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Analyzing the possibilities of creating a system for measuring the environment

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***Abstract* — This article is focused to IoT environmental measurement technical possibilities. The article describes ESP32 as an IoT microcontroller. Environmental measurement sensors are also presented focused to dust, gas, humidity and temperature sensors.**

***Keywords* — Environmental, Measurement, Monitoring system**

I. INTRODUCTION

Environmental measurements are important task. By environmental measurements, it gets its actual status. These statuses can be dangerous to life. The measurement results are mostly used for the public, which use it how they should dress or how to plan different outdoor activities. The environment can also be monitored in closed rooms, such as in the household or in the production facility. In households is usually about the temperature and humidity of the air that the user wants to have at a comfortable level. In the case of production is acts about hazardous gas, dust and radiation.

The monitoring system should contains a control unit (microcontroller) and sensors which record the characteristics of the environment in that the monitoring system is located. Such a monitoring system should be connected to a central system which serves to archive data and make it accessible to the user.

The monitoring system should match the essential requirements. The first requirement is the ability to connect multiple measurement nodes to one system. The system should archive the data centrally and should be able to measure more quantities at the same time. It should be a universal system, which means that can be added more quantities and measurement nodes without any interfering with the structure of the system.

II. MODULE ESP32S

ESP32 is low cost development board with WiFi and Bluetooth chips. This module has become an improved successor to his older brother ESP8266 and gave new opportunities for developers to implement innovative ideas in the sphere of Internet of Thing.

A. Properties

Compared to its predecessor, this module opens up new possibilities for adding Bluetooth v4.2 communication and faster Wi-Fi speeds up to 150 Mbps with 2.4 GHz transmitter / receiver and WPA / WPA2 security. The ESP32S chip, which is on *Fig. 2*, includes a dual-core 32-bit Tensilica LX6 processor with a 240MHz frequency, one core being used by a WiFi chip to maintain communication with the server and the second is available to the user. Next includes 448 kB ROM memory for booting and retaining processor instructions, SRAM memory up to 520kB for data and for source code. The ESP32S has a total of 38 GPIO pins, of which are two 12-bit ADC converters, one of which

has 9 input channels, two single-channel 8-bit digital analogue converters, 8 touch sensors, hall and temperature sensors, 3 pins for UART and 4 pins for SPI, 2 pins for I2S and for I2C too. Any GPIO pin also supports pulse-width modulation. The power supply voltage of the module is from 2.3 to 3.6 V and the operating temperature range from -55 to +125 ° C. The module has a total of 5 power pins, 3 GND, 1 VIN 3.3 V and 1 VIN 5 V. The pin for external reset is also output. The description of the ESP32S-NodeMCU pinou can be seen on *Fig. 2* [1].

