A Study in Virtual Educational Training System for Police with Augmented Reality Technology

O.H. Sei-youen
Department of Police Administration, Semyung University, 65 Semyeong-ro,
Jecheon-si, 27136 Chungcheongbuk-do, Republic of Korea

Abstract: Compared to the other administrative organizations as police has distinct occupational characteristics and risk factors such as a criminal investigation, traffic control, there are higher level of danger and hazard. Therefore, the thesis would like to propose a virtual educational training system model for police with augmented reality technology to minimize loss of human lives and accidents during police operations and enhance efficiency level in various tasks of police. In reference to the tasks of police, official statistical materials were monitored and actual cases of augmented technology application to various police operations were observed. Based on the cases of augmented reality application proposed in the preceding research, a virtual training system model with augmented technology is established for police which can effectively enhance the quality of various police operations. The virtual educational training system model for police with augmented technology makes the trainees log in the server with an ID for an access to the situationally prepared educational training contents by using a wearable HMD. The contents server displays which educational contents to be conducted for trainees in consideration of trainee information and the virtual educational training is initiated when all sensors attached on helmets and vests of trainees get activated. Furthermore, all training data obtained from the augmented reality devices is stored in the server then the most appropriate educational contents are provided for trainees for their future education trainings. The system utilizes wearable HMD allowing long-time training and increases overall efficiency of the training as various types of devices are freely available. In addition, as various educational contents server is provided, training information of trainees is stored in the server when all sensors get activated, then become analyzed, the system allows implementation of optimal and customized educational training for future trainings as well as rapid judgement and measures in actual situations.

Key words: Augmented reality, rolice, virtual educational training, educational training contents, HMD, customized, efficiency

INTRODUCTION

Recently, our society has been striving for precautionary preventions of crimes in cooperation with judicial institutes to respond to increased crimes. However, despite of the efforts of police to respond to crimes, crime types are being more diversified and developed annually and even unfortunate circumstances such as an injury or a death of police occur during police operations dealing with crimes. Among the 11,311 cases of overall assembly demonstrations in 2015, illegal violent protests took up 30 cases which is 0.26%, presenting decreasing trend compared to the previous year 0.33%, however, the number of injured police due to the illegal assembly and demonstrations was 302 in 2015 which increased by 287.1% from 78 in 2014. Moreover, injuries and deaths of police during control of drunk driving and traffic is continuously occurring, resulting in

190 in total from 2010-2015 (NPA., 2016). Especially, compared to other administrative or private organizations, police operations have distinct characteristics and many hazardous factors in actions of prevention and investigation of crimes. Accidental situations can unexpectedly occur anytime and anywhere, hence, rapid judgement and reaction capability are the most significant factors for minimization of loss of human lives in situational conditions.

Therefore, as a scientific method to enhance various performances of police effectively and to reduce loss of human lives and accidents driving from such distinct characteristics is considered to be necessary, the thesis would like to propose a virtual training system model for police with augmented reality technology.

The virtual educational training system for police with augmented reality technology aims at higher efficiency in task-performances with smaller loss of human
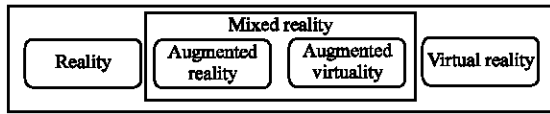
Fig. 1: Virtuality contiuum

Fig. 2: Performance property of augmented reality

lives and less accidents by executing various and situational education contents which considers distinct characteristics and risks of police operations. The system implementation of the virtual training for police involves trainees with wearable HMD devices and when trainers access to the situational training contents server, the education contents to be practiced is augmented and displayed via. HMD screen. As all sensors attached to the trainees get activated, the virtual educational training is initiated, then all training data obtained from the augmented reality devices is stored in the server and feedback is generated through a comparative analysis. Furthermore, as the educational training data of a trained police officer can be comparatively analyzed and stored, appropriately customized education programs become available for each police member. That is, police officers can be and will be expected to maintain rapid judgment ability and situationally responsive capability in accordance with probable risk factors in actual circumstances.

