JIEE Časopis priemyselnej elektrotechniky
Journal of Industrial Electrical Engineering
ISSN 2454-0900
www.jiee.eu

Design and implementation access system based on an embedded system

[1]*MiroslavKACVINSKÝ*, [2]*JánMOLNÁR*

[1, 2]Department of Theoretical and Industrial Electrical Engineering, FEI TU of Košice, Slovak Republic

[1]miroslav.kacvinsky@student.tuke.sk, [2]jan.molnar@tuke.sk

***Abstract*—This article is dedicated to the design and implementation of an embedded system access system. The first part describes the design and implementation of the system describing what its components are made of. The second part describes what an embedded system is and what it has. The third part describes the three main components of the proposed system in detail. Finally, in conclusion, we summarise important information we have learned from the article.**

***Keywords*—Embedded system, Orange Pi Zero, NodeMCU ESP8266, RFID reader**

I. INTRODUCTION

Since embedded systems are currently very widespread and can be encountered everywhere, we have decided to use them to design and implement them in the access system. Access systems are systems that are used to access rooms, buildings, premises, and so on without using keys. They are very popular and are increasingly replacing the classic key system. This approach is made by a chip card and a chip card reader by simply adding a card to the reader and accessing it. But if it worked by the attachment of any chip card, everybody would have access to the room and we do not want it. Therefore, such a system contains a database (list) where only those cards that have access to the given object are registered and so we limit undue access to the room, buildings, etc.

Our access system will be comprised of three components. The main part represents Orange Pi Zero, which serves as a server, NodeMCU ESP8266 serves for communication with an RFID card reader. These three components will be described later in detail later. Fig. 1 shows a simple block diagram of the system.

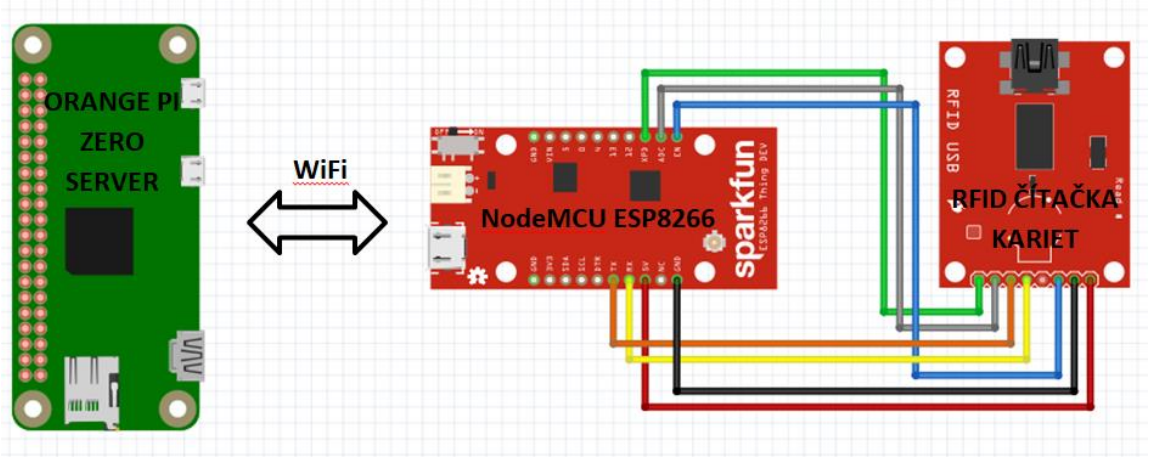

Fig. 1 Block diagram of the system. [1]

So the server will run on Orange Pi Zero, which will be connected via the Ethernet cable to the

router. The server will communicate with NodeMCU ESP8266 via a local Wi-Fi connection and a card reader will be connected to the ESP8266. By attaching the card to the reader it sends the information to ESP8266 and it evaluates it and sends it over the Wi-Fi to the server where it compares the data of the attached card with the data in the server database - then it decides whether the card has access and whether the door opens. We can manage all the tabs in the database on the created websites, for example, who and when they entered or left the building.

II. EMBEDDED SYSTEM

The embedded system in brief means an embedded system which is actually a combination of computer hardware and software. It is designed for a specific function or for specific functions within a larger system. Industrial machines, agricultural and manufacturing equipment, automobiles, medical devices, cameras, home appliances, aircraft, vending machines and toys, as well as mobile devices are places for a built-in system.

