VR HARDWARE LAB (ROOM 106)

- **Corner Cave VR System**
  - Corner projection setup with tracked interactivity, 4 PPT eyes, Christie Captiva 3D projector.
  - Integrated Oculus units with long cables for PPT walking, 3D glasses
- **3D Wall**
  - WorldViz 3D Wall Touch PRO
- **Head Mounted Display (HMD)**
  - nVisor SX111
  - HTC Vive
  - Samsung GearVR
  - Hollow Lens
  - Z800 Dual Pro Ruggedized
  - Google Glass and Shutter Glasses
  - Oculus Rift Head set + Oculus Touch
  - NVIDIA 3D Vision Glasses Kit
- **VR Gloves**
  - Cyber Glove III, Wireless
  - 5DT Data Glove 5 Ultra, RH
  - 5DT Data Glove 5 Ultra, LH
  - 5DT Data Glove Ultra Wireless Kit
- **Motion Detection**
  - 3D Wall Touch Pro cameras
  - Virtual Cube Head Tracker
  - Microsoft Kinect
  - Wireless 6DOF tracked hand wand
- **3D Gaming Desktops**
  - Alienware Aurora-R4

VR SOFTWARE LAB (ROOM 312)

- **Modeling**: 3D StudioMax, Maya, Soft Image, Mudbox, Motion Builder, Blender.
- **VR Programming**: Vizard 5.0, Virtools 5.0, Unity 3D, VRML pad, Microsoft Visual Studio, OpenGL, ARToolkit, ALVAR libraries.
- **18 Alienware Aurora-R4 3D Gaming Desktops,** NVIDIA's GeForce GTX 1080

GRANTS

- **MITRE/ USM/AAC Award:** Collaborative Grant (UMBC/BSU): Inferring Cyber-attacks and Building Resilient Cyber-Physical Systems, Sponsor: MITRE and University System of Maryland (USM), Award Period: January 2019 through January 2020.
- **ARL Grant:** Avatars to represent human behavior in a Collaborative Virtual Environment, under The U.S. Army Research Laboratory (ARL), Award: W911NF-17-S-0003, funded by ARL-HRED division under Assessment and Analysis campaign. Award Period: 09/05/2018 to 09/04/2019, Award Amount: $85,000.00.
- **ARL Grant:** Megacity: Avatars in Collaborative Virtual Environment (CVE) approach for Decision Making, under U.S. Army Research Laboratory (ARL), Award No. 12396753, funded by ARL-HRED division under Assessment and Analysis campaign, Amount: $85,000.00, Period: 08/4/2017 to 08/3/2018.
- **NSF**: "A Problem-Based Learning Approach to Teach Gaming and Development of Gaming Instructional Modules to Enhance Student Learning in Lower Level Core Courses". NSF-HRD-1238784, Amount: $299,500, Period: 2012 to 2017.
- **DHS: Department of Homeland Security:** Scientific Leadership Award, "Developing Homeland Security Expertise to Support Emergency Evacuation Research", 2011-ST-062-000050, Award Amount: $249, 901.29 Award Period 2011 to 2015.
- **NSF**: "Increasing Expertise of Minority Students by Development of a Virtual and Augmented Reality Laboratory for Research and Education at Bowie State University", NSF-HRD-1137541, Award Amount: $299,489, Period: 2011 to 2014.

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DR. SHARAD SHARMA

DIRECTOR OF VIRTUAL REALITY LABORATORY

DEPARTMENT OF COMPUTER SCIENCE

BOWIE STATE UNIVERSITY

ROOM NO: 106 AND 312 CSB

GOAL

The goal of this VR laboratory is to introduce students to Virtual Reality (VR) hardware, software, and provide an opportunity for them to apply this knowledge to applications for education and games. This laboratory applies cutting-edge VR technology currently available in academia and industry. The lab applies research methods from social science, human-computer interaction, and data visualization to address the challenge of including social, emotional, and communication factors into modeling and simulation of crowd behavior.

