РУХАНИ ЖАҢҒЫРУ

20 АСТАНА

ЕУРАЗИЯ ҰЛТТЫҚ УНИВЕРСИТЕТІ

Студенттер мен жас ғалымдардың
«ҒЫЛЫМ ЖӘНЕ БІЛІМ - 2018»
XIII Халықаралық ғылыми конференциясы

СБОРНИК МАТЕРИАЛОВ

XIII Международная научная конференция
студентов и молодых ученых
«НАУКА И ОБРАЗОВАНИЕ - 2018»

The XIII International Scientific Conference
for Students and Young Scientists
«SCIENCE AND EDUCATION - 2018»

12th April 2018, Astana

ҚАЗАҚСТАН РЕСПУБЛИКАСЫ БІЛІМ ЖӘНЕ ҒЫЛЫМ МИНИСТРЛІГІ
Л.Н. ГУМИЛЕВ АТЫНДАҒЫ ЕУРАЗИЯ ҰЛТТЫҚ УНИВЕРСИТЕТІ

Студенттер мен жас ғалымдардың «Ғылым және білім - 2018» атты XIII Халықаралық ғылыми конференциясының БАЯНДАМАЛАР ЖИНАҒЫ

СБОРНИК МАТЕРИАЛОВ XIII Международной научной конференции студентов и молодых ученых «Наука и образование - 2018»

PROCEEDINGS of the XIII International Scientific Conference for students and young scholars «Science and education - 2018»

2018 жыл 12 сәуір

Астана

УДК 378

ББК 74.58
Ғ 96

Ғ 96
«Ғылым және білім – 2018» атты студенттер мен жас ғалымдардың XIII Халықаралық ғылыми конференциясы = XIII Международная научная конференция студентов и молодых ученых «Наука и образование - 2018» = The XIII International Scientific Conference for students and young scholars «Science and education - 2018». – Астана: http://www.enu.kz/ru/nauka/nauka-i-obrazovanie/, 2018. – 7513 стр. (қазақша, орысша, ағылшынша).

ISBN 978-9965-31-997-6

Жинаққа студенттердің, магистранттардың, докоранттардың және жас ғалымдардың жаратылыстану-техникалық және гуманитарлық ғылымдардың өзекті мәселелері бойынша баяндамалары енгізілген.

The proceedings are the papers of students, undergraduates, doctoral students and young researchers on topical issues of natural and technical sciences and humanities.

В сборник вошли доклады студентов, магистрантов, докторантов и молодых ученых по актуальным вопросам естественно-технических и гуманитарных наук.

УДК 378

ББК 74.58

ISBN 978-9965-31-997-6

©Л.Н. Гумилев атындағы Еуразия ұлттық университеті, 2018

depends on a method of tutoring and data used in tutoring. At last, it is desirable that segmentation of medical images and algorithms of classification demanded that they had the following characteristics: a) accuracy, b) reliability, c) repeatability, d) reliability and e) the least dependence on the operator.

Literature

1. Automated Detection of Circulating Tumor Cells with Naive Bayesian Classifiers https://onlinelibrary.wiley.com/doi/pdf/10.1002/cyto.a.22471
2. Dougherty ER, Lotufo RA. Hands-On Morphological Image Processing. Bellingham, WA: SPIE Press; 2003.
3. Coelho LP. Mahotas: Open source software for scriptable computer vision. JORS 2013;1:e3.
4. Pedregosa F, Varoquaux G, Gramfort A, Michel V, Thirion B, Grisel O, Blondel M, Prettenhofer P, Weiss R, Dubourg V, et al. S
5. Problems and solutions of computer graphics and geometric modeling to digital biomedicine http://www.graphicon.ru/html/2015/Proceedings.pdf
6. Sequence-independent segmentation of magnetic resonance images http://nmr.mgh.harvard.edu/~fischl/reprints/sequence_independent_segmentation_reprint.pdf
7. А. Ю. Зубов, О. В. Сенюкова. GraphiCon 2015. Сегментация изображений магнитно-резонансной томографии головного мозга с помощью сопоставления с несколькими атласами.

