Signals that describe natural phenomena or human environment can be characterized by a sequence of samples taken with a fixed time interval (uniform sampling rate), or only in specific moments, for example, when a signal value exceeds a certain threshold.

In this project, it is proposed to analyze signals by registering them only when they reach their maxima or minima called *local extrema*. The local extrema of a signal contain a valuable information about its time course. For example, changes in the share price on the stock market are best reflected by the trend shift, i.e., certain dates when the share prices are no longer growing and start to drop, or vice versa. The moments of a change of trend are also crucial for the analysis of the financial results of enterprises, or the economic situatation of countries.

Moreover, only on the basis of local signal extrema, one can reproduce information about how the signal behaved in between, although no signal measurements were made during the time between local extrema. Reconstructing this information can be theoretically even perfect, provided that the extrema occur frequently enough. It can be proved that if the signal values have a Gaussian distribution, which often occurs in nature, the exact signal reconstruction is possible. As a part of this project, the algorithms for both exact and approximate signal reconstruction based solely on its local extrema will be designed.

The informative value of many human pshysiological signals is included in their local extrema. The examples are electrocardiographic (ECG) or the photoplethysmography (PPG) signals. These signals and many others are registered by telemedical home care systems that allow remote and holistic monitoring of many physiological parameters registered by sensors located on the surface or inside the patient body. In most telemedicine healthcare systems, ECG signal sampling occurs every 1 ms, which is 1000 times per second. Nevertheless, for many diagnostic purposes, it is essential to detect only a few extrema per second (heart rate is equal approximately to 60-100 beats per minute, and there are 5 extremes for a single evolution of the heart, marked on the figures below with the symbols P, Q, R, S, T). To illustrate informative value of local extrema for medical diagnosis, the model of ECG signal of healthy people is shown in Fig. 1, while the model of ECG signal with inverted T wave suggesting myocardial infarction respectively in Fig. 2.

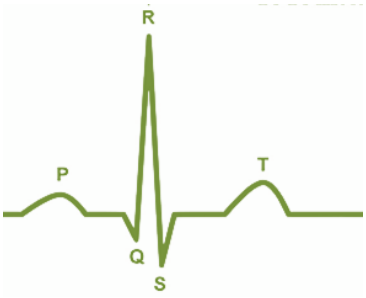

Fig.1. Model of ECG signal for healthy people

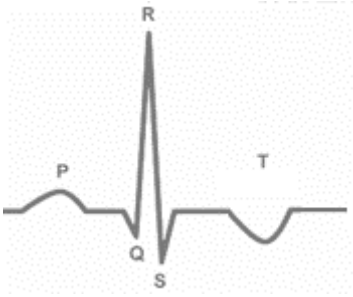

Fig. 2. Model of ECG signal with inverted T wave suggesting myocardial infarction

Therefore, detection of ECG signal extrema solely can save a lot of energy consumed by the monitoring device and thus extend the life of its battery.