ICONIET 2020
INTERNATIONAL CONFERENCE ON INNOVATION, ENTREPRENEURSHIP AND TECHNOLOGY

ICONETSI
International Conference on Engineering and Information Technology for Sustainable Industry 2020

Certificate of Participation

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Dr. Ary Syahriar, DIC.

as a Presenter

with paper title:

"Thermostat Influence Simulation During Warm-up Period in SI-Engine Cooling System"

in International Conference on Engineering and Information Technology for Sustainable Industry (ICONETSI 2020)
in conjunction with International Conference on Innovation, Entrepreneurship and Technology (ICONIET 2020)

held in Indonesia, on 28 -29 September 2020

ICONIET

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Swiss German University

ICONETSI

Dr. Tanika D Sofianti, ST, MT
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ICONETSI

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MESSAGE FROM RECTOR

Swiss German University (SGU) has been established for 20 years. As a university committed to striving for quality education, SGU organizes its annual event, the International Conference on Innovation, Entrepreneurship and Technology – ICONIET to give a platform for researchers, practitioners, government officials to present and discuss their works. The ICONIET 2020 consists of two sub-conferences, namely "International Conference on Engineering and Information Technology for Sustainable Industry 2020 (ICONETSI)" on Monday & Tuesday, 28-29 September 2020 and "International Conference on Global Innovation and Trend in Economy (INCOGITE 2020)" on Thursday, 5 November 2020.

The conference has the same theme as the 20th anniversary of SGU, "Transforming Digitally, Empowering Globally". Digital transformation is a must. It connects technology specialists across all sectors and fields in order to meet business needs and market requirements. It builds innovation and high-tech know-how to assist business initiatives or to upgrade technology for future growth. SGU has also participated in education for empowering communities globally. By lifting up individuals within communities, SGU encourages and supports sustainable community and economic development. Good quality of education and research will generate technology, innovation and entrepreneurship which will eventually improve quality of life and the prosperity of societies, nations and the world as a whole.

This year, the ICONIET is conducted in the midst of pandemic Covid-19 and hence, will be fully virtual using video conferencing. I'd like to take this opportunity to welcome all honorable guests, speakers, presenters and participants, who have come not only from Indonesia, but also from different countries such as Germany, Japan, Malaysia, the United Stated, Singapore, Egypt and Taiwan.

I'd like to personally thank the Committee of ICONIET 2020, including the committee of ICONETSI and INCOGITE 2020, who have put their utmost efforts into organizing this event. I wish to express my gratitude to the Ministry of Research, Technology and BRIN for their continuous support to our research. I would also like to thank SGU's University partners, the South Westphalia University of Applied Sciences and the University of Applied Sciences Jena in Germany, as well as the International Management Institute (IMI) in Switzerland.

We do hope that the conference will be beneficial and mind-opening for all participating parties. Let us use this event to exchange ideas and to extend our networking virtually, with the aim of empowering the wider global community.

Respectfully yours,

Dr. rer. nat. Filiana Santoso
Rector of Swiss German University

MESSAGE FROM CONFERENCE CHAIR

I would like to welcome you to the 2020 1st International Conference on Engineering and Information Technology for Sustainable Industry, Tangerang, Indonesia. ICONETSI 2020 provides a scientific platform for both local and international researchers, engineers and technologists who work in all aspects of Engineering and Information Technology for Sustainable Industry to exchange their latest research results. In addition to the contributed papers, internationally well-known experts are also invited to deliver keynote and plenary speeches at ICONETSI 2020. We are honored to have the distinguished keynote speakers: Prof. Bambang PS Brodjonegoro, Ph.D of the Minister of Research and Technology – BRIN, INDONESIA; and also Prof. Dr. Engg. Koichi Murata of Nihon University, Japan; Prof. Dr. Eng. Agus Purwanto of Universitas Sebelas Maret, Indonesia; Assoc. Prof. Dr. Waseem Haider of Central Michigan University, USA; Dr. Anto Satriyo Nugroho of Agency for Assessment and Application of Technology – BPPT, Indonesia; Assoc. Prof. Yudi Fernando PhD M.LogM of Universiti Malaysia Pahang, Malaysia; and Dr. Charles Lim, BSc., MSc. of Swiss German University, Indonesia as our invited speakers.

The conference is organized as a set of tracks in Sustainable Energy and Environment, Production and Operation Management, Logistics and Supply Chain, Ergonomic and Human Factors, Automation, Mechatronics and Robotics, Cyber Security and AI, and Software Engineering.

In this first event of ICONETSI 2020, we have received 125 paper submissions from Germany, Japan, Taiwan, Singapore, Egypt and Indonesia. To ensure the high quality of papers in ICONETSI 2020, each submission is reviewed by no less than three reviewers through a blind review process. In addition, we also carefully check the similarity rating to avoid plagiarism, and the writing format according to the conference proceedings template for each submission. After a careful review process, the program committee accepted 76 high quality full papers for presentation in ICONETSI 2020.

The successful organization of ICONETSI 2020 has required strong support from Indonesia Honeynet Project, Industrial Engineering Higher Education Organizing Cooperation Agency (BKSTI), Pusat Unggulan Iptek (PUI) Baterai Lithium Universitas Sebelas Maret, and Indonesian Association for Pattern Recognition (INAPR).

Most of all, I thank you, the participants, for enriching this conference by your presence. I am thankful to the conference organizing committee members, the track chairs, the session chairs, and the numerous volunteers, without whose generous contributions, this conference would not have set a record number of presentations and number of participants, higher than our expectation, especially considering some difficulties that happened during the Covid-19 pandemic. We truly believe the participants will find the discussion fruitful, and will enjoy the opportunity of setting up future collaborations.

