



**BUSITEMA  
UNIVERSITY**  
*Pursuing Excellence*

P.O. Box 236, Tororo, Uganda  
Gen: +256 - 45 444 8838  
Fax: +256 - 45 4436517  
Email: [info@adm.busitema.ac.ug](mailto:info@adm.busitema.ac.ug)

[www.busitema.ac.ug](http://www.busitema.ac.ug)

**FACULTY OF ENGINEERING**

**DEPARTMENT OF COMPUTER ENGINEERING**

**AN AUTOMATIC ILLEGAL PARKING DETECTION AND  
ALERTING SYSTEM: A CASE STUDY OF GULU CITY**

**BY**

**ANGULO ISAAC**

**REG.NO: BU/UP/2018/2910**

**EMAIL: [isaacangulo544@gmail.com](mailto:isaacangulo544@gmail.com)**

**TEL: 0785730652 / 0756431452**

**SUPERVISOR: MR. ALUNYU ANDREW**

A FINAL YEAR PROJECT SUBMITTED TO THE DEPARTMENT OF  
COMPUTER ENGINEERING IN PARTIAL FULFILLMENT FOR THE AWARD OF A  
BACHELOR OF SCIENCE DEGREE IN COMPUTER ENGINEERING AT

**BUSITEMA UNIVERSITY**

**JANUARY 2023**

## **ACKNOWLEDGEMENT**

My supervisor, Mr. Alunyu Andrew has been a vital requirement in helping achieve this project report. Thank you so much for the aid offered to me.

Many fellow students offered help in form of advice and information and it is also greatly recognized.

Special thanks to my family for their never ending financial and advisory support. May God reward them abundantly.

Above all, I acknowledge the Almighty God for the gift of life, wisdom and guidance. For without Him, I would not have been able to accomplish this project report.

## **ABSTRACT**

This project presents an automatic illegal parking detection and alerting system, a case study of Gulu city. In Uganda, whether in cities or towns, illegal parking of vehicles is becoming a common vice. According to the Independent magazine, Christopher Balmoi Omara, Gulu city engineer, says the current traffic mess along the busy streets is due to bad road design that do not provide parking spaces and added that some of the parking spaces being used are meant for bicycle lane and pedestrian walkways as the errant motorists park in ungazetted places. With the increasing population, they realized the need for parking, and a study was undertaken that gave a number of proposals on addressing the current traffic challenges which include turning some of the streets into one-way and banning the parking of vehicles on other streets and the city council will partner with city investors to designate parking ground incase parking is completely prohibited in some streets[5].

As vehicles are banned from parking on some streets, there is need monitor and control illegal parking of vehicles in these streets in order to enforce the measures to curb the current traffic challenges in the city.

The developed system allows for automatic detection and alerting of illegal vehicle parking so that the authorities can keep track of vehicle parking at prohibited places.

## DECLARATION

I **ANGULO ISAAC BU/UP/2018/2910** declare that this report is original and has not been published or submitted before to any university or higher institution of learning.

Sign..... *Angulo* .....

Date..... *30<sup>th</sup> January, 2023* .....

## DEDICATION

I dedicate this report to my Great God, beloved parents, friends, lecturers and all the classmates for their contributions towards the journey of achieving my degree in Computer Engineering.

Sign..... *Angulo* .....

Date..... *30<sup>th</sup> January, 2023* .....

## **APPROVAL**

This dissertation Report has been submitted with the approval of the following supervisor.

**Supervisor: MR. ALUNYU ANDREW**

Sign:  .....

Date: .....30th January 2023.....

**Department of Computer Engineering**

**Faculty of Engineering**

## **LIST OF ABBREVIATION AND ACRONYMS**

<b>SHOG-SVM</b>	Sketched Histogram of Oriented Gradient-Support Vector Machine
<b>SSD</b>	Single Short Multibox Detector
<b>AC</b>	Alternating Current
<b>DC</b>	Direct Current
<b>LED</b>	Light Emitting Diode
<b>PWM</b>	Pulse Width Modulation
<b>ICSP</b>	In-Circuit Serial Programming
<b>RFID</b>	Radio Frequency Identification
<b>IDE</b>	Integrated Development Environment
<b>GSM</b>	Global System for Mobile Connection
<b>SIM</b>	Subscriber Identity Module
<b>LCD</b>	Liquid Crystal Display
<b>i-LIDs</b>	Imaginary Library for Intelligent Detection Systems.
<b>2-D</b>	2-Dimension
<b>ROI</b>	Region of Operation
<b>ID</b>	Identification
<b>COVID-19</b>	Coronavirus Disease 2019
<b>URA</b>	Uganda Revenue Authority

