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Design & Fabrication of Multipurpose RTA Robot

Mr. A. R. Devshette[1], Mr. Atharva.B.Shinde[2], Mr. Hrishikesh Jade[3],Mr. Omkar Kharode[4], Mr. Sahil.N.Kazi[5]

Professor, Department of Mechanical Engg, JSPM's Rajarshi Shahu College of Engineering, Tathawade, Pune[1]

Undergraduate Scholar, Department of Mechanical Engg, JSPM's Rajarshi Shahu College of Engineering Tathawade, Pune[2-5]

Abstract: The detection and disposal of explosive devices in military operations are of utmost importance to ensure the safety of personnel and equipment. This research paper presents a comprehensive study on the design, development, and application of a wireless military bomb disposal robot. The proposed robot integrates wireless communication capabilities, robust mobility, and specialized tools to enhance bomb disposal operations in military settings.

The paper discusses the design considerations, functionality, and performance evaluation of the robot, focusing on its effectiveness in mitigating risks and improving operational efficiency. The robot is controlled by a bomb technician through a dedicated application on the controlling site. User inputs are transmitted wirelessly over ZigBee to the receiver, where they are received, identified, and relayed to the appropriate robot module for action.

The robot comprises a sturdy base, a versatile robotic arm, and an integrated wireless camera. The robotic arm utilizes DC motors for precise control of the elbow and gripper movements. By deploying the robot in bomb disposal operations, the lives of bomb experts and commandos are safeguarded, ensuring the safety of both military personnel and civilians.

Keywords: bomb disposal robot, wireless communication, military operations, risk mitigation, operational efficiency, robot design, performance evaluation.

I.INTRODUCTION

For many years, humans have been the core motivation for the development of the robot system. It surely had many challenges and limitations with the robotic research that had taken place thus far. Many efforts have been taken for the development of robots to be used as a replacement for humans to do tasks that are a bit critical and risky to human life who have been constantly exposedto methods like bomb disposing, machine cuttings, etc. We aim to develop a versatile robot capable of performing bomb diffusion and disposal tasks. The robot will be remotely operated by a skilled bomb disposal expert, ensuring safe control from a distance. Its robotic arm will effectively handle the bomb, carefully relocating it to a secure location outside the danger zone, away from any populated areas. The robot is controlled by the control module wirelessly and is used for cutting the wires in the bomb and 3 DC motors 10 rpm video feedback is viewed live using a wireless camera that supports night vision as well and the bomb can be diffused as well as get disposed. In case of any misshapen only the robot gets damaged and human life can be saved using this robot and the technology is safe and can be well implemented.

The main objective of the control module is to control the robot wirelessly. The control module consists of a 7-inch LCD display which is used to view the video captured from the wireless camera. The bomb disposal controller would be used to control the robot up to a range of 100 meters for disposing and defusing the bomb. The control module also consists of the board which houses the Switches and joystick-based controller to control the robot wirelessly, which is done by interfacing these switches to the ATMEGA8 IC. The control module consists of a transmitter which is used to transmit the input function to the receiver which is placed in the robot.

The transmitter consists of an ATMEGA328 microcontroller which is programmed and when the inputs are received via the corresponding pins from the ATMEGA8 IC are givento the transmitter which transmits the input to the receiver and the robot is said to function accordingly.

II.PROBLEM STATEMENT

The problem we are addressing is the inefficient management of time in the workplace, resulting in decreased productivity and missed deadlines. This issue affects both individual employees and the overall performance of the

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organization. Current practices and tools are insufficient in helping employees effectively allocate their time and prioritize tasks. As a result, we need a solution that streamlines time management processes, improves productivity, and ensures timely completion of tasks.

III. OBJECTIVE

To increase the efficiency and safety of bomb disposal operations in military settings, it is urgentlynecessary to introduce a wireless military bomb disposal robot. Develop a wireless bomb disposal robot to enhance human safety by reducing the risk of injury or loss of life for bomb disposal experts. The integration of wireless communication and camera interfacing will provide enhanced situational awareness, allowing operators to make informed decisions during the disposal process and minimize unintended consequences. Remote operation capabilities will enable operators to maintain a safe distance while effectively controlling the robot in hazardous or inaccessible locations. The robot's specialized tools, sensors, and mobility will improve efficiency, enabling quicker identification, handling, and disposal of explosive devices. Additionally, designing the robot with all-terrain capabilities will ensure adaptability to diverse military environments.

