



Route optimization for NADRA Mobile Registration Van (MRV) for Karachi

MUHAMMAD ARSHAD¹, GHAZALA GUL JUNEJO¹, SYEDA HIRA FATIMA NAQVI¹, FIDA H. KHOSO², MARYAM GHORI¹, HIDAYATULLAH SHAIKH³

¹Department of Computer Science, Sindh Madarsatul Islam University, Karachi

²Dawood University of Engineering and Technology (DUET), Karachi

³Department of Computer Science, Shah Abdul Latif University Khairpur

Cite this:

Muhammad A, G.G. Junejo, SHF Naqvi, FH Khoso, M. Gori and H. Shaikh (2022). Route optimization for NADRA mobile registration van (MRV) for Karachi. Sindh Uni. Res.J. (SS) 54:3 2022.

Corresponding author

PCS21F004@stu.smiu.edu.pk

Abstract

Optimization is the ability of the computers when multiple destinations are available and one of the easiest and shortest paths has to be obtained where the human being failed to solve the problem. Many people find a challenging task to find out NADRA registration center and, in this case, NADRA has started a mobile registration van in which a vehicle has to visit various routes for the registration of CNIC. Various teams are asked to visit sites and provide services to common people. During this journey the teams have to go to multiple locations, and, in this case, repetition may occur, more fuel has to be consumed so time is consumed. In this paper, a GUI-based integrated application has been created in which Genetic Algorithm (GA) has been used to find out the optimal path for the NADRA mobile registration van. The registration teams were given the optimal path or the shortest path so that they can visit the shortest route and save fuel and time. The study can be extended to compare other optimization algorithms and the scheme can be extended to further districts or provinces of Pakistan.

Keywords: NADRA, Mobile Registration Van, Optimization, Genetic Algorithm.

Introduction

Artificial intelligence has the property which helps machines to behave like a human beings and provides platforms to do human tasks. Machines make human tasks easy (Nayak, & Vathasavai, 2017; Coit, & Smith, 1996). Optimization or finding the best-suited path is one of the major areas where a human being is not good enough to find an accurate and optimized path when there are multiple destinations (Maulik, & Bandyopadhyay, 2000). Optimization algorithms namely Genetic Algorithms, and E-Harmony are special-purpose algorithms to provide efficiency and accuracy which may not be available or possible by a human being. The optimization algorithms have many applications where that perform to extract the best-suited solutions. One of the applications is the NADRA's newly introduced Mobile Registration Vans (MRV) to dedicate for visiting various places for the issue of national identity cards for the people of Pakistan. The MRV visits various sites on the union council wise in a particular district and then in this way sometimes the MRV has to visit the same place, or the repetition is possible to the same place. Because of such repetition, much of the fuel and time of the MRV team is wasted and efficiency is degraded. In integrated optimization, an algorithm-based application is designed to provide a solution that can be visualized graphically.



Copyright: © 2022 by the authors. This is an open access publication published under the terms and on conditions of the Creative Commons attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

Karachi is the capital city of Sindh province of Pakistan. Karachi is a division in administrative units and is further divided into seven districts. These districts are further divided into 18 towns and finally, the towns are segmented into 178 Union Councils. The total number of Union Councils (UCs) in the Karachi division in all of the seven districts is 178 (<https://en-academic.com/dic.nsf/enwiki/4780380>).

Assessing the multiple selections or the choices and the extraction or finding the best-suited option is called optimization (Thomas et al., 2021; Jianchun et al., 2021). Many successful applications and implementations have been reported in the literature including wireless sensor networks (Shuang, et al., 2021), Medical Image Retrieval (Dhupam et al., 2021; Haifeng, et al., 2021), Medical diagnosis (Mohammed, et al., 2022; Hao-yu Liao, et al., 2021), wireless body area networks (Monica, et al., 2021), m-health (Abeer et al., 2020), and others. Genetic Algorithm (GA) (Alba & Fernando, 2021; Muhammad et al., 2021), Artificial Bee Colony (ABC) (Tunchan, 2021; Alireza, et al., 2021), and others are the more common algorithms used for optimization. The GA algorithm is considered as the heuristic AI algorithm which copies the natural selection, and these natural selection solutions are presented in optimization solutions. Natural selection and its optimization problems are solved by Genetic Algorithms, especially with the bigger classes. The Genetic algorithm in Software Engineering is a copy of the organic calculating algorithm that was tossed once in 1859 by British scientist Charles Darwin (Michalewicz, 1992), the GA in Software Engineering has been proposed by Professor John Holland from the USA in which the Genetic algorithm is used in software Engineering Calculations in the field of Artificial Intelligence (Yildirim et al., 2008). The purpose of this paper is to develop a GUI-based integrated application using Genetic Algorithm (GA) to find out the optimal path for the NADRA mobile registration van.

