Modern technologies allow to significantly improve the quality of sports trainings. Due to employing various types of sensors, for instance sensors measuring acceleration, as well as multi-camera systems, it is possible to precisely reconstruct the movement performed by the athletes. This allows to analyze the movement and provides important feedback for both the athletes and their coaches. Proposed project intends to go one step further by providing training support with augmented reality.

Augmented reality is a system, which can join the real world with the virtual world, commonly by displaying computer generated objects over video feed from a camera, for instance in a smartphone. The most recent solutions, however, provide completely new level of mixing the real and the virtual worlds. Head-mounted augmented reality sets are equipped with special glasses, with transparent lenses, on which the computer generated objects may be displayed. Moreover, due to employing dedicated sensors for scanning the user's environment, these objects are fitted to the perceived real world and displayed as if they were actual elements of the reality, located in a certain position of the surroundings. The user may, for instance, look at an empty table and see a number of 3D computer generated objects, fitted in such manner, as to make the impression, that they are actually laying on the table. Due to additional sensors, which can track the movement of the user's hands, it is even possible to interact with these virtual objects. This technology is quite new, although it has many potentially interesting applications, such as visualizations for medical doctors or architects.

Proposed project aims at employing an augmented reality set, such as described above, for support of fencing training. Fencing is well suited for such an application, because the weapon and the hand are constantly in the field of view of the fencer, and therefore in the field of view of the augmented reality set. The main concept it to visualize correct trajectories for the weapon during the exercise. The fencer will see the real world with overlaid, computer generated lines, which will guide him how to correctly move the weapon in a particular exercise. The lines will be fitted to the current position of the weapon and the hand. During the exercise the system will also provide feedback, to what degree is the performed action correct, meaning how closely does the current trajectory match the expected one. Intuitively, such exercises supported by augmented reality should significantly improve the efficiency of fencing training.

Development of the proposed system requires research of methods in the computer vision and machine learning areas. Precise tracking of the weapon and the hands is needed, as well as analysis of the performed motion, by employing RGB and depth cameras provided be the augmented reality set. Additional inertial sensor mounted on fencer's hand may prove helpful as well. Based on the data recorded with fencing experts, the system must learn how the correct trajectories look like in particular exercises, as well as be able to generate such trajectories for practice of the other fencers. Moreover, the system must be able to measure how closely the performed exercise matches the expected movement. Finally, the system needs to fit the generated trajectories to the real world and display them by using the glasses in the augmented reality set. All developed methods may be useful in other projects regarding augmented reality as well. Proposed system may prove to be an innovative tool for support of fencing training.