DATA ACQUISITION SYSTEM FOR BREATHING MONITORING

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Abstract. *In the article is proposed a new and improved data acquisition system for breathing monitoring. This system consist of a new type of transducers, data packages transmitter and receiver and the software for theirs in real time processing.*
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Introduction

In the [1, 2] was presented the computer aided breathing monitoring and training system where data were captured from the inductive transducers. These types of transducers didn't permit to the patient to go away from the computer, because of the limited wire length. By the way, at the same time with ribcage and/or abdomen movement the non-linearity of transducers is raising. They are also sensible to the external electromagnetic fields. To exclude these difficulties in the present work was proposed to improve the data acquisition system. For this reason, we designed the new type of transducers that function on the other principle. They are more sensible to the small movement of ribcage and /or abdomen than the inductive. We revised the modality of data transmission to the computer, with a view to offer more freedom to the patient during the testing. Using the Mouse System protocol format, the proposed transducers convert the ribcage and abdomen movements in impulse packets, which further are transmitted via wireless waves. Simultaneously, this type of transducers is not sensible to electromagnetic induction and non-linear in functioning. The transmission frequency was taken equally to 144 MHz. This permits us to use an antenna with optimal dimensions, that don't burden the breathing monitoring system using. The maximum distance at that was possible the data reception/acquisition is more than 200 m. The data packages are receipted by the receiver that are coupled to the computer serial COM-port. After that they are fitted to logical level compatible with TTL logic, they are processed by main program as described in [1].

The improved structure of breathing monitoring system

The improved structure of breathing monitoring system is presented in fig.1. In this structure some of important components are the transducers.

These ones were elaborated on the other principle than the inductive. On the base of these new transducers type we have used the functioning principle of mouse, which grace to the photo couple converts the mechanical motion, i.e. the rotation of wheel, in electrical impulses. To enhance the transducers sensibility to small movements, in theirs mechanical part was incorporated a multiplier, grace to which we obtained more than 30 impulses generation per each millimeter of ribcage and/or abdomen movement. These transducers give the possibility to measure the movement values until 55 millimeters. This, of course, is a restriction, that is conditioned by the diameter value of multiplier biggest wheel. The single difficulty of this type of transducers will be the assurance of theirs protection against excessive illumination. Usually the transducers are placed into separated boxes, which are fixed onto belts. They are supplied from 5V battery. From the

output sides of this block, the signals Clock and Data are applied to the encoding block.

The data encoding and transmission block

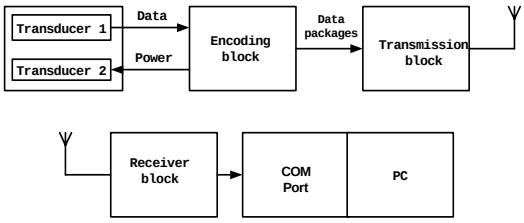

Fig.1. The data acquisition system structure

This block, that is presented in the fig.2, are designed on the micro controller PIC 16C54, which can function on the frequency until 20 MHz.

