Design of Tactical Multipurpose All–Terrain Mobile Robot

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Abstracts: Robotic systems that can assist soldiers in dangerous operations are essential technologies that improve safety and efficiency. This paper presents the development of mobile robots that can assist soldiers with target acquisition and surveillance on the battlefield. We have built a prototype that incorporates a firearm system that can perform shooting tasks. Our aim is to design and develop mobile robots that can cope with challenging scenarios such as terrorist attacks and rescue missions. Our robots can transmit photographic images or live streaming via a spy camera, and based on the visual information, soldiers can fire at their target with a gun mounted on the robot. We discussed the key technologies needed to design and manufacture such combat robots. Existing high-specification combat robots are expensive and inaccessible to students and researchers interested in the field. This paper reveals the technologies to develop a low-cost combat robot. This system can be used for real-time applications at an affordable price by using more advanced technology to improve its accuracy.

Keywords: Mobile Robot (MR), Surveillance, Firearm System, Battlefield, Camera, Telemetry.

1. INTRODUCTION

The use of robots in military operations has increased in recent years, as they can offer several advantages over human soldiers, such as improved performance, reduced risk of casualties, and lower costs [1]. However, most existing military robots are designed for specific tasks, such as bomb disposal, reconnaissance, or surveillance, and often require human supervision or intervention. In addition, many of today's military robots are expensive and complex, making them inaccessible to students or researchers wishing to explore the field of combat robotics [2,3]. In this paper, we present the development of a low-cost mobile robot prototype that can assist soldiers with target acquisition and surveillance on the battlefield. Our robot can perform shooting tasks using a firearm system mounted on its chassis. Our aim is to design and develop a mobile robot that can cope with challenging scenarios, such as terrorist attacks and rescue missions, where human intervention may be difficult or dangerous. Our robot can transmit photographic images or live streaming via a spy camera, and based on the visual information, soldiers can fire at their target with a gun attached to the robot. We discuss the key technologies required to design and build such a combat robot, including hardware components, simulation, communication protocols, and control equations. We also demonstrate the performance of our prototype in various experiments and simulations. The main contribution of this paper is as follows

- To demonstrate the technologies for developing a low-cost combat robot that can be used for real-time applications at an affordable price, using more advanced technology to improve its accuracy.
- Our work can inspire students and researchers interested in the field and provide a platform for them to test and improve their ideas.
- Our work can contribute to the advancement of military robotics and improve the safety and effectiveness of soldiers on the battlefield.

The rest of this paper is organised as follows: Section 2 reviews the related work on combat robots; Section 3 describes the proposed work; Section 4 shows the architecture design of the work; Section 5 contains a flow chart section; Section 6 is a detail of the components used in the prototyping; Section7; says about the wireless surveillance system; Section 8 describe the equation of mobile robot and Section 9 describe the equation of firearm for the MATLAB simulation; Section 10 structure design of the prototype robot in 2D and 3; Section 11 result and discussion on the project with simulation, data graph and prototype view of the robot; Section 12 conclusion, limitations and future work.

2. RELATED WORK

The development of mobile robots that can help soldiers detect and monitor targets on the battlefield is an active area of research. The US Army's Artificial Intelligence Task Force (AITF) is working with Carnegie Mellon University's National Robotics Engineering Centre (CMU NREC) on a project called Aided Threat Recognition from Mobile Cooperative and Autonomous Sensors (ATR-MCAS). ATR-MCAS is an AI-enabled system of networked, state-of-the-art air and ground vehicles using sensors and edge computing. The vehicles carry sensors that enable them to navigate within areas of interest to identify, classify, and geo-locate entities, obstacles and potential threats reducing the cognitive load on soldiers. The system is also capable of aggregating and distributing the targeting data, which can then be used to make recommendations and predictions based on the combined threat picture provided [4]. In addition to target detection and surveillance, mobile robots are also being developed for other military applications, such as transporting wounded troops and neutralizing explosives. These robots are equipped with advanced sensors, cameras and artificial intelligence to perform their tasks autonomously or with minimal human supervision [5,6]. Mobile robots are playing an increasingly important role in military operations, from patrolling to dealing with potential explosives. "Equipped with appropriate sensors and cameras for different missions, mobile robots are remotely controlled for reconnaissance patrols and relay video images back to an operator. "The robots can neutralize suspicious objects that could explode. The platform has a robotic arm to pick up explosives or suspected hazards in military or civilian environments", "The mobile robotic platform is mounted on a rectangular box with electronic equipment. The platform moves on wheels or tracks, or both, and is usually battery powered. Communications equipment and sensors can detect images, sounds, gases and other hazards. The communications systems read the sensors and relay the information to the operator. According to Goldenberg, the US military has recently begun equipping mobile robotic platforms to carry small and medium-sized firearms [7]. Robotics can help meet the challenges posed by the specter of urban terrorism. "Rather than having humans approach dangers such as unattended objects or car bombs, robots are used. If an operator concludes that a dangerous object could explode, the robot could neutralize the object by firing to detonate it". "Mobile robots detect and detonate underground mines or improvised explosive devices. The same mobile robotic systems are used to neutralize or detonate abandoned ordnance and mines after conflicts have ended [7,8].

