

Design and Implementation of Unmanned Autonomous Armed Cart Used for Military Purposes

Haider T. Salem, Hassan F. Khazaal, Abdul Amer T. Abbas.
Wasit University / College of Engineering

Abstract— the save of soldier's life in battlefield is an important thing in any battle plan. One of the solutions to economize the numbers of losses of soldiers' life's, is to use unmanned autonomous cart to perform some deadly functions in place of soldiers. This research proposes unmanned armed cart to support Iraqi army operations and to protect the soldiers from the snipers deadly shooting and from the explosion of mines. The proposed cart is armored and moving on four wheels. It is armed with machine gun and supplied with camera. All the commands of operations were performed using Programmable Logic Controller "PLC". The experimental performance passed successfully by the use of remote control.

Keywords: PLC, Remote Control, Robotic, unmanned armed

1. Introduction

mart and remotely controlled weapons play an important role in recent decades' wars because of its capability to economize the battlefield losses, especially the soldier's life. One of these weapons is the armed cart[1-4]. The importance of armed unmanned cart comes from that it can be used to perform deadly or dangerous missions. These missions may be the salvation of soldiers from the battlefield, entering the radioactive area, fighting the enemies, and taking off the embedded bombs, mines, and blasts. The unmanned cart can be armed with machine gun and camera to trap the snipers or the groups of enemies, so these carts may call lethal weapons[2]. But the use of this cart must be controllable under the command of authorized persons and obeying the rule of humanity ethics [5]. In this research, an unmanned armed remotely controlled cart has been proposed in order to support the official army in the battlefield, by performing some of the deadly tasks due to its capability to carry a machine gun and camera to explore the location of enemies and fighting them.

2. Literature review

A soldier's life is one of the priorities of decision makers in any battlefield plans so this is taking the attention of the designers of the weapons to make the weapons as safe as possible, and the soldiers are kept away from the direct fire.

Recently the battlefield witnessed the proliferation of a variety of unmanned remotely controlled weapons like;

Unmanned aerial vehicle, armored cart, and mine clearance. All of these weapons was invented through researchers. In[1] the author proposes a report on the uses of robotic equipment in military and industry by making a comparison between the benefits of uses the robots in each type. In[2] the author points out the obstacles facing the advancement of unmanned weapon to be more significant in the various troop kinds of the united states armies. In[3] the authors present the insight of the peace organizations, United Nations, and human right organization upon the development of unmanned weapons, is it morally to be fully automated weapons or it must be under

control giving some recommendations about this. In[6] the author presents the vision of the development of autonomous robots toward medical uses in the battlefield and the importance of the integration between the armed autonomous vehicle and medical robot vehicle at the battlefield in the future. In [5] the authors presenting a report on the responsibility and morality of using autonomous systems and the rule of ethics that governing its uses. From all of the presented articles and reports, it can be seen that the military organizations spend billions of dollars to develop unmanned machines to economize the losses of battlefields, on the other hand there is a non-governmental organization (NGOs) that conflict with the developments of robotic armed machines used for military purposes until the clear defining the responsibility, morality, and ethics of the uses of robotic machines in wars. Whereas in medical side, the responses on that sector encourage the developing of unmanned machines, to use it for the salvation of injured soldiers in the battlefield.

3. Unmanned Cart Structure

The designed unmanned cart structure consists two main parts:

- A- Mechanical part.
- B- Electrical part.

A. Mechanical part

The mechanical part of the cart consists of:

- 1- Cart body.
- 2- Rotating joints and stand.
- 3- Gunslinger and shock absorbent.

1) Cart body

The cart body represents the case that contains all the parts (mechanical and electrical) of the unmanned cart. It is made from thick metal to protect the electrical parts from flinders and direct shooting. The case is carried on four wheels to ease the movement of the cart.

2) Rotating Joints with stand

To make the weapon operating in tactical movements, three gears have been used as rotating joints. two of these gears are used for azimuth rotation is fixed on the base of the iron standoff (1 m) in length that used to carry weapon slinger, to be rotated 270 degrees in azimuth directions, while the third gear is used to rotate weapon slinger in 60 degrees in elevation

directions. Figures (1-3) shows the gears used for azimuth direction, the gear used for elevation rotating, and the iron stand respectively.



Fig.1 Gears used for azimuth movement



Fig. (2) Gear used for elevation movement



Fig. (3) Iron stand

3) *Gunslinger and shock absorber.*

These parts of unmanned cart have been used for proven the

weapon (machine gun or any suitable desired weapon) and the camera on the top of the iron stand. the camera must be aligning with a weapon with high accuracy for the purpose of exactly shooting.