Warm Regards,
Assoc. Prof. Dr. Tanika D Sofianti
ICONETSI 2020 General Chair

Keynote Speaker

Prof. Bambang Permadi Soemantri Brodjonegoro, Ph.D

Minister of Research and Technology - The National Research and Innovation Agency of the Republic of Indonesia

Short Biography:

Prof. Bambang Permadi Soemantri Brodjonegoro, Ph.D is the Minister of Research and Technology and Head of the National Research and Innovation Agency of the Republic of Indonesia. Previously, he was the Minister of National Development Planning of the Republic of Indonesia from 2016 to 2019 and also the Minister of Finance from 2014 until 2016. He has also worked in various roles in the Ministry of Finance. The opportunities to contribute as the Minister of Research and Technology, Minister of National Development Planning, and Minister of Finance have established Prof. Brodjonegoro's career in integrating Indonesia's research, technology, innovation, development planning, financing, and economic stabilization. Prof. Brodjonegoro earned his Ph.D in Urban and Regional Planning from the University of Illinois at Urbana–Champaign, United States in 1997. Afterward, he started his academic career as a lecturer in Universitas Indonesia and became Dean of the faculty of economics, Universitas Indonesia from 2005 to 2009. His research mostly focuses on Economics. He has also been actively involved in various local and international organizations and Indonesian companies, including being the director-general of the Islamic Research and Training Institute (IRTI), Islamic Development Bank Group, Jeddah, The Kingdom of Saudi Arabia in 2010. He was also awarded several honor and awards, including Bintang Maha Putra Utama from President of Indonesia and Bintang Bhayangkara Utama from the Indonesian National Police.

Invited Speaker 1

On the Role of Industrial Engineering in the COVID-19 Era

Prof. Dr. Eng. Koichi Murata
Nihon University, Japan.

Abstract:

The purpose of this study is to consider the role of industrial engineering in the era of COVID-19. This paper is divided into three parts. Firstly, the history of industrial engineering is reviewed to confirm the richness and compensation of life brought by the division of labor. The second part describes the exchange that should be paired with the division of labor, and what it is likely to be, and then explains that the integration of the division of labor and its exchange is a future issue for humanity. The third part, regarding the touch strategy that is the first step of exchange, reviews the concept of visual management, which is a precedent case, and tries to systematize the three touch strategies that were tried in the early stages of the spread of COVID-19 in Japan. The results obtained from this survey show that it is important for industrial engineering, which has been trying to understand management resources from various perspectives, to engage not only in the division of labor, but also in their exchange. Also, in an era where environmental destruction and digitalization are progressing at a speed that humanity does not notice, the findings can be considered as a problem in order to produce human resource workers whose value is higher than ever.

Short Biography:

Koichi Murata is the head of operations & production management laboratory and a professor at the Department of Industrial Engineering and Management, College of Industrial Technology, Nihon University. He previously worked in industry as an industrial engineer at the flagship factory of Murata Manufacturing Co., Ltd., which is a global leader mainly in the manufacturing of electronic components. His research interests include operations & production management, kaizen, lean management, visual management, technology transfer, knowledge management, sustainable supply chain and others. Dr. Murata has published articles in international academic journals such as International Journal of Production Research, Sustainability, Journal of the Operations Research Society of Japan, and others. He was interviewed for NHK and the Associated Press (AP) about the prospects for the manufacturing industry.

Invited Speaker 2

Honeynet Threat Sharing – One step closer to Cyber Situational Awareness

Dr. Charles Lim, BSc., MSc., CTIA, CHFI, EDRP, ECSA, ECSP, ECIH, CEH, CEI
Swiss German University; Indonesia Honeynet Project

Abstract:

As organizations are digitally transforming their business, they are encountering security risks to slow down their intent. A collection of honeypots, i.e. honeynet, are often deployed in their infrastructure to detect the early cyber security attacks into the infrastructure, allowing the organization to be more aware of the emerging threats. Organizations may forge to stay relevant, timely and accurate in assessing these threats when they are willing to share these threats to the community of interest, providing the first step to cyber situational awareness.

Short Biography:

Charles Lim is a Cyber Security Researcher and Lecturer at Swiss German University, an independent researcher who works closely with Badan Siber dan Sandi Negara (BSSN) and a professional IT security related consultant and trainer. He is one of the recipients of the 2019 ISIF Asia Network Operations Research Grants and 2020 Internet Operations Research Grants. He also holds a few security professional certifications in the area of incident response, threat intelligence and security analyst, from ECCOUNCIL. He has a Doctorate degree in Electrical Engineering from Universitas Indonesia, Master of Science in Electrical Engineering from University of Hawaii, USA and his research includes Malware Analysis, Digital Forensics, Cloud Security, and IT Security Architecture. He is actively involved with many cyber security communities, such as Indonesia Honeynet Project (IHP), ACAD CSIRT (Academy Computer Security Incident Response Team), Indonesia Digital Forensics Association (AFDI), and others.

Invited Speaker 3

Recent Trends in 3D Printing

Assoc. Prof. Dr. Waseem Haider
Central Michigan University, USA

Abstract:

Additive manufacturing or 3D printing of metals is emerging and rapidly growing manufacturing technique from prototyping to large production runs. This process involves the fusion of metal powder bed by selectively melting above the melting temperature and building layers on top of each other. The imminent advantages of producing complex geometries, unprecedented manufacturing flexibility, product customization and at the same time economically viable process makes it a potentially disruptive technology for different industrial applications. The huge interest of industries for adapting this technology also brought the attention of research community to work in this area with full potential. The changed melting and solidification dynamics during additive manufacturing, results into striking differences in the microstructural evolution in comparison to the one obtained through conventional casting process. The microstructure variation strongly impacts the other structural properties of the material, e.g. mechanical, electrochemical etc. and this provides different avenues for the research community. Our group is working to elucidate the electrochemical response and the nature of passive oxide film formed on the additively manufactured 316L stainless steel for varying applications (biomedical, petrochemical and food industries).

