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Development of Advance Mobility system for Military Robots

Mr. Ajay Gani[1], Mr. Hritik Sharbidre[2], Mr. Lukman Nalband[3], Mr. Vaibhav Mane[4], Prof. Pravina Mali[5]

[1]Department of Electrical and Electronics Engineering S.G.Balekundri Institute of Technology Belagavi, India ajaygani483@gmail.com
[2]Department of Electrical and Electronics Engineering S.G.Balekundri Institute of Technology Belagavi,India hritiksharbidre@zohomail.in
[3]Department of Electrical and Electronics Engineering S.G.Balekundri Institute of TechnologyBelagavi,India likmanalband269@gmail.com
[4]Department of Electrical and Electronics Engineering S.G.Balekundri Institute of Technology Belagavi,India Vaibhavmane1025@gmail.com
[5]Department of Electrical and Electronics Engineering S.G.Balekundri Institute of Technology Belagavi,India pravinamali@sgbit.edu.in
1. S G Balekundri Institute of Technology, Department of Electrical and Electronic Engineering Belagavi.

2. Visvesvaraya Technological University Belagavi.

ABSTRACT-

The proposed project aims to design and develop a robot specifically for military applications. Robots can effectively handle risky and unmanageable tasks, making them ideal for use in the military. The project will involve extensive research and development, as well as testing and validation, to ensure the robot meets the requirements of military application. The end result will be an advanced mobility system for military robots that can handle challenging terrain and environments with greater ease and efficiency, reducing the risks to human soldiers.

Keywords: Military Robot, Linear actuator, Belt drive system, Mecanum wheels System.

I. INTRODUCTION

Military robots are mobile robots controlled from a distance, serving a range of military purposes from transportation and search and rescue to offensive operations. They are currently deployed and actively developed for use in hazardous scenarios, safeguarding lives in situations such as attacks, bombings, and critical rescue missions. These robots are equipped with specialized sensors and tools to accomplish specific objectives.

The military requires advanced mobility systems for their robots to operate effectively in different surface. The robots need to move seamlessly from indoor to outdoor environments without any hassle, and the current mobility systems are insufficient to meet these requirements. The need for a versatile mobility system that can facilitate both indoor and off-road movement is crucial for military operations. Therefore, the development of an advanced mobility system for military robots is essential to enhance their effectiveness in different environments.

The aim of this project is to develop an advanced mobility system for military robots that can facilitate both indoor and off-road movement. The system will Mecanum wheels are omnidirectional wheels that can move in any direction, making them ideal for indoor environments. On the other hand, the rubber track system provides better traction and stability in off-road environments, making it a suitable choice for outdoor use. The integration of these two systems will create a versatile mobility platform that can adapt to different surfaces, enhancing the effectiveness of military robots in diverse environments.

II. Existing System

The existing system make use of either belt drive system of Mecanum wheels system. Which is challenging as belt system is good for off-road but is not very fast is plane flat surface and the Mecanum wheel is good for flat surface but not for rough surface.

Fig 1. Rubber Track/Belt Robot.

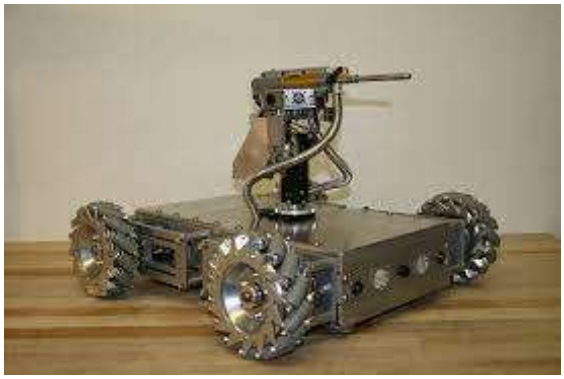

Fig 2. Mecanum Wheels Robot

III. Proposed System Design and its Implementation

We have developed a unique mobility solution that combines a belt drive system with Mecanum wheels to tackle mobility challenges. This system allows for faster movement on off-road surfaces with the use of the belt system and faster speeds on flat surfaces with the Mecanum wheels. Our robot also has the potential to include additional features such as a camera system.

