IJCSE International Journal of Computer Sciences and Engineering Open Access
Research Paper Vol.-7, Issue-9, Sept 2019 E-ISSN: 2347-2693

ATmega8 Microcontroller

Tuba Javed Khanji[1], Mohd Ayaz Qureshi[2], Shakila Shaikh[3*]

[1,2]Department of Computer Science, Rizvi College of Engineering, Mumbai, India
[3]Department of Computational Science and Technology, Rizvi College of Engineering, Mumbai, India

**Corresponding Author: shakilashaikh48@gmail.com*

DOI: https://doi.org/10.26438/ijcse/v7i9.210213 | Available online at: www.ijcseonline.org

Accepted: 10/Sept/2019, Published: 30/Sept/2019

***Abstract*—** A Microcontroller is a tiny computer on a single chip and it is also termed as a control device. Likely to a computer, the Microcontroller is made with a variety of peripherals like i/o units, memory, Timers, serial data communications, programmable. In this article, we will be studying in detail about the Atmega8 microcontroller. It is a low power 8 bit CMOS microcontroller that can execute powerful instructions per clock cycle. It's small size, low cost and easy availability have helped to become substitutes for PLC controllers, analog circuits, etc. It can be used in embedded applications & automatically controlled devices like remote control devices, control systems, power tools, electronic devices, etc.

Keyword – AVR; microcontroller; architecture;

I. INTRODUCTION

ATmega8 is an 8 bit CMOS built microcontroller from the AVR family (developed by Atmel Corporation in 1996) and is built on the RSIC (Reduced Instruction Set Computer) architecture. Its basic advantage is it doesn't contain any accumulator and the result of any operation can be stored in any register, defined by the instruction. It comes in three packages: PDIP, MLF, and TQFP. The first one contains 28 pins and the second comes with 32-pin on each module. Its program memory is of 8KB flash memory, enough to store several instructions. The 8K flash is divided into 2 parts-lower part used as boot flash section, and upper part used as application flash section. Two memories of RAM and EEPROM contain 1K and 512 Bytes respectively. AVR ATmega family also supports SPI, TWI, UART, USB, CAN, etc. Analog capabilities such as ADC and DAC are available, a built-in temperature sensor and internal voltage reference, a brownout detector, a fast analog comparator, and a programmable analog gain amplifier [1].

Figure 1: ATmega8 microcontroller

II. LITERATURE REVIEW

Based on the AVR RISC architecture, the ATmega8 is a low-power CMOS 8-bit microcontroller. Executing powerful instructions per clock cycle, the ATmega8 achieves throughputs approaching 1 MIPS per MHz. This allowed the system designed to optimize power consumption versus processing speed [2].

The ATmega8 provides the following features:

- In-System Programmable Flash along with Read-While-Write capabilities – 8 Kilobytes [3].
- EEPROM – 512 bytes
- I/O lines (general-purpose) – 23
- Working registers (general-purpose) – 32
- Timer/Counters (flexible) with compare modes – 3
- Interrupts (internal and external)
- USART (a serial programmable)
- Two-wire Serial Interface (byte-oriented)
- A 6-channel ADC with; eight channels in TQFP & QFN/MLF packages (with 10-bit accuracy)
- Watchdog Timer (programmable) with Internal Oscillator, an SPI serial port
- Selectable power-saving modes – five software.

The Idle mode makes the CPU stop while allowing the SRAM, Timer/Counters, SPI port, and interrupt system to continue functioning [4].

In Power-down mode, it saves the register contents but freezes the Oscillator. This disabling all other chip functions until the next Interrupt or Hardware Reset.

In Power-save mode, the asynchronous timer continues to run, this allows the user to maintain a timer base while the rest of the device is sleeping.

The ADC Noise Reduction mode makes the CPU and all I/O modules to stop except; asynchronous timer and ADC. This is to minimize switching noise during ADC conversions [5]. The Standby mode runs the crystal/resonator Oscillator while the rest of the device is sleeping. This allows a very fast start-up combined with low-power consumption.

This device is manufactured by Atmel's high-density nonvolatile memory technology. Through an SPI serial interface, the Flash Program memory can be reprogrammed In-System, either by a conventional non-volatile memory programmer or by an On-chip boot program running on the AVR core. In the Application Flash memory, the boot program uses any interface to download the application program. The software in the Boot Flash Section will continue to run while the Application Flash section is updated, providing true Read-While-Write operation. On a monolithic chip, combining an 8-bit RISC CPU with In-System Self-Programmable Flash, the Atmel ATmega8 is a powerful microcontroller providing a high-flexible and cost-effective solution to many embedded control applications [6].