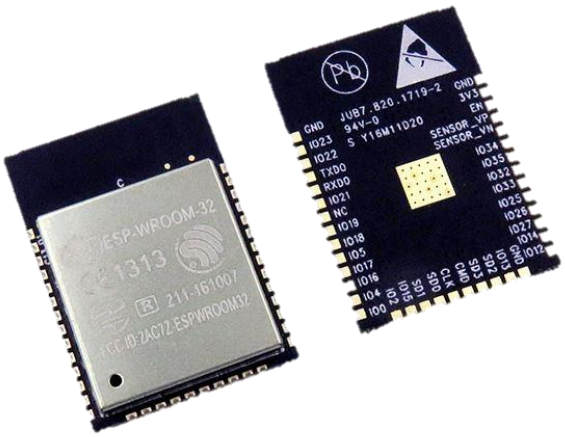

Fig. 1 Chip ESP32S

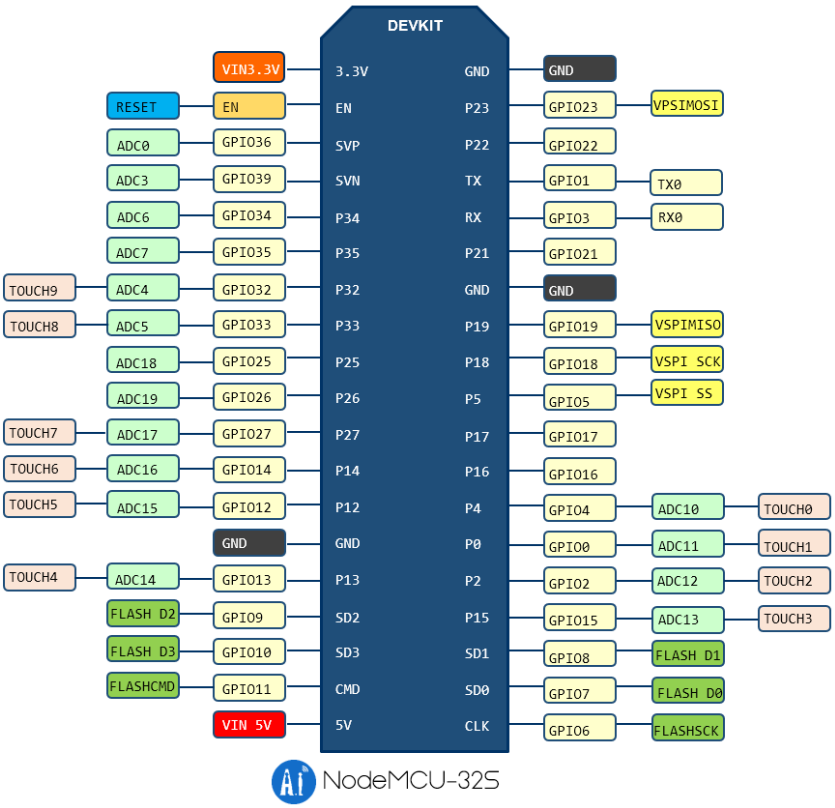

Fig. 2 Pinout of ESP32S-NodeMC*U*

III. ENVIRONMENTAL SENSORS

By measuring the environment, it is possible to measure many of its properties. An environment that is measured consists of various gases and solid elements. Therefore, can be measured different gases, dust nuisance, temperature and humidity and it is also possible to measure the radiation, such as radiation.

A. Sensor of temperature and humidity HTU21D

The HTU21D, can be seen on *Fig. 3*, is digital sensor of temperature and humidity with high-mileage, by MEAS company. Its dimensions are only 3 x 3 x 0.9 mm and communication between the sensor and the microcontroller works with the I^2C interface. Sensor resolution can be set manually by user 12/14bit, 8/12bit, 10/13bit and 11/11bit (H / T).

The humidity sensor has a 0-100% measuring range, a 0.04% resolution for 12-bit and 0.7% for an 8-bit converter, an accuracy of 3% in the range (20-80%) and 5% in the range (<20%;>80%), response time is 3 ms for 12-bit and 16 ms for 8-bit converter settings.

For temperature measurement, this sensor has a measuring range of -45 to +125 °C. The measurement accuracy at room temperature +25 °C is ± 0.3 °C, response time 10 s and power supply voltage range from 1.5 to 3.6 V [2].

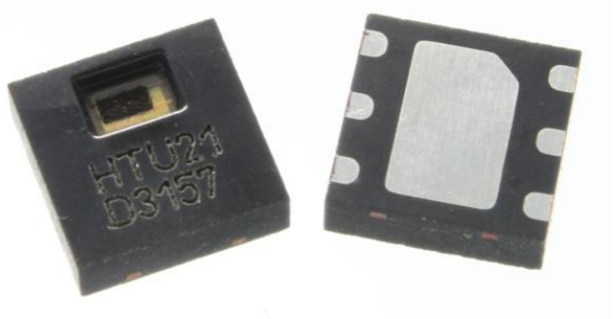

Fig. 3 Sensor of temperature and humidity HTU21D

B. Gas sensors MQ-X

Sensors MQ-X are inexpensive and have a long service life. Individual sensors measure one or more gases. All sensors in this category are powered by 5 V and preheating time is 24 to 48 hours. The gas concentration is determined in ppm, the number of particles of measured gas per million of all particles in the measured environment [3]. Example of this sensor is on *Fig. 4* and comparison of MQ-X sensors is in the **Chyba! Nenašiel sa žiaden zdroj odkazov.**.

Fig. 4 Sensor MQ-3

Table 1
Comparison of sensors MQ-X

Sensor /Properties	MQ-2	MQ-3	MQ-4	MQ-5	MQ-6	MQ-7	MQ-8	MQ-9	MQ-135
Measured gasses	Flammable and combustible gasses	Alcohol	Natural gas	Natural gas and LPG	LPG and Butane gas	CO	Hydrogen	CO and flammable gasses	Ammonia, Sulfide, Benzene
Concentration	300-10000ppm	0,04-4mg/l	300-10000ppm	200-10000ppm	300-10000ppm	10-10000ppm	100-10000ppm	CO: 10-10000ppm flammable gasses: 100-10000ppm	10-10000ppm
Supply voltage [V]	5	5	5	5	5	5	5	5	5
Preheating time [h]	48	48	48	24	48	48	48	48	48

C. Dust sensor

Sensor PPD42NS, by SHINYE company can be seen on *Fig. 5*, is dust sensor, which uses an optical system for scanning. It is the infrared light by IR LED (infrared diode). Reflected infrared light is reflected to phototransistors, which are placed diagonally in the sensor. Its supply voltage is +5 V, it can record particles with a size of 1 μm and greater, a concentration range 0 - 28,000 pcs/l and a working voltage from 0 to + 45 °C [4].

Fig. 5 Dust sensor PPD42NS

IV. CONCLUSION

There are many environmental measurement systems on the market. However, any such system can only measure what sensor the manufacturer implements into the system. For this reason, it is a good idea to create custom measuring systems. Such systems can be customized by the user himself. It can archive the measured data, make its own interpretation of the measured results, and in the end, it is the opportunity to connect that measurement system to other systems.

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