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LoRa BASED SMART AGRICULTURE NETWORK

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GOAL OF THE STUDY

This work presents the prototype of a LoRaWAN based network meeting the needs of smart farming with low power consumption and incorporating most important sensors for measuring and keeping track of air temperature, relative humidity, soil moisture, UV, IR and daylight intensity. The system comprises LoRaWAN compatible novel hardware and algorithms with interfaces for web and Android users. Devices used as nodes and gateways are produced with the same card design. Google Firebase is used on the server side and a web-based interface on the user side.

METHODOLOGY OF THE INVESTIGATION

The system will be explained under four main subsections: node, gateway, real-time server and end user interface.

THE NODE: A STM32L151 series processor is used, which has tasks such as processing and evaluating sensor information and undertaking other controls. A SI1145 sensor is used to measure UV, IR and daylight intensity, a SI7021 is used to measure air temperature and humidity, and a hygrometer with analog output is used to measure soil moisture. HopeRF's RFM95W module is used to transmit the information received from the sensors wirelessly .

THE GATEWAY: In addition to this, ESP8266 WROOM-02 is used in the gateway card to provide internet access. RFM95W with SPI protocol is used; SI1145 and SI7021 sensors are used with the I2C communication protocol; ESP8266 is the serial communication protocol.

THE SERVER: In order to ensure that the information received by the Gateway can be viewed by the end user, a real-time server is created. Real-time cloud storage is realized by utilizing Google's Firebase service.

THE USER SIDE: A web-based interface has been developed so that the information saved on the server can be viewed by the end user. HTML, CSS and Javascript are used in the software of the interface. In order to login to the system, a user login panel is created. It is possible to log in to the panel with the e-mail and password defined on the server. The graphics are updated simultaneously with the server. In other words the user can see the active nodes from the left side of the screen and can switch between them.