UDC 004.42

FEATURES OF HARDWARE-SOFTWARE ACCELERATION OF SIGNAL PROCESSING IN MICROCONTROLLER SYSTEMS

Masgut O.O.
deputat01kz@inbox.ru
L.N. Gumilyov Eurasian National University, Astana, Kazakhstan.
Supervisor – S. Atanov

Arduino is a complete system that allows you to manage various systems and read data from different sources. The main advantage of Arduino is the standardized distribution of the outputs, which allows the use of ready-to-use solutions that extend the capabilities of the system.

Using special cards called Shields, you can expand the capabilities of Arduino by connecting, for example, a network card, a driver for controlling a stepper motor or a distance sensor.

Consider the main ways to increase the processing speed of the Arduino board.

- Mechanical replacement of Quartz, by increasing the frequency of the controller and thereby increasing the speed of work. The standard operating frequency is 16 MHz.

- Programmatically change the speed of work, using the method of accessing the line to the port.

At the beginning of the work we will test the actual speed of the digitalWrite function on the Arduino Mega2560 board and consider the possibility to speed up the program several dozen times. At the core of the Arduino Mega2560 debug card is the AT2560 microcontroller, which operates at a clock speed of 16 MHz. If we translate these 16 million oscillations into a time interval, then we get a rather small period equal to 62.5 ns.

The commands, written in Wiring, are converted into simpler commands, the so-called machine code, which the microcontroller is already executing directly. Some commands of the microcontroller are executed in one clock cycle of the microcontroller, some require more cycles, respectively, and runtime. Therefore, one, in our opinion, a simple command or function will be

performed by the microcontroller for a few, maybe even a few tens or hundreds of cycles. Besides, besides calculations, we need read / write operations in memory, so the average frequency of command processing will be significantly different from the clock frequency of the microcontroller.

Let's try to find out how much is a simple command for changing the value on the digital output Arduino - digitalWrite. Let's do some experiments. In the first experiment, execute the following code.

```
void setup()
{
pinMode(13, OUTPUT);
}
void loop()
{
digitalWrite(13, HIGH);
digitalWrite(13, LOW);
```

}

Figure 1 - Sketch of LED work

In Figure 1, we received data that the working sketch uses 1030 bytes of memory.

In order to see what actually happens on the 13th output, let's use the oscilloscope. The oscillogram of the signal at 13 pin looks like this:

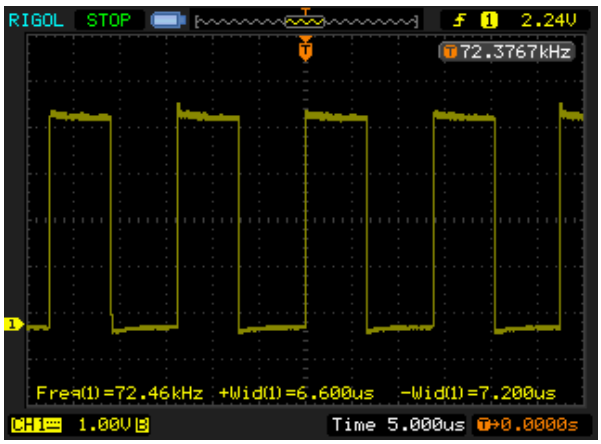

Figure 2 – Speed of the standard program running

It seems that the command digitalWrite (13, HIGH) is executed in 6.6 μs, and digitalWrite (13, LOW) in 7.2 μs. Total 13.8 microseconds. This is much longer than 62.5 ns, in fact, 220 times longer. Also, you can see that the LOW state (7.2 μs) takes longer than the HIGH state (6.6 μs).

