

## 45. SENSOR DATA COLLECTING DEVICE

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The description of sensor data collecting device is presented in this paper. Embedded systems impact on up-to-date devices is analyzed.

It is common knowledge that embedded system is a vital part of up-to-date computer techniques. In other words, it is a part of computer hardware system designed to carry out a set of particular functions. Different types of detectors with microcontrollers as a control center can be found in various devices, such as weather stations, smart watches or GPS-trackers. The variety of functionality of such devices can be overwhelming. Software system design is the basis for information to be processed, displayed, and transmitted in relevant form. As a result, the utility is capable of compiling and storing enough data from detectors to transfer it to computer firmware.

Therefore, producing moving objects monitoring hardware-software complex is needed at least in educational purposes [1]. A microcontroller, temperature and pressure detectors, modules with built-in gyroscope, integrated with SD-card and an accelerometer are the main parts of the device (figure 1). Microcontroller STM32 was chosen as a center. Chips STM32 grouped in appropriate series are based on 32-bit core Central Processing Unit.

Each microcontroller has CPU's core, static memory, flash-memory, debug interface. The core structure is known to have plenty of options. Debug board STM32 with core Cortex-M3 was chosen, because this one is widely distributed.

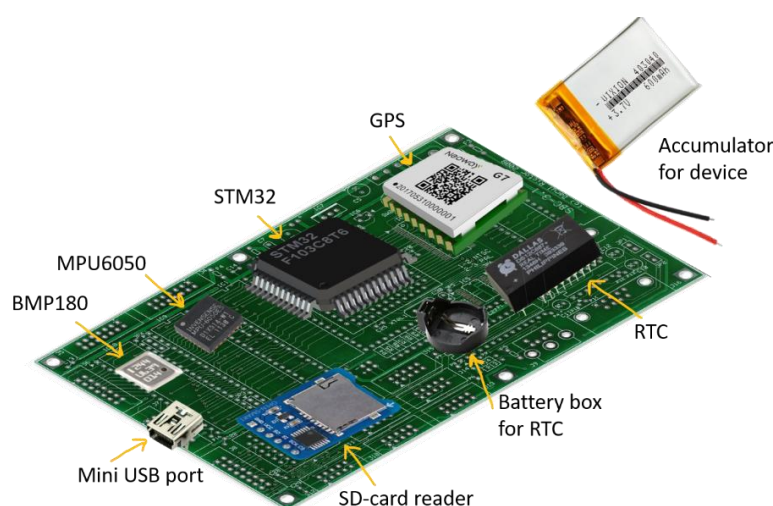


Figure 1. Sensor data collecting device

Temperature and pressure detectors, modules with built-in gyroscope, real clock time accelerometer are connected with microcontroller through the interface (figure 2). Data and clock generators receive data. The clock is generated by master- slave responses when a byte is perceived. In total, there can be up to 127 software-addressed devices on two-wire bus, depending on the purpose of the device. For a receiver to be chosen the master uses the unique address component of the 7-bit addressing mode.

The addressing procedure is as follows: the first byte after START signal determines which slave is addressed by the master to carry out the exchange cycle. The direction of data transfer is determined by the eighth, least significant bit. "Zero" means the master has chosen the slave to record data. "One" stands for the master receiving data from the slave. Each system device verifies the first 7 bits after an address is sent.

Obtaining data from temperature and pressure detectors. Each microcircuit BMP180 is factory-standardized. Then, Read Only Memory loads calibration factors into a module's memory.

Obtaining data from accelerometer and gyroscope. MPU6050 has 3-axial accelerometer and gyroscope integrated. Gyroscope tracks the velocity of rotation or the velocity of changing angular position along the X, Y, and Z dimensions. For the measurement to be performed MEMS technology and Coriolis effect are used. After data is obtained the device checks if the data coincides with real time [2].

Obtaining data from GPS-module. For the location to be determined GPS-module Troyka based on Neoway G7 chip is used. It gains global positioning satellite's signals GPS, GLONASS, Galileo and then aligns geographic values, rate of moving, elevation and real current time. After that GPS plugged-in to microcontroller setting up a frequency of update rate is needed. And the last one is SPI interface. SPI stands for "Serial Peripheral Bus" which means "bus for connecting peripherals". It is to link main master

device with the one or more slaves. Only the master forms clock impulses. For connected devices to be distinguished the SS - Slave Select wire has been added to the protocol.

Obtaining data from SD card-module. There are two ways of card's interaction: SPI and SDIO. The latter is faster and is used in mobile phones, digital devices. FatFS data library is used to work with SD-card. It is not until all necessary modules are connected that the device defines its location on the map and in space.

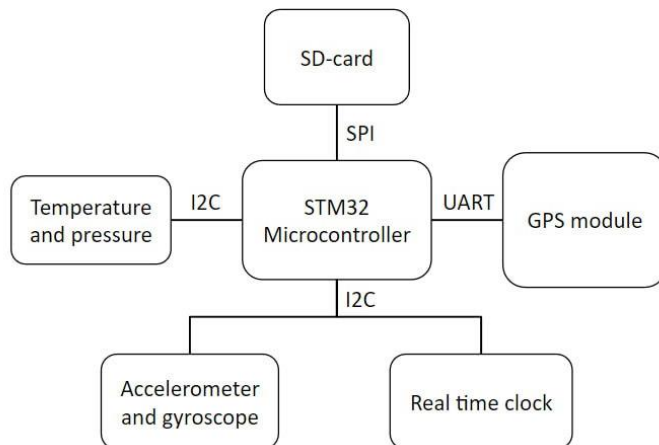


Figure 2. Block diagram of the electronic components “STM32 microcontroller”

The next step is software designing for obtained data to be visualized, .NET. platform was chosen as a means. The App consists of two main tabs and an additional one. The Tab with 3D plane model, where the data is obtained from gyroscope and accelerometer, is a primary one. The plane turns out to be the same as MPU6050. Besides, there is information about temperature, pressure, rotation angles and current time on tab [3].

An additional tab includes movement and location data; data from the GPS module, a map, a graph of the object speed, temperature, pressure, date and time, latitude, longitude, the number of satellites involved in data transmission.

While treating theoretical basics and taking into account practical capabilities software-hardware module has been ultimately designed. It can be used for flying machines controlling.

#### References:

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