Materials and Methods

System Model

The system contains a scenario of 178 union councils of Karachi city plotted on the plane showing x coordinates and y coordinates. The UCs are shown as the points on the plane as shown in Figure 1(a), where the UCs are shown as the blue points on the plane. The main parameters of the GA have been extracted and used after some of the modifications and merging. The model has been simulated on MATLAB 2020.

GA as an optimization algorithm

The Genetic Algorithm has been fine-tuned and used with adjusted parameters by using the N number of Union Councils, in the case of the current study the N has been used as one hundred seventy-eight. A number of repetitions have been represented as γ ,

status and the initial values have been represented as $\phi_{initial}$, path optimization has been represented as P_{optim} . Maximum paths have been created when a number of union councils are to visit by the NADRA Mobile Registration Van and the optimal route has been selected so that the fuel can be less consumed and time can be saved, in this way the repetition of the MRV can be avoided. The Genetic Algorithms and the fine-tuned operators will find the efficient way in which the MRV will save fuel and time.

Results & Discussion

The Union councils have been plotted and simulated and the optimal path has been found using Genetic

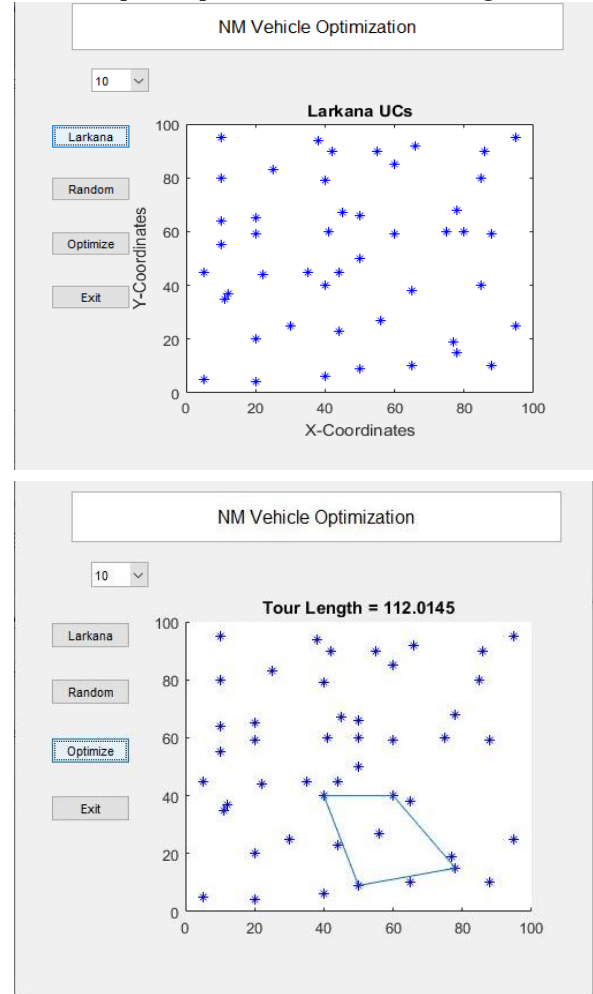


Figure 1. (a) Initial plotting of UCs (b) initial start from random site.

Algorithm using modified parameters. Figure 2 (a), (b) and Figure 3(a), (b), show the process of finding optimal path from available paths.

Figure 2 (a), (b) show the process of optimization using GA and Figure 3 (a) also show the process of optimization, whereas 3 (b) show the final tour of the NADRA mobile registration van and the final tour

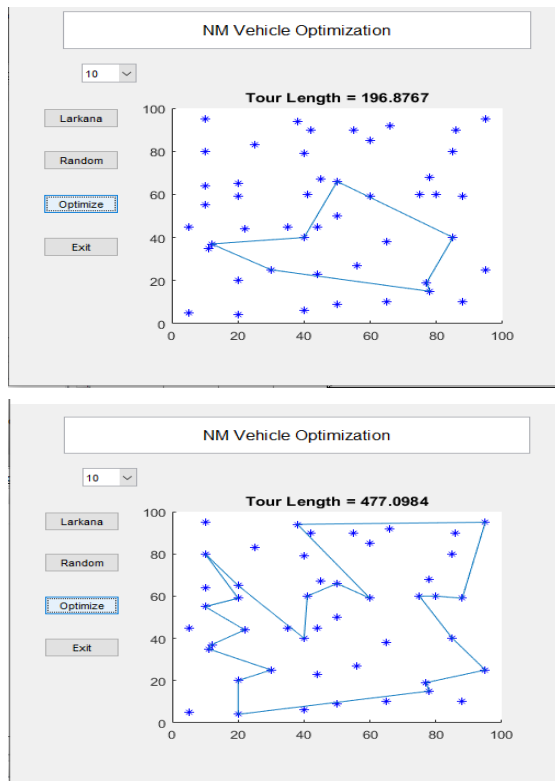


Figure 2. (a) & (b) Optimization of 178 UCs in progress.

length has been recorded as 608.2894Km. The found optimal path is still has be more optimized so in this case Figure 4 shows the further optimized path in which the distance is shown as 588.8044Km.

