

Table of contents

Volume 1007

2020

◀ Previous issue Next issue ▶

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Preface

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011001

Preface

+ Open abstract



View article



PDF

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011002

Peer review declaration

+ Open abstract



View article



PDF

Papers

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012001

CALCULATION OF CHANGE ORDER FOR ROAD PROJECTS IN JAKARTA

Mega Waty and Hendrik Sulistio

[+ Open abstract](#)

[View article](#)

[PDF](#)

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012002

Escalation quality of wooden beams as building construction with densification technology

James Rilatupa, Rahmad Samosir and Sally S. Napitupulu

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[View article](#)

[PDF](#)

OPEN ACCESS

012003

The potential use of Indonesian glutinous rice flour as nanoparticles organic filler for dental impression materials

V Takarini, L A T W Asri, R Suratman and B K Hadi

[+ Open abstract](#)

[View article](#)

[PDF](#)

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012004

Interior Design Of National Library With Environmentally Sustainability Materials

L Hartini, B Wibawa, R Situmorang and F Raissa

[+ Open abstract](#)

[View article](#)

[PDF](#)

OPEN ACCESS

012005

Development of Risk-Based Standardized WBS (Work Breakdown Structure) for Safety Planning of Coal Mine Project with Surface Mining Methode

Faqih Andy Maulana and Yusuf Latief

[+ Open abstract](#)

[View article](#)

[PDF](#)

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012006

Decision Making Application for Housing Development Investment

Harun Immanuel, Wati Asriningsih Pranoto and Mark Setiadi

[+ Open abstract](#)

[View article](#)

[PDF](#)

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012007

Development of WBS Dictionary and Checklist Based on WBS of Railway Construction for Safety Planning

D V Aryanto, L S R Supriadi and Y Latief

+ Open abstract



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012008

Analysis of Design Paradigms based on Technology Features at Galeri Indonesia Kaya

Andreas Y. Wibisono, Rudy Trisno and Fermanto Lianto

+ Open abstract



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012009

Development of WBS (Work Breakdown Structure) Dictionary and Checklist for Safety Planning of Tunnel Construction

N A Dewi, L S R Supriadi and Y Latief

+ Open abstract



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012010

Investment analysis of boarding house in tanah abang district

Arnold Pramudita, Wati Asriningsih Pranoto and Mark Setiadi

+ Open abstract



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PDF

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012011

Decision making analysis for water distribution improvement projects

Dedi Alfa Julian Purba, Wati Asriningsih Pranoto and Mark Setiadi

+ Open abstract



View article



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012012

The Reduction Effect of Al-Cu Series 2024 on the Processing Rolled In Mechanical Properties

Erwin Siahaan

[+ Open abstract](#)

[View article](#)

[PDF](#)

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012013

The Effect of Reduction Cross Section Area and Rolling Temperature in Mechanical Properties of Al-Cu

Erwin Siahaan

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[View article](#)

[PDF](#)

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012014

Development of WBS Dictionary and Checklist Based On WBS (Work Breakdown Structure) on Support Facilities in Dam Construction Works For Safety Planning

B F Azzahra, L S R Supriadi, Y Latief and F Muslim

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[View article](#)

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012015

A study on the response of high aspect ratio composite wing structures due to gust load

Matza Gusto Andika, Bambang Kismono Hadi and Rianto Adhy Sasongko

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[View article](#)

[PDF](#)

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012016

Experimental study on the crashworthiness response of hybrid Al/GFRP crash-box structures under axial compression loading

Citra Asti Rosalia, Ichsan Setya Putra, Tatacipta Dirgantara, Annisa Jusuf and Bambang K. Hadi

[+ Open abstract](#)

[View article](#)

[PDF](#)

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012017

Guidelines for Concept of Settlement Design with Digital Infrastructure Facilities

Indra Mulyana, Fermanto Lianto and Surya Gunanta

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[View article](#)

[PDF](#)


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012018

Floating Neighbourhood to anticipate Jakarta Flooding

Donny Victorianus, Naniek Widayati and Eddy Supriyatna

+ [Open abstract](#)

 [View article](#)

 [PDF](#)

OPEN ACCESS

012019

Reintroducing Urban Wildlife through Green Façade Technology in Vertical Housings

Rio Sanjaya, Samsu Hendra Siwi, Fermanto Lianto and S. Martinus Bambang

+ [Open abstract](#)

 [View article](#)

 [PDF](#)

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012020

The effectiveness of special carriages for female in protecting female train passengers

L S Putranto and A N Tajudin

+ [Open abstract](#)

 [View article](#)

 [PDF](#)

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012021

Identification of E-Maintenance Elements and Indicators that Affect Maintenance Performance of High Rise Building: A Literature Review

Nurul Inayah Wardahni, Leni Sagita Riantini, Yusuf Latief and Rossy Armyn Machfudiyanto

+ [Open abstract](#)

 [View article](#)

 [PDF](#)

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012022

Recognition of Pedestrian Traffic Light using Tensorflow And SSD MobileNet V2

Evan, Meirista Wulandari and Eko Syamsudin

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 [View article](#)