Short Biography:

Dr. Waseem Haider is a tenured associate professor at School of Engineering and Technology, Central Michigan University, USA. He earned his PhD in Mechanical Engineering from Florida International University in 2010. He got a post-doctoral fellowship in materials science and engineering at Pennsylvania State University. Afterwards, he joined orthopedic research labs as a research scientist at State University of New York. Soon after that, he joined University of Texas as tenure track assistant professor where he served for three years. Dr. Haider's research focuses on Materials Science and Biomedical Engineering with special emphasis on Biomedical Materials Surface Chemistry, Electrochemistry, Bulk Metallic Glasses, and Nanomaterials. His research is supported by National Science Foundation and Department of Defense.

Invited Speaker 4

Engineering Design and Blockchain Technology for Sustainable Industry: A Circular Economy Perspective

Assoc. Prof. Yudi Fernando PhD M.LogM
Universiti Malaysia Pahang, Malaysia

Abstract:

The manufacturing industry is an essential sector, especially in developing countries, and significantly contributes to a nation's economy. These significant contributions are due to the availability of vendors with capabilities supporting low-cost production with quality materials. These significant contributions should not overlook other outputs from this industry as one of the largest emitters of greenhouse gasses, pollution, and waste that contribute to negative environmental impacts. These externalities are due to waste from the energy and material resources required to be processed into finished products. While the manufacturing industry has contributed enormously to wealth and job creation, thus improving quality of life, this is happening at the expense of delivering unsustainable amounts of solid waste and pollution. Due to many competing factors, the manufacturing industry is transforming from a linear economy model (make, use and discard) to a global circular economy in which the components of products are fed back to production after their service life. Yet, scanty evidence exists on how the manufacturing firms report on the success story of the remanufacturing process of leftover materials, return products and scrap. In the past, environmental concerns were mostly neglected in the manufacturing and supply chain processes. Circular economy, a term which used to be known as the remanufacturing of scrap, is an alternative method to counter this issue. The engineering redesign needs to be adopted with the proper integrity platform. Blockchain technology can be used to improve visibility, transparency and the accurate computation of the production and overall supply chain's carbon footprint. Blockchain technology has a high level of security and cannot be hacked. It can be used to support the integration of energy production, utilization, transmission, and storage so that every carbon footprint activity and carbon trading transaction can be tracked and no data can be manipulated. In regard to the importance of engineering design using circular economy concept and industrial revolution 4.0 enabler technology like blockchain, I will be presenting a remanufacturing model for sustainable industry that will assist the industry and academia to find alternative solutions to turn waste into value-added products.

Keywords: remanufacturing; design; circular economy; blockchain technology; industrial revolution 4.0; sustainability

Short Biography :

Yudi Fernando is an Associate Professor and holds a PhD. He is the Editor-in-Chief Industrial Management: An International Journal and Managing Editor of Journal of Governance and Integrity at the Faculty of Industrial Management, Universiti Malaysia Pahang. He is a Research Committee Chair and founding member of the Malaysian Association of Business and Management Scholars (MABMS). He is also a member of the Society of Logisticians, Malaysia/Pertubuhan Pakar Logistik Malaysia (LogM). Prof. Yudi is involved actively as the assessor for ABEST21 (Alliance of Business Education and Scholarship for Tomorrow) program-based accreditation system. His research interest is in the areas of sustainable supply chain; circular economy 4.0 and blockchain technology and he has supervised 9 PhDs, 11 ongoing, and more than 70 Master theses. His works can be found in the top tier journals such as: Journal of Cleaner Production, *Resources, Conservation* & Recycling, Sustainable Production and Consumption; tourism management International Journal of Information Management; Food Control, Journal of Energy Policy and others.

Invited Speaker 5

Biometrics Technology for Better Public Services

Dr. Eng. Anto Satriyo Nugroho
Center for Information and Communication Technology,
Agency for Assessment and Application of Technology (PTIK BPPT)

Abstract:

Kartu Tanda Penduduk Elektronik (KTP-el) is a National electronic ID card which is issued by the Indonesian government. The goal of KTP-el is to develop an accurate national population database, and ensure a single identity number (SIN) for the citizens. The unique identity of each citizen is verified using biometrics data: ten fingerprint scans, two iris scans and a face scan. More than 190 million citizens have had their biometrics data taken. The scale of biometrics data is the second largest biometrics data in the world after those collected by Unique Identification Authority of India (UIDAI). The data opens various applications such as biometrics authentication for banking, forensic identifications, and electronic voting. In this presentation, we will discuss several topics including biometrics testing of KTP-el Reader, the usage of KTP-el and biometrics for public services, and the future of biometrics data.

Short Biography:

Anto Satriyo Nugroho works for the Center of Information & Communication Technology, Agency for the Assessment & Application of Technology (PTIK BPPT), Indonesia. He completed his B.Eng. (1995), M.Eng. (2000) and Dr.Eng. (2003) in Electrical and Computer Engineering from Nagoya Institute of Technology, Japan. From 2003 to 2007, he was working as visiting professor at School of Life System Science & Technology, Chukyo University, Japan. His research interest is on pattern recognition and computer vision with applied field of interest in Multimodal biometrics Identification and Computer Aided Diagnosis for Malaria Detection. He is the 1st president of Indonesian Association for Pattern Recognition (INAPR), and an Indonesian Governing Board member of International Association of Pattern Recognition (IAPR). Dr. Anto Satriyo Nugroho is a member of IEEE, Indonesian Association for Pattern Recognition (INAPR), Indonesian Association for Computational Linguistics (INACL) and Indonesian Society of Soft Computing.