Conclusion

NADRA registration officers or the teams are required to visit various locations in Karachi city to facilitate common people for the issue of their computerized national identity card. The Union councils are having the differentiating distances among the routes. The van must find the optimal path without repetition, so that the fuel and time can be saved. The problem is typical and very difficult for human being and for the solution GA has been used. The GUI based application has been created to find the easiest and shortest path. The registration teams are given optimized or easiest and shortest paths so that they can visit easily along with saving of fuel and time. The current study can be extended by implementing or extending the study using various other state of the art optimization algorithms. The study can also be extended to other districts or provinces of Pakistan.

References

Abeer Al-Maridi, Amr Mohamed, Aiman Erbad (2020). AI-based techniques on edge devices to optimize energy efficiency in m-Health applications, Editor(s): Amr Mohamed, Energy

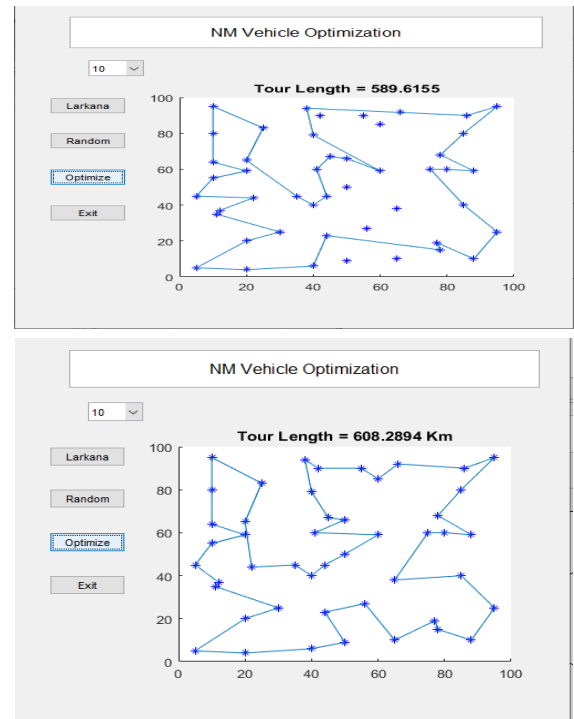


Figure 3. (a) Optimization in progress (b) Final Tour Length

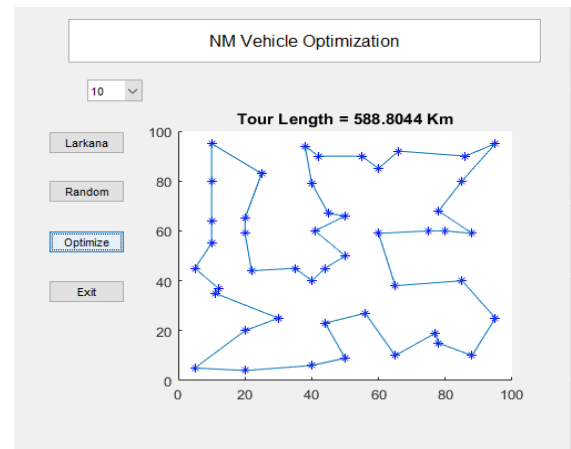


Figure 4. More optimized Tour length in terms of distance

Efficiency of Medical Devices and Healthcare Applications, Academic Press, 2020, Pages 1-23, ISBN 9780128190456, <https://doi.org/10.1016/B978-0-12-819045-6.00001-7>.

Alba Muñoz, & Fernando Rubio (2021). Evaluating genetic algorithms through the approximability hierarchy, Journal of Computational Science, Volume 53, 2021, 101388, ISSN 1877-7503, <https://doi.org/10.1016/j.jocs.2021.101388>.