3. PROJECT WORK

Our project is an unmanned all-terrain defense vehicle based on wireless technology. A microcontroller-based multi-purpose defense robot can shoot the incoming enemy by sensing through a PIR sensor or manual operation [9]. This robot has two modes of operation, manual and automatic. In the manual mode, the robot will work on the input given by the operator or through a transmitter system device with the help of the transmitter and receiver; according to that, the gun should automatically point in that direction and should wait for the shoot command from the operator. In automatic mode, the robot will use a camera to detect the unwanted entry of a target and will shoot the target with human permission or input. Functions such as wireless surveillance systems with night vision cameras (for surveillance), telemetry systems, laser gun firing systems and automatic lighting systems for night vision are proposed in the system. The proposed research has functions such as a wireless surveillance system with a night vision camera and a transmitter and receiver system used for surveillance. The camera is connected through the transmitter and receiver system to communicate and send the live video footage to the monitoring unit (receiver section), which will be helpful to the operator to get the exact and current situation of the target for shooting or rescue. The telemetry system plays an important role in the whole project in order to understand the robot's information [10]. It consists of sensors such as temperature, pressure, and accelerometer. It can display real-time data to the station. This will help to know the state of the atmospheric climate data. It can also be updated to collect data in areas where it is impossible for humans to reach. A 360-degree laser gun system is used to shoot at the target with the manipulator attached to the robot. This system has a laser pointer to help aim at the target and make a perfect shot. An automatic night vision lighting system is used to show the path and helps the operator to get a clear view of the battlefield. The robot has a bomb detection system with a metal detection sensor module to detect the presence of metal inclusions concealed within an object.

The system can move forward; if the obstacle sensor detects an object, it changes direction. The robot scans the head assembly to move 320 degrees (right and left) and 45 degrees (up and down). This movement stops when any target is detected and fires (gunshot) and LED flashes. Relays and high torque DC geared motors as outputs, obstacle sensor, PIR sensor, and limit switch as inputs.2 NOS of 6V rechargeable battery for 12V are used as power sources. The buzzer is used to produce a warning sound when the temperature sensor detects fire. The image and sound are captured by the audio and video system via a wireless camera signal. The electronic mechanism consists of an ATMEL 89s52 microcontroller, RF transmitter and receiver, RF encoder and decoder, LM35, ULN2803 driver IC, 12v SPDT relays, battery supply, and DC (direct current) gear motors. To trigger a laser light, an object must be detected, an image captured, the image streamed, and a signal received from the controller. In this approach, an IR sensor detects the target, captures an image, and then tracks the detected object with a camera. The detailed explanation of the work continues in the next section.

4. HARDWARE ARCHITECTURE

The system is remotely controlled, self-powered and has all the controls of a mobile robot. Figure 1 shows the functional block diagram of the hardware implementation of the robot system. A laser gun system is installed on it to shoot the target remotely when required. A microcontroller called Atmel 899S52 receives commands from the transmitter and sends them to the receiver [11]. It contains various sensors such as PIR and IR sensors to provide input to the controller. The AT89S52 is a low power, high performance 8-bit CMOS microcontroller with 8k bytes of Flash programmable erasable read-only memory (PEROM). The chip-on-flash allows the programable memory to be reprogrammed in-system or by a conventional non-volatile memory programmer [12]. This system can read the input data from different sensors for different applications.

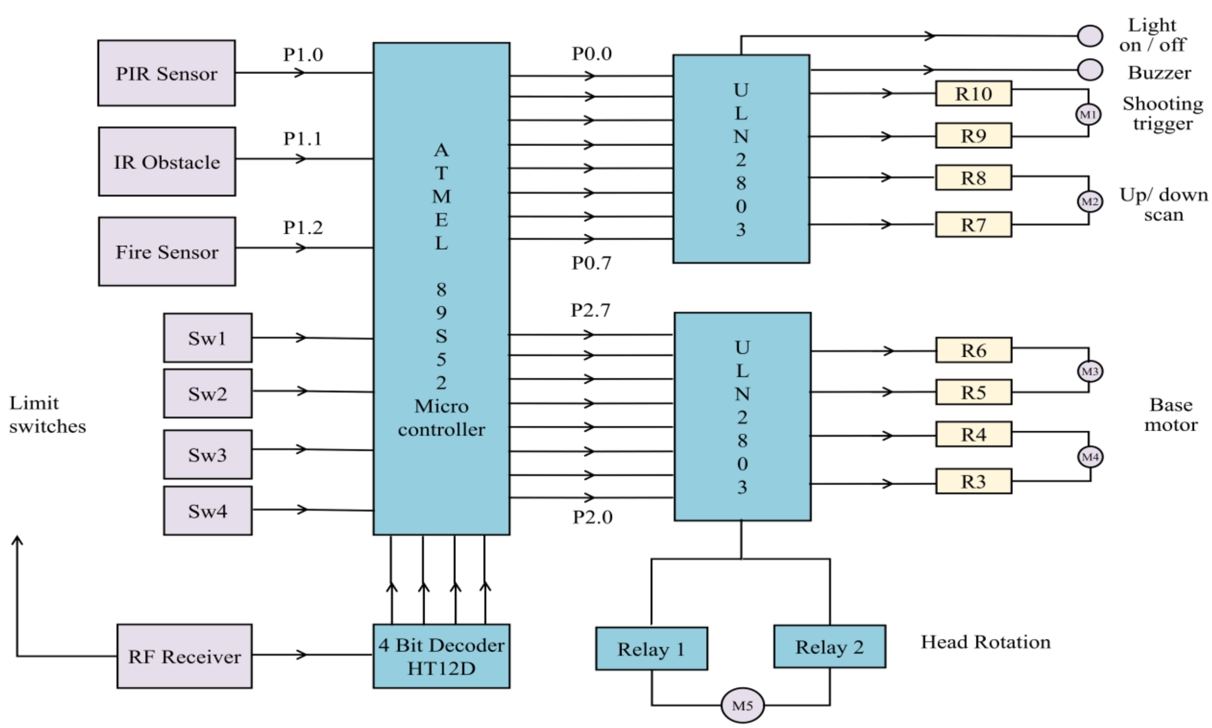


FIGURE 1. Working Block Diagram.

