

Active Electronic Assault System (AEAS)

A live computerized combat system



Initial Project and Group Identification

Department of Electrical Engineering & Computer Science

EEL 4914 Senior Design I

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Project Description:

The Active Electronic Assault System (AEAS) will be a fully featured, live, accurate, adaptable and computerized combat system. Many current US Army trainers assert the low fidelity and negative training issues associated with current laser based combat training systems. High cost, low accuracy (due to beam divergence), impenetrability of foliage or other soft obstructions, and low fidelity hit notification mechanisms are just some of the more prevalent issues with current laser based systems. We want to develop a low cost, easy to use, high fidelity system that will allow soldiers to train more effectively and in more realistic conditions. The successful implementation of this project may also prove to have applications in numerous other fields such as commercial gaming (since it'll be a lot of fun!).

The implementation of AEAS will consist of three main parts:

1. **Weapon attachment device** - this will be an electronic device that can easily be attached to any particular weapon with a trigger, specifically military weapons. This will allow soldiers to use their own personal weapons in combat training. The device will measure weapon orientation which is communicated to the main server and will provide a means of pinpointing the weapon's location and orientation in 3-dimensional space. The weapon attachment will run on battery power. A 'shot' signal will be sent to the main server when the user presses the trigger.
2. **Body attachment device** - this will provide a means of pinpointing the user's location in 3D space. Small vibration motors will be attached to various locations of the user's bodies to provide localized 'hit' penalties when the corresponding message is received from the main server. If there is enough time and resources, we can also attempt to provide motion tracking of players by utilizing additional IMUs attached to the user's bodies.
3. **Main server** - this will be a distinct hardware and software system that pieces the combat scenario together. When a 'shot' signal is received from a weapon attachment device, data concerning the weapon orientation and position will be captured and used to mathematically determine the shot trajectory based on predefined weapon specifications. If another user is determined to be within the bullet trajectory, a signal is sent to the body attachment device assigned to that user with data concerning where they were hit. This server will also provide a front end web accessible GUI that will allow trainers to view the scenario as it progresses in real time, as well as keep logs of all of the data so that it can be used in soldier's After Action Reviews (AAR).

Specifications & Requirements

- Electronic bullets should be accurate to within 5 cm at a firing distance of 25 m.
- Based on the max field distance, weapon orientation information should be accurate to within 0.11 degrees. Formula: $\text{deg accuracy} = \tan^{-1}(\text{bullet accuracy}/\text{distance})$.
- All battery operated devices must last for at least 2 hours of continuous use.
- Data will be sampled at no less than 1 KHz to create an active system.
- Bandwidth between the attachment devices and the server should be no slower than 50 Kbps to create an active scenario display.
- Weapon attachment will have a total weight of no more than 5 lbs.
- Weapon attachment should take up no more than a 5 in³ area.
- Body Attachment will have a total weight of no more than 5 lbs.
- The system must have the ability to accommodate a variable number of users (between 1 and 20) even though the project itself (most likely) will not provide more than two systems.
- The system must be able to maintain communication among all components within a bounded area no smaller than 25 m (width) X 25 m (length) X 5 m (height).
- Latency (time delay) of the system should be limited to 1 second maximum (the user should not be able to easily observe hit detection or firing delays).
- GUI display should not have a latency greater than 1 second.
- All data shown in the GUI must be precise (conformance to other established specifications such as position detection) and accurate (up-to-date).
- The body attachment is expected to notify users of injury through the use of vibration devices on the body part that has been hit (arms, legs, torso) for a minimum of five hit regions.

