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UNMANNED COMBAT GROUND VEHICLE (UCGV).

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Abstract: - Unmanned combat ground vehicles (UCGVs) are becoming increasingly popular as a tool for military operations. These vehicles can perform a wide range of tasks on the battlefield, such as reconnaissance, surveillance, and combat operations. They are designed to provide a safer and more efficient way to conduct military operations, minimizing the risk to soldiers' lives. The unmanned combat ground vehicle you described is a prime example of such a vehicle. It can be remotely controlled from a distance of up to 1 km by a single soldier, providing a high degree of flexibility and mobility. With its rocket launcher, it can effectively destroy enemy vehicles and neutralize threats, making it a valuable asset in combat operations. Additionally, the unmanned combat ground vehicle's ability to perform different tasks, such as border patrolling and surgical strikes, makes it a versatile tool for military operations. Its compact size and maneuverability allow it to operate in a variety of terrains and environments, making it an effective tool for both offensive and defensive operation.

Keywords: - UCGV, Rocket, Remote controlled, Arduino Uno & Mega.

I. INTRODUCTION

The UCGV (Unmanned Combat Ground Vehicle) is described as a military vehicle used for combat and border patrolling purposes. It is controlled remotely by a single operator using a transmitter with a range of 1 km. The UCGV is equipped with 18 rocket launchers, each with a range of 150 meters. During combat situations, the UCGV is used to protect soldiers' lives and reduce the number of casualties by firing rockets at terrorist UGVs (Unmanned Ground Vehicles) or vehicles that pose a threat. The operator selects the target using a camera mounted on the rocket launcher and sends the command to fire the rocket using the transmitter.

For border patrolling, the UCGV is used to detect and destroy any suspicious targets using rockets specially designed with a shaped charge to penetrate the target. The rocket is also equipped with wings to stabilize it during flight. The UCGV has a maximum speed of 20 km/h and an igniter to ignite the propellant charge of the rocket for firing. Overall, the UCGV appears to be a useful tool for military operations and border patrolling.

II. LITERATURE REVIEW

[1] The study described by Shahdib et al. [11] involves the use of an ultrasonic sensor and camera for object detection and size measurement in an autonomous vehicle. The range of distances collected by the ultrasonic sensor is combined with

the image captured by the camera to obtain information about the object's location and size. To determine the actual size of an object in the image, the researchers used the known angle of view of the camera and the distance obtained from the ultrasonic sensor to calculate the horizontal viewing length on a 2D plane. The aspect ratio of the image was then used to determine the object's actual size.

-Shahdib.

[2] UGV stands for Unmanned Ground Vehicle, which is a type of robotic vehicle that operates on the ground without a human operator on board. The UGV is designed to perform a variety of tasks, including supporting infantry operations as mentioned in your quote from.

-Ronald Watkins.

[3] McConnell et al. developed a system that uses robots for indoor transportation of items. The system is equipped with a USB camera and a Raspberry Pi to identify waypoints and navigate the robot from one point to another. The camera is used to capture images of QR codes from a distance of more than 4.2 meters away. The robot first rotates itself and captures a series of images to identify the QR codes. Once the QR codes are identified, the robot can navigate to the desired location. This system can be useful in various applications, such as in factories,

warehouses, and hospitals, where there is a need for efficient and automated transportation of items.

-McConell

[4] According to RNA Lt. Col. Sjoerd Meissen, four weaponized unmanned machines have been deployed in an operational experiment. This deployment is significant because it is believed to be the first time such weaponized UGVs have been deployed in the West. Additionally, Meissen notes that they are operating in a semi-operational environment and are being monitored by the Russians.

-Jared keller

[5] Estonia's deployment of an unarmed UGV in Mali in 2019 shows how such technology can be used for surveillance and reconnaissance purposes, providing troops with a better understanding of the battlefield. Russia's confirmation of deploying armed UGVs in Syria in 2018 highlights the potential for UGVs to be used for offensive operations, and the risks associated with the militarization of such technology.

-Matthew gault

[6] The autonomous patrol and dynamic route planning features make KAPGAN useful for surveillance and reconnaissance missions. The ability to neutralize air and ground targets and integrate various weapon systems makes it useful for military operations. Additionally, the upgradeable perimeter surveillance system with a 5 km line of sight adds to its versatility. Overall, KAPGAN seems like a highly capable platform with a range of features that make it suitable for a wide range of tasks.

-Yusuf cetiner

[7] It seems like this trial is focused on testing a new technology that has the potential to significantly improve the military's capabilities by reducing the risk to soldiers and enhancing their effectiveness. However, there are some challenges associated with the system that need to be addressed, such as reducing the cognitive burden on personnel and implementing automation to enable remote and autonomous operation.