Invited Speaker 6

Recent Progress of Lithium Ion Battery for Electric Vehicles

Prof. Dr. Eng. Agus Purwanto, ST. MT
Lithium Battery Research and Technology Centre,
Universitas Sebelas Maret, Surakarta, Indonesia

Abstract:

At the end of 2019, the Nobel prize in chemistry was awarded for the advancement of Li-ion batteries considering its discovery promotes the current technology and lifestyle. Li-ion batteries (LIBs) are considered as a vital and predominant power source for various wireless and portable electronics, and have even been applied to high performance Electric Vehicles, especially BEV and HEV. It is predicted by 2030, the largest Li-ion Batteries market will be electric vehicles, mainly cars. As it progressed, current problems found during the development of LIBs were addressed and needed to be overcome such as performance, cost, weight and size. However, cell chemistry and thermal management became the main focus. Cell chemistry considers not only the electrochemical performance, but also its availability to avoid material shortage in the future. It appears that $LiFePO_4$ and graphite system was selected due to its safety properties. However, future trends tend to use nickel rich cathode and silicon-graphite anode for high voltage (up to 5 V) and high energy density batteries. However, high energy density results in high thermal runaway risk, thus making thermal management and failure mechanisms equally as important as cell chemistry. Failure mechanisms of LIBs have been extensively studied. From the material level, challenges such as undesired side reaction, particle breakage and passivation and metal dissolution are often found. However, the current technology of morphology control, nano-layer coatings and structural modification can be used to solve these problems. At the cell level, extensive safety tests, i.e. a mechanical test, thermal test and electrical abuse test are necessary to assure the safety of LIB cells for EVs. With good battery cell design, safety issues can still emerge due to the use of liquid electrolyte which is often flammable and unstable at elevated voltage and temperature. This phenomenon has initiated the development of solid electrolytes for high safety all-solid-state batteries (ASSB). In conclusion, LIBs bring numerous advantages for civilization, however, during worldwide EV application, intrinsic and extrinsic challenges still remain under investigation. With excellent efforts, high safety electric vehicles will undoubtedly be achieved in the near future.

Short Biography:

Agus Purwanto is recognized as an Indonesian developer of Lithium Ion Batteries (LIBs) and the leader of the Centre of Excellence for Electrical Energy Storage Technology

(CEFEEST) Universitas Sebelas Maret. His current work is developing LIBs active material and design. He is the author of over 100 scientific papers, co-inventor of 14 inventions and a Professor in Chemical Engineering.

Agus Purwanto was born in Sragen, Indonesia in 1975 and currently lives with his family in Solo. He obtained his bachelor and master degree in Chemical Engineering from Institut Teknologi 10th November 1998 and 2002 respectively, and his Doctoral degree from Hiroshima University. He is taking a faculty position in the Chemical Engineering Department of Universitas Sebelas Maret.

Agus Purwanto has collaborated with many organizations and industries such as Indonesian Endowment Fund for Education (LPDP), Indonesian Institute of Science (LIPI), the National Nuclear Energy Agency (BATAN), PT Pertamina and Toyota. Agus Purwanto has received multiple awards including: Outstanding Lecturers of Universitas Sebelas Maret (2011), Academic Leader in Technology by Ministry of Research and Technology and Higher Education (2017), and Science and Technology Award by ITSF (2020).

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(ICONETSI 2020)

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SUSTAINABLE ENERGY AND ENVIRONMENT

Thermostat Influence Simulation During Warm-up Period In SI-Engine Cooling System

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ABSTRACT

This study shows the simulation of thermostatic valve in the cooling system of Spark Ignition (SI) Engine and the behavior of warm up period for difference ambient temperature. There is a condition in the field if there is malfunction on thermostat the fastest solutions to do is to remove it. This study result shows that the simulation without thermostat have 3 time longer than a system with thermostat to reach the working temperature. If the time to reach the optimal temperature last longer, the combustion process becomes inefficient. The experimental data will be used to calculate new equation for difference ambient temperature and the result shows the recommendation to fix the cooling system with new thermostat rather than remove it.

CCS CONCEPTS

•Computing methodologies~Modeling and simulation~Model development and analysis~Model verification and validation

KEYWORDS

Spark Ignition, Cooling System, Modelling, Thermostat Valve, OBD-II

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1 Introduction

Heat is one of the impacts on the process of energy converting. In an engine the chemical energy converted into mechanical energy to drive a vehicle. This heat comes from the combustion of fuel mixture and the friction of engine components against each other.[10] Economical direct injection diesel engine can only utilize at most 43% of the energy stored in the fuel and for Spark-ignition engine it only shows one third of overall energy (Fig 1). The primary functions of the cooling system in internal combustion engine are:

- To reach the operating temperature of engine as soon as possible.
- To remove excess heat due to the process on the engine.

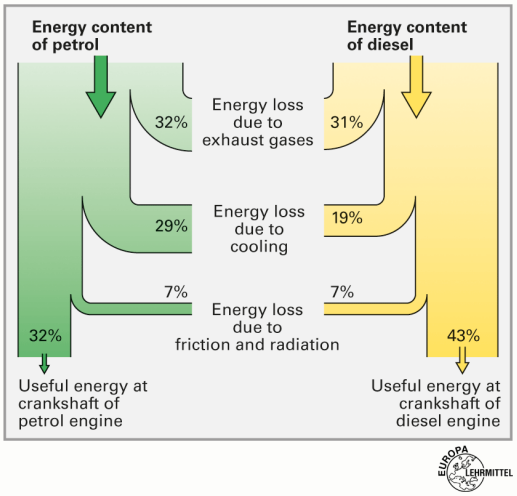

Figure 1: Sankey Diagram [5]

In an automotive engine, the heat comes from the friction of engine components and the combustion itself. This rising temperature must be managed to prevent the failure in engine mechanical system. This failure comes from overheating oil film between the mechanical components and also make a failure in metal components itself. With maintain the engine temperature we can also maintain the bad impact such as : high fuel consumption, low engine efficiency and poor exhaust emission [7][6][4].

