

COMPUTER CONTROLLED AIMING AND TAGGING SYSTEM

CONCEPT GENERATION

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PROBLEM STATEMENT

Static non-destructive method to test and evaluate the Computer Controlled Aiming and Tagging System used on missiles

Need to test dispersion, accuracy and latency of the marking system

Constraints:

Less than 1 degree resolution

Traverse the entire forward hemisphere in less than 1 second

Under 50 lb.

Safe firing mechanism

Target location via manual input



EXISTING SYSTEMS

There are none!



TAGGING SYSTEMS

- Paintball Marker
- Tippmann A5



PROS:

- Durable and reliable
- Relatively inexpensive
- Railing System
- Easy to disassemble
- Extremely customizable

CONS:

- Heavier
- Must upgrade for electric trigger system
- External hosing system
- Can be inaccurate
 - Possibly due to barrel



TAGGING SYSTEMS

- Empire Invert Mini
- **PROS:**
 - Light Weight
 - Compact
 - Completely Electronic
 - Easily Integrate
 - Completely enclosed hosing and wiring
- **CONS:**
 - Not Streamlined
 - Not easily modifiable
 - Relatively Expensive



BARRELS



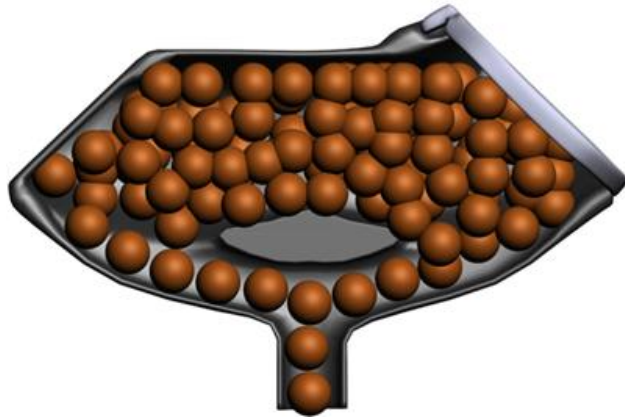
- **Hammerhead**
 - Longer
 - Rifled Barrel
 - Keeps pressure throughout barrel
- **Freedom Fighter**
 - Affordable
 - Only fits A5 marker
- **MoFo**
 - Carbon Fiber barrel
 - Can fit any marker
 - Expensive



BALL FEEDING

Standard Hopper

- Large and non-aerodynamic
- Can break balls and clog gun
- Has feeding and jamming issues
- Hinders full range of motion



Q-Loader Hooper

- Streamlined and movable
- Spring loaded
- can feed against gravity
- Does not get jammed



PRESSURE SYSTEM

CO2

- Can get very cold and destroy internal parts
- Internal conditions fluctuate greatly due to external temperatures and conditions
- Cheap

Compressed Air

- Reliable
- Easily attainable
- Captures moisture in the air which goes through the gun
- Expensive

Nitrogen

- Reliable
- Maintains a more stable pressure in paintball tanks under different ambient temperatures
- Pure Nitrogen contains no moisture
- Expensive



MARKING PAINT

Regular Paintballs

- Not a very long shelf life
- Can burst inside gun
- Inconsistent size and accuracy



