



VeroScale: A Secure and Real-Time IoT-Based System for Material Weight Data Management

UNDERGRADUATE THESIS
Submitted as one of the requirements to obtain
Sarjana Komputer (S.Kom.)

By:
Arief Maizaki
001202200147

FACULTY OF COMPUTER SCIENCE
INFORMATION SYSTEM STUDY PROGRAM
CIKARANG
AUGUST, 2025

SIMILARITY INDEX REPORT

Arief Maizaki - Thesis

ORIGINALITY REPORT

5%

SIMILARITY INDEX

4%

INTERNET SOURCES

1%

PUBLICATIONS

4%

STUDENT PAPERS

PRIMARY SOURCES

1

Submitted to President University

Student Paper

1%

2

repository.president.ac.id

Internet Source

1%

3

hal.inria.fr

Internet Source

<1%

4

Submitted to Help University College

Student Paper

<1%

5

Submitted to Pukyong National University

Student Paper

<1%

6

www.playbite.com

Internet Source

<1%

7

Submitted to University of Greenwich

Student Paper

<1%

8

Submitted to University of Westminster

Student Paper

<1%

9

David Peles, Shai Netser, Natalie Ray,
Taghreed Suliman, Shlomo Wagner.

<1%

GPT ZERO

© GPTZero Version 2025-08-22-base

Arief Report Veroscale.docx - 8/27/2025

AI Report

We predict this text is

Human Generated

AI Probability

0%

This number is the probability that the document is AI generated, not a percentage of AI text in the document.

Plagiarism



The plagiarism scan was not run for this document. Go to gptzero.me to check for plagiarism.

Arief Report Veroscale.docx - 8/27/2025

Indah Setyoningrum

VeroScale: A Secure and Real-Time IoT-Based System for Material Weight Data Management

ABSTRACT

VeroScale is a web application developed using Next.js and PostgreSQL to optimize material weighing processes in industries. The system implements role-based access control with four levels: Administrator, Manager, Marketing, and Operator. The application integrates IoT technology through RFID scanners and digital scales for real-time automation with approval workflows ensuring data validation.

Multi-layered security is implemented through JWT authentication and Arcjet protection. Responsive interface is built with Tailwind CSS for multi-device compatibility. The system shows optimal performance with 1.7-second loading time. This platform contributes to industrial digitalization through scalable solutions with complete audit trails for operational transparency.

TABLE OF CONTENTS

GPT ZERO.....	9
ABSTRACT.....	10
DEDICATION.....	11
ACKNOWLEDGMENTS.....	12
TABLE OF CONTENTS.....	13
LIST OF TABLES.....	18
LIST OF FIGURES.....	20
CHAPTER I	22
PROPOSAL.....	22
I.1 PROBLEM FORMULATION.....	22
I.1.1 Background of the Problem.....	22
I.1.2 Problem Statement.....	23
I.1.3 Objective.....	24
I.1.4 Problem from a Customer Perspective.....	24
I.2 PROBLEM CONSTRAINT ANALYSIS.....	25
I.3 PROBLEM FUNCTIONAL ANALYSIS.....	25
I.4 SOLUTION SELECTION.....	26
Alternative Solution 1: ESP-32 Based IoT System with Firebase Integration.....	26
Alternative Solution 2: Local Processing with a Raspberry Pi.....	26
Alternative Solution 3: Arduino with LoRaWAN for Remote Locations.....	27
Solution Selection: Why We Chose Solution 1.....	27
I.5 SOLUTION USAGE SCENARIOS.....	29
I.5.1 Scenario 1: Real-Time Monitoring on the Production Floor.....	29
I.5.2 Scenario 2: Quality Validation and Calibration Management.....	30
I.5.3 Scenario 3: Multi-Device Integration and Operations Scalability.....	30
I.6 DEVELOPMENT EFFORT.....	31
I.6.1 . Man-months.....	31
I.6.2 Machine-Month Allocation(Machine-months).....	32
I.6.3 Development tools.....	32
I.6.4 Test Equipment.....	32
I.6.5 Cost estimation.....	32
I.6.6 Timelines.....	34
I.7 CONCLUSION.....	35
CHAPTER II	36
SPECIFICATION.....	36
II.1 EXISTING AND PROPOSED SYSTEM.....	36
II.1.1 Existing Business Process.....	36