Literature review
Concept of augmented reality: Augmented reality refers to a technology which provides higher level of senses of immersion and reality compared to the existing virtual reality as it matches 2D or 3D virtual objects with the real world which is shown through the display device and provides them to users (Azuma, 1997). As described in Fig. 1, it means a serious of continuum from real environment comprised of only real objects to virtual environment comprised of only virtual objects and if virtual images are augmented based on real environment in consideration of such continuum, it is called Augmented Reality (AR) and if real images are augmented based on virtual environment, it is called augmented virtuality (Gyeong-Hui and Sei-Youen, 2016).

The performance property of augmented reality technology is to keep real images or any virtual world in video-form, then to show the video through human eyes as image data as depicted in Fig. 2. Technologies to visualize such augmented reality consist of various technologies such as marker detection technology, marker registration technology, tracking technology and object rendering. Procedures of marker detection technology, marker registration technology and tracking are carried
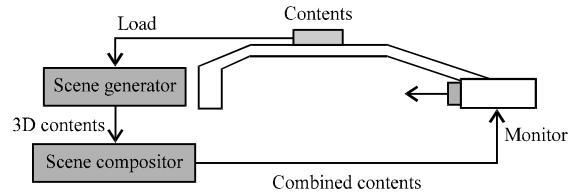
out via. real-time image processes, hence, they result in collecting data from connected cameras and expressing them via. processing (Milgram and Kishino, 1994).

Augmented reality technology today is applied in various industrial settings including manufacturing, national defense, robot and construction as well as entertainment like 3D movies and especially in association with military, repetitive training using EOD simulation has been enabled (Hyun-Ho, 2016).

Therefore, considering the dangerousness, sporadicalness and distinctiveness of police operations, various virtual educational training with augmented reality for police is necessary as it allows minimization of loss of human lives among both police and people and efficient responses among against incidents.

Distinct characteristics of police operations and augmented reality: Unlike other private organizations and administrative organizations, police operation exhibit its own unique distinctiveness of police administration in aspects of crime prevention and investigation. Such distinctiveness of police administration suggests eight traits: sporadicalness, maneuverability, authority, systemicity, political neutrality and tendencies of isolation and conservatism (Hwang-Woo, 2008). Particularly, in dangerousness, sporadicalness and maneuverability of police operations involves injuries or loss of human lives if rapid judgement and measures are not proceeded as police should deal with unpredicted situations and incident occurrences.

Therefore, as police officers practice situational virtual trainings in advance, rapid decision-making and responses become available against incidents in real-time situations, leading to higher level of efficiency of police operations and minimization of incidents. That is if situationally different trainings are practiced, repetitive mistakes made during police operations can be reduced and as police equipment can be freely utilized in long term via. wearable HMD for education, rapid data check and responses to situations become available in a more urgent atmosphere.

Such augmented reality technology can be an effective tool to complement the distinctiveness of police

operations. In other words, for police operations which requires rapid decision-making and maneuverability to respond to dangerous and sporadic incidents, utilization of augmented reality technology will supplement insufficient information in real world and eventually will allow rapid decision-making capability (Kang-Hyun and Yoon-Ho, 2011).

Cases of augmented reality technology in police operations: If augmented reality technology is adapted to police operations, much higher level of efficiency will be resulted than the current police operation standard. Cowper and Buerger (2003) comprehensively categorized potentially adoptable areas of police operations for augmented reality into five: patrol, Swat operation, crime investigation, educational training and supervision and explained them. Especially, in terms of educational training, virtual training is said to be practicable via. advanced simulation trainings with augmented virtual dangers upon real geographical features (Cowper and Buerger, 2003; Cowper, 2004).

