MEASUREMENT DATA ACQUISITION SYSTEM UTILISING THE GSM PHONE SYSTEM

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Abstract

We present a new approach to designing of application which can be used for data acquisition. Cellular phone is used to transfer the data. Connecting many phones builds highly scalable measurement network. SMS messages were used to transfer the data.

Key words: computer networks, data acquisition, GSM, EIS

1 Introduction

The basic idea of the presented measuring system is to create a highly scalable measurement network, which could operate in extreme weather conditions without the need for daily and burdensome maintenance, as well as fulfilling the conditions of the least disturbance to the environment. It was assumed that the system will be built on the existing commercial GSM network infrastructure, and technologies implemented in devices working in it. Thi skind of network could be sed for monitoring and modelling environment and environmental Risks[1]. This is extremely important due to European regulations concerning environmental impact assessment (EIS) [2]

For the purpose of mobile phone networks, with the exception of transmission of voice conversation, a standard SMS (Short Message Service) was created allowing users to send 150/160 text characters. These messages are transmitted via electromagnetic waves with appropriate frequencies. But from the point of the functioning of the system modulating / demodulating the message itself and delivering it to the final customer falls on the shoulders of the GSM service provider. Implementation of the proposed system does not require any prior preparation of the hardware because it runs in the same hardware infrastructure conditions as each private user of any GSM network.

For the proposed measurement system to work according to the plan, a so-called Receiver should be created, whose goal is to receive text messages sent to its pre-determined input ports and to build a group of Transmitters (broadcasting stations), gathering relevant measurement data, and then sending them to the Receiver via the selected GSM network. This idea is presented in Figure 1

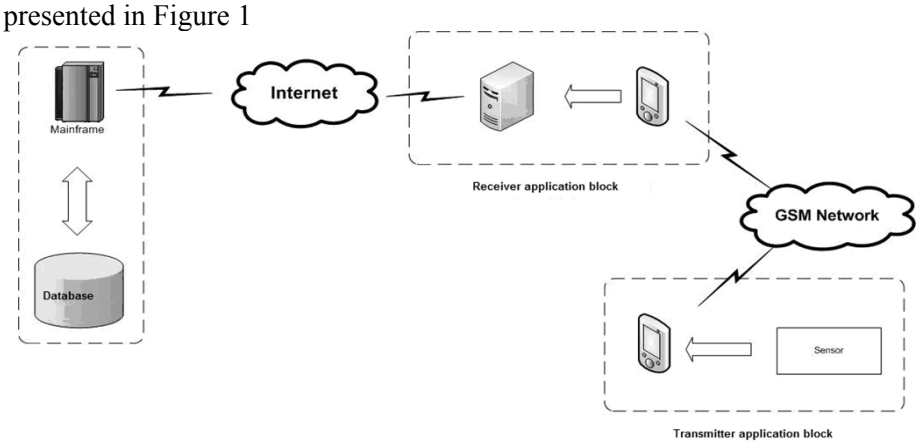


Figure 1. Block diagram of the measurement system

2 Hardware requirements

Broadcastig Stations are supposed to gather specific data in the appropriate measurement intervals, and then convert it appropriately and send via the cellular network to the Receiver. Their hub is virtually any mobile phone, becoming a bridge between the actual sensor and an appropriate database. This proposal stems from the fact that mobile phones became a part of fashion that prevails in the society (frequent exchange of mobile phones) with rapid changes taking place at the same time in the scope of development and modernization of the equipment. The effect of the observed progress is a very short lifetime of certain phone models, although they still have high technical efficiency. Thus, it is possible to use phones that are "unfashionable" or destroyed only in the outer – visual level.

This is an additional ecological aspect of the design. It is necessary to pay attention to the rapidly growing number of mobile GSM devices in the world markets and the emerging problem resulting from the disposal of equipment created using older technologies no longer present in the market. The introduction of the proposed solution expands the functionality of the device – namely the mobile phone, increasing its social usefulness.