IV. EXPERIMENTAL WORK & PROCESS

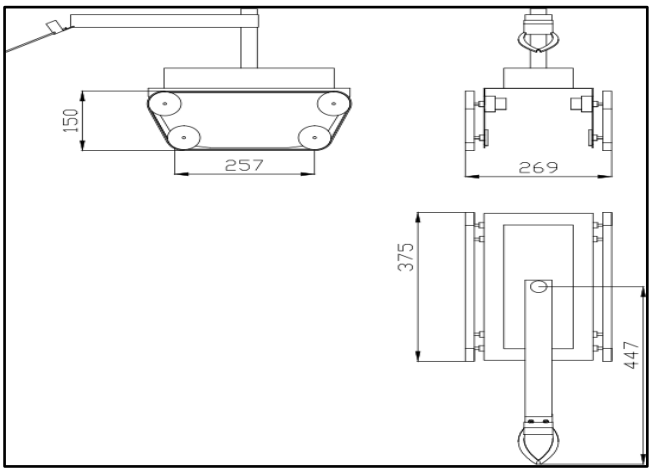
The experimental work for the design and manufacturing of the Multipurpose RTA Robot involved several steps and processes. The following section provides an overview of the experimental work conducted.

A. Materials Selection:

Material selection for a RTA robot involves considering lightweight yet strong options such as aluminum alloys, carbon fiber composites, and high-strength plastics for the chassis and structure. For protective armor, impact-resistant materials like Kevlar, steel plates, or blast-resistant composites are important. Good electrical conductivity and insulation properties are required for electronics, with materials like copper or aluminum conductors and heat-resistant plastics. Sensor housings and camera enclosures can utilize polycarbonate or high-impact acrylic. Manipulator arms may benefit from titanium alloys or high-strength steels. The choice of materials for wheels or tracks depends on terrain, with rubber or composite materials suitable for urban environments, and reinforced rubber or metal alloys for rugged terrains.

B. CAD Drawing:

A detailed CAD (Computer-Aided Design) drawing was created to visualize the RTA Robot design and its components. The CAD drawing served as a blueprint for the construction process, providing precise measurements and dimensions for each part.



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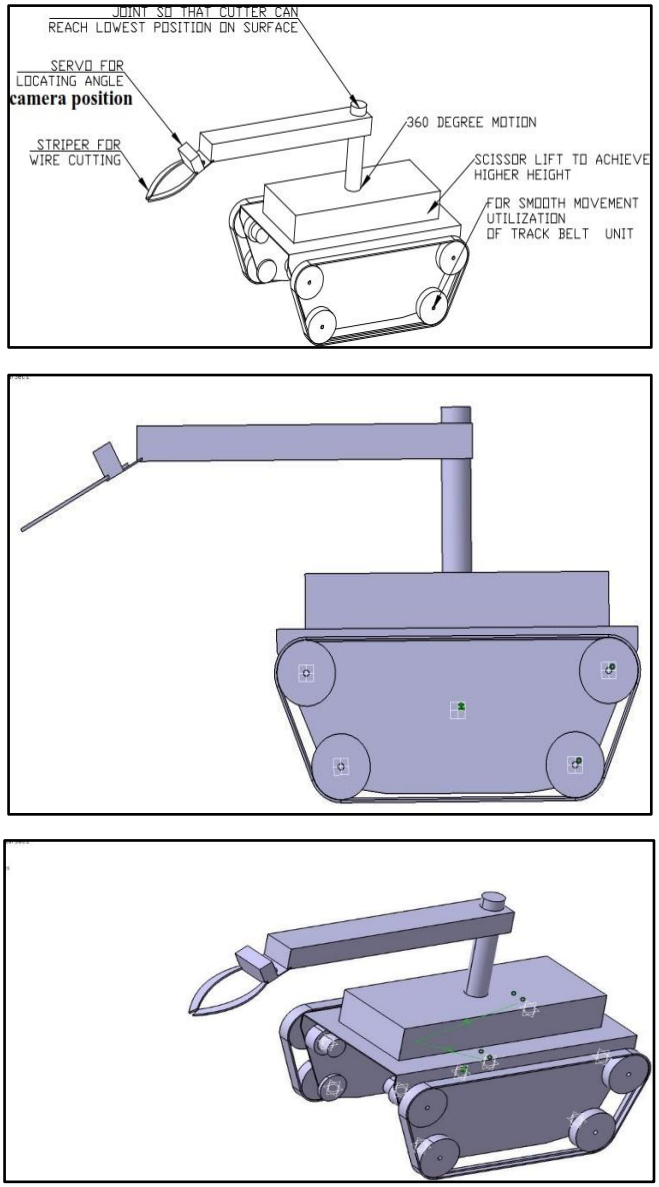

