

CSCI 339-80 Embedded Systems

Instructor

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Done by

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Voice recorder using Z8 board

Abstract:

This project describes how to Record, Store and Play back using the z8f6403 , with the A/D converter , the flash memory ,the D/A converter , a speaker and a microphone .

Introduction:

This project shows the A/D converter for sound conversion from analog to digital , the flash memory for recording the digital voice and the pulse width modulation (PWM) for conversion the digital to analog and play back the sound .

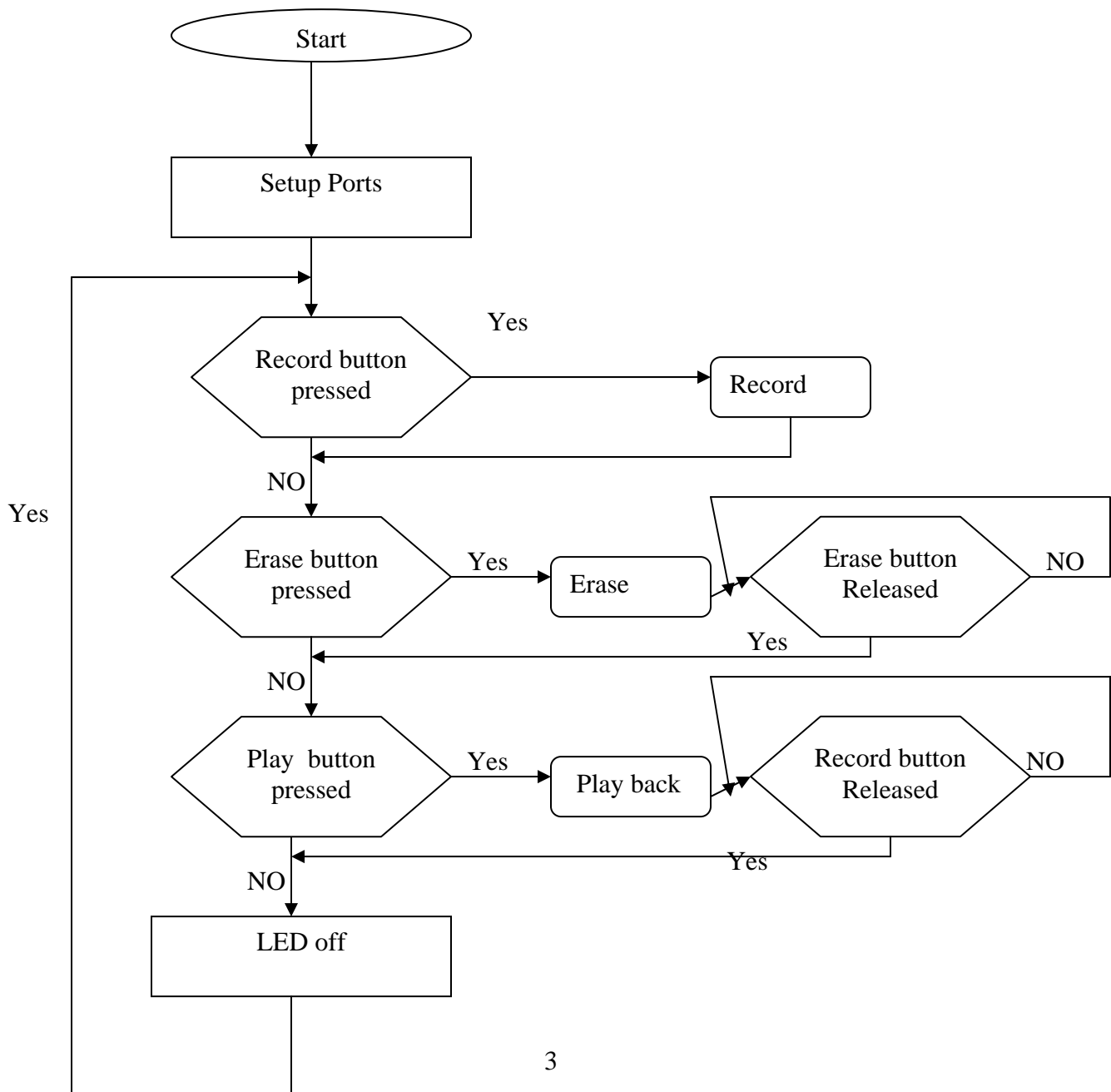
The flash memory is 64KB (65,536 bytes) of non-volatile memory with read/write/erase capability. The Flash Memory can b programmed and erased in-circuit by either user code or through the On-Chip Debugger, The Flash memory array is arranged in pages with 512 bytes per page. The 512-byte page is the minimum Flash block size that can be erased. Each page is divided into 8 rows of 64 bytes. The Flash memory also contains a High Sector that can be enabled for writes and erase separately from the rest of the Flash array. The first 2 bytes of the Flash Program memory are used as Option Bits. The data flash should be erased before data is store. Erasing the flash can be done in combination with programming a page as single page erase or as block erase, with a block we can erase 8 pages in size.