Based on the received signal, the controller gives the command to the driver to move forward, backward, left and right. For locomotion, the ULN2803 motor drive is used to receive the input from the controller as an output and can give a command to the motor to run in a clockwise and anticlockwise direction. The firing trigger is also connected to the motor drive, which gives the output to the trigger motor to operate or fire when the sensor receives an input. The 4-bit decoder is used to convert the code into a set of signals received by the receiver. The transmitter and receiver module operate at a frequency of 433 MHz. The supplied module has a quartz stabilised oscillator to maintain accurate frequency control for the best range [13-16].

5. FLOW CHART

The sequential representation of the project's processes can be found in this section. this approach involves detecting an object, capturing an image, streaming the captured image, receiving the signal from the control unit, and triggering the laser light [17], in this approach, an IR sensor detects the target, then the image is captured and the detected object is tracked by a camera. If not, the sensor continues to detect the enemy from different angles. using wireless communication technology, the captured image is then emailed to the control room using a transmitter and receiver [18]. When the target image is received in the signal and on the live stream, the person in the control unit verifies that it is the target. using wireless communication, a laser dot target is triggered when it receives a response from the processor. After executing this loop, the system is reset, and this loop is executed again in the same way. The explanation of the working flow chart is shown in Figure 2.

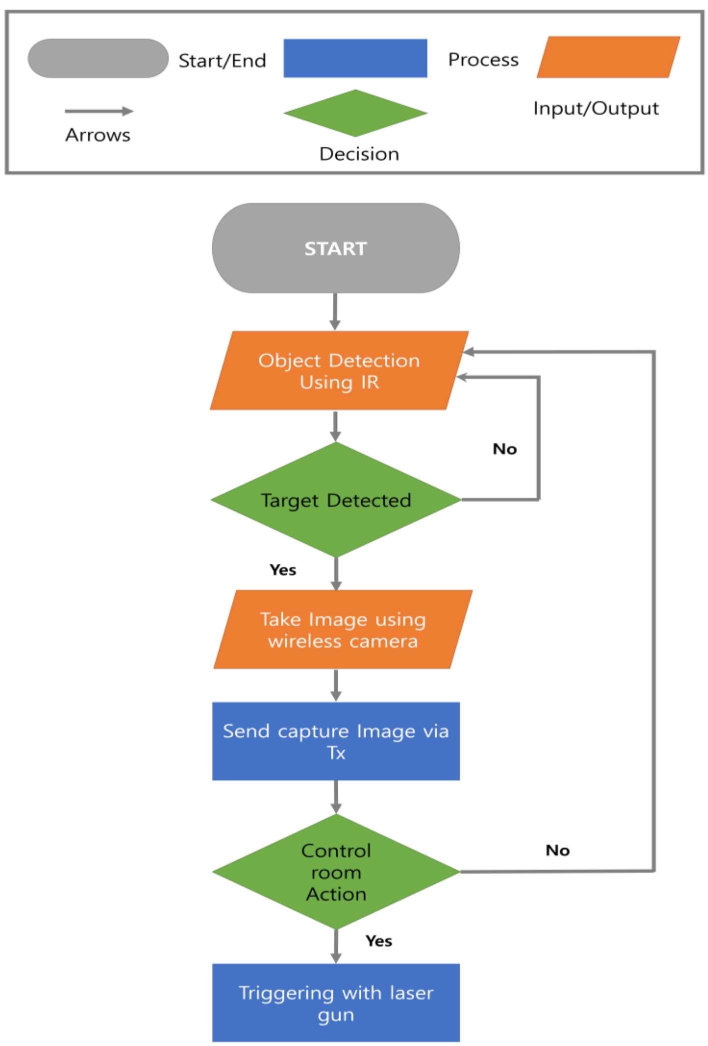


FIGURE 2. Flow chart

6. COMPONENTS

In this section, we describe the use of the components in the proposed work. The system has different components that are used for prototype development. Mostly the hardware system such as sensors, motors, controllers, drivers, etc. These components play an essential role in the design of the system. The study of the working principle and design of the components has been explained in Table 1.

Table 1. Main electrical and electronics components specification of hardware

Components	**Specification**
Microcontroller (AT89S52)	8k bytes of flash 256 bytes of RAM 32 I/O lines
Sensor (PIR, IR)	Input Voltage +5V OperatingVoltage-3.3~5V operating distance- 2~30c
Metal Sensor	Operating Voltage – 9v Output – 5v Detecting Range – (1-10) cm
Dc Motor	DC Voltage- 1VDC ~30VDC Low Speed-0.1rpm~ 1500rpm Torque-0.1kg. cm to 400kg.cm

6.1. Microcontroller Circuit (AT89S52)

It is the brain of the whole system, controlling all input and output functions of the sensor with transmit and receive activities. The AT89S52 offers standard features such as - 8k bytes of Flash, 256 bytes of RAM, and 32 I/O lines. The static logic design for zero frequency operation supports two software selectable power saving modes [19]. The Atmel AT89S52 is a powerful microcontroller that provides high performance and cost-effective performance for various embedded systems for many applications. The idle mode shuts down the CPU to allow the RAM, timer/counter to operate. The power-down mode preserves the RAM contents. However, it freezes the oscillator as it can disable all other chip functions until the next interrupt or hardware reset occurs [20].

