Program Book

Sustainable Empowerment of Innovative Solutions Through the Development of Integrated Scientific Researches to Enhance the Advanced Technological World

A Joint Conference of International Conference on Sustainable Engineering Development and Technological Innovation (ICSEDTI) and Forum Pendidikan Tinggi Teknik Elektro Indonesia - International Conference Electrical Engineering (FORTEI-ICEE)

Tanjungpinang, Riau Islands, Indonesia October 11Th - 13Th 2022

Program Book of

2022 International Conference on Sustainable Engineering Development and Technological Innovation (ICSEDTI) & Forum Pendidikan Tinggi Teknik Elektro Indonesia – International Conference Electrical Engineering (FORTEI-ICEE)

Tanjungpinang, Riau Island, Indonesia

October, 11th – 13th 2022

Organized by:

The Engineering Faculty of
Universitas Maritim Raja Ali Haji
(UMRAH)

WELCOME MESSAGE FROM
THE DEAN OF FACULTY OF ENGINEERING
UNIVERSITAS MARITIM RAJA ALI HAJI

To all the committees and all academic civitas of Faculty of Engineering, Universitas Maritim Raja Ali Haji, I am very pleased with the participation of the speakers, presenters, participants, and everybody involved in organizing the 1st International Conference on Sustainable Engineering Development and Technological Innovation (ICSEDTI) in conjunction with the 2nd FORTEI International Conference on Electrical Engineering (FORTEI-ICEE) on the 12th of October 2022 in Tanjungpinang, Riau Islands, Indonesia.

The Engineering Faculty of Universitas Maritim Raja Ali Haji (UMRAH) welcome all of the guests to Riau Islands, one of the Provinces of Indonesia that geographically resembles Indonesia. Riau Islands Province consists of around 2000 islands scattered across vast ocean that covers about 97.65 % of its area. With such characteristics, challenges such as the provision of logistics, telecommunication, and energy are inherent. The Faculty of Engineering of UMRAH are there to answer the challenges through engineering developments and technological innovations that are not only effective or efficient, but also sustainable. We look forward to integrate the islands through internet and telecommunication, advanced logistics system that utilizes IoT, Artificial Intelligence, and Big Data, which is supported by the supply of sustainable energy harnessed from the sun, wind, and ocean wave. In addition to that, with the advantage of being in the proximity of neighboring countries, such as Singapore, Malaysia, Thailand, and Brunei, we are confident that regional collaboration in technological advances that will be beneficial to mankind and environment can be can be accomplished.

Finally, with such resolve, we are pleased to host this event that marks the beginning of our endeavour in the new era of engineering and technological innovation where sustainability is emphasized greatly. We hope that this event will foster great collaborations among the participants. We wish you success in this conference and may you feel enjoy, happy and comfortable during your stay in Tanjungpinang, Riau Islands, Indonesia.

Sincerely,

Ir. Sapta Nugraha, S.T., M.Eng.

Dean of the Faculty of Engineering

Universitas Maritim Raja Ali Haji

WELCOME MESSAGE FROM
THE CONFERENCE CHAIR OF 1st ICSEDTI & 2nd FORTEI-ICEE 2022

Indonesia has set a goal to become the World Maritime Axis under the leadership of the elected president. The meaning is that Indonesia's future transformation will rely on maritime power as the backbone of national development. There will be a shift in the paradigm of development that has been continent-based to a maritime-based one that covers aspects of political, economic, social, cultural and legal development as well as defense and security.

Sustainable empowerment of innovative solutions through the development of integrated scientific researches to enhance the advanced technological world. It's means that the maritime sector which is the identity of Indonesia must be explored together as much as possible so that later it will be able to support the economy.

The ICSEDTI and FORTEI-ICEE joint conferences are a form of UMRAH Engineering Faculty to participate in various national and international activities to initiate the sustainable empowerment of collaborative research as a vital role in creating quality of Innovation and Human Resources (HR) with strong maritime insight. This obsession of course must be achieved with hard work and support from all parties, going through stages in which there are various challenges and obstacles. However, by considering various supporting factors, this obsession is not a dream but a reality that can be achieved, with careful planning, accurate strategy and hard work.

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Thank you!

Sincerely yours,

Deny Nusyirwan, S.T., M.Sc
The 1st ICSEDTI & 2nd FORTEI-ICEE 2022 Conference Chair

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CONFERENCE INFORMATION

Date	:	October, 12th (Wednesday)
Organizer	:	Faculty of Engineering, Universitas Maritim Raja Ali Haji (UMRAH)
Venue	:	Aston Tanjungpinang Hotel and Conference Center, Jl. Adisucipto KM. 11 Tanjungpinang, 29125
Official Language	:	English
Secretariat	:	Faculty of Engineering, Universitas Maritim Raja Ali Haji (UMRAH) Phone : +62 852 0013 4360 Email : ICSEDTI@umrah.ac.id & ft@umrah.ac.id Web : https://ft.umrah.ac.id
Conference Website	:	https://icsedti.or.id/ & https://fortei-icee.org/

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ICSEDTI SCOPE OF THE CONFERENCE

Informatics Technology

- Artificial Intelligence
- Data Mining
- Big Data Technology
- Mobile Computing
- Machine Learning
- IT Infrastructure Development
- Information System and Management
- Software Management
- Cyber Security
- Microservices Architecture

Electrical Technology

- Telecommunications
- Paper Battery
- Renewable Energy
- Ultrasonic Motor
- Power Theft Detection
- Wireless Electricity
- Micro Fuels Cells
- Micro-power Generator
- Nano Technology
- Microprosessor Based Motor Speed Controller
- Molecular Electronics

Marine Technology

- Naval Architecture
- Ship Production and Material Technology
- Marine Engineering
- Marine Transportation
- Marine Robotics and Digitalship Technology

Advanced Manufacturing Technology and Applications

- Advanced Design and Manufacturing (Methods)
- Manufacturing System and Management
- Lean Manufacturing 3D
- Reliability and Maintenance Engineering
- Smart Production
- Matchining and Forging Technology
- Machine Learning for Manufacturing

Manufacturing Systems and Automation

- Industry 4.0 and IoT
- Production Planning and Control
- Production and Operation Management
- Hybrid Products
- Multidisciplinary
- Product Development
- Industrial Robotic
- Automation and Discreate Event Systems
- Applications for Smart Production Systems

