**LOCKHEED MARTIN**

# Swarming Robots

They will find you...          ISU  ECpE          Group: May 13-08

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## Introduction

**Problem Statement**

Every day, all over the globe men and women are placed in dangerous situations; soldiers go to war, police officers keep the peace and rescue workers face dangers to save the lives of others. However, is all this risk necessary? By utilizing the technology of autonomous vehicles the dangers these people face can be drastically reduced, while allowing them to do more than ever before.

The aim of this project is to create a swarm of autonomous vehicles that can cooperate to accomplish simple missions while adapting to changing situations in real time. There will be one "command center" which will send missions to the swarm and allow the user to track mission progress. The swarm will need to autonomously decide how to search a specified area to best complete the given mission. Each vehicle will be equipped with GPS sensors, a webcam and other sensors that will help them traverse the search area.
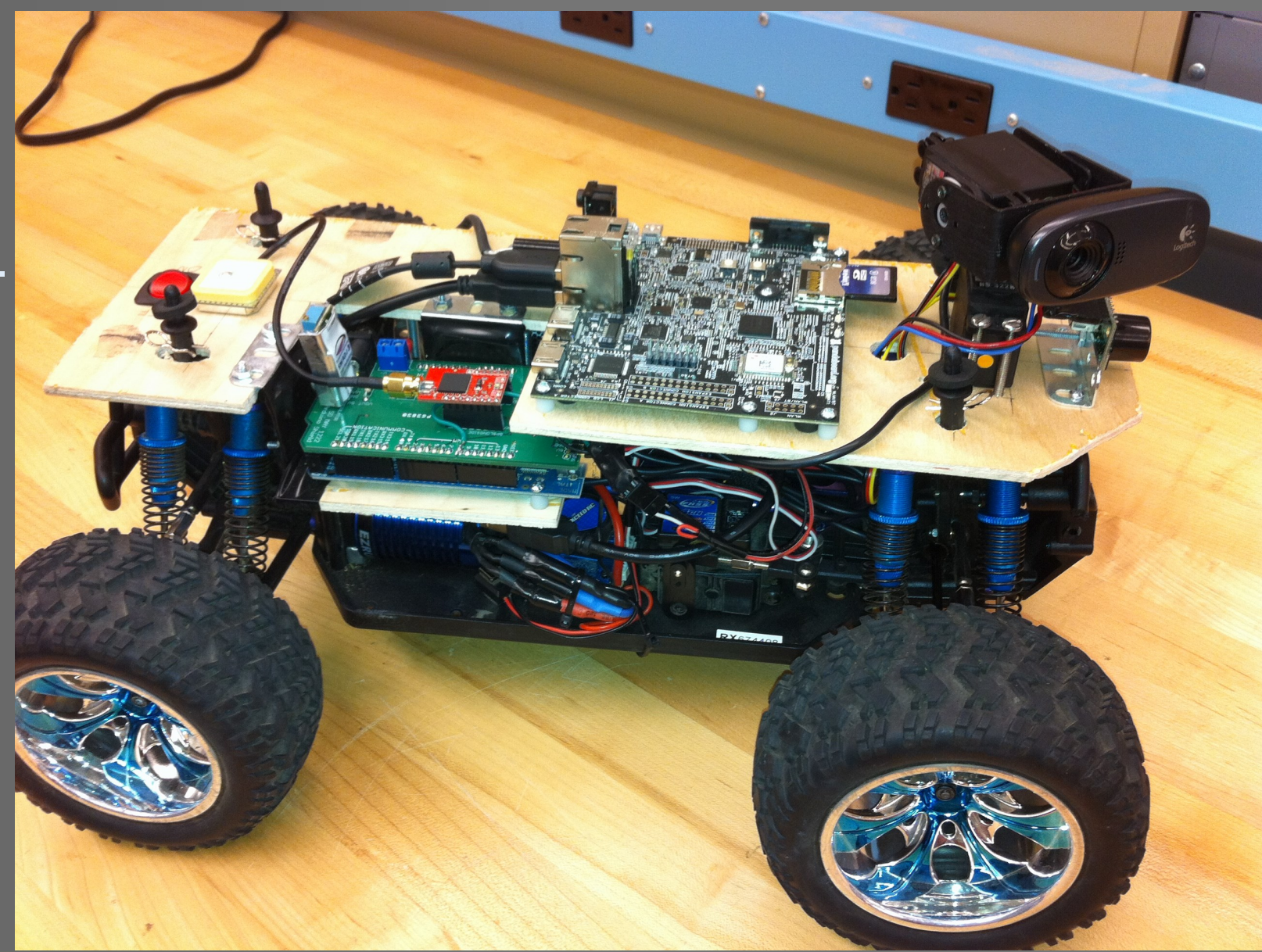
## Design Requirements

**Functional**

- Nodes in the network must be able to work together to complete mission objective
- The network must be ad-hoc
- If a node drops out of the network; each node must calculate where to move in order to repair the network
- Routes must be planned and re-planned dynamically as needed
- Ability to autonomously drive within 5 meters of a given coordinate that is reachable with the current battery life
- Each vehicle must have a unique payload, physical or virtual (robotic arm, bucket, water bottle, etc.)