Drafting

C. Cutting, Welding, and Drilling:

The MS sheet metal was cut and shaped according to the CAD drawing specifications. Various cutting tools and equipment were employed to achieve the desired shapes and sizes. Welding techniques were utilized to join the different parts of the frame securely. Additionally, drilling was performed to create holes for attaching components and assembling the RTA Robot.

D. Finishing and Polishing:

After the assembly was complete, the RTA Robot underwent finishing and polishing processes to enhance its appearance and smooth out any rough edges. Finishing techniques, such as sanding and painting, were employed to provide a clean and professional look to the RTA Robot. Spray paint was used to add a protective layer and improve its aesthetic appeal.

E. Integration of Components:

The Geared 5v DC motors, Arduino UNO, Bluetooth model, Wire stripper, Tires/wheels, L298N motor driver were integrated into the RTA Robot as per the design specifications. Wiring connections were made to ensure proper functioning and control of the RTA Robot.

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F. Testing and Evaluation:

Once the construction and integration of components were completed, the RTA Robot underwent comprehensive testing and evaluation. The functionality of the hardware parts was verified to ensure proper operation. The RTA Robot was tested for its payload capacity, maneuverability, obstacle detection, and overall performance.

Throughout the experimental work, meticulous attention was given to safety measures and quality control. Protocols were followed to ensure the proper functioning and reliability of the RTA Robot. Any necessary adjustments or modifications were made to address any issues identified during the testing phase.

The experimental work undertaken in the design and manufacturing of the RTA Robot involved cutting, welding, drilling, finishing, and polishing processes. These steps, along with the integration of the chosen materials and components, resulted in developing a functional RTA prototype ready for further refinement and optimization.

V. RESULTS AND DISCUSSION

The Multipurpose All Terrain Army Robot has demonstrated several positive outcomes and achieved significant results in its applications. The robot's intuitive user interface, advanced feedback of sensor and enriched visual awareness contribute to improved performance and effectiveness in explosive ordnance disposal missions. Its onboard manipulator arm with a dexterous gripper enablesthe removal of detonators and provides an enlarged workspace for delicate tasks. Furthermore, the robot's flexible and modular design, utilizing commercial off-the-shelf components, ensures ease of maintenance and repairs.

Through its use in explosive ordnance disposal, the robot has proven to be a reliable and capable platform. It reduces the risk to human operators by allowing them to maintain a safe distance from potentially dangerous situations. The robot's ability to traverse a variety of terrains and handle explosives contributes to enhanced safety, efficiency, and effectiveness in bomb disposal operations.The intuitive operation and simplified maintenance of the robot make it a practical and accessible tool for both military and law enforcement agencies.

Drawing upon the analysis we made, the Multipurpose All Terrain Army Robot offers substantial advantages over traditional methods of explosive ordnance disposal. Its ability to perform tasks previously only possible by human workers wearing blast suits significantly reduces the risk to human life. The robot's features, including intuitive controls, enhanced sensor feedback, and an enlarged workspace, contribute to improved performance and efficiency. Its flexible and modular design, along with the usefulness of commercial off-the-shelf components, makes it a cost-effective and easily maintainable solution.

VI. FUTURE SCOPE

The future scope of the Multipurpose All Terrain Army Robot is promising with advancements in autonomous navigation, manipulation capabilities, AI integration, and sensor technologies. Further improvements may include a step climbing mechanism, wireless video transmission, enhanced vision sensing, removable or multi-gripper robotic arms, AI decision-making, and night vision capabilities. Ongoing research aims to reduce size, weight, and cost while enhancing reliability. These developments will make the robot an indispensable tool for explosive ordnance disposal missions, offering improved mobility, situational awareness, versatility, and adaptability in diverse environments.