Information Industry and Management

- Engineering Economy and Cost Analysis
- Global Manufacturing and Management
- Supply Chain Management
- Logistics Engineering and Management
- Ergonomics and Its Applications
- Industrial Internet of Things
- Block Chain for Manufacturing and Management

Mechanical Engineering

- Material Engineering
- Biomaterials
- Fuels and Combustion
- Instrumentation and Control
- Automation and Mechatronics
- System Dynamics and Simulation

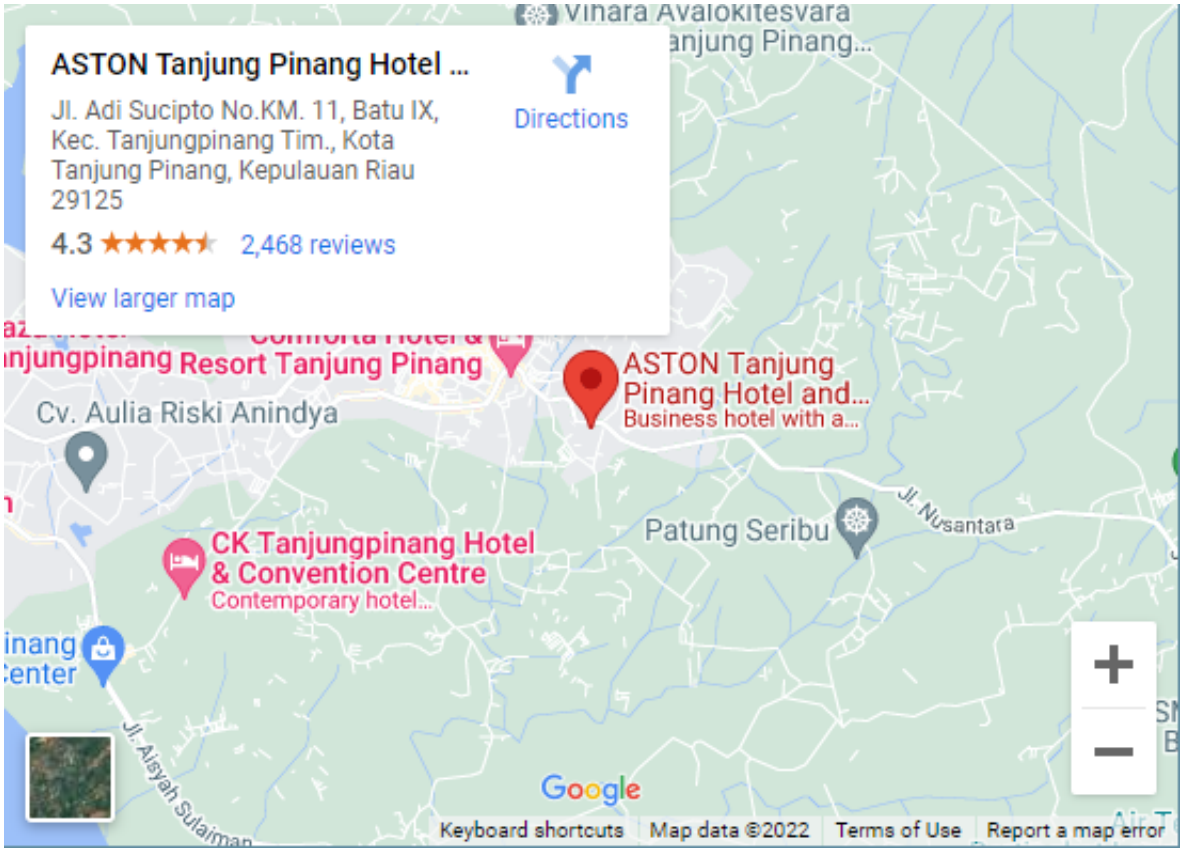
VENUE MAP

Aston Tanjungpinang Hotel and Conference Center, Jl. Adisucipto KM. 11
Tanjungpinang, 29125

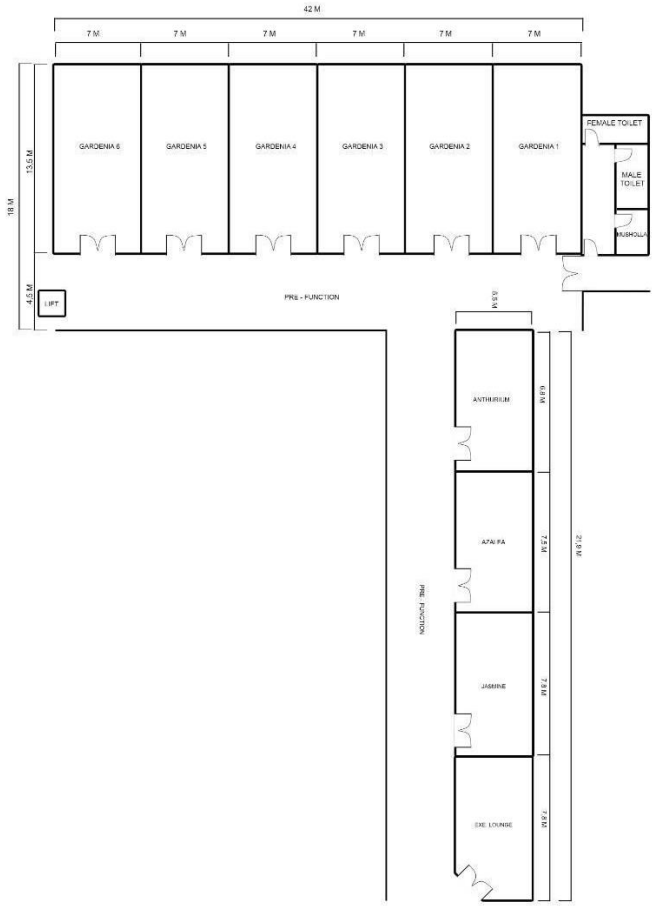
Phone : +62 85218515451

Email : tanjungpinanginfo@astonhotelsinternational.com

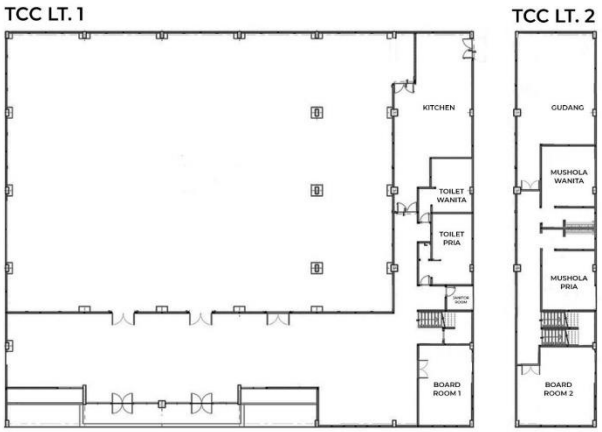
Web : https://www.astonhotelsinternational.com/en/hotel/view/39/aston-tanjung-pinang-hotel---conference-center



