STATS

“Self Targeting Android Turret System”

Group 8

Elso Caponi

Mike Lakus

Jonathan Thomas

Ali Marar

Sponsored by: TBA

2. Project Description

The self targeting android turret system or as we like to refer to it as “STATS” will be a slightly different take on previously designed turret systems. We plan on creating a camera based weapon system that uses software to locate a moving target and a combination of hardware and software to match a mounted air soft weapon’s point of aim to the located target in the camera’s view. We will create a base where we will house our circuit boards, camera, weapon, as well as the power system and related hardware.

The turret will use servo motors that will allow it to move in both the X and Y plane in order to follow a target as it progresses across the camera’s field of view. There will also be a mechanism that can pull the trigger on the air soft gun when an object is detected and release the trigger after a preset amount of time. Due to the fact that we will be using an electronic air soft gun we can expect that a large number of shots will be fired in a period of a few seconds which should put enough rounds on target to be sufficient.

Another important part of this turret is that we hope to link the camera system to our circuit board and through the use of Wi-Fi send the video signal to an android device. The android device will serve as an interface to the turret itself, showing the user exactly what the camera has in its view. With this additional step we can add such features as video recording, in order to store video directly to the android device. There is also an option where we can program the turret to have a manual mode and allow the user to control the turret manually through the android device, selecting targets as he or she chooses.

The motivation for this project is to learn how to build an electronic device that not only has a hardware and electronics requirement, but also requires us to learn how to program a device to communicate with a piece of equipment. We hope to gain knowledge in the design of circuits as well as the methods of controlling them through code and programs written individually. This group is an even split of computer and electrical engineering students, so we hope that by working together we can achieve something that bridges the gap between program and hardware design.

Our main goal for this project is to create a working device that can track and target a moving object within a reasonable distance effectively. We also want to be able to produce as many of the above features as we can in our given time frame. We have set our must have requirements to include a turret system that autonomously shoots moving objects and transmits video feed to an android tablet or phone through the use of Wi-Fi. Our secondary goals include making a manual mode with user controlled targeting, adding a friendly fire avoidance system, making the entire system as lightweight and as inexpensive as possible yet remaining durable, and creating a way to store video footage on the user’s device.

3) Specifications

Project will consist of an automated turret broken down into sections

Weapon: An AEG, electric airsoft gun will be used. The weapon of choice will be of compact design; either PDW (personal defense weapon) or SMG (sub-machine gun). The airsoft gun used will have primary and secondary requirements to meet. The primary requirements will be met accordingly for optimal performance, while secondary objective can be slightly modified depending on the scenario.

Primary: First and foremost, the airsoft gun will need to fire automatically. A gun firing automatically requires the trigger to be pulled back and held. As long as the trigger is held back, the weapon will continue to fire. For this project, semi-auto firing will not be an option. This type of firing requires the trigger to be pulled back and released after each round. Since this project will use an automatic airsoft gun, a greater number of rounds can be sent down range compared to a gun firing only semi-automatic. Typically, the unit of measurement for the number of rounds leaving the barrel over a set time is RPM, or rounds per minute. This project will require an airsoft gun yielding approximately 300 RPM. This will allow the weapon to fire 5 rounds every second, increasing the chance of hitting the desired target. The second primary requirement will be the muzzle velocity of the airsoft gun. This is measure in FPS, or feet per second. For this project, the maximum range the turret will be around 50 ft (15 m). A gun firing 250 FPS will be able to hit this mark. An ideal value would be 300 FPS. This would let the round travel on a straight path over a further distance.

Secondary: The BB weight (the weight of the round) must also be taken into consideration. Airsoft BBs are sold in weight by 0.12 gram, 0.20 gram, and higher. Depending on the quality of the airsoft gun, some do not accept the 0.12 gram BBs. Typically, higher-end guns will use 0.20 gram BBs or higher. The 0.12 gram BBs are used primarily in lower-end airsoft guns. The two main differentiating factors between these two weights are the FPS and accuracy. With 0.12 BBs, the round will leave the barrel at an increased velocity (usually around 30 FPS higher), but will be far less accurate due to their light weight and elements such as wind and foliage. With 0.20 BBs, the user will sacrifice some velocity for dramatically improved accuracy. These heavier BBs will be less affected by wind and light brush, as well as travel further. Additionally, higher end airsoft guns are rated for 0.20g BBs, so no conversion will be required to determine velocity. This project will utilize the 0.20 gram BBs for more accurate shots. The other secondary requirement is the hop-up unit installed within the airsoft gun. The hop-up unit performs one basic task: put backspin on the BB as it leaves the barrel. By doing this, the BB will travel on a more level and further trajectory than an airsoft gun without a hop-up installed. Fortunately, based off all other requirement, if a higher-end gun is used, hop-up is always installed. Many lower-end guns also contain this unit, however.