Another important problem that every active (sending/receiving) electronic device faces is its appropriate powering. The system is designed to operate

mainly in the open country, in often hard to access areas, not having adequate energy infrastructure necessary for its power. The problem has been, to a large extent, already solved by the manufacturers of mobile phones themselves. In the quest for greater durability of these devices, they try to create energy-efficient electronic systems, which require much less energy for their operation. This allows the use of renewable energy sources. Basically, we are talking mainly about solar power, but also the broadcasting station can be equipped with the appropriate elements to generate energy from water or wind power. Just a small panel transforming solar energy on the surface of the housing is enough to get it properly powered.

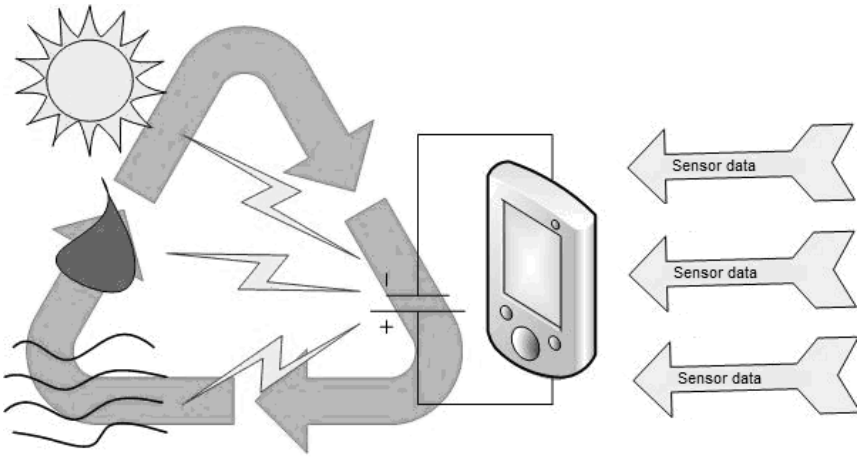


Figure 2. Powering the Broadcasting Station with renewable energy sources

The Receiving Station is to receive the text messages coming from the Broadcasting Station and then to transfer them to the databases. Its "architecture" can take up two directions.

1. May consist of a mobile phone acting as listener of the SMS receiving ports and a PC, whose task is to read data stored in the phone and inputting them into an existing database.
2. GSM phone equipped with Google's Android system allowing to implement an appropriate JAVA programming language library, giving the possibility to communicate with most commercial databases. At the same time the vast majority of these phones have a built-in WiFi wireless communication, excluding the need for a PC.

In principle, the collected measurement data can be of any type, ranging from simple temperature measurement, through the strength and direction of the wind, and ending with the measurements of environmental contamination

or radiation. The system allows for any configuration and is highly flexible in terms of the number and quality of performed measurements.

3 Software

The number and diversity of available mobile phones could pose a problem in the area of software because it is difficult to create an application that works in the same way on a large number of different platforms. Java was chosen as a programming language by SUN company. Its design allows for great flexibility when it comes to the system and the machine on which the program will be executed.

The project involves the use of one application on the Broadcasting Station side, and two or three on the Receiver side (depending on the variant of the Receiving Station).

The task of the application of the Broadcasting Station is to launch the actual measurements made with real sensors connected to the device via serial ports, in specified time intervals and collecting them in a relevant memory unit. After a specified number of such measurements the program "opens" a standard GSM SMS connection on the appropriate output port, fills the stream with the data obtained from measurements, and in the end "closes" the stream and ends the GSM connection with the network until the next data "package" is gathered. When the program is started it waits, for example, till to a full hour with the first made measurement (you can treat it as a kind of synchronization). Afterwards, it works in a "continuous" loop, until the application is manually turned off.

