

Cost-Efficient Design and Implementation of Weather Base Station and Satellite Communication System

Using Realtek Software Defined Radio and Raspberry Pi 2



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in
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**Cost-Efficient Design and Implementation of Weather Base
Station and Satellite Communication System Using Realtek
Software Defined Radio and Raspberry Pi 2**



By

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A thesis submitted to School of System and Technology (SST) in partial fulfillment of the requirements for the degree of MS in Electrical Engineering

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Declaration

I **Salman Mahmood** Roll No. **13021050002** student of **MS** in **Electrical Engineering**, hereby declare that the matter presented in the thesis titled **“Cost-Efficient Design and Implementation of Weather Base Station and Satellite Communication System Using Realtek Software Defined Radio and Raspberry Pi 2”** is my own work and has not been printed, published and submitted as thesis or in any form in any other University, Research Institution etc. in Pakistan or abroad.

Date

Signature of Deponent

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Publications

Some ideas, figures of this dissertation have appeared in the following publication

1. Salman Mahmood, Muhammad Tahir Mushtaq , Ghulam Jaffer (2016), Cost Efficient Design Approach for Receiving the NOAA Weather Satellites Data, IEEE Aerospace Conference 2016, Montana, USA

Abstract

National Oceanic and Atmospheric Administration has group of artificial satellites orbiting Earth. Such satellites are benefiting humanity for 6 decades by transmitting data related to weather and climate. By processing such data researchers can predict weather situations and climate related disasters. Receiving data of such satellites is very costly process. In first phase of this research a cost efficient system for receiving and decoding data from the weather satellite NOAA 18 was designed and implemented, in order to establish a weather ground station first of its kind in the region. A special purpose Quadrifilar Helicoidal Antenna and Trifilar Balun were designed and implemented to improve the signal strength at location of project i.e. Lahore. Realtek Software Defined Radio was used as RF receiver which was integrated with Raspberry Pi 2. The combination of QHA, Trifilar Balun, RTL SDR and Raspberry Pi 2 proved a cost efficient setup for weather base station with fantastic results. The innovative setup was 38 times cheaper than previously implemented systems. In second phase of this research the cost efficient construction of SDR based satellite communication system was created. In which ground and space segments were developed. Raspberry Pi 2 was programmed with the help of python and C to work as a Software Defined Radio. It's General Purpose Input Output Pin 4 and Pin 18 were used for transmitting audio, text and image (video) over five modulation schemes which were FM, SSB, VFO, FSK and SSTV at flexible range of 50 MHz to 750 MHz. Attachment of RTL SDR with Raspberry Pi 2 made it to receive and decode RF signals within the range of 24Mhz to 1.8GHz. The improvisational marvel of Raspberry Pi 2 as transceiver proved perfect replacement for costly transceiving systems such as Universal Software Radio Peripherals and HAM Radios. This setup proved to be 30 times cheaper than previously used communication systems and perfect to be considered as communication system for any student satellite project.

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**Dedicated
to
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