Project Hardware Parts:

- 1) z8f6403 which contains a built in flash memory , A/D and D/A converters
- 2) speaker connected to timer zero
- 3) microphone connected to ANA0

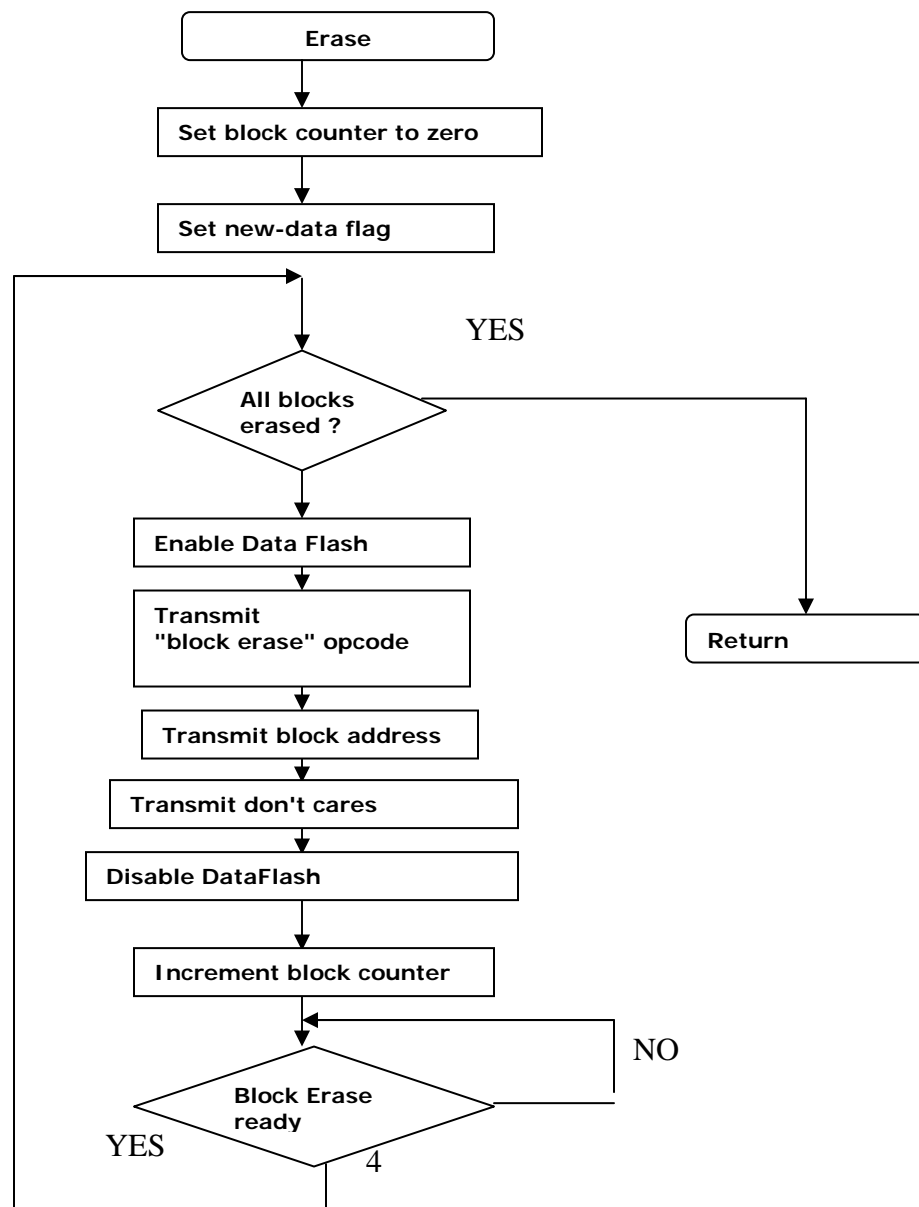
Discussion of the project

The project mainly will be as follows

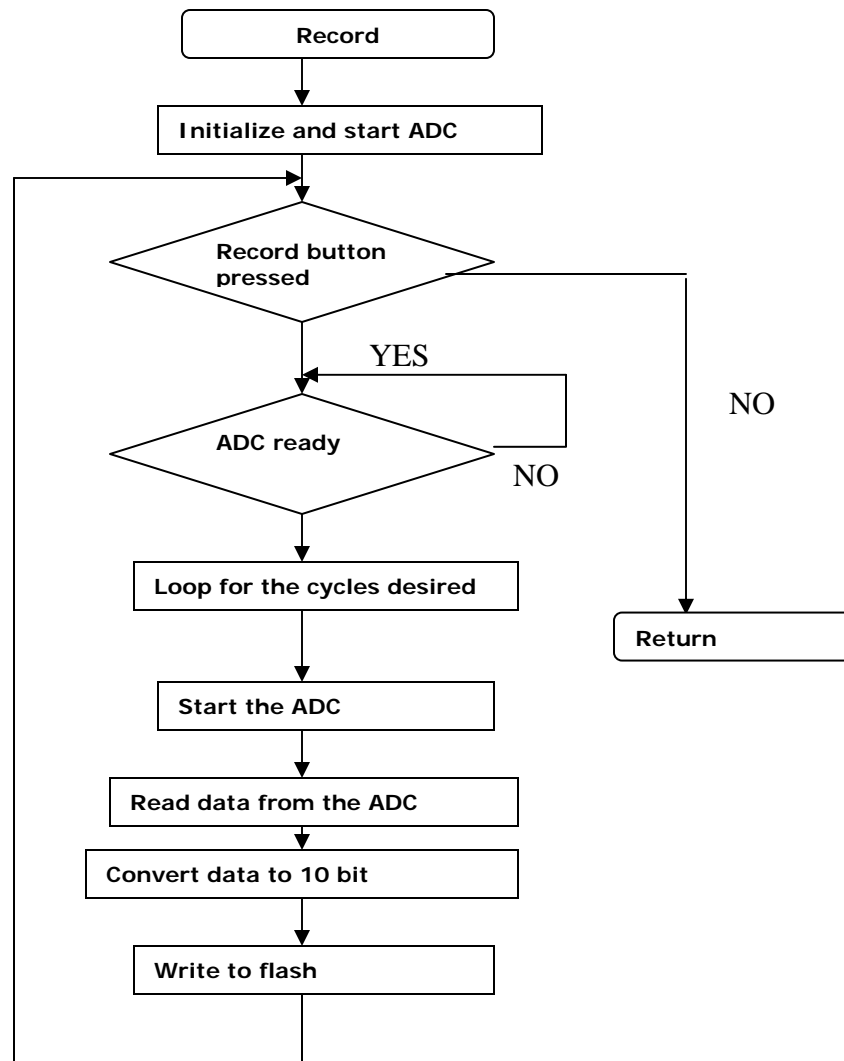


In the main loop the three pushbuttons are scanned. If one of them is pressed the LED is turned on to show that the system is busy, and the corresponding subroutine is called. During the main loop the LED is turned off to indicate that the system is running idle.

Erase: Before data can be written into the memory the Data Flash has to be erased.