Alireza Gholami, Hamid Khoshdast, Ahmad Hassanzadeh (2021). Applying hybrid genetic and artificial bee colony algorithms to simulate

- a bio-treatment of synthetic dye-polluted wastewater using a rhamnolipid biosurfactant, *Journal of Environmental Management*, Volume 299, 2021, 113666, ISSN 0301-4797, <https://doi.org/10.1016/j.jenvman.2021.113666>.
- Coit, D. W., & Smith, A. E. (1996). Reliability optimization of series-parallel systems using a genetic algorithm. *IEEE Transactions on reliability*, 45(2), 254-260.
- Dhupam Bhanu Mahesh, Gorti Satyanarayana Murty, D. Rajya Lakshmi (2021). Optimized Local Weber and Gradient Pattern-based medical image retrieval and optimized Convolutional Neural Network-based classification, *Biomedical Signal Processing and Control*, Volume 70, 2021, 102971, ISSN 1746-8094, <https://doi.org/10.1016/j.bspc.2021.102971>.
- Haifeng Wang, Daehan Won, Sang Won Yoon (2021). An adaptive neural architecture optimization model for retinal disorder diagnosis on 3D medical images, *Applied Soft Computing*, Volume 111, 2021, 107686, ISSN 1568-4946, <https://doi.org/10.1016/j.asoc.2021.107686>.
- Hao-yu Liao, Willie Cade, Sara Behdad (2021). Markov chain optimization of repair and replacement decisions of medical equipment, *Resources, Conservation and Recycling*, Volume 171, 2021, 105609, ISSN 0921-3449, <https://doi.org/10.1016/j.resconrec.2021.105609>.
- <https://en-academic.com/dic.nsf/enwiki/4780380>
Available online, (Accessed on 12th November, 2021).
- Jianchun Xu, Wenxin Zhou, Hangyu Li, Xiaopu Wang, Shuyang Liu, Ling Fan (2021). Stochastic simplex approximation gradient for reservoir production optimization: Algorithm testing and parameter analysis, *Journal of Petroleum Science and Engineering*, 2021, 109755, ISSN 0920-4105, <https://doi.org/10.1016/j.petrol.2021.109755>.
- Maulik, U., & Bandyopadhyay, S. (2000). Genetic algorithm-based clustering technique. *Pattern recognition*, 33(9), 1455-1465.
- Michalewicz Z., *Genetic algorithms + data structures = Evolution programs*. 1992.
- Mohammed Alweshah, Saleh Alkhalaileh, Mohammed Azmi Al-Betar, Azuraliza Abu Bakar (2022). Coronavirus herd immunity optimizer with greedy crossover for feature selection in medical diagnosis, *Knowledge-Based Systems*, Volume 235, 2022, 107629, ISSN 0950-7051, <https://doi.org/10.1016/j.knsys.2021.107629>.
- Monica Kaushik, Sindhu Hak Gupta, Vipin Balyan (2021). An approach to optimize performance of CM3A cooperative WBAN operating in UWB, *Sustainable Computing: Informatics and Systems*, Volume 30, 2021, 100523, ISSN 2210-5379, <https://doi.org/10.1016/j.suscom.2021.100523>.
- Muhammad Sohaib Ajmal, Zeshan Iqbal, Farrukh Zeeshan Khan, Muneer Ahmad, Iftikhar Ahmad, Brij B. Gupta (2021). Hybrid ant genetic algorithm for efficient task scheduling in cloud data centers, *Computers & Electrical Engineering*, Volume 95, 2021, 107419, ISSN 0045-7906, <https://doi.org/10.1016/j.compeleceng.2021.107419>.
- Nayak, P., & Vathasavai, B. (2017). Genetic algorithm based clustering approach for wireless sensor network to optimize routing techniques. In *2017 7th International Conference on Cloud Computing, Data Science & Engineering-Confluence* (pp. 373-380). IEEE.
- Shuang Liang, Zhiyi Fang, Geng Sun, Chi Lin, Jiahui Li, Songyang Li, Aimin Wang (2021). Charging UAV deployment for improving charging performance of wireless rechargeable sensor networks via joint optimization approach, *Computer Networks*, Volume 201, 2021, 108573, ISSN 1389-1286, <https://doi.org/10.1016/j.comnet.2021.108573>.
- Thomas Kleinert, Julian Manns, Martin Schmidt, Dieter Weninger (2021). Pre-solving Linear Bi-level Optimization Problems, *EURO Journal on Computational Optimization*, 2021, 100020, ISSN 2192-4406, <https://doi.org/10.1016/j.ejco.2021.100020>.
- Tunchan Cura, (2021). A rapidly converging artificial bee colony algorithm for portfolio optimization, *Knowledge-Based Systems*, Volume 233, 2021, 107505, ISSN 0950-7051, <https://doi.org/10.1016/j.knsys.2021.107505>.
- Yıldırım K. S., T. E. Kalaycı, and A. Uğur (2008). "Optimizing Coverage in a K-Covered and Connected Sensor Network Using Genetic Algorithms," *Proc. 9th WSEAS Int. Conf. Evol. Comput.*, pp. 21–26, 2008.