

## Background

Embedded systems are a combination of software and electrical hardware designed to perform a multitude of specific functions. There are increasingly large number of electronics and electro-mechanical systems that rely on embedded system design to perform a set of tasks. Many of these embedded designs employ a software controlled microcontroller, single board computer (SBC), and/or Field Programmable Gate Array (FPGA). The use of embedded systems has many advantages including upgradeable firmware, lower component count, and quicker development time.

## Approach

Embedded designs are used in many consumer devices, and the available technologies can be leveraged for numerous projects including quick proof of concept all the way to final deliverable designs. Advanced Design and Manufacturing (ADM) has used a variety of micro-controllers, SBCs and FPGAs throughout many design, evaluation, and production stages. Here are a few examples:

- Arduino and mbed are good open source microcontroller systems for quick proof of concept.

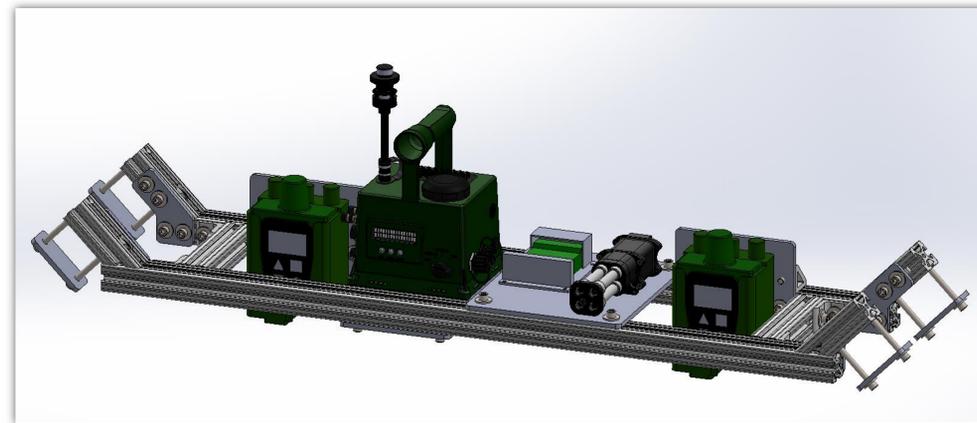
*Example: Smart Colorimetric Assay Reader (SmartCAR)*

- Microcontrollers are the most basic type of software programmable systems, and available as a wide array of products, such as Microchip's dsPIC family, Silicon Lab's 8051 devices, and Atmel's AVR product line.

*Example: Husky Mounted Detection System Trainer (HMDS-T)*

- FPGA: The FPGA architecture is the most flexible, allowing for configuration of hardware components at power-on. They provide the ability to add hardware-driven peripherals such as an Analog to Digital converter (ADC) and serial communication ports. Some devices include built-in microcontrollers.

*Example: Extending the Reach of the Warfighter through Robotics.*



## Extending the Reach of the Warfighter through Robotics

An FPGA with embedded power pc processor was used to interface with an AN/UDR-14 Radiac, Joint Chemical Agent Detector (JCAD), TAC BIO, and vapor collection system. Software on the FPGA does various control functions on the CBRN payload, and provides data translation between the proprietary interfaces on the various detectors. A Common CBRN Sensor interface (CCSI) network connection is used to access and control the payload. This system is used on the RecTamer Autonomous un-manned ground vehicle.

## Smart Colorimetric Assay Reader (SmartCAR)

A functional prototype using an mbed LPC1768 microcontroller to interface with pushbuttons, display, camera, and lighting. With this design, the user is able to insert the test strip and the SmartCAR will take a picture for analysis. ADM provided a prototype to read color assay strips for various agents and continuation of efforts to include additional agents.

## Husky Mounted Detection System Trainer (HMDS-T)

An 8051 microcontroller was used to provide RFID targets and detection for the HMDS-T. By interfacing with an RF module, the microcontroller is able to deliver / receive messages between a vehicle-based transceiver and a buried threat tag. The transmitted packet information includes the type of threat information and the transceiver is able to detect signal strength to calculate the tag detection location. This system is a cost effective approach to train soldiers in using HMDS to detect buried hazards such as mines and improvised explosive devices.