6.2 Sensor

An important component in creating a robot is a sensing unit, which helps the robot to sense its environment and provides input to the robot. The sensors used for this project are PIR, IR and metal detector. The PIR sensor detects general movement and gives information about who or what has moved. PIR sensors are called passive infrared sensors or sometimes PID (passive infrared detector) [21]. A PIR sensor in this robot senses unwanted movement and gives the input to the controller.IR sensor is used in a wide range of wireless applications involving remote control and sensing. It has an infrared part in the electromagnetic spectrum which can be divided into three primary regions - near IR, mid-IR & far IR [22,23]. This sensor is used to detect the object close to the robot. The robot can move in a certain direction as soon as the infrared sensor and the passive infrared sensor detect a signal, avoiding the obstacles in its path. A metal detector sensor is an electromechanical device used to detect the presence of metal. A metal detector sensor identifies the presence of explosives, which is a bomb detector. The specification of the sensor is given in Table 1.

6.3 Power supply circuit

The backbone of any electronic circuit system is the power supply, which provides the necessary power for operation, e.g., the microcontroller, along with all the semiconductors on board, the circuit needs +5V, and the buzzer, motor, etc. needs +12V. The power supply provides a regulated output of +5V and an unregulated output of +12V. The IC7805, which has three terminals GND, IN, and OUT, provides the +5V regulation [24,25].

6.4 DC Motors

This project used DC (direct current) motors to move the robot. It works with a 12v DC power supply. [26]. the specification of the motor is given in Table 1. The motor driver uln2803 is bidirectional. it allows the working speed and direction of the two motors to be controlled simultaneously. it contains NPN Darlington pairs that provide high voltage characteristics along with common cathode diodes for switching inductive loads [27]. each channel of the uln2803a consists of an NPN Darlington transistor. this connection provides the effect with a single transistor connected between the input and base of the pre-driver Darlington NPN. control of inductive loads using logic obtained from the control unit. in the uln2803, the Darlington array acts as 8 individual switches that can be switched on and off as required. high power loads can be driven by these Darlington pairs using logic from the controller [28].

Table 2. Behaviour of motors

Operation	A	B
Start	1 (High)	1 (High)
Clockwise	0 (Low)	1 (High)
Anti-clockwise	1 (High)	0 (Low)
Stop	0 (Low)	0 (Low)

These control pins are controlled by the logic values sent by the microcontroller, the input and two output pins for each motor show the behaviour of the motor with different inputs as shown in Table 2.

7. WIRELESS SURVEILLANCE SYSTEM

The wireless camera monitoring system is used for monitoring in this project. This system allows the robot to perform live streaming. it works on the principle of AV transmitter and receiver. The av module has a transmitter and receiver unit, which is shown in Figure 3, (a) av receiver and wireless camera (b) working circuit of transmitter and receiver. wireless AV receiver, and transmitter with a camera these two units are used for the whole system. the camera is placed on the robot with a transmitter built into it. This captures the video and sends it through the transmitter unit to the AV receiver.

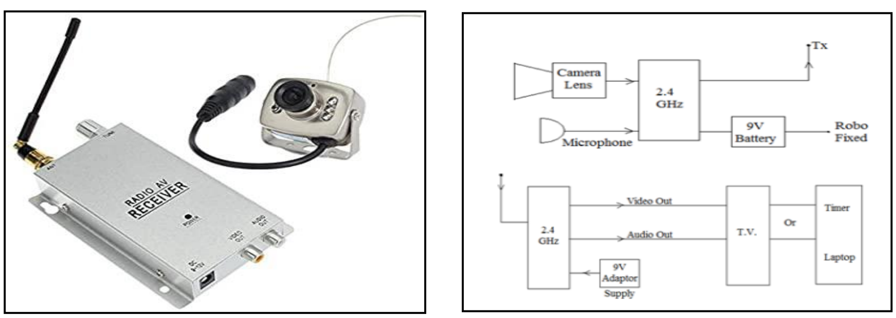


Figure 3. (a) AV receiver and wireless camera (b) Architecture of transmitter and receiver.

Figure 3 shows the camera system used for live streaming and surveillance. The figure shown has two setups: a transmitter and a receiver. The transmitter consists of a camera for video and a microphone for voice input, given to the controller that signal will pass through the transmitter antenna on a 2.4GHZ frequency band [29]. This system required a 9-volt battery source to operate the system. At the same time, the receiver receives the transmitted signal as an input in the form of an audio and video signal to the display unit, which can be anything from a TV to a laptop or system.

7.1 Telemetry System

The telemetry system is essential for the defence robotics system. It can be helpful to get all the current data of the robot [30]. We have used a telemetry system in our robot using Arduino at mega; it has a different integrated sensor that will send the data to the base station and keep updating the data like - temperature, humidity, pressure, and location of the robot. As we can see below, Figure 4, (a) Block diagram of the telemetry system (b) Base station of the telemetry system (a) shows the block diagram of the transmitting part of the telemetry that will be available in the robot. It has various sensor inputs given to the controller as input, the controller sends the data to the base station via a radio transmitter device. A 9-12V power supply was required to operate the system.