The cooling system in an automotive engine consist of sub system such as: radiator, Radiator Fan, Water Pump and Thermostatic valve. On traditional engine cooling system, the mechanical connected fan and wax type of thermostatic valve are used. Latterly the development of cooling system technology, the wax thermostatic valve replace with electric controlled thermostatic valve and mechanical fan drive replaced with electric fan [3][11]. Figure 2 shows the schematic system of engine cooling, the function of thermostatic valve is to open and close the valve that allows coolant to pass the radiator or direct through bypass.

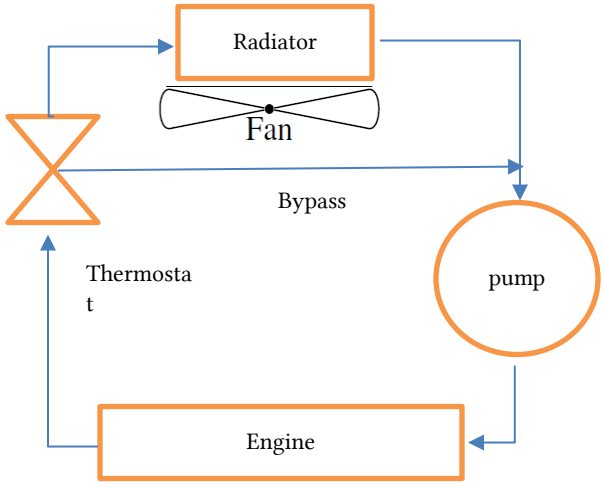

Figure 2: Schematic of Cooling System [2]

Thermostat in vehicle known as 'engine cooling control valves', is a part located in the engine cooling system and control the engine's temperature. This temperature consists of warm up period and operating temperature. In normal condition the engine need only partial part of coolant and in the full load condition the engine need the maximum flow of coolant. The difference amount of coolant must be controlled by engine cooling system. In warm up period, if the coolant flows through the radiator, the engine will be too cold, and the time to get the optimal operating temperature is too high. The thermostat sense the temperature and react with the opening valve. With this system, the optimal temperature will be achieved with short time. It will be closed in cold temperature and will be open in opening temperature. In this paper the thermostatic valve will be open at 80°C, this temperature has been determined by experimental result. This temperature means the thermostat has started opening. Another thermostat behavior has been researched by Arici et al, the opening temperature is 88°C (fig 3).[1] When the thermostat open, the coolant flows through the radiator, so the temperature will be reduced and the electric fan will be activated in certain temperature to help the coolant absorb the heat.

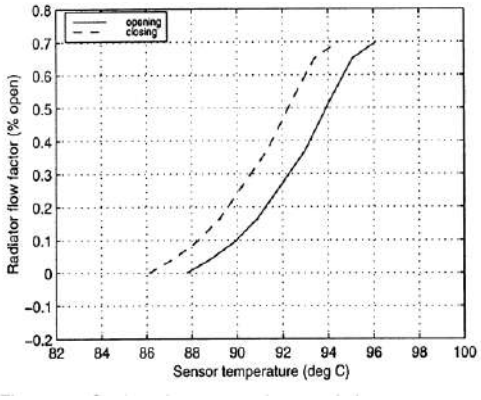

Figure 3: Thermostat characteristic [1]

2 Method

The method consists of 3 steps. The first step is data collecting. It was an experiment with a temperature measuring tools. The second step is a simulation. It was simulated using Simulink® software. The last method is mathematical calculation that be calculated with exponential equation. The equation used is based on the plot of graph.

2.1 Data Collecting

The experiment using a Sport Utility Vehicle (SUV) 1500cc with Spark ignition (SI) engine as a test vehicle. The coolant temperature data can be retrieved using standard OBD-II scanner device. The main menu of OBD-II scanner consist of: error read/erase, actuator activation and data stream. The function of OBD-II for this purpose is "Data Stream". This function allow user to get the actual data of engine such as: Temperature of coolant, temperature of air intake etc. The block diagram of data collecting shows on figure 4.

2.2 Simulations

Simulink® is used to make simulations, all of data parameter are used to make the simulation closer to reality. The data subsystem consists of: Thermostat, Radiator, Water Pump and Engine. The important data has been filled. The data are opening valve temperature (353,15 K), the coolant volume and the physical dimension of the sub system. The other parameter which are not examined in this research, filled using the parameter values in the simulation

