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iRescue: Emergency Response System using Smartphones and Smart Sensor Network

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Background: Recent earthquakes in 2010 Haiti (137,000 Fatalities) and 2011 Japan (19,295 Fatalities) have shown tremendous devastation that cam reek on society (CADAT 2011). In the aftermath of a natural disaster, emergency responses must act quickly to save lives, since the life and death of victims trapped inside the building will be up to how first responders can rapidly find and rescue them. However, the current emergency response systems in most countries are mostly depending on first responders' intuition to search for victims. In complex buildings or in situation where the first responders' sight is not clear, it is very difficult to find survived victims trapped inside the building without any auxiliary device. In this study, a Cyber-Physical System (CPS) called iRescue(Illini Rescue System) will be presented in order to help trapped victim inside a building.

Proposed research: iRescue is a Cyber-Physical System that will have four sub-systems: (1) Victim Positioning System (VPS) that estimates the location of the victims, (2) Victim Assessment System (VAS) that assesses the physical status of the victim, (3) Structure Assessment System (SAS) that assesses the physical condition of the structure (building) and (4) Victim Evacuation System (VES) that provides the optimized evacuation route based on the victim's and structure condition.

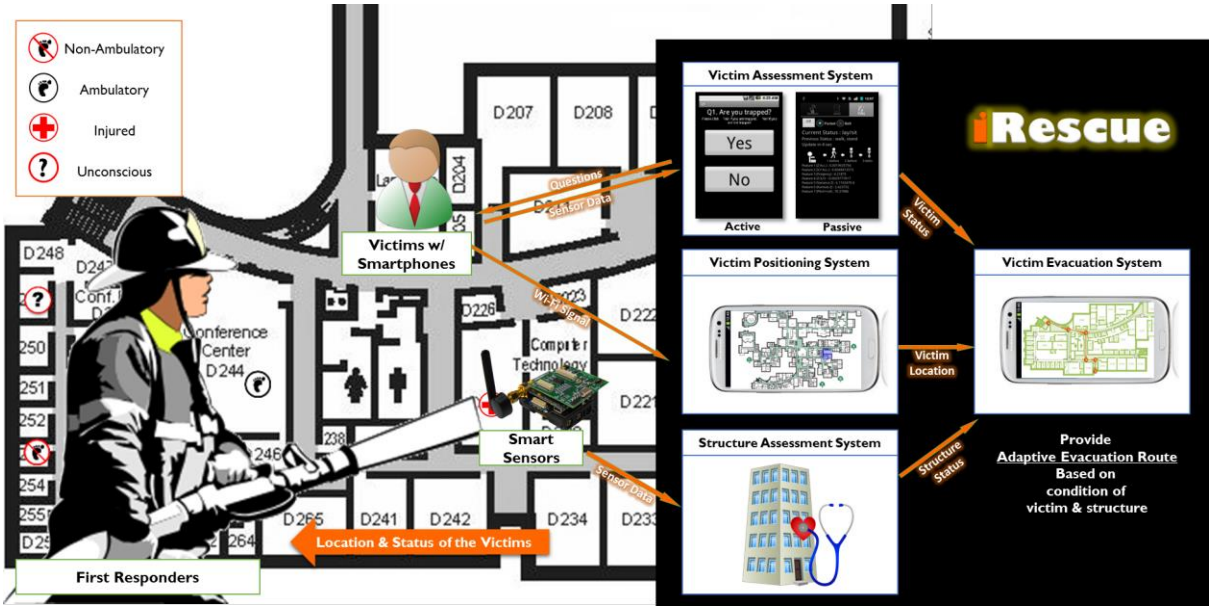

Figure 1: Configuration of iRescue

The VPS is an indoor localization system that is designed to estimate the locations of the victims using the RSSI of the Wi-Fi signals from various wireless access points (WAP) by referencing the fingerprinting map of a building under disaster, which can be preliminarily built by measuring the RSSI at distributed points in the building.

The VAS is an activity recognition system that is designed to estimate the status of the victim using the sensor measurement of the smartphone. Features that can be calculated from the measured data with minimal computation are selected, and they are linked with victim's status by machine learning.

The SAS will be a structure damage estimation system that will use smart sensor network and quadcopters. Using smart sensor network of the structure, the damage location probability will be calculated by conducting Structure Health Monitoring (SHM). Also using pictures taken from drone (quadcopters) together with the Structure from Motion(SFM) technique, the damage structural member will be assessed.

The location and status information of the victims estimated by using VPS and VAS and the real-time structure information estimated by SAS will be transmitted to both first responders and victims by using WLAN (Wireless Local Area Network) that can be built at the disaster building using a WAP in a short time. By providing the information to the first responders shortly, the rescue process is expected to be significantly improved with reduced rescue time.

Potential impact in CPS: CPS has dramatically developed in IT area, but there are still lots of area such as emergency response where advanced technology is not utilized fully. The proposed research will have impact on extending the broad of the CPS into other area by combining not only computer science area (mobile computing and wireless network), but also other areas such as civil engineering and emergency systems.

References

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