In fact, US marin corps implemented augmented reality for their infantry training. Presenting a virtual enemy on a wide field, attacking the enemy with real marine corps weapons can be practiced and as various equipment such as weapons and bullets are visualized for uses, the effectiveness of training becomes maximized. Furthermore, using a display-mounted AITT (Augmented Immersive Team Trainer) helmet, overlap virtual objects on a real situation map and by using augmented reality technology, fire-exercise in rainy seasons becomes available and training-time can be reduce (Anonymous, 2017).

Augmented reality technology is already being utilized in various areas of police operations. Most of all, utilization of CCTV with augmented reality pertained to crime inspection simplifies the courses of direct movements for patrol and guard and allows understanding of scenes in blind spots where generally were impossible to be identified or similar understanding level with actual patrol by settling an AR machine in a fixed space and receiving real-time data of patrolling spaces (Ha-Yan *et al.*, 2016).

In relation to traffic control tasks, Dubai police officers are recently suggesting utilization of google glass for their tasks to enable tracking those who violate the traffic laws. That is behaviors, faces and driver licenses of drivers are linked to the HMD device, more accurate data regarding observed situations is transported to the police headquarters, then police officers can receive additional data back from the headquarters rapidly. Data such as vehicle descriptions, traffic violation history and vehicle ownership is visualized through the HMD, thus, existing traffic police officers can reduce the level of danger in traffic and parking controls and less police human-resource arrangement becomes possible for tasks with economic cost-reduction.

IAPLS is a product developed by a surveillance system company in Austria and is a system which discovers suspected terrorists or criminals among crowds via. facial recognition function of smartphones with augmented reality technology and warns criminals or terrorists through loudspeakers. Through an automatically recognized self-positioning system if police officers in a patrol area put their smartphones to the front and observe suspects in crowds, the device recognizes the face, match with data and if the suspect is discovered as a criminal, the locations is notified to facilitate tracking processes.

Hence, if augmented reality technology is applied to police educational training, situationally diversified scenarios become enabled and more efficient trainings become possible as well as reduction in police training cost and in loss of human lives deriving from crimes.

MATERIALS AND METHODS

Proposal model of virtual educational training system for police with augmented reality technology: Study 3 would propose a virtual educational training system with augmented reality technology to enable police play their roles in diversified and rapidly-changing circumstances at a high efficiency.

The system consists of three components: situational training contents server where various educational contents are stored for virtual training visualization, database server which stores training data and analyzes it for feedback and other various sensors with HMD which enables provision and augmentation of training content data through a screen for logged-in trainees connected to content server.

System components and functions
Situational training contents server: Situational training server is a server that stores various educational contents related to police training. Police virtual training contents which are visualized through a HMD device are designed for real-time exchange of various contents which trainees desire for from the contents server. If trainees turn on the HMD switch, off-line training contents server is logged-in via. Bluetooth, then various training contents get transferred from the contents server through HMD. In terms of training contents, various virtual training contents pertained to police training are dealt with and
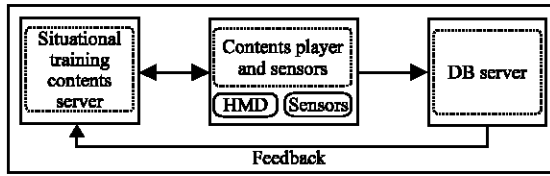
Fig. 3: Proposed virtual educational training system for police with augmented reality technology

they are comprised of contents which cultivate optimal responses to various risks in different probable situations in association with crime investigation, anti-terrorism and responses to assembly demonstration.

