Analysis of Signal Strength Variations in GSM networks in Libyan Academy

Marai M. Abousetta[#1] , Walid T. Shanab[#2]
[#1]Libyan Academy of graduate Studies- Tripoli, Libya
[1] m.abousetta@academy.edu.ly
[#2] lecture at higher institute of Engineering Technology- Tripoli, Libya
[2] walid.t.shanab72@gmail.com

Abstract

The factors affecting mobile signals are the distance between the nearest mobile phone tower, transmission power, network congestion, antenna efficiency, and obstacles such as cloud cover, dense trees, buildings, etc. Most mobile devices use a set of bars of increasing height to display the approximate strength of the signal received to the mobile user. When the signal strength is measured vertically on the ground floor, there are many obstacles that cause the signal value to decrease. While moving vertically to the upper line, the signal strength is constantly decreasing due to the lack of obstruction. In this research, the GSM signal strength is recorded at different times of the day to note the signal strength variation in the premises of the Academy - Janzour. Also, a mirrored measurement grid is used at different levels of the building and different heights above the ground, in order to characterize the change of signal strength with different height and level with dry weather.

Keywords— efficiency، GSM، signal strength**.**

I. INTRODUCTION

With the development of technology over time, there was a shift in the usage of wireless devices, not too long ago mobile phones were just convenient communication alternatives when the user was outdoor, or away from a building with a landline. At the present time, over 70% of mobile phones usage take place in-buildings, And it became necessary that the users remain connected all time by their mobile phones, they want one phone number they can use at all of their locations, rather than having separate numbers for home, office and travel. In addition to this shift, data usage is rising quickly, and is in demand in every location. And here lies the importance of providing coverage inside buildings.
Many people suffer from problems related to poor reception of the cell phone network, or even from the presence of areas completely outside the scope of cellular coverage, and the reasons behind the network weakness vary, which may be for reasons related to the telecommunications company and distribution areas of coverage towers, or for reasons related to your mobile phone or your sim card.
The following are the most common causes of network weakness:

• Coverage towers: Telecom companies distribute a number of coverage towers within the borders of the country, to cover them almost completely, but sometimes there may not be enough towers to provide sufficient coverage, and when you move away from the tower, the network may deteriorate until you lose it completely.

• Obstacles: You may sometimes notice weak or lost network signal in specific areas only or within certain rooms within a building, and the reason behind this is due to the quality of materials used in construction, some of which prevent the network from reaching your phone [1, 2, and 3].

II. METHODOLOGY

The methodology used to implement this research is as follows: Searching for sites of poor coverage, and a practical model will be established and implemented on the ground. Measuring received signals in different sites for investigation..

III. DESIGN SYSTEM

The figure (1) shows the whole system, where consists of GSM module and RF antennas and microcontroller.

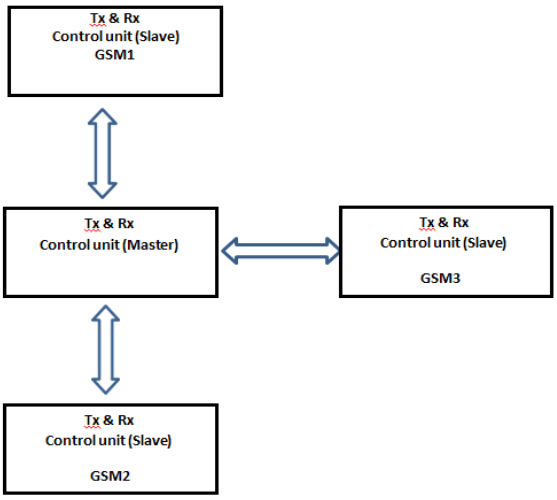


Fig..1 Block diagram of the project

A . Project requirements

- Arduino boards as microcontroller.
- Wireless Communication Boards (NRF24L01).
- Global System for Mobile Communications (GSM).
- Connecting wires.
- Energy source.

B. Free Space Losses (FSL)

For line-of-sight propagation the received signal Pr is a function of distance and frequency as in the following formula[4].

$$P_r = P_t \left(\frac{C}{4\pi f D}\right)^2$$

Or

$$\mathbf{FSL} = -10\ Log\left(\frac{C}{4\pi fD}\right)^2 = -147 + 20\log(f) + 20\log(d)\ \ dB$$

Where:
P_t : Transmitted signal power
C: Speed of light
D : distance between transmitter and receiver
f: frequency used

IV. DESIGN OF THE PRACTICAL PART

The main task of the thesis system is to measure the signal strength at different locations within the area (building) to be monitored, and this is done by means of several measuring components called slave units. A number of slave units that are distributed within the building are wirelessly connected to a single control unit called the master unit. The main unit is directly connected to the computer. The proposed measuring system consists of two main units which will be described in the following sub-sections.

A. The master unit

The master unit is the main unit in the system which is responsible for the system management such as organizing and arranging slave units. Fig-(2) Shows the master unit.