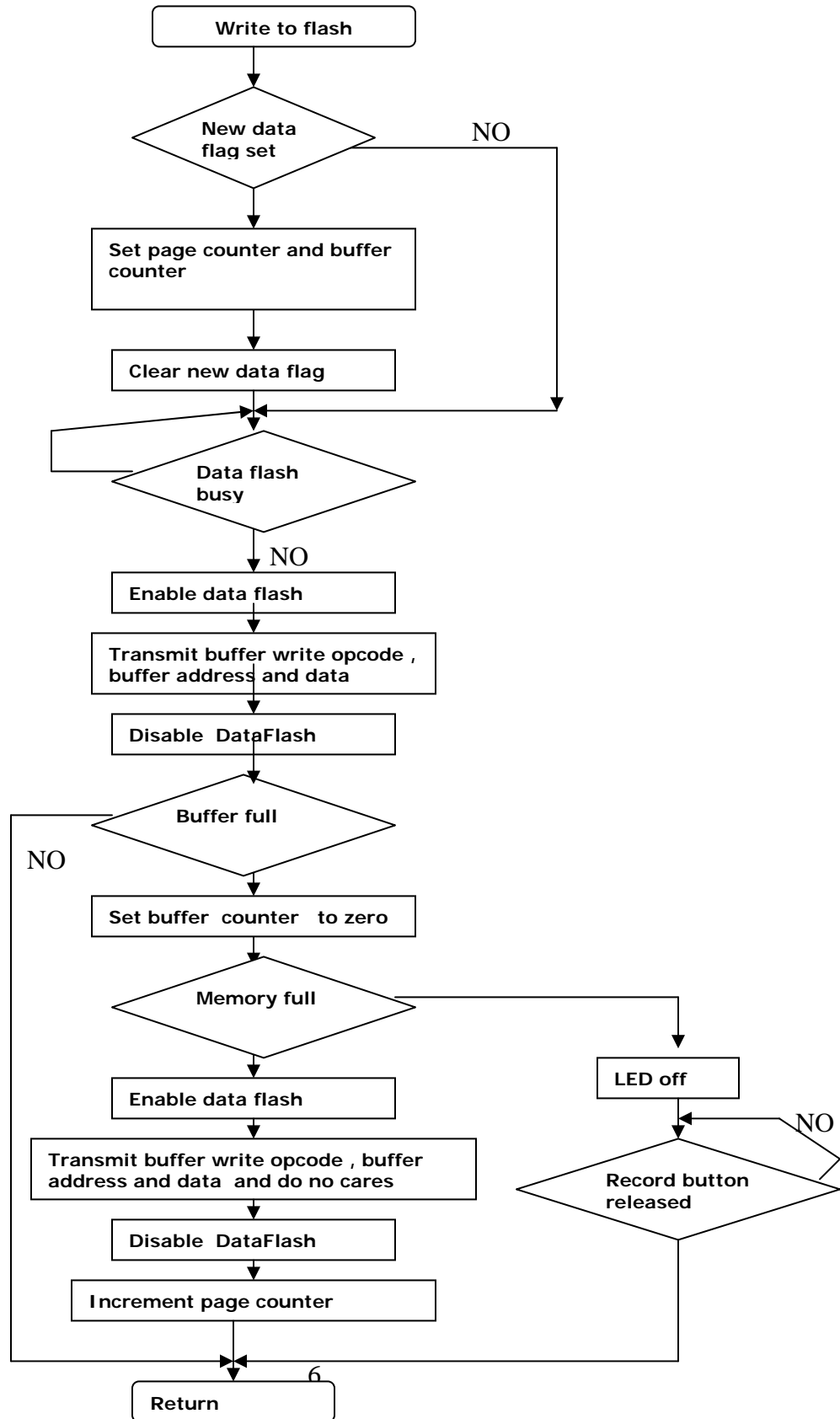


When the “erase” subroutine is called, a flag is set which indicates that in the next recording cycle the new data can be stored at the beginning of the Data Flash.



