LOW COST NETWORK FOR INTERNET OF THINGS

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INTRODUCTION

This work presents a network of low-cost sensors and actuators based on a home automation network applying concepts of Internet of Things. The network can be assembled with components easily accessible and programmed with Open Source software, aiming to ease the reproduction of this project.

KEYWORDS

Internet of Things, Home Automation, Service Oriented Architecture, Low-cost network, REST

NETWORK ARCHITECTURE

The network architecture proposed has three types of nodes: the local node, the border node and the master node.

The local nodes communicate with each other and with the master node through wireless communication modules. In addition to the wireless module, local nodes have also a processor and, optionally, sensors and actuators provided as services.

The border node is responsible for interfacing the local network with the Internet, its presence is important to treat the TCP[4]/IP[5] (Transmission Control Protocol/Internet Protocol) stack and other Internet standard from the local nodes.

The master node is responsible for communication between border and local nodes. Without the master node, the border node must have the wireless hardware and firmware.

The figure 1 shows the overview of the proposed network architecture. A Client may communicate with the border node using HTTP Protocol. The border node translates the HTTP Request to a protocol that the local nodes understand and send to master node. The master node send the request to the destination through the local nodes.

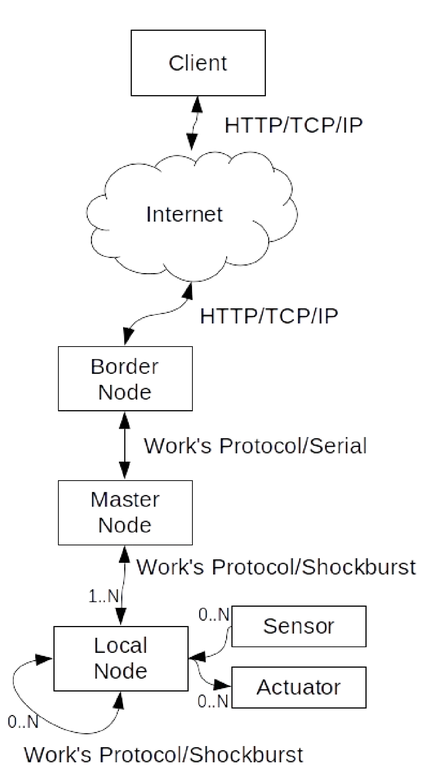

Fig. 1 Proposed Network Architecture

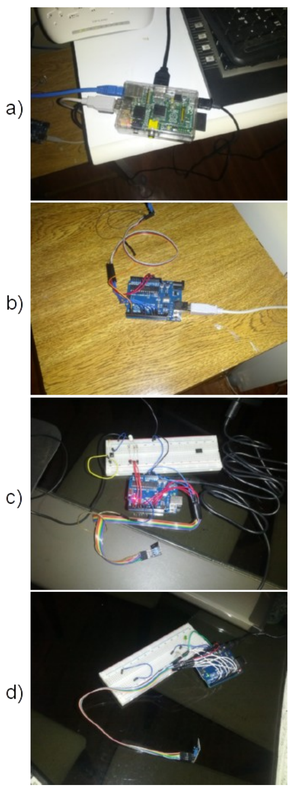

Fig. 5 All the nodes of the network implemented in the Use Case

PROVISION OF SERVICE

Recent projects of the Internet of Things use mostly the REST architecture to provide services. The basic four methods to access a resource in the REST architecture are: GET, POST, PUT and DELETE.

Despite the local network provides their services to the Internet through HTTP protocol, the local infrastructure does not provide suitable conditions for HTTP. A simple protocol was developed in order to enable the provision of services for the local network.

The header information of the packet of this simple protocol can be viewed in firgure 2. This header have the address of the sender and the destination, a identifier to avoid duplicated packets, the information that indicates if the packet is a request or a response and the extra information of the request or response.