B. The slave unit

The monitoring system contains several slave units controlled by one master unit. These slave units are installed at different locations around the area to be covered and it is responsible for measuring the signal strength at these locations. The slave unit reads (measures) the signal strength for more than one time (the number of the readings is called the reading counter, which can be set to any value to increase the (accuracy) and the time between every two readings has been set to 150 millisecond (this time is fixed and the administrator cannot change it), then the slave unit computes the average before sending it to the master unit. Figure (3) shows the slave unit.

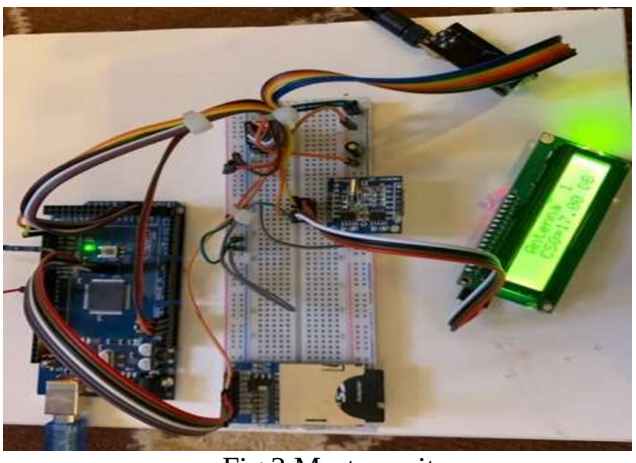


Fig 2 Master unit.

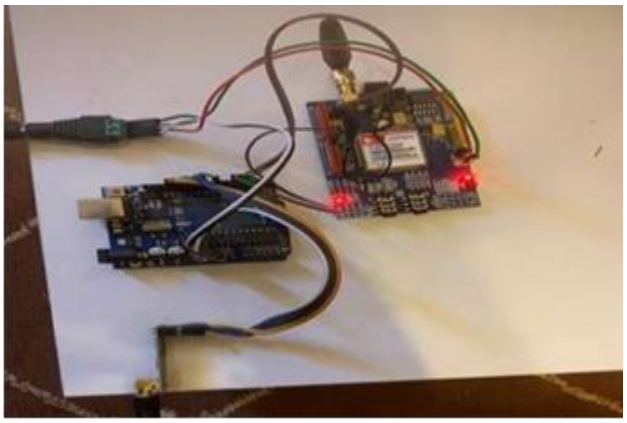


Fig 3 Slave unit.

V. MEASUREMENT RESULTS

The proposed monitoring system has been tested on a real indoor coverage system; The test was carried out using one main unit with three dependent units in the libyan site openly on different swabs. As shown in Figure (4).

Fig 4 libyana site

A. Outdoor coverage system tests

Table (1) shows the results at different distances from antenna.(slaves).

Table (2) Table (1)

distance	Date	Day	Time	Slave1	Slave2	Slave3
First floor	23/8/2022	tuesday	10:25:03	23 dBm	28 dBm	27 dBm
First floor	23/8/2022	tuesday	10:27:04	24 dBm	28 dBm	27 dBm
Second floor	23/8/2022	tuesday	10:53:58	17dBm	30 dBm	29 dBm
Second floor	23/8/2022	tuesday	10:55:58	15 dBm	30 dBm	28 dBm
Third floor	23/8/2022	tuesday	11:29:04	16 dBm	28 dBm	29 dBm
Third floor	23/8/2022	tuesday	11:31:04	16 dBm	30 dBm	30 dBm
First floor	24/8/2022	wednesday	9:32:03	18 dBm	29 dBm	28 dBm
First floor	24/8/2022	wednesday	9:34:04	18 dBm	29 dBm	28 dBm
Second floor	24/8/2022	wednesday	10:05:03	19 dBm	29 dBm	28 dBm
Second floor	24/8/2022	wednesday	10:07:56	19 dBm	28 dBm	28 dBm
Third floor	24/8/2022	wednesday	10:35:03	19 dBm	30 dBm	31 dBm
Third floor	24/8/2022	wednesday	10:37:04	19 dBm	30 dBm	31 dBm
First floor	25/8/2022	thursday	10:05:48	16 dBm	28 dBm	28 dBm
First floor	25/8/2022	thursday	10:07:48	16 dBm	28 dBm	28 dBm
Second floor	25/8/2022	thursday	10:42:04	19 dBm	29 dBm	29 dBm
Second floor	25/8/2022	thursday	10:44:04	19 dBm	29 dBm	29 dBm
Third floor	25/8/2022	thursday	11:09:52	21 dBm	30 dBm	29 dBm
Third floor	25/8/2022	thursday	11:11:52	21 dBm	30 dBm	29 dBm

distance	Slave1	Slave2	Slave3
30m	31 dBm	17 dBm	17 dBm
30m	31 dBm	17 dBm	17 dBm
30m	31 dBm	16 dBm	17 dBm
30m	31 dBm	16 dBm	17 dBm
30m	31 dBm	17 dBm	16 dBm
500m	26 dBm	17 dBm	18 dBm
500m	26 dBm	17 dBm	18 dBm
500m	26 dBm	17 dBm	18 dBm
500m	26 dBm	17 dBm	17 dBm
500m	27 dBm	17 dBm	17 dBm
1k	26 dBm	24 dBm	22 dBm
1k	26 dBm	24 dBm	22 dBm
1k	25 dBm	23 dBm	24 dBm
1k	25 dBm	25 dBm	24 dBm
1k	27 dBm	25 dBm	24 dBm

