TUV - ADDS

Tactical Up-armored Vehicle - Automatic Distress Detection System

A. PROJECT DESCRIPTION:

1. PROJECT NAME:

Tactical Up-armored Vehicle - Automatic Distress Detection System (TUV-ADDS)

2. PROJECT MEMBERS:

1. Alyssa Almanza
2. Eric Nachtigal
3. Jason Skopek
4. Julien Mansier

3. PROJECT SPONSORS:

We currently do not have any sponsor. We are, however, writing proposals for several DOD contract companies for project support.

4. PROJECT INFORMATION CONTRIBUTORS:

- Nicole Coeyman - Improvised Explosive Device Effects Simulator (IEDES) program Lead Engineer, U.S. Army Program Executive Office Simulation, Training, and Instrumentation (PEO STRI), Product Manager Training Devices (PM TRADE), Product Manager Live Training Systems (PM LTS).
- Brittney Johnson - U.S. Army, Deployed to Iraq. Combat Vehicle Systems (CVS) Team Military Analyst, PEO STRI, PM TRADE, PM LTS.
- Eduardo Irizarry - United States Marine Corp, Deployed to Iraq and Afghanistan. Subject Matter Expert for Lockheed Martin.
- Yair Guzman - United States Navy, Deployed to Iraq.

5. PROJECT NARRATIVE:

The concept of the Tactical Up-armored Vehicle – Automatic Distress Detection System (TUV-ADDS) is to be able to automatically detect that a vehicle is in distress by recognizing certain characteristics of a distress causing event, and accurately communicate that there is a need for help and the position of where it is needed to other vehicles in the area. The scope of the system is meant to be relative to up-armored, but not heavy armored tactical vehicles, and two specific distress instances; roll-over and significant IED hits.

The motivation of this project came from the interest many of the group members had in pursuing a defense related project. Many members hope that having a defense related project will be beneficial in pursuing a defense or military related career.

We hope to achieve in the creation of TUV-ADDS, a system that is not only successful in detecting specific event s and recognizing that they are important, but also having the system contact others in these events for help and relay the distressed vehicles position . From speaking with some military experts who have been in the recent Iraq and Afghanistan theaters, we have heard of several instances where vehicles become nonoperational and help was needed. Usually the vehicle occupants have to radio this request, but we thought that it might be helpful to the user if these requests were automatically sent to commands or nearby vehicles. Therefore, our goal is to make TUV-ADDS user-friendly, accurate at detecting specific events and relaying position, and out of the way so that it is not a burden to the user. The objective is to allow the user to focus on what is wrong with their vehicle, engage an enemy or even save time when trying to escape a vehicle, and know that there is help on the way without having to call for it themselves.

B. SPECIFICATIONS AND REQUIREMENTS:

- Module A - Sensor Module
  - Sensor MCU
    - Must have a clock speed of between 5 - 10MHz
    - Must have a minimum of 5 data lines
    - Must have extensive Interrupt Service Routines
    - Must be able to communicate data in packets with the main processors
  - Accelerometer
    - Sensitivity: +/- 20g
    - Rise/Fall time: < 25ns
    - Three axis capable: X, Y and Z
    - Bandwidth:500 to 1000 Hz
  - Temperature
    - Range: up too 150°C
    - Accuracy: +/- 0.5°C
    - Response time: < 1,000 ms
  - Flash/Photodioes
    - Rise/Fall time: < 3.0us
    - Detect near the visible light spectrum: 400 to 800nm

- Module B - The Brain and Mouth
  - Main Processor
    - Must have a minimum clock speed of 20 MHz
    - Must have multiple extensive interrupt services
    - Must be able to run multiple data lines simultaneously
    - Must have a minimum flash ram size of 512K
    - Must contain a WatchDog Timer
    - Must be able to packet data for data lines
    - Minimum supply voltage

- Comm
  - Must have a minimum range of 100ft
  - Must be able to send packets
  - Must have a low fail rate
  - Must have interference avoidance capabilities
  - Minimum supply voltage