Beginning from the simplest ones that do not have a user interface (UI), for example on devices where the embedded system is designed to perform one task, to the more complicated ones with a graphical user interface (GUI) such as mobile devices. User interfaces can include buttons, LEDs, touch screen capture, and more. Some systems also use remote user interfaces. Examples of embedded systems are shown in Fig. 2. [2]

Fig. 2 Embedded systems. [3]

The basic component of their electronic part is the so-called a microcontroller (MCU), which is a microprocessor complete with memory and several peripherals. [2]

III. SPECIFIC PROPERTIES OF EMBEDDED SYSTEMS

Embedded systems today are largely full-featured computer systems, containing one or more 8 to 64 bit word processors, an operating memory and many peripheral devices. Unlike general-purpose computer systems such as personal computers, embedded systems are characterized by the following differences:

The basic programming language for today's embedded system microprocessors is C / C ++. In addition to the usual knowledge of the C / C ++ and Assembler programming languages, the programmer's requirements are enhanced by a detailed knowledge of the startup process of the

microprocessor, the interrupt subsystem, the knowledge of the linker to correctly create a memory map stored in the ROM / FLASH memory and running the program. An experienced programmer should also know how a C language translator works with the segments, call functions of C functions for the ability to call functions written in Assembler from C, and vice versa. Another separate chapter of programmer's knowledge is the use of C-based constant objects, that is, content that does not change over the course of the application. These are, for example, function tables, structures with constant content, or pointers to an object whose position does not change.

The largest manufacturers of embedded systems include Apple, IBM, Intel and Texas Instruments, as well as many other companies that are less well-known in the industry. One very important manufacturer in this area is ARM, which began as Acorn, a computer manufacturer. ARIS architecture based on RISC, licensed by other companies, has been widely used in mobile phones and PDAs, and remains the most widespread company in the integrated world. [2]

IV. ORANGE PI ZERO

Generally, Orange Pi is one-axis mini computers developed by Chinese company Shenzhen Xunlong Software CO., Limited. There are a large numbers of models that differ in terms of parameters and price. In this article, we will focus mainly on the Orange Pi Zero.

Orange Pi Zero is shown in Fig. 3. It is primarily intended for the creation of peripherals without the need for a keyboard or monitor. The only way to use it, is to connect it via Ethernet cable or Wi-Fi. It has small dimensions and can be connected to the operating system using the Putty or WinSCP client via the SSH protocol. [4]

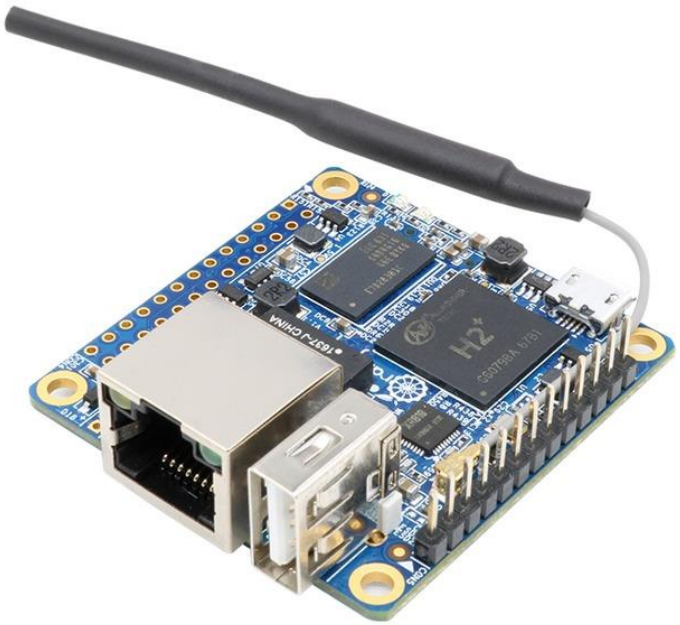

Fig. 3 Orange Pi Zero. [5]

As far as technical support is concerned, the manufacturer's page can be found at www.orangepi.org. Typically, the models are sold on sites such as AliExpress, Ebay, Banggood, but they can also be downloaded from a Slovak site such as www.gme.sk. In the table Tab. 1 it is possible to see the technical parameters of Orange Pi Zero.