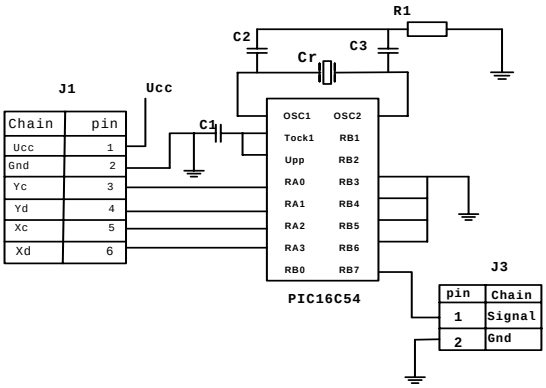

Fig. 2. The data encoding block

One of this circuit advantages is the wide scope of voltage supply (2,5-6,25V) and the small consumption of energy. Grace to encoding procedure the data are packaged into packages, which are transmitted via wireless waves. For data encoding is used standard Mouse System protocol. Thus was excluded the necessity to elaborate a special driver that will be able to support the standard which will be similar with standard for the mouse. The encoding data packages go out through the pin RB7 of PIC controller. Each data package is constituted from 8 bits. For the data packing was elaborated the subroutine Byte. Inside of this is called the subroutine Bit (fig.3), that controls the creation of start-bit. The data encoding and the connected procedures are made of in conformity with flow-charts which are presented in fig. 4 and fig.5. So as the data packages consist of five bytes, the routine Byte is called twice for XValue and for YValue. The encoded data transmission is accomplished by transmitter that modulated the signal basis frequency of 144 MHz. The transmitter consists of one transistor (fig. 6). From the testing, for the supply voltage of 9 V and receiver sensibility of 10 μV, we obtained that the transmission length may be over 300m. The length of transmission and reception antenna is of 0,5m. In order to provide the getting of optimal parameters for the transmitter was selected the transistor for which the admissible frequency is twice great than generator work frequency. As a signal for the modulation of basis frequency serve the encoded data packages from the PIC output. Those, being applied to the varicap, these data packages impose it to modify the self-capacity, conditioning the change of generator frequency.

The data packages receiver block

The reception of data packages is performed by the receiver that is elaborated on the IC KA22429 (fig.7). The circuitry of receiver consist of: FM amplifier, detector of signal modulated in frequency, in frequency tuned generator and system for automatic capture of signal within considered frequency band. For smooth frequency retuning, it is necessary to vary the drop voltage on diode VD1, i.e. that conditioning the capacity change of this. As diode is a component of oscillating circuit of frequency generator this capacity change will challenge the frequency therefore the tuning frequency of reception. The receiver input circuit consists of antenna and oscillating circuit (L2, C15, C16, and C17) with resonant frequency of 144MHz. The data packages are transmitted to the amplifier and level translation, which is designed on transistor VT1. From the output of DD1 the data packages are applied to the pin RD of RS 232 interface, whence are taken by main program for processing as in [1].