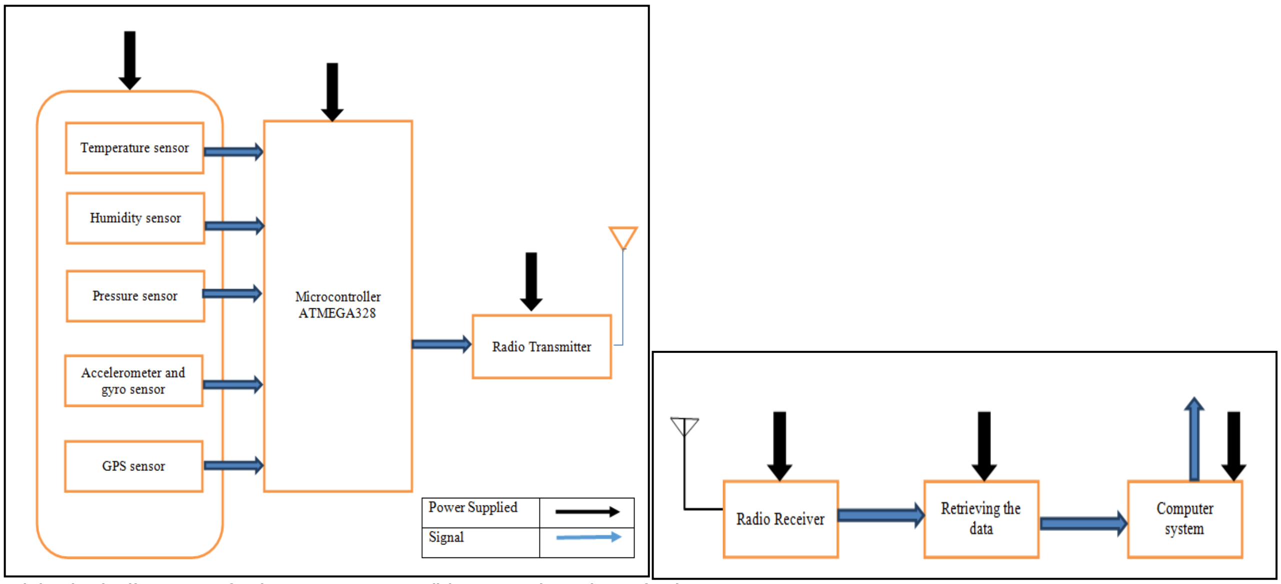


Figure 4. (a) Block diagram of telemetry system (b) Ground station of telemetry system.

However, figure 4 shows that the data signal received by the radio receiver and the data received is retrieved and sent to the computer system using the internet network. The black arrow sign is for the power source indicator and the blue arrow sign indicates the signal sent from one block to another.

8. KINEMATIC EQUATION FOR MOBILE ROBOT

The kinematics equations of mobile robots, including the unicycle, bicycle, differential drive and Ackermann models. In this topic we will look at the variables and specific equations of each motion model. These models can be used to simulate different mobile robots [31]. For example, $[x \quad y \quad \theta]$ three-dimensional vectors representing the robot's state.

- x - Robot x-position in meters
- y-robot y-position in meters
- θ-robot heading in radians

8.1 Kinematic Equation

Entering the wheel speed as a steering angle or heading rate depends on the name-value argument of the robot input [32]. It affects the equations when this input change occurs.

$$\begin{bmatrix} \dot{x} \\ \dot{y} \\ \dot{\theta} \end{bmatrix} = \begin{bmatrix} \frac{r}{2}\cos(\theta) & \frac{r}{2}\cos(\theta) \\ \frac{r}{2}\sin(\theta) & \frac{r}{2}\sin(\theta) \\ -r/2d & r/2d \end{bmatrix} \begin{bmatrix} \dot{\phi}L \\ \dot{\phi}R \end{bmatrix} \qquad (1)$$

8.2 Wheel Speed Equation

The inputs in the generalized format are the speed $v = \frac{r}{2}(\dot{\phi}R + \dot{\phi}L)$, and angular velocity $\omega = \frac{r}{2d}(\dot{\phi}R - \dot{\phi}L)$ It simplifies to

$$\begin{bmatrix} \dot{x} \\ \dot{y} \\ \dot{\theta} \end{bmatrix} = \begin{bmatrix} \cos(\theta) & 0 \\ \sin(\theta) & 0 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} v \\ \omega \end{bmatrix} \tag{2}$$

Behaviour of the Firearm in Zero Mode and Active Mode. Let's consider a simple 2D robotic arm with two joints. In rest mode, the arm will have fixed joint angles, while in active mode the joint angles will change based on some input [33].

9. EQUATION FOR FIREARM

Behaviour of the Firearm in Zero Mode and Active Mode. Let's consider a simple 2D robotic arm with two joints. In rest mode, the arm will have fixed joint angles, while in active mode the joint angles will change based on some input [33].

