

# Visual sensing and Data Analytics

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## 1. Research Overview

Dr. Khzaeli and his research team at UOP are working on multimedia analysis and using contextual cueing to improve segmentation, scene detection and object recognition (Figure 1 presents a framework for visual sensing applications). This research will ultimately contribute to sport biomechanics, training environment and building information modelling.

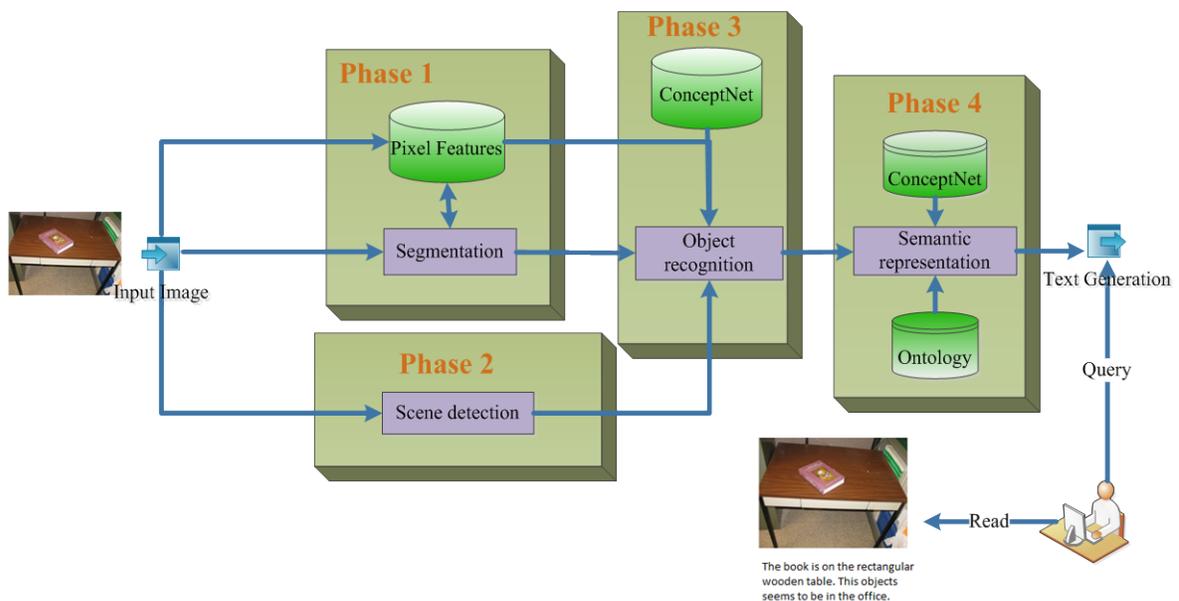


Figure 1: Multimedia Object Analysis Framework

The use of information technology will continue to transform the industries in the years ahead. The ultimate goal is to gain the ability to derive information from available data in order to store and extract information and visualize it in a way to obtain useful insights.

## 2. Gesture Based Human Computer Interaction for Biomechanics [1-6]

In recent years, many algorithms have been proposed to address the problem of human parts detection, pose estimation and body tracking from 3D data. Earlier research estimated human poses and body tracking using stereo cameras. In the past few years, the research has focused on the use of time-of-flight range cameras (TOF). Recent technological advances have led to the development of novel depth cameras that allow acquiring dense, three-dimensional scans of a scene in real-time, without the need for multi-camera systems.

In sport biomechanics having knowledge on the position and orientation of an athlete is vital when assessing performance, injury risk and joint loading. Since the inception of the discipline, scientists have searched for a method of obtaining this information quickly and accurately.

Our research has focused on implementing real-time 3D scans of a scene to aid in the ergonomics analysis in a work environment. Kinect sensors have been used to explore the use of depth cameras in several analysis contexts including body segment tracking, whole-body person tracking and 3D scanning. The major steps of this process in summarized in the following figure:

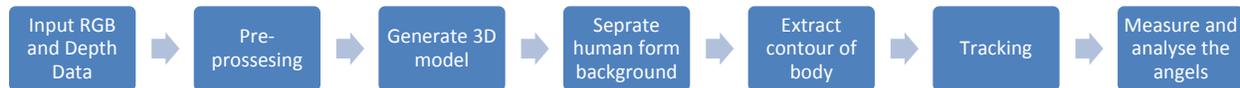


Figure 2: Tracking and 3D scanning Framework

In another research multimedia and gesture analysis is being combined together to measure the level of attention and participation of students in the classroom. For example, students' verbal and nonverbal behaviors have been recorded and correlated with observers' reports to predict students' levels of engagement, with the goal of developing automated systems that could help predict and assist learning. Studies have shown that quality of attention depends on several factors, including fatigue, motivation, emotion, and enjoyment. Attention has been proven to be associated with student performance and learning.

### 3. Building Information Modeling and Visual Sensing [7-10]

Building Information Modeling (BIM) is becoming widely used in the construction and building management industries. BIM building models provide object-oriented 3D modeling of building components, as well as the ability to attach additional data and documents to building components. Creating BIM models for existing buildings, and maintaining the models throughout building lifecycles, is a difficult and time-consuming task. Research on the use of imaging in construction and building information modeling (BIM) is still in its early stages. Imaging has been investigated in reconstructing building models, construction quality assurance and progress monitoring, and construction safety. In recent years, Building Information Modeling (BIM) has become more integrated in the construction industry. BIM is an intelligent model-based process that gets the right information to the right people at the right time.

I developed a new fully automated object identification framework for image and video which will identify objects and wall configurations and their special relationships in commercial office spaces for comparison to and updating of BIM models of the spaces.

At University of the Pacific, we are in the process of establishing a "5D Augmented Reality Center" (3D modeling, time and cost) in the School of Engineering. This center will offer emerging technology of "Building Information Modeling" in which students will research the latest information on BIM technologies and how to integrate BIM into the project delivery processes.

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