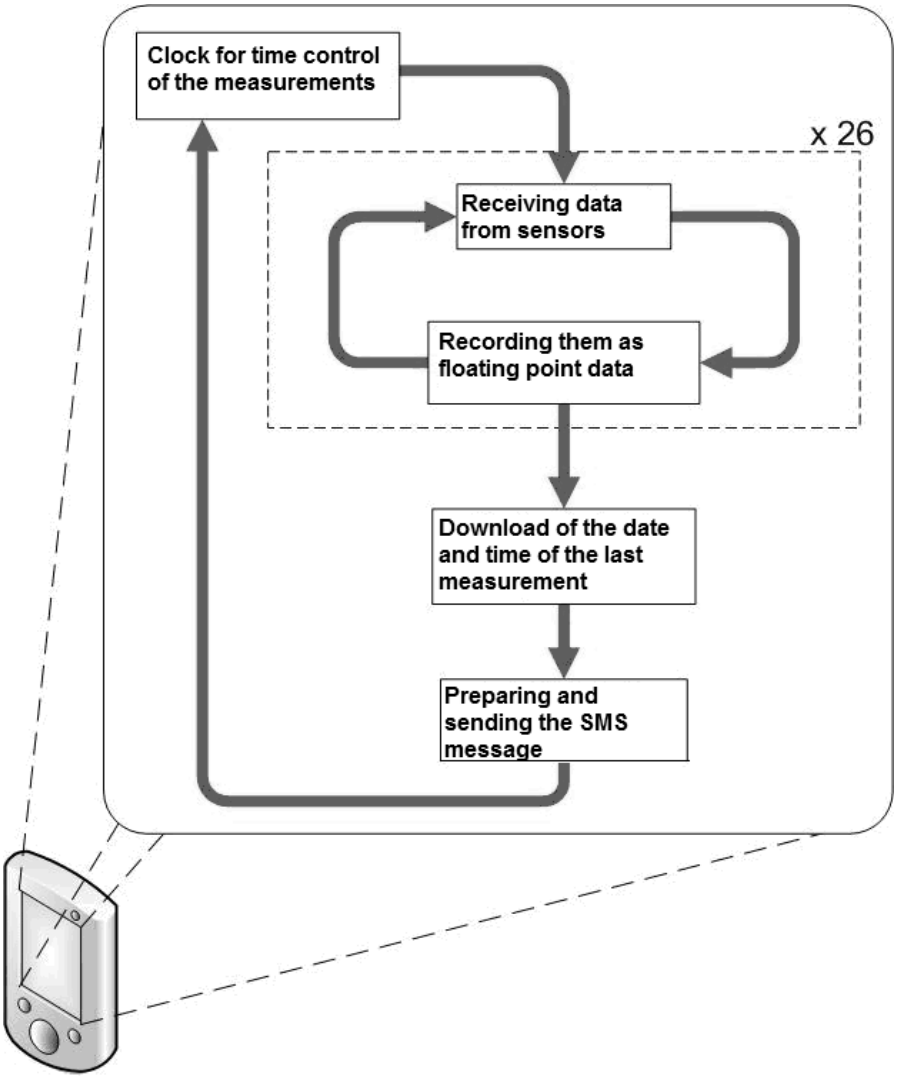


Figure 3. Broadcasting Station program operation diagram

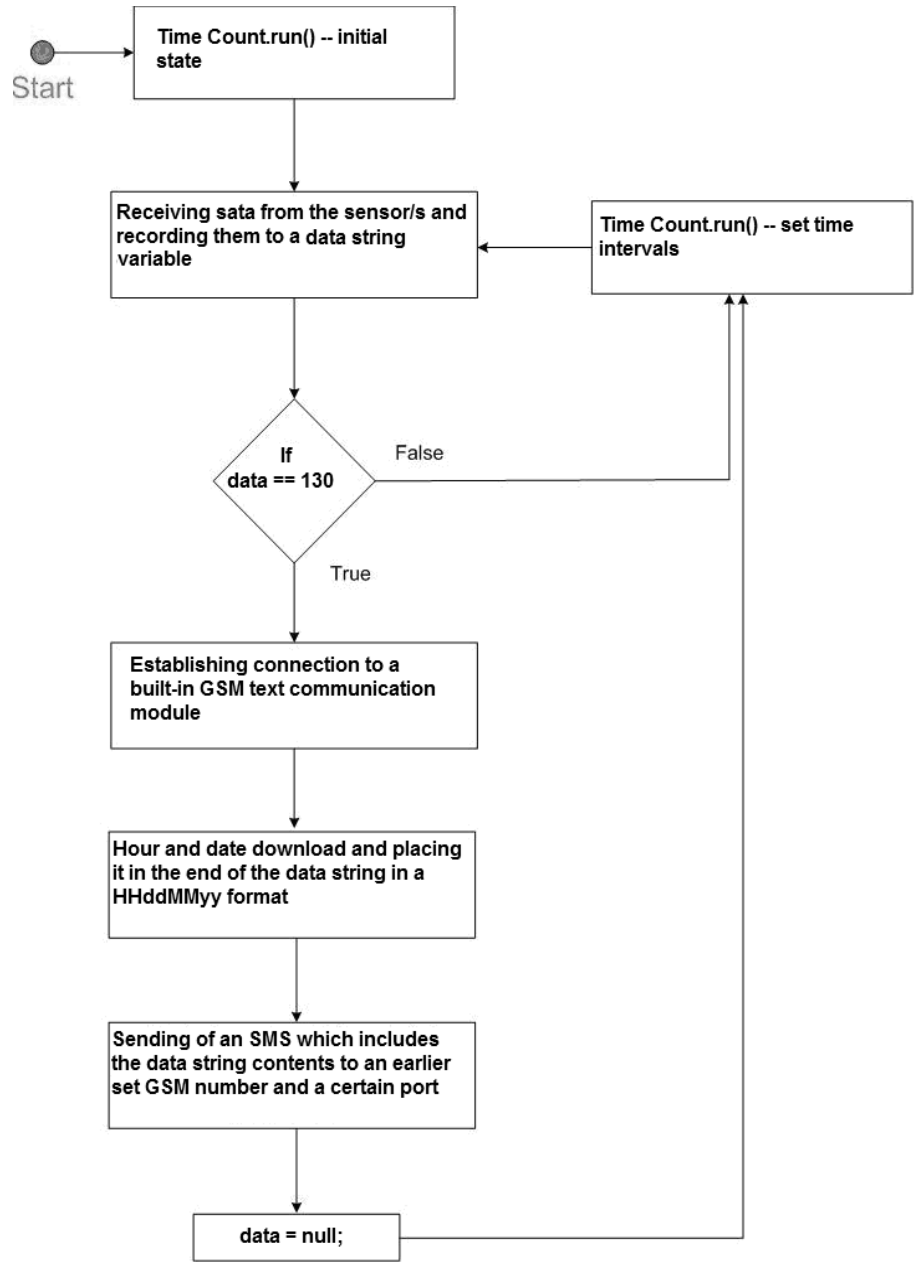


Figure 4. Simplified algorithm of the Broadcasting Station functioning

The application running within the receiving station is a prepared application of the Broadcasting Station. At startup, it "opens" the receiving function on the same port, with which text messages will be sent from the Broadcasting Station. When it receives such a message a so called Event takes place. This event calls the procedure for reading the data contained in GSM text messages, and then stores it in a text file in the internal memory of the phone. This file is signed with a GSM subscriber number, from which it was obtained. Then it waits for the arrival of the next text message.