Camera: This will be the eyes of the turret. The camera will be mounted next to the platform for largest FOV (field of view). The camera build will be of a rugged design. This will allow for the camera to endure any disruptions (wind, dust, projectiles, etc.) while maintain field of view. Resolution of the camera will not be an important factor, as long as tracking performs as it should. A camera of 480p or 720p will work, but if 1080p or higher is available, it will be considered.

Mounting mechanism: The mounting mechanism will be used to mount the weapon to the servo motors. It has been suggested that the component on the front of a bike that connects frame to wheel looks viable. If this is not accessible, our own mount could be produced. The mount will have to be able to connect to the servo motors to have movement in the X and Y plane. The main requirement of the mount is to have easy access to the airsoft gun. This would allow for quick troubleshooting if the airsoft gun fails to work properly (i.e. BB jammed in barrel). Additionally, the mount will be built of durable material to withstand the torque of the servos turning an airsoft gun at reasonable speeds.

Servos: Two high torque servo motors (enough torque to rotate an approx. 5lb airsoft gun without lag) will be needed to move the turret. As mentioned above, the servos align the airsoft gun with the target in the X and Y axis in the FOV. For this project, the FOV is projected to be greater than 90 degrees and less than 180 degrees. The range of motion will actually rely on the camera FOV. If the camera is able to see the target, the servos will aim the airsoft gun accordingly. A third servo will be used for the trigger pull.

Battery: A combination of batteries will be needed for the weapon system, servo motors, and PCB. An airsoft gun battery for a higher-end electric gun is typically a 1200 mAh. These batteries are rechargeable with no more than a 2 hour charge time. This battery is separate from the others, and will be found internally in the airsoft gun. For the servos and PCB, standard DC batteries will be used, and replaced if needed. The voltage will most like be 5V depending on the servo and PCB requirements once final design is implemented.

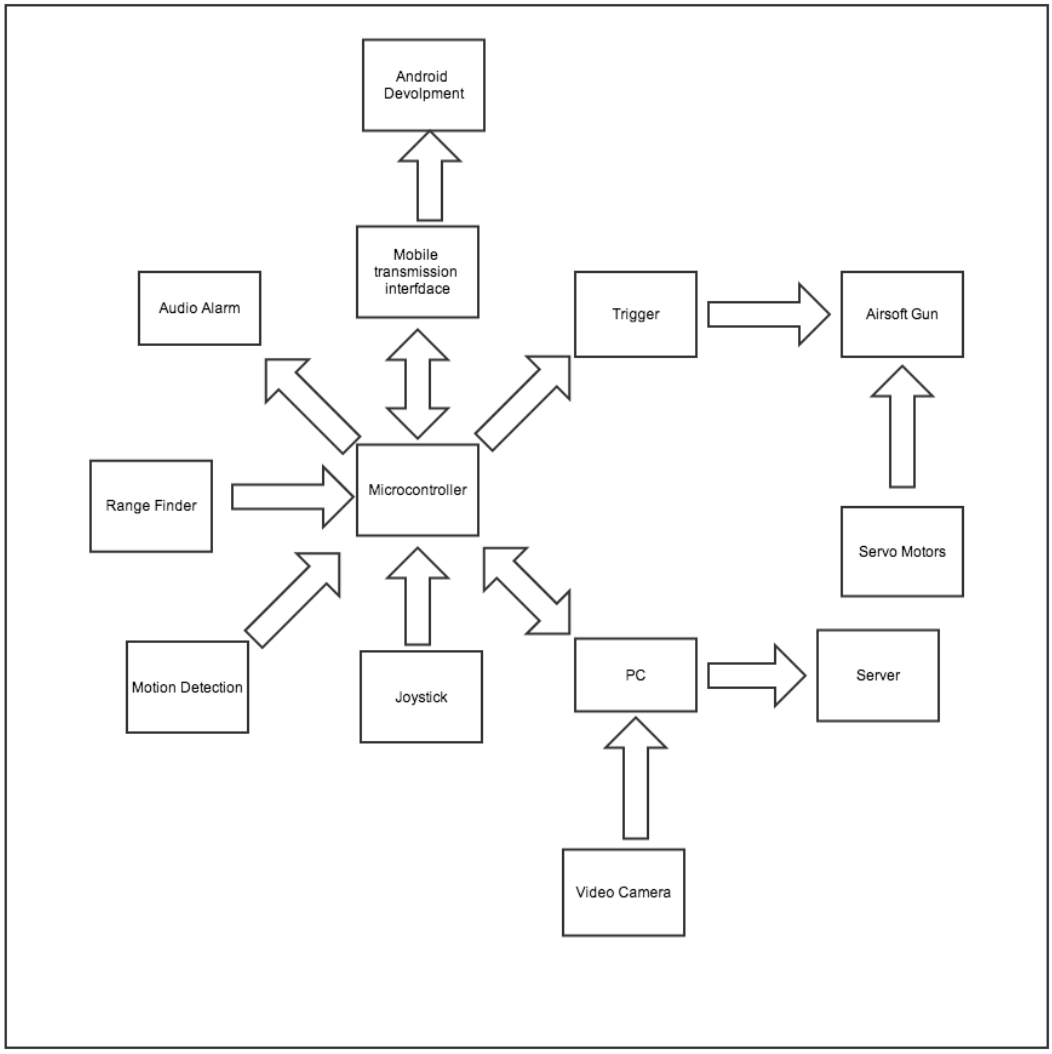
Platform: The turret will be mounted to a stable foundation to minimize shaking caused by torque of servo motors and the inertia of the airsoft gun. A 3-4 prong mount is the first design being considered. This will give the turret decent elevation from the ground and good support. A slab design will also be taken into consideration. This design will mount the servo setup to a high weigh slab (approx. 1x2 ft.). The slab will also allow for camera and PCB mounting, so the entire system can be moved without disassembling.