II.1.2 Proposed Business Process.....	38
II.2 GLOBAL DESCRIPTION OF THE PRODUCT.....	40
II.2.1 Main Functionality.....	40
II.2.2 User Characteristics.....	41
II.2.2.1 Staff Operational.....	41
II.2.2.2 Marketing.....	41
II.2.2.3 Manager.....	42
II. 2.2.4 Admin.....	42
II.2.3. Constraints.....	45
II.2.4. Product Development Environment.....	46
II.2.5. Product Operational Environment.....	47
II.3. REQUIREMENT ANALYSIS.....	49
II.3.1. Hardware Interface.....	49
II.3.2. Software Interface.....	50
II.3.3. Communication Interface.....	50
II.3.4. Functional Description.....	51
II.3.4.1. Use Case Diagram.....	51
II.3.4.2. Use Case Scenarios.....	52
II.3.5. Data Requirement from user’s perspective.....	59
II.3.5.1. ERD (Entity Relationship Diagram).....	59
II.3.5.2. Data Dictionary.....	59
Table 2.13. Role Data Dictionary Role.....	61
II.3.6. Functional Requirement from user’s perspective.....	63
II.3.6.1. Context Diagram.....	66
II.3.6.2. Activity Diagram and Data Flow Diagram.....	67
Data Flow Diagram.....	69
Describe in detail the process inside the Activity Diagram and Data flow diagram.....	71
II.3.7. Non-Functional Requirement.....	72
II.4. SPECIFICATION TESTING.....	73
II.4.1. Performance Testing.....	73
II.4.2. Usability Testing.....	74
CHAPTER III	75
DESIGN.....	75
III.1 ALTERNATIVE SOLUTION DESIGN.....	75
III.1.1 A Secure and Real-Time IoT-Based System for Material Weight Data Management.....	75
III.1.1.1. User Roles Block:.....	76
III.1.1.2. `Data Collection Block (Data Collection):.....	77
III.1.1.3. Data Processing Block:.....	77
III.1.1.4. VeroScale IoT Integration Module:.....	77

III.1.1.5. Response Group Block (Response Group):.....	77
III.1.2 Local Processing with a Raspberry Pi.....	77
III.1.2.1 User Roles and Data Collection Blocks:.....	79
III.1.2.2 Processing Unit:.....	79
III.1.2.3 Response Group Block (Response Group):.....	79
III.1.3 Arduino with LoRaWAN for Remote Locations.....	79
III.1.3.1 Processing Unit:.....	81
III.1.3.2 Block Output (Output):.....	81
III.2. RATIONAL/SYSTEMATIC DESIGN.....	82
III.2.1. Comparison Table.....	82
III.2.2. Quantitative Solution Selection.....	83
III.2.3. Solution Selection.....	84
III.3. HIERARCHICAL/ITERATIVE DESIGN.....	86
III.3.1. Data Flow Diagram of VeroScale.....	86
Data Flow Diagram Level 0.....	86
Data Flow Diagram Level 1.....	87
III.3.2. Global Variable / Message Passing Interface.....	87
III.3.3. Scrum Methodology Implement steps in Software Engineering Design.....	91
III.3.2. Provide the details of component references and libraries used.....	96
III.3.2.1. Frontend Components.....	96
III.3.2.4. Supporting Tools & Environment.....	96
III.3.4. Provide clear and correct modelling by using existing modelling standards.....	97
III.3.4.1. Use Case Diagram.....	97
III.3.4.2. Activity Diagram.....	98
III.3.4.3. Data Flow Diagram.....	100
III.3.4.5. Entity Relationship Diagram.....	101
III.4. VERIFICATION DEMONSTRATION AND PROOF OF DESIGN PROCESS.....	101
III.4.1. Simulation Scenario.....	102
III.4.2. Simulation Result.....	102
III.4.3. Discussion and explanation based on the simulation results.....	103
III.5. STANDARDS USED.....	103
III.6. IMPLEMENTATION AND TESTING PLANS.....	105
1. Gantt Chart: Project Timeline.....	105
CHAPTER IV	107
IMPLEMENTATION.....	107
IV.1 DESIGNS IMPLEMENTATION.....	107
IV.1.1 Functions/Procedure/Class implementation.....	107
IV.1.1.1 RBAC (Role Based Access Control).....	110
IV.1.2 Database implementation.....	115
Database System: PostgreSQL/Supabase.....	115