III. PIN DIAGRAM, ANALYSIS, AND ARCHITECTURE

One of the main features of the Atmega8 Microcontroller is that all the pins of the Microcontroller support two signals except 5-pins. The Atmega8 microcontroller consists of 28 pins;

- pins 9,10,14,15,16,17,18,19 - port B
- pins 23,24,25,26,27,28,1 - port C
- pins 2,3,4,5,6,11,12 - port D.

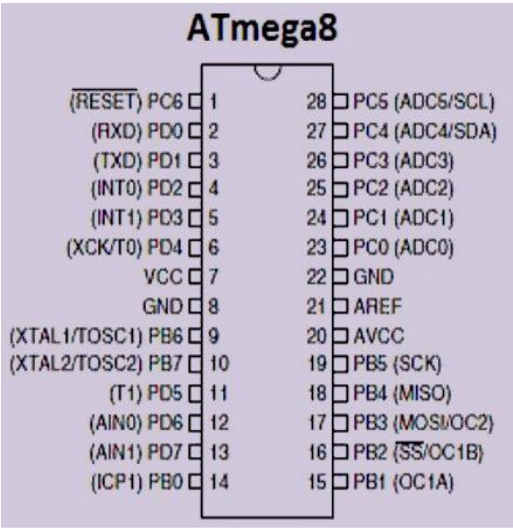

Figure 2: Pin Diagram

- **VCC** Digital supply voltage.
- **GND** Ground.
- **Port B (PB7…PB0)** Port B, an 8-bit bi-directional I/O port with internal pull-up resistors, selected for each bit. The Port B output buffers have characteristics of the symmetrical drive with both high sink and source capability. As inputs of Port B, if the pull-up resistors are activated then pins that are externally pulled low will source current.
- **Port C (PC7...PC0)** Port C is a 7-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port C output buffers have characteristics of the symmetrical drive with both high sink and source capability. As inputs of Port C, if the pull-up resistors are activated then pins that are externally pulled low will source current.
- **PC6/RESET** PC6 is used as an I/O pin if the RSTDISBL Fuse is programmed. And if it is unprogrammed, PC6 is used as a Reset input. Even if the clock is not running, a low level on this pin longer than minimum pulse length generates a Reset.
- **Port D (PD7…PD0)** Port D, an 8-bit bi-directional I/O port with internal pull-up resistors, selected for each bit. The Port D output buffers have characteristics of the symmetrical drive with both high sink and source capability. As inputs of Port D, if the pull-up resistors are activated then pins that are externally pulled low will source current.
- **AVCC** AVCC is the supply voltage pin for the A/D Converter, Port C (3...0), and ADC (7..6). Externally connected to VCC, even when ADC is not used. Connected to VCC through a low-pass filter, when ADC is used.
- **AREF** AREF, an analog reference pin (for A/D Converter).
- **ADC7...6** In the TQFP and QFN/MLF package, ADC7…6 serves as analog inputs to the A/D converter. Pins are powered from the analog supply and they serve as 10-bit ADC channels [2].

The maximum usable ADC clock frequency as 4MHz, The limit to this is the set-up time on the S/H capacitor, which we measured as 500ns (1us if the MUX capacitor has changed). At 4MHz a clock cycle is 125ns, so the 2 clock cycle S/H capacitor charge time in free-running mode is a bit short. In the first sample mode, you get 2.5 clock periods, and single-sample mode gives essentially infinite (since the last sample was taken). So in theory, it looks like it should be able to run right up to the Nyquist frequency of 114kHz. This would be for single sample mode, with a 500ns pause between samples (4MHZ/(13.5 + 4)/2). One of these days we'll get around to testing that out.

