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ABSTRACT

One of the most important components of hostage rescue efforts is an agreement on hostage release. Mistakes by officers in taking action during the negotiation process can endanger the safety of personnel and officers as well as victims being held hostage. Lack of communication often leads to dangerous conflicts that can hinder hostage taking. To overcome this problem, we designed a special negotiation robot that is armed to ensure the safety and security of officers in carrying out their duties, both in war situations and hostage release operations. By having a weapon, officers responsible for the safety of victims can carry out their duties without compromising their personal safety. These military robots enable negotiation and monitoring without threatening lives, providing a more efficient and safer approach. Additionally, the robot's ability to operate autonomously with the help of artificial intelligence allows for quicker assessment of the situation and more appropriate responses, thereby increasing the chances of success of a rescue mission without increasing risks for the humans involved. The robot is also equipped with advanced sensors and machine learning algorithms that can detect changes in a hostage taker's behavior and body language, providing valuable information to the negotiation team to devise more effective strategies. Thus, the implementation of this technology not only increases the security and efficiency of military operations, but also paves the way for further innovation in the use of robotics and Artificial Intelligence in various aspects of defense and security.

Keywords: FPV camera; GPS; LIDAR sensor; ultrasonic; infrared

1. INTRODUCTION

Rapid advances in science and technology, especially in the fields of electronics and robotics, have great potential to simplify and make human life easier [1]. Robotic automation, which acts as a substitute for humans in a variety of tasks, offers many benefits, one of which is the ability to operate in environments that are dangerous or pose a high risk to humans. The military sector is an example of a defense system that faces various challenges in carrying out its duties, especially in reconnaissance missions which often cause casualties, thus encouraging the need for innovative technological solutions [2].

As robotics technology evolves, it contributes to improving the quality of human life. Robots have become irreplaceable tools in the contemporary world due to their flexibility in performing tasks and functions that assist human endeavors, thereby simplifying human activities [3]. A robot, defined as a mechanical device capable of performing physical tasks, operates either under human supervision and control or through predetermined programs, often driven by artificial intelligence [4]. Artificial Intelligence (AI), a branch of science, provides intelligence to machines, especially in the field of computer programming [5], [6].

There are three keywords reprogrammable, multipurpose, and the ability to move materials, parts, and tools that indicate the defining characteristics of a robot [7]. In the military and disaster management context, efforts to reduce the number of human casualties in various military operations

inspire many ideas and innovations. The use of robots in industrial and household settings is usually driven by aspirations to replace human workers in appropriate and demanding tasks.

Mobile robots represent the most commonly used type, meeting needs in both households and industry [8]. To fulfill the specified tasks, mobile robots must have the capability for automatic movement to complement human performance [9]. Terrorist acts, driven not only by financial motives but also rooted in political-ideological resistance, demand careful handling [10]. Ensuring the safety and security of personnel is a critical consideration in a variety of operations, whether in combat situations against adversaries or during hostage rescue missions [11]. Using a variety of methods in hostage rescue is important to ensure the best possible agreement between the enemy and the authorities responsible for the hostage's safety [12]. Negotiations are a key aspect in hostage rescue missions, and mistakes in the negotiation process can pose a threat to the safety of both rescuers and personnel involved, as well as ensuring the safety of the hostages being held [13].

The research objectives of the Smart Army Robot design based on Artificial Intelligence (AI) as a monitoring and negotiation medium include developing robots that can autonomously carry out monitoring in high-risk areas, collect real-time data regarding the situation in the field, and create an AI system for negotiations with interested parties. hostile. This research aims to reduce risks for military personnel by replacing human presence in hazardous areas, providing accurate data to support decision making, and advancing AI and robotics technologies in military contexts. Additionally, this research examines the integration of robotic technology with existing military systems, examines the ethical and legal implications of its use, and develops guidelines and regulations that comply with international law and human rights principles. It is hoped that this research can improve the security and effectiveness of military operations through sophisticated and responsible technological innovation.

2. METHOD

Methods for Designing Smart Army Robots as Monitoring and Negotiation Tools Based on Artificial Intelligence utilize data from Arduino, FPV (First Person View) cameras, GPS, and robot sensors, which involves the integration of various technological components to build a system that can monitor and interact with its environment effectively Intelligent [14]. The Arduino acts as a control center that coordinates input from FPV cameras that provide real-time video for visual monitoring, GPS modules that provide accurate location data for navigation and tracking, and various sensors that collect environmental information such as distance and presence of objects. Data from all these components is processed by AI algorithms that can carry out situational analysis and decision-making for negotiations with opposing parties, making this robot an effective and responsive tool in military operations [15].

Research flow diagram

In the flow diagram in Figure 1, the design process begins with the data collection stage where all relevant information and data are collected, followed by the data analysis stage to interpret and understand the data that has been collected.

