SafeCRobot

Virtual Reality immersive Safety Training environment for Robotised and Automated Construction sites

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SUMMARY

Technological advancement has led to the increased reliance on machines in place of human construction workers. Advanced robotic systems are becoming commonplace on construction sites, including autonomous and semi-autonomous vehicles. However, it is widely acknowledged that construction trades still require human skills thus creating working environment with high interaction between humans, advanced driven and autonomous machines and materials. As a result of these developments, the EU commission of Safety and Health has forecast that one of the greatest occupational safety risks will emanate from Machine-Human-Interactions (MHI) (EU-OSHA, 2016). Despite the efficiency gains of automation and robotics on sites, emergent MHI risks needs to be mitigated through improving workers training and skills in the perception and mitigation of risks related to their usage and interactions.

More than 20% of fatal accidents is attributable to machine-human-interaction (MIA) on site within Europe (Eurostat 2014). The UK construction industry recorded 196 fatalities between 2012/13 to 2013/14 with 10% resulting from collisions with moving machines (HSE, 2017). Furthermore, the most commonly reported workplace risk related to the use of 'machines or tools', with 'vehicle' related accidents regarded as one of the top three self-reported risks by construction workers (HSE, 2017). In Germany, 54,440 notifiable, 1,676 serious and 52 fatal industrial accidents were as a result of vehicles (i.e. forklifts) between the years 2010 to 2014 (DGUV, 2014). Furthermore, there were 336 collision related accidents involving earthmoving equipment between 2008 and 2015 with 36 associated fatalities. In addition to fatalities, MIA has ergonomic implications including mental overload from monitoring Visual-Display-Units (VDU) to the operation of many complex controls which are a key feature of advanced machinery, equipment or robots (EU-OSHA, 2016).

Consequently, despite the broader benefits of automation, there remains several risks associated with their application of advanced technology (i.e. robotics and automation) both to operators and other human workers interacting with these systems within the same workspaces. Despite safety features incorporated in machines and robots there remains a high

degree of fatalities from their interactions with humans. Therefore, a construction worker's ability to recognise hazardous situations is an essential skill for accident prevention. Selfregulation is therefore regarded as the last but most critical defence line in the elimination of accidents emanating from failures in safety systems incorporated in occupational machinery, equipment and robots.

Many researchers have promoted 'experiential' learning for improving hazard perception as well as inculcating safe working training. However, it may be costly to expose workers to such risk for the purposes of training. Thus, safer training environments can be created through virtual reality (VR) and 3D simulation of real-life construction MIA scenarios for the purposes of training novices. These VR environments are now extensively used for cost effective and risks free training and upskilling through virtual representation of risky scenarios in which workers can interact with supported immersive technologies. Such simulations for safety have been successfully used in industries such as aviation that is recognised among the best in terms of safety. VR interactive applications will thus provide an opportunity for simulating the working conditions and identifying MHI associated risk of robotics and advanced machinery use in construction sites.

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