-Andy martin

[8] Its ability to travel at speeds between 30-50 km/hour and cover a range of 100 km is impressive, as is its carrying capacity of 550 kg. It's good to hear that the Arion-SMET was designed with a variety of mission types in mind, including ammunition transport, medical evacuation, reconnaissance, and fire support. With these capabilities, it could help increase the effectiveness and safety of infantry operations by reducing the need for human transport of supplies and equipment.

-Aaron lariosa

[9] The system's capabilities in terms of pan and tilt speed and continuous rotation are particularly impressive, and the advanced sensor options you mentioned would make it a valuable asset for surveillance and security purposes. Its suitability for maritime, border, aviation, and defense applications, as well as its ability to counter

unmanned aerial vehicles and provide perimeter security, highlight the system's versatility and adaptability.

-Olivia

[10] The W. Smith and H. Peng model appears to be a method for evaluating the performance of small unmanned ground vehicles (SUGVs) on uneven terrain. The authors suggest that this model is a better option than using the widely used Bekker theory, which can lead to large errors. The model involves the use of the Differential Evolution (DE) algorithm, which is a type of optimization algorithm, implemented within the LIGGGHTS software. LIGGGHTS is an open-source software that combines computational fluid dynamics (CFD) and the discrete element method (DEM) to simulate complex particle systems.

-W Smith and H. Peng

III. EXPERIMENT

There are three experiments performed on our rocket.

1. First Experiment

Faulty ignition system: The ignition system may not have functioned properly and failed to ignite the propellant charge. This could be due to a variety of factors such as incorrect wiring, faulty switches, or defective igniters.

Incomplete combustion: The propellant charge did ignite but the rocket did not move, it could be due to incomplete combustion. This could be caused by factors such as inadequate mixing of the propellants, insufficient oxygen supply, or incorrect ratios of fuel and oxidizer.

Structural issues: It is also possible that there were structural issues with the rocket or launcher that prevented it from functioning properly. For example, the rocket may have been too heavy or unbalanced, or the launcher may not have been able to withstand the force of the ignition.

2. Second experiment

over-explosion during our rocket test due to the large amount of propellant charge used. When a propellant charge is ignited, it releases a large amount of energy in the form of heat and gas. If too much propellant is used, the resulting explosion can exceed the capacity of the rocket and launcher, causing damage or destruction.

3. Third experiment

Our team was able to carefully examine and address the problems in the first and second stage of our rocket during the third test. It's also great that the propellant charge successfully ignited and produced the required back blast, and that the rocket was able to move forward from the launcher and hit the target successfully. It's important to continue testing and refining the design of our rocket to ensure that it is safe and reliable for future launches.

IV. MATERIAL

The material used in our UCGV project is

- **Controller**

Arduino Uno and mega

Arduino Uno and Mega are types of microcontrollers that are commonly used in various projects. The Uno and Mega boards are both popular choices for building electronic projects due to their affordability, ease of use, and versatility. Arduino Uno as a transmitter and the Mega as a receiver in order to control the overall function of an unmanned ground combat vehicle (UCGV). The Arduino Uno would be responsible for sending commands to the UCGV, while the Mega would receive these commands and translate them into specific actions for the vehicle to perform. The specific details of how this system would be implemented would depend on the specific requirements of our project, but the Arduino platform provides a wide range of tools and libraries that can be used to develop custom solutions for a variety of applications.

- **Nrf24l01 module**

The NRF24L01 module is a wireless transceiver module that operates on the 2.4GHz band and is capable of transmitting data over long distances. However, the maximum range of the module can vary depending on a number of factors such as the antenna used, the environment, and any obstacles that may be present. the NRF24L01 module is connected to both an Arduino Uno and Mega, the effective range of the module will depend on the specifics of your project. It is important to carefully consider the range requirements of our project and take steps to optimize the performance of the NRF24L01 module, such as using high-quality antennas and minimizing sources of interference.

- **DC Gear Motor**

The Orange OG555 450 RPM DC gear motor is a small motor commonly used in robotics, automation, and other applications that require precise and controlled movement. Here are some additional details about the motor:

Voltage: The motor is rated for 12 volts DC.

Current: The motor draws about 0.6 amps at its rated load.

Torque: The motor can produce up to 5 kg-cm of torque at its rated load.

Gear ratio: The motor has a 1:30 gear ratio, which means that the output shaft rotates 30 times slower than the input shaft.

Dimensions: 98mm in length and 38mm in width.