Aston Tanjungpinang Hotel Plan:



Trans Convention Centre Tanjungpinang Plan:



TECHNICAL PROGRAM
The schedule of ICSEDTI – FORTEI ICEE Joint Conference

THE OPENING OF ICSEDTI - ICEE JOINT CONFERENCE	**12 October 2022 Trans Convention Center**
07:30 - 08:30	Registration and Reception
08:30 - 08:35	Opening by MC
08:35 - 08:40	Prayer Recitation
08:40 - 08:45	National Anthem "Indonesia Raya"
08:45 - 08:50	Opening Speech from The Chair of ICSEDTI-ICEE Joint Conference: **Deny Nusyirwan, S.T., M.Si.**
08:50 - 09:00	Opening Speech from The Chairman of IEEE Indonesia: **Dr. Wahyudi Hasbi**
09:00 - 09:10	Opening Speech from The Chairman of FORTEI: **Prof. Ir. Hadi Suyono, S.T., M.T. Ph.D., IPU., ASEAN.Eng.**
09:10 - 09:15	Opening Speech from The Dean of Engineering Faculty of UMRAH: **Ir. Sapta Nugraha, S.T., M.Eng.**
09:15 - 09:25	Opening Speech from The Rector of UMRAH: **Prof. Dr. Ir. Agung Dhamar Syakti, S.Pi., DEA**
09:25 - 09:50	Keynote Speech – 1: **Prof. Selo, S.T., M.T., M.Sc., Ph.D.** (attending)
09:50 - 10:15	Keynote Speech – 2: **Prof. Goib Wiranto** (attending)
10:15 - 10:25	**Coffee Break**
10:25 - 10:50	Keynote Speech – 3: **Prof. Yvon Kemarrec** (online)
10:50 - 11:15	Keynote Speech – 4: **Prof. Dr. Ian Gibson** (online)
11:15 - 11:40	Keynote Speech – 5: **Dr. Ing. Ilham Habibie, MBA** (online)
11:40 - 13:00	Lunch & Prayer Break
13:00 - 17:30	Parallel session

PARALLEL SESSION

Parallel session of ICSEDTI:

PARALLEL SESSION : ICSEDTI OFFLINE	**October 12th, 2022**
Venue: GARDENIA 3	**13.00 - 17.30**

Plenary Speaker	**The Relevance of Competencies in the Field of Naval Engineering with the Real Needs of the Shipping Industries in Kepulauan Riau Province** Trisno Susilo
Plenary Speaker	**The Role Of Engineers In The Field Of Shipping Engineering In Regional Development And Sustainable Community Economic Growth In The Kepulauan Riau Province** Mulia Pamadi
Plenary Speaker	**Digital Transformation As a Strategy To Enhance The Advanced Technological Bussines** Budi Sulistiarto
ABS 04	**Surrogate Model-Based Optimization of Offshore Jacket Structure to Develop Minimum Structure** Rudi Walujo Prastianto; Ferdita Syalsabila; Daniel Mohammad Rosyid; Yeyes Mulyadi; Kriyo Sambodho
ABS 05	**Stress Concentration Factor Estimation of a Multiplanar DKT Tubular Joint through Finite Element and Machine Learning Approaches** Rudi Walujo Prastianto; Fulgentius Agiel Admiral; Yoyok Setyo Hadiwidodo; Daniel Mohammad Rosyid; Yeyes Mulyadi; Kriyo Sambodho
ABS 08	**Development Of Temperature Control And Monitoring System For Precision Aquaculture Based On The Internet of Things** Tauriq Fuji Nur Akbar; Hanif Fakhrurroja; Hollanda Arief Kusuma
ABS 14	**A Review of Artificial Intelligence-Enabled Electric Vehicles in Traffic Congestion Management** Sakti Prajna Mahardhika; Okkie Putriani
ABS 18	**Slamming Induced Vibrations in Oil Bulk and Ore (OBO) Carriers in Head Seas** Muhd. Ridho Baihaque; Mogheshwar Gokul Rajasekaran; Salaamin Amineen Nur Zakri Ag; Muhammad Haziq Julkipli; Muhammad Zaki Prawira; Mohamad Firzuan Raffy; Muzlifah Mansor

PARALLEL SESSION : ICSEDTI ONLINE — October 12th, 2022
Venue: GARDENIA 4 — 13.00 - 17.30

Plenary Speaker	**Future Ship Powering Options: Exploring Alternative Methods Of Ship Propulsion** Ab Saman Abdul Kadir
Plenary Speaker	**Investigation Of Closed Loop Re-Additive Manufacturing Of Waste Polymer** Mazher Iqbal Mohammed
Plenary Speaker	**Powering The Future With Hydrogen: A Hydrogen-Powered Boat As Future of Ocean Travel** Joerg Dieter Weigl
ABS 01	**Evaluation Study on Ship-To-Ship Loading/Offloading Safety Operation by Numerical Fluid Dynamics Method** Rudi Walujo Prastianto; Fahmy Ardhiansyah; Eko Budi Djatmiko; Murdjito
ABS 09	**Numerical and Experimental Study of Gravitational Water Vortex Turbine at Different Number of Blade** Himsar Ambarita; Burhan Hafid; Iman Telaumbanua; Idham Kamil; Farel H. Napitupulu
ABS 11	**Designing an IoT-Based Freshwater Crayfish Cultivation Monitoring Dashboard** Sonia Marselina; Hanif Fakhrurroja; Betha Nurina Sari
ABS 17	**Strength Analysis Of The Deck Crane Barge Using The Finite Element Method** Kharis Abdullah; Sumardiono; Hariyanto Soeroso
ABS 29	**Implementation Prototype Method on Queue System Development on Android Application** Agistira Lamunde; Alena Uperiati; Nurul Hayaty
ABS 03	**Sentiment Analysis Of Health Protocol Policy using K-NN and Cosine Similarity Measure** Nola Ritha; Nurul Hayaty; Tekad Matulatan; Alena Uperiati; Muhamad Radzi Rathomi; Martaleli Bettiza; Fidya Farasalsabila