Orange Pi Zero has three expansion ports:

- 3 pins near the Ethernet connector on which RX, TX, and GND are. These can be connected to a PC to the network port monitor and monitor the boot condition by using the converter. It is possible to set up the whole system with them.

- 2x13 pin.
- 1x13 pin. [4]

Table 1
Technical parameters. [4]

CPU	H2 Quad-core Cortex-A7 H.265/HEVC 1080P.
GPU	Mali400MP2 GPU @600MHz Supports OpenGL ES 2.0
Memory (SDRAM)	256MB/512MB DDR3 SDRAM(Shared with GPU) (256MB standard version)
Onboard Storage	TF card (Max. 32GB)/ Spi Flash
Onboard Network	10/100M Ethernet RJ45 POE is default off.
Onboard WIFI	XR819, IEEE 802.11 b/g/n
Audio Input	MIC
Video Outputs	Supports external board via 13pins
Power Source	USB OTG can supply power
USB 2.0 Ports	Only One USB 2.0 HOST, one USB 2.0 OTG
Buttons	Power Button (This is officially documented, but there is no button on my board)
Low-level peripherals	26 Pins Header, compatible with Raspberry Pi B+ 13 Pins Header, with 2x USB, IR pin, AUDIO(MIC, AV)
LED	Power led & Status led
Supported OS	Android, Lubuntu, Debian, Raspbian
Product size	48 mm × 46mm
Weight	26g

V. NODEMCU ESP8266

The NodeMCU development board shown in Fig. 4 is an interesting platform. It integrates the Wi-Fi chip ESP8266, which takes care of the computing and Wi-Fi parts of the device. The board has gone through three hardware versions with two versions of the ESP8266 chip. ESP8266 can also be called System on a Chip (SoC). It offers everything a regular developer needs from a wide range of hardware programming options to the processor overflow. [6]

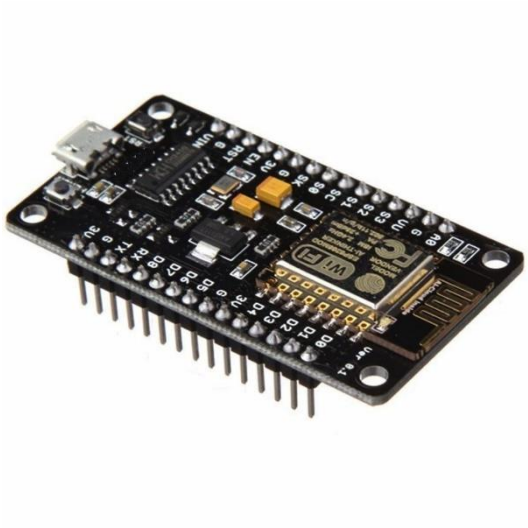

Fig. 4 NodeMCU ESP8266. [7]

ESP8266 - The heart of NodeMCU includes the Xtensa LX 106 single-core 32-bit processor with RISC instruction set and 80 MHz, which can be up to 160 MHz. The board has become very popular due to the huge memory of the program. Up to 1 MB of compiled code can be uploaded to the board, for comparison of Arduino Uno it is only 32 kB, NodeMCU is equipped with a 4MB flash memory.

NodeMCU offers up to 11 GPIO pins, all except for GPIO16 being PWM modulated. The output pin of the GPIO pin is 12 mA at 3.3 V. The pins are not 5 V tolerant, although some sources say they are. With the long-term load on 5V, the ESP8266 chip will overheat with its subsequent failure, respectively destruction. There is only one analog pin on the board. Standard ESP8266 Vio uses 0-1 V but thanks to NodeMCU components it works in the range 0-3.3 V. ESP8266 also incorporates the implementation of Wi-Fi standard 802.11 to 2.4 GHz in b / g / n bands, while band b has a guaranteed best gain of 25 dB. [6]

VI. Software Specifications and Programming Options

NodeMCU supports standard interfaces like OneWire, I2C, SPI, UART, and ADC... The initial version of NodeMCU boards has a new firmware and programming. The first boards had a NON-OS SDK for ESP8266, which allowed you to interpret the Lua language in which these chips were programmed. Lua's syntax is very similar to Wiring.