The shock absorber used for damping the reaction of the weapon undershooting operation. Figures (4,5) shows the gunslinger with shock absorber and guns lock.



Fig. 4 Gunslinger and shock absorber



Fig. 5 Gun's lock

B. Electrical part.

The electrical part consists the following:

- 1- Programmable logic controller (PLC).
- 2- Control distribution circuits.
- 3- Electrical machines and actuator.
- 4- Wiring harness.
- 5- Battery and battery charger.
- 6- Remote control and communication circuit.
- 7- The Camera.

1) Programmable logic controller (PLC).

This part is the heart of the armed cart, that it has the main role of controlling all the actions of the cart through the commands emitted from it. The PLC is programmed to produce the commands for control the operation and the movements of the cart in all directions, operating the weapon for shooting in elevation and azimuth directions, and controlling the operation of the camera. Also, the PLC can be programmed to control any additional devices for any additional jobs required from the cart.

2) Control distribution circuits.

These circuits used to distribute the commands that come from the PLC through a variety of relays and contactors to all the devices included in the cart to perform their functions. Figures (6,7) show how the distribution circuits perform its functions.

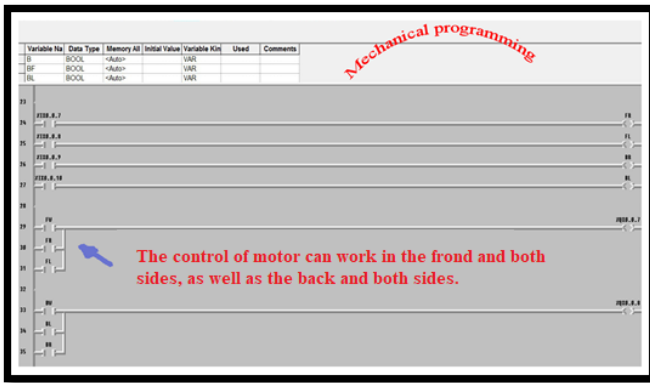


Fig. 6 Distribution Circuit for cart's wheel's movements

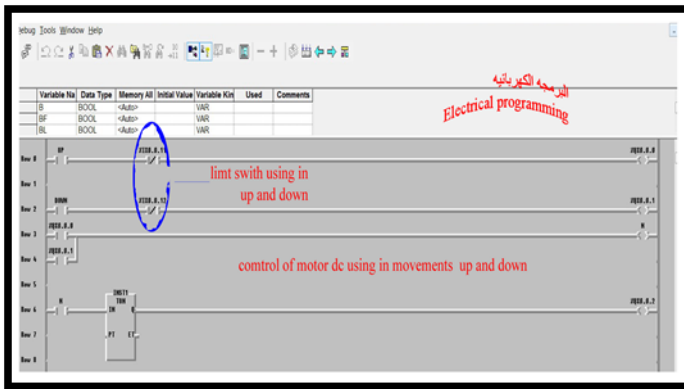


Fig. 7 Distribution Circuit for weapon elevation's movements

3) Electrical machines and actuator.

In order to operate and rotate all the gears within the cart, a variety of DC machines and rectifiers have been used. These machines used to derive the cart's wheels, rotating the stand of the weapon and gunslinger in azimuth and elevation directions, while the actuator used to actuate the gun operation using a command of the operation. Figure (8) presenting the operation algorithm of DC motors driving the cart wheels.

In this mode, programs are normally operated.

