Cell Tower Management System

Joy Abdelmasseh, Mark Nabil, Mark Samir, Nermeen Haggag

October 14, 2019

Abstract

Network coverage is very important. Companies find many problems to find an accurate place to locate the antenna/cell-tower.This happens according to network coverage and many other aspects such as population, network traffic and distance between any other antenna,..etc . The process is done by getting the images required. After that we make the required extraction features such as distance between each building, height of the buildings ..etc.Also,by using a dataset for population and network traffic. According to this calculations the proposed project must decide which the accurate place to deploy it without having any failure.

1 Introduction

1.1 Background

Nowadays, mobile network coverage is growing fast. So cell tower stations need to be placed in the correct location not to be manually placed or fixed. As manual placing causes long time for repairing. Another huge issue is determining the place to allocate the cell tower due to the high buildings that makes signal block or placing a cell-tower in a place which have no events or users.But the network workers do not have the enough knowledge to know the correct location for the cell-tower. These days, Network Operations Center (NOC) is a centralized location where can supervise, monitor and maintain client network. The NOC is a central point for software distribution, updating and network troubleshooting. NOC is helping to monitor infrastructure capacity and health. But if anything is flagged by the NOC, the team can work to solve the issue manually as the network workers go and see the issue in the location which takes a long time to repair. In our proposed project, we need to focus on using machines only as knowing the right place for allocating a new cell tower by having a good network without losing any data by the coverage holes. It is depending on the location to choose the highest buildings to avoid any blocks or holes between the signals. If we are having any issue in the Network, we should know in which place the network is needed more and try to fix it by focusing to replace humans by machines. Further,There are some properties we should focus on it like the coverage holes which is each two antennas have a suitable

distance to be connected between each other and do not have any blocks due to microwaves transmissions. Finally, to know the place you want to deploy the antenna in according to the network coverage in the place, population, distance between the antennas, height,distance and the spacing between buildings.After finishing these properties by using geographical information system (GIS) for taking the decision by using machine learning .

1.2 Motivation

In the market need we try to do our best to switch anything manually to automated approaches system. Also not to have human beings who detect and take the decision even if it was right or wrong place to put the antenna, without any testing or experiments about even if this place will harm the users surrounded it or it will cover a high percents of users around it or it will low percents of users. Our proposed system will help to detect the exact/proper type of base station which will cover the required place without any coverage holes. Also it makes choosing the correct place for antenna easier and faster and transmission type than manually detection of all that requirements. Academic need the researchers try to use Geographical Information System(GIS) and Machine learning to choose the proper location for the antenna with respect to the accepted distance between antennas with suitable power use and school,building crowded with people to reduce it's harmful effect on human bodies.

1.3 Problem Definitions

Our proposed system aims to find the finest locations to deploy cell towers. This aim can be fulfilled by an approach of several procedures. At first, we will use image processing to extract the features and GIS to get building altitudes and measure spaces between buildings,height and network coverage. Also to know the location actually by using the GIS. Then we will build up a model, its inputs will be the power use that may have danger on the people who lives in this place. Also by deploying the cell towers without having coverage holes between each two of them and information extracted from image processing. Its output will be the place where the cell-tower will reside by machine learning.

2 Project Description

2.1 Objective

The project main aim is to make the deployment of the cell tower more easier and automated without the interference of the human being. There are multiple struggles in placing the cell tower as it cost the companies so much to detect the great location. Several algorithms are used before to recognise the best tower locations such as Greedy approach then by ratio Heuristics and finally by Genetic algorithm, According to the paper Algorithmic Approach For Strategic Cell Tower Placement []. Now we use the image processing to extract

the features, then use GIS to get some measurements needed to know the best location. The Location is also decided according to the network coverage in the area and the population.

2.2 Scope

The proposed system aims to find the finest places to deploy cell-towers.

2.3 Project Overview

The project aim is to find the best location for placing an antenna, by finding the best building with the best dimensions and network coverage, by using image processing to extract features. After that we make some measurements such as (Distance between buildings, population of the location, distance between the building and the base station and network coverage from this building) by using GIS Also the system after deciding which building to place in it the antenna by machine learning.

3 Similar System Information

3.1 Similar System Description

Hammad Hafiz, Harjeet Aulakh and Kaamran Raahemifar [1] proposed this research for automated approach of cell tower placement as cellular network are growing fast , They need to increase the coverage and quality of service. As manual cell tower placement is time consuming , subject to error and inefficiency results. They uses Bound and Branch Algorithm to solve this problem and try to automated placement approach. They detect this parameters to work on the algorithm as a: The squared space area , b: The mobile terminals (users) as nodes, c: Heterogeneous network, d: Applications nodes (AP) as cluster header (CH), e: A node x is considered to be a neighbor of another node y if x lies within the transmission range of y, and f: The neighbors of a CH become members of that cluster and can no longer be executed in algorithm after one node has chosen as CH. Program is more generic and performance efficient.