9.1 Zero Mode Equation

In zero mode, the joint angles remain constant, and the arm doesn't move.

$$\begin{aligned} \theta_1 &= \theta_{1_{\text{zero}}} \\ \theta_2 &= \theta_{2_{\text{zero}}} \end{aligned} \tag{3}$$

9.2 Active Mode Equation

$$\begin{aligned} \theta_1(t + \Delta t) &= \theta_1(t) + \Delta\theta_{1_{\text{desired}}} \\ \theta_2(t + \Delta t) &= \theta_2(t) + \Delta\theta_{2_{\text{desired}}} \end{aligned} \tag{4}$$

And for the end-effector position in active mode:

$$\begin{aligned} x &= L_1 \cos(\theta_1) + L_2 \cos(\theta_1 + \theta_2) \\ y &= L_1 \sin(\theta_1) + L_2 \sin(\theta_1 + \theta_2) \end{aligned} \tag{5}$$

Where:

- $\theta_{1_{\text{zero}}}$ and $\theta_{2_{\text{zero}}}$ are the fixed joint angles in zero mode.
- $\Delta\theta_{1_{\text{desired}}}$ and $\Delta\theta_{2_{\text{desired}}}$ are the desired changes in joint angles in active mode.
- L_1 is the length of the first arm segment.
- L_2 is the length of the second arm segment.

These equations describe the behaviour of the robot arm in both rest and active modes. In the zero mode of equation 3, the arm position remains fixed, while in the active mode of equation 4, the arm position changes based on the desired changes in joint angles. We have incorporated Equation 5 into our MATLAB simulation code to model the behaviour of the robotic arm, accordingly, as shown in Figure 9.

10.STRUCTURE DESIGN

This section contains information on the design of the system model. The 2D and 3D system models were designed prior to prototyping.

10.1 2-D Design

For the manufacture of mechanical parts in the workshop, 2D design is essential so that a preview of the desired parts can be viewed before manufacturing begins. The mechanical design of the proposed robot has been shown in Figure 5(a), (b) using CREO Parametric software. The mechanical mechanism consists of the L-angle aluminium and 1.5mm aluminium plates, chain sprockets and chain track mechanism for off-road locomotion. The Robot can move in all directions. The base will have 4 wheels.

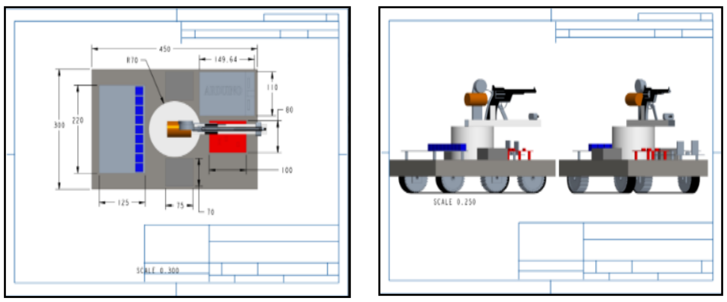


Figure 5. The 2d design of the robot (a) Side view, (b) Top view (c) Front view.

2 wheels are interlinked (front left and rear left) and the other 2 wheels are interlinked (front right and rear right).2-DC gear motors are used to drive the basic movement. In addition, a base rotation of 320 degrees, fitted by the fake gun, is used for up-and-down movement of 45 to 60 degrees for shooting.

10.2 3-D Design

The 3D model of the proposed system, designed in CREO Parametric software, helps to give a 3D view of the robot and is developed in the workshop according to the measurement. Figure 6. The 3D design of the robot (a) side view, (b) front view, which consists of all the components on it, wheels for robot movement with a crawler belt that will provide grip in all terrain. The camera is placed at the bottom of the gun system, which will also help to get a clear view of the target. The dimensions of the robot are 450 mm x 380 mm x 321 mm. The mechanical design includes the frame body with a fixed gun and trigger mechanism. The design has been made to ensure that the electronic components are safe during operation. The distance between the two wheels is 300. The length of the gun base is 272.5 mm, which also houses the camera. The height of the gun trigger system is 20mm. The height of the gun actuator is 100 mm, which gives a proper 360-degree rotation to the base of the trigger system. The size of the telemetry system is 19.68 mm x 110 mm. The size of the primary control circuit is 220 mm x 125 mm. 3D design technology makes it possible to visualize the stereoscopic effects of mechanical products in advance, which stimulates creativity, promotes different design ideas, and helps to create more perfect mechanical parts.

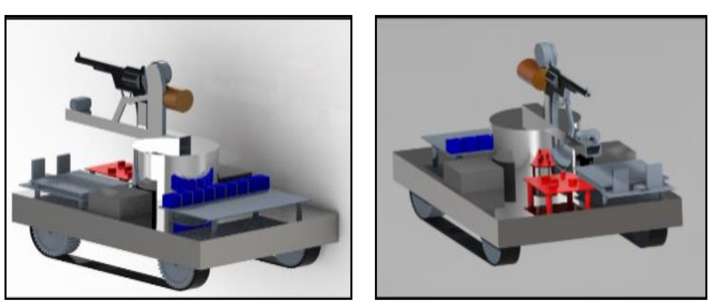


Figure 6. 3D design of the robot (a) Side view, (b) Front view

The dimensional description of the prototype robot is given in Table 3. Physical description. As per the design parameter of length, width and height has been shown in the table, all measurements are in mm.

Table 3. Dimensional description

Length (mm)	450
Width (mm)	380
Height (mm)	321

11.RESULT AND DISCUSSION

In this section, we present the results of our study, including the output of the telemetry system, the results of the gun simulation performed in MATLAB, and the results of the prototyping phase.