Parallel session of FORTEI-ICEEE:

PARALLEL SESSION : FORTEI ICEE HYBRID	**October 12th, 2022**
Venue: GARDENIA 1	**13.00 - 17.30**

Plenary Speaker	**The Present And Future Are Digital: Intelligent Instrumentation System for Remote Areas The Kepulauan Riau Province** Hanif Fakhrurija
Plenary Speaker	**Solar Powered Boat: A Multidisciplinary Engineering Challenge For Undergraduate Students** Martin Henz
[1570845558]	**Supervisory System for On-Grid Solar Power Plant** Reno Muhammad Fadilla; Nanang Ismail; Tri Desmana Rachmilda; Ibrahim Nur A
[1570841012]	**Implementation of Internet of Things in Agriculture Irrigation System for Remote Monitoring and Controlling with Solar Energy** Muhammad Afnan Habibi; Arya Kusumawardana; Langlang Gumilar; Bayu Arivia Putra; Rasyid San Adjie; Adi Izhar Che Ani
[1570838825]	**Autonomous Mobile Robot Design with Behaviour-Based Control Architecture Using Adaptive Neuro-Fuzzy Inference System (ANFIS)** Andi Adriansyah; Eko Ihsanto; Julpri Andika
[1570844869]	**Placement of Harmonic Filter and Detuned Reactor to Improve Power Quality in Renewable Energy Ring Topology Distribution Network** Langlang Gumilar; AN Afandi; Denis Eka Cahyani
[1570831420]	**Design and Implementation of a K-Band Active Frequency Quadrupler with Low DC Power Consumption** Okan Özdemir; Mesut Kartal
[1570844154]	**Multilayers Physical Authentication and NoSQL PRESENT Algoritm for Data Center** Zaidan Nuraga Chuldun; Desi Marlena; Dimas Febriyan Priambodo; Arizal Arizal
[1570834423]	**Modeling of Digital Scale Based on IoT** Muhammad Ifan Saputra; Sri Ratna Sulistiyanti; Arinto Setyawan; Umi Murdika; Yonathan Tri Handiko

[1570852970] **Smart University Development Challenges Using Lora or Sigfox Technology: A Systematic Literature Review**
Bayu Devanda Putra; Rizal Munadi; Hubbul Walidainy; Syahrial Syahrial; Teuku Yuliar Arif; Alfin Turangga Putra

[1570843162] **Deep Learning Implementation for Snail Trails Detection in Photovoltaic Module**
Fitriyanty Dwi Lestary; Syafaruddin Syafaruddin; Intan Sari Areni

[1570848055] **Brainwaves Analysis Using Electroencephalogram (EEG) in Nursing Mothers for Relaxation Conditions**
Munawar A Riyadi; Al Ikhsan Nugraha; Anggorowati Anggorowati

PARALLEL SESSION : FORTEI ICEE (OFFLINE) October 12th, 2022
Venue: GARDENIA 2 13.00 - 17.30

Plenary Speaker	**The Concept of Building a Habitable House for the Sea Tribe Community Based on Local Wisdom** Rusli
[1570850722]	**Fuzzy Logic Sliding Mode Control Based on SEPIC Converter for MPPT in WECS** Fitta Rhia; Muhammad Khamim Asy'ari
[1570844022]	**Influence of Magnetic Skewing Segmentation on the Cogging and Voltage of a Permanent Magnet Synchronous Generator** Rini Nur Hasanah; Miroslav Markovic; Wijono Wijono; Bernadus Blasio Arsoni
[1570841524]	**A Development of an Accelerometer-Based Vibration Detector System to Evaluate Hand Motion in Different Shooting Positions** Jeki Saputra; Didik R. Santoso; Hari Arief Dharmawa; Rini Nur Hasanah
[1570841031]	**Design of Electrical Load Controller Using Microcontroller for Micro Hydroelectric in Andungbiru, Probolinggo, East Java, Indonesia** Teguh Utomo; Mahfudz Shidiq; Rini Nur Hasanah; Lunde Ardhenta
[1570834470]	**Brain-Computer Interface Based on Neural Network with Dynamically Evolved for Hand Movement Classification** Khairul Anam; Widhi Winata Sakti; Mahardhika Pratama; Saiful Bukhori; Faruq Sandi Hanggara; Budi Liswanto
[1570853622]	**Multiclass Classification of COVID-19, Pneumonia, or Normal Lungs Based on Chest X-Ray Images with Ensemble Deep Learning** Novie Theresia Br. Pasaribu; Tarissya Brilianna Saputra; Audyanti Gany; Jimmy Hasugian; Erwani Merry Sartika
[1570856222]	**A Generic FPGA Module for QCM Sensor Array Processing using Neural Network** Adharul Muttaqin; Setyawan P Sakti; Agus Naba; Panca Mudjirahardjo
[1570833380]	**A Review of Image Processing Approaches of the Iridology as A Biomedical** Devan Junesco Vresdian; Anindya Ananda Hapsari

[1570834525] **SSIM as Validation Technique on Normalization Segmented Iris**
Devan Junesco Vresdian; Anindya Ananda Hapsari

[1570847997] **Analysis of Power Quality in Voltage Parallel Process on Maintenance Without Outage**
Retno Aita Diantari; Atthariq Nurrachman

International Conference on Engineering Development and Technological Innovation
website:
doi:
Research Paper

Design And Implementation of Three Phase Motor Driver For PWM-Based BLDC Motor Speed Control

Hendri[1], andDoni Tri Putra Yanto[2]
{hendri@ft.unp.ac.id[1], doni@ft.unp.ac.id}[2]

[2]Electrical Engineering Department, Faculty of Engineering, Universitas NegeriPadang