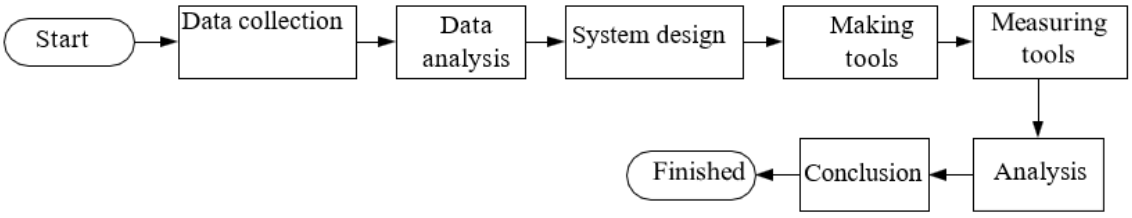

Figure 1. Research flow diagram.

Next, the system planning stage is carried out to design the system that will be created based on the results of data analysis. After that, the tool creation stage is carried out to realize the system design into concrete physical or software form. The tools that have been created are then tested in the tool testing stage to ensure the functionality and reliability of the system that has been designed. The results of this testing are further analyzed in the analysis stage, which is then used to draw up conclusions that summarize the findings and results of the entire design process.

Finally, the entire process is considered complete once the conclusion stage is completed, marking the end of the design cycle.

Figure 2 illustrates that this robot has a sturdy design and is equipped with various important technological components to carry out monitoring and negotiation functions. On the top of the vehicle, there is a camera that functions for real-time visual monitoring, allowing direct supervision by the operator or command center. Additional sensors installed around the vehicle help detect objects, measure distance, and avoid obstacles, increasing operational safety. The integrated GPS module provides accurate location data for precise navigation and vehicle position tracking during operation. The large wheels and strong suspension system are designed to handle various types of terrain, providing good traction and ensuring the vehicle remains stable on uneven surfaces. The front of the vehicle is equipped with a grille and lights, which may also contain secondary sensors or cameras to expand monitoring capabilities. The electronics compartment in the vehicle houses various important components such as Arduino as a control center, battery, and communication module that maintains connectivity with the command center. Top-mounted communications antennas allow the vehicle to communicate over long distances, ensuring efficient coordination during military operations. This vehicle also has the potential to be equipped with small arms or other additional tools integrated with AI systems to increase tactical operational capabilities on the battlefield.

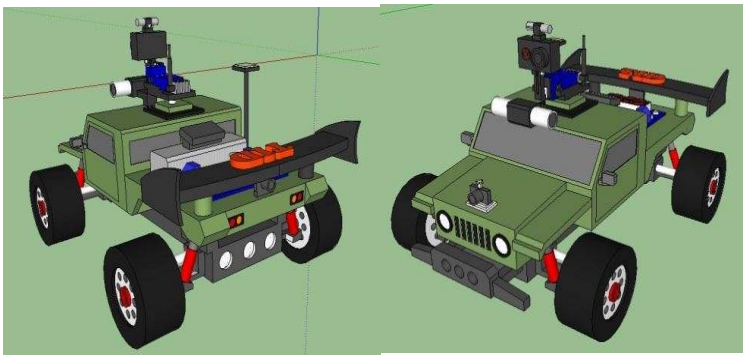

Figure 2. Overall design of the tool [15].

a) FPV camera.
An FPV camera is installed on the robot to provide real-time video of the surrounding environment. These cameras send a live feed to the command center or operator, enabling visual monitoring of the situation.

b) GPS (global positioning system)
A GPS module is installed on the robot to provide accurate location information. This GPS data is used to navigate the robot in the operating field and to track the robot's position in real time, both by the command center and by the robot's internal navigation algorithm.

c) Robot Sensors.
Various sensors (such as ultrasonic, infrared, or LIDAR sensors) are installed on the robot to detect surrounding objects, measure distance, and avoid obstacles. These sensors help the robot to move autonomously and avoid danger.

d) AI algorithms for data processing and negotiations.
Data from the FPV camera, GPS, and robot sensors are collected and analyzed by AI algorithms integrated into the robot system. AI uses image processing to analyze video from FPV cameras, determine position and movement based on GPS data, and interpret sensor data to identify obstacles or threats. Additionally, advanced AI algorithms enable robots to conduct negotiations through natural language processing, enabling effective communication with adversaries or allies in the field.

e) Communication and decision making.
The robot is equipped with a communication module that allows real-time data exchange with the command center. Data obtained from sensors and cameras is sent to the command center for further analysis, while strategic decisions generated by AI can be implemented directly by robots in the field.

3. RESULTS AND DISCUSSION

The results and discussion of this robotic vehicle show that by integrating real-time data from various components such as FPV cameras, ultrasonic, infrared, and lidar sensors, as well as a GPS module processed by an AI system, this vehicle is capable of monitoring the situation with live video sent. To the command center. GPS data enables precise navigation so that vehicles can move accurately and efficiently in the field of operation. These sensors detect objects and obstacles, providing critical information that is processed by AI to avoid danger and ensure safe travel. In addition, the AI system also enables the vehicle to conduct effective negotiations with counterparties using natural language processing, responding to changing situations quickly and precisely. Thus, these robotic vehicles provide fast and accurate responses to various operational conditions, increasing efficiency and safety in military operations.