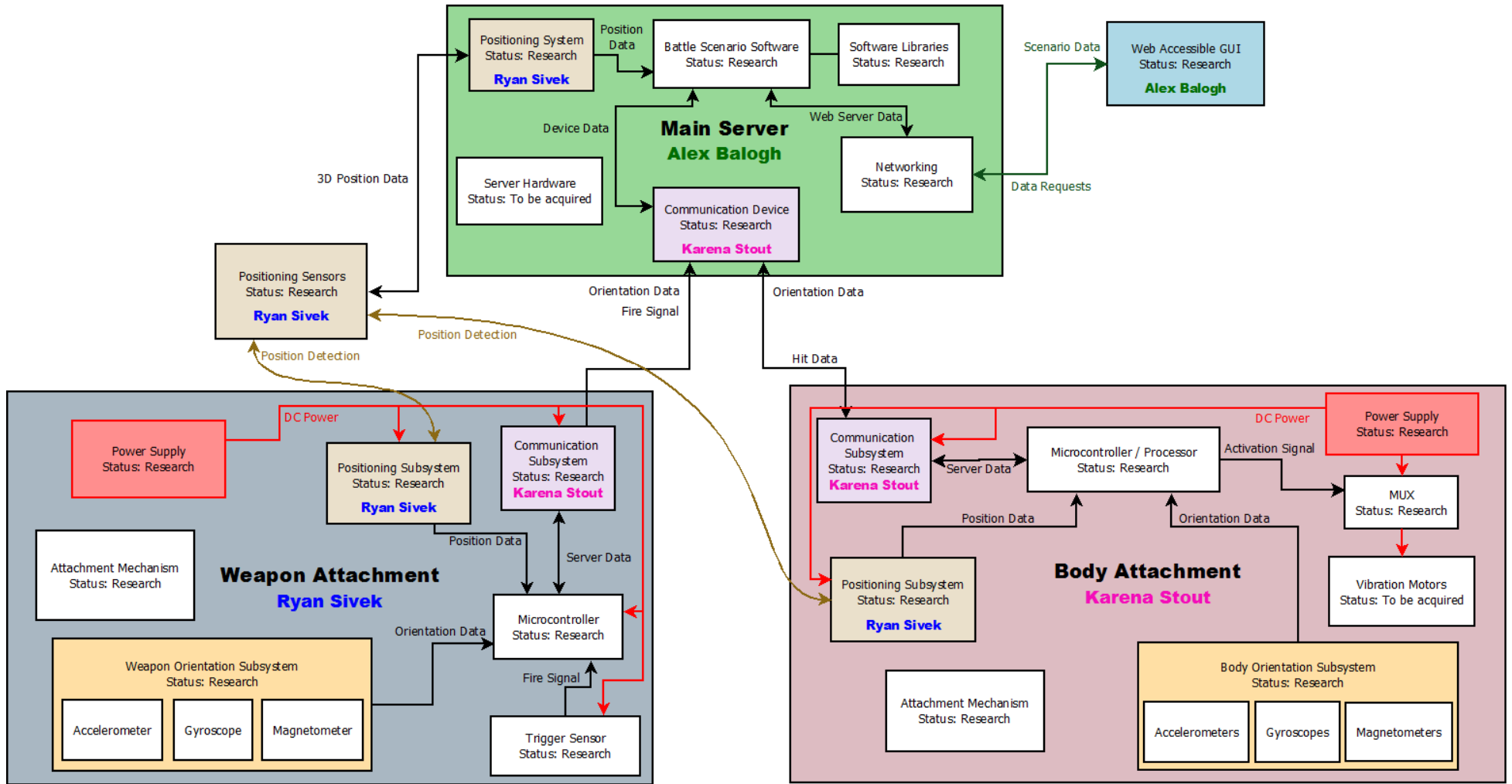


Figure 1: Overview of Main Project Components

Budget

Component	Quantity	Estimated Cost
Sensors/Microcontroller Atmel Inertial Two Sensors Xplained development board	2	\$60
Unit Positioning Ultrasonic position sensor	20	\$120
Power Supply Battery	3	\$30
Vibration Device 10mm Shaftless Vibration Motor 3.4mm Button Type	5	\$25
Wireless Communications Bluetooth	3	\$150
Server Hardware Raspberry Pi Model B	1	\$50
RFID Reader Parallax RFID Read/Write Module - Serial	2	\$100
RFID Tag	1	\$2
Trigger Sensor Parallax Flexiforce Pressure Sensor	1	\$25
Cables for Positioning System	20	\$30
Miscellaneous Unforeseen expenditures	NA	\$150
	TOTAL:	\$742

Table 1: Approximate cost to develop the system.

We are confident that the project will be fully sponsored by the MITRE Corporation, of which Ryan is an employee. If, however, funding is not available, the team is also prepared to equally divide the cost amongst all members.