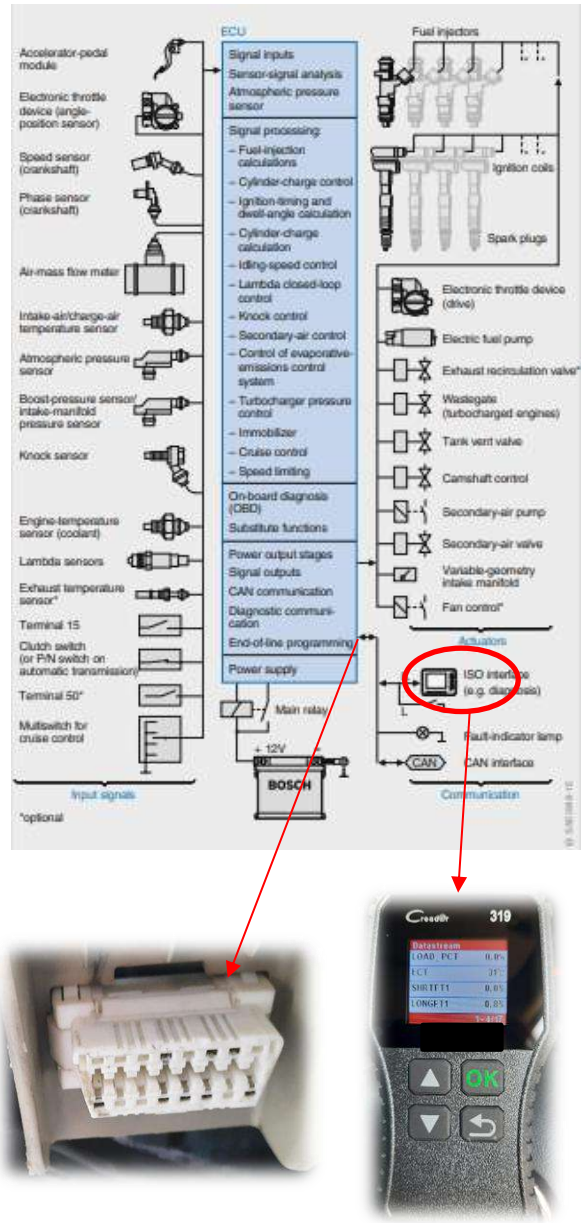

Figure 4: Automotive OBD-II Components [9]

2.3 Mathematical Analysis

The temperature graph has been analyzed with mathematical equation. The formula of the graph has been determined. This formula could be used to make the mathematical analysis in future work.

3 Simulations and Experimental

The simulations is used to examine the time to reach the working temperature. The method that has been used in this simulation is elimination model. The eliminated subsystem is Thermostat. The first simulation using a thermostat and the second simulation does not used thermostat.

Figure 5 and 6 shows a simulation created using Simulink. There are 2 model of simulation such as: with thermostat and without thermostat

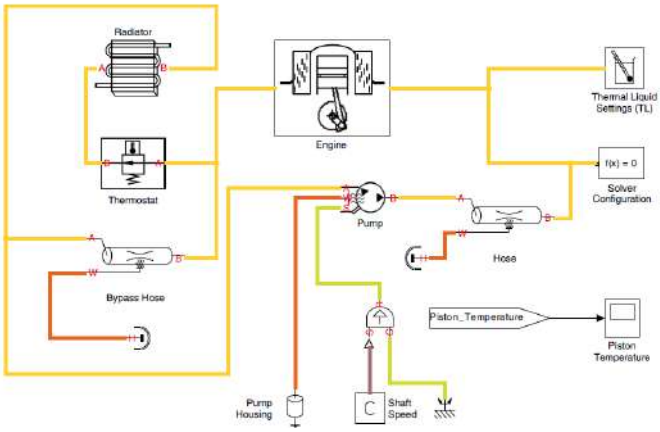

Figure 5: Simulation of Engine Cooling System

There are many sub system of engine simulation, in this case the simulation using a necessary detail according to the cooling system (Fig.5)

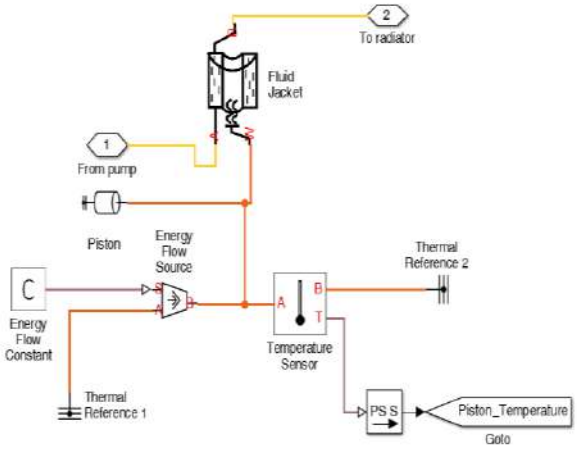

Figure 6: Detail of Engine Sub System

4 Result and Discussion

Fig 7 shows the result of temperature simulation with thermostat and without thermostat. Without thermostat the temperature need more time to reach working temperature

The function of thermostat is to regulate the water flow through the radiator. The opening temperature of thermostatic valve from our test vehicle is 80° C or 353,15 K.

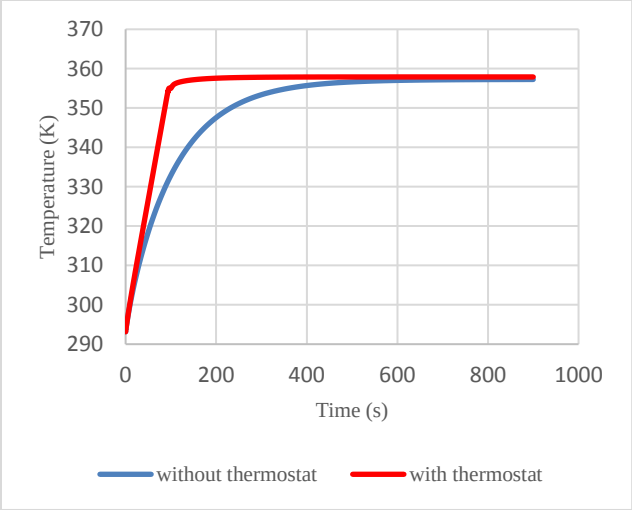

Figure 7: Result of Simulations with and without thermostat

As shown on figure 7, The system with thermostat need 91 s to reach the 353 K temperature. The system without thermostat need 291 s to reach the 353 K temperature. longer time to reach the working temperature make inefficiency of engine. This efficiency will be examined on next project.