The rubber track or belt system is powered by a high-power DC motor, enabling the robot to move quickly and efficiently on rough surfaces. When operating indoors or on flat surfaces, the Mecanum drive system is used, with a linear actuator lifting the rubber track or belt system off the ground, allowing the Mecanum wheels to take over.

The robot's structure is built with a robust steel pipe frame shaped like an H, providing a stable base to support the various components. The Mecanum wheels are strategically positioned in the central part of the robot's body, along with the motor, which

powers them directly, ensuring an efficient transfer of power.

The wiper motors, located at the back of the robot's body, support the rubber track or belt system, while the linear actuators, with one end attached to the center of the steel frame and the other to the top back of the robot's body, lift the track or belt system off the ground when the robot needs to switch to Mecanum wheels while operating on flat surfaces or indoors.

The steel pipe frame provides durability, allowing the robot to withstand harsh terrain and impacts while maintaining stability.

The robot also consists of some additional feature to it like lights, fan, obstacle detection using ultrasonic sensor, and a “Pick and Place” robot to demonstrate its application in military.

Fig 3. Front view

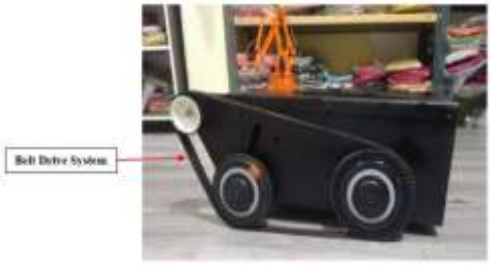

Fig 4. Side View

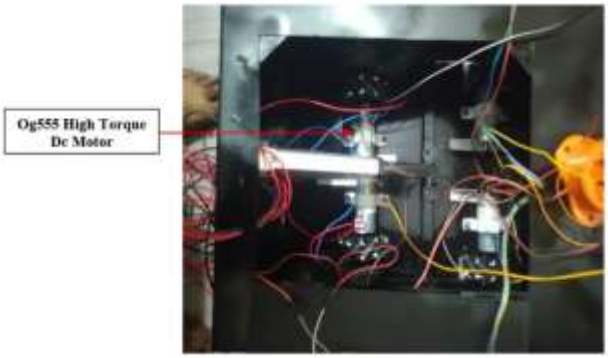

Fig 5. Internal View

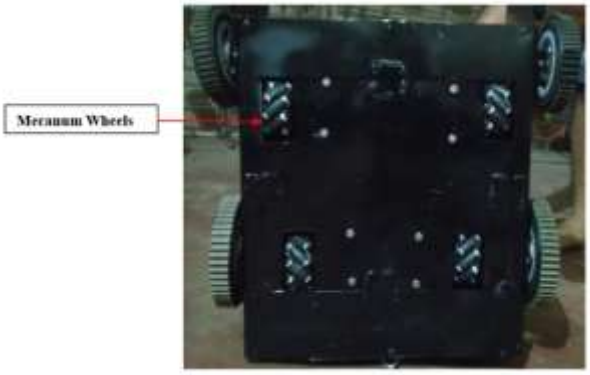

Fig 6. Bottom View

Dimensions

The length of the robot is 21 inches that is 534mm. with belt track base of 19 inches that is 480mm. The Breadth of Robot is 16 inches 400mm. and height is of 8 inches that is 200mmThe dimensions are based on the size of parts that we intend to use like Motor's, linear actuator, Mecanum wheels, etc.

Connection

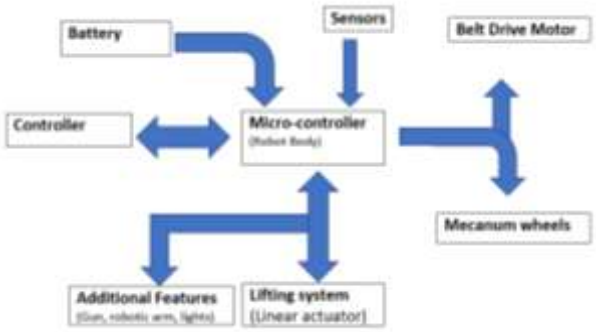

Fig 7. Block Diagram.

