Building a high-level interface with ESP8266 for management of devices in IoT

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1. Introduction

We see the Internet of Things [IoT] as billions of smart, connected "things" that will encompass every aspect of our lives [1]. The IoT is comprised of smart machines interacting and communicating with other machines, objects, environments and infrastructures. The IoT is defined in many different ways, and it includes many aspects of life - from connected homes and cities to connected cars and roads to devices that track an individual's behavior and use the data collected.

In this paper we present the results of an in-depth research into IoT issues. We aimed to develop a prototype of service that provides a high-level interface to a set of IoT devices using ESP8266, which could manage devices of IoT. Our goal was to create a circuit board integrated with ESP8266 and software that ensures management of a set of devices communicating over Wi-Fi network.

ESP8266 is a highly integrated chip. It offers a complete and self-contained Wi-Fi networking solution, allowing it to either host the application or to offload all Wi-Fi networking functions from another application processor. We have chosen ESP8266 due to its powerful on-board processing and storage capabilities that allow it to be integrated with sensors and other application-specific devices through its GPIOs.

2. Description of a problem solution

Our prototype system consists of a number of elements (see Fig. 1, where the communication interface is shown). It represents a circuit board (Device) communication with various types of clients, connected to the same network, like android applications or telnet clients running on a given operating system.

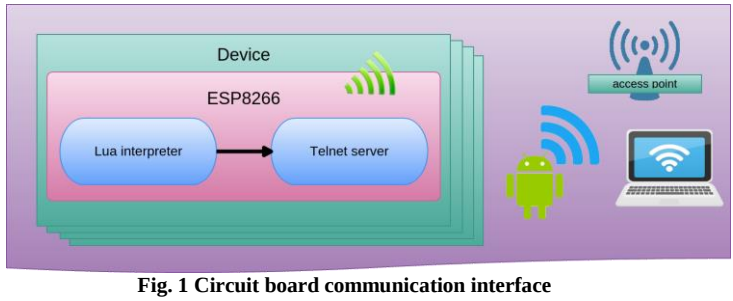

Fig. 1 Circuit board communication interface

Lua [2] is a lightweight programming language designed primarily for embedded systems and clients. It is running on ESP8266 processor. There are some important functions defined and loaded on startup. Basically this platform has been selected because it is easy to control the system just by interpreting commands.

Telnet provides an interactive text-oriented communication facility using a virtual terminal connection, which features great flexibility. There are commands defined, each command can control a different functionality of the system, each of these commands is interpreted by Lua and executed. This solution makes it easy to define an own system, which can provide a user friendly interface for the management of devices in IoT.

3. Results

As a proof-of-concept we have created an android application that implements a circuit board interface. It provides a view for connecting to devices. The devices are configured to control LED brightness by pulse-width modulation (PWM) also as a proximity detector located on circuit boards. The application sends commands to telnet clients and steers each device separately. The functions used by the telnet client are written in Lua and located on ESP8266 microcontroller, at startup each device loads appropriate procedures.

The main aspect to test was the reliability provided by our modules the system is composed of. The testing procedure relies on user activities. At first the user connects to different circuit board modules. Then there are various type of views that provide user friendly interfaces, e.g., setting LED brightness (see Fig. 2). Within the tests performed, the system proved its responsiveness and proper functioning.

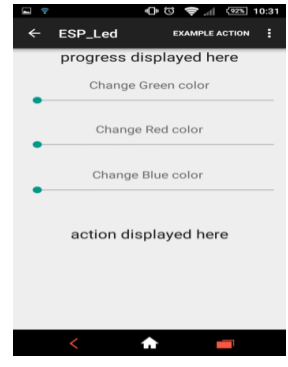

Fig. 2 LED setting GUI

4. Concluding remarks

There are many systems that provide similar solutions for management issues of the Intenet of Things. For example, Contiki [3] is an operating system for the Internet of Things, it connects tiny low-cost, low-power microcontrollers. By contrast, we aimed to develop a solution with convenient circuit boards and interfaces. The test results are very promising - the system is responsive and stable. Future work aims to extend the current API and allow the user to develop their own modules by involving various sensors, e.g., for temperature, humidity, etc. The management of devices requires some changes, with special focus on the configurability of the environment. We are going to make the circuit board more adjustable, so that the user could connect and manage various devices of their choice.

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