To prevent the uncontrolled temperature rising, the engine equipped with a fan. The radiator fan are using the mechanical system or mechanical system. Figure 8 shows the experimental result of engine coolant temperature in complete period until fan motor activated. The graph shows the warm up period, the opening time of thermostatic valve that caused the flat graph and the rising temperature until fan motor active (98°C) and inactive (95°C). The system of temperature reading and motor fan actuation control the engine coolant temperature between 98°-95° C

Figure 9 shows the experimental data result of engine coolant temperature in warm up period with different ambient temperature 29°C and 31°C. according to this graph the formula of time and temperature could be written as exponential function [8]:

$$y = be^{mx} \quad (1)$$

$$m = \frac{1}{x_2 - x_1} \ln \frac{y_2}{y_1} \quad (2)$$

$$b = y_1 e^{-mx_1} \quad (3)$$

y = *Temperature (Kelvin)*
m = *gradient*
x = *time (second)*
b = *ambient temperature (Kelvin)*

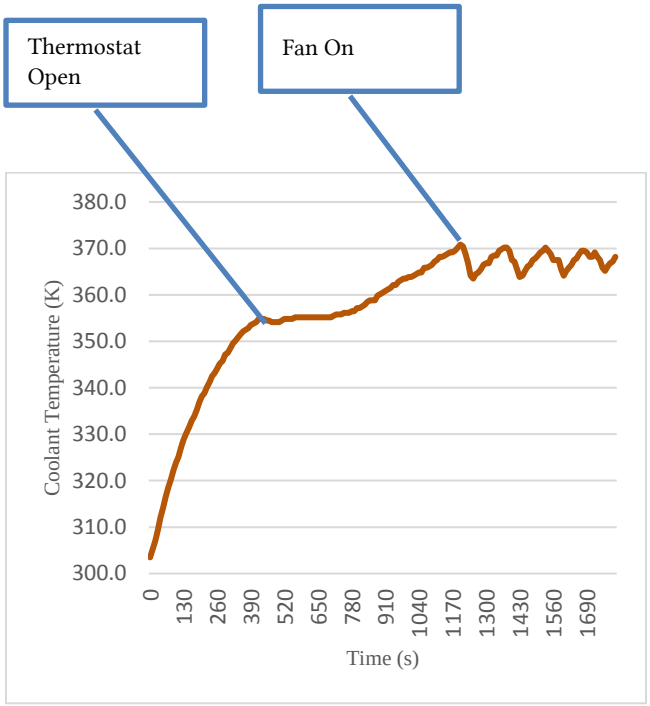

Figure 8: Result of Experimental Data in complete period

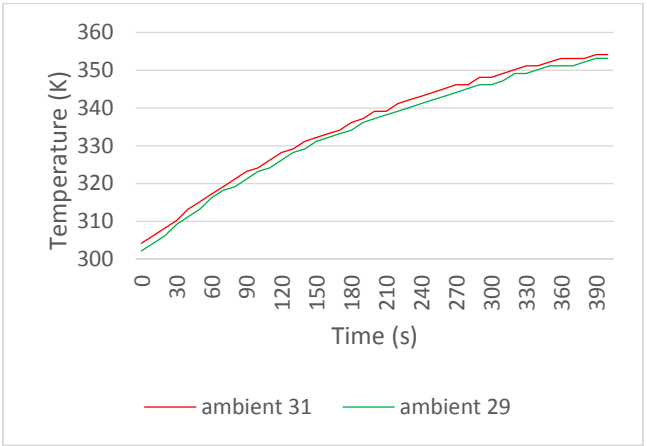

Figure 9: Result of Experimental Data in in different ambient temperature

The calculation of average graph as sampling data has been developed (figure 10). The average data using the result of 29°C and 31°C temperature. this average data has been used to determine the new formula of warm up behavior.

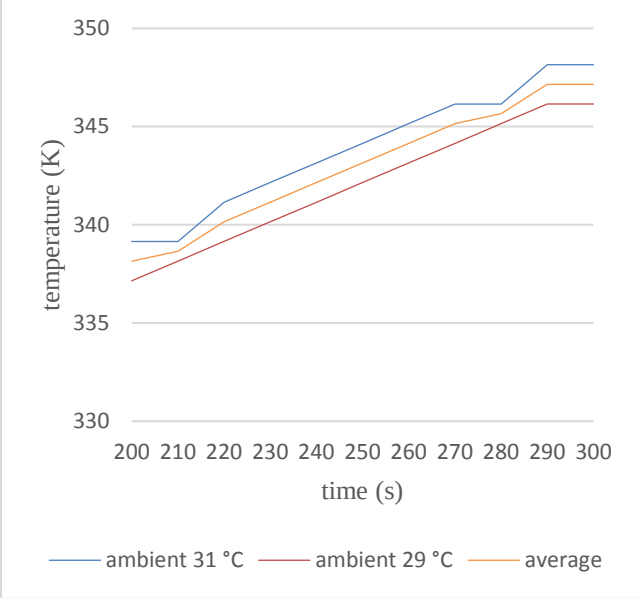

Figure 10: Average Data for calculations

According to equation (1), (2), (3) and figure 10 datasheet, we make a new equation to calculate the warm up behavior. This new equation are:

$$m = \frac{1}{(360-0)} \ln \frac{352,15}{303,15}$$

$$m = \frac{1}{360} \ln 1,16 = 4,16E-4$$

$$b = 303,15\ e^{-5,46*10^{-4}*0} = 303,15$$

$$y = 303,15\ e^{4,16*10^{-4}*x} \qquad (4)$$

The plot has been developed to validate the equation 4. Figure 11 shows The graph of equation (4) :

