Progress of miniaturization and increase in resolution of widely available video cameras allowed a rapid progress of vision-based innovative simulation systems. With the advent of high-quality smartphones enabling not only the acquisition, but at the same time processing and displaying of data, it became possible practical application of the concept of augmented reality (AR).

The part presents an example of Attitude Indicator Augmented Reality (AR) control for the unmanned aerial vehicles (UAV) ground control station. The article describes perspective heads-up display overlaid on the image, which is acquired from the UAV rotatable camera. Article shows the mechanisms of aircraft camera calibration with the AR artificial horizon. The whole algorithm of the render instructions is presented. Elements used in the augmented reality are as follows: 3D artificial horizon, latitude and longitude, GPS info, executed command, time to command end, percent of command accomplish, fuel and battery level, height and speed vertical scale, landing field direction arrow, unmanned vehicle marks.

Another discussed application of AR is an attempt to improve existing methods of measuring the range of motion of people during rehabilitation. Range of motion measurements are used by physicians, physical therapists and veterinarians. There is a need for a solution that would increase the accuracy and repeatability of the measurements obtained. Commonly used methods based on tests using a classical goniometer are often inaccurate and depend on the individual interpretation of result by the therapist. The use of motion capture data to RoM measurements results in an accuracy of order of tens of micrometers, which is mainly due to the precision of the Motion Capture system. During the test, patient is not constrained by any device and has a total freedom of movement. It allows to carry out a medical examination not only during flexion and extension of the one limb but more limbs during dynamic movement such as walking.

However, one should keep in mind that to a large extent the effectiveness of augmented reality systems depends on use for its implementation video acquisition components and tracking algorithms.
One of the main problems of image acquisition by the UAV is the need for the use of opto-electronic gimbals which tend to be expensive, and the moving parts are subject to frequent breakdowns. An alternative may be a multi objective solution devoid of moving parts. One of the solutions designed in such a way is Omnidirectional Video Acquisition Device (OVAD), a device, which was implemented using analog cameras and STM32 microcontroller, has proven its validity during testing process. The device may be found useful in many applications, both civilian and military. However, size and weight of the device made it difficult to implement OVAD on small unmanned vehicles. Proposed solution is FPGA-based OVAD, which is the result of OVAD further development.

Due to the significant differences in the acquired image from thermal imaging cameras and visible light cameras it is often necessary to develop independent algorithms for filtering and tracking the objects of interest pointed by the human operator. Within the part there is presented a novel long-term object tracking method called SETh. It is an adaptive tracking by detection method which allows near real-time tracking within challenging sequences. The algorithm consists of three stages: detection, verification and learning. In order to measure the performance of the method, video data set consisting of more than a hundred videos was created and manually labeled by a human. Quality of the tracking by SETh was compared against five state-of-the-art methods. The presented method achieved results comparable and mostly exceeding the existing methods, which proved its capability for real life applications like vision-based control of UAVs.

Another study was to examine the influence of image thresholding on the correctness of pattern recognition in grey scale images. The method based on moment invariants, which were the elements of feature vectors defining the features of the recognized object, was used by authors in order to recognize the objects. The article presents the influence of image thresholding with histogram equalization for exemplary images on the distribution of the distance between pattern vector and feature vector for every pixel of an image. The authors have paid great attention to the fact that proper selection of the thresholds is significant for distinguishing given object classes. The aim of the following study was to develop a procedure which guarantees the separation between the part of an image where we have the recognized object and the part of the image which corresponds to the terrain where the object moves. The authors have presented the method which uses moment invariants for creating feature vectors which define the features of the recognized object and the features of the background. The presented method is based on calculating the distance between the values of invariant functions calculated for an object and the background. On top of that, the study presents the example of recognizing the object moving in various types of a terrains.

Concluding, the part includes a number of important challenges in the fields mentioned above. At the same time valuable suggestions and conclusions from authors are presented and discussed in detail.