Construction operations are inherently dangerous due to the harsh, unstructured and dynamic nature of the work environment. Of all construction activities excavation stands out as having one of the highest levels of uncertainty among the other difficulties faced. The danger associated with excavation stems from the presence of invaluable buried infrastructure sharing common space with the earth and soil that an excavator operator would remove during the course of operations. As a result, operators have to use extreme caution while navigating their equipment’s digging implement to avoid accidental contact with the buried utilities. In spite of the best efforts of operators and crews, accidental strikes often occur between excavator buckets and underground utilities such as gas, electric, water, telecommunications, etc. Some estimates state that a utility line is struck every three minutes somewhere in the United States. The period from 1992 through 2011 saw a total of 1325 significant accidents, resulting in 148 fatalities, 532 injuries and leading to damages totaling over $530 million. In order to prevent such accidents, the law requires anyone carrying out excavation to get the excavation area pre-marked before any work can begin. These markings, in the form of spray paint or stakes, provide the approximate location of the utilities but do not provide any depth value. In addition the markings are temporary in nature and are no longer present once the top surface is removed. Thus excavation operators require assistance in two forms – first, in terms of visual guidance to see where the utilities lie, and second, through spatial awareness concerning the location of the equipment’s end-effector in relation to the nearest utility. Thus the fundamental problem this research addresses is how such spatial-visual assistance can be provided to operators in real-time to improve their decision making process. Through this research, a comprehensive framework was developed to monitor construction activities in real-time. The framework creates an abstract representation of the real world in a virtual environment using 3D models of the excavator, buried utilities and jobsite terrain. Data from sensors in the real world is used to update the position and orientation of the equipment in the virtual world. Finally, real-time proximity monitoring and collision detection between the equipment end-effector and buried utilities is carried out to provide distance and collision prevention information to the operator. Thus through this framework, equipment operators will have superior visual and spatial awareness of their jobsite and surroundings, leading to accident prevention.