To operate the motor, we will need a motor driver that can handle the voltage and current requirements of the motor. We can control the speed and direction of the motor by varying the voltage and polarity of the input signals to the motor driver.

- **Wheel**

Here are some additional details about the wheel:

Material: The wheel is made of a combination of hard plastic and silicon rubber, which provides both durability and grip.

Load capacity: The wheel is capable of supporting a load of up to 20 kg (44 lbs). It's important to note that this rating assumes that the load is evenly distributed across the wheel and that the wheel is used within its specified operating conditions.

Rotation: The wheel is rotated using a pulley, which is connected to a motor through a belt drive. This setup allows for precise control over the speed and direction of the wheel, which can be important for certain applications.

- **Battery**

The Quanta Amaron battery is a 12V lead-acid battery commonly used in various applications, including as a power source for Unmanned Ground Vehicles (UGCVs). Here are some additional details about the battery:

Voltage: The battery has a nominal voltage of 12 volts, which means it's designed to provide a consistent voltage level over its operating range.

Capacity: The battery has a capacity of 7 ampere-hours (Ah), which means it can deliver a current of 7 amps for one hour before being fully discharged. This capacity rating determines how long the battery can provide power to a load before needing to be recharged.

- **MS sheet**

A mild steel sheet with a thickness of 0.6mm is commonly used in various applications due to its strength and durability. The thickness of 0.6mm is sufficient to support the weight of a cannon and the parts of a controller, as long as the design and manufacturing process take into account the specific requirements and stresses that will be placed on the material.

- **MS box pipe**

Using a mild steel (MS) box pipe to make the chassis of an unmanned combat ground vehicle (UCGV) is a common and effective practice in engineering. The use of a box pipe can provide a strong, rigid, and lightweight structure that can support all the components of the UCGV.

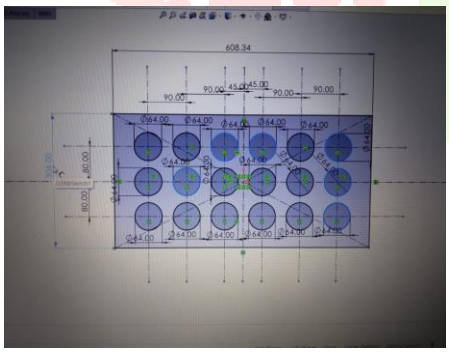
Mild steel is a popular material for making structural components due to its high strength and durability, as well as its relatively low cost. A box pipe made from mild steel is especially effective as it can provide a high strength-to-weight ratio, allowing for a strong and rigid structure that is still lightweight and easy to maneuver.

By using a box pipe to make the chassis of the UCGV, the vehicle can be made strong enough to withstand the rigors of combat and rough terrain. The box pipe can also provide additional protection for the components housed within the chassis, as it can act as a shield against impact and damage from external sources.

- **Steel Pipe**

Using 32mm diameter and 2mm thickness round pipes to make a cannon for an unmanned ground combat vehicle (UCGV) can be an effective approach, depending on the specific requirements and use case of the cannon. A round pipe made from mild steel with a 32mm diameter and 2mm thickness can provide sufficient strength and durability to contain the rocket and withstand the pressure generated by the propellant charge when it explodes inside the pipe.

V. IMAGES OF UNMANNED COMBAT GROUND VEHICLES.



2d diagram of Canon and rocket launcher

Model of canon

Chassis of UCGV

Complete assembly of UCGV and Front view of UCGV.

VI. EXPERIMENT SETUP

After collecting all the components as per the material list, we are going to assemble the cannon and chassis. Then we will proceed to make the transmitter and receiver. We have used Arduino Uno as the transmitter and Arduino Mega as the receiver. To make the transmitter, we created a circuit diagram and connected all the circuits as per the diagram. Then we connected the NRF24L01 module to the transmitter.

For making the receiver, we connected the motor driver to the Arduino Mega to drive the motors of our UCGV. We also connected the relay to the Arduino Mega to launch the rockets on targets. After that, we connected the NRF24L01 module to the Arduino Mega. Once the circuit connections were completed, we uploaded the code to Arduino Uno and Mega. After completing the coding process, we tested the UCGV. We operated the vehicle and tested its range, and we were able to achieve a range of up to 750 meters.

Next, we proceeded to test the rocket launching and its range. The rocket was successfully launched by the cannon by sending the command from the transmitter.

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VIII. CONCLUSION

The system was found to be performing according to expectations, and the team became familiar with different components and materials used in the project. The rocket was able to achieve a range of up to 150m, which is also within the expected range. The UCGV able to achieve the range without obstacles 500 meters. The project has been successful in meeting its objectives, and the team has gained valuable knowledge and experience in the process.