11.1 Output of Telemetry System

The temperature and humidity output is shown in Figure 7. Change in temperature and humidity as the robot moves from one location to another. It shows that when the robot moves to another location the change in temperature is recorded. The results show the two different outputs from the telemetry system. We have recorded through the serial output in Arduino IDE the temperature and humidity basically the same while in the constant position, which means the robot is not moving in any direction.

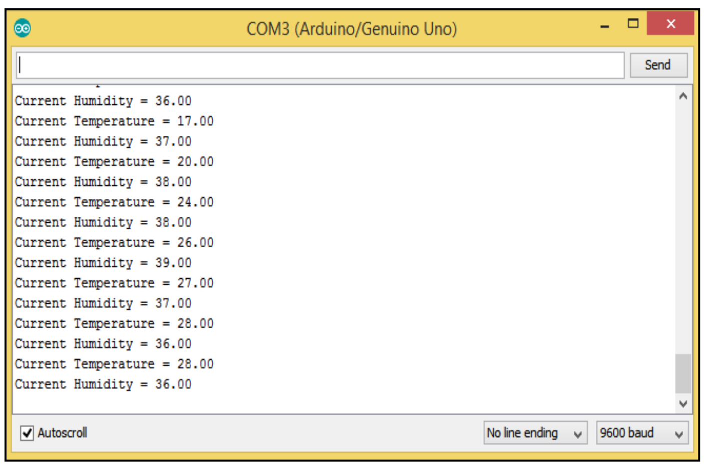


Figure 7. Change in Temperature and Humidity when the robot changes the place.

As it moves from one place to another, the temperature changes by 17-28 degrees as the humidity changes. This means that the robot moves the telemetry system to send data according to the change of location.

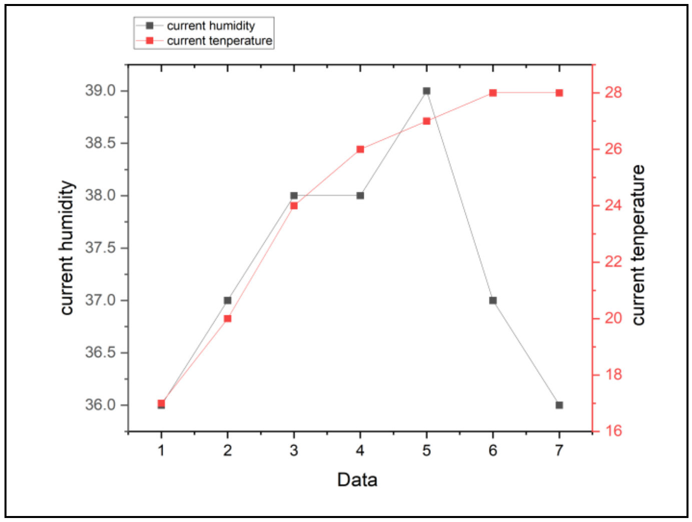
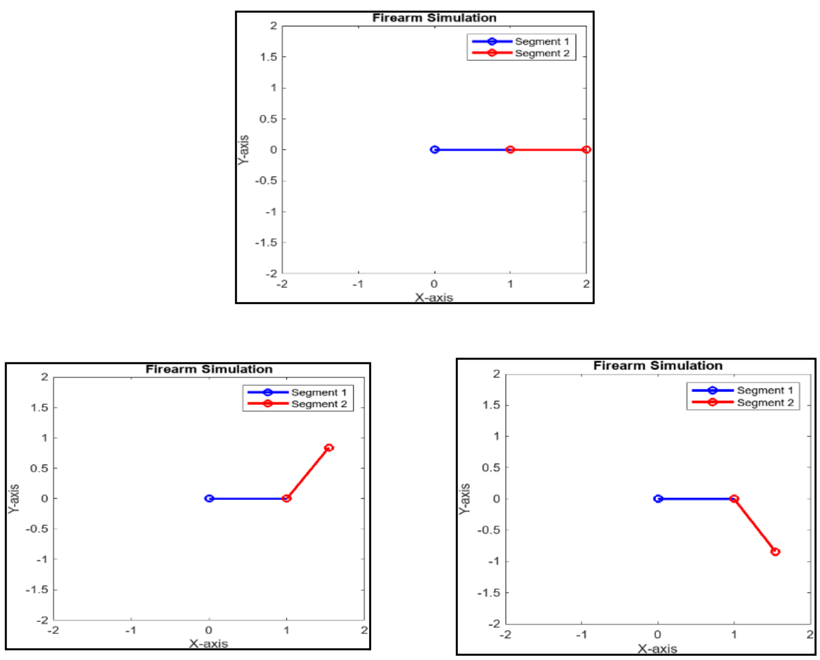


Figure 8. Graphical representation of telemetry data output.

Figure 8 is a graphical representation of the current humidity and temperature data from Figure 7. The red line represents the current humidity, and the black line represents the current temperature. The graph shows that the humidity ranges from 36.5 to 39.0 and the temperature ranges from 18 to 28 degrees. The humidity has a peak at data point 2 and a trough at data point 6, while the temperature has a peak at data point 4 and a trough at data point 7. The graph is used to monitor the performance of the robot in terms of its humidity and temperature levels. It has been helpful in identifying potential problems and issues with the robot's operation, such as overheating or excessive moisture build-up. By analysing the data in the graph, it may be possible to adjust the operation of the robot to improve its performance and prevent potential problems [34].