How the tool works.

a) Activation and control: The robot is activated using a LiPo battery. Control is carried out via remote control and a GSM module that allows communication via SMS and telephone calls.
b) Monitoring and navigation: FPV cameras provide real-time video for visual monitoring by operators. The GPS module provides accurate location information for navigation and robot position tracking.
c) Obstacle detection and avoidance: Various sensors (ultrasonic, infrared, LIDAR) detect objects around the robot and measure the distance to avoid obstacles.
d) Data processing and negotiations: Data from cameras, GPS, and sensors are processed by artificial intelligence (AI) algorithms that analyze the situation and make decisions. Robots can conduct negotiations through natural language processing, enabling effective communication with opponents or allies.
e) Real-time Communication: Data is sent in real-time to the command center for further analysis, while AI implements strategic decisions in the field.

Block diagrams.

The block diagram for the smart army robot design involves various components as input, process, and output. Input comes from the FPV Camera which captures real-time images and video, the remote control which is used by the operator to control the robot remotely, and the video sender which sends video signals to the receiving device. The process is carried out by Arduino, which acts as the robot's brain by receiving and processing data from the remote control and other sensors, as well as a GSM module that allows long-distance communication via cellular networks. The output is produced by Servo 1 and Servo 2 which move certain parts of the robot, such as the camera or robot arm, as well as speakers which are used for audio output such as voice alerts or communication with humans. Figure 3 this process flow ensures that the robot can operate effectively as an AI-based monitoring and negotiation tool, be controlled remotely, and respond according to conditions in the field.

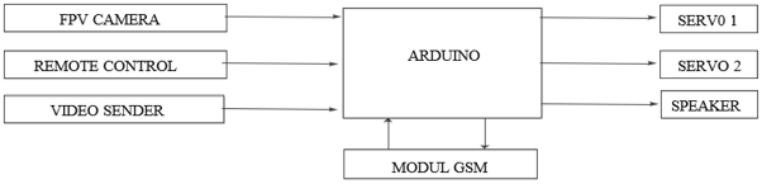

Figure 3. Block diagram [15]

It can be seen that the Arduino Uno functions as a data processing center. Input from the FPV camera, remote control, and video sender is processed by the Arduino Uno, which then produces an output signal that drives servo 1 and servo 2 to control camera movement, and uses the speaker as an audio output medium. Additionally, a GSM module is integrated to send information to users via calls and SMS.

System working principle

In general, the system starts operating after being activated by a 12.4 volt, 2200 mAh LiPo battery. This system processes commands based on instructions received from the remote control, GSM module, FPV camera, GPS, and video transmitter. The GSM module functions as a robot

communication medium, sending information via SMS and telephone calls. Once activated, the robot is controlled using a remote control, and the camera is used as an input device to monitor the environment around the robot. Upon reaching its goal, a negotiation procedure can be initiated through communication between the user and the counterparty, facilitated by input devices such as microphones and output devices such as speakers, which are routed through telephone calls. GPS will provide location coordinates which will be sent via SMS.

Research result.

The result of this research is the creation of a smart army robot based on artificial intelligence (AI) which is capable of monitoring and negotiating in high-risk areas autonomously and in real-time. This robot is equipped with an FPV camera, remote control, and video sender for capturing and transmitting visual data, and uses an Arduino and GSM module for data processing and remote communication. The output of this robot involves the use of servos to move robot parts and speakers for audio communication. Thus, these robots can replace human presence in dangerous areas, collect accurate data to support military decision-making and conduct negotiations with hostile parties, all within a framework that complies with international law and human rights principles.

Analysis results.

Analysis of the research results shows that this AI-based Smart Army Robot significantly increases security and efficiency in military operations in high-risk areas. With real-time monitoring capabilities provided by the FPV Camera and video sender, as well as remote control via remote control and GSM module, this robot allows for more accurate and responsive data collection. Data processing by the Arduino ensures that commands are executed with precision via the servo and speaker, enabling dynamic interaction with the surrounding environment. The use of AI technology in negotiations also offers the potential to de-escalate conflict in a safer and more controlled manner. However, the implementation of these robots must consider ethical and legal aspects, ensuring that their use complies with human rights principles and international regulations. Overall, these innovations contribute to the advancement of modern military strategy, leveraging advanced technologies to achieve better and safer outcomes.

1. CONCLUSION

After testing the system, conclusions can be drawn. The use of cameras facilitates a better understanding of objects both in front and behind the robot, thereby increasing user caution when controlling the robot. The development of an AI-based Robotic Technology System in the military sector for monitoring negotiations will simplify the negotiation process for hostage release, thereby reducing the risk of loss of life..

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