The implementation of the digitalWrite function in the Wiring language is, to put it mildly, not optimal. If you look at its implementation in Assembler, you can find several checks, in particular, it is checked whether it is necessary to switch off the PWM timer after the previous analogWrite () function. The fastest implementation, but at the same time the most time-consuming writing, could be in Assembler. But writing code in Assembler is quite difficult, especially if we talk about debugging assembly code. One of the trade-offs can be the use of optimized libraries that implement various I / O functions.

In order to reduce the time to change the state of an output, you can use direct write commands in the port register. To change the values of pins 8 to 13, the PORTB register is used in which it is necessary to write the data word (the two least significant bits of this data word, that is, 1 and 2 bits are not used, and the remaining six - just set the state of the digital ports 8 to 13) . To change the state of digital pins from 0 to 7, PORTD is used.

```
void setup()
{
pinMode(13, OUTPUT);
}
void loop()
{
 // create our infinite cycle
 while (1)
 {
  PORTB |= (1<<7); // set the state pin13 as HIGH
  PORTB &= - (1<<7); // set the state pin13 as LOW
 }
```

Figure 3 – Sketch flashing LED, access via ports

In Figure 3, we received data that the working sketch uses 638 bytes of memory. Compared with Figure 3, after accessing the line to the ports, the memory occupied by the sketch has significantly decreased.

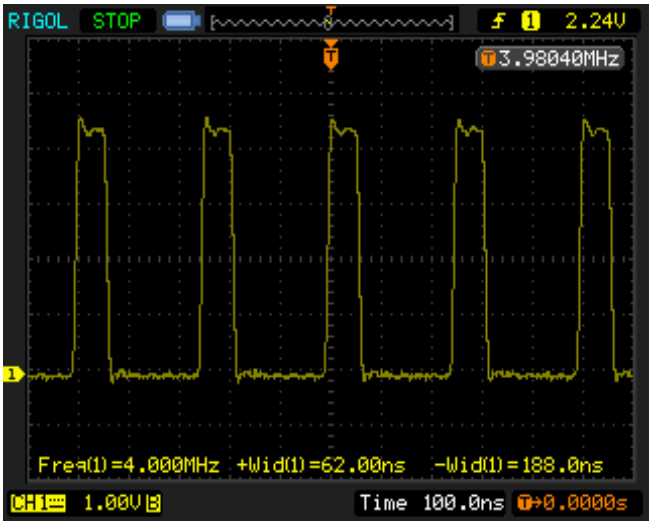

Figure 4 – The result of the program connected through the port

Conclusion

Thus, the conducted research of the microcontroller system showed the possibility of significant acceleration of the execution speed of the program, as well as the possibility of reducing the occupied memory capacity. If we talk about recommendations when optimizing the code of the program, then:

• Using the port registers instead of the digitalWrite function can significantly increase the speed of the program execution.

• By using the infinite loop, nested in loop (), while (1) {...}, we can save a few clock cycles of the processor at each turn of the loop.

Literature

1. Блум Д. Изучаем Arduino: инструменты и методы технического волшебства.БХВ-Петербург,2018. – 336с

2. Соммер У. Программирование микроконтроллерных плат Arduino/Freeduino. БХВ-Петербург,2012. – 240с

3. Ревич Ю. Занимательная электроника. БХВ-Петербург, 2015. – 713с

4. Петин В. Проекты с использованием контроллера Arduino. БХВ-Петербург, 2015. – 443 с

5. Карвинен Т., Карвинен К., Валтокари В. Делаем сенсоры.Проекты сенсорных устройств на базе Arduino. Вильямс, 2015. – 448с

6. Perea F. Arduino Essentials. Packt Publishing , 2015. – 206 p

7. Оксер Д., Блемингс Х. Practical Arduino: Cool Projects for Open Source Hardware. Apress, 2010. – 445 p

8. Anderson R., Cervo D. Pro Arduino. Apress, 2013. – 350 c

9. Банци М. Arduino для начинающих волшебников. Rid group, 2012. –128с

10. Монк С. Programming Arduino Getting Started with Sketches. McGraw-Hill Education TAB; 2 edition, 2016. – 191 p