 [PDF](#)

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012023

Forecasting Using Artificial Neural Networks and Aggregate Production Planning and Dynamic Model of Inventory Control for Rib and Single Knit Fabric

Lina Gozali, Iveline Anne Marie, Shelinsca Hoswari, Andre Jonathan Christifan, Priskila Abigail Gunawan, Maria Fatima Gracia Charista Elliani and Tira Natasha

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012024

Suggestion of Raw Material Warehouse Layout Improvement Using Class-Based Storage Method (case study of PT. XYZ)

Lina Gozali, Iveline Anne Marie, Natalia, Graziella Michele Kustandi and Evelyn Adisurya

[+ Open abstract](#) [View article](#) [PDF](#)

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012025

The Influences of Silver Content in Lead-Free Solder Sn-0,7CuxAg (SAC) in Physical and Mechanical Properties

Erwin Siahaan and Abrar Riza

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012026

A Proposal of image-based measurement instead of laser-based measurement for indoor application

J R Hartono and F J Oei

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012027

Raw materials inventory analysis with Bayes-fishbone and safety stock in PT. XYZ

Monica Djuhana and Lina Gozali

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012028

Quality Control For PT. Straightway Primex With Bayes-Fishbone Metods and Control Chart Analysis

Maria Charista and Lina Gozali

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012029

Application of MRP System for Control of Raw Material Inventory with EOQ Lot Sizing

Andre Jonathan Christifan and Lina Gozali

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012030

Line Balancing Analysis on Finishing Line Dabbing Soap at PT. XYZ

Stephanie Alexandra and Lina Gozali

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012031

Covid-19 Series: A rule-based decision support system for analysis behavior of people while working from home

Henderi, Rani Putri Merliasari, Harco L.H. S. Warnars and Sugiyatno

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OPEN ACCESS

012032

Aerodynamics Analysis of Mobil Irit Tarumanagara using CFD Method

Poppy Kesuma, Steven Darmawan and Agus Halim

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012033

Analysis of Shell and Tube Heat Exchanger Type

Harto Tanujaya and Abrar Riza

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012034

Face Anti-Spoofing Method with Blinking Eye and HSV Texture Analysis

Raden Budiarto Hadiprakoso

[+](#) [Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012035

Flow investigation of cross-flow turbine using CFD method

Joshua Aditya Sardjono, Steven Darmawan and Harto Tanujaya

[+](#) [Open abstract](#) [View article](#) [PDF](#)

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012036

Characterize of Corrosion Rate and Mechanical Properties of Low Carbon Steel in Potassium Chromate Solution

Erwin Siahaan and Rosehan

[+](#) [Open abstract](#) [View article](#) [PDF](#)

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012037

Determination of minimum trucks and routes used in the case of municipal solid waste transportation in Bandung City with greedy algorithm

Nur Alim Habibi, Ari Yanuar Ridwan and Erlangga Bayu Setyawan

[+](#) [Open abstract](#) [View article](#) [PDF](#)

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012038

Assessment of existing urban drainage system under contemporary rainfall in Tangerang, Indonesia

V Kurniawan and W A Pranoto

[+](#) [Open abstract](#) [View article](#) [PDF](#)

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012039

Design a Group Decision Support System Model to Determine Accreditation of Early Childhood Education Institutions

Muhammad Syaukani and Abdul Kadir

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012040

Implementation of Hybrid Method of Eckenrode and DIA for the Determination Customer Class

Abdul Kadir and Muhammad Syaukani

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012041

Analysis of LED Lumener for Street Lighting Based on lamp Housing, Drivers and Optics to get Luminous Efficacy

Endah Setyaningsih, Yohanes Calvinus and Yunita A. Sabtalistia

[+ Open abstract](#) [View article](#) [PDF](#)

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012042

Exploration of the Security of Free Data Encryption Applications for Cloud Storage

Eka Hero Ramadhani, Herman Kabetta and Amiruddin Amiruddin

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012043

Development of Web Crawler to Build Indonesian Text Corpus

Janson Hendryli and Viny C Mawardi

[+ Open abstract](#) [View article](#) [PDF](#)

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012044

Performance of Generator Translation and Rotation Motion on Vertical Direction for Sea Wave Power Plant

Anizar Indriani, Yeni Suhartini, Hendra, Hernadewita and Rispani

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012045

Critical buckling load analysis on spherical shells under various geometric imperfections

Liliek Darmawan and Leo S Tediarto

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012046

Design Development of Financial Citizenship Model for Women in Indonesia

Ignatius Roni Setyawan, Ishak Ramli and Indra Listyarti

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OPEN ACCESS

012047

Optimization Injection Moulding Parameter Process Using General Factorial Design in Small Medium Enterprise Industries

Lithrone Laricha Salomon, Wilson Kosasih and Ricko

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012048

Implementation of rotary parking system model using wi-fi as transmission media

Hugeng Hugeng, Abia Deo Purwo Putranto and Henry Candra

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012049

The Effect of Using Composite Column for Enhancing Structural Stiffness

Christian Juniarto and Sunarjo Leman

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012050

Automation systems in automatic assembling gear shaft output as car gearbox part at PT. Matahari Megah