IV.1.3 Integration Module.....	116
IV.1.4 Implementation Verification.....	121
IV.2 PRODUCT DISPLAY.....	122
IV.2.1 Software Product Display.....	122
Figure 4.26. Issues Pages.....	130
IV.3 COMPONENT COST ANALYSIS.....	132
IV.4 MANUAL GUIDE.....	133
IV.4.1 SYSTEM BUILD DOCUMENTATION FROM THE SOURCE (Developer Perspective).....	133
A. Clone the Repository.....	133
B. Install Dependencies.....	133
C. Configure Environment Variables.....	133
IV.4.2 SYSTEM INSTALLATION (Hardware, Software, Network installation from the user perspective).....	134
Minimum Hardware Requirements (server):.....	134
Minimum Hardware Requirements (client/user):.....	134
Software Requirements:.....	135
IV.4.3 User Guide per User Role.....	137
IV.5 VIDEO DEMONSTRATION.....	144
Provide links to your video demonstration. The video must contain:.....	144
IV.5.1 How to build a system.....	144
IV.5.2 How to install the system.....	144
IV.5.3 How to use the system.....	144
CHAPTER V	145
V.1 RESTATE THE PROBLEM AS STATED IN THE FORM 1 DOCUMENT.....	145
V.1.1 Background of the Problem.....	145
V.1.2 Problem from a Customer Perspective.....	146
V.2 RESTATE THE SPECIFICATIONS STATED IN THE F-200 DOCUMENT.....	147
V.2.1 Main Functionality.....	147
V.2.2 User Characteristics.....	148
Staff Operational.....	148
Marketing.....	149
V.2.3 Constraints.....	152
V.2.4 Product Development Environment.....	153
V.2.5 Product Operational Environment.....	154
V.3 FUNCTIONAL TESTING.....	155
V.3.1 Testing results of every function in the specification.....	155
V.3.1.1.1. Problem Functional Analysis (Based on F100 – Problem Functional Analysis).....	155
V.3.2 Present qualitative testing.....	165

Result of User Acceptance Test.....	166
Conclusion.....	168
V.3.3 Detail the test procedures that are carried out according to the design.....	168
V.3.4 Procedures for the demo are created and verified.....	168
V.4 TESTING OTHER SPECIFICATION.....	169
V.4.1 Non-functional specifications.....	169
Performance.....	169
Usability.....	170
User Authentication and Role Based Access Control.....	171
Compatibility.....	173
V.4.2 A photo/recording of the test is shown in the document.....	174
REFERENCES.....	188

LIST OF TABLES

Table 1.1 Alternative Solutions.....	29
Table. 1.2 Man-months.....	31
Table 1.3. Cost estimation.....	33
Table 2.1. User Characteristics.....	45
Table 2.2. Constraints.....	46
Table 2.3. Product development environment.....	47
Table 2.4. Product Operational Environment.....	48
Table 2.5. Hardware Interface.....	50
Table 2.6. Software Interface.....	50
Table 2.7. Communication interface.....	51
Table 2.8. Weighing Data Verification.....	54
Table 2.9. Weighing and Data Recording Use Case.....	55
Table 2.10. . Weighing Data Verification.....	56
Table 2.11. Supporting Data Management.....	58
Table 2.12. User Data Dictionary User.....	60
Table 2.13. Weight_Record Data Dictionary Weight Record.....	62
Table 2.14. Session Data Dictionary Session.....	63
Table 2.15. Ref_Item Data Dictionary Ref Item.....	63
Table 2.16. Non-Functional Requirement.....	73
Table 2.17. Performance Testing.....	73
Table 2.17. Usability Testing.....	74
Table 3.1. Solution Comparison.....	83
Table 3.2. Alternative Solution 1.....	83
Table 3.3. Alternative Solution 3.....	84
Table 3.4. Solution Selection.....	84
Table 3.5 Scale Data Processing Flow Table.....	89
Table 3.6, Inter-Component Interaction Table (Message Passing Interface).....	90
Table 3.7. Security and Authentication Workflow Table.....	91
Table 3.8 User Interaction Table with System Data.....	91
Table 3.9. Scrum Team Composition and Roles Table.....	93
Table 3.10. Product Backlog.....	95
Table 3.11. Frontend Components.....	96
Table 3.14. Supporting Tools & Environment.....	97