RF Remote and Sensor: This will be used to identify targets accordingly. An object or person in the turret's FOV wearing a remote of the correct frequency will be allowed to walk freely without being targeted. If no frequency, or the wrong frequency is recorded, the turret will engage.

PCB design: PCB will contain wifi connection to link all commands to an external android device. Our PCB will contain the appropriate components to perform the following features:

1) Track targets in the turret's FOV
2) Move servo motors to lock on to target
3) Identify friend or foe
4) Fire the airsoft weapon
5) Other additional features if needed

4. Block Diagram



5) Budget

This is a rough initial estimate of the cost the design and build an automated airsoft turret.

• Airsoft Gun with battery:	$0 - $150 (May have one in current possession)
• BBs:	$20
• Camera:	$0 - $50 (May have one in current possession)
• Servo and Airsoft gun mount:	$30
• Base platform:	$0 - $20 (May have one in current possession)
• Servo Motors:	$30
• PCB:	$70
• Tracking/Target recognition:	$60
• RF Reader:	$20
• Wifi Chip:	$15
• Batteries:	$10
• Resistors / Capacitors:	$8
• Wiring:	$5
• Misc. parts:	$0 - $50
ESTIMATED TOTAL:	**$268 - $538**

6) Project Milestone

Below are two tables for our spring and summer semesters in Senior Design 1 and 2 respectively. The goal at the end of Senior Design 1 is to have the final detailed description of our project written. Most of the time spent in Senior Design 1 and even into Senior Design 2 will be used for research. In Senior Design 2, the whole semester will be devoted to building, testing, and debugging our project.

Spring 2014 (16 weeks):

Milestone	Assigned to	Expected completion date
Form a project group	Everyone	End of week three
Choose a project	Everyone	End of week three
Create meeting schedule	Everyone	End of week three
Submit Project and Group Identification Document	Everyone	Beginning of fourth week (1/28)
- Create members' roles	Everyone	
- Project description	Elso	
- Specification and requirements	Mike	
- Block diagrams	Ali	
- Project budget	Mike & Ali	
- Project milestone	Jon	
Research	Everyone	Throughout entire project
Decide roles for project paper	Everyone	End of week six
Have 40 pages written	Everyone	End of week nine
Have 80 pages written	Everyone	End of week eleven
Have 120 pages written	Everyone	End of week fourteen
Review/finalize paper	Everyone	End of week fifteen
Submit paper	Everyone	End of week sixteen

Summer 2014 (12 weeks):

Milestone	Expected completion date
Gather materials	Beginning of week one
Build project	End of week five
- Set up mount/ attach gun	
- Attach camera to gun	
- Connect PCB	
- Connect processor	
- Programming	
Test	End of week six
Debugging	End of week twelve
Submit final project	End of week twelve