Kevin Raynaldo, Steven Darmawan, Agus Halim and Asih Nugroho

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS	012051
Quality Control on Bucket Production Process Using Quality Tools Method (Case Study: A Medium Sized Company)	
Avriana Handriany and Wilson Kosasih	
+ Open abstract	View article
	PDF
<hr/>	
OPEN ACCESS	012052
Deep Excavation in Very Soft Soil Using Cross Wall as Lateral Support	
Oktaffian Widjaja and Chaidir Anwar Makarim	
+ Open abstract	View article
	PDF
<hr/>	
OPEN ACCESS	012053
Classification of Fertilizer Using OpenCV Based on Color Characteristic	
Jovahn Shannich Charlie, Meirista Wulandari and Nurwijayanti	
+ Open abstract	View article
	PDF
<hr/>	
OPEN ACCESS	012054
Utilization of Rainwater Harvesting for Groundwater Conservation in Educational Building	
Endah Lestari, RR. Mekar Ageng Kinasti and Desi Putri	
+ Open abstract	View article
	PDF
<hr/>	
OPEN ACCESS	012055
Effects of opening dimension in shear wall on the behavior of high-rise building structure due to earthquake load	
Fathur Rohman and Sunarjo Leman	
+ Open abstract	View article
	PDF
<hr/>	
OPEN ACCESS	012056
Utilization of machining technology in the production process of Jepara wood carving furniture	

Eddy Supriyatna, Agustinus Purna Irawan, Maitri Widya and Mutiara

[+](#) Open abstract [View article](#) [PDF](#)

OPEN ACCESS

012057

Dynamic Response of Rigid Pavement Plate due to Localized Blast Load

Anjas Budi Priono and Sofia W. Alisjahbana

[+](#) Open abstract [View article](#) [PDF](#)

OPEN ACCESS

012058

Embossment effect analysis on compression of mild steel using finite element methods

Altheo Darmawan and Sunarjo Leman

[+](#) Open abstract [View article](#) [PDF](#)

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012059

Model selection of online motorcycle taxi and motorcycle modes on work trips

Risdiyanto, A Munawar, M Z Irawan and A A Nugraha

[+](#) Open abstract [View article](#) [PDF](#)

OPEN ACCESS

012060

Implementation of Lashkari et al Scheme and Convergent Encryption on Cloud-Based Secure Deduplication Application

Hermawan Setiawan and Rico Setyawan

[+](#) Open abstract [View article](#) [PDF](#)

OPEN ACCESS

012061

Analysis of Welding Strength S45C Material in Spot Welding Process with Variations in Welding Press Time and Electrode Diameter

Sobron M.Lubis, Rosehan and Styven Erlely

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012062

Multiple Linear Regression Analysis On Effect Of Time Variations And Voltage Variations On Spot Welding Against Shear Strength Of Aa5083 Material Using Ibm Spss Application

Gugun Wiranto, Sobron Y Lubis and Rosehan

+ [Open abstract](#)

 [View article](#)

 [PDF](#)

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012063

The effect of online food ordering to home based and non-home-based trip

Leksmono Suryo Leksmono Suryo and Vincentius

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 [View article](#)

 [PDF](#)

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012064

Quality Management System in Automatic Machine Construction Based on ISO 9001

Meivi Venisa Gosan and Wilson Kosasih

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 [View article](#)

 [PDF](#)

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012065

Mechanical Characteristics of the Asphaltic Concrete Mixture with the Addition of Steel Fibers

Joshua Christabel Pardamean and Anissa Noor Tajudin

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 [View article](#)

 [PDF](#)

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012066

Earned Value Analysis on National Salt Warehouse Construction Project

Pramudita Budi Santoso and Hendrik Sulistio

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 [View article](#)

 [PDF](#)

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012067

Model Expert System for Diagnosis of Covid-19 Using Naïve Bayes Classifier

D Silahudin, Henderi and A Holidin

[+ Open abstract](#)

[View article](#)

[PDF](#)

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012068

Characteristics of grocery and daily needs shopping in Greater Jakarta

L S Putranto, D B E Dharmowiyono and P Anggita

[+ Open abstract](#)

[View article](#)

[PDF](#)

OPEN ACCESS

012069

Interest and implementation of construction certification law in Indonesia

Trisna Ekasartika, Jason Lim and Iwan B. Santoso

[+ Open abstract](#)

[View article](#)

[PDF](#)

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012070

The implementation of non-unit-based scheduling method in a housing project

Kevin Natanael Christiawan and Onnyxiforus Gondokusumo

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[View article](#)

[PDF](#)

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012071

The implementation of fuzzy trapezoidal critical path method in a housing project

James Kurniawan and Onnyxiforus Gondokusumo

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[View article](#)

[PDF](#)

OPEN ACCESS

012072

Learning the Basic Structure of Several Ransomwares Using Static Analysis Technique

Amiruddin Amiruddin, Candra Kurniawan, Eka Hero Ramadhani and Julio Rinaldi

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[View article](#)

[PDF](#)