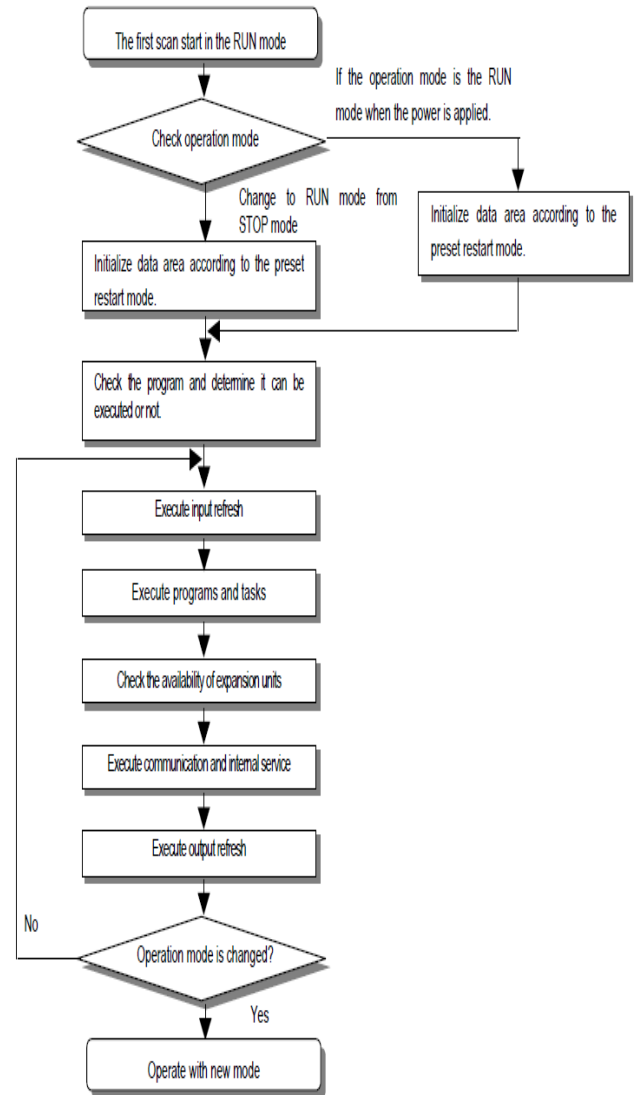


Fig. 8 The cart movement operation's algorithm

Figure (9) shows the speed control circuit to control the speed of the cart movements.

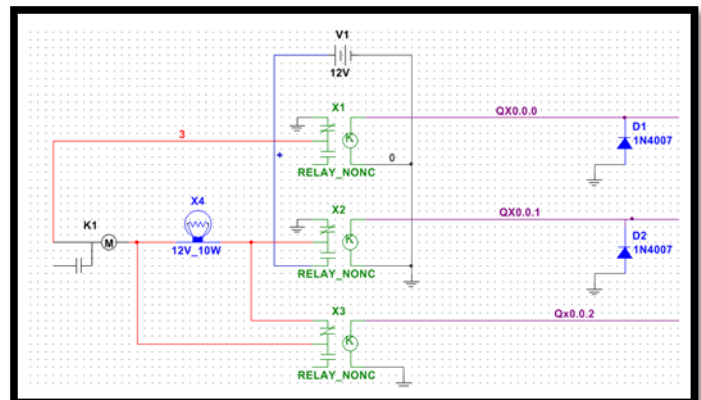


Fig. 9 The cart speed control circuit

4) Wiring Harness.

The wiring harness represents the interconnection or interfacing between the PLC and all the devices that controlled by the PLC inside the cart.

5) Battery and battery charger.

The cart is provided by a battery to supply electricity power to all the electrical devices. In order to continue the battery, live, a battery charger has been supplied to the cart to charge the battery during the rest of the cart.

6) Remote control and communication circuit.

The cart is provided with a remote sensor in order to receive the commands of operation of the PLC from the operator. These commands are supplied from the remote control unit that operated by the operator or commander to actuate the operation of the whole cart's electrical circuits. Also, the cart communicates with commander through transmitting the camera information to up to date the battlefield situation to the commander.

7) The camera.

The unmanned cart like any moving robot is blind without any sensing device. Moreover, as we were mentioned earlier that this cart is designed to serve in battlefield, so it must be provided with camera to be the eye of the commander in the battlefield. The camera is positioned and aligned with machine gun to use it by the commander to guide the cart in the field in order to survey the field where the cart is moving, and discover the objects (enemies, mines, traps) that may make dangerous or affecting the soldier's life. The battlefield scene situation transferred lively from the camera wirelessly to the commander to make proper decision for cart actions. So the camera plays a significant role in operating and driving the unmanned cart, in addition to its role for discovering and treating all the dangerous situations.

4. Cart operation's test and evaluation

The cart is experimentally tested in a training battlefield, to evaluate its performance. The test covering the operation of the cart movements, and its actions through the operation of the weapon with checking the alignment of the weapon with the camera to make the shooting is more accuracy. The experimental performance operation of the prototype of the autonomous armed cart is encouraged and all the commands had been executed precisely, except the alignment of the camera which needs more precise accuracy Figure (10) presenting the unmanned armed cart.



Fig. 10 Unmanned armed cart

5. Conclusion

As the cart is operated and tested successfully it is satisfying the purpose of made, also its support the armies tactical operations. This cart will economize battlefield costs and losses of humans and costs. The performance of the cart could be developed by adding more functions, like; a detector of Explosive materials, the detector of mines, arm to de operate and lifting mines, infrared camera, and movement detector, in order to be more active and more economy.

6. References

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