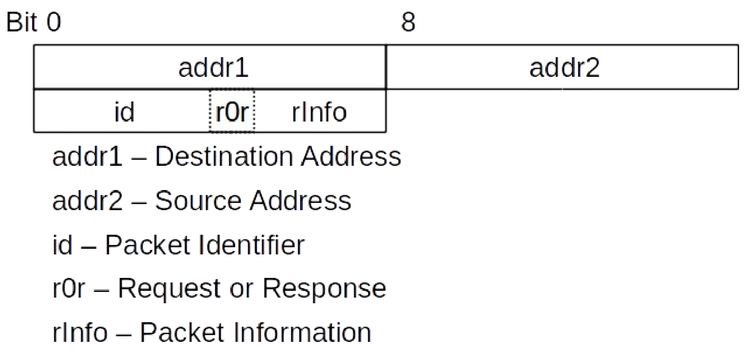

Fig. 2 Packet Header

USE CASE

The use case implemented was used to validate the proposed architecture. The designed network has two local nodes, one of them connected to the LED Multicolor and the other consuming the service of the LED. The local node consumer has a LDR sensor which provides the information that will be used to control the LED, this node provides the service to activate or deactivate the automatic control of the LED on the network.

The local and master node were implemented using the Arduino platform, for being a low-cost and a open source platform. The wireless module used in the network was the NRF24L01. The border node was implemented using the Raspberry Pi board with the Raspbian OS. The HTTP server was implemented using NodeJS. The Communication between the master and border node was done through a serial communication emulated in a USB communication.

The block diagram of the use case can be seen in figure 3. The client that consumes the services of the two local nodes was implemented in HTML and Javascript, the figure 4 presents its execution in a browser.

Fig. 4 Client implemented to consume the services of the Use Case

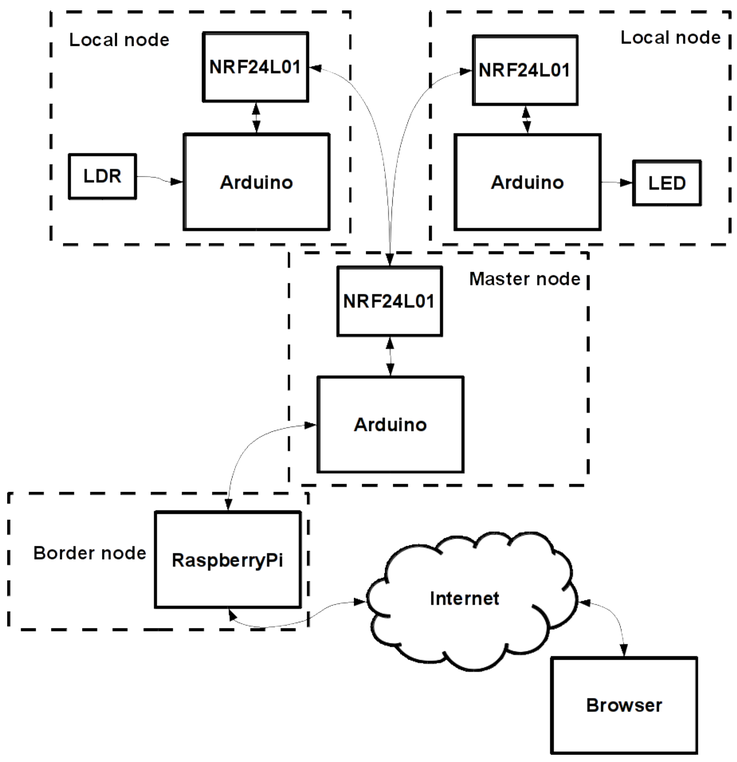

Fig. 3 Block diagram of the Use Case

RESULTS

The proposed use case was successfully implemented. The provision of services on the local network to the Internet worked properly and the consumption of services on the local network also worked properly.

The nodes mounted can be observed in figure 5, the nodes are: a) Border Node, b) Master Node, c) and d) Local Nodes.

CONCLUSIONS

The network designed and implemented can serve as a basis for future works. Even it the network is limited, it allows communication between devices and the Internet, providing services. The use of easily accessible components and open source tools allows the reproduction of the experiment with a low cost.

The code used in this work can be found on GitHub (https://github.com/fernandomalmeida/tcc-domotica).

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