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012073

Impact of commercially popular machine mechanisms using simulation tool in computer-aided design for improvements in mechanical engineering curriculum

Amit L Talli, Ahmed A. Hussien, Mazlan Mohamed and Ayub Ahmed Janvekar

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 [View article](#)

 [PDF](#)

OPEN ACCESS

012074

APPLICATION OF OPINION CLASSIFICATION FOR FASTFOOD RESTAURANT POPULARITY USING INSTAGRAM

Elvandio Frinandy, Dedi Trisnawarman and Ery Dewayani

+ [Open abstract](#)

 [View article](#)

 [PDF](#)

OPEN ACCESS

012075

Decision Support System Of Food Selection For Obese Sufferer

Yohan Ivandri Yuana

+ [Open abstract](#)

 [View article](#)

 [PDF](#)

OPEN ACCESS

012076

Study of selecting floor cover by using the value engineering method in the housing project

F L Labuan and M Waty

+ [Open abstract](#)

 [View article](#)

 [PDF](#)

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012077

Legal Institution Mapping Information System in DKI Jakarta

Muhamad Arda Bily, Dedi Trisnawarman and Tri Sutrisno

+ [Open abstract](#)

 [View article](#)

 [PDF](#)

OPEN ACCESS

012078

Assembly Line Balancing with The Yamazumi Method

Silvi Ariyanti, M. Rifa'i Azhar and M. Sobron Yamin Lubis

[+](#) [Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012079

Real-Time Information System Basic Needs Price Change Predictions in The Traditional Market

Reza Mukhlis Qurbany, Dedi Trisnawarman and Tri Sutrisno

[+](#) [Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012080

Study of Lighting, Humidity, and Ventilation in RISHA Design at Kampung Deret Petogogan, Jakarta

Fanuel Fang, M. Bambang Susetyarto, Fermanto Lianto and Samsu Hendra Siwi

[+](#) [Open abstract](#) [View article](#) [PDF](#)

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012081

Co-Working Space with Biophilic Design Approach in Lot.6 SCBD, South Jakarta

C Simarmata, S Gunanta and T Fatimah

[+](#) [Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012082

Automated image analysis and improvisations to manage palm oil plantation

M N Akhtar, S. A. Khan, Mazlan Mohamed and Ayub Ahmed Janvekar

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OPEN ACCESS

012083

Analysis of Schedule Project Management's Indicators and Cost Project Management's Indicators in Interior Construction

Chaterine and Manlian Ronald A. Simanjuntak

[+](#) [Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS	012084
Analysis of Important Factors in Choosing or Using Process Alternative Dispute Resolution of Construction Project From Contractor's Perspective (Case Study in XYZ Company, Ltd's)	
Daniel Dianto Arintonang and Manlian Ronald A. Simanjuntak	
+ Open abstract View article PDF	
<hr/>	
OPEN ACCESS	012085
Comparation Study Performance Diesel Engine Using Biodiesel with Secondary Data	
Iqbal Muhammad Febriansyah, Abrar Riza and Steven Darmawan	
+ Open abstract View article PDF	
<hr/>	
OPEN ACCESS	012086
Energy Efficiency Efforts at Dukuh Golf Kemayoran Apartment	
Friska Hasibuan, Fermanto Lianto, Samsu Hendra Siwi and S. Martinus Bambang	
+ Open abstract View article PDF	
<hr/>	
OPEN ACCESS	012087
Tarumanagara University Campus 1 Sky-bridge Structure Evaluation	
Hadi Pranata and Jonathan Thomas	
+ Open abstract View article PDF	
<hr/>	
OPEN ACCESS	012088
Ergonomic Analysis By Using REBA, WERA And Biomechanics Method In The Production Process Of Women's Bags In Small Industry (SME)	
Lamto Widodo, Adianto, Yenita and Christian Ruslie	
+ Open abstract View article PDF	
<hr/>	
OPEN ACCESS	012089
The Design of Coffee Grinder Machine Knockdown With 8 Levels of Coarseness	

Frans Jusuf Daywin, Lina Gozali, Carla Olyvia Doaly, Adnan Salim, Abdurrafi Ibrahim, Maria Fatima and Pingkan Inggriid

[+](#) Open abstract [View article](#) [PDF](#)

OPEN ACCESS

012090

Risk identification of Design And Build at school building construction project in central Jakarta

Andreas Suharyanto and Manlian Ronald A. Simanjuntak

[+](#) Open abstract [View article](#) [PDF](#)

OPEN ACCESS

012091

Risk Identification in Procurement of Precast Facade on High Rise Buildings in Jakarta

Ardian Sulistianto and Manlian Ronald. A. Simajuntak

[+](#) Open abstract [View article](#) [PDF](#)

OPEN ACCESS

012092

Risk Identification in Procurement of Glass facade in High-Rise Office Buildings in Jakarta

Reinaldi Tanumihardja and Manlian Ronald A. Simanjuntak

[+](#) Open abstract [View article](#) [PDF](#)

OPEN ACCESS

012093

Minimization Total Tardiness in Lathe and Turret Department Using Genetic Algorithm