RAP4 G.O.L.F. Paintballs

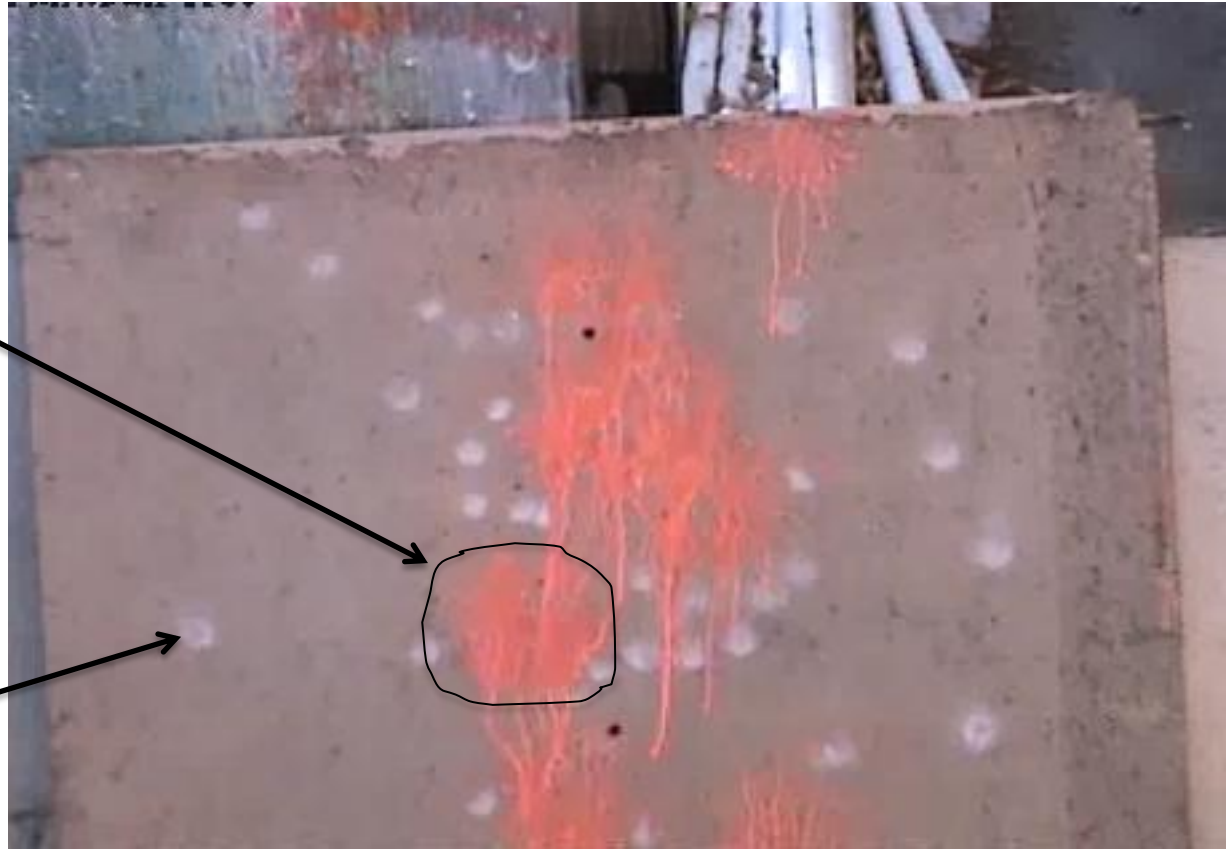
- Dimpled for better aerodynamics for further ball flight and accuracy
- Filled with powder that leaves a point that doesn't run
- Does not warp under different weather conditions



MARKING PAINT

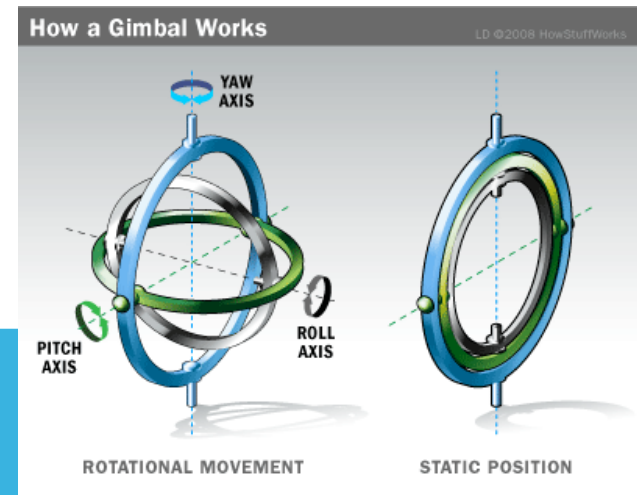
Regular Paintball
Mark

G.O.L.F. Mark



MECHANISM

- Will incorporate a Double Gimbal assembly
- A gimbal is a pivoted support that allows the rotation of an object about a single axis.
- Double-Gimbal assembly will provide the mechanism with two degrees of freedom
 - Requires two motors