Abstract. The Along with the times, the need for motors that have high efficiency, high torque, high and variable speed, and low maintenance costs has increased. one of these motors is a Brushless DC motor that uses electric commutation so that it has high efficiency and long operating time. Therefore, to meet the need for high efficiency, high torque, high and variable speed, and low maintenance costs, a Brushless DC motor (BLDC) or a Brushless AC motor (BLAC) is used. BLDC motors are widely used in industry compared to other types of motors, because BLDC motors have many advantages. But there is also a weakness of the BLDC motor, namely the difficulty in regulating the speed. With this condition the author is interested in making an innovation to overcome this problem, by making a three-phase motor driver as a BLDC motor control to regulate the rotation of the BLDC motor so that the speed can be varied. This three-phase motor driver consists of an Arduino Nano microcontroller and a three-phase inverter circuit that uses an IRF3205 MOSFET. The Arduino Nano microcontroller is used as a MOSFET ignition in a three-phase inverter circuit, the result is The success parameter of this research is being able to determine the commutation of the BLDC motor which is then controlled by a three-phase inverter through the Arduino NANO microcontroller to control the speed of the BLDC motor with a certain frequency.

Keywords: Brushless DC Motor, Arduino NANO, 3 Phase Inverter, Hall Effect Sensor, MOSFET IRF 3505.

1 Introduction

Along with the times, the need for motors that have high efficiency, high torque, high speed and can be varied, and low maintenance costs is increasing. These weaknesses can be overcome by using a Brushless DC motor that uses electric commutation so that it has high efficiency and long operating time[1]–[3]. Therefore, to meet the need for high efficiency, high torque, high and variable speed, and low maintenance costs, a Brushless DC motor (BLDC) or a BrushlesS AC motor (BLAC) is used. In order for the BLDC motor to work, it is necessary to have a rotating magnetic field in the stator[4]–[6]. To obtain the rotating magnetic field of the stator, a

3-phase ac voltage source is needed on the motor stator. Therefore, a 3-phase inverter is used to convert the DC voltage into a 3-phase ac voltage. Based on the form of 3-phase ac voltage generated by the inverter, there are 2 methods used in controlling the BLDC motor inverter, namely by using the sinusoidal Pulse Width Modulation (PWM) method and the six-step method[7]–[9]. The six-step method is a method that is often used in controlling BLDC motors. This happens because this method is easy to implement and has a simple algorithm. The waves generated from this method are square or trapezoidal.

1.1 Brushless DC Motor

Brushless DC motor or also known as electronically commutated motor (electric commutated motor) is a type of synchronous motor that is supplied by a DC power source to operate its control and has an electrical commutation system. In general, BLDC consists of two parts, namely the rotor, the moving part, which is made of permanent magnets and the stator, the stationary part, which is made of 3-phase coils. Although it is a 3-phase AC synchronous electric motor, this motor is still called a BLDC because in its implementation BLDC uses a DC source as the main energy source which is then converted into AC voltage using a 3-phase inverter. The purpose of applying a 3-phase AC voltage to the BLDC stator is to create a rotating magnetic field of the stator to attract the rotor magnets[10]–[12].

Because there are no brushes on the BLDC motor, to determine the right commutation timing on this motor so that a constant torque and speed is obtained, 3 Hall sensors and an encoder are needed. In the Hall sensor, the commutation timing is determined by detecting the magnetic field of the rotor using 3 Hall sensors to get 6 different timing combinations.

1.2 Hall Effect Sensor

Hall Effect Sensor is a transducer that can convert magnetic information into electrical signals for further processing of electronic circuits. This Hall Effect sensor is often used as a sensor to detect proximity (proximity), detect position (positioning), detect speed (speed), detect movement direction (directional) and detect electric current (current sensing)[13]–[15]. A transducer that varies its output voltage in response to a magnetic field. Hall sensors are usually used for timing wheel and axle speed, such as for internal combustion engines with ignition timing, tachometers and anti-lock braking systems. In brushless DC electric motors there is a Hall sensor to detect the position of the permanent magnet contained in the motor which will send signal to the microcontroller to provide a switching signal for the mosfet so that it can rotate the BLDC motor. In the BLDC motor itself, there are 3 hall sensors with different angles of 120 degrees so that they can form 6 combinations.

1.3 Three Phase Inverter

Inverter is a converter to convert DC voltage into AC output voltage whose frequency can be adjusted. The output variable voltage can be set by setting the input voltage. If the input voltage is constant, then we can adjust the output voltage by adjusting the gain of the inverter which is usually done with PWM control[16], [17]. To be able to carry out the Six-Step steps, a 3-Phase Driver consisting of six MOSFETs is needed as shown in Figure 1.

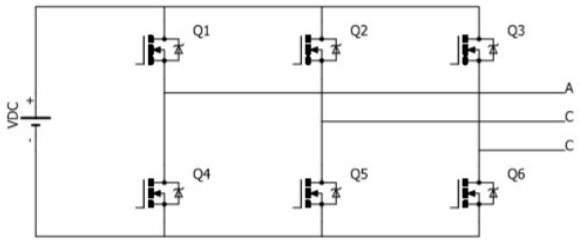


Fig. 1. 3-Phase Inverter

MOSFETs Q1, Q2, Q3, Q4, Q5 and Q6 (usually using MOSFETs) are controlled following a periodic sequence of 6 states.

Table 1. The sequence of steps so that the motor rotates clockwise (CW).

Time (Step)	Hall Input			Phase A		Phase B		Phase C	
	A	B	C	Q1	Q2	Q3	Q4	Q5	Q6
1	0	0	1	0	0	0	1	1	0
2	1	0	1	1	0	0	1	0	0
3	1	0	0	1	0	0	0	0	1
4	1	1	0	0	0	1	0	0	1
5	0	1	0	0	1	1	0	0	0
6	0	1	1	0	1	0	0	1	0

In this design, N channel MOSFET is used as a switch. MOSFETs have smaller power losses due to the switching process compared to other types of transistors. The MOSFET used in this final project is a MOSFET of the IRF3250 type. MOSFET type IRF3205 is an NPN type transistor capable of working up to 110A. Since the IRF3205 has a maximum current of up to 110A, some MOSFETs may be subject to PWM signals. The use of PWM on transistors can increase a transistor stress.

