The abstract

of master attestative work

on a subject:

"Research of time series pocessing methods in multimodal applications"

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Work urgency

Almost all modern devices have the built in gauges. Office printer, the kitchen refrigerator, a communicator and suchlike have some gauges which provide their intellectual functioning.

These gauges can register both the low-level information (acceleration, light exposure) and the high-level information uniting some low-lewel information (accuracy level: low, average, high).

There is a problem in adaptation of devices and their gauges for uniform decision-making among current tendencies in working out of modern technologies.

Such a problem can be solved by the separate device or by device system associating

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Modern smart phones are an expedient example of such systems as they unite different gauges: of acceleration, of time, of illumination etc. Such systems are called as multimodal.

Basis of multimodal systems functioning is permanent data gathering, processing and forecasting. For these purposes the data received from gauges is used.

In a life, for example, statistical changes of temperature within a month can be used for granting of council to the user about expediency of footwear or outer clothing.

In the work dealt I with the low-level data read from accelerometer built in phone.

The accelerometer gauge registered accelerations on three axes (X, Y, Z) which united in time numbers.

Time numbers are a good statistical material for analysis of investigated processes and finding the necessary laws at them.

The work purpose

The work purpose was research of polytypic time numbers processing methods agreed to three possible variants of user's activity: sports exercises (run, sports walking), the user's interface for contactless digital devices control in the house and the interface for dynamic computer games playing.

The polytypic data collected in each of the given problems needed analysis and choice of the most expedient method for proccessing and decision-making.

The main components allocation from three time numbers which are responsible for change of body's position in space was the basic problem in task with moving and person's movements recognition. The smoothing methods (a sliding average, a double sliding average, exponential smoothing, double exponential smoothing and Kalman filtering) analysis has been carried out for this purpose.

«Training with the teacher» methods have been considered for a problem of contactless digital equipment control in a house: a method of forecasting by matching offered Nidleman-Vunsh and a q-grams method effective for revealing of all possible matchings on the set length.

The user interface creation problem for dynamic games requires instant reaction to movements of the user. As the data read from the accelerometer gauge are very much noisy and need permanent Wi-Fi transfer that brings a time lag, it was necessary to solve two problems – elimination of noise and forecasting.

Five methods realised already have been compared for the purpose of best smoothing, and methods of linear and autoregressive forecasting have been analysed for the purpose of best forecasting.

Understanding of time numbers character and ability to predict the further behaviour of processes are key line of intellectual possibilities of modern devices.

They allows behaviour of applications to be adapted for processes which influence system from the outside.

Capacity and quality of applications considering a context can be essentially increased not only thanks to the account of the context past and present, but also thanks to forecasting and reaction to the future contexts.

Problems which resolve in work

1. Research of features of existing methods of preliminary time numbers processing.

2. Research of features of some heuristic algorithms of time numbers comparison for the purpose of templates allocation.

3. Research of methods of low-level context forecasting.

4. Working out and experimental research of methods and algorithms.

The reached results

Having solved problems which was stated in work the author protects:

▪ results of the analysis of some methods and their expediency at use in mobile applications;

▪ results of research on examples of multimodal interaction components construction;

▪ results of research: influence of methods accuracy on the decision of tasks in view; an operating time of methods; adaptation of forecasting to a context; influence of the contexts sizes for the period of their comparison.

Scientific novelty of work

Scientific novelty of work consists that:

▪ data handling methods are analysed and applied, approaches which them unite are offered;

▪ updating of method of smoothing by a sliding average and updating of algorithm of two sequences comparison are developed;

▪ application of problems of bioengineering algorithms in mobile applications is offered and is realised.

Practical value of work

Practical value of work consists that:

▪ efficiency of the offered methods with reference to a mobile operating system is experimentally investigated and proved;

▪ methods of recognition of person movements which will be used in monitoring systems of person's ability to live further are developed.

Conclusions

Results of modeling of the chosen methods have been compared with results of modelling of their analogues. Besides, results of the forecast alignment algorithm realised in the mobile application according to a real problem of person's movements recognition have been presented.

The conducted researches have shown that the low level of abstraction of the data is useful to problems of smoothing and forecasting of values of the gauge in case when the real data appears with a delay.

It has been shown that algorithms of alignment have identical speed of performance which does not depend on distinction in volumes of compared contexts.

Processes of person's movement have been analised in work: when phone lies in a trouser or shirts pocket; processes of description with a hand of some geometrical figures holding a phone in a hand; and processes of an inclination of phone within one point of space while using a phone as the interface of the user for a computer game.

Work contains 92 with., 56 fig., 34 sources.