Additionally, the integration of artificial intelligence will enable the robot to make intelligent decisions on its own, improving its autonomy and decision-making speed. Night vision capabilities can be added to enhance visibility in low-light or dark environments, expanding the robot's operational capabilities.

Ongoing research and development efforts will continue to focus on reducing the size, weight, and cost of the robot while enhancing its reliability and performance. These advancements will make the Multipurpose All Terrain Army Robot an invaluable asset in explosive ordnance disposal missions, providing enhanced mobility, adaptability, and efficiency in diverse and challenging environments. The future holds immense potential for the continued evolution and application of this remarkable robot, revolutionizing the field of bomb disposal and contributing to improved safety and operational success.

VII. CONCLUSION

Drawing upon the analysis we made, the Multipurpose All Terrain Army Robot offers substantial advantages over traditional methods of explosive ordnance disposal. Its ability to perform tasks previously only possible by human workers wearing blast suits significantly reduces the risk to human life. The robot's features, including intuitive controls, enhanced sensor feedback, and an enlarged workspace,contribute to improved performance and efficiency. Its flexible and modular

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design, along with the usefulness of commercial off-the-shelf components, makes it a cost-effective and easily maintainable solution.

The RTA Robot has been designed in order to meet the needs of the bomb disposal squad, the military, and the police and also for the Personnel who handle radioactive materials. It application is countless and would be used in different environmental situations and scenarios. For instance, at one place it would be used by the bomb disposal squad, while at another instance it would be used for handling mines. While another application is to provide up to date information in a situation of the hostage.

Drawing upon the analysis we made, it is evident that the Multipurpose All Terrain Army Robot offers substantial advantages over traditional methods of explosive ordnance disposal. By performing tasks that were previously limited to human workers wearing blast suits, the robot significantly reduces the risk to human life. Its advanced features, including intuitive controls, enhanced sensor feedback, and an enlarged workspace, contribute to improved performance and efficiency in bomb disposal operations. Additionally, the robot's flexible and modular design, coupled with the commercial off-the-shelf components, ensures cost-effectiveness and easy maintenance. Its versatility allows it to meet the needs of bomb disposal squads, military personnel, police forces, and those handling radioactive materials. With its countless applications in different environmental situations and scenarios, such as mine clearance and providing up-to-date information in hostage situations, the Multipurpose All Terrain Army Robot proves to be an invaluable asset.

REFERENCES

1. “Design and Implementation of Bomb Diffusion Sing Surveillance Robot using RFTechnology " Reddy Pannala, DR. R.V. Krishnaiah, International Journal of VLSI system Design and communication system 2013.
2. “Hand Gesture Recognition Bomb Diffusing Surveillance Robot”, Sagar Randive, Neha Lokhande, Apoorva Kamat, Shubhrojit Chakraborty, Vishal Pande, National Conference On Emerging Trends in Engineering & Technology 2012.
3. “A Multipurpose Robot for Military Tribute to Defense Ministry”, V. Prasanna, Balaji & H. Goutham, International Journal on Theoretical And Applied Research in Mechanical Engineering (IJTARME), 2013
4. Bomb Detection and diffusion in Planes by Application of Robotics”, Prashant Limje, Shailesh Khekale, Special Issue for National Conference on Recent Advances in Technology And Management for Integrated Growth, 2013.
5. PIC Microcontroller and Embedded Systems: Using Assembly and C for PIC16 by Muhammad Mazedi.
6. Serial Camera Module Programming Instructions and Tutorial by future electronics.
7. GSM-based versatile robotic vehicle using Pic microcontroller, Abhishek Sharma
8. Davor Antonic, Zeljko Ban, and Mario Zagar. Demini ng robots - requirements and constraints. Automatika, 42(3-4), 2001.
9. J.D. Nicoud and M.K. Habib. The pemex-b autonomous demining robot: perception and navigation strategies. In Proceedings of intelligent robots and systems, pages 4 19-424, Pittsburgh, PA, 1995.
10. Y. Baudoin and E. Colon. Humanitarian demining a nd robots. In lEE E International Conference on Con trol Applications, pages 433-435, Trieste, Italy, Septe mber 1998.
11. H. Cruz, J. Lisboa, P. Santana, R. Maltez, J. Barata, a nd L. Flores. Two sustainableand compliant robots for humanitarian demining. 2005.