Milestones

	Name	Start	Finish	Duration	Qtr 4, 2013				Qtr 1, 2014			Qtr 2, 2014		
					Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	
1	Deliverables	9/9/13 8:00 AM	4/11/14 5:00 PM	155 days?										
2	Initial Project Document	9/9/13 8:00 AM	9/17/13 5:00 PM	7 days?										
3	Final Research Document	10/4/13 12:00 PM	11/15/13 1:00 PM	30 days?										
4	Critical Design Review	1/6/14 8:00 AM	1/20/14 5:00 PM	11 days?										
5	Conference Paper	3/17/14 8:00 AM	4/11/14 5:00 PM	20 days?										
6	Final Project Document	3/3/14 8:00 AM	4/11/14 5:00 PM	30 days?										
7	Presentation	3/24/14 8:00 AM	4/11/14 5:00 PM	15 days?										
8	Research Phase	8/26/13 8:00 AM	10/28/13 5:00 PM	46 days?										
9	Position System Research	8/26/13 8:00 AM	9/20/13 5:00 PM	20 days?										
10	Orientation System Research	8/26/13 8:00 AM	9/27/13 5:00 PM	25 days?										
11	Communications Research	9/2/13 8:00 AM	10/4/13 5:00 PM	25 days?										
12	Power Research	10/11/13 8:00 AM	10/25/13 5:00 PM	11 days?										
13	Microcontroller Research	9/16/13 8:00 AM	10/25/13 5:00 PM	30 days?										
14	Trigger Sensor Research	9/13/13 8:00 AM	10/4/13 5:00 PM	16 days?										
15	Server Hardware Research	9/2/13 8:00 AM	9/9/13 5:00 PM	6 days?										
16	Server Software Research	9/9/13 8:00 AM	10/11/13 5:00 PM	25 days?										
17	Server Networking Research	9/9/13 8:00 AM	9/20/13 5:00 PM	10 days?										
18	Circuit Design Research	10/14/13 8:00 AM	10/28/13 5:00 PM	11 days?										
19	Design Phase	9/20/13 8:00 AM	4/1/14 5:00 PM	138 days?										
20	Weapon Attachment Design	10/21/13 8:00 AM	11/11/13 5:00 PM	16 days?										
21	Body Attachment Design	10/21/13 8:00 AM	11/11/13 5:00 PM	16 days?										
22	Communication System Design	10/7/13 8:00 AM	10/28/13 5:00 PM	16 days?										
23	Positioning System Design	9/20/13 8:00 AM	10/28/13 5:00 PM	27 days?										
24	Server Software Design	10/14/13 8:00 AM	11/4/13 5:00 PM	16 days?										
25	Web GUI Design	3/10/14 8:00 AM	4/1/14 5:00 PM	17 days?										
26	Acquisition Phase	9/9/13 8:00 AM	11/15/13 5:00 PM	50 days?										
27	Server Hardware Acquisition	9/9/13 8:00 AM	9/16/13 5:00 PM	6 days?										
28	Position System Acquisition	9/27/13 8:00 AM	10/18/13 5:00 PM	16 days?										
29	Orientation System Acquisition	10/4/13 8:00 AM	10/25/13 5:00 PM	16 days?										
30	Communications Acquisition	10/11/13 8:00 AM	11/1/13 5:00 PM	16 days?										
31	Power Acquisition	10/25/13 8:00 AM	11/15/13 5:00 PM	16 days?										
32	Microcontroller Acquisition	10/18/13 8:00 AM	11/8/13 5:00 PM	16 days?										
33	Trigger Sensor Acquisition	10/4/13 8:00 AM	10/25/13 5:00 PM	16 days?										
34	Prototype Phase	12/16/13 8:00 AM	3/19/14 5:00 PM	68 days?										
35	Weapon Attachment Initial Prototyping	12/16/13 8:00 AM	2/3/14 5:00 PM	36 days?										
36	Body Attachment Initial Prototyping	12/16/13 8:00 AM	2/3/14 5:00 PM	36 days?										
37	Weapon Attachment Final Prototyping	3/3/14 8:00 AM	3/19/14 5:00 PM	13 days?										
38	Body Attachment Final Prototyping	3/3/14 8:00 AM	3/19/14 5:00 PM	13 days?										
39	Test Phase	12/16/13 8:00 AM	4/1/14 5:00 PM	77 days?										
40	Position Precision Analysis	12/16/13 8:00 AM	1/27/14 5:00 PM	31 days?										
41	Orientation Precision Analysis	12/16/13 8:00 AM	1/27/14 5:00 PM	31 days?										
42	Weapon Attachment Initial Testing	2/3/14 8:00 AM	2/24/14 5:00 PM	16 days?										
43	Body Attachment Initial Testing	2/3/14 8:00 AM	2/24/14 5:00 PM	16 days?										
44	Weapon Attachment Final Testing	3/19/14 8:00 AM	3/26/14 5:00 PM	6 days?										
45	Body Attachment Final Testing	3/19/14 8:00 AM	3/26/14 5:00 PM	6 days?										
46	Server Testing	1/6/14 8:00 AM	2/10/14 5:00 PM	26 days?										
47	Initial Integrated Testing	2/10/14 8:00 AM	3/3/14 5:00 PM	16 days?										
48	Final Integrated Testing	3/19/14 8:00 AM	4/1/14 5:00 PM	10 days?										
49	Web GUI Testing	3/19/14 8:00 AM	4/1/14 5:00 PM	10 days?										