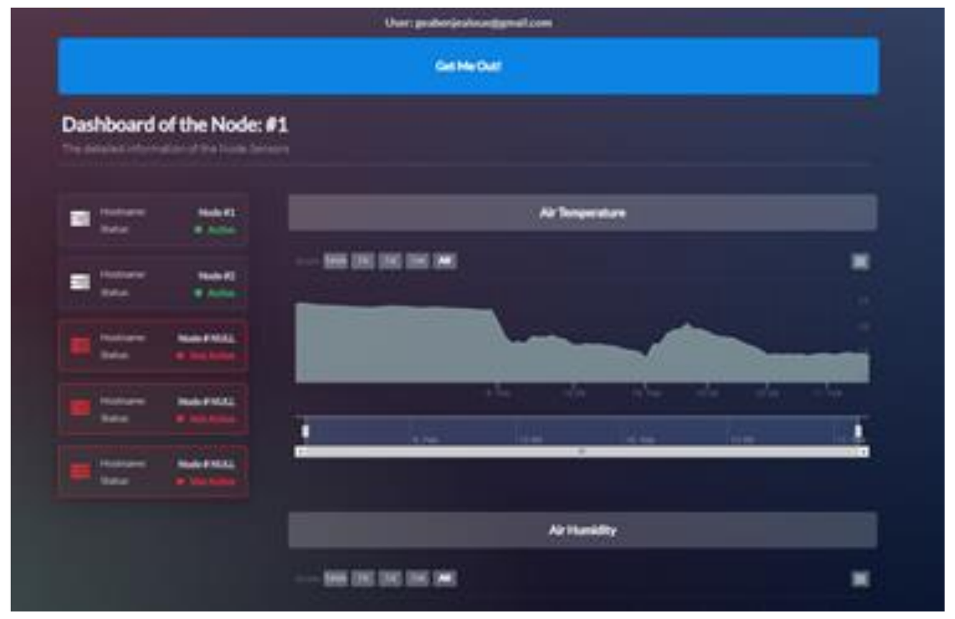

Fig. 1. Web Interface

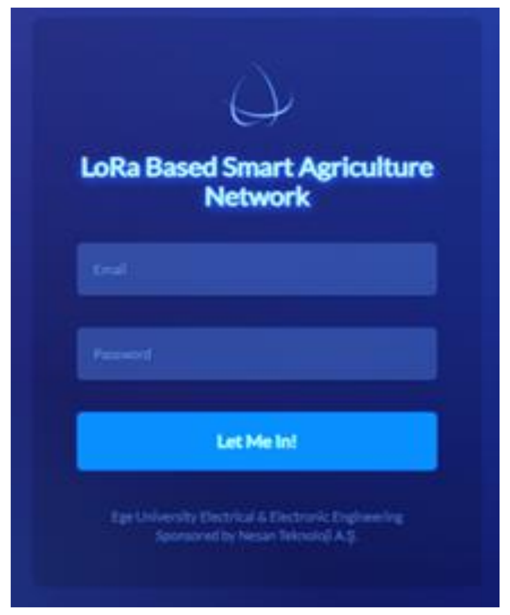

Fig.2 User Login Screen

MAIN RESULTS FROM THE STUDY

The novel LoRaWAN based smart agriculture network allows for remotely monitoring environmental conditions in farmlands and soil parameters.

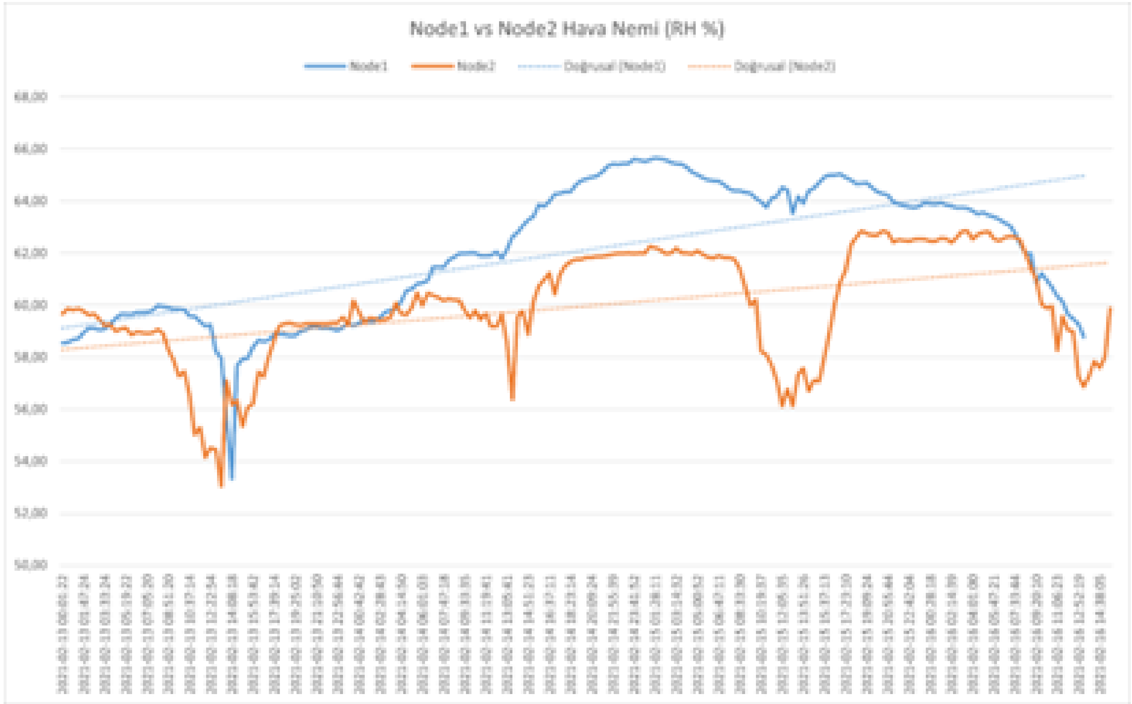

Fig. 3. Farmland humidity results

Propagation tests: RSSI was measured for distances from 0.5 to 6.5 km at ground level, and at 60 m above ground level. Highest LOS was observed at 60m and 5.5 km. For each test 100 data packets were transmitted in each distance-scatter factor pair, and the RSSI and SNR values were averaged in order to derive more accurate readings.

Farmland tests: The node devices were placed on the farmland of the Ege University campus. Gateway device was located in the Department of EEE.

CONCLUSIONS

This paper discusses the original design of LoRaWAN based sensor node and gateway devices which can be used for different smart farming applications. A prototype LoRaWAN network is established where collected field data is transmitted and kept on a real-time server implementing IoT. A suitable web-based interface and Android interface were also created.

The node devices used in the project, the hardware and software of gateway devices and the end user interfaces are a novel design. Making the hardware and software of the system original without combining and using ready-made modules in the project has set a reference for designing LoRa standard compatible devices to be used in smart agriculture and related IoT projects.

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