DESIRED MOTOR CHARACTERISTICS

- Reasonable cost
- High Torque for rapid change of direction
- Feedback capabilities
- Accurate positioning mechanism



TYPES OF MOTORS

- SMART Motors
- Servo Motors
- Basic DC Motors



SMART MOTORS

- Made by Animatics Corporation
- High torque motor
- Integrated motor, controller, amplifier, encoder and communications bus
- Very Expensive
upwards of \$500



SERVO MOTORS

- Made by multiple companies
- Additional components needed for operation
- Cheaper than SMART Motors



DC MOTORS

- Widely produced product
- Very cheap
- Do not have position control



MOTOR DECISION MATRIX

Rating:

0: Lowest Score

5: Highest Score

		Concepts					
		Smart Motors		Servo Motors		Basic DC Motors	
Specifications	Weight	Rating	Score	Rating	Score	Rating	Score
Cost	30%	0	0	3	0.9	4	1.2
Position Accuracy	15%	4	0.6	4	0.6	1	0.15
Response Time	20%	4	0.8	3	0.6	1	0.2
Additional Components Required	10%	5	0.5	2	0.2	1	0.1
Overall Size	25%	3	0.75	2	0.5	3	0.75
Total	100%		2.65		2.8		2.4

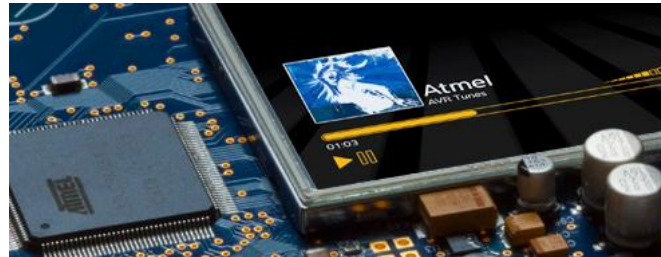


CONTROLLERS

- Arduino



- Atmel AVR

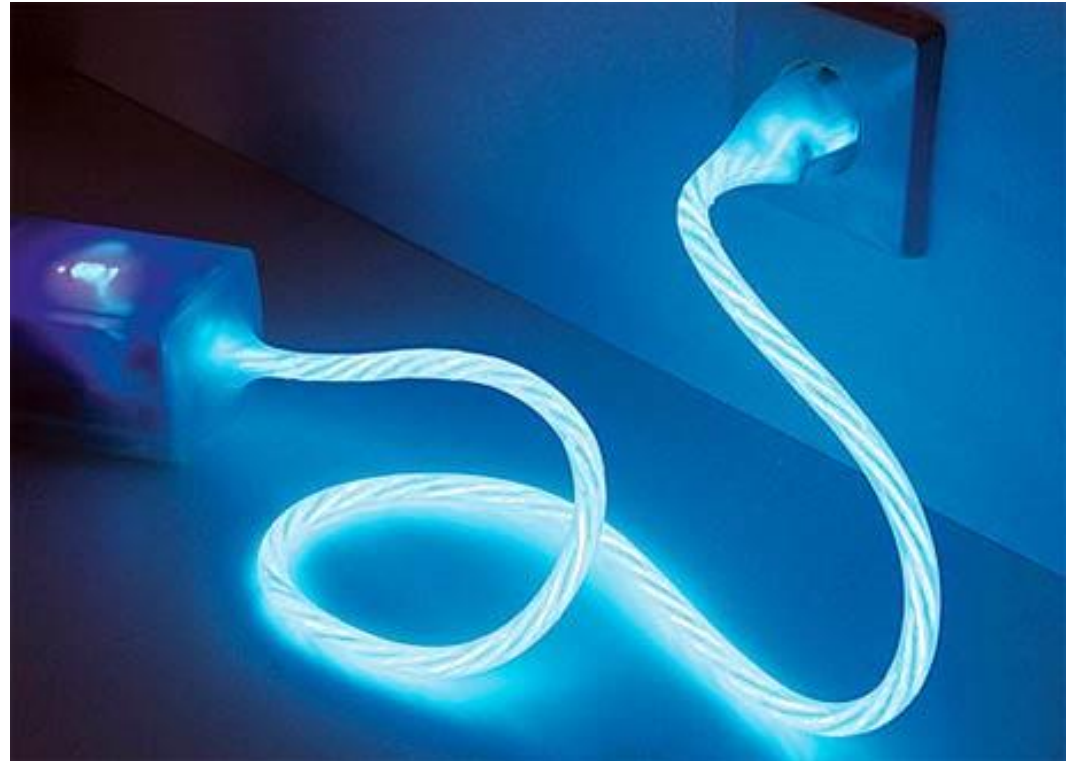


