Environmental Monitoring System Using USRP and Single Board Computer

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Abstract **- Universal Software Defined Radio Peripheral (USRP), GNU Radio, and Raspberry Pi board (single board computer) are used to establish a simple communication network. The communication network is configured to monitor the physical quantities of the environment. The quantities such as temperature, humidity, and the luminous efficacy values can be measured by the sensors. A set of sensor modules are used to monitor the physical quantities of the environment and the values of the sensor modules will be stored in a SD card. The SD card module is attached with the sensor module. A Raspberry pi board is used as sensor node. The sensor node uses Inter Integrated Circuit (I2C) communication to transfer data [2] from the the sensors to a SD card. The mobile nodes periodically measure the physical quantities of the environment and send the information to the storage medium. The present state values of the sensor nodes are forwarded to the base station. The sensor node has states such as active, Data-On, Data-Off, and idle. The state values of the network will be sent to the base station, periodically. The energy level ratio of the rechargeable battery is measured by the sensor nodes and the information regarding the energy level ratio is sent to the USRP base station periodically. The network is used to monitor the environment, and observe the changes in the environment. Also the network can be used to perform research works, such as monitoring the changes in the physical quantities of the environment, and controlling the environment.**

Keywords —GNU Radio, GPIO, Node, I₂C, SPI, SD card, and USRP

I. INTRODUCTION

People use different environmental monitoring systems for different purposes. The environmental monitoring systems are used by people to monitor and learn the environment. The monitoring system may include communication protocols, such as Wi-Fi, Wi-Max, Internet of Thing (IOT), Bluetooth and etc. Each type of the network protocol has their own advantages and disadvantages. The communication network design is constructed based on the system requirements, and some non-functional requirements [1]. Some modern networks may contain certain facilities than conventional type of networks. Some other type of networks are used for industrial applications. The industrial networks may require high bandwidth capacity, and high link capacity [2]. The final category of networks are used for research and academic purposes.

978-1-6654-4429-3/21/$31.00 ©2021 IEEE

The industrial network may differ from the networks, that are used for research and academic activities [2]. The requirement of the industrial network may differ from research and academic networks. Universal Software Defined Radio (USRP) is a device, which is used to configure a communication network between sensor modules and a base station. The communication network could be established by Quad band GSM radio protocol.

The communication network contains a base station and sensor module. The sensor modules are powered by rechargeable battery and the modules are deployed in a sensing environment. The device is used to monitor temperature, humidity, and luminous efficacy values of the environment. A full duplex communication network is established between sensor node and the base station. The network is established using a GSM module [4]. The GSM module is attached to the sensor module. The USRP device is used to establish, and monitor the communication link between sensor nodes and the base station. The measurements are collected from the environment and the values are stored in a SD card of the sensor node. The sensor node is deployed in the region where the research work is carried and implemented. The Fig.1 illustrates a USRP base station.

Nowadays, there are different types of environmental monitoring systems are used to monitor the environment. The system may include Wi-Fi, Wi-Max, Internet of Thing (IOT), Bluetooth and etc. The communication networks are designed in order to satisfy the system requirements, and some non-functional requirements of the end systems and end users [1]. Also some modern networks may contain certain facilities than conventional type of networks. Some networks are used by industrial applications, which contain high bandwidth capacity, and high link capacity [2]. The final category of networks are used for research and academic purposes. The networks, used by industries may differ from the networks, which are used for research and academic activities [2].

Fig. 1. Thes base station with USRP transceiver

The sensor values will be measured and stored in the SD card of sensor module and the nodes are connected with USRP base station in order to establish a communication network. The sensor nodes are powered by 9V Li-ion rechargeable battery and the battery energy levels will be indicated in a display terminal of the sensor node [2]. The