ANDROID-BASED ROBOT FOR BOMB DISPOSAL AND MILITARY SPYING

Ms. Pranali Khemraj Hemane[1], Mr. Anand Bamne[2], Mr. Shubham Chauragade[3], Mr. Avdhesh Jaiswal[4], Dr. Shrikant V. Sonekar[5]
[1,2,5]J D College of Engineering & Management, Department of Computer Science and Engineering, Nagpur, India

Abstract: *In the contemporary landscape of security threats, particularly concerning explosives and the safety of military personnel, the development of an* ***Android-based robot*** *for bomb disposal and military surveillance is crucial. This innovative project aims to minimize human exposure to perilous tasks, thereby enhancing operational safety and efficiency. The robot is operated via a user-friendly Android application, allowing for remote control from a safe distance. It features a live camera feed, enabling operators to observe hazardous environments in real-time. With its articulated robotic arm, the robot can delicately manipulate and dispose of explosive devices. Its compact design facilitates navigation through confined spaces, making it suitable for both densely populated urban settings and isolated rural areas. A standout feature of this robot is its compatibility with robust 4G and emerging 5G networks, which ensures reliable communication even in remote locations. GPS tracking capabilities provide precise location data, while integrated motion sensors allow for stealthy movement in sensitive areas. Tailored to meet India's specific security needs, this cost-effective solution not only bolsters national defense but also prioritizes the safety of personnel. By merging existing mobile technology with advanced robotics, this project holds significant promise for transforming safety protocols and defense strategies in the future.*
Keyword: **Robotic arm, wireless camera, Sensor, Actuators, Detector, ESP32, Wi-Fi, MQTT**

1. Introduction

Our initiative focuses on enhancing global security and safeguarding military personnel by transforming how surveillance and bomb disposal operations are conducted. Central to this project is the development of an Android-based robot equipped with a robotic arm specifically engineered to tackle tasks in hazardous and hard-to-reach environments. By harnessing IoT sensors we facilitate real-time monitoring, allowing operators to view their surroundings from the robot's perspective, thus improving both precision and decision-making.We are implementing the MQTT protocol over standard Wi-Fi to ensure seamless connectivity, optimized for ESP32 microcontrollers. This configuration guarantees reliable communication with minimal latency, even in demanding conditions. The robotic system integrates servo motors and DC motors enabling precise control of both the arm's movements and the robot's navigation. This design allows the robot to traverse complex terrains while accurately manipulating objects. A significant challenge in bomb disposal is identifying whether an explosive device is concealed among various obstacles. To tackle this issue, we are incorporating advanced IoT technologies, including metal detectors, proximity sensors, and cameras to automate the detection and confirmation of explosive devices. The live video feed captured by the robotic arm provides operators with a comprehensive view, facilitating informed decisions while keeping personnel at a safe distance. Our aim is to create a smart, automated system that merges robotics, IoT, and advanced communication protocols for effective and safe bomb detection. This innovation not only protects military personnel but also illustrates how technology can bolster global security and enhance disaster response capabilities. By integrating robotics with IoT, we are paving the way for safer and more efficient solutions in high-risk scenarios.

2. Literature Review

1. A research studies published in IJCRT in 2022, titled *"Bomb Detecting And Defusing Robot"* by gokulanathan, prince , surya , roshan , sanjai. Research highlights that bomb detector just acts as a metal detector to detect any metal in the required areas. Since the bombs are made up of metals. Robot movements are controlled through Bluetooth communication using smart phone.
2. A research article published in IEEE in 2018, "Gesture controlled Bomb Diffusing Mobile Robot" by Dakshit, Jeevangi, Tamanneeta, Sailaja in that they have studied about gesture recognition is main base of the system . Hand gesture control system has been unfolding the entire humanity to quite a range of applications , such as human android interaction, automation and control.
3. Research published in International Conference on Robotics, Electrical and Signal Processing Techniques in 2021 by Anjir Ahmed Chowdhury Md. Akter Hamid Md. Nahian Al Subri Ivan in that they have implemented Bomb diffusing arm with dual live streaming and control by web server via internet.
4. The article published in BBC in 2016, Initially, the controls for these robots were complicated, requiring specific training; now games console controllers are being used to operate them. "The prerequisite, in such high-pressure environments, is to make the controls as intuitive and as simple as possible," says Professor Sethu Vijayakumar, director of the Edinburgh Centre of Robotics.