- ArbotiX Robocontroller



POWER SUPPLY

- Rechargeable Battery
- Generator
- Wall Plug



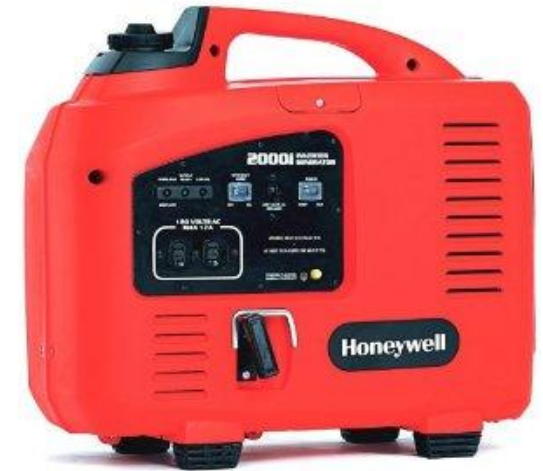
RECHARGEABLE BATTERY

- Small and Compact
- Light Weight
- Readily available
- Cost between \$20 and \$40



GENERATOR

- Plenty of power
- Will be small enough to move around with system
- Will inhibit the range of motion of system
- Will need to also buy fuel source for generator
- Expensive \$99 to \$350



WALL PLUG

- Universal plug can be plugged in anywhere
- Limited to power output of the wall
- Limited range of movability due to the cord
- Must be close enough to an outlet
- Cheap: Costs the amount of a power cord



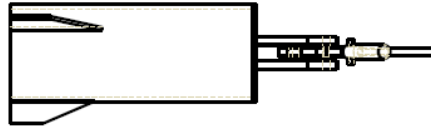
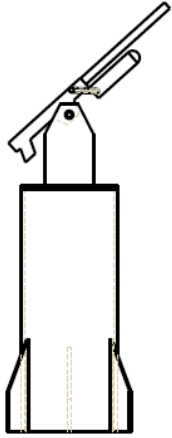
POWER SUPPLY DECISION MATRIX

Rating:
 0: Lowest Score
 5: Highest Score

Concepts

Specifications	Weight	Rechargeable Battery		Generator		Wall Plug	
		Rating	Score	Rating	Score	Rating	Score
Cost	25%	2	0.5	2	0.5	5	1.25
Power	15%	3	0.45	5	0.75	3	0.45
Size	20%	5	1	1	0.2	5	1
Maneuverability	25%	5	1.25	2	0.5	1	0.25
Ease of Use	15%	3	0.45	3	0.45	3	0.45
Total	100%		3.65		2.4		3.4