I Gede Wira Ranata, Dida Diah Damayanti and Murni Dwi Astuti

[+](#) Open abstract [View article](#) [PDF](#)

OPEN ACCESS

012094

Proposed assembly line balancing using mixed integer programming to minimize idle time of union fuselage

Ni Putu Cynthia Sasmita Dewi, Dida Diah Damayanti and Murni Dwi Astuti

[+](#) Open abstract [View article](#) [PDF](#)

-
- OPEN ACCESS** 012095
Bamboo Composite Compressive Strength With Three Layer Configuration
Sofyan Djamil, NPG Suardana, Agustinus P. Irawan, IKG Sugita, Sobron Y Lubis and Dicky T
[+](#) [Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012096
Qualitative Analysis of Maintenance and Operational Management at Abdul Muis Technical Office Building
Janerizka Bari Putri and Manlian Ronald A. Simanjuntak
[+](#) [Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012097
Material Module Technology in Amartapura Apartment, Lippo Karawaci
Sidi Ahyar Wiraguna, M. B. Susetyarto, Fermanto Lianto and Samsu Hendra Siwi
[+](#) [Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012098
Seismic Evaluation of Buildings using Adaptive Force-Based Multimode Pushover Analysis
Albert, Daniel Christiano and Hadi Pranata
[+](#) [Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012099
Assembly Line Balancing Using Genetic Algorithm Method to Minimize Number of Working Stations: A Case Study in Car Manufacturing
Dida Diah Damayanti, Murni Dwi Astuti, Erlangga Bayu Setyawan and Arif Faisal Ramdani
[+](#) [Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012100
Safety audit of becakayu toll road

Ni Luh Putu Shinta Eka Setyarini, Aniek Prihatiningsih and Kevin Tanes

[+](#) [Open abstract](#) [View article](#) [PDF](#)

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012101

Repair techniques in Underwater Pipelines for Drinking Water

Tri Suyono, Agustinus Purna Irawan and Wati Asriningsih Pranoto

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OPEN ACCESS

012102

Development of Relationship between Liquid Limit and Clay Content for West Java Soils

B Widjaja and K Kurniawan

[+](#) [Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012103

Decision Support System for Election and Evaluation of Assistant Lecturer Using Analytical Hierarchy Process and Simple Additive Weighting: case study Faculty of Information Technology Tarumanagara University

Melvin, Tri Sutrisno and Dyah Erny Herwindiati

[+](#) [Open abstract](#) [View article](#) [PDF](#)

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012104

Performance Evaluation of Dual System Structure with Belt Truss

Dwi Prasetyo Utomo and Roesdiman Soegiarso

[+](#) [Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012105

Development Method for Nickel Electroplating on Aluminium

Tjokorda Gde Tirta Nindhia, Dewa ngakan Ketut Putra Negara, I Wayan Agus Saputra and Pradeep Kr. Sharma

[+](#) [Open abstract](#) [View article](#) [PDF](#)


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012106

Digital Communication of Chinese Millennial Generation in Building the Creative Economy of Surakarta

Sinta Paramita and Lydia Irena

+ Open abstract

 View article

 PDF

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012107

Optimization of Kevlar and Coir Fibre Reinforced with Epoxy Based Composites to improve machining characteristics- A Review

M J Vinaykumar, A.S Srikantappa and M Ramkumar

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 View article

 PDF

OPEN ACCESS

012108

Failure Analyses on Corrosion of Hot Water Tank Storage Made from Stainless Steel

Tjokorda Gde Tirta Nindhia, I Putu Widya Semara, I Wayan Bandem Adnyana, I Wayan Surata and I Gusti Komang Dwijana

+ Open abstract

 View article

 PDF

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012109

Development of automatic Landsat data download engine

K A Pradono, Y D Safitri, B S Adhitama, Y F Hestrio, M Soleh, H Gunawan, N Widijatmiko and W Sunarmodo

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012110

Accuracy comparison methods between putro's method with husain's method for validating damaged physical documents

Prasetyo Adi Wibowo Putro, Andi Parada Tambunan and Pandu Bagus

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 View article

 PDF

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012111

A WEB-BASED ONLINE STORE APPLICATION FOR FABRIC MATERIAL SALES

Alfonso, Dali Santun Naga and Zyad Rusdi

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OPEN ACCESS

012112

Website application for locating and reserving house and boardroom for rent based on selected location or region

Fensen, Ery Dewayani and Wasino

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OPEN ACCESS

012113

Android-Based Application for Intangible Cultural Heritage in Balai Pelestarian Nilai Budaya Jawa Barat

Jayson, Ery Dewayani and Zyad Rusdi

[+](#) [Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012114

E-Commerce application for selling "Blue Salt" products and general fish maintenance tools for koi fish treatment