The Authors HaiderKadhimHoomod , Intisar Al-Mejibli ,Abbas IssaJabboory[2]The Researchers proposed this paper to guarantee the efficient quality of service that is includes adequate coverage and good call quality with minimum cost. the main problem is that increasing in utilization of cell phones and number of cell phone users in rural and urban areas has requested the network specialists to grow their scope to cover all spots In wireless communication system, the cell towers distribution requires effort such as network planning and cost as it needs expensive equipment's like Global Positioning System (GPS). This proposed paper is depending on the technique of Self-Organizing Map (SOM)

neural network with effective modification and used suitable model of path loss propagation. It clusters the subscribers (nodes) by using optimized clustering technique to find minimum appropriate number of cell towers and optimizing their distribution. The Important parameters for the algorithm are coverage area and interference depend upon the locations of these cell towers. The algorithm, also the algorithm takes into its consideration received power and path loss for each subscriber .

Abdullah Al-Sahly, Mohammad Mehedi ,Hassan Majed Al-Rubaian , Muhammad Al-Qurishi [3] The Researchers proposed this paper for the need for more base stations to cover the highly need mobile connectivity. The main Problem is that the side effects of the base station by Radio Frequency (RF) waves to establish communication among users. The RF waves are harmful for the human beings if absorbed by the tissue, Some common disease the faces people who are nearby the base station without the accepted distance they face Headaches, Discomfort and Anxiety. The researchers try to use GIS to map the accepted distance between building and base stations. As in consideration of RF radiation the system helps you to find the safe area .

3.2 Comparison with Proposed Project

Comparison System				
	Paper 1	Paper 2	Paper 3	Our Proposed Pa- per
Method	Using Bound and Branch algorithm	Global Positioning System (GPS)	Geographical Information System	Image Process- ing+Machine learning
Accuracy	Not Mentioned	Not Mentioned	Not Mentioned	-
Data-sets	Not Mentioned	GPS Maps	GIS Maps , Data- set Contains: data collected, processed and stored	Satellite Imagery and Population dataset

3.3 Screen Shots from previous systems (if needed)

4 Project Management and Deliverable

4.1 Tasks and Time Plan

4.2 Budget and Resource Costs

4.3 Supportive Documents

5 References

1. Hafiz, H., Aulakh, H., Raahemifar, K. (2013). Antenna placement optimization for cellular networks. 2013 26th IEEE Canadian Conference on Electrical and Computer Engineering (CCECE). doi:10.1109/ccece.2013.6567765 "https://ieeexplore.ieee.org/document/6567765"

2. Abdullah Al–Sahly ; Mohammad Mehedi Hassan ; Majed Al–Rubaian ; Muhammad Al–Qurishi. Using GIS for Measuring Mobile Tower Radiation on Human. IEEE Xplore: 23 August 2018. DOI: 10.1109/CAIS.2018.8441997 "https://ieeexplore.ieee.org/document/8441997"

3. Haider Kadhim Hoomod , Intisar Al-Mejibli , Abbas IssaJabboory. Optimizing SOM for cell towers distribution. IEEE Xplore: 13 July 2017. Doi:10.1109/NTICT.2017.7976136. https://ieeexplore.ieee.org/document/7976136

4. Siqueira, G. L., Vasquez, E. A., Gomes, R. A., Sampaio, C. B., Socorro, M. A. (n.d.). Optimization of base station antenna position based on propagation measurements on dense urban microcells. 1997 IEEE 47th Vehicular Technology Conference. Technology in Motion.doi:10.1109/vetec.1997.600507 "Hub:." Sci, https://sci-hub.tw/10.1109/VETEC.1997.600507.

5. Kashyap, R., Bhuvan, M. S., Chamarti, S., Bhat, P., Jothish, M., Annappa, K. (2014). Algorithmic Approach for Strategic Cell Tower Placement. 2014 5th International Conference on Intelligent Systems, Modelling and Simulation. doi:10.1109/isms.2014.112 "Hub: ." Sci, https://sci-hub.tw/https://ieeexplore.ieee.org/document/7280982.

6. Linman, Daniel, et al. "How to Write a Project Description: Key Criteria and Steps." Your Guide to Project Management Best Practices, 12 June 2018, https://mymanagementguide.com/how-to-write-a-project-description-key-criteria-and-steps/.

7. “Smart Guides Guide to Understanding Poor Mobile Network Coverage.” TelcoAntennas, 2019 Telco Antennas ABN: 30 145 543 951 https://www.telcoantennas.com.au/buying/smart-guides/guide-to-understanding-poor-mobile-network-coverage/.

8. “Directional Antenna.” Directional Antenna - an Overview — ScienceDirect Topics, https://www.sciencedirect.com/topics/computer-science/ directional-antenna. 2019 Elsevier B.V.

9. 4.2. “3G / 4G / 5G Coverage Map, Egypt.” 3G / 4G / 5G Coverage in Egypt - NPerf.com, https://www.nperf.com/en/map/EG/-/-/signal/?ll=26.804002450251545lg=30.800000000000022zoom=6.