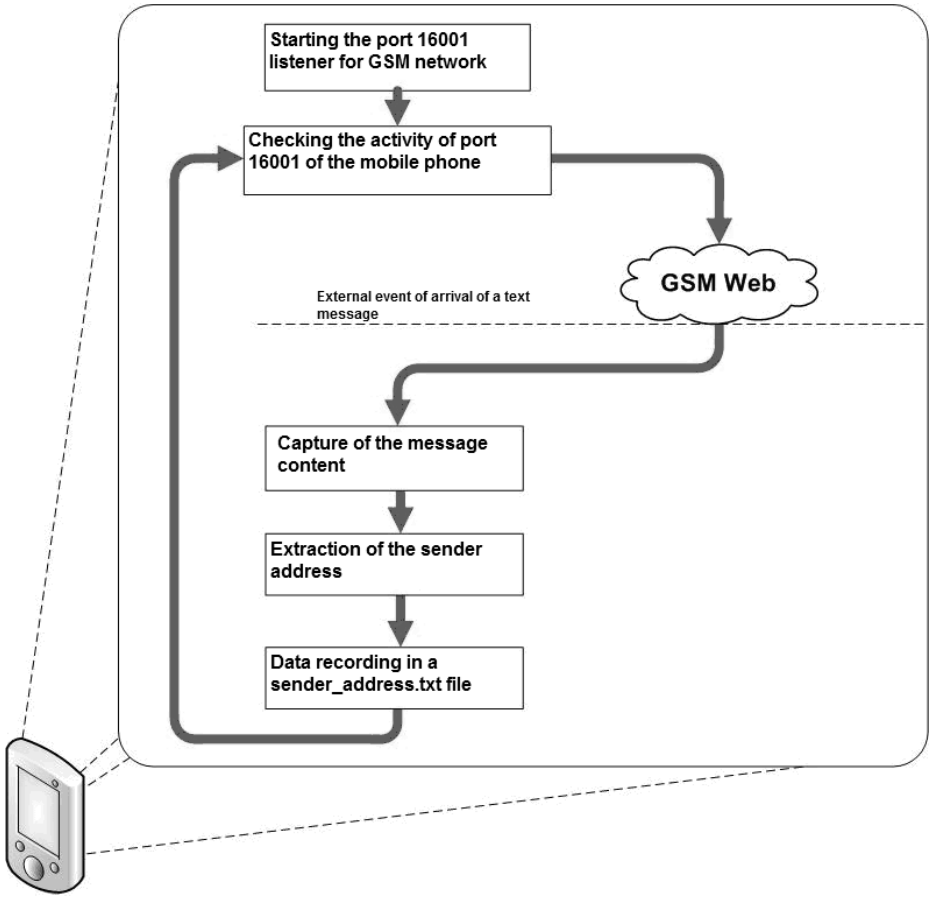


Figure 5. Receiving Station – mobile phone – operating diagram

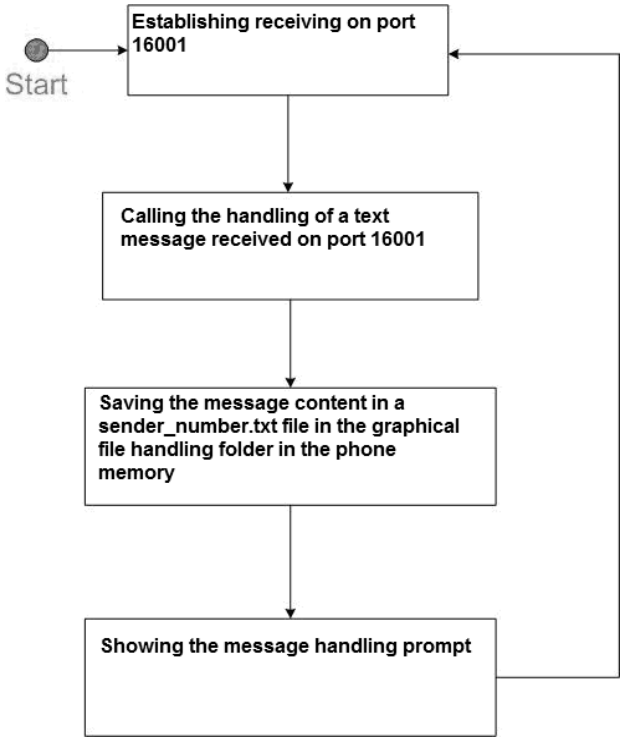
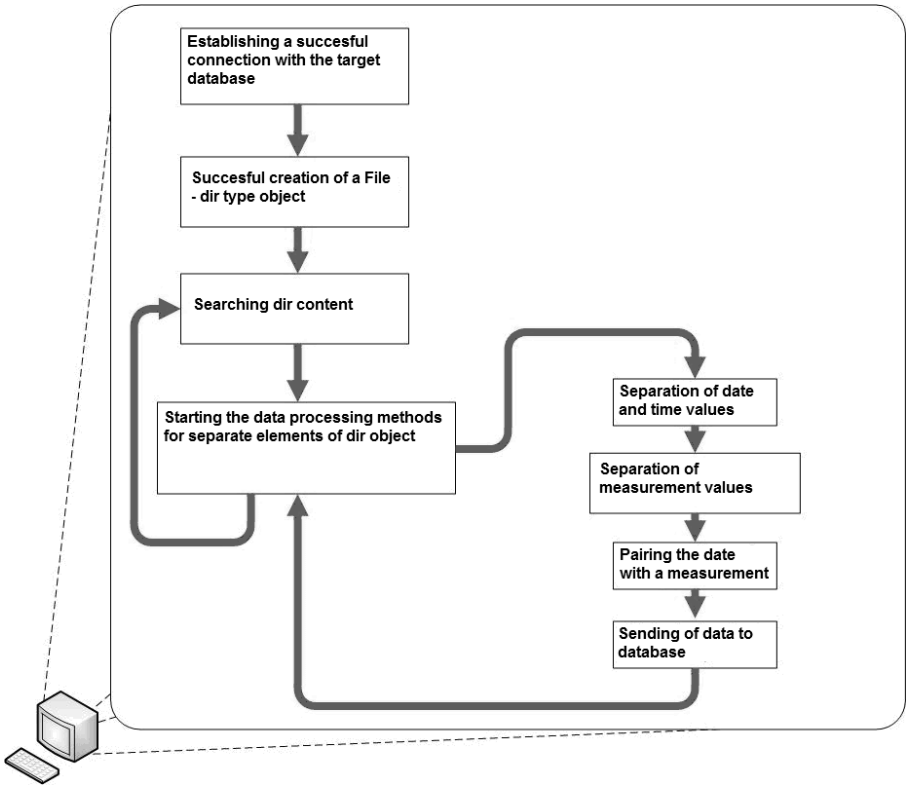


Figure 6. Simplified algorithm of the Receiving Station – mobile phone – application.

The second one forming the receiving station block runs PC machine, whose task is to search continuously a specific location in the Receiver phone memory in search for text files containing measurement data. The application then completes the data (measurement data are stripped of all unnecessary information) and sends to the database via the Internet.