**Non-Functional**

- The system must be able to share output from any sensor type
- At any point in time, the current information that a node has about other nodes in the network must not be older than 20 seconds
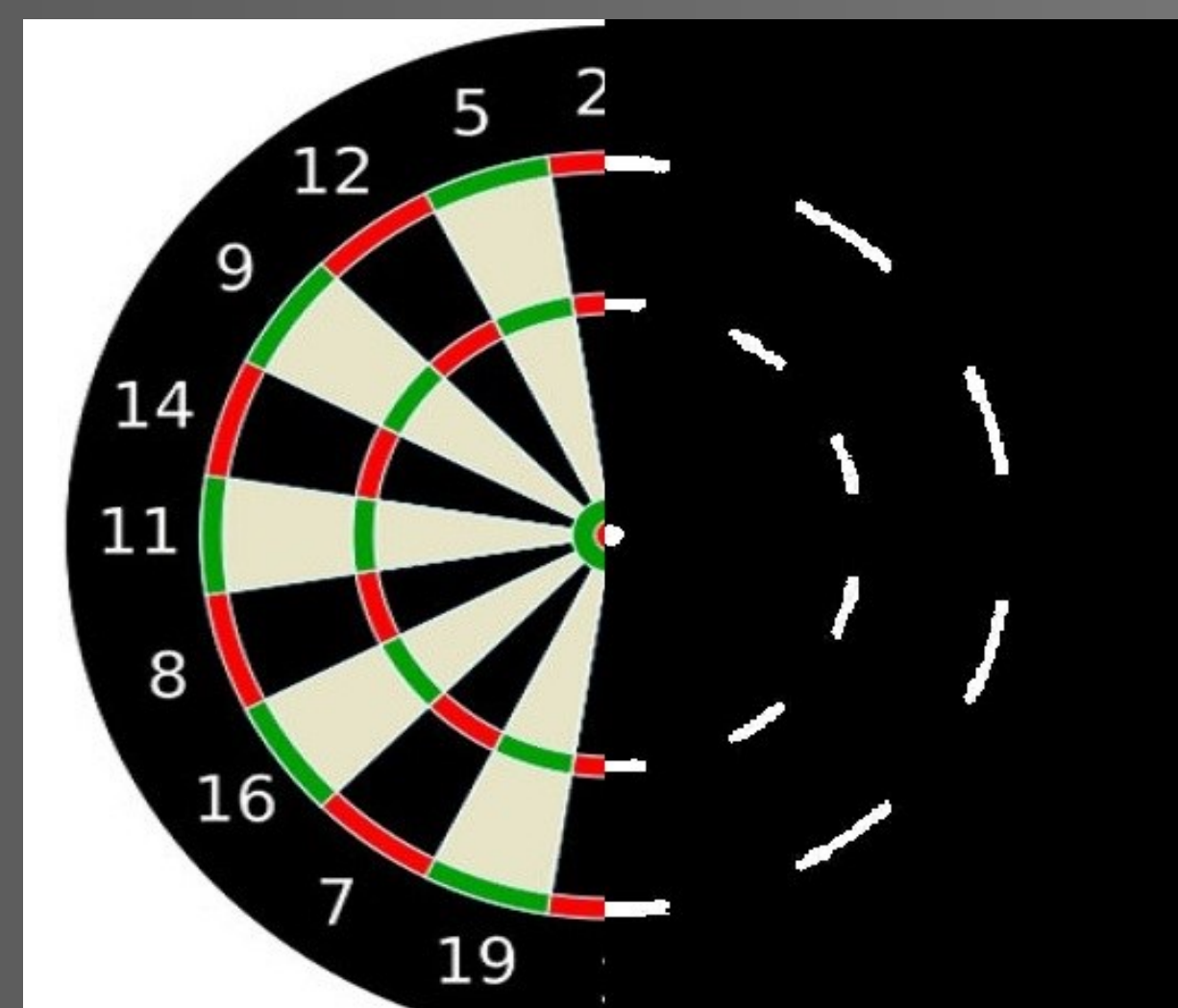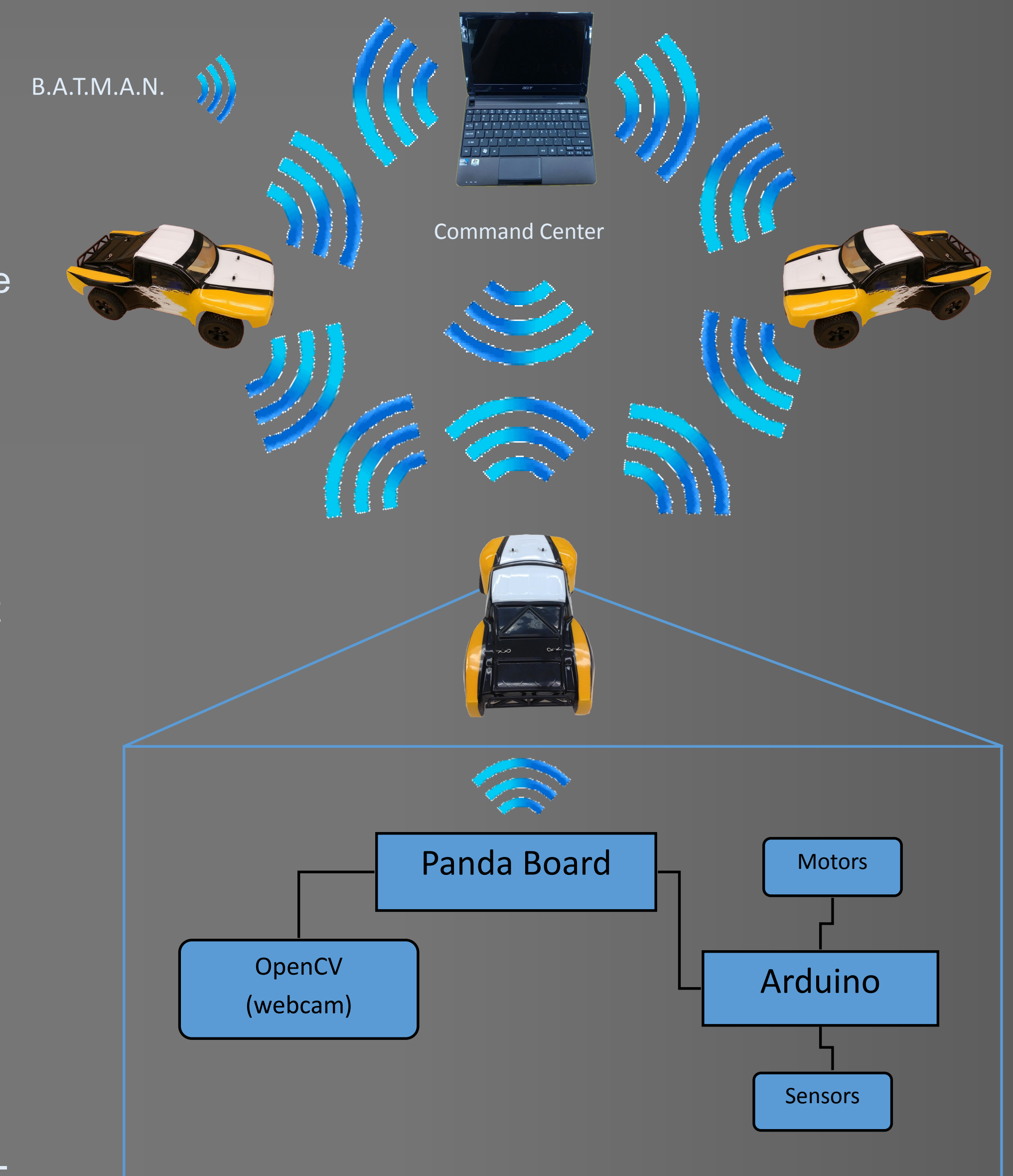
## Operating Environment