Martinus Budiman, Dali Santun Naga and Zyad Rusdi

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OPEN ACCESS

012115

Web-Based Inventory Information System in Antariksa Stores

Devan Ariesta, Zyad Rusdi and Tri Sutrisno

[+](#) [Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012116

Forensic Analysis of Instagram on Android

Carolin Alisabeth and Yogha Restu Pramadi

[+](#) [Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS	012117
DEVELOPMENT OF TARUMANAGARA UNIVERSITY TRACER STUDY INFORMATION SYSTEM	
Muhamad Hafiz, Ery Dewayani and Wasino	
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Classification of historic buildings in Indonesia with svd algorithm based on texture and color characteristics (case: temples, historic mosques, historic churches, and historic Confucian temples)	
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Development of Platformer Endless Running Game "Endless Jetride" on Android	
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Improving the Quality of Coffee Shops in Jabodetabek Area by Application and Modification of Coffee Roaster Machine Capacity 400-600 Gram Coffee Beans Using the Reverse Engineering and Engineering Design Method	
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Android Arcade-Style Racing Game "CarsTime" With Antigravitation Theme	

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Car shape clustering using sobel edge detection with divisive average linkage and single linkage algorithm (case: bus, sedan, citycar, mpv, and truck)

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Experimental study on luminous intensity of white LEDs of different configurations	
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Retrieval Based Chatbot on Tarumanagara University With Multilayer Perceptron	
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Application of online presence and recommendations of students that have a low value using the multi-objective optimization method on the base of ratio analysis	
Excel Tanwijaya, Dali Santun Naga and Viny Christanti	
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Smart Street Lighting System with Data Monitoring	
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Fruit Maturity Classification Using Convolutional Neural Networks Method	

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Investigation on the Micro Hydropower Undershot Type Floating Blade Tilt Angle for Low-flow Hydropower		
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Forecasting Analysis at PT. Lion Metal Works Using Artificial Neural Network		
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Recruitment of prospective employees application using SMART and Promethee method		
Bagus Mulyawan, Kelvin Hendersen and Manatap Dolok Lauro		
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OPEN ACCESS	012186	
Implementation of Improved Apriori Algorithm for Drug Planograms in XYZ Pharmacies and Analysis of Medicinal Procurement Planning Using ABC Critical Index Methods		
Aldy Pratama, Bagus Mulyawan and Tri Sutrisno		
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New Relationship between Linear Shrinkage and Shrinkage Limit for Expansive Soils		
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OPEN ACCESS	012188	
Application of the case based reasoning & sorensen-dice coefficient method for fitness exercise program		

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Blockchain Application in Internet of Things for Securing Transaction in Ethereum TestNet

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Abstract. This system is designed by using Lolin D32 as the processor dan MPL3115A2 for the sensors. This system is designed to show that devices that based on Internet of Things (IoT) could be secured by using blockchain technology. The blockchain technology is based on Ethereum which will be tested in Ropsten Testnet network. Processor module connects to Internet through WiFi module which is one of the Lolin D32 features. This WiFi module connects to router which is used for designing and testing the system. This system wants to prove that the data which are acquired from sensor module MPL3115A2 (altitude, temperature and pressure) and positioning data could be sign and verify within the processor Lolin D32. Before sending the data, the data will be formatted. Data will be stored in smart contract. The smart contract is an Ethereum program which is written using Solidity language. This smart contract is deployed into Ropsten network. The numbers of testing that have been carried out are 516 times. These testings proved as success. The data which were sent to Ropsten network could be proved that they were recorded successfully. These are done by checking through etherscan.io.

1. Introduction

Microcontroller is the main part of Internet of Things (IoT) system, because all processes are started by microcontroller. Sensors and actuators are connected with the microcontroller. Microcontroller obtains and processes data from those devices and then dispatches the data to network which is connected to the microcontroller. The conclusion is that all the processes in IoT are started from microcontroller. Thus, securitization is the process of securing data in the microcontroller [1]. So, the application of blockchain in IoT in this design is about signing data in the microcontroller [2].

IoT as a new wave of Internet has a main problem in security. With the blockchain technology, this problem should be resolved. In this design, the focuses are:

1. Could a transaction signing be conducted in the microcontroller?
2. Could the transaction be processed in Ethereum Virtual Machine?
3. Could the transaction be verified?

This design uses Remote Procedure Call (RPC) from Infura. It also uses etherscan.io for checking whether a transaction is verified by a node in a blockchain network. The data which are acquired from sensor are height, temperature, pressure and position. As for the advantages from blockchain technology, there are disadvantages also. The disadvantages are length of time that is needed to complete a transaction, a fee to process each transaction, and this technology is still in a development stage.



2. Method

2.1. Block Diagram

Client module is a microcontroller module which could do a signing process for a transaction to a node. For the sake of interaction to Ethereum Network, this process empowers RPC. The RPC that is used in this system is Infura. Infura will relay data from client module to Ethereum Network. This transaction data will be verified by Ethereum Virtual Machine (EVM). EVM will be located in TestNet of Ethereum Network, i.e. Ropsten. This verification result could be monitored through etherscan.io. Figure 1 shows the block diagram of this system.