- GPS
  - Must be accurate with in 5 meters
  - Frequent updates would be preferred
  - Must be have Speed accuracy of above 60 mph
  - A cold start up time of below 35 secs
  - Supply voltage below 5V

- Gyro
  - 3 axis
  - Supply voltage below 5V
  - High Refresh rate
  - High Shock Resistance

- Module C - Vehicle Health System (VHS)
  - Diagnostic MCU
    - A simple, low-power processor will suffice
    - Must have a minimum of 3 data control lines
    - Must have a clock speed of between 5 - 10 MHz
    - Must have intterupt service capabilities

  - Tire Pressure
    - Be able to detect drastic changes in tire pressure
    - Must take several readings per second
    - Must be able to withstand high pressures

- Module D - Drive Unit
  - Drive MCU
    - The MCU from the Sensor Module will suffice

  - Drive RF
    - A device equivolent to the Main Comm will suffice
  - Actuator
    - Must be a linear actuator
    - Must have a max force below 20 lbs
    - Must have a smooth extention
    - Position must be stable

- Servo
  - A turning radius no less than 180 degrees
  - High Torque
  - Maximum turning speed
  - Able to adapt to hardware

- Switch
  - A simple relay switch will suffice

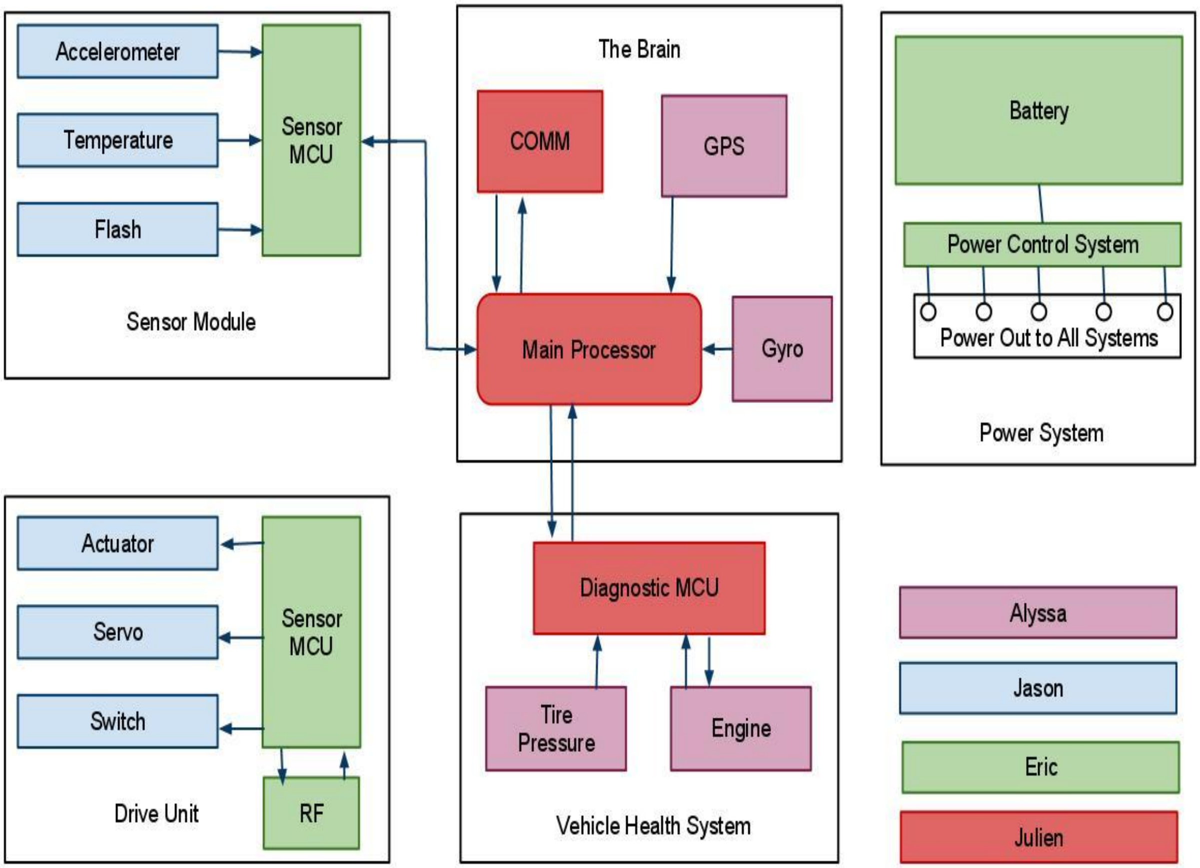
- Module E - Power Control System
  - Must allow several different voltage outputs i.e. 1V, 2.2V, 3.3V, 5V
  - Must have consistent current
  - Must be stable
  - Must have a fail safe