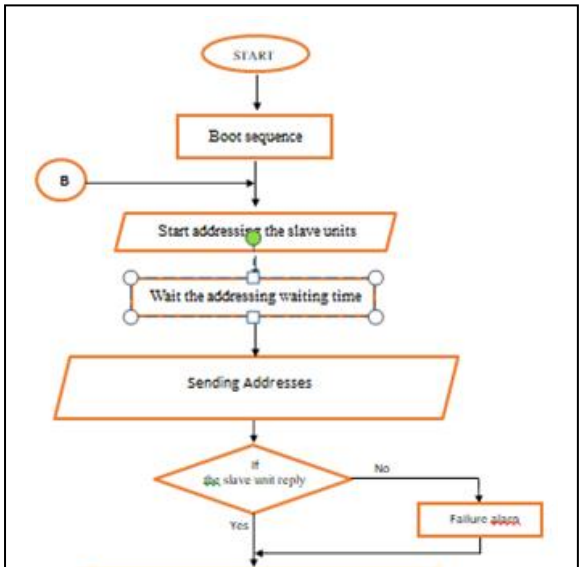
B. Coverage system tests

The proposed monitoring system has been tested on a real indoor coverage system; The test was conducted using one main unit with three sub-modules in the 3-storey Corner College of Engineering It contains the new orbital. Table 2 shows the results at different distances in college.(slaves).

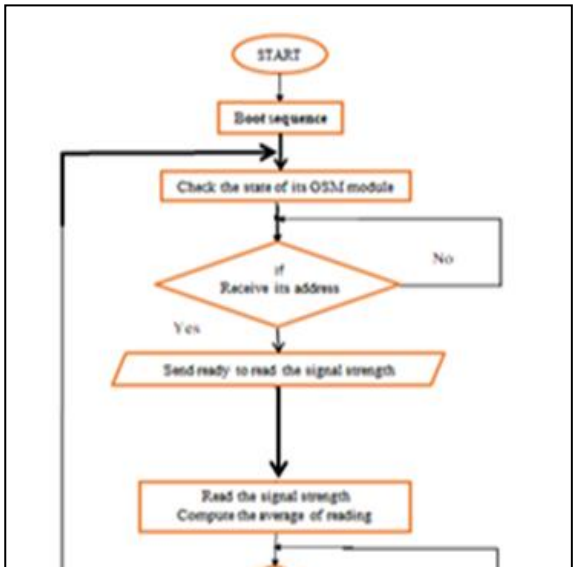
VI. THE MONITORING SYSTEM FLOWCHART

The monitoring system has two different flowcharts one for the master unit and the other for the slave unit, the two flowcharts has been simplified to make them easier to understand.

A. Slave flowchart



B. Master flowchart



VII. CONCLUSIONS

The aim of this research was to solve the problems of signal loss in the mobile phone next to the College of Engineering and from the results we obtained. It is recommended to use some types of systems to reproduce the signal, as is the case with Repeater or one of the different types of DAS system. We suggest to have cooperation with relevant association to get some important information sent transmitted power (pt) etc.

REFERENCES

[1] http://harriscommunications.com/distributed-antenna-system-das-tutorial (visited on 9:30 pm 23-04-2016)
[2] Bjorn Olav Solberg /Indoor coverage solutions /12-9-2012.
[3] https://en.wikipedia.org/wiki/Cellular_repeater#External_directional_antenna (visited on 10:00 pm 23-04-2016)
[4] http://www.stelladoradus.com/indoor-coverage-problems-solutions-james- browne/ (visited on 10:05 pm 23-04-2016)
[5] https://en.wikipedia.org/wiki/Distributed_antenna_system (visited on 10:10 pm (04-2016)
[6] Stefan Scheinert / HOW To - Indoor Building Multi Services Part 2
[7] http://www.animate.com/the-importance-of-network-monitoring/(visited on 10:20 pm 23-04-2016)
[8] https://en.wikipedia.org/wiki/Base_transceiver_station (visited on 10:30 pm 23- 04-2016)
[9] Ericsson GSM System / RBS 2206 Installation and Integration Manual / 17-6- 2004.
[10] Netvox technology company / Intelligent Home Automation System Based on ZigBee® Wireless Sensor Network Technology / 2010.
[11] Digi International, Inc / XBEE® FAMILY FEATURES COMPARISON / 2016.
[12] Digi International, Inc / Xbee-PRO® 900HP and XCF RF Modules S3 and S3B / 2015.
[13] https://www.arduino.cc/en/Guide/Introduction (visited on 11:00 pm 23-04-2016).