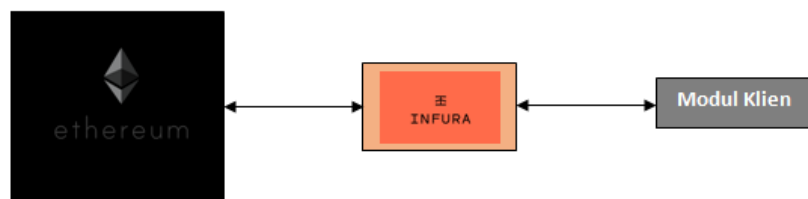


Figure 1. Block Diagram

2.2. System Architecture

Figure 2 shows the system architecture. This architecture consists of two parts, i.e. external and internal part. External part consists of infura.io and etherscan.io. Infura is used to connect IoT module (hardware) to EVM by using RPC. Etherscan.io is a website that is used to monitor the verification process by EVM. Internal part consists of IoT module and smart contract which is deploy in EVM.

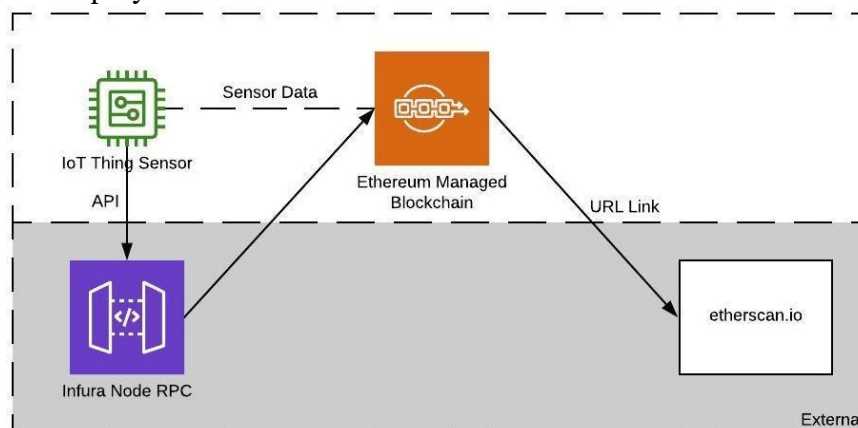


Figure 2. System Architecture

2.3. System Environment

Figure 3 shows the system environment. In this figure, client or system designer or user interacts by using etherscan.io to check the validation of a transaction. Client will input a transaction hash as an identification of a transaction or client could input smart contract address if the client want to verify all transactions. This is the only interaction between system and client.

As stated in Figure 1, the internal part in this system environment is called acquisition system. It consists of hardware and software. The hardware is microcontroller module which

uses Lolin D32. The software is a program which creates transactions. This system will relay a transaction to infura.io by using RPC with a link that is hardcoded.

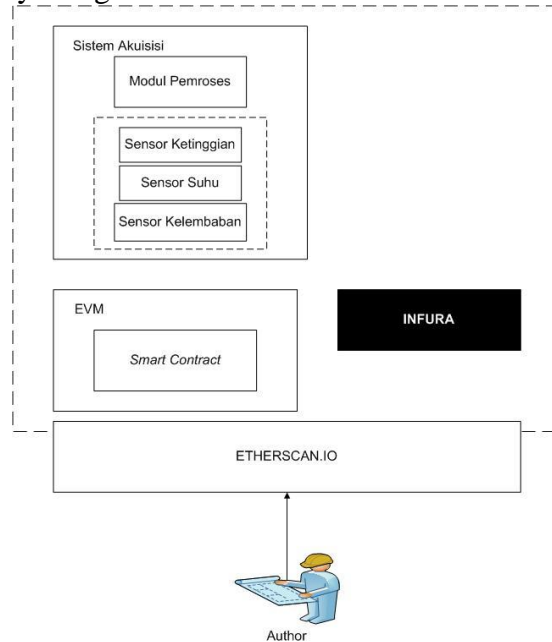


Figure 3. System Environment

2.4. Activity Diagram

Figure 4 shows activity diagram for this system. The process is started by client which initiates signing process. *Signer* subsystem will take over the process by conducting *Connecting, Initiating, Getting Information, Preparing* and *Sending Transaction*.

After these processes are done, *Verifier* subsystem will be activated to verify the transaction. The result will be returned to the Client for checking. This will complete the whole cycle of the system.

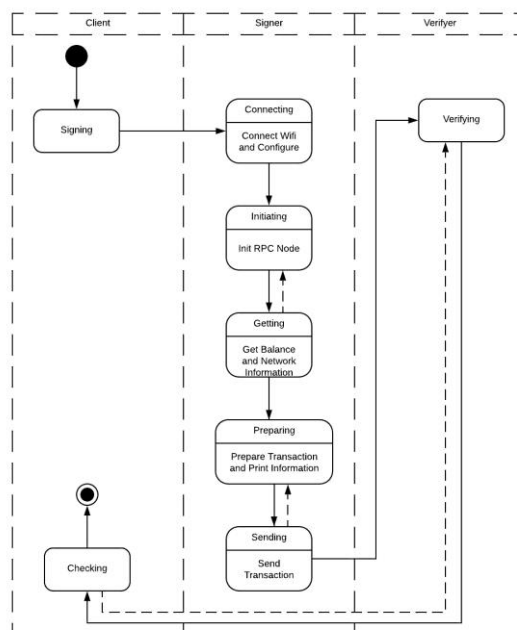


Figure 4. Activity Diagram

3. Results and discussion

Figure 5 shows the result of integration testing by using Zerinth console. Data which were used for testing are position (connected = 1), height (38.5625 m = 0x26), pressure (100 kPa = 0x64), and temperature (28.125°C = 0x1C). These data were formatted before sending to the network. After formatting, the data were 0x011C6426. The transaction hash for this testing is 0x85c012cc0c43a49331ea523a3d29deffe9c41de5d4ea604f28c5498fbfb4f47d. The result could be checked through etherscan.io. Wallet address which was used to process the transaction was 0x81b7e08f65bdf5648606c89998a9cc8164397647.