3. Problem Statement

Although Bomb disposal operations put lives at constant risk. Our project addresses this by creating a robot that helps bomb squads inspect and analyze suspicious objects remotely, reducing direct exposure to danger. Equipped with sensors and a live camera, the robot provides real-time data to guide decisions and plan safe disposal. It also records events for further analysis, ensuring safer and more informed operations in hazardous situations.

4. Methodology

4.1 Project Design and Hardware Assembly:

To start our project, we will design the hardware layout for our robot, incorporating essential components such as the robotic arm, mobile vehicle, metal detector, cutting tool, ESP32 microcontroller, and camera module.

After finalizing the design, we will assemble and integrate these components into a functional prototype. We'll ensure that all connections are secure and that communication interfaces operate smoothly, creating a cohesive system capable of effectively addressing the challenges of bomb disposal and surveillance.

4.2 Software Development:

To bring our robot to life, we will develop the firmware for the ESP32 microcontroller, enabling it to manage various subsystems, including the robotic arm, vehicle movement, metal sensor, and cutter deployment.

Next, we will implement communication protocols like Wi-Fi or Bluetooth to establish a reliable connection between the ESP32 and the Android app. This will ensure smooth interaction between the robot and its operator. Finally, we will create a user-friendly Android app that allows for remote control of the robot's arm, vehicle, and cutter. The app will also feature live camera feedback and bomb detection alerts, making it easy for users to monitor and control operations effectively.

4.3 Wireless Communication Setup:

Configure the ESP32 microcontroller and Android app to establish a wireless communication link.Ensure data transmission is secure and reliable.

Implement real-time data exchange between the ESP32 and the Android app, allowing for remote control and live feedback.

4.4. Robotic Arm Calibration and Testing:

Calibrate the robotic arm to ensure precise and controlled movement.
Conduct extensive testing to validate the functionality of the robotic arm, including its ability to pick up, manipulate, and safely handle objects resembling explosive devices.

4.5. Vehicle Mobility and Navigation Testing:

Test the mobility and navigation capabilities of the robotic vehicle, ensuring it can move in various terrains and environments.
Verify the vehicle's responsiveness to commands from the Android app.

4.6. Metal Detection and Hazard Identification:

Integrate and calibrate the metal sensor to detect metallic components accurately.
Perform tests to validate the metal sensor's ability to identify potential hazards, such as explosive devices.

4.7. Cutter Deployment and Safety Measures:

Test the mobility and navigation capabilities of the robotic vehicle, ensuring it can move in various terrains and environments.
Verify the vehicle's responsiveness to commands from the Android app.

4.8. Camera Feed Integration:

Configure the camera module to provide a live video feed.
Establish a connection between the camera module and the Android app, allowing operators to receive real-time visual feedback.