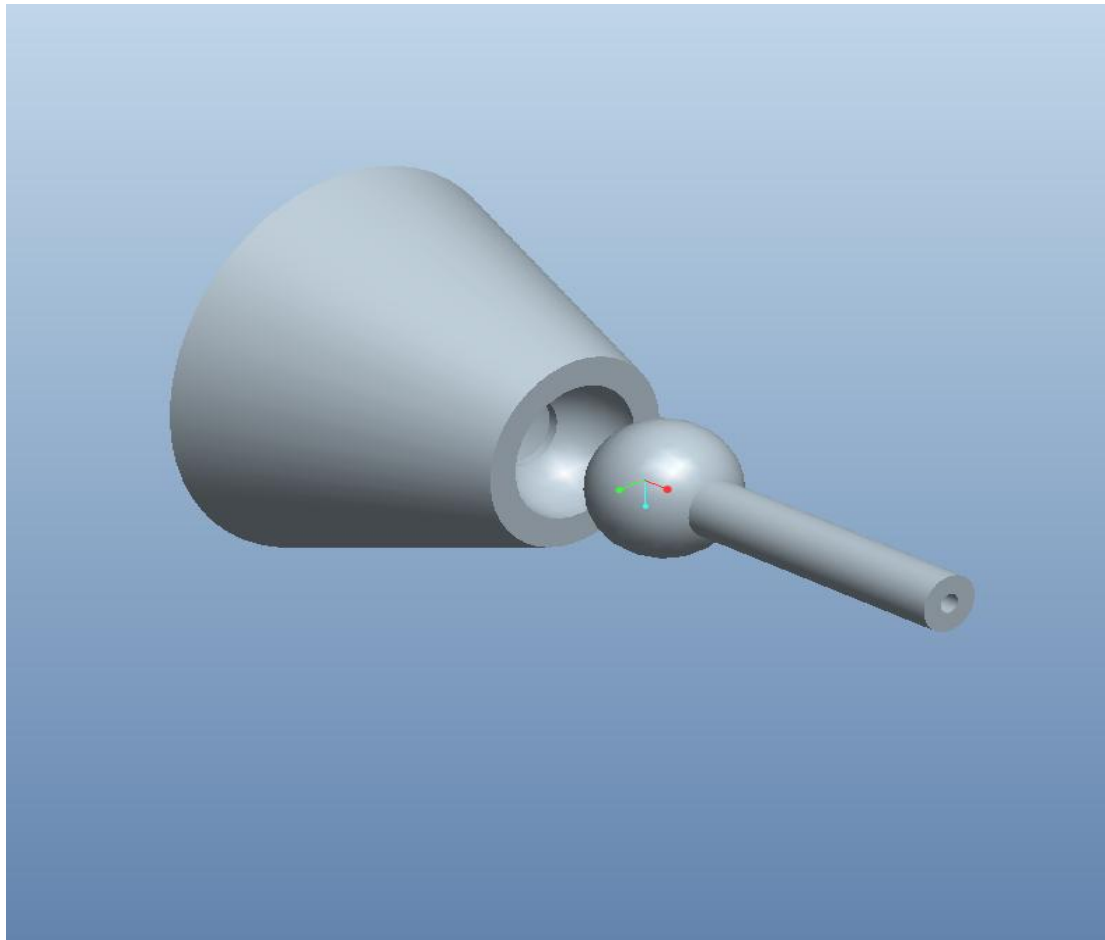




- Houses all electronics and gearing inside shell
- Mounts gun perpendicular to housing
- PROS:
 - Compact and streamlined
- CONS:
 - Make sure hosing and electronics get tangled up when spinning

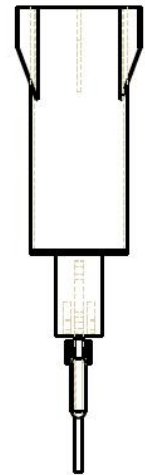
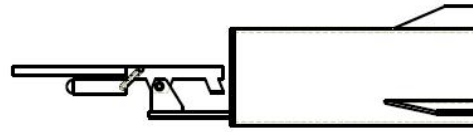
CONCEPT 1





- **Ball and Socket design**
- **PROS:**
 - Very compact and aerodynamic
- **CONS:**
 - Difficult to build to exact specifications
 - Wires could get tangles