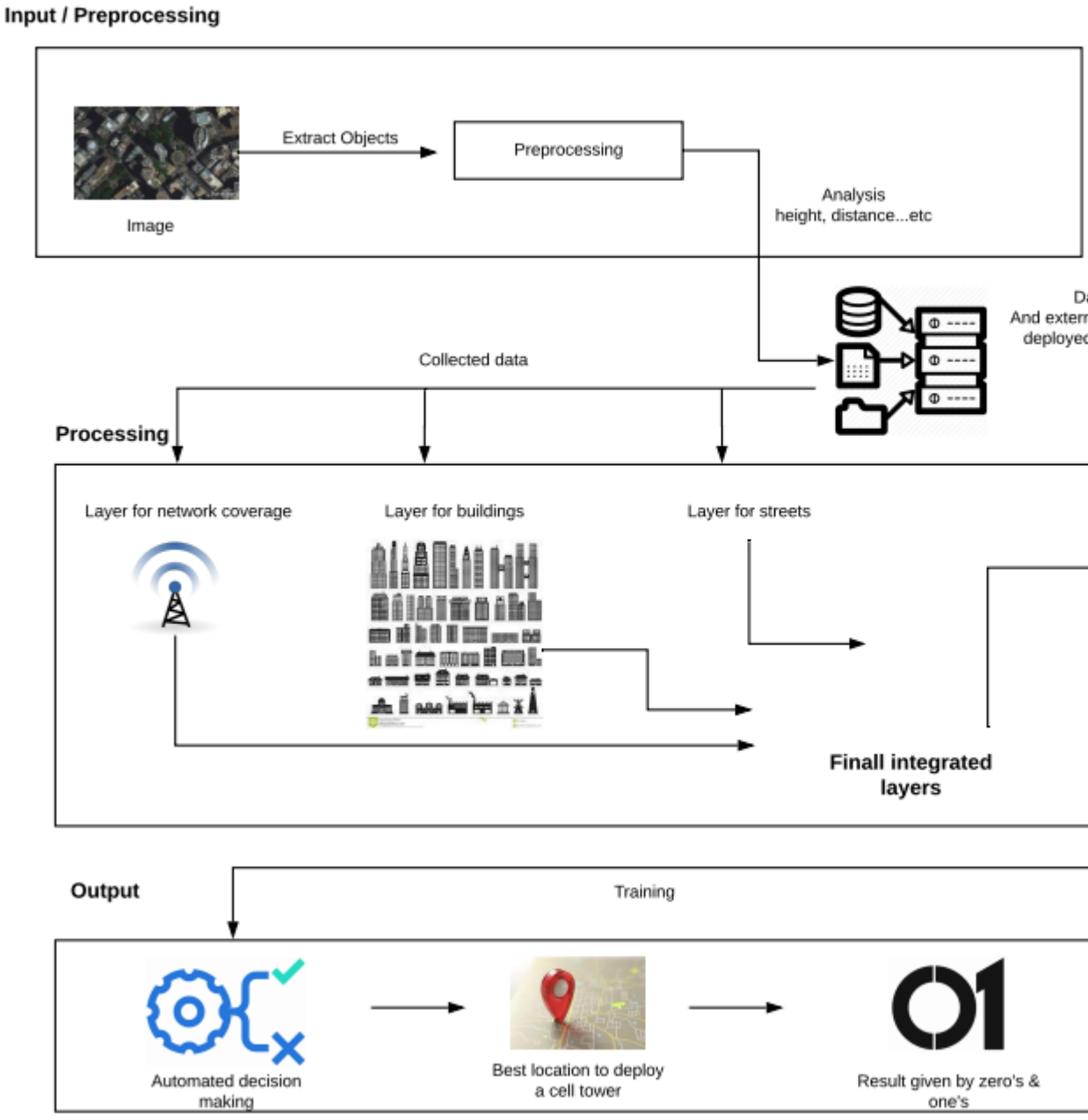

Figure 1: Overview

Task	Start Date	End Date
Choosing topic	26-7-2019	10-9-2019
Demo code	10-9-2019	1-10-2019
Proposal document	1-10-2019	7-10-2019
Proposal presentation	8-10-2019	8-10-2019
prototype	9-10-2019	9-11-2019
Dataset collection	10-11-2019	15-11-2019
Dataset classification	16-11-2019	20-11-2019
SRS writing	21-11-2019	10-12-2019
SRS presentation	Second week of dec	Second week of dec
Implementing app	15-12-2019	30-1-2020
SDD writing	1-2-2020	10-2-2020
SDD presentation	Second week of feb	Second week of feb
Prototype evaluation	3 days after midterms	3 days after midterms
Writing paper	-----	-----
Deliver the paper	2nd sem	2nd sem
Writing thesis	21-6-2020	30-6-2020
Final presentation	24-6-2020	24-6-2020

Figure 2: Figure 3 : Task and Time Plan