Figuure 7. Receiving Station – computer – operating diagram

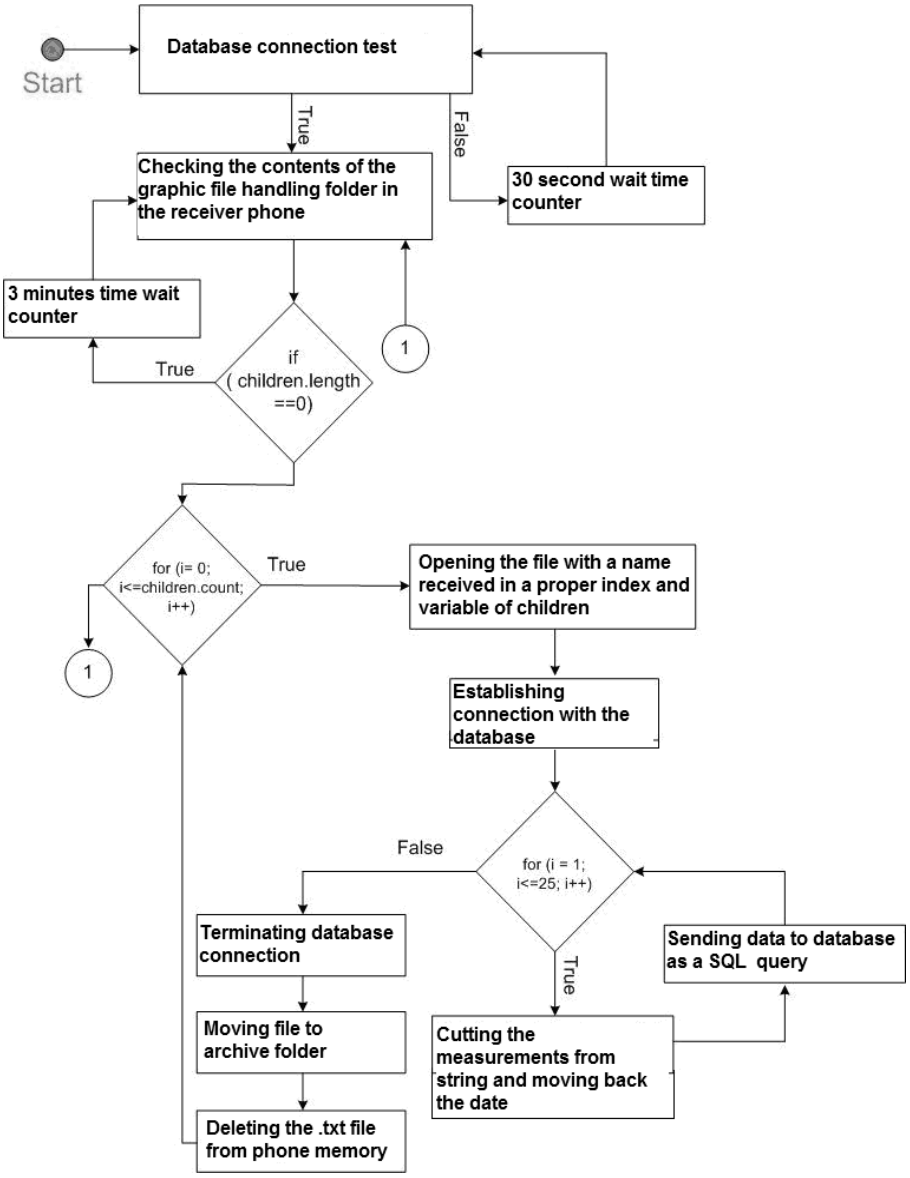


Figure 8. Simplified algorithm of the Receiving Station – computer – application

For a variant of the receiving station operating under the control of Google's Android system both of these applications run within a single machine as separate threads.

4 Operational costs of the measurement system

The project assumed maximizing the amount of data per a single text message. Currently it allows to send 26 measurements with an accuracy of one thousandth of a certain value. This is achieved without compression and encryption, features which also can be implemented. In terms of operating costs, the system is also very attractive. For a single transmitting station the annual cost of an hourly basis (assuming that a text message costs 0.01 PLN) single measurement with an accuracy of one thousandth is 3.36 PLN. Any reduction in accuracy, even further, reduces these costs.

5 Conclusions

The main advantages of the system are: high scalability, low operating costs, ready infrastructure for data transportation, energy independence of the Broadcasting Stations, the use of equipment intended for recycling.

The only drawback of the system is the current lack of possibility to receive real-time measurements. Currently works on the introduction of this functionality are also in progress.

The project is constantly improved with new functionalities and methods of transmission and storage of data. To minimize the costs of transporting data over the GSM network, it is being considered to transfer measurement results via the GPRS standard, but the current availability of this service in the territory of Poland is not at a level similar to SMS, which significantly limits its use.

References

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