2. BLDC Motor Simulation using Proteus

This paper discusses the simulation results of a BLDC motor using Proteus software. This simulation is carried out when designing the tool or before making the tool, it is useful to find out the results needed as an illustration of the real results of making the tool.

The implementation of the tool uses a 3-phase inverter to control the BLDC motor using a digital control system in the form of an Arduino NANO microcontroller. Next, we will discuss the simulation of the implementation of using a 3-phase inverter to control a BLDC motor using the Proteus software.

At the time of designing the tool the author needs an overview of the final result of making the tool in the form of the BLDC motor[18], [19]. Therefore, the author uses Proteus software to perform the necessary simulations to see an overview of the final result. The following describes the system circuit of the BLDC simulated with Proteus in the Figure 2 & 3.

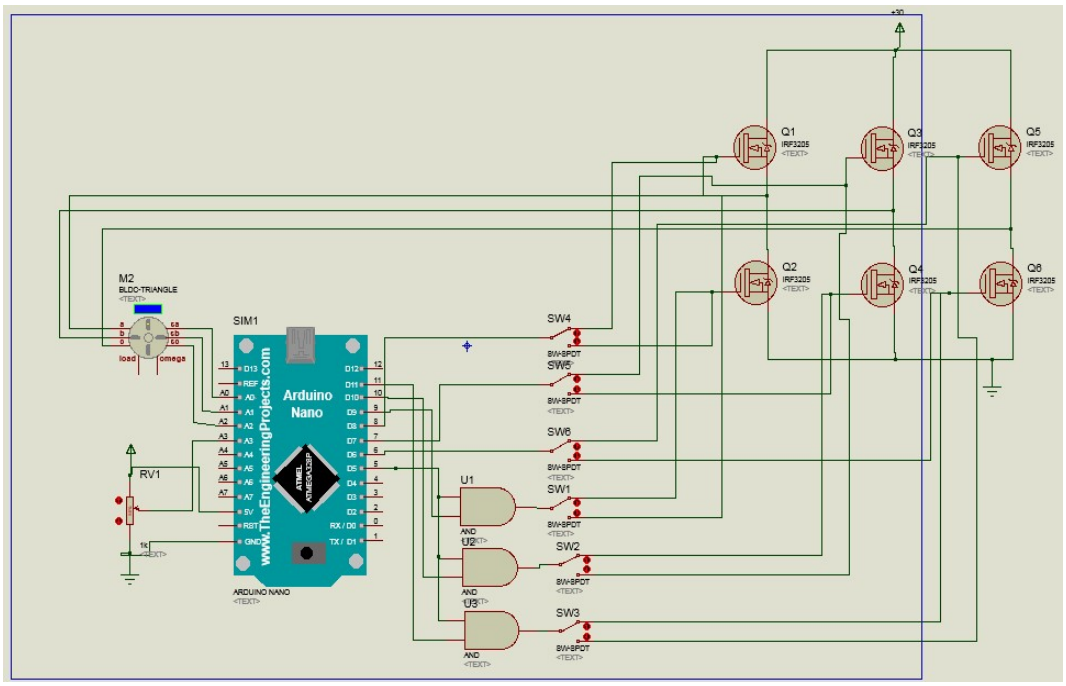


Fig. 2. BLDC Simulation Control Using Proteus

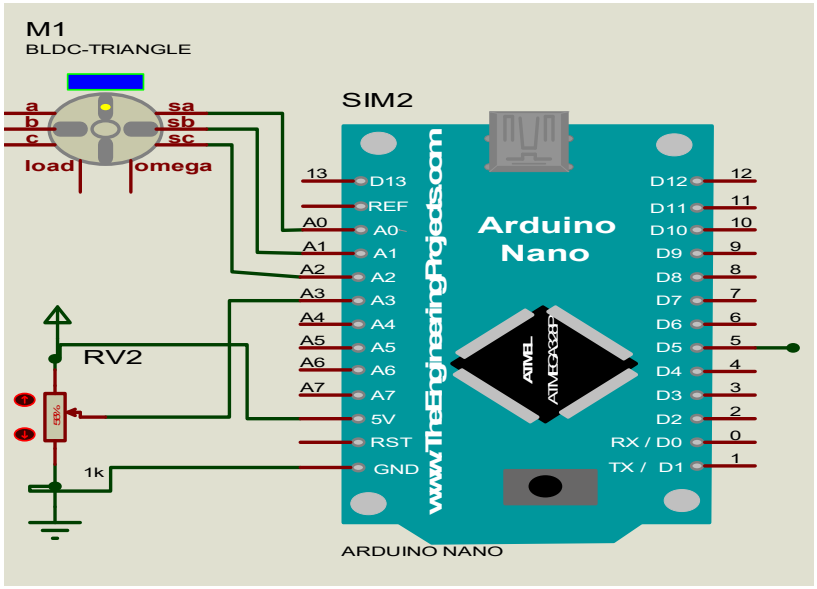


Fig. 3. Port positioning for BLDC motor and Potentiometer

Based on Figure 2, it is explained that the minimum system circuit gets an input signal in the form of an ADC input on Pin PC0 and input from the hall effect sensor readings on the rotor position with the following mechanism: H1 on pin A0, H2 on pin A1, and H3 on pin A2. The output signal generated by the Arduino NANO microcontroller will be issued by the output side on PA3 as a set duty cycle and PD10, PD9, PD8, PD7, PD6, PD5 as a PWM set. Before it will be an input signal for the TTL 7408 IC which will produce an output in the form of a switching PWM. The TTL 7408 IC requires a 5 Volt supply voltage.