Netbook—Fedora, PandaBoard—Ubuntu, Arduino (c), BATMAN, OpenCV, C
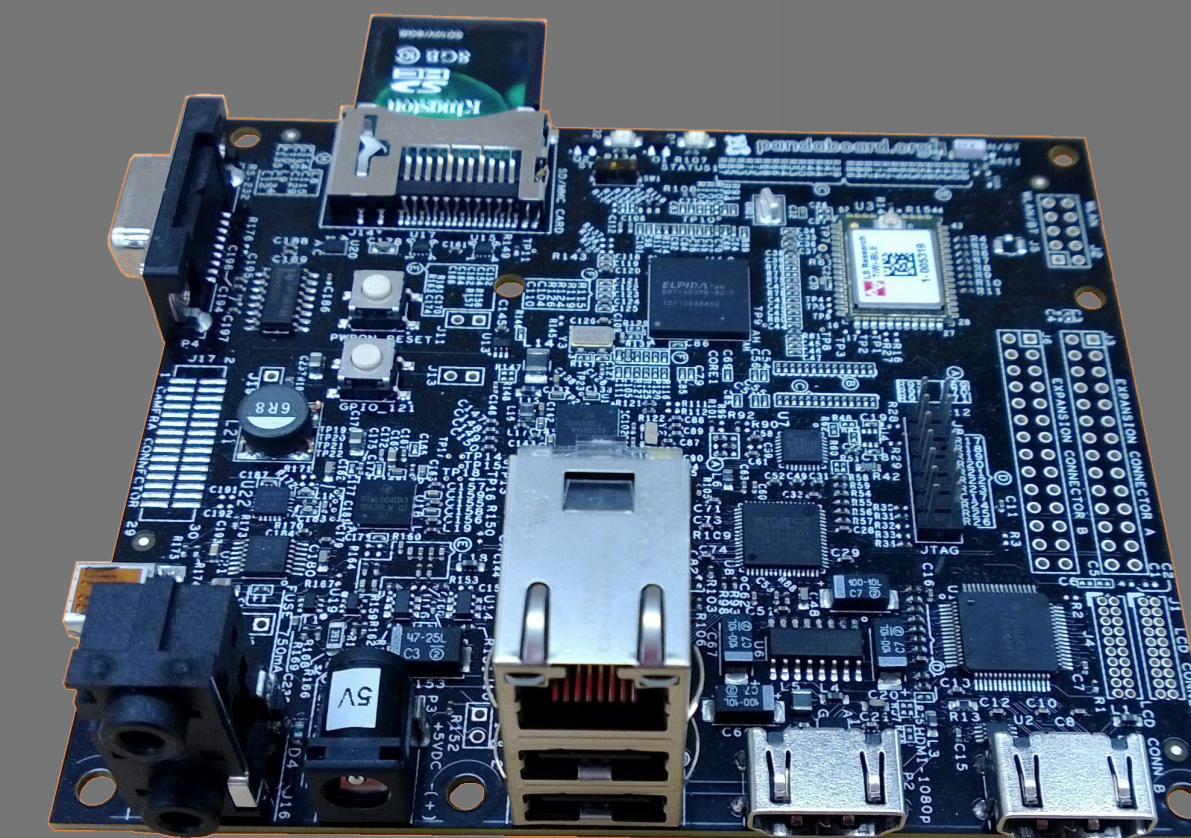