The record subroutine consists of the setup of the A/D converter and an empty loop, which is performed as long as the “record” button is pressed. The ANA0 pin is used in this project as the input of the voice, In the ADC Control and Status Register the ADC is enabled with a clock division factor of 32, set to single conversion mode, interrupts enabled and the interrupt flag is cleared. The A/D conversion is also immediately started. The first conversion takes longer than the following conversions after this time the ADC interrupt occurs, indicating that the conversion is finished and the result can be read out of the ADC Data Register.

The analog signal from the microphone is sampled, to a frequency; this frequency should be the same as the output (PWM) frequency



Writing to data flash is done by writing first to a buffer and when this buffer is full writing its contents to one page of the main memory.

In the subroutine - write to flash -in the code the letter j represent the byte number in the buffer , and the variable k represent the page number the buffer will be written to , if the new data flag indicate that the data flash is empty , both counters are set to zero .

If the memory already indicates some data, the variables indicate the next free location in the memory, which ensures that new data is directly appended to the memory contents.

If the memory filled up a loop is executed until the record button is released, any data record while the memory is filled will be lost .

The flash memory is divided into 128 pages, every page with 512 byte per page. As shown in figure below taken from Z8 encore microcontroller with flash.

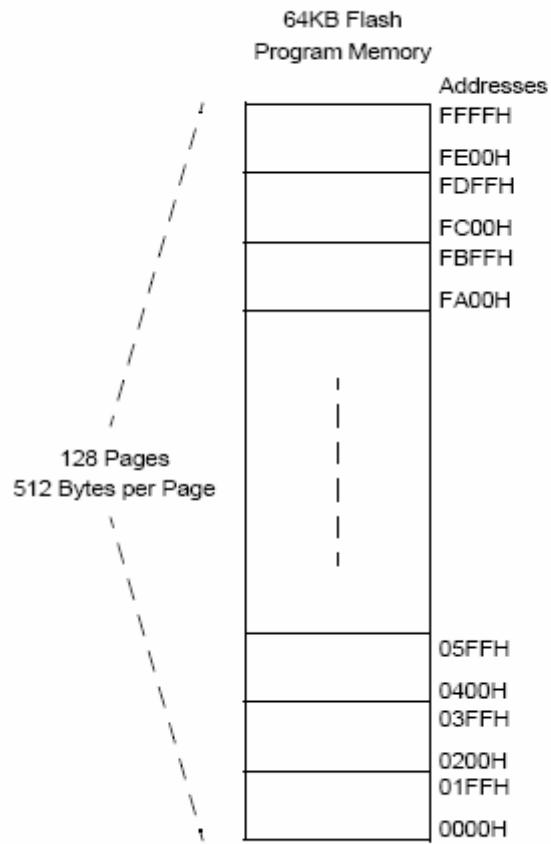
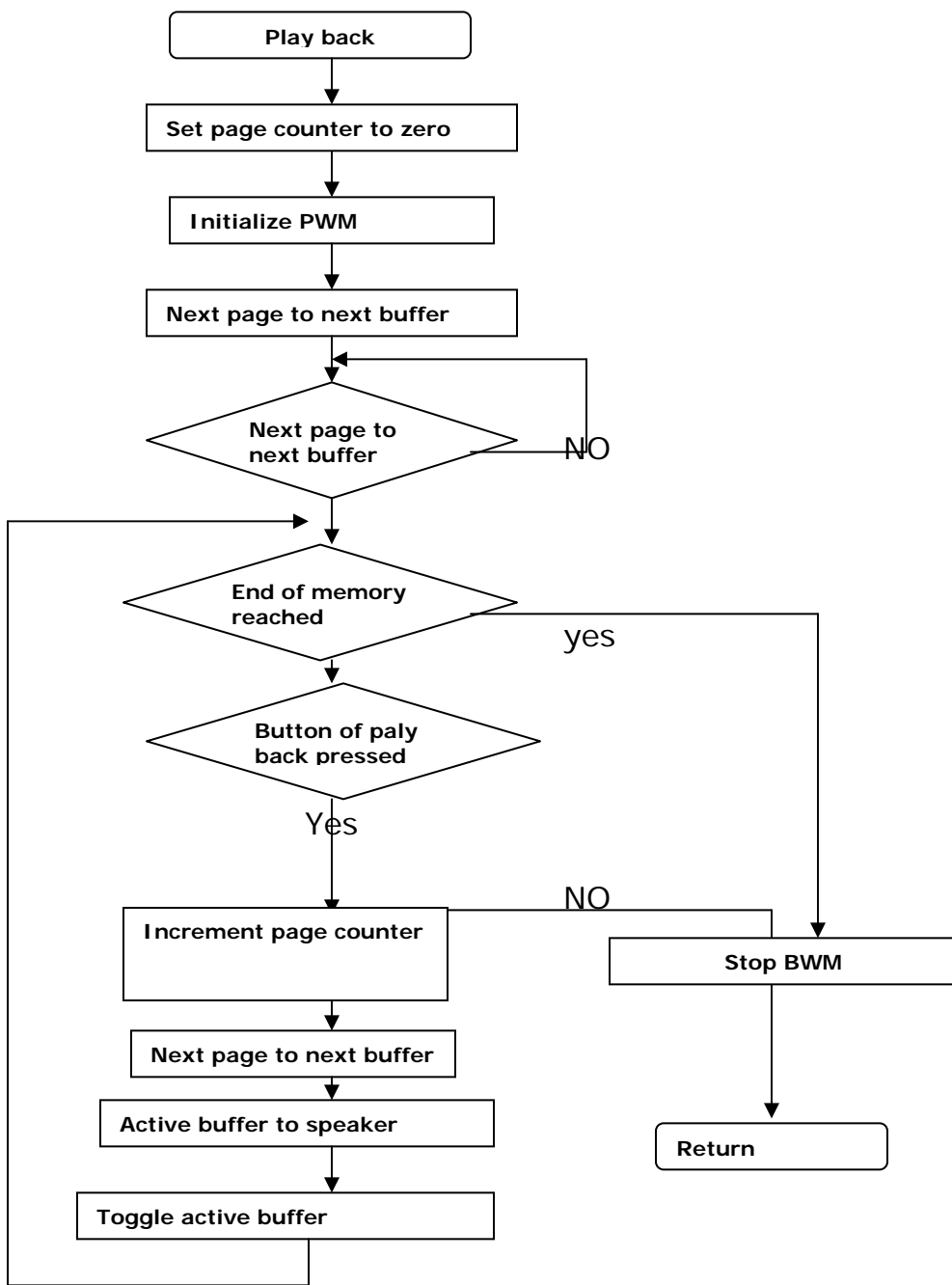