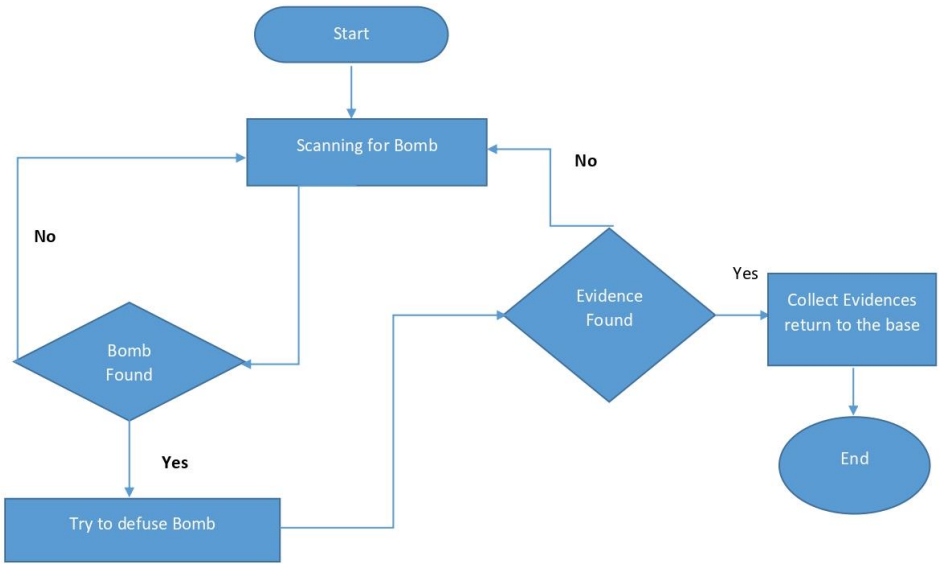
4.9. Field Testing and Evaluation

Conduct a series of controlled field tests and simulations to evaluate the robot's overall performance in bomb disposal scenarios.
Assess the effectiveness of remote control, metal detection, cutter deployment, and live feedback in realistic conditions.