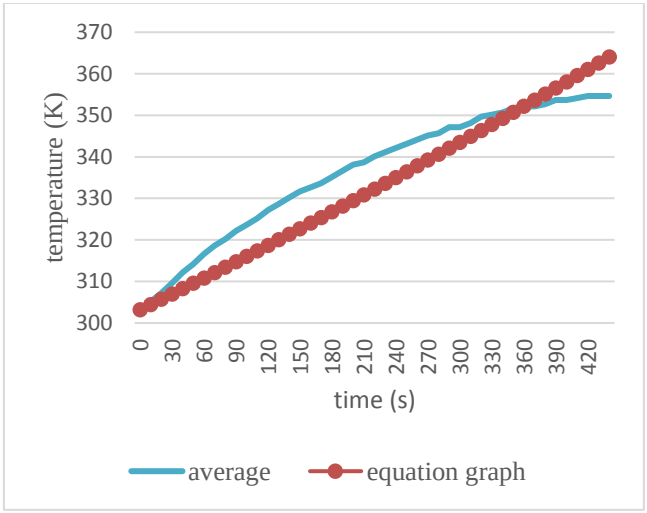

Figure 11: Average Data for calculations

The number of 303,15 comes from ambient temperature, with this equation, the new calculation of difference ambient temperature could be calculated as shown on figure 12. For example for new ambient temperature in 41°C.

$$y = (41 + 273,15)e^{4,16*10^{-4}*x}$$

$$y = 314,15\ e^{4,16*10^{-4}*x}$$

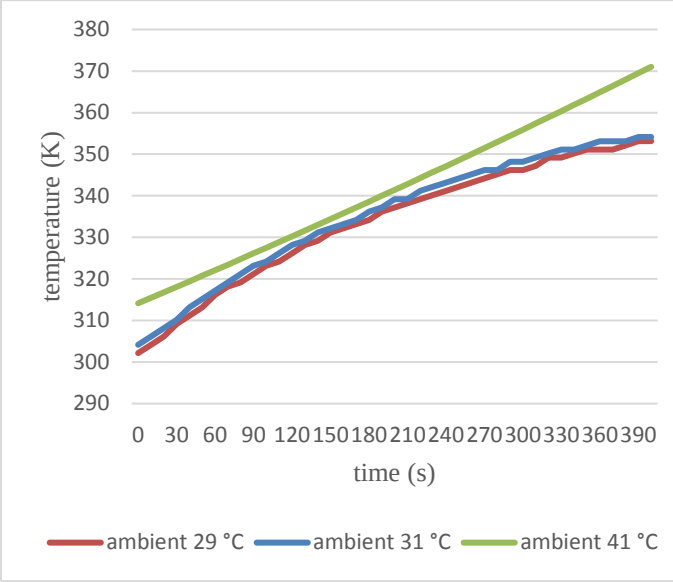

Figure 12: Graph of Equation

5 Conclusion

The Simulation to shows the engine coolant temperature has been made with simulink®. It shows that the system without thermostat have more than 3 times longer than the system with thermostat, to reach the working temperature. The experimental data has been take from vehicle using an OBD-II device. The ambient temperature difference of 2°C has a little effect to graphic result. But in an extreme condition the ambient temperature could affect in wide range. The equation of warm up behavior have been developed.

REFERENCES

[1] Oner Arici, John H. Johnson, and Ajey J. Kulkarni. 1999. The vehicle engine cooling system simulation part 1 - Model development. *SAE Tech. Pap.* 724 (1999). DOI:https://doi.org/10.4271/1999-01-0240

[2] Saif Siddique Butt, Robert Prabel, and Harald Aschemann. 2014. Robust input-output linearization with input constraints for an engine cooling system. *Proc. Am. Control Conf.* (2014), 4555–4560. DOI:https://doi.org/10.1109/ACC.2014.6858647

[3] Teresa Castiglione, Francesco Pizzonia, and Sergio Bova. 2016. A novel cooling system control strategy for internal combustion engines. *SAE Int. J. Mater. Manuf.* 9, 2 (2016), 294–302. DOI:https://doi.org/10.4271/2016-01-0226

[4] Roberto Cipollone and Davide Di Battista. 2015. Sliding vane rotary pump in engine cooling system for automotive sector. *Appl. Therm. Eng.* 76, (2015), 157–166. DOI:https://doi.org/10.1016/j.applthermaleng.2014.11.001

[5] Richad et al Fischer. 2014. *Modern Automotive Technology* (2nd ed.). Haan-Gruiten.

[6] Koorosh Khanjani, Jiamei Deng, and Andrzej Ordys. 2014. Controlling variable coolant temperature in internal combustion engines and its effects on fuel consumption. *SAE Tech. Pap.* 2014-Novem, (2014). DOI:https://doi.org/10.4271/2014-32-0064

[7] Franz W. Koch and Frank G. Haubner. 2000. Cooling system development and optimization for di engines. *SAE Tech. Pap.* 724 (2000). DOI:https://doi.org/10.4271/2000-01-0283

[8] William J Palm III. 2017. *System Dynamics* (3rd ed.). Mc Graw Hill, New York.

[9] Konrad Reif (Ed.). 2015. *Gasoline Engine Management.* Springer Vieweg.

[10] Konrad Reif and Karl-Heinz Dietsche. 2014. *Automotive Handbook* (9th ed.). Robert Bosch GmbH, Karlsruhe.

[11] X. Zou, J. A. Jordan, and M. Shillor. 1999. A dynamic model for a thermostat. *J. Eng. Math.* 36, 4 (1999), 291–310. DOI:https://doi.org/10.1023/A:1004587425961