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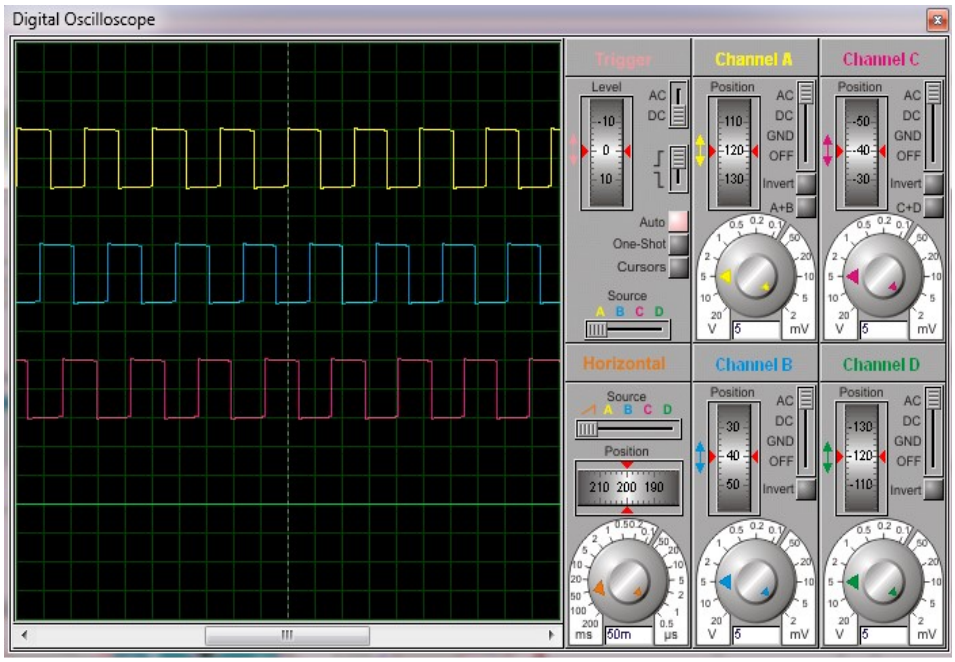
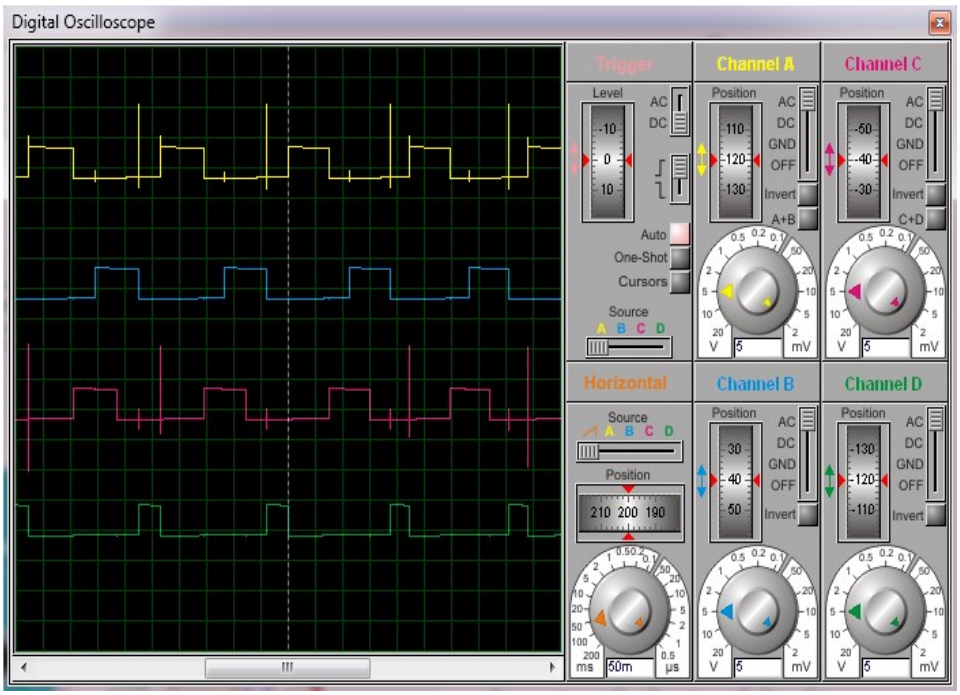


Fig.4. Hall Sensors A, B, and C Clockwise.



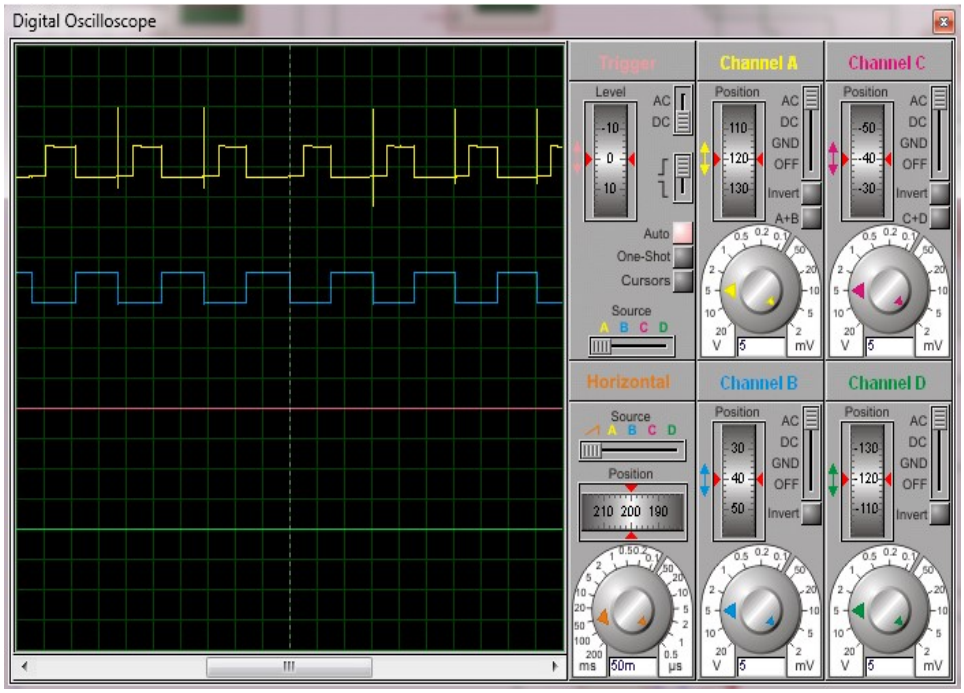


Fig.5. Clockwise (CW) Switching MOSFET.

