bomb detection. Most of the bombs emit the RF signal which can be captured by the RF detector. It works by emitting a low power radio frequency signal and analyzing the reflected signal to detect the changes in the surrounding environment. Explosives and other dangerous materials can interfere with the radio frequency signal, causing a change in the reflected signal and altering security personal to potential threat.



Figure 1: RF Signal Generation and Detection

### Electronic Flat Panel

Electronic flat panel displays, such as LCD (liquid crystal display), OLED (organic light-emitting diode), and LED (light-emitting diode) displays, work on the principle of manipulating light to create images. It uses backlighting which is a light source, usually a set of white LEDs or a fluorescent lamp, is used to illuminate the display from behind. Light polarization which polarizes the light by passing through a polarizing filter. This filter allows only light waves oscillating in one direction to pass through. Liquid crystal layer that is in an LCD display, a layer of liquid crystals is sandwiched between two sheets of glass. These liquid crystals can be twisted to control the polarization of the light

passing through them. Control of liquid crystals: When an electric current is applied to the liquid crystals, they twist and change the polarization of the light passing through them. The amount of twist in the liquid crystals is controlled by applying a voltage to each pixel, which determines the brightness and color of that pixel. Color filters: A layer of color filters is placed over the liquid crystal layer to create the colors needed for the image. Each pixel has three sub-pixels, each with a different color filter (red, green, or blue). Display driver: A display driver chip controls the voltage applied to each pixel, based on the input image signal. Image formation: By controlling the voltage applied to each pixel, the display can create an image on the screen by allowing the right amount of light to pass through the liquid crystal layer and color filters.

In OLED and LED displays, the basic principles are similar, but the light-emitting materials are different. OLED displays use organic materials that emit light when an electric current is passed through them, while LED displays use tiny light-emitting diodes to create the image through transparency.

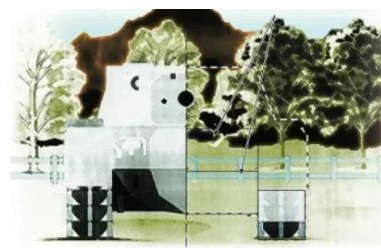


Figure 2: Working of Electronic Flat Panel

### Gas Spoofer

GPS spoofer involves three main steps: Signal generation: The GPS spoofer generates a fake GPS signal that is transmitted at the same frequency as the real GPS signal. This signal contains false location information, which is designed to deceive GPS receivers into thinking that the spoofer is the legitimate GPS signal.

Signal amplification: The GPS spoofer amplifies the fake GPS signal to make it stronger than the real GPS signal. This is necessary because GPS receivers typically use the strongest signal to determine the user's location.

Signal transmission: The GPS spoofer transmits the amplified fake GPS signal to the targeted GPS

receiver, which receives the signal and uses it to determine the user's location.

### 3. Proposed Methodology

The implementation of this work is to resolve the problem of replacing a human army with an autonomous robot which can be used in any terrains and can be operated in three modes and also comes with a night vision camera for continuous monitoring.

**Autonomous mode** - Obstacle detection by Ultrasonic sensor. **Remote control** - By Bluetooth module, **Voice Control**. This works on the mechanism of PSD (Protect, Spot, Defend) mechanism where Spot –Bomb detection using RF detection circuit within the range of 50 m. Detection of suspicious objects like drones in which a camera will be trained using ML classification in order to check whether an unknown object is suspicious. Mitsubishi camera which can detect a object at a distance of 100m will be trained.

**Protect** - 1. Protecting our bot without getting identified by the enemies by using camouflage Principle of hiding.

2. A typical adaptive camouflage system would likely include a network of flexible **electronic flat-panel** display units arrayed in the form of a blanket that would cover all observable surfaces of an object that one seeks to cloak.

**Defend** - Mechanism which will be able to defend the enemy's drone/missiles will be used and some of them includes:

#### GPS Spoofers

This device sends a new signal to the drone, replacing the communication with GPS satellites it uses for navigation. In this way, the drone is 'spoofed' into thinking it's somewhere else. By dynamically altering the GPS coordinates in real-time, the drone's position can be controlled by the spoofer.

#### High Power Microwave

High Power Microwave (HPM) devices generate an Electromagnetic Pulse (EMP) capable of disrupting electronic devices. The EMP interferes with radio links and disrupts or even destroys the electronic circuit in drones due to damaging voltage

and current it creates. It has an antenna to focus the EMP signal in certain direction in order to reduce the damage in unnecessary areas.