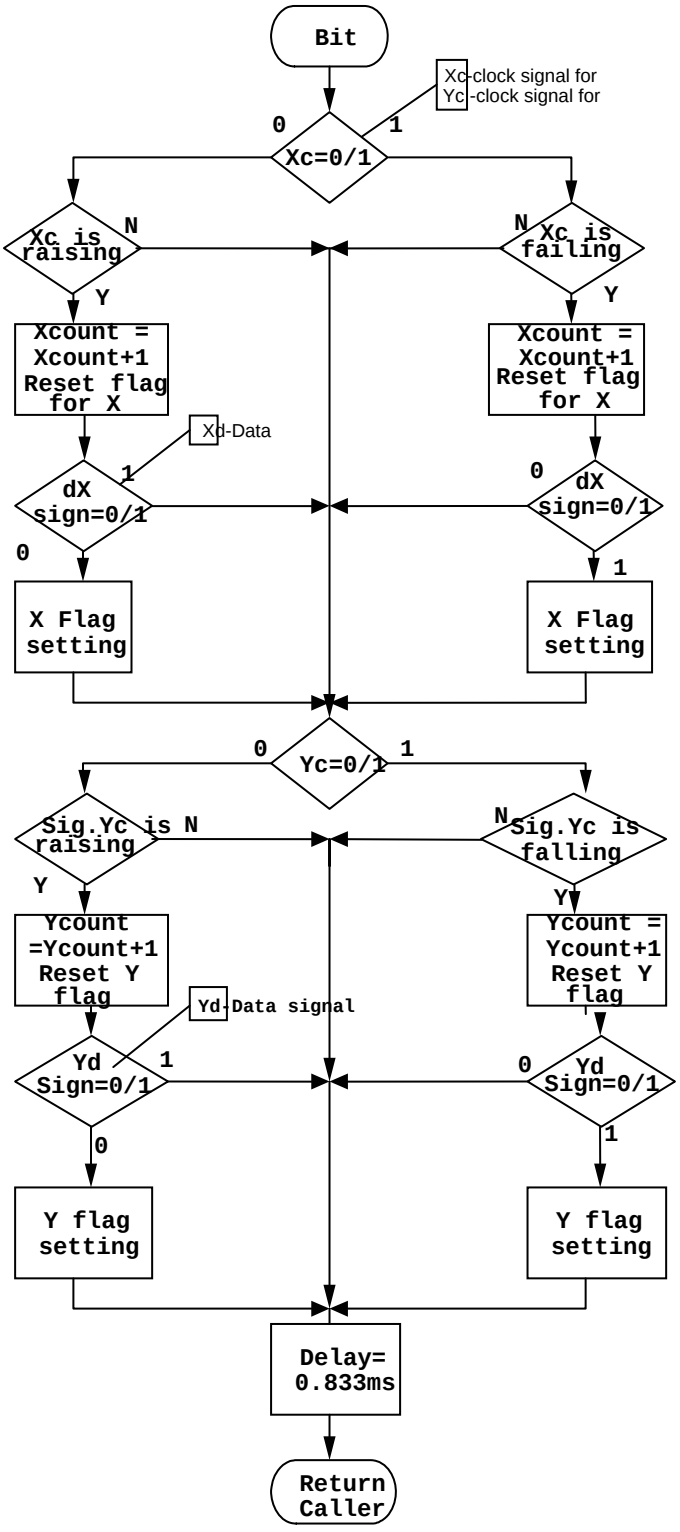

Fig. 3. The flow chart of subroutine Bit

The data processing block

The block is a software that was elaborated for data packages preprocessing before theirs processing by main program. This block is designed in Delphi. Until be taken by the main program, the data packages are processed by Mouse Driver. Through the standard work procedures for the mouse port, inside this block it is masked the mouse cursor button and read the state values. The obtained data are stored in dynamic buffering tables (ExportArray1 and ExportArray2), whence are taken by the main program. The data reading subroutine specified the processes that should be executed with highest priority. Thus, for the data reading and theirs preprocessing are allotted time quantum, during this the operating system will not be requested for the other application that can be executed in parallel with the main program.

Conclusions

The elaboration of data acquisition system for the breathing monitoring is a problem that can have different solutions. One of this is proposed in present work. This solution is relatively cheap and don't have the difficulties characteristic for inductive transducers. In the same time, the patient has the "freedom" during the testing, he isn't strongly built to the computer, therefore, the bio "feed back" that can appear during this time, completely is eliminated. This data acquisition system can be further on improved, especially the transmitter and the receiver parties, if we will use the GSM standard. This permits us to improve the quality of transmission, minimize the system construction and reduce the energy consumption.