## TABLE OF FIGURES

Figure 1: Block Diagram (Conceptual Design for the system).....	14
Figure 2: Flow chart.....	19
Figure 3: Arduino Nano .....	20
Figure 4: MFRC522 RFID.....	21
<i>Figure 5: GSM SIM800L module</i> .....	21
Figure 6:Jumper wires.....	22
Figure 7:Light Emitting Diodes .....	22
Figure 8:LCD with I <sup>2</sup> C module.....	23
Figure 9:Female Header pins .....	23
Figure 10: Buzzer.....	24
Figure 11: Circuit Diagram .....	25

## TABLE OF CONTENTS

<b>CHAPTER ONE: INTRODUCTION</b> .....	1
<b>1.0 Background</b> .....	1
<b>1.1 Problem Statement</b> .....	3
<b>1.2 Objectives</b> .....	4
<b>1.2.1 Main objective</b> .....	4
<b>1.2.2 Specific objectives</b> .....	4
<b>1.3 Justification</b> .....	4
<b>1.4 Significance</b> .....	4
<b>1.5 Scope of Study</b> .....	5
<b>1.5.1 Geographical scope</b> .....	5
<b>1.4.3 Time scope</b> .....	5



<b>2.0 INTRODUCTION.....</b>	<b>6</b>
<b>2.1 Related systems .....</b>	<b>6</b>
<b>2.1.1 Manual system.....</b>	<b>6</b>
<b>2.1.4 Detection and identification of illegally parked vehicles at No parking area. ....</b>	<b>7</b>
<b>CHAPTER THREE: METHODOLOGY.....</b>	<b>11</b>
<b>3.0 INTRODUCTION.....</b>	<b>11</b>
<b>3.1.1 Literature review.....</b>	<b>11</b>
<b>3.1.3 Consultation.....</b>	<b>11</b>
<b>3.2 Requirements analysis .....</b>	<b>11</b>
<b>3.2.1 Functional Requirements .....</b>	<b>12</b>
<b>3.2.2 Non-functional requirements .....</b>	<b>12</b>
<b>3.3 SYSTEM DESIGN AND DEVELOPMENT .....</b>	<b>12</b>
<b>3.3.1 Hardware tools .....</b>	<b>12</b>
<b>3.3.2 Software tools .....</b>	<b>14</b>
<b>3.3.3 Proposed Conceptual Design for The System.....</b>	<b>14</b>
<b>3.4 VALIDATION AND TESTING .....</b>	<b>15</b>
<b>3.4.1 Unit testing.....</b>	<b>15</b>
<b>3.4.2 Integration Testing .....</b>	<b>15</b>
<b>3.4.3 System Testing.....</b>	<b>15</b>
<b>3.4.4 Validation.....</b>	<b>15</b>
<b>CHAPTER FOUR: SYSTEM ANALYSIS AND DESIGN.....</b>	<b>16</b>
<b>4.1 Introduction.....</b>	<b>16</b>
<b>4.2 System Analysis .....</b>	<b>16</b>
<b>4.2.1 Functional analysis.....</b>	<b>16</b>
<b>4.2.2 Requirements analysis .....</b>	<b>16</b>
<b>4.2.2.1 Functional requirements .....</b>	<b>17</b>

4.2.2.2 Nonfunctional requirements.....	17
4.3 System design and analysis .....	17
4.3.1 Software analysis.....	18
4.3.2 Hardware analysis.....	18
4.3.3 Logical design of the system.....	19
4.3.5 Components used in hardware design.....	20
4.3.7 Circuit Diagram .....	24
<b>CHAPTER FIVE: IMPLEMENTATION AND TESTING AND VALIDATION.....</b>	<b>26</b>
5.0 Introduction.....	26
5.1 Breadboard components assembling.....	26
5.2 System development platforms.....	26
5.2.1 Circuit.io .....	26
5.2.2 Arduino .....	26
5.3 Code Designs.....	26
5.4 System evaluation.....	27
5.5 System Validation.....	27
5.6 System testing .....	27
5.7 Soldering on printed circuit board (PCB). .....	27
5.8 Continuity testing.....	28
<b>CHAPTER SIX: DISCUSSION AND RECOMMENDATIONS.....</b>	<b>29</b>
6.1 Introduction.....	29
6.2 Relevance of Findings .....	29
6.3 Appraisal of the Work.....	29
6.4 Recommendations .....	29
6.5 Challenges.....	30
6.6 Conclusion .....	30

## **CHAPTER ONE: INTRODUCTION**

### **1.0 Background**

Vehicle parking is the act of bringing a vehicle that one is driving to a halt and leaving it temporarily in a car park or by the roadside. Illegal parking of vehicles involves parking vehicles in unauthorized places without permission. Unauthorized parking places are any other places other than the gazetted areas where vehicles can park yet they are not allowed to.

