The problem of monitoring of the elderly and disabled persons (called *patients* hereinafter) has recently attracted the great interest of the international engineering, healthcare and scientific communities. There are multiple reasons for that: ageing society, increasing longevity with simultaneously decreasing healthy life expectancy, and, last but not least, insufficient medical and nursing personnel that could constantly watch over the elderly and disabled persons. The monitoring should allow non-invasive tracking of the movements of those persons and their vital bodily functions, such as heart beat or breathing rhythm. Moreover, it should be capable of detecting and preventing person's falls, since among elderly people falls are the main (direct or indirect) cause of death.

The rapid development of measurement and computer techniques is constantly providing new tools for automation of the patients' monitoring, which may compensate for the insufficient medical and nursing personnel and errors caused by humans due to fatigue or lack of attention.

Impulse-radar sensors (called *radar sensors* hereinafter) and infrared depth sensors (called *depth sensors* hereinafter) have lately attracted the attention of the research community. They do not violate patients' privacy and they do not enforce cumbersome constant wearing of the measurement devices; moreover, they do not require permanent modification of the home environment. In this respect, those techniques are superior to vision-based solutions, to wearable solutions, utilising accelerometric devices attached to person's clothing, and to environmental solutions based on the sensors installed *e.g.* in a floor or furniture of the patient's home.

A radar sensor is emitting short ultra-low-power electromagnetic impulses, which are reflected by all the objects present in the patient's environment. Those reflected impulses are then captured by the sensor receiver, which, based on the acquired signal, is tracking changes that occur in the area; in particular – changes of the position of the monitored person. The principles of operation of depth sensor are to some extent similar: it illuminates the environment with invisible infrared radiation and, on the basis of the signals reflected from various objects, it constructs a 3D model of the observed scene. After appropriate processing of acquired data, a pair of radar sensors and a depth sensor provide at their output the two-dimensional coordinates of the position of a patient; this is not only important information in itself, but information which also allows for estimation of other health-related quantities.

Data representative of the patient's location (*i.e.* in the occupied room) enables one to make inference concerning the patient's health condition on the basis of the changes in his/her daily routines. For example, early onset of dementia can cause the increase in wandering out of the apartment. On the other hand, qualitative and quantitative characteristics of the patient's movements (such as mean walking velocity) can be used for identification of the changes in his/her health condition. Walking is very complicated and involves all bodily functions; to be able to walk at a normal velocity ($\geq$ 1 m/s), the overall health status must be good which means that if it deteriorates, it will be possible to infer this by a quick assessment of the person's walking manner. In the context of these considerations, it becomes apparent that precise estimation of the person's position is of key importance because other health-related quantities are derived from the sequences of the position coordinates; therefore, the uncertainty of the estimation of these quantities is strictly related to the uncertainty of the position estimation.

Since radar sensors and depth sensors operate according to different physical principles, they have specific complementary advantages and disadvantages: radar sensors offer a broad field of view and capacity of the through-the-wall monitoring, but their accuracy is relatively low; on the other hand, the depth sensors are more accurate, but their coverage is limited and they cannot detect occluded targets. Taking into account the reliability theory, one may expect that the combination of such sensors, followed by adequate data fusion, could bring the increase in the accuracy of the monitoring.

The aim of the research will be, therefore, to develop an effective algorithmic basis for fusion of measurement data acquired by means of radar sensors and depth sensors, to assess the performance of the developed algorithms when applied for estimation of the position of a monitored person, and of other health-related quantities, and to formulate the recommendations of practical nature concerning, *e.g.*, the placement of sensors and suitability of procedures of data fusion, taking into account the variety of health-related quantities to be monitored.

The development of accurate and fast algorithms for data fusion will directly influence further development of the techniques of unobtrusive monitoring. When the usability of the radar-based and depth-camera-based techniques is proven and well-grounded, further advancements can be introduced, and it has to be stressed that these techniques have much more to offer: radar sensors can detect heart beat and breathing of a person, while depth sensors can be efficiently used to detect person's falls. Therefore, the intellectual effort invested in the development of a theoretical and algorithmic basis for fusion of measurement data from those sensors is certainly worthwhile because, indirectly, it will enhance the quality of life of numerous persons.