[Robotic T-shirt Launching System Mark II]

By

[Ziyu xiao]

[Moyang Guo]

[Hao ding]

[Yixiang Guo]

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1. Introduction

- Problem

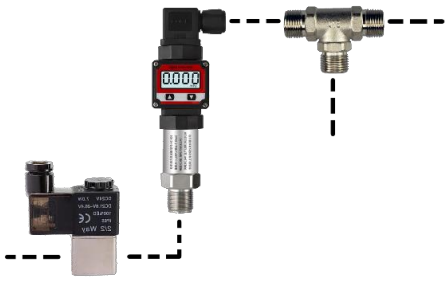
  The problem identified is the limitations of the previous T-shirt launcher design, which was a single-shot launcher that required manual reloading and could only adjust the angle and direction automatically. This design limited the efficiency and effectiveness of the launcher, making it unsuitable for certain scenarios.

- Solution

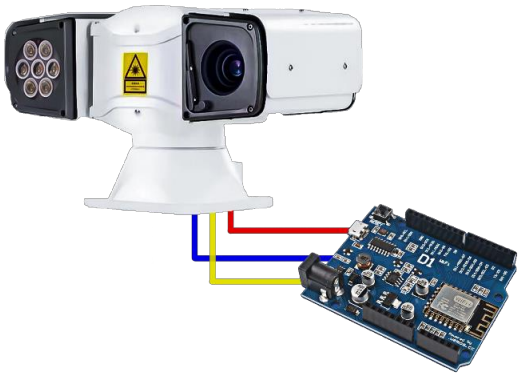
  Our proposed solution is the development of the Robotic T-shirt Launcher Mark II, which is an advanced and fully automated system that addresses the limitations of the previous model. The launcher will be able to launch multiple T-shirts without manual reloading, and it will include more advanced features such as the ability to adjust the trajectory of the launch. Additionally, we plan to build it into a wearable device that could be carried on our shoulders, allowing for greater mobility and flexibility in use.

  The launcher will consist of various components that work together to provide a powerful and reliable weapon system. The automatic loading system will be designed to be fully automated without the need for manual intervention. The control system will be responsible for managing the various components of the system, including the electromagnetic valves that control the airflow, the actuator controllers for the loading mechanism, and the gimbal controller for targeting. Overall, our proposed solution will provide a more efficient, reliable, and advanced launcher system that meets the needs of users.

- Visual Aid



Power system (electric power, air pump)



Control system (stabilizer, controller, Arduino, firing device)

Detection system (Camera, sighting, ranging, detection software)

Pneumatic system (Cylinder, pressure relief valve)

Secure system (Check valve, air-tight, pressure sensor,catch)

- High-Level requirements list

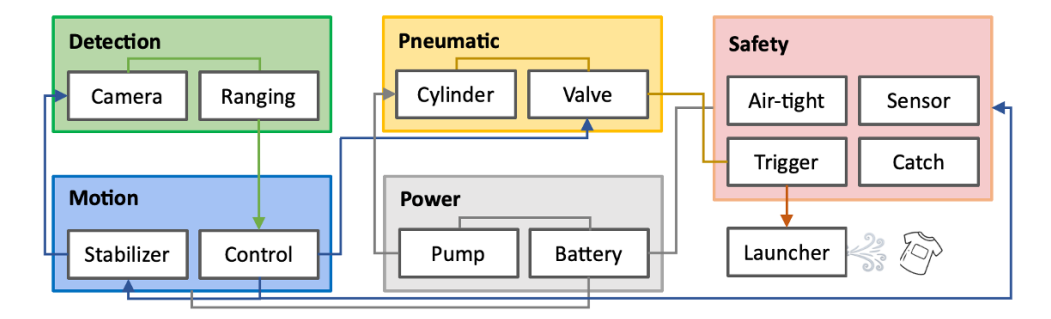
  a. Functionality: The launcher should be able to launch T-shirts accurately and consistently at a controlled angle and velocity. The system should be able to handle multiple T-shirts without the need for manual reloading, and the entire launch process and angle control should be initiated and controlled by a single button.

  b. Airtight and Adequate Air Pressure: The launcher's air channel should have high airtightness and be able to generate sufficient air pressure to launch T-shirts effectively. The air pressure should be able to be adjusted and controlled to suit different launch scenarios.

  c. Automation: The loading system should be fully automated, with T-shirts being automatically loaded into the air chamber without the need for manual intervention. The loading mechanism should be designed to be reliable and efficient, and the electrical control system should be able to manage the entire process automatically.