The connection of the robot is done as per the above block diagram. Were the micro controller being the brain of the robot (we used Arduino Mega 2560) which is responsible to control every action.

The robot is controlled using a controller that consists of various switch. A set of two DPDT switch (one for each motor) is use to control the belt drive system which uses wiper motor, as they have a high torque rating.

A set of two joystick module are connected to Arduino mega to control the Mecanum wheel system, we used TA6586 motor driver for the Mecanum wheel motor.

And on/off switch are used to turn on and off the robot and other electronic present on it like, lights, fan, sensor, robotic arm.

A Two position DPDT switch is used to control the action of the linear actuator, were limit switch are used to stop the Actuator at Top limit and Bottom limit.

Controller board.

This controller is a wired connection, it has 3 DPDT switch to control 2 Wiper motor and 1 Actuator, 2 joystick to controller Mecanum wheels and switch to turn on/off electronic, 4 potentiometers to control robotic arm.

VI. Hardware

1) Linear Actuator: A Linear actuator with a stroke length of 100mm, a speed of 7mm/s, and a maximum load capacity of 1500N at 12V is suitable for a lifting system.

Fig 8. Linear actuator.

2)Mecanum Wheels: The set of Mecanum wheels measures 80mm (4 inches) and comes with two right wheels and two left wheels, each consisting of nine rollers. The wheels are capable of independent driving, enabling the robot to move in any direction without changing the direction of wheel spin.

Fig 9. Mecanum Wheels

3)Arduino Mega: Arduino Mega is a microcontroller board based on the ATmega2560 microcontroller. It is designed for projects that require more input/output (I/O) pins and more processing power than what is available on the standard Arduino boards. The board has 54 digital I/O pins, 16 Analog inputs, and 4 serial ports.

Fig 10. Arduino Mega

4)Wiper Motor: Wiper motor is commonly used in robotics applications due to its compact size and high torque output. It is a 12V DC motor that can generate up to 20 Nm of torque, making it suitable for powering robotic arms, grippers, and other mechanisms that require high torque

Fig 11. Wiper motor

5) High torque dc motor: The OG555 DC motor is a high-torque motor with a compact design. It is capable of delivering high torque even at low speeds, making it ideal for applications that require precise control and high-power output.

Fig 12. Og555 dc motor

6) TA6586 Motor Driver Module: The TA6586 Motor Driver Module is a compact and reliable module designed to drive DC motors with a maximum current of 3A. It can be controlled using a simple digital input signal, making it easy to integrate into a variety of projects.

Fig 13. TA6586 motor driver

7) Joystick Module: A joystick module is a lever-like control device used in robotics and automation applications to move a machine or robot. It uses potentiometers or Hall-effect sensors to determine the position of the handle, which is then translated into movement commands. Joystick modules are simple, effective, and customizable to individual preferences.

Fig 14. Joystick module

8) DPDT Rocker Switch: A DPDT switch is a two-pole, two-position switch that can control two separate circuits or functions.

Fig 15. DPDT Switch

9) Limit Switch: Limit switches are electromechanical devices that are used to detect the presence or absence of an object within a specific range of motion. They consist of a mechanical lever that is activated when an object comes into contact with it, and an electrical switch that signals the presence of the object.

Fig 16. Limit Switch

10) Rubber Track: Rubber tracks offer excellent traction on soft and uneven terrain, absorb shock and vibration for a smoother ride, and distribute weight evenly to reduce the risk of getting stuck.

Fig 17. Rubber Track

11) Steel Sheet and Pipe: 20-gauge steel sheet and square pipe are used to make body of the robot as it is strong and easy to work with.