Table 3.15 Simulation Result.....	103
Table 3.16 Standards Used.....	104
Table 4.1 Implementation Verification.....	122
Table 4.2 COMPONENT COST ANALYSIS.....	132
Table 5.1 User Characteristics.....	152
Table 5.2 Constraints.....	153
Table 5.3 Product Development Environment.....	154
Table 5.4 Product Operational Environment.....	155
Table 5.5 Problem Functional Analysis.....	156
Table 5.6 Functional Requirement Testing Result.....	161
Table 5.7 Specification Testing.....	165
Table 5.8 Performance Testing Result.....	170
Table 5.9 User Authentication Testing Result.....	173
Table 5.10 Compatibility Testing Result.....	174
Table 5.11. Pictures of Testing Results.....	187

LIST OF FIGURES

Figure 1.1. Timeline.....	34
Figure 2.1. Figure Existing Business Process.....	36
Figure 2.2. Figure Proposed Business Process.....	38
Figure 2.3. Use Case Diagram.....	52
Figure 2.4. Entity Relationship Diagram.....	59
Figure 2.5. Context Diagram.....	66
Figure 2.6. Activity Diagram.....	67
Figure 2.7. Activity Diagram.....	68
Figure 2.7. Data Flow Diagram.....	70
Figure 3.1. Block diagram level 0 alternative 1.....	76
Figure 3.1. Block Diagram Level 1 Alternative 1.....	76
Figure 3.3. Block diagram level 0 alternative 2.....	78
Figure 3.4. Block diagram level 1 alternative 2.....	78
Figure 3.5 .Block diagram level 0 alternative 3.....	80
Figure 3.6. Block diagram level 1 alternative 3.....	80
Figure 3.7 Data Flow Diagram Level 0.....	86
Figure 3.8 Data Flow Diagram Level 1.....	87
Figure 3.9 Use Case Diagram.....	97
Figure 3.10 Activity Diagram.....	98
Figure 3.11 Activity Diagram.....	100
Figure 3.12 Data Flow Diagram.....	100
Figure 3.13. Entity Relationship Diagram.....	101
Figure 3.14 IGantt Chart: Project Timeline.....	105
Figure 3.15. S-chart Diagram.....	106
Figure 4.1. Functions/Procedure/Class implementation.....	107
Figure 4.2 Code JSON Web Token.....	110
Figure 4.3. Password Hashing.....	111
Figure 4.3. Session & Token Management.....	112
Figure 4.4. Environment Variables.....	112
Figure 4.5. Weight Data Entry & Real-Time Data.....	113
Figure 4.6. Database & API Abstraction.....	114
Figure 4.7. Database implementation.....	115
Figure 4.8. Integration Module.....	117

Figure 4.9. Authentication and Token Verification.....	118
Figure 4.10. Role-Based Data Access Control.....	119
Figure 4.11. Sample Management and Weight Tracking.....	119
Figure 4.12. User Session and Activity Logging.....	120
Figure 4.13. User Session and Activity Logging.....	120
Figure 4.14. User Session and Activity Logging.....	120
Figure 4.15. Login Page.....	123
Figure 4.16. Main Page / Dashboard.....	124
Figure 4.17 . .Dashboard Sections.....	125
Figure 4.18. Samples Sections.....	126
Figure 4.19 Modal form to add.....	126
Figure 4.20 Modal form to add.....	126
Figure 4.21 Delete confirmation.....	126
Figure 4.22. Weight Records Sections.....	127
Figure 4.23. My Records.....	128
Figure 4.24. Record Details.....	128
Figure 4.25. Profile Page.....	129
Figure 4.27. Issues Pages.....	130
Figure 4.28. Notify Issues.....	131
Figure 4.3 Clone the Repository.....	133
Figure 4.4. Install Dependencies.....	133
Figure 4.5 Configure Environment Variables.....	134
Figure 4.6 Run the Development Server.....	134
Figure 5.1. Activity Diagram.....	157
Figure 5.2 UAT Meet with client.....	166
Figure 5.3 User Acceptance Test Sheet.....	168