- Module F - Software
  - Main Processor
    - Will utilize extensive intterupt services
    - Will send all data in packets
    - Will utilize high clock speed for efficient data control
    - Will utilize processor fast wake-up time to keep power consuption at a minimum

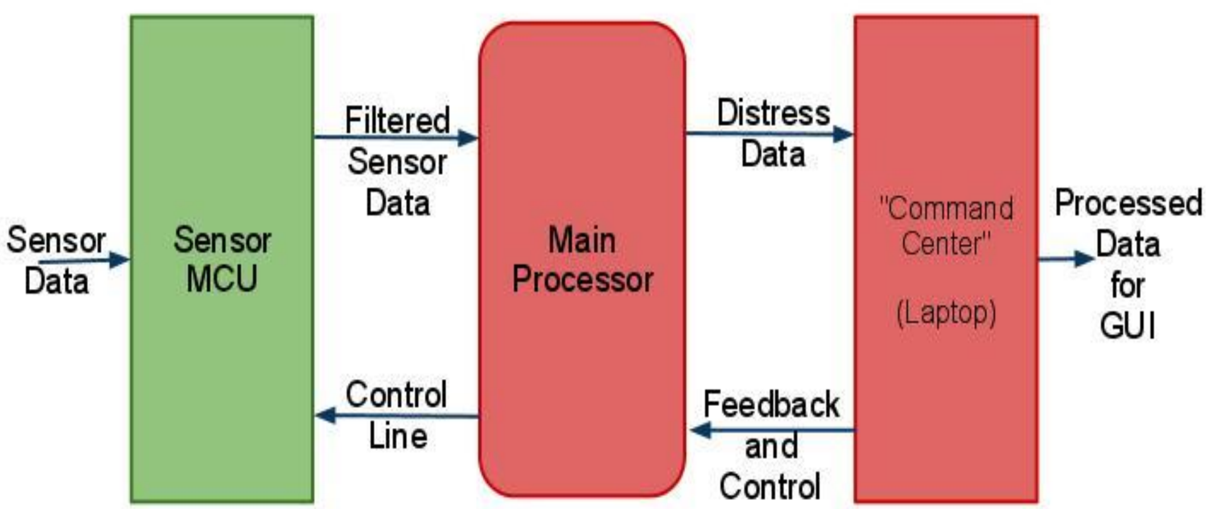
  - Command Center
    - Intuitive GUI
    - Stable Platform
    - Must be able to decode data packets from Serial (WiFi)
    - User will have control over previous vital data
    - Development will be done in either C++ or Java

C. BLOCK DIAGRAM:

1. HARDWARE BLOCK DIAGRAM:



2. SOFTWARE BLOCK DIAGRAM:



3. BLOCK STATUS:

Device	Group Member	Status
Accelerometer	Jason Skopek	To Be Acquired
Temperature Sensor	Jason Skopek	To Be Acquired
Flash Sensor	Jason Skopek	To Be Acquired
Actuator	Jason Skopek	To Be Acquired
Servo	Jason Skopek	To Be Acquired
Switch	Jason Skopek	To Be Acquired
Sensor MCU	Eric Nachtigal	To Be Acquired
Drive MCU	Eric Nachtigal	To Be Acquired
Drive RF	Eric Nachtigal	To Be Acquired
Battery	Eric Nachtigal	To Be Acquired
Power Control System	Eric Nachtigal	Research
GPS	Alyssa Almanza	To Be Acquired
Gyro	Alyssa Almanza	To Be Acquired
Tire Pressure	Alyssa Almanza	Research
Engine Health	Alyssa Almanza	Research
Main Processor	Julien Mansier	To Be Acquired
VHS MCU	Julien Mansier	To Be Acquired
Main Comm	Julien Mansier	To Be Acquired
Data Packing Software	Julien Mansier	Research
Data Comm	Julien Mansier	Research
Command Center GUI	Julien Mansier	Research