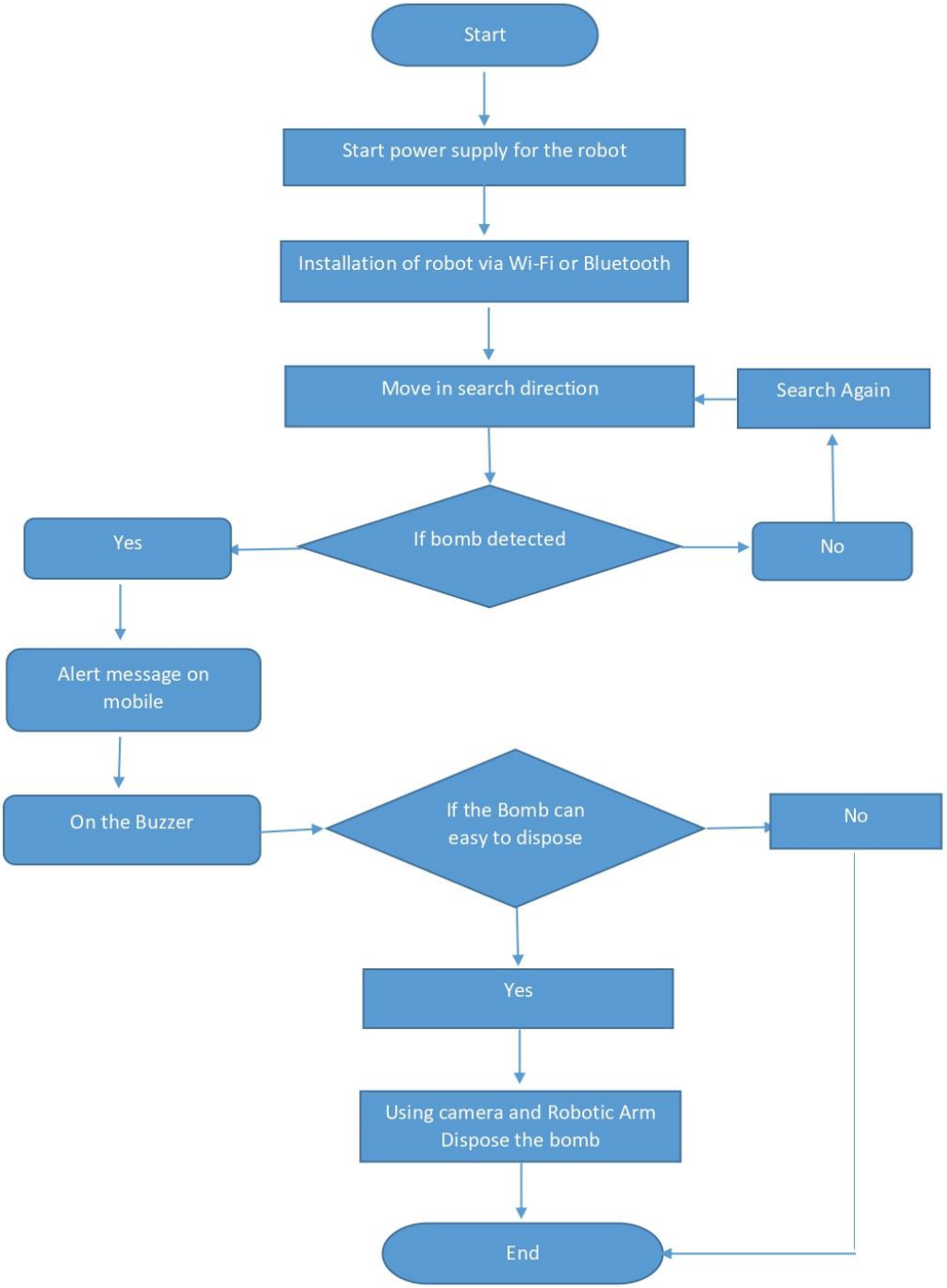
4.10. Data Collection and Analysis

Collect data from the field tests, including performance metrics, response times, and successful bomb disposal outcomes.
Analyze the collected data to assess the system's reliability, safety, and efficiency.

5. Flowchart:



5.1. ***Flowchart of Robotic Arm***


Start
Start power supply for the robot
Installation of robot via Wi-Fi or Bluetooth
Move in search direction
Search Again
If bomb detected
Yes
No
Alert message on mobile
On the Buzzer
If the Bomb can easy to dispose
No
Yes
Using camera and Robotic Arm Dispose the bomb
End

6. Benefits

Safety: Android-based robots can be used to safely inspect and disarm bombs, without putting human personnel at risk.

Precision: Android-based robots can be equipped with high-resolution cameras and sensors, allowing them to perform delicate tasks with precision.

Speed: Android-based robots can be programmed to move and operate quickly, allowing them to respond to bomb threats quickly and efficiently.

Flexibility: Android-based robots can be customized to meet the specific needs of different bomb disposal teams.

Cost-effectiveness: Android-based robots are relatively inexpensive to develop and maintain, making them a cost-effective solution for bomb disposal teams.

Reduced risk of human error: Android-based robots are less likely to make mistakes than human personnel, which can help to reduce the risk of accidents and injuries.

Increased situational awareness: Android-based robots can be equipped with a variety of sensors that can provide bomb disposal teams with a more complete picture of the situation, helping them to make better

7. Drawbacks

Limited Terrain Navigation
The robotic vehicle may face challenges navigating highly uneven or debris-filled terrains, which are common in bomb-threat scenarios. This could reduce its effectiveness in certain environments.

Sensor Limitations
Metal detectors and other sensors may produce false positives or fail to detect non-metallic explosive components, reducing reliability in complex scenarios.

Latency in Wireless Communication
Wireless communication (even with protocols like MQTT) might experience delays in areas with poor network connectivity, impacting real-time control and feedback.

Power Dependency
The robot's reliance on a battery-powered system could limit its operational time, requiring frequent recharges or battery swaps during extended missions.

Cutter Deployment Risks
Despite safety protocols, improper deployment of the cutter mechanism could inadvertently damage sensitive components of the bomb or trigger it in certain situations.

8. Conclusion

Our goal is to develop a useful equipment for engineers by using IOT wireless technology. Creating an efficient robotic system and accessing visual feed remotely, each associated with a corresponding lab test, is the aim of this project. system offers a practical solution for designing simple robots that assist in military applications. The robot is remotely controlled from a central control room, allowing for manual operation. Initially, the DC motor rotations are tested using simulations, and once validated, the hardware setup for the robot is constructed. A buzzer is triggered whenever the robot detects metal, prompting further investigation. A wireless camera mounted on the robot provides live visuals, enabling the operator to confirm whether the detected object poses a threat. If it is identified as hazardous, the robotic arm can be manually operated to safely disarm the bomb. This design has the potential to significantly reduce risks for bomb disposal squads in military and police operations.

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