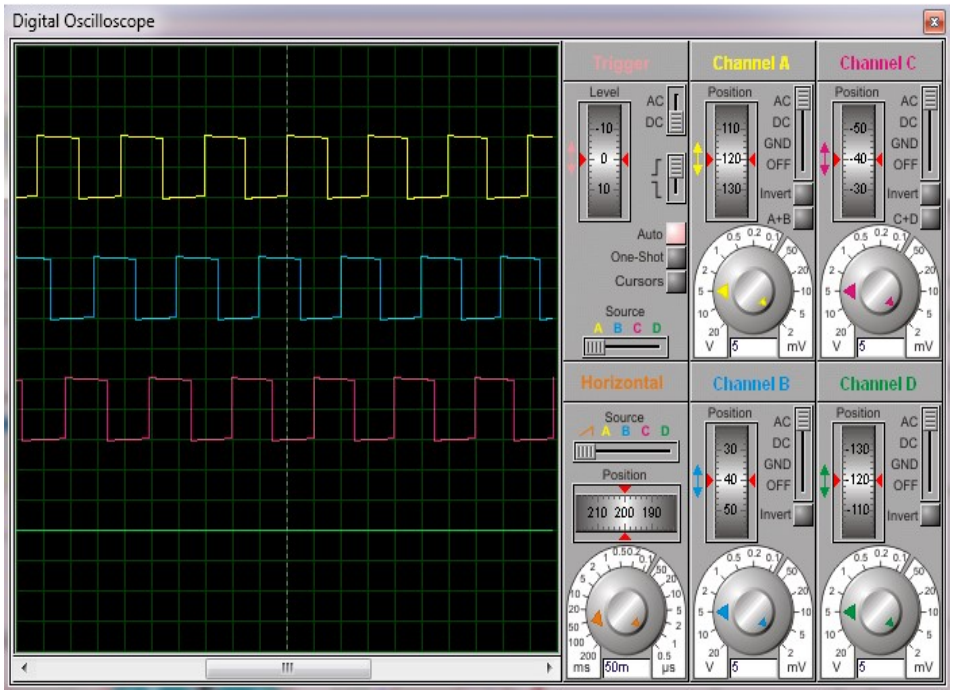


Fig. 6. Hall Sensors A, B and C Counterclockwise (CCW)

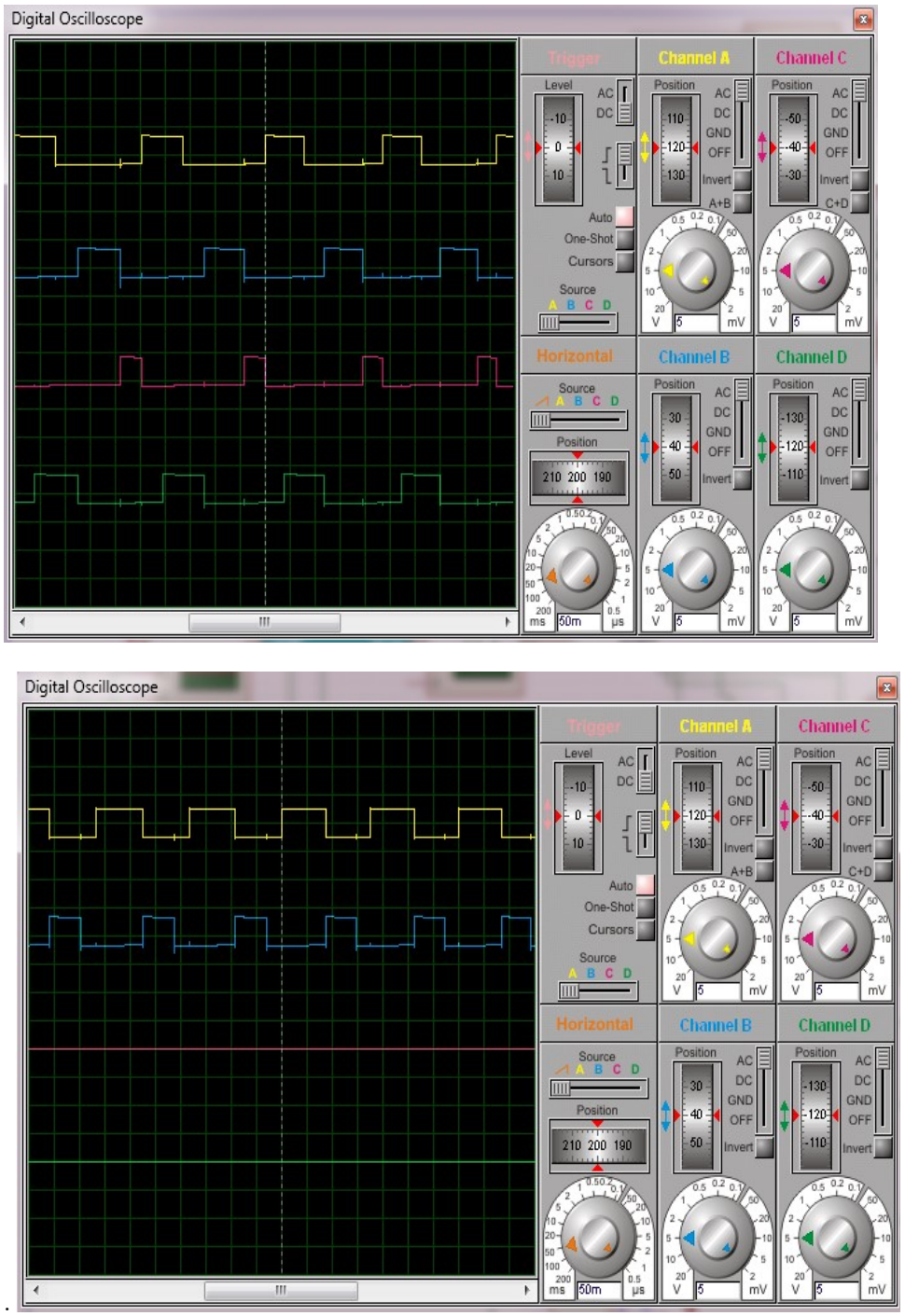


Fig. 7. Counter-Clockwise (CCW) Switching MOSFET

3. Conclusion

Previously, the design and simulation of the tool making program as well as testing the speed settings for the BRUSHLESS DC motor have been carried out. So in this case it can be concluded that by increasing the value of the duty cycle it will increase the speed of the motor and increase the output voltage of the inverter and increase the current of the inverter and with the increase in the switching frequency given it will increase the speed of the BRUSHLESS DC motor.After testing and discussing this tool, the authors suggest that in addition to using a hall sensor as a rotor position detector, it may also be possible to use a back-emf motor circuit because by using a hall sensor when the motor speed is too high, the hall sensor is often not read.

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