2. Design

- Block Diagram



- Subsystem Overview

  The power system of the block diagram consists of an air pump, air cylinder, quick exhaust valve, and connecting elements. These components are responsible for providing the necessary power and pressure to the system to shoot out the bullet. The air pump is responsible for pressurizing the air cylinder, which stores the compressed air needed to launch the bullet. The quick exhaust valve is responsible for rapidly releasing the compressed air, allowing the bullet to be launched at high speed. The connecting elements are responsible for joining the components together, creating a complete power system.

The control system is responsible for managing the various components of the system, including the electromagnetic valves that control the airflow, the actuator controllers for the loading mechanism, and the gimbal controller for targeting. The control system consists of a gimbal controller, actuator controllers, electromagnetic valves, and a microcontroller such as an Arduino. The gimbal controller is responsible for aiming the launcher, while the actuator controllers manage the loading mechanism. The electromagnetic valves control the airflow, regulating the compressed air to launch the bullet. The microcontroller acts as the central control unit that manages all the components, ensuring they work together efficiently.

The detection system consists of a camera, aim assist, rangefinder, and detection software. The camera is used to provide visual feedback to the user, enabling them to aim and lock onto targets effectively. The aim assist system is responsible for helping the user aim the launcher. The rangefinder measures the distance between the user and the target, providing crucial information for accurate targeting. The detection software enables advanced features such as automatic firing, angle adjustment, and target recognition lock-on, allowing the user to engage targets effectively. The human-machine interface can be used for advanced users to provide intuitive interaction with the system.

The secure system of the block diagram consists of a one-way valve, air-tightness, and pressure sensors. The one-way valve ensures the compressed air only flows in one direction, preventing it from flowing back into the air pump. The air-tightness of the system is critical to ensure that no air leaks from the system and that the pressure remains consistent. Pressure sensors are used to monitor the air pressure, ensuring it remains within safe operating limits.

The pneumatic system of the block diagram consists of an air cylinder and a pressure release valve. The air cylinder stores the compressed air needed to launch the bullet, while the pressure release valve is used to vent the air cylinder, allowing it to be reloaded safely. The pneumatic system is an essential part of the launcher, responsible for providing the necessary power to launch the bullet.

- Subsystem Requirements

(1) Power system Requirements:
- The air pump must provide sufficient pressure to launch the T-shirt.
- The air cylinder must store enough compressed air to launch multiple T-shirts without the need for constant refilling.
- The quick exhaust valve must have a fast response time and be capable of releasing a sufficient amount of compressed air to launch the T-shirt.
- The connecting elements must be leak-proof and able to withstand the pressure generated by the system.

(2) Control system Requirements:

- The electromagnetic valves must be able to control the airflow with precision and accuracy.
- The actuator controllers must be capable of moving the bullet into the launch position quickly and reliably.
- The gimbal controller must be able to adjust the launch trajectory with precision.
- The microcontroller must be able to process data quickly and send commands to the different components with minimal delay.

(3) Detection system Requirements:

- The camera must be able to capture high-quality images of the target.
- The targeting mechanism must be able to adjust the position of the launcher with precision.
- The detection software must be able to recognize targets accurately and calculate the optimal trajectory for launching the T-shirt.
- The human-machine interface must be user-friendly and provide advanced features for experienced users.

(4) Secure system Requirements:

- The one-way valve must be able to prevent air from flowing back into the system.
- The system must be airtight, preventing leaks.
- The pressure sensors must be able to monitor the pressure of the compressed air accurately.

(5) Pneumatic system Requirements:

- The air cylinder must be able to store enough compressed air to launch multiple T- shirt.
- The actuator controllers must be able to move the T- shirt into the launch position quickly and reliably.
- The relief valve must be able to release excess pressure quickly.

- Tolerance Analysis

One aspect of the Robotic T-shirt Launcher Mark II that poses a risk to successful completion of the project is the air channel. The airtightness of the air channel is crucial for generating sufficient air pressure to launch T-shirts effectively. To ensure that the air channel is airtight, we will conduct a tolerance analysis to determine the allowable tolerances for the various components of the air channel. This analysis will involve simulating the manufacturing process and determining the impact of component variation on the final product.

3. Ethic and Safety

The IEEE Code of Ethics emphasizes the importance of protecting the public, and we will ensure that the launcher is designed with safety in mind. This will include incorporating safety mechanisms such as emergency stop buttons and implementing additional components to measure critical values such as ga tightness to prevent gas leaks. In addition, we will consider potential ethical issues that may arise from the misuse of the launcher. The ACM Code of Ethics states that professionals should be

mindful of the potential impact of their work on society and take steps to minimize negative consequences.

We will also review state and federal regulations, industry standards, and campus policies to ensure that our design meets all applicable safety and regulatory standards. We will conduct thorough testing and ensure that the launcher is safe for use by both operators and bystanders.