Contents player and sensors: Contents player is a device providing various training contents information to logged-in trainees through the connection between HMD and situational training contents server. Furthermore, as various sensors such as body-action, ground and shelling detection sensors are attached to the helmet and the vest for virtual educational training, training data of trainees is collected though detections including actions of body and firearm uses, then transported to the database server. The working sequence of contents player is designed as:

- Training contents server access via. HMD
- Contents server log-in by trainee
- Selection of virtual educational training program contents
- Transportation of educational training contents to the HMD of trainee
- Augment and display the received educational training contents which situational programs are inherent, through a HMD screen

Database server: Database server stores acquired data set from all sensors and trainee trainings and analyze it. In other words, stored data from virtual training contents is comparatively analyzed in the server, based on the data analysis result, compensate weaknesses for future virtual trainings, hence, privately-customized programs become available for provision.

Proposed system: Virtual educational training system for police with augmented reality technology can be visualized as Fig. 3:

- Access to the police educational training contents from HMD4
- Log-in the contents server by recognizing trainee with a trainee ID

- Match the received trainee information from the contents server and transport desired training program contents for the trainee to HMD
- Augment and display the received training contents from contents server through HMD
- Various sensors on the helmet and the vest of trainee get activated
- All training data acquired from augmented reality device(equipment) is stored in database server
- Personal training data which has been stored is comparatively analyzed and feedback is provided

RESULTS AND DISCUSSION

Evaluation of proposed system: This thesis proposed virtual educational training system for police with augmented reality technology in order to efficiently improve the performance of police in their tasks, at the same time, to reduce loss of human lives and accidents occurring during police operations.

The proposed virtual training system for police accesses to the police training contents server via Bluetooth, using HMD and the training gets initiated when the contents server is logged-in. As trainees are logged-in into contents server, trainee information is matched then, they can select appropriately set training contents among various situational training contents. Such situational training contents server stores various training contents, hence, allows trainees to proceed preliminary trainings, allowing rapid judgement and responses to unexpected real situations.

Police operations involve various equipment such as guns, handcuffs and ropes, thus, there should be no inconvenience for body actions during virtual educational training. However, while hand held type accommodates mobile cellphones such as a smart-device, there are difficulties to have long-term practice of police virtual training (Kim *et al.*, 2001), the wearable HMD enables long-term training as well as higher training effectiveness as various equipment can be freely used.

When various sensors including body-action detection sensor, ground detection sensor and shelling detection sensor attached to the helmet and the vest of trainees are activated, all training data of trainees is stored in database server. Particularly in case of the body-action detection sensor, it allows linkage of actions by trainees upon a virtual character via. motion-sensors such as motion and its lines.

Acquired training data from all sensors are stored in database server, then personal training data set is comparatively analyzed. Based on the result of such comparative analysis, trainees can be given with optimal training program which is individually customized for future virtual trainings.

CONCLUSION

As crimes recently gets diversified, higher level of economic cost is needed for crime prevention and investigation by police and injuries and deaths of police officers are constantly increasing. Considering the facts, preparation of a system which can flexibly respond to various accidents is extremely significant.

Therefore, virtual training with augmented reality for police allows police officers practice virtual educational training covering various contents in advance, resulting in rapid and efficient responses to probable incidents in real situations.

Augmented reality technology is useful for data search as various information related to the real object that is visible can be immediately identified. As such a strength enables more effective training via. augmented reality, it will be able to play a significant instrumental role in police operations.

Especially in ways that police operations and tasks are to prevent and respond to incidents occurring in various circumstances, there are higher degrees of dangerousness and stronger need for maneuverability, hence, agile responses should be involved.

Thus, considering such a reality, virtual educational training system model with augmented reality technology has been proposed for police to allow optimal responses and rapid decision-making procedures related to police operations. Through the system as preliminary training in different and various situations becomes possible, repetitive mistakes during police operations can be reduced and loss of human lives and property can be minimized in occurrences.

However, for the establishment of the virtual educational training system with augmented reality for police, budget for system development and contents development should be preceded.

RECOMMENDATIONS

Moreover, as future researches which augmented reality is utilized in various fields such as crime investigation and patrol among police operations, except educational training should be consistently implemented.

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