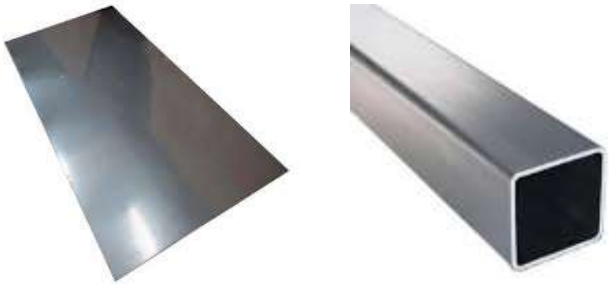

Fig 18. Steel sheet and square pipe.

12) Ultrasonic sensor: An ultrasonic sensor is a device that uses sound waves to detect objects and measure distances. It works by emitting high-frequency sound waves and then measuring the time it takes for the sound waves to bounce back after hitting an object.

Fig 19. Ultrasonic sensor

13) Robotic Arm: A robotic arm for a military robot is a mechanical arm that is designed to perform tasks in hazardous or remote environments. It is capable of carrying out a wide range of tasks, such as lifting and moving objects, manipulating tools and equipment, and performing inspections

Fig 20. Robotic Arm.

14) Lead Acid Battery (12V 9Ah) This is a 12V, 9Ah lead-acid battery, commonly used in various applications, such as uninterruptible power supplies, electric scooters, and small electric vehicles. The

battery has a moderate capacity and voltage, making it suitable for powering small to medium-sized devices or systems that require continuous and reliable power.

Fig 21. Lead Acid Battery

V. Software

Fig 22. Arduino IDE

Arduino IDE is programming software which we used to program our robots control; we used 'C' language to code.

Arduino IDE is an open-source software program used for programming and uploading code to Arduino microcontrollers. It is a user-friendly platform designed to make programming simple and accessible for beginners while offering advanced features for experienced developers.

VI. Result

1. The development of an advanced mobility system for military robots has been successfully achieved.

2. The system includes both off-road belt drive and flat surface Mecanum wheel options for versatile movement in any terrain.

3. The speed of the Mecanum wheels has been tested to be 3.1 km/h, while the belt drive system operates at 2.8 km/h.

4. The robot is equipped with an ultrasonic sensor that can detect obstacles up to a distance of 75cm, with a minimum detection distance 20cm allowing it to avoid collisions and navigate complex environments.

VII. Conclusion and Future Work

In conclusion, the development of an advanced mobility system for military robots with both off-road belt drive and flat surface Mecanum wheel options, along

with additional features such as an ultrasonic sensor, robotic arm, and camera, is a significant achievement in the field of robotics.

The development of an advanced mobility system for military robots is an important step towards enhancing the capabilities of military operations. We can add many features like GPS tracking, Weaponization, wireless connectivity, Self-controlled, etc.

VIII. Reference

1. Raju Hajare and Mallikarjuna Gowda, "Design and development of combat robot for military applications". BMS Institute of Technology. July 2020 (International Journal of Reconfigurable andEmbedded Systems (IJRES)).

2. Gauri Khapre, "Military surveillance and deployment robot". Department of Electronics Engineering, LTCOE, Navi Mumbai. Published 30 July 2018 Computer Science International journal of engineering research and technology.

3. Bin Zi & Daoming Wang Hefei University of Technology the Design and Development of an Omni-Directional Mobile Robot Oriented to an Intelligent Manufacturing System September 2017 Sensors 17(9):2073 DOI:10.3390/s1709207 License CC BY 4.0

4. Development and Implementation of Fire Fighting Robot July 2020 Journal of Advanced Research in Dynamical and Control Systems 12(07):2020 Authors: Md. Rasheduzzaman International Islamic University Chittagong Abdul Awal Royal University of Dhaka Sk. Md. Golam Mostafa Asian Institute of Technology

5. Design and development of an autonomous omni-directional mobile robot with Mecanum wheels May 201 DOI:10.1109/AQTR.2014.6857869 Conference: 2014 IEEE International Conference on Automation, Quality and Testing, Robotics (AQTR Authors: Mihai Olimpiu Tatar Universitatea Tehnica Cluj-Napoca Catalin Popovici D. Mandru Universitatea Tehnica Cluj-Napoca