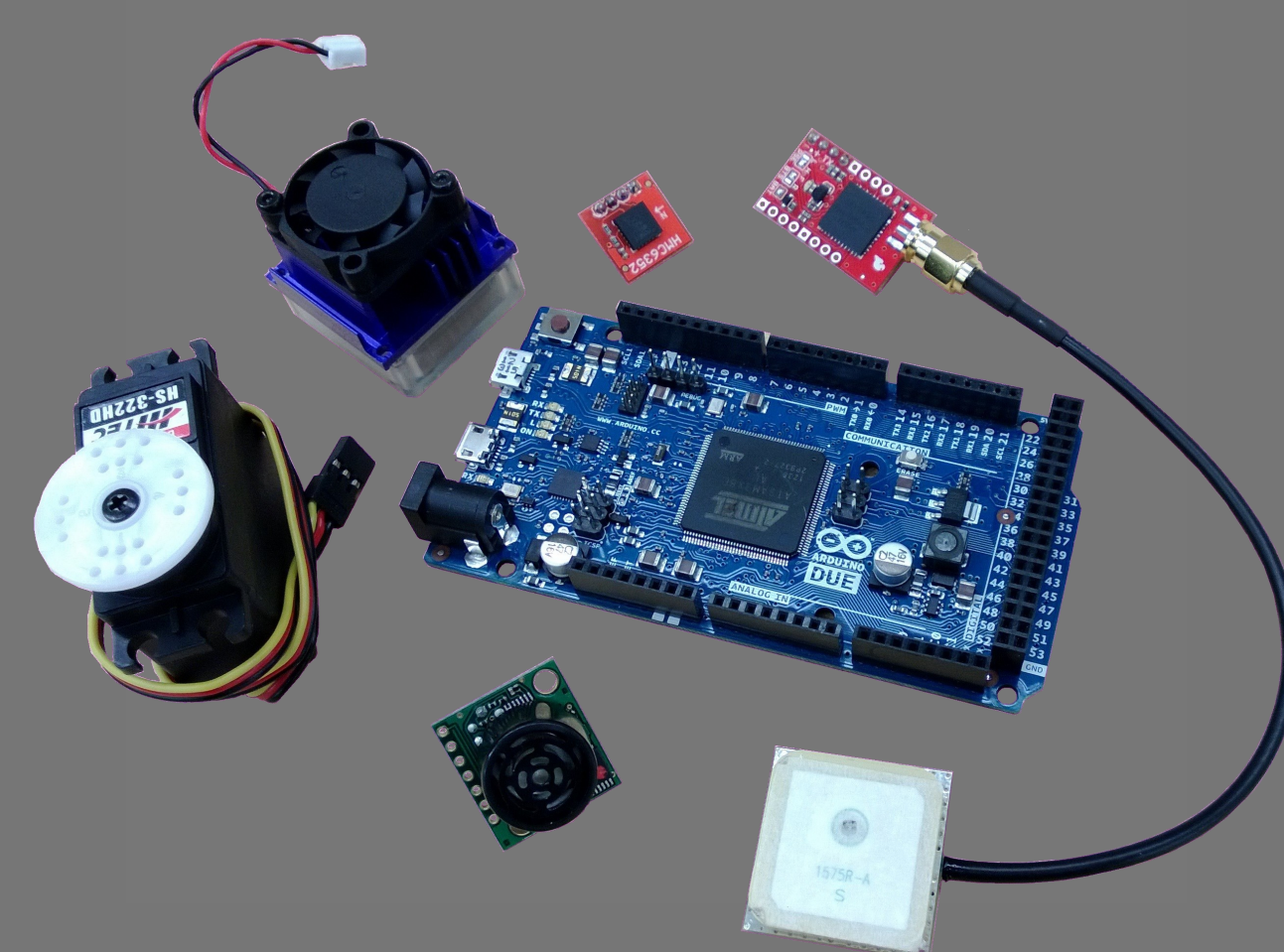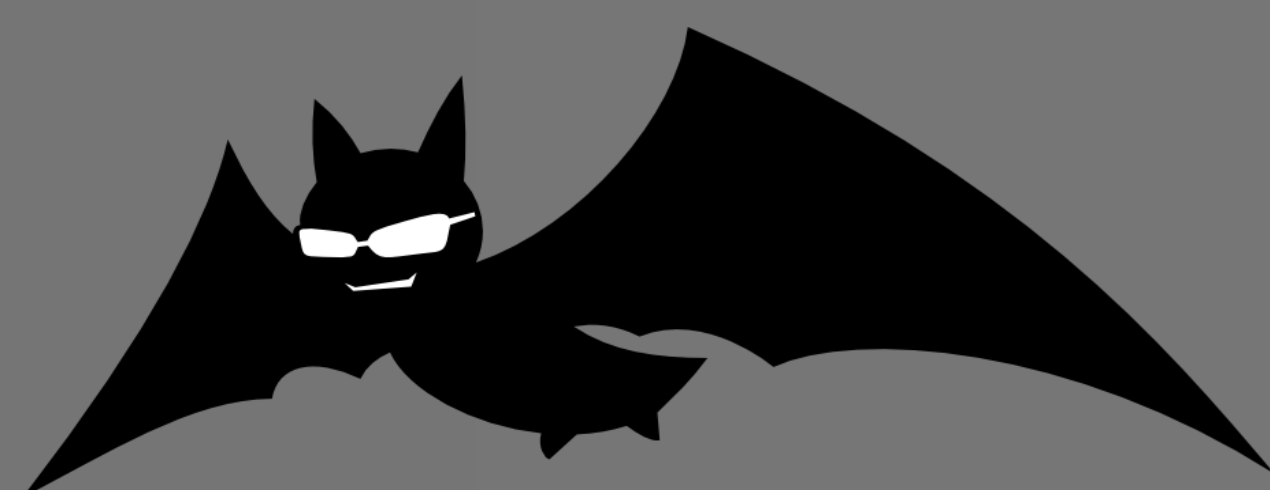
## Intended Uses