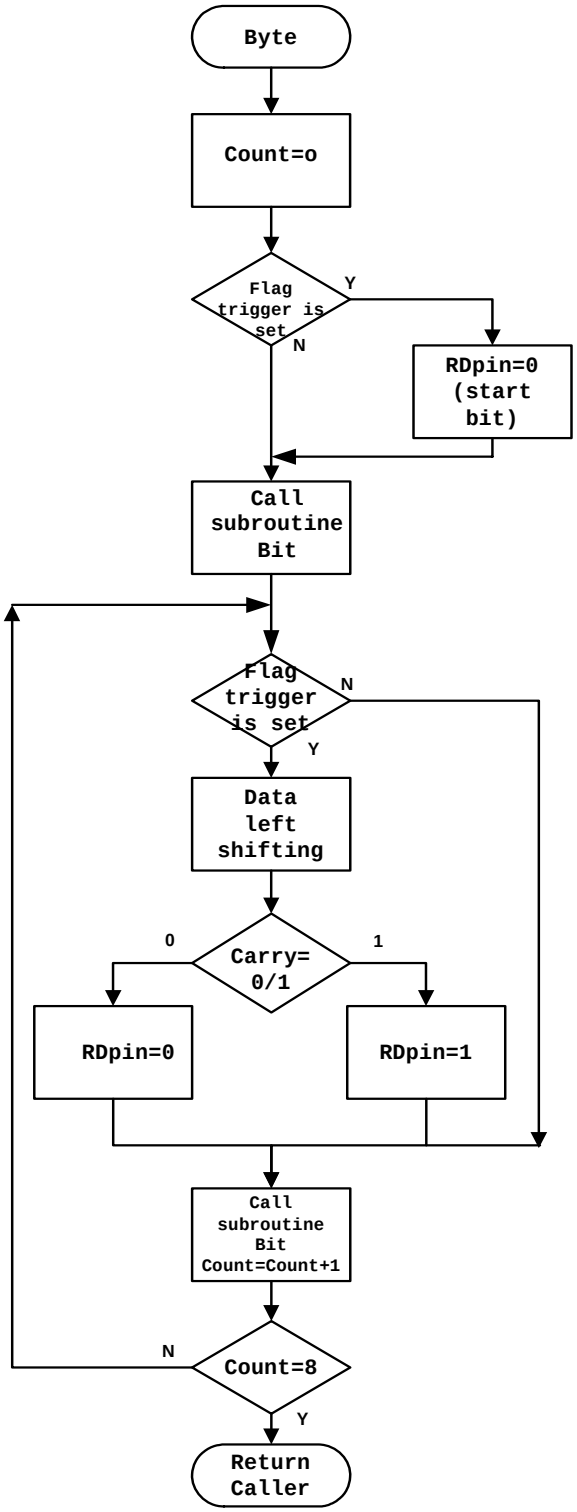

Fig.4.The flow chart of subroutine Byte

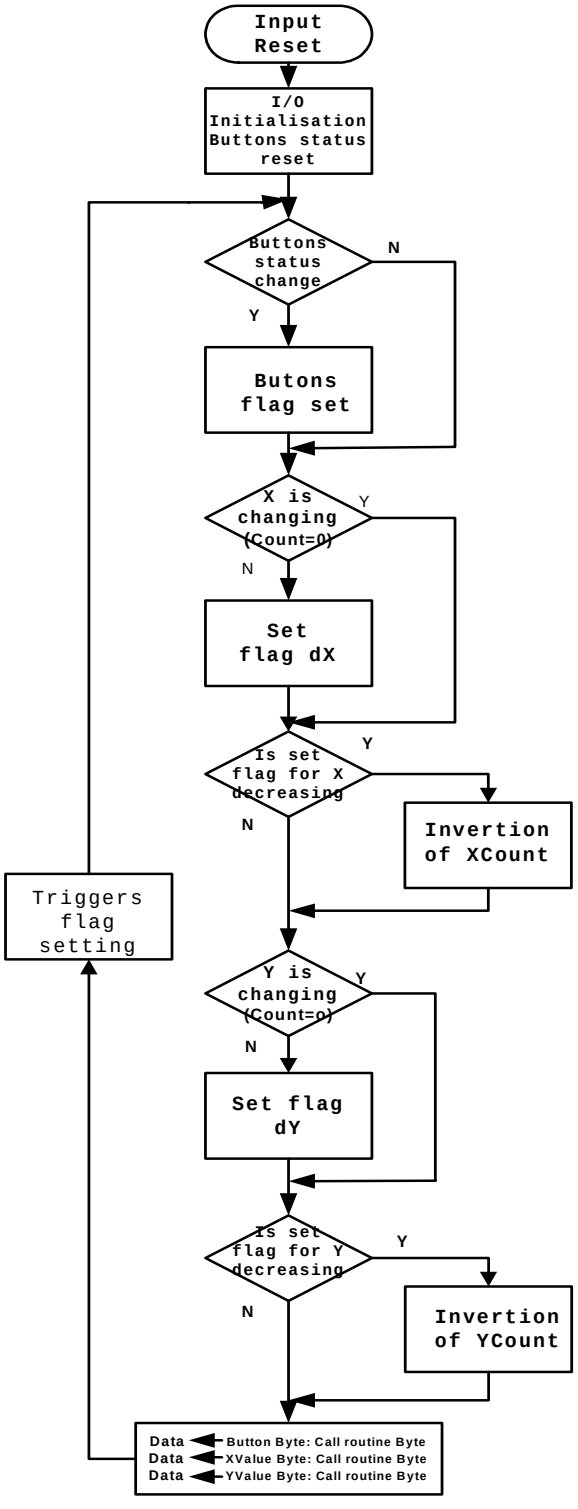

Fig.5.The flow chart of data encoding program

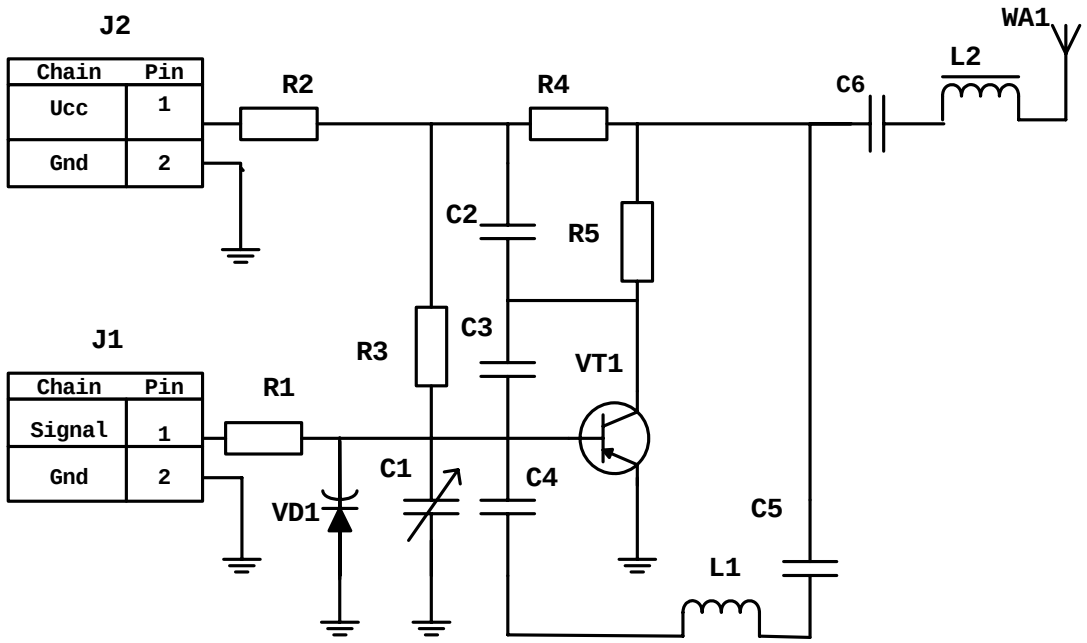

Fig. 6. The data packages transmitter block

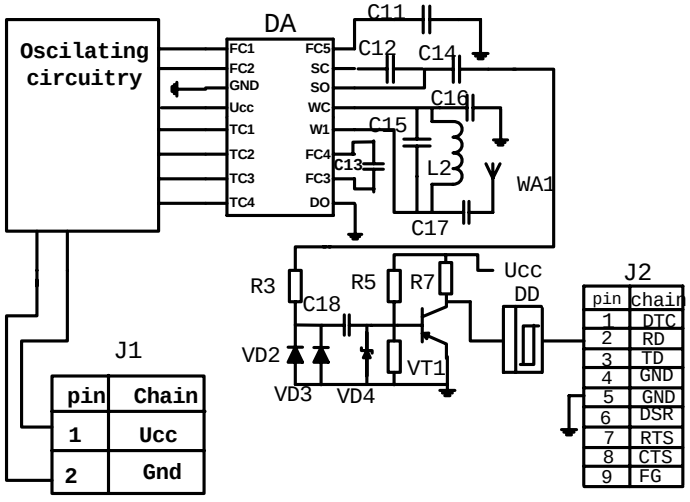

Fig. 7. The data packages receiver block

References

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