A few weeks after the release, however, the Arduino core version of the 0.0.1 version of the Arduino core project was discovered. It is being taught that the stage of programming board availability via ArduinoIDE began with classical Arduino commands.

The ESP8266 chips were very popular with the Arduinists, especially for Internet connectivity and especially for their price and ease of implementation of the project. This Arduino core solution, which has been gradually evolving, has shifted the popularity of NodeMCU boards further into the forefront.

The Arduino Core version is now 2.4.0. The project allows for a full board to be programmed as a classic Arduino including a web part.

The board can create HTTP, HTTPS request POST and GET methods, and has a fully integrated MQTT protocol that allows you to use the board even on Smart Home solutions while supporting WEP, WPA / WPA2 PSK encryption.

Arduino Core is not the only conversion of a board to another language. Today, the board can also be programmed in Micropython, Javascript, Lispe, and others. NodeMCU can also be programmed over OTA (On the air) wirelessly without having to connect the device to the computer where the code is located. This is one of the biggest benefits of why to choose NodeMCU. [6]

VII. Conclusion

In this article, we were able to read about the design of the access system, its implementation and components of which is composed. We created a simple block diagram and described the functions of the individual components in the system. We have also summarised what embedded systems are and

what they have, and in the end, we have detailed the components of the system.

ACKNOWLEDGMENT

We support research activities in Slovakia / Project is co-financed from EU funds. This article was developed within the Project "Centre of Excellence of the Integrated Research & Exploitation the Advanced Materials and Technologies in the Automotive Electronics ", ITMS 26220120055

REFERENCES

[1]. Fig. 1 block diagram of the system. Available on the Internet: <http://fritzing.org/home/>.
[2]. What is an embedded system. Available on the Internet: <https://internetofthingsagenda.techtarget.com/definition/embedded-system>.
[3]. Fig. 2 Embedded systems. Available on the Internet: <http://slideplayer.com/slide/3298762/>.
[4]. What is Orange Pi Zero. Available on the Internet: <http://www.orangepi.org/orangepizero/>.
[5]. Picture 3 Orange Pi Zero. Available on the Internet: <https://miniboard.com.ua/boards/422-orange-pi-zero.html>
[6]. NodeMCU ESP 8266. Available on the Internet: <https://www.root.cz/clanky/nodemcu-a-jeho-verzie-doska-s-wi-fi-cipom-esp8266/>
[7]. Fig. 4 NodeMCU ESP 8266. Available on the Internet: <http://modtronix.com.au/product/nodemcu-v1/>
[1] Guzan M., Špaldonová D., Hodulíková A., Tomčíková I., Gladyr A.: Boundary Surface and Load Plane of the Ternary Memory, In: Electromechanical and energy saving systems. Vol. 15, no. 3 (2011), p. 163-167. - ISSN 2072–2052
[2] Bereš M., Perduľak J., Kováč D.: Autonomous mobile robot with obstacles prediction In: SSIEE 2014 : proceeding of scientific and student's works in the field of Industrial Electrical Engineering : volume 3. - Košice : TU, 2014 S. 166-169. - ISBN 978-80-553-1711-4
[3] Kováčová I., Kováč D., Vince T.: Elektromagnetická kompatibilita - 1. vyd - Košice : TU, - 2009. - 137 s. - ISBN 978-80-553-0150-1.
[4] Bučko,R., Kováč,D., Konokh,I.: Embedded systém and speech recognition, Electromechanical and energy saving systems: Quarterly research and production journal Vol. 2011, No. 3 (2011), pp. 168-172, ISSN 2072-2052.
[5] Dziak,J. : Linear circuit simulation using MATLAB and modeling of nonlinear elements, In: SCYR 2014 Proceeding from Comference: 20.5.2014: Herľany, S. 70 - 71, Košice : Technická univerzita v Košiciach, 2014 /978-80-553-1714-4/.
[6] Jacko P., Kováč D.,: Converters and time conversion measurement of STM32F446RE microcontroller , In: Electromechanical and energy systems. Modeling and optimatization methods. - Kremenchuk : Kremenchuk Mykhailo Ostrohradskyi National University, 2017 P. 154-155. - ISSN 2079-5106.