Searching large open areas to eliminate the need for large groups of individuals, such as search and rescue missions, as well as eliminating the risk associated with the search, such as mapping a mine field.

## System Design



## Better Approach to Mobile Ad-Hoc Networking

### OpenCV
- Open source visual recognition library
- Used to do object recognition based on color

### B.A.T.M.A.N.
- Open source kernel module for mesh networking
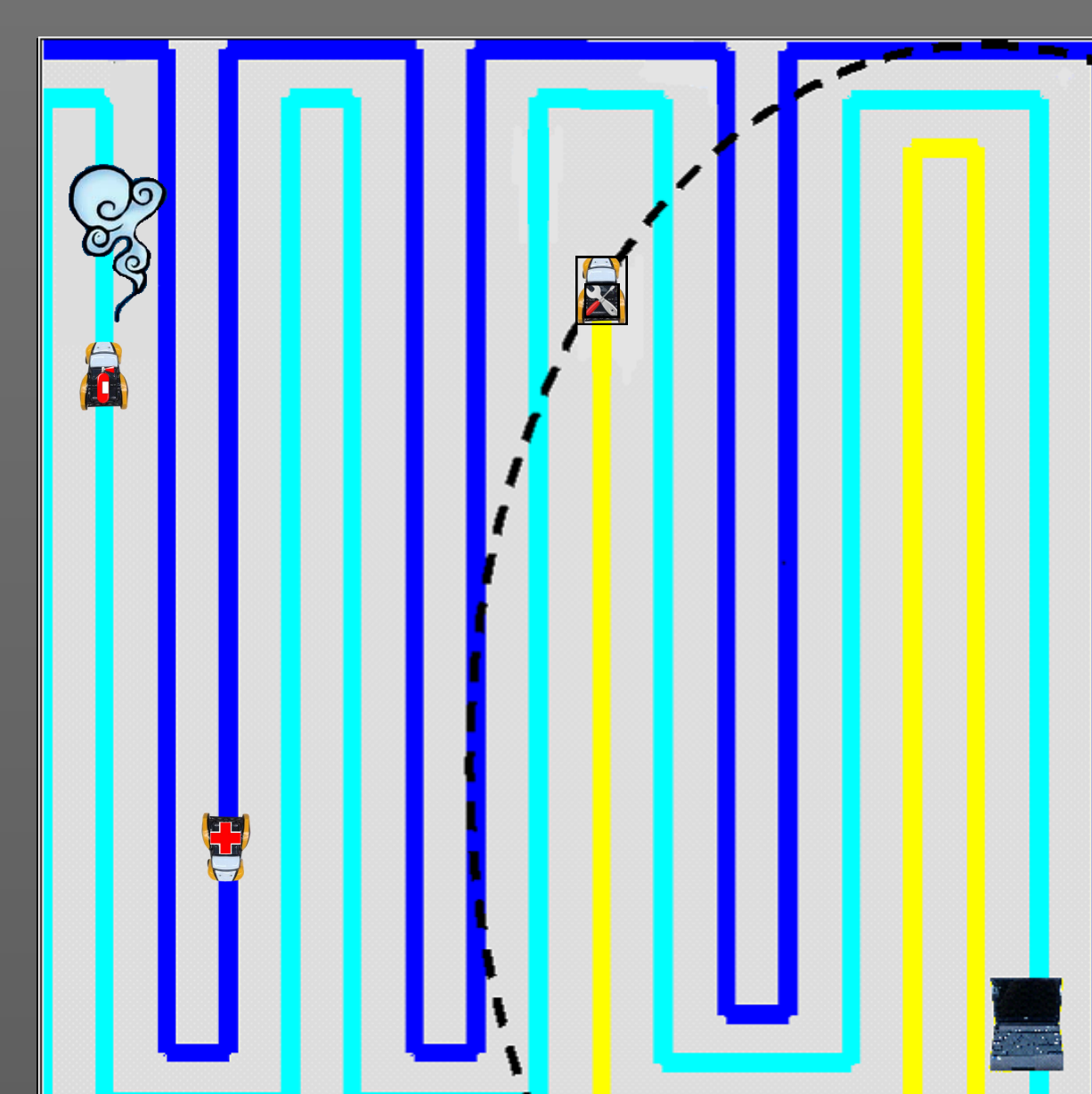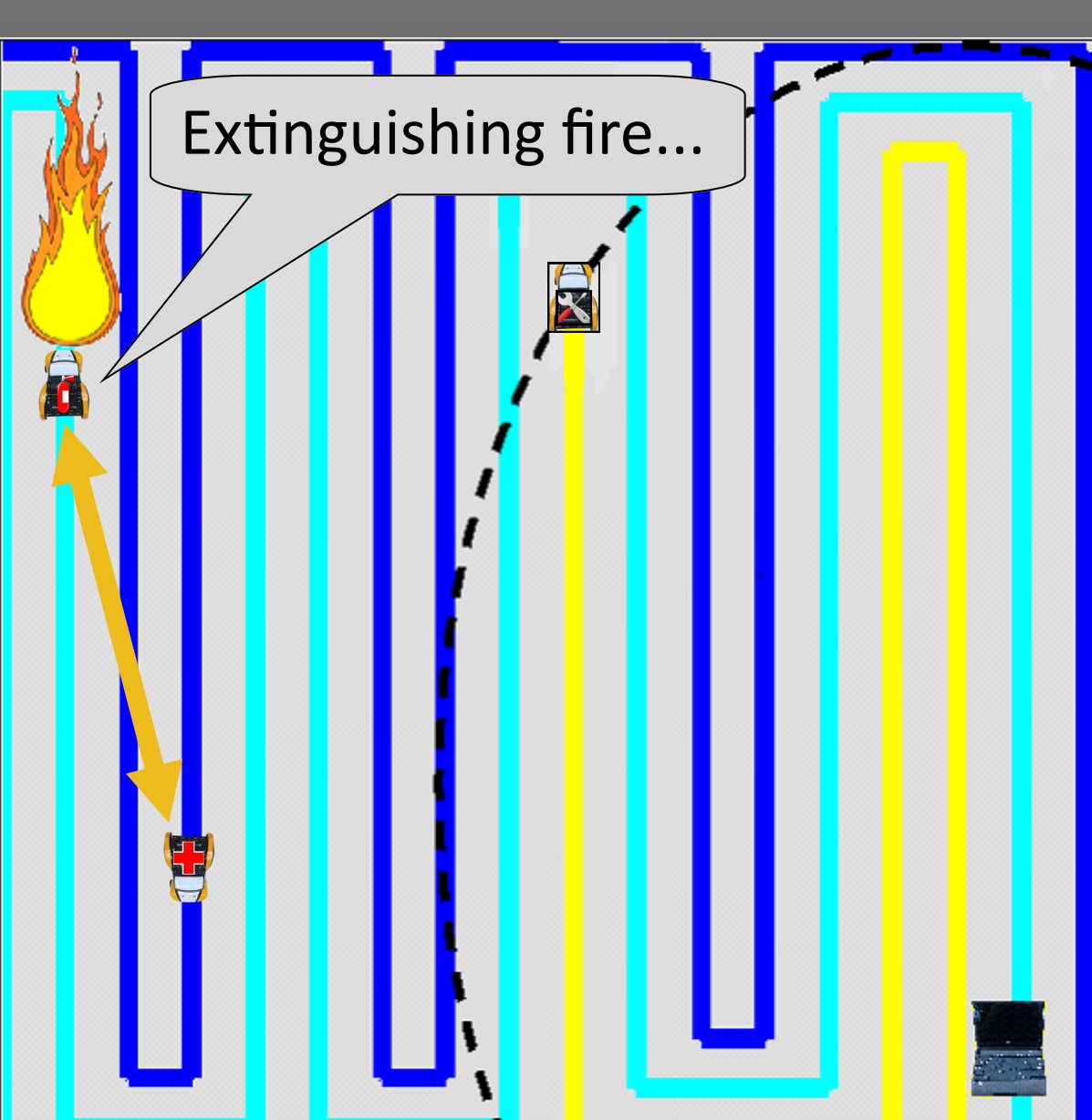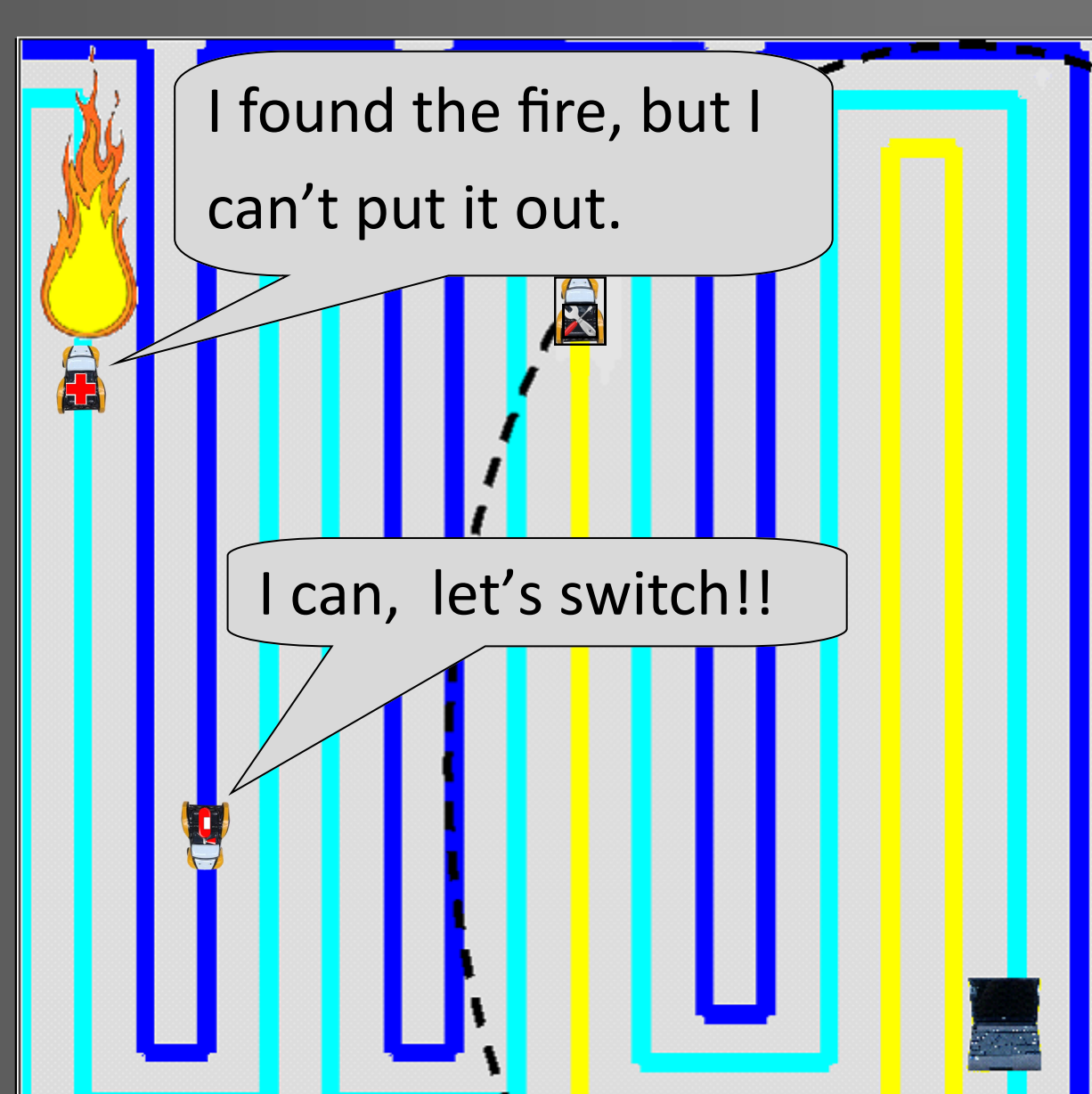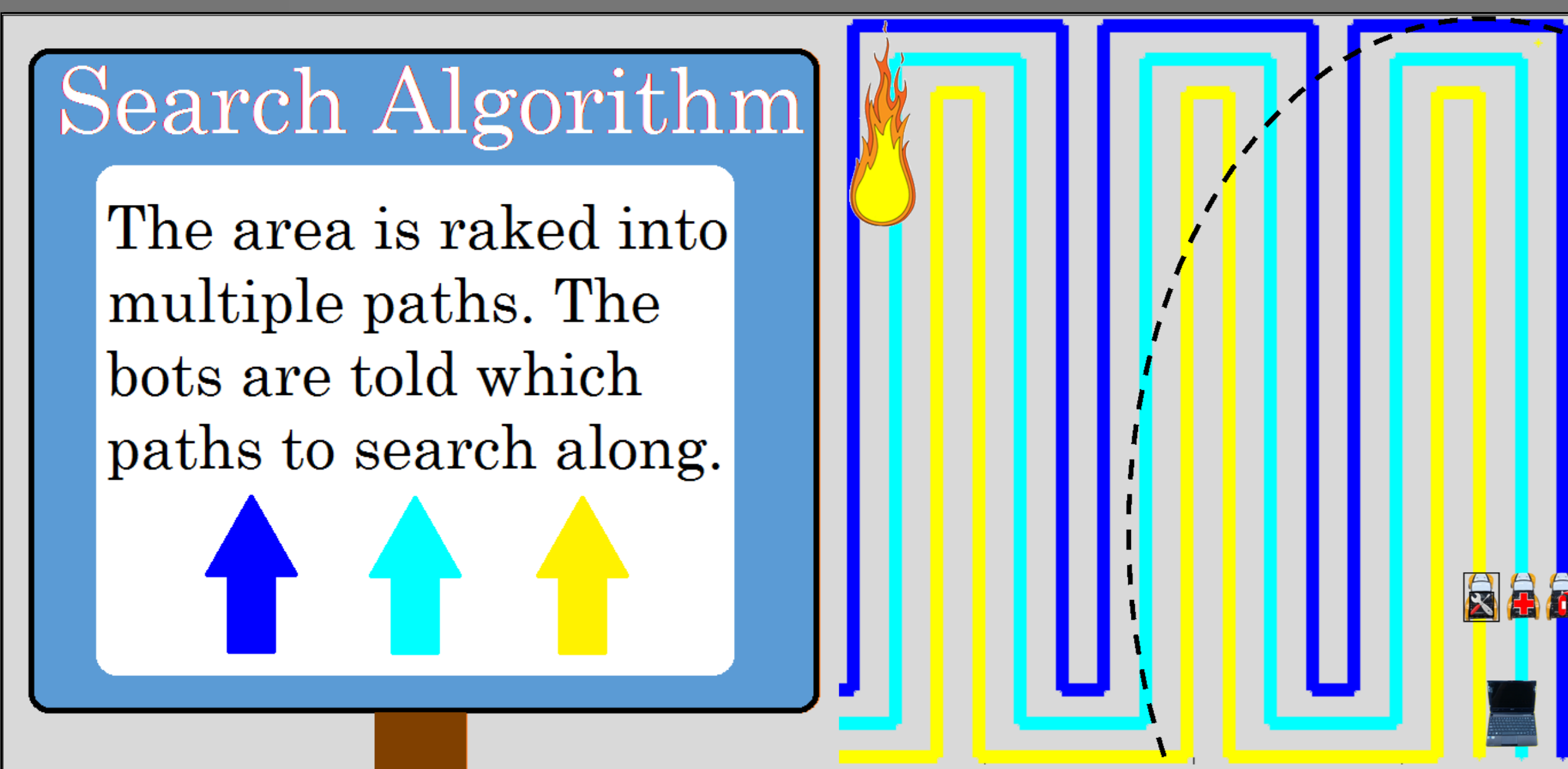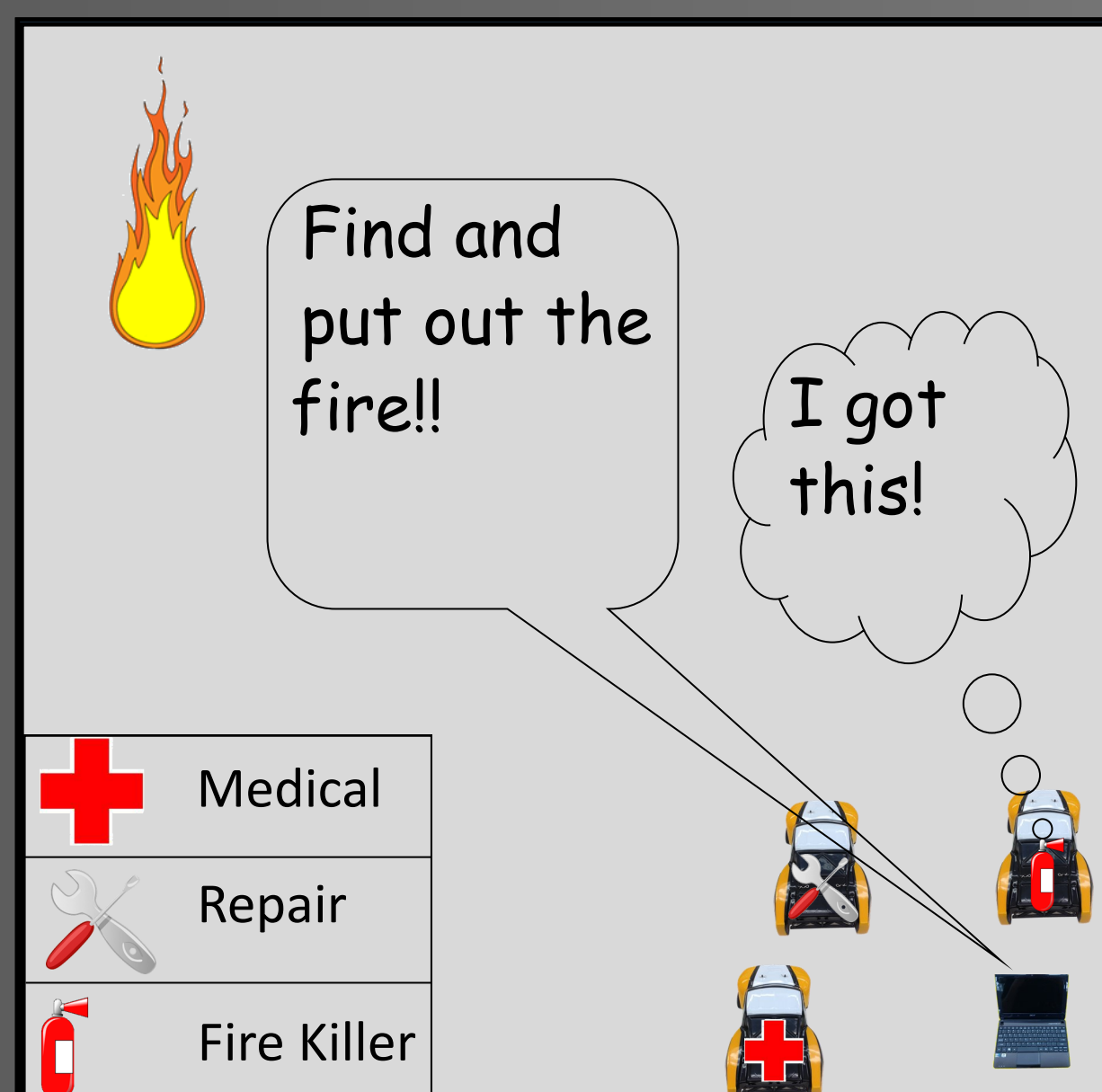- Used to communicate between bots and Command Center over Wi-Fi

### Arduino
- Open source microcontroller platform
- Used to control sensors servos and motors

### Pandaboard
- Embedded PC running Ubuntu
- Used to control OpenCV, BATMAN and interfaces with Arduino

### Command Center
- System user interface
- Used to initiate missions and to gather and display information pertaining to swarm

### Search Algorithm

The area is raked into multiple paths. The bots are told which paths to search along.



## Testing

- Cumulative approach
- Test all components individually
- Test B.A.T.M.A.N. with Pandaboard
- Add OpenCV
- Add Arduino
- Add Command Center
- Test complete system

## Points of Expansion

- Search Algorithm
  - Irregular search area
  - Efficiency
- Heterogeneous Swarm
  - Aerial vehicles
  - Aquatic vehicles
- Advanced Object Recognition
- Distributed Computing