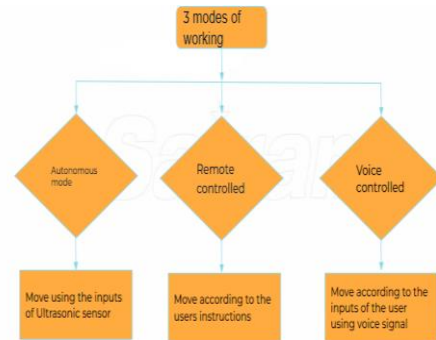


Figure 3: Flow Chart Rover Control

The figure 3 shows the flowchart of the various working modes of the rover which includes working on autonomous mode by getting the inputs from Ultrasonic sensor which will pave the way for further intrusion detection. The second shows about the remote-controlled mode which can be done through Bluetooth connection. The last mode of controlling is through voice controlled.

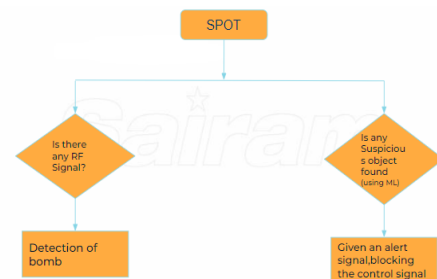


Figure 4: Flow Chart of Spotting

The figure 4 shows about the flowchart which represents the 2 ways of spotting mechanism. The first one represents the bomb detection using RF signal detection which will send an alert signal to the user at the end. The second mode of detection is through ML which gives an alert signal if there are any intrusions in the sky and gives a positive signal to the user if the object is not an airplane or a bird which will confirm the arrival of the intruding object and thus further actions can be made accordingly.



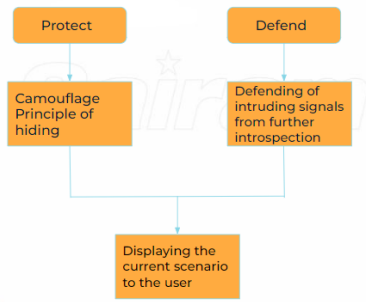


Figure 5: Flow Chart for protect and defend

The figure 5 shows about the flow chart for the protect and defend mechanism which uses adaptive camouflage principle for protecting the rover and defending of the intruding object without human intervention using various mechanisms like GPS Spoofers, High power microwave technology.

### 4. Results and Discussion

#### RF Detector

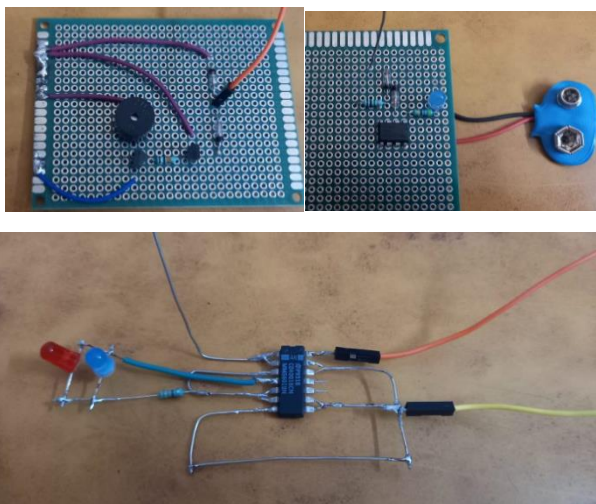


Figure 6: RF Detector Circuits

#### All Surface Rover



Figure 7: All Surface Rover

The figure 6 represents RF detector circuit which can be used to detect the bomb using the RF signal generated by them and the figure 7 represents the rover which will be able to move in all terrains without any intervention.

### 5. Future Scope

This autonomous robot can be made energy efficient by using the solar energy to work at day time and also to save them for further introspection seamlessly even at night time. The bomb detection mechanism can further be enhanced by removal of the bomb autonomously without human interference by placing the arms in the rover in such a way that it will find the coordinates of the bomb and also diffuse them on its own.

### 6. Conclusion

The results show a multipurpose surveillance robot that can be used in military applications for both spying and detecting landmines by operating in two modes which includes autonomous as well as in manual mode when instructed by the user. Also, the result aims to work in all cases and in all the conditions without being caught by the enemy side. This will also help in alerting using an alert system. Since this surveillance system acts well in all the possible scenarios it will solve almost all problems which will be faced in intrusion surveillance in the areas where human surveillance is not possible. Using all these principles this Rover will act as a one stop solution for all the security problems in the area where human surveillance is not possible.

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