MISSION

The students and faculty are pioneering the use of VR technology in areas such as data visualization, VR evacuation drills, multi user virtual environment (MUVE), augmented reality (AR), human behavior modelling, agent-based modeling, simulation (ABMS) and multi-agent system (MAS).

ACTIVITIES

VR Lab provides students and researchers with high quality 3D gaming workstations, stereoscopic displays, motion trackers, 3D input devices, and force feedback devices.

RESEARCH PROJECTS

Our current research projects mainly focus in the areas of Virtual Reality (VR), Augmented Reality (AR) and Software Engineering (SE).

I. VIRTUAL REALITY (VR)

Game-Theme based Instructional Modules

The aim of this project is to create game theme based instructional (GTI) modules with more inquiry based problem-solving activities and hand-on experiences based using VR, AR and Gaming.

Multi-User Virtual Environment (MUVE) or Collaborative Virtual Environment (CVE) for Evacuations Drills, Emergency Response and Decision Making

The project proposes an experimental design setup for assessing human behavior in emergency evacuations among a team of players in a game setup. Following are the MUVEs designed as a part of our research work.

1. Subway Evacuation

The Subway MUVE allows for large groups of people to participate in virtual evacuation drills at the same time. We have defined rules for computer controlled agents and also providing controls to the user controlled agents to navigate. We incorporate Oculus Rift for performing immersive drills.

2. Airplane Evacuation

Airplane MUVE could be used as an educational and training tool for depicting emergency scenarios. We have conducted user studies (50 sessions) for virtual evacuation drills performed in both immersive (HMD) and non-immersive (Desktop) environments.

3. Mega-City Evacuation

The CVE acts as a platform for training and decision making for SWAT teams, fire responders, and traffic clearance personnel. The novelty of our work lies in modeling behaviors (hostile, non-hostile, selfish, leader-following) for computer-controlled agents so that they can interact with user-controlled agents in a CVE.

4. School Bus Evacuation

The goal of the proposed work is to develop CVE for training elementary school teachers to respond to active shooter emergency events. CVE is a concept similar to a virtual reality First-Person game.

5. University Campus Evacuation

The goal of this work is to develop an immersive VR training module for emergency response training. Our proposed application shows CVE environment for performing active shooter training and evacuation drills using oculus rift.

6. Crowd Behavior and Traffic Intersection Problem in a Virtual City

The project aims at developing a crowd behavior capability in a virtual city where there are traffic intersection junctions for people to cross the road. The MUVE consists of individuals and group behaviors with differing levels of fidelity. Participants enter MUVE as a car avatar where the goal is to safely drive in the city by following traffic laws. User studies were conducted for both immersive and non-immersive environments.

II. AUGMENTED REALITY (AR)

1. Mobile Augmented Reality Application (MARA) for campus navigation

We have developed a MARA using UNITY 3D which helps people to safely evacuate a building in case of an emergency. Our solution includes putting the markers at key spots in the building, such that the user can use their phones to view the 3D representation of the building and exits.

2. AR with HoloLens: Building Evacuation
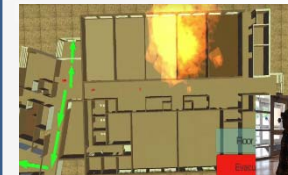
We demonstrate how AR technology can provide spatial context 3D visualization that promotes spatial knowledge acquisition and support cognitive mapping. It also gives path to the various exits from current location as well as directions to safe zone.

III. SOFTWARE ENGINEERING (SE)

Modelling evacuation behavior in a multi agent system

We are developing crowd-modeling and emergency behavior modeling capability in a goal finding application using C#.

We are modelling the agent behaviors in two different approaches to reach the exits (goals) during evacuation.

1) Combination of combining Genetic Algorithm (GA) with Neural Networks (NN).
2) By creating a Fuzzy Rule based System for evacuation behavior.