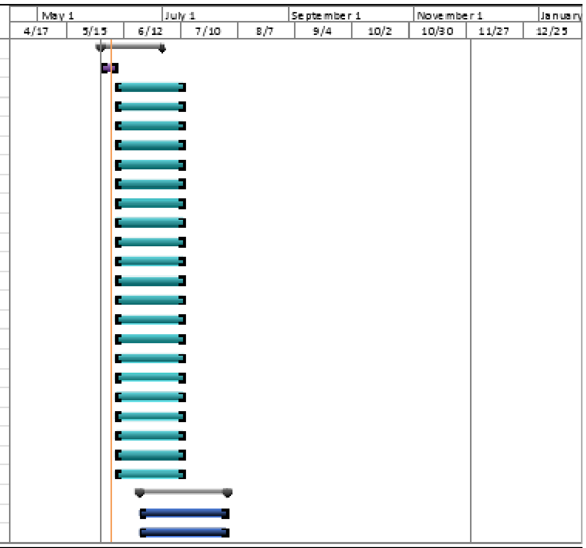
D. BUDGET:

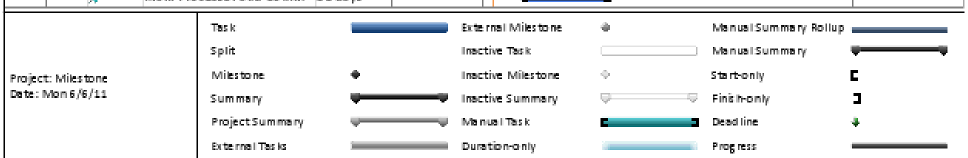
The budget for this project will be between 400-800 dollars with a potential overrun to approximately 1400 dollars. Looking at the itemized budget we could easily fall to the lower end of the projected costs if we give ourselves enough time to work with the components and not have to purchase the more expensive but easier to use components. We are going to attempt to source as much of the project from sample programs offered by semiconductor manufacturers. We plan to fund the project by splitting the costs of the components at the time of purchase.

Budget	Low	High	Average	Low Part	High Part
Vehicle	30	350	180	Metal Frame	Powerwheels
Battery	10	250	45	Racers Edge 6 Cell	Thunder Power g6
Power Control Systems	10	25	15	SparkFun	Jameco
CPU	1	50	20	TI Arm Cortex M3	TI ARM Cortex A8
Sensor MCU	0.25	6	2	TI MSP430	Atmel ATMega
Drive MCU	0.25	6	2	TI MSP430	Atmel ATMega
Tire Pressure Sensor	7	22	0	Adafruit Industries	SEN-08712
Flash Sensor	0.3	1.99	0.9	TBD	TSL14S-LF
Accelerometer	3.09	53.16	9	Bosch Sensortec BMA220	ADIS16240ABCZ
Temperature Sensor	3.5	3.5	3.5	TMP03FSZ Analog Devices	
GPS	50	90	55	Venus w/ SMA connect	GS407 Helical
Vehicle Health MCU	1	5	2.5	MSP430 (low end)	MSP430 (high end)
Actuator	40	90	0	MigaOne Linear	FA-400-L-12-18"
Servo	14	45	20	SparkFun	RobotZone
Engine Switch	0.99	17	3	Panasonic Corp	Tyco
Main Comm (one end)	44	80	45	XBee	XBee Pro
Drive RF	10	100	20	Stepper Motor, Driver board	RC controlor
Gyroscope	7.53	13.57	10	L3G4200DTR	L3G4200DTRIC
PCB Fabrication	43	60	50	SunStone Circuits	ExpressPCB
33% Misc. Expenses	91.05	418.85	159.36		
Total	366.96	1688.08	642.26		