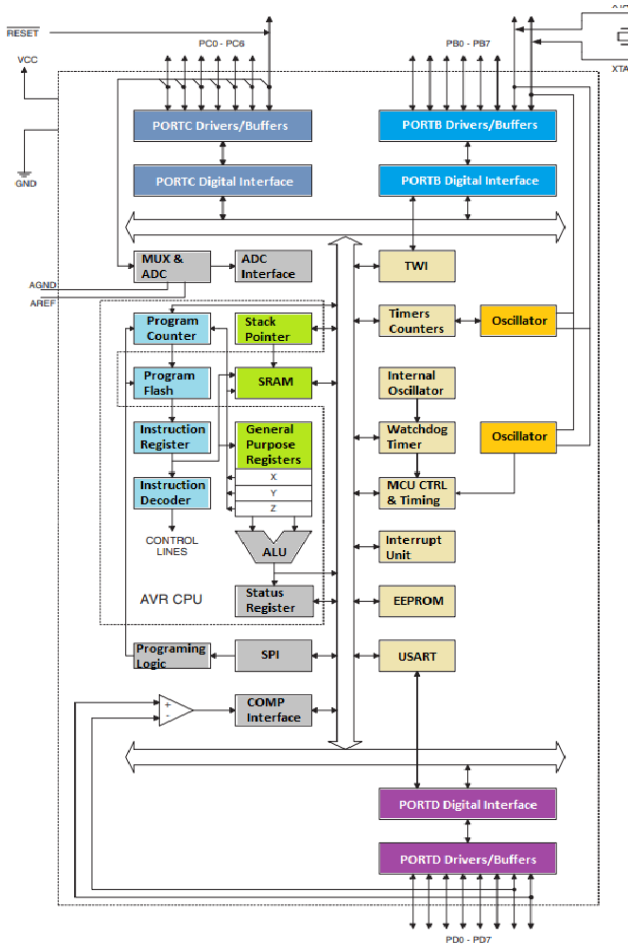

Figure 3: ATmega8 Microcontroller Architecture

- Memory: Internal SRAM (1Kilobyte), Flash program memory (8 Kb) and EEPROM (512 Bytes).
- I/O Ports: It has three ports, namely port-B, port-C, and port-D and 23 I/O line can be attained from these ports.
- Interrupts: At port D; two Exterior Interrupt sources. Nineteen dissimilar interrupts vectors supporting nineteen events produced by interior peripherals.
- Timer/Counter: There are 3-Internal Timers are accessible, 8 bit-2, 16 bit-1, presenting numerous operating modes & supporting internal/external clocking.
- Serial Peripheral Interface (SPI): ATmega8 microcontroller holds three integrated communication devices and SPI, 4-pins is one of them allocated to the Microcontroller implementing this system of communication.
- USART: USART, one of the most powerful communication solutions. Microcontroller ATmega8 supports; synchronous & asynchronous data transmission schemes and has three pins allocated for that.
- TWI (Two Wire Interface): Another communication device that is present in ATmega8 is the Two-Wire Interface. It allows designers to set up a commutation between two devices using just two wires along with a common ground connection, As the TWI output is made employing open collector outputs and thus external pull up resistors are required to make the circuit.
- Analog Comparator: A comparator module is integrated into the IC that provides a comparison facility between two voltages connected to the two inputs of the Analog comparator via External pins attached to the microcontroller.
- Analog to Digital Converter: Inbuilt analog to digital converter converts an analog input into digital data of 10bit resolution. For most of the low-end applications, this much resolution is enough [4].

IV. RESULTS AND DISCUSSION

As a result, the ATmega8 microcontroller has a defined architecture, unique features like - 8kb Flash memory which is divided into two different parts, ADC Noise Reduction mode, Standby mode, etc. It poses properties like analog to digital convertor. It also has different types of interrupts and addressing modes, it has a programming facility too and a basic pin diagram. It's small size, low cost and easy availability have helped to become substitutes for PLC controllers, analog circuits, etc [7].

ATmega8 Microcontroller Applications

- Used in embedded and robotics system
- It is widely used in students' projects
- Home Security System
- For the designing of quadcopters
- Industrial Automation
- Industrial control systems
- SMPS and Power Regulation systems
- Embedded systems like coffee machines, vending machines.

V. CONCLUSION AND FUTURE SCOPE

The Atmega8 microcontrollers proved to found many practical applications, both in scientific research and industrial use. Atmega8 microprocessors are offered in a wide variety of package styles, they have low power consumption over a wide operation voltage range and allow excellent code density. Embedded AD/DA converters, better support for communication protocols and more flexible programming have proved to be more efficient in many cases of real applications comparing to even a small PLC controller. ATmega8 microcontroller has no pin change interrupt as the result you are limited to the two external

interrupts. For future scope, it can be used to make a thermometer [8], i.e. can be used to measure temperature since have the capability to measure temperature between (-50)-degree Celsius to (155)-degree Celsius [9].