Figure 84. Flash Memory Arrangement

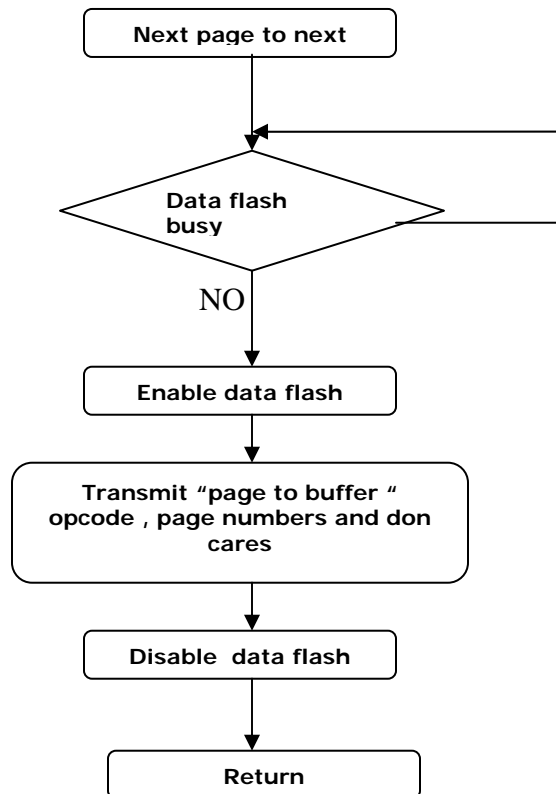


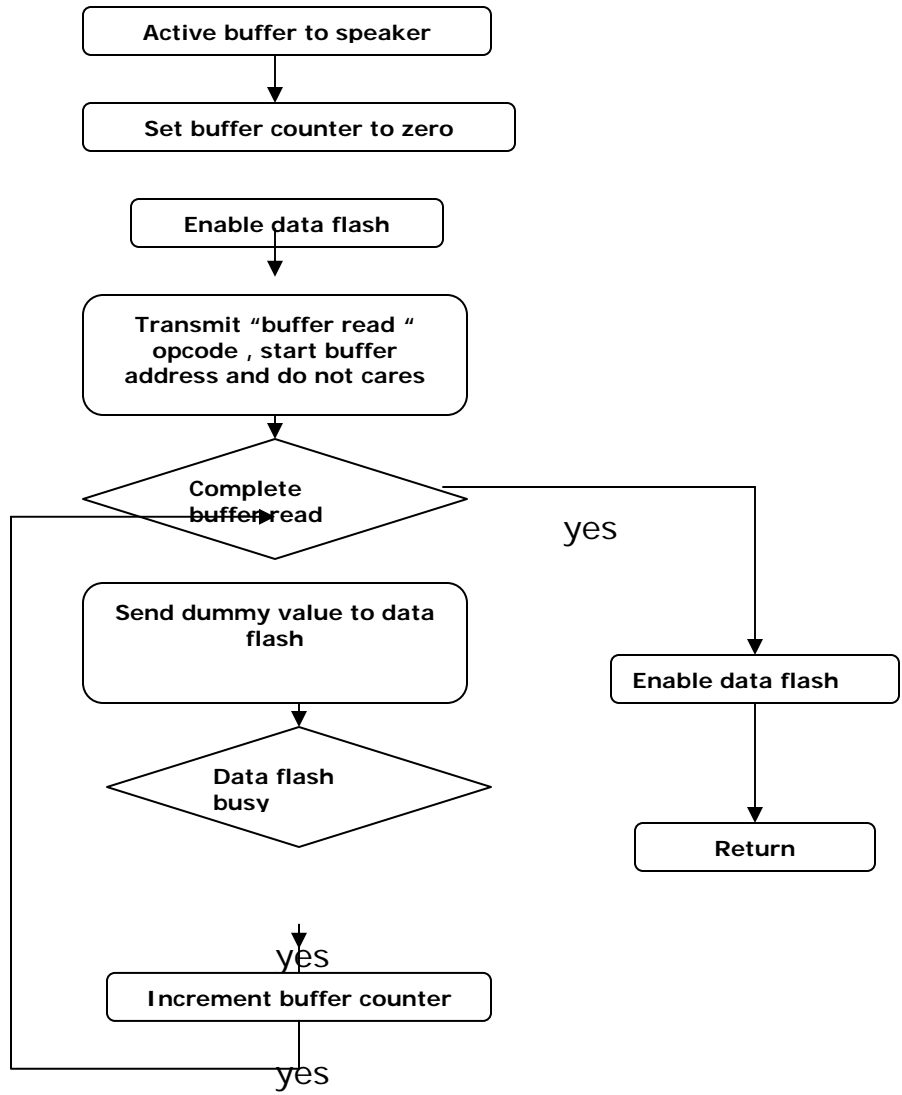
Play back

In the subroutine play black , the content of the data flash are read out and they modulated as an 10- bit PWM , to achieve higher speed data is not read out directly from the main memory but alternately transferred to one of the buffers , then read from the buffer in the mean time the next page is copied in to the other buffer , for the PWM the timer is used , to get the highest possible frequency the PWM clock divider is set to 1.

When the set up is done the first page is copied into the buffer , and also transfer the appropriate command to the data flash , the page to buffer transfer is started , then for reading a byte from the buffer a dummy value has to be written to data flash .

When the PWM counter contains zero , a timer overflow interrupt occurs , this interrupt is used to synchronize the data out put from the flash to the PWM frequency .





References

- 1) **Z8 Encore Microcontrollers with Flash Memory and 10-bit A/D converter application**
- 2) **Digital to analog converter using PWM in the Z8 Encore**
- 3) **Instructor slides**
- 4) **Using Z8 Encore for DMA-ADC implementation**