E. PROJECT MILESTONES:

ID	Task Mode	Task Name	Duration
1		Phase 1 - Research	22 days
2		Initial Write-Up	6 days
3		Accelerometer	24 days
4		Temperature Sensor	24 days
5		Flash Sensor	24 days
6		Actuator	24 days
7		Servo	24 days
8		Switch	24 days
9		Sensor MCU	24 days
10		Drive MCU	24 days
11		Drive RF	24 days
12		Battery	24 days
13		Power Control System	24 days
14		GPS	24 days
15		Gyro	24 days
16		Tire Pressure	24 days
17		Engine Health	24 days
18		Main Processir	24 days
19		VHS MCU	24 days
20		Main Comm	24 days
21		Data Packing Software	24 days
22		Data Comm	24 days
23		Command Center GUI	24 days
24		Phase 2 - Design	31 days
25		Sensor Module	31 days
26		Main Processor and Comm	31 days





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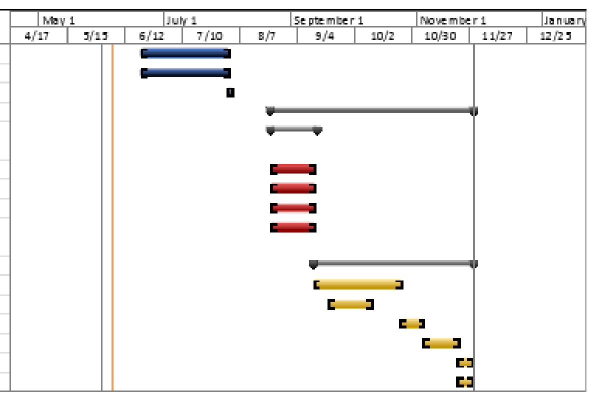
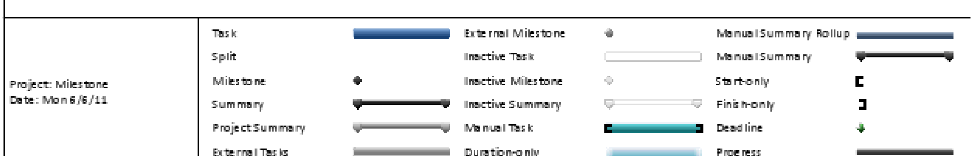
ID	Task Mode	Task Name	Duration
27		Vehicle Integration	31 days
28		Command Center GUI	31 days
29		Final Design Document	3 days
30		Phase 3 - Implementation	71 days
31		Phase 3.A - Initial Prototype	17 days
32		Test/Build Sensor Module	16 days
33		Test/Build Main Comm	16 days
34		Test/Build Drive Unit	16 days
35		Test/Build Command Center GUI	16 days
36		Phase 3.B - Final Prototype	56 days
37		Test/ Debug Circuit	31 days?
38		Build Circuit	16 days?
39		Design Review	10 days?
40		Final Revisions	12 days
41		Final Documentation	6 days
42		Presentation	6 days





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F. ACRONYM LIST:

ARM: Application Real-time Embedded
CPU: Central Processing Unit
CVS: Combat Vehicle Systems
DOD: Department of Defense
GPS: Global Positioning System
GUI: Graphical User Interface
Gyro: Gyroscope
IED: Improvised Explosive Device
IEDES: Improvised Explosive Device Effects Simulator
MCU: Micro Controller Unit
PCB: Printed Circuit Board
PEO STRI: U.S. Army Program Executive Office Simulation, Training, and Instrumentation
PM LTS: Product Manager Live Training Systems
PM TRADE: Product Manager Training Devices
RF: Radio Frequency
Servo: Servomechanism
TBD: To Be Determined
TI: Texas Instruments
TUV-ADDS: Tactical Up-armored Vehicle - Automatic Distress Detection System
VHS: Vehicle Health System