11.2 Firearm Simulation



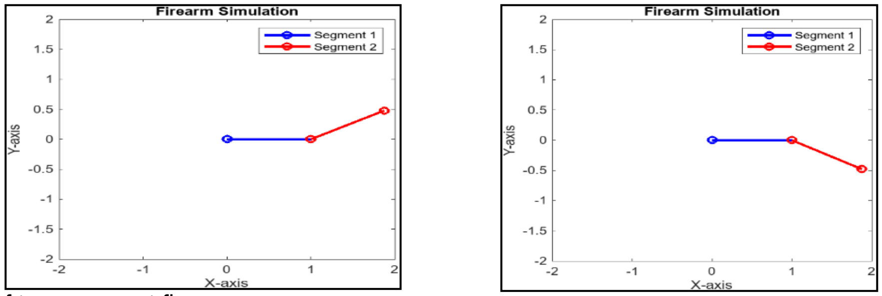


Figure 9. Simulation of two-segment firearm.

Figure 9 shows the behaviour of a two-segment robotic arm and visualizes its motion in a MATLAB graph. The robotic arm consists of two connected segments, each defined by its length (armLength1 and armLength2) and joint angles (θ_1 and θ_2) from EQN 3,4. The simulation loop allows interaction with the arm, switching between "active mode" and "zero mode" based on input. In "active mode" the joint angles (θ_1 and θ_2) are incrementally updated, causing the arm to simulate motion. The forward kinematics equations calculate the final effector position (x, y) based on the joint angles and arm lengths. The visualization consists of two lines: a blue line representing the first arm segment and a red line representing the second segment. The graph is updated in real-time and shows the changing configuration of the robot arm in (0,0) (0.5, -0.5) (1, -1) in both modes. The x-axis and y-axis labels and legend provide context for understanding the arm's orientation. The demonstration of a two-segment gun movement effectively illustrates how changes in joint angles result in different end-effector positions and arm configurations.

11.3 Prototype Result

The development of the robot has been proposed as a system in this paper. The model has four side views as we can see in Figure 10. Figure 11 Top view and front view. Shows the left and right view of the robot with a battery, toy gun, chain track and wheel and telemetry system.

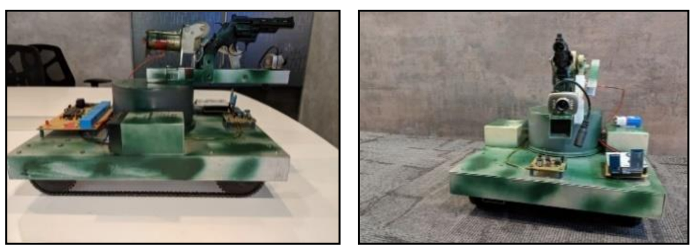


Figure 10. Left & Right-side view.

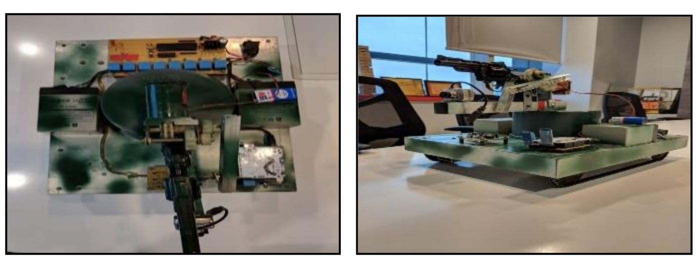


Figure 11. Top & Front view.

The design of the prototype has been successfully developed as per the 2D and 3D models and safety as per the given design parameters. In Figure 10 shows. robot has a camera, telemetry system, all electronic parts boards, sensors, and a toy laser gun. Design a remote-controlled robot to give the robot orientation and operate the laser gun.

CONCLUSIONS

This paper describes the development of an affordable prototype mobile robot. The development of combat robots requires the use of various technologies, but these technologies are usually secret and difficult for the public to understand. The disclosure of these techniques in this paper will be helpful to students or researchers interested in this field. We have completed the design and development of a low-cost combat robot that uses a remote control with an attached fake gun to fire targets over any terrain path with a chain track mechanism. The robot moves in two modes: auto-mode and user-controlled mode. In automatic mode, the robot moves at different speeds depending on the terrain. If an obstacle is detected, the robot will avoid the path and create a new one. If a target is detected in the path, the robot operator checks the camera and fires at the target. The robot has a telemetry system to send environmental data to the receiver. We are currently working on using UWB sensor fusion technology to improve localisation performance and accuracy. The proposed research can be further developed and improved in many areas, such as the electronic system can be made safer and more accurate. The system can improve more mechanical parts and design can be added and implanted in the future. Communication with a robot could be improved over long distances. A cyber security system can be safe and accurate for communication. A bomb dispersal system can be implemented. AI and ML algorithms can be used to make robots self-aware. Computer vision techniques can be used to learn the vision system. Mapping can be done to take self-direction and reach the target. During the experiment, the prototype system worked perfectly and was successfully tested. In our work, the sensor and camera play an essential role in the operation. When a target is detected by a camera, the operator can shoot manually after confirmation. The proposed research study and experiment will help to design a real-time defence robot system that can serve the military and help the soldier in various operations.

CONFLICT OF INTEREST

The author declares no conflict of interest.

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