The population in developing countries like Uganda is increasing and so the need for means of transportation within the limited road network. Uganda's current population is 48,632,034 people and is expected to grow by 2.71% by the year 2025 and 2.59% by year 2035[1]. With the increasing population, there is going to be more need for goods and services leading to an increasing number of vehicles on the road to do the transportation of goods and services. The number of vehicles on the Ugandan roads increased by over 500,000(100%) in the last 20 years [2]. According to URA estimates, there were 635,656 vehicles in Uganda by 2011, which is an increase from 50,102 in 1991[2]. As already noted, according to the statistics from the Ministry of Works and Transport as of June 2020, the estimated number of vehicles in Uganda stood at 2.3 million [3].

Also in Uganda with many municipalities attaining the state of a city as of July 1 2020 for example Arua, Gulu, Jinja, Mbarara, Fort Portal, Mbale, and Masaka[4], the volume of vehicle traffic on the streets has increased ever since yet the road infrastructure is not well planned for, as the streets are narrow and have not many places that have been gazetted for parking leading to parking in ungazetted places hence the need to map/provide more legal parking space for these vehicles. Gulu attained city status in July 2020 and has since witnessed an increased volume of traffic[5].

Christopher Balmoi Omara, Gulu city Engineer says the current traffic mess along the busy streets is due to bad road designs that do not provide parking spaces. Omara says most of the double lane streets don't have the provision of parking vehicles adding that some of the parking spaces being used were initially meant for bicycle lane and pedestrian walkways. He notes that with the growing population, they realized there is need for parking which forced them to undertake a study that

## References

- [1] “Uganda population(2022)-Worldometer.” <https://www.worldometers.info/world-population/uganda-population/> (accessed Jul. 13, 2022).
- [2] J. Ogwang, “The New Vision.” [Online]. Available: <https://allafrica.com/stories/201101120130.html#:~:text=THE number of vehicles plying,increase from 50%2C102 in 1991.>
- [3] “STUDY REPORT STATUS OF MOTOR VEHICLE INSURANCE IN UGANDA,” 2020. Accessed: Jul. 13, 2022. [Online]. Available: [https://ira.go.ug/cp/uploads/STATUS OF MOTOR VEHICLE INSURANCE IN UGANDA \(1\).pdf](https://ira.go.ug/cp/uploads/STATUS OF MOTOR VEHICLE INSURANCE IN UGANDA (1).pdf)
- [4] “Municipalities become cities,” *The Independent*, 2020. [Online]. Available: <https://www.independent.co.ug/municipalities-become-cities/>
- [5] “Gulu city to designate one-way streets to curb traffic mess,” *The Independent January 21, 2022*. [Online]. Available: <https://www.independent.co.ug/gulu-city-to-designate-one-way-streets-to-curb-traffic-mess/>
- [6] THE INDEPENDENT, “Truck drivers making stop overs in ungazetted places along Kampala-Gulu highway.” [Online]. Available: <https://www.independent.co.ug/truck-drivers-making-stop-overs-in-ungazetted-places-along-kampala-gulu-highway/>
- [7] X. Xie, C. Wang, S. Chen, G. Shi, and Z. Zhao, “Real-time illegal parking detection system based on deep learning,” in *ACM International Conference Proceeding Series*, Jun. 2017, vol. Part F1285, pp. 23–27. doi: 10.1145/3094243.3094261.
- [8] J. IEEE Industrial Electronics Society. Annual Conference (41st: 2015: Yokohama, Institute of Electrical and Electronics Engineers, and IEEE Industrial Electronics Society, *IECON2015: 41st Annual Conference of the IEEE Industrial Electronics Society: November 9-12, 2015, Pacifico Yokohama, Yokohama, Japan.*
- [9] Institute of Electrical and Electronics Engineers *et al.*, *International Conference on Communications and Signal Processing (ICCSP), 2014 3-5 April 2014, Melmaruvathur; proceedings.*

- [10] J. T. Lee, M. S. Ryoo, M. Riley, and J. K. Aggarwal, “Real-time illegal parking detection in outdoor environments using 1-D transformation,” *IEEE Trans. Circuits Syst. Video Technol.*, vol. 19, no. 7, pp. 1014–1024, Jul. 2009, doi: 10.1109/TCSVT.2009.2020249.
- [11] “Arduino Uno Rev3”, [Online]. Available: <https://store.arduino.cc/products/arduino-uno-rev3>
- [12] “Radio Frequency Identification”, [Online]. Available: <https://www.fda.gov/radiation-emitting-products/electromagnetic-compatibility-emc/radio-frequency-identification-rfid>