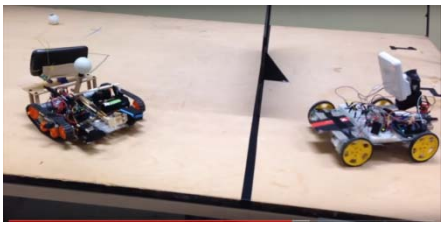
RYERSON UNIVERSITY

MDM MASTER OF DIGITAL MEDIA

School of Computer Science - CPS813 Final Exercise: Plutonium Dioxide Dilemma

Exam Background - Informational Sheet



Human Robot Interaction (HRI)

The HRI course is a multidisciplinary upper year computer science course with a focus on small scale mobile robotics. This course enables students to study, understand, design and create robotic systems to interact with remote environments.

HRI Exam

The HRI exam is a practical exam which tests the knowledge and skills that students have obtained throughout the course. Students working in their groups will have designed, created, and fine-tuned a small scale mobile robot, with off the shelf sensors and parts, and are tested on the robot's ability to perform certain tasks throughout the semester. The exam presents a set of new challenges for the groups to accomplish with their robot. The exam is set in the Student Learning Center at Ryerson and the task will be to use their robots to search for a mock chemical device, while having to neutralize mock IEDs along the way, make a map of the unknown environment, and indicate the location of the chemical device on the map.

The goal is for students to apply robotic technology to real world applications.

Improvised Explosive Device

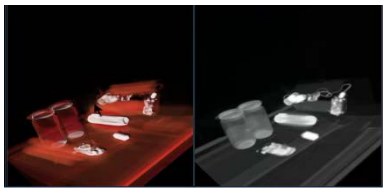
An Improvised Explosive Device is a bomb designed to inflict damage to people and property. IEDs and can be improvised with commonly available materials such as fertilizer and store bought chemicals. The nature of a suspected IED is that it is composed of volatile and dangerous unknown elements, and can range in form, size and power. The Boston Marathon Bombing and Manhattan Dumpster Bomb are examples of high risk situations that can that cause mass casualties and serious harm to people.

Explosive Disposal Units and Neutralization

People that deal with IEDs, are specialized response teams such as explosive disposal units (EDU). These people must determine the nature of the device and neutralize the threat. One neutralization method is to fire a disrupter cannon. It is a cannon that shoots a water round to separate the parts of the IED, in hopes of disabling it. EDU are specifically not trying to blow things up.

NCART – Our Team's Research

In our research, we utilize medical imaging technology such as a CT scanner to identify key components of a concealed IED without tampering with it directly. After obtaining scanning data, we create a 3D model of the device and place the device in a game engine capable of applying 3D physics. We use the reasoning obtained from the game for a number of things; perform precise targeting of key neutralization points with the disruptor shots, obtain additional information on the location and densities of interior components, archive IED mockups and incidents, aid in EDU planning and training, and most recently perform post-splatter analysis.



Contact:

Christopher Chan

PhD. Candidate in Computer Science | NCART @ Ryerson University
christopher.c.chan@ryerson.ca | 416-979-5000 x 2758
http://ncart.scs.ryerson.ca/ | http://christopherchan.info/

Real World Implications
The very nature of IEDs are that they are improvised and unknown, when developed by, say insurgents in Afghanistan, every IED may be different, so there are no standards to the make of it, otherwise it will not be called improvised, it'll just be an explosive device.

That is why there is much to research and to understand how to handle situations involving IEDs in the safest and quickest manner. IEDs, however have common components, such as a detonator, explosive, triggering device, etc… and as researchers we build upon this knowledge to theorize some heuristics as to the possible ways of neutralization.

This technology is already in place and in use but for other fields, I'm simply repurposing technologies such as 3d modeling, splatter analysis, game engine physics, in real world IED applications.

What is your hope for the technology in the future? To be used in military missions or for OPP?
I would say that any type of public safety personnel, even airport security, can benefit from our work. Not only can this methodology scan IEDs safely, but it can augment their current processes with additional information provided by an automated 3D model, such additional information can reveal information about the density of this unknown mass, and provide a list of possible explosive analogs of the same density. It can also provide the exact location of the unknown element within a concealed container, typical of IEDs.

Who will benefit most for this technique you have developed?
Immediately, I can see airport security personnel benefitting from this technique, faster queues through security and obviously a more secure and definitive process, with the computer doing most of the analysis, pinpointing a list of potential explosives that may be closest to the unknown density scanned.

But that's just the start, and it'll be quite consistent as long as any new explosive material is developed and documented.

Another good feature of this technique of modeling and gaming is for training purposes, it is almost always unsafe for explosive disposal units to train on the field, so this way they'll be able to get a pseudo hands on experience. Additionally, past real IEDs and the explosives used, the type, the make, the design, can all be documented and archived in a way to possibly estimate the potential maximum damage this improvised device can make.

IEDs do not need to be stationary, nowadays we're seeing UAVs dropping off IEDs and this kind of explosion with some basic heuristics, physics and fluid dynamics analysis, we can model a useful information such as splatter points where there's most damage to a very high degree of accuracy.

But this all depends on the plausibility of our work coupled with confirmation of the accuracy of the results and lastly, whether or not it is adopted by public safety.