Bridge Device for Mounting and Local Adjustment of Wireless Sensor Network

Stiliyan Y. Georgiev, Hristo G. Kolev and Petko A. Todorov

Abstract—The remote sensor networks are used for collecting area-specific data and retransmit them through radio for further processing. For proper mounting and initial functional test of sensors as part of a larger sensor field system is comfortably to use portable bridge devise for mounting and local adjustment of sensor system. The devise translates the sensor system radio communication channel to the widely used Bluetooth standard. Such way any available smart devise can be used as input-output terminal for communication and adjustment of sensors part of the sensor system. The created radio bridge device is compact, functional, cheap and a useful addition to any LoRa sensor system.

Index Terms—Bluetooth; LoRa; Radio Bridge; Sensor System.

I. INTRODUCTION

The remote sensor networks are used to collect area-specific data and retransmit them for further processing. Often the area may be hard to reach and without available power grid. The latter imposes the need of autonomous power supply for sensors that build up these sensor networks, which determines the demand for low power consumption. In addition, the sensors should have appropriate radio modules for transmitting their data. In recent years the long range, low power wireless LoRa platform has been promoted as a good solution combining low power consumption and a wide range of radio coverage [1].

The row sensor data and/or some row data derivatives must be transmitted in near real time to one or more data acquisition (DA) centers where the data can be visualized in a flexible and user-friendly way, to make analysis of incoming information [2],[3], data fusion [4] and offers suggestions for possible reaction consistent with preset procedures. Thus the presented integral information enables comprehensive analysis and subsequently adequate and fast response.

Such systems must by flexible, i.e., to allow the addition or subtraction of sensor devices without deteriorating the overall system performance. An example of system meeting the above requirements is a seismic sensor system developed in IMSETHC-BAS. The system sensors are transmitting the already processed information to DA center through short encrypted messages through own independent LoRa radio network.

During the sensor devise installation process is necessary to verify the functionality of that particular sensor. The local GPS coordinates should also be determined and sent to the DA center database where they are stored in complies with the identification number of the mounted sensor. The sensors with autonomous power supply (battery) and a radio module as a means of communication should be energy-saving and it is not appropriate to incorporate within a GPS module that consumes energy all the time. Also it is economically unjustified to use the incorporated GPS module only during the mounting procedure or during the position change.

This requires the use of a device that can receive and transmit real-time commands and information from the sensors and at the same time be able to send data to a DA center.

One particular solution is the use of separate Radio module, which is running on the sensor system standard and network settings and is hardwired to Laptop. This is working solution, but uncomfortable in terms of operating comfort.

Another possibility is the use of personal digital assistant (PDA) [5]. A personal digital assistant is a mobile device that functions as a personal information manager (handheld PC). This solution offers ease of use, but is expensive. The development of such devise specialized for the particular sensory system with build in system radio module would be very resource consuming.

II. PURPOSE

The need arises to create a device that meets the following requirements: to connect to each new installed sensor; to receive information from the sensor and send queries and commands; to determine the sensor local GPS coordinates and transmits them to the DA center database in relation to the new mounted sensor identification number; to send the local GPS coordinates to the sensor itself where the position can be stored in the Flash memory.

The purpose of this work was to create radio bridge device for mounting and local adjustment of wireless sensor network.

III. RADIO BRIDGE DEVICE

To solve this problem, we created autonomous powered bridge module, which translates the sensor system LoRa radio standard to the widely used Bluetooth radio standard [6]. The conversion of LoRa to Bluetooth radio standard and vice versa gives the possibility to visualize the incoming
The created devise consists of LoRa radio module tuned on the seismic sensor system radio network, Bluetooth radio module compatible with the standard smart devices, microcontroller and battery (Fig. 1). The firmware embedded in the microcontroller represents a simple bridge between two UART interfaces that adjusts the communication speed between two Baud Rates (9600 for LoRa and 115200 for Bluetooth) and tracks the level of devise own battery. 

IV. MOBILE APPLICATION SOFTWARE

The communication software is developed to provide convenient connectivity with the Seismic Sensors LoRa radio network. The main view of the Android based mounting and adjustment software is presented on (Fig. 2). 

The bidirectional transformation of the messages (data and service) between LoRa radio network and Bluetooth protocol makes possible the effective system deployment and adjustment. The application trough Bluetooth connectivity is able to receive and visualize messages as well send commands to the sensors. The main functionalities of the software application are:

• To monitor the communication between DA center and the separate sensors; 
• To send test commands to the sensors; 
• To receive data messages; 
• To determine the GPS coordinates of the particular sensor and sends them to DA center in relation with.
the sensor identification number;

This technology assists during the system deployment process in the following aspects:

- Mounting – during the mounting of every single sensor his GPS coordinates are acquired through the application which is send to the DA center along with the sensor ID.

- Diagnostics – the application enables the possibility of sending local service commands (status, battery level, temperature) to the sensors, which can guaranty their normal work in outdoor conditions.

The radio bridge device is intended to facilitate the sensory system during installation and diagnostics. After initial initialization the device provides functionalities to receive and transmit all communication messages from an LoRa radio network to a pre-established Bluetooth connectivity and wise versa. In that way the field operator is given an easy access to the working conditions of the system. On the figure below (Fig. 3) is shown how the communication data flow is organized.

![Diagram of radio communication network](image)

The LoRa/Bluetooth bridge device provides full access to the LoRa sensor network with a simple smart device that runs on Android. The latter allows the person who mounts a new sensors or does sensory field maintenance to monitor the entire data stream in the LoRa radio network and resolve the detected malfunctions on the spot.

V. CONCLUSION

The created radio bridge device is a useful addition to any LoRa sensor system. The main benefits of the device are: Compact, Functional, Cheap. Software technologies used behind the development of this device is universal and easy for implementation in any portable mobile device with standard Bluetooth and GPS modules. With increasing numbers of electronic connected devices, we will be able to use this input-output terminal for communication and adjustment, which will give us the additional properties and benefits of installation, local testing and diagnostics of sensor networks. Moreover, using the standard interface connection between radio and Bluetooth allows easy of use and switch between different communications technologies (LoRa, ZigBee etc.).

REFERENCES


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