REFERENCES

[1] "An Overview of ATmega AVR Microcontrollers Used in Scientific Research and Industrial Applications" Wojciech Kunikowski, Ernest Czerwiński, Paweł Olejnik, Jan Awrejcewicz Department of Automation, Biomechanics and Mechatronics, Lodz University of Technology, 90–924 Łódź, 1/15 Stefanowski str

[2] "UNSW School of Computer Science and Engineering - General AVR Info". Cse.unsw.edu.au. Archived from the original on 2012-06-23. Retrieved 2012-09-19.

[3]*AVR Programming: Learning to Write Software for Hardware*; Elliot Williams; Maker Media; 474 pages; 2014.

[4] "CPU lecture". OpenCores. Retrieved 2015-02-16.

[5]"AVRHardware Design Considerations" (PDF) (application note). Atmel Corporation. Jun 2015. p. 5. Retrieved 14 Jun 2015. The reset line has an internal pull-up resistor, but if the environment is noisy it can be insufficient and reset can, therefore, occur sporadically.

[6]*" LGT8F88A FLASH Microcontroller". LogicGreen Technologies. Archived from the original on 2017-08-29. Retrieved 2019-01-18*, a clone of the ATmega88.

[7] "pAVR:: Overview".OpenCores.Retrieved 2012-09-19

[8] Principles of Thermodynamics **(**Jan 1979 29) J A Beattie I Oppenheim Beattie, J.A., Oppenheim, I. (1979). Principles of Thermodynamics, Elsevier Scientific Publishing Company, Amsterdam, ISBN 0-444-41806-7, page 29.

[9] Rashmi Deshmukh, Anagha Zade, Rasika Bhusari, "*Temperature Monitoring and Regulating System for Power Saving*", International Journal of Computer Engineering, Vol.**1**, Issue.**2**, pp.36-37, **2013**.

[10] Tiwari, R. Sam, and S. Shaikh, "Analysis and prediction of churn customers for the telecommunication industry," *2017 International Conference on I-SMAC (IoT in Social, Mobile, Analytics, and Cloud) (I-SMAC)*, Palladam, 2017, pp. 218-222. DOI: 10.1109/I-SMAC.2017.8058343

[12]S. Nevada, P. Yadav, J. Thomas, and S. Shaikh, "Weather prediction: A novel approach for measuring and analyzing weather data," *2017 International Conference on I-SMAC (IoT in Social, Mobile, Analytics, and Cloud) (I-SMAC)*, Palladam, 2017, pp. 414-417. DOI: 10.1109/I-SMAC.2017.8058382

[13]S. Shaikh, S. Rathi, and P. Janrao, "IRuSL: Image Recommendation Using Semantic Link," *2016 8th International Conference on Computational Intelligence and Communication Networks (CICN)*, Tehri, 2016, pp. 305-308. DOI: 10.1109/CICN.2016.66

[14]S. Shaikh, S. Rathi, and P. Janrao, "Recommendation System in E-Commerce Websites: A Graph-Based Approached," *2017 IEEE 7th International Advance Computing Conference (IACC)*, Hyderabad, 2017, pp. 931-934. DOI: 10.1109/IACC.2017.0189

[15]A. Fasiku, Ayodeji Ireti, B. Olawale, Jimoh Babatunde, C. Abiola Oluwatoyin B., "*Comparison of Intel Single-Core and Intel Dual-Core Processor Performance*", International Journal of Scientific Research in Computer Science and Engineering, Vol.1, Issue.1, pp.1-9, 2013

[16]M. Sora, J. Talukdar, S. Majumder, P.H Talukdhar, U.Sharmah, "*Word-level detection of Galo and Adi language using acoustical cues*", International Journal of Scientific Research in Computer Science and Engineering, Vol.1, Issue.1, pp.10-13, 2013

[17]Manish Mishra, Piyush Shukla, Rajeev Pandey, "*Assessment on different tools used for Simulation of Routing for Low power and lossy Networks(RPL)*", International Journal of Scientific Research in Network Security and Communication, Vol.7, Issue.4, pp.26-32, 2019

Authors Profile

Tuba Javed is pursuing a Bachelor of Computer Engineering from Rizvi College Of Engineering which is affiliated with Mumbai University. She has done NPTEL course on python, and DBMS. She has immense knowledge of C, C++, Python, Java, HTML, and even Digital Marketing. She has a great interest in data analytics and has the plan to pursue a Master Of Engineering Degree in Database in the future.

Ayaz Qureshi is pursuing a Bachelor of Computer Engineering from Rizvi College Of Engineering which is affiliated with Mumbai University. He has immense knowledge of C, HTML, CSS, DBMS, etc. He has done NPTEL course on Python, and DBMS. He will pursue a Master Of Engineering degree in Web Development.