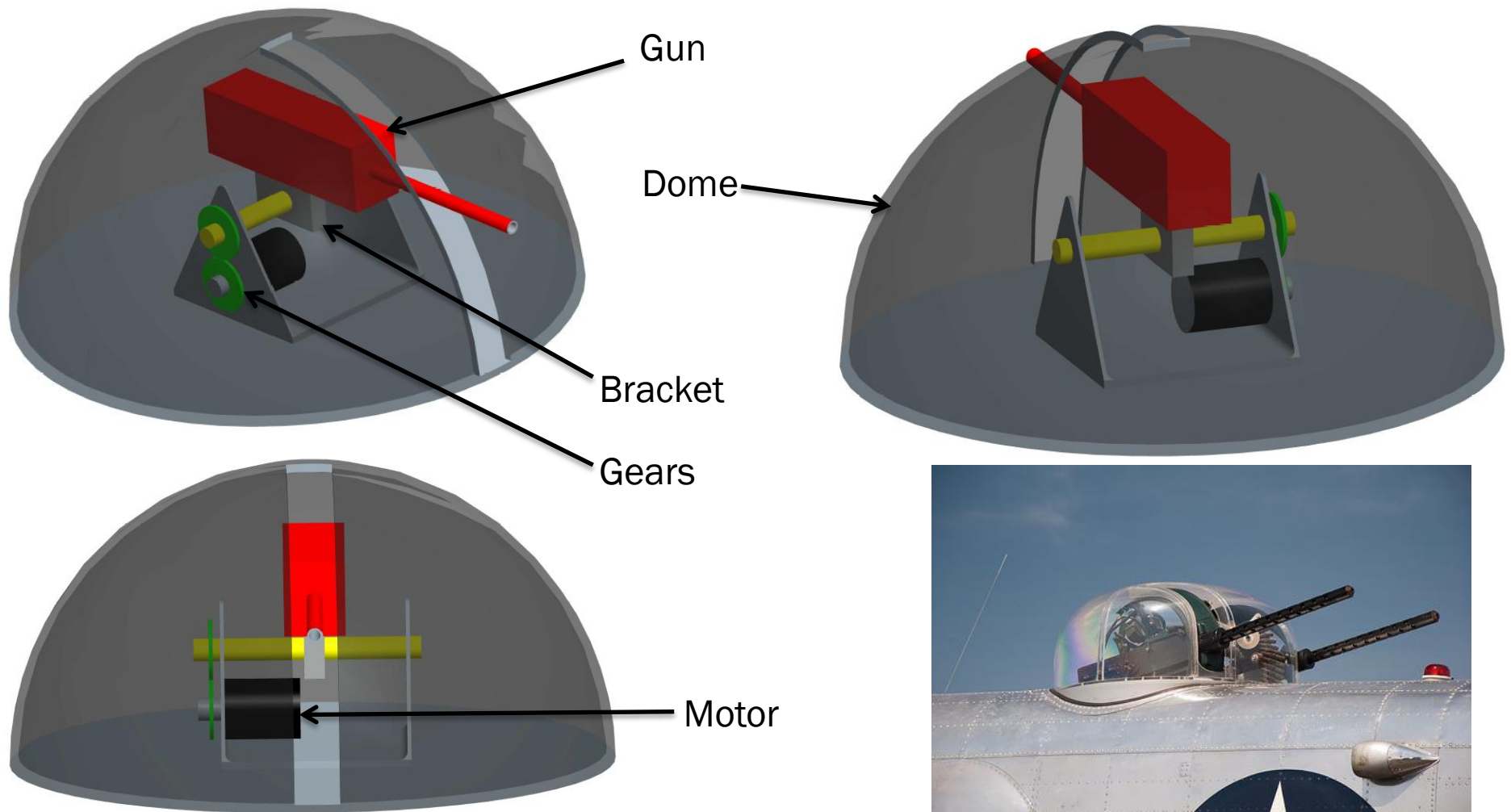
CONCEPT 2



- Houses all electronics and gearing inside shell
- Mounts gun parallel to housing
- **PROS:**
 - Compact and streamlined and allows hosing a direct path to housing
- **CONS:**
 - Stress on the platform mount the gun sits on
 - Electronics and hosing might get tangled while gun rotates



CONCEPT 3



- Houses all electronics and gear inside dome
- Mounts gun on bracket which is mounted on rod
- Uses gears to control gun elevation
- **PROS:**
 - Entire system is enclosed so electronics and hoses wont get tangled when spinning
- **CONS:**
 - Not streamlined and not easily attached to cable for future testing

QUESTIONS?

REFERENCES

- <http://www.trossenrobotics.com/p/arbotix-robot-controller.aspx>
- http://www.atmel.com/dyn/products/product_card.asp?part_id=4117&category_id=163&family_id=607&subfamily_id=2138
- http://store.diydrones.com/product_p/br-dev-09152.htm
- <http://www.tippmann.com/index.aspx>
- <http://www.hammerheadpaintball.com/>