The testing result could be shown in Figure 6. From this figure, it could be concluded that the transaction was successfully processed to EVM. The data was completely secure according to blockchain method. From this figure, it was stated that the process needed 0,000000018000000017 ETH as a processing fee.

```

Begin of Sensor Initialization for modul MPL3115A2..
Sensor Initialized and Ready to Use...
Begin to Initiating Network Driver...
Driver initialized...
Connecting to WiFi...
WiFi Connected to 3Com
Asking ethereum...
Begin of Initiating of the RPC Node..
Initiating RPC Node Success..
Begin of Getting Information..
Getting of the Ethereum Ballance in Wallet..
Balance: 0x26e704247c3389c8 in Wallet Address 0x9Ad8Ee5E185455D6E7205bF63cE3808EDa44A2Ff
Success in Retrieving Ballance..
Getting off Gas Price to Process a Transaction..
Gas Price: 1000000000
Gas Price Acquired..
Getting of the Transaction Count or Nonce..
TCount: 516
Chain: 3
Success in Retrieving Transaction Count..
Getting Information is Done Successfully..
Altitude: 38.5625 meter [ 0x26 ]
Pressure: 100 kPa [ 0x64 ]
Temperature: 28.125 Celcius [ 0x1C ]
Begin of Preparing Transaction Object..
Setting wei..
WEI Price: 0
WEI Value Set..
Setting GAS Price..
GAS Set..
Setting Smart Contract Address..
Wallet Address for Transaction: 0x81b7e08f65bdf5648606c89998a9cc8164397647
Address Set..
Setting Up Data for Transaction..
Data to be sent: 0x011C6426
Data Set Up Done..
Setting Nonce..
Nonce 516
Nonce Set..
Object Preparing Done..
Signing Completed...
Begin of Sending Value..
Sending values... [ 0x011C6426 ]
Sending Completed..
Monitor your transaction at:
https://ropsten.etherscan.io/tx/0x85c012cc0c43a49331ea523a3d29deffe9c41de5d4ea604f28c5498fbfb4f47d
Sent!

```

Figure 5. Testing Code

Transaction count or nonce was 516. This show that the testing was conducted for 516 times through the blockchain network. The testing was carried out in every 30 seconds. This length of time is also the length of time which is needed for completing one process cycle. So, in one day there should be 2.880 data which will be processed to the network.

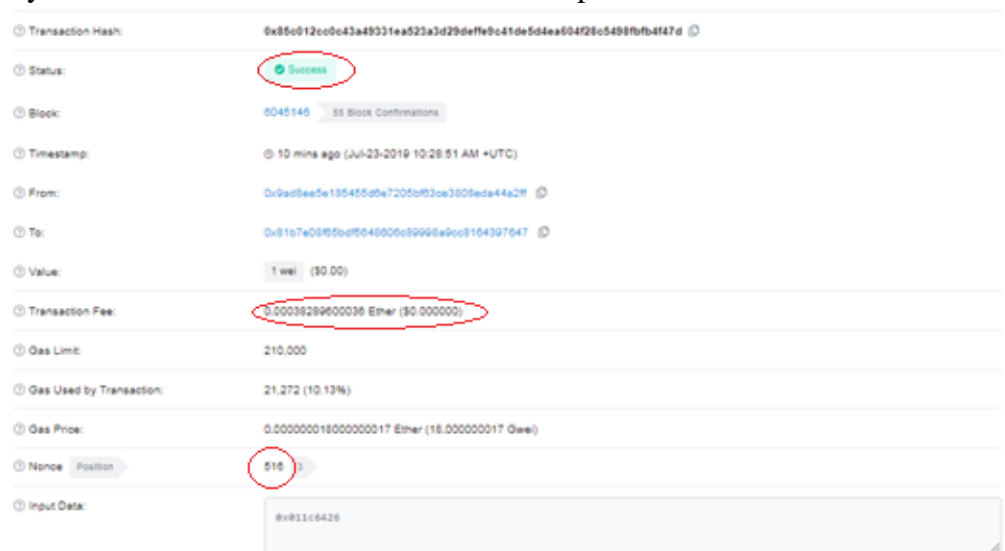


Figure 6. Verification in etherscan.io

4. Conclusion

This system design proves that data in IoT system could be securitized by using blockchain technology. The testings which have been conducted were 516 times (according to nonce field in etherscan.io). These proved that the data were successfully recorded to state variables.

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