Android-based Indonesian sign language model using robot hand

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Abstract. Sign language is one of the most effective ways to communicate with deaf people. However, not everyone is able to use sign language. Therefore, in this study, a sign language display system was created using a hand robot that was moved through an Android-based application on a smartphone to overcome this problem. The design and development of the system begin from the manufacture of hardware consisting of one hand robot with 11 servo motors as the actuators, the Arduino Mega 2560 microcontroller as the main controller and a Bluetooth module for wireless communication between hand robot and smartphone. Then software development is carried out on the hand robot controller and android based application on a smartphone. Furthermore, system testing is carried out by validating the results of the letters and numbers shown by hand robot with gestures in the Indonesian Language Signalling System Dictionary (SIBI). The results show that the hand robot has been able to display letters and numbers according to the instructions given by an Android-based application on a smartphone with an 80% accuracy rate.

1. Introduction

Sign language is a major issue in disabled people, particularly among deaf people. Until now, sign language is the most effective way for deaf people to be able to communicate using different gesture, hand movement, body or facial expression. Sign language is very unique, every gesture has a different meaning for different people [1]. It depends on how they express their thoughts. Due to its unique, every country has their own sign language [2], as well as in Indonesia, namely the Indonesian sign language (ISL) [3]. ISL can be broadly divided into two, the alphabet and word gesture. For the alphabet gesture, ISL refers to the American Sign Language (ASL), while for the word gesture refer to Indonesian common symbolize [4,5]. However, in daily life, word gesture is the common sign language used in Indonesia due to practice and have a much larger sign. The main component of the gesture is formed by the fingers and hand movements [6].

There is growing research into technology for sign language recognition. To date, there are two approaches that have been widely used, contact and vision-based approach [7]. Contact-based involve physical interaction, while vision-based approaches use data collected from images or video frames captured using the camera as an input of the system [6,8]. The visual sensor has shown safety and good accurately [9,10]. Although, many sign language recognition systems that had been developed, most of them were implemented using desktop and laptop computer, which is impractical due to its weight and size [4]. For example, in 2014, Kosova Sign Language recognition system has been developed using...
Kinect with skeleton positions, the shape of the hand, hand position relative to other body parts, and hand movement direction [11].

Nowadays, robots are working cooperatively with human beings to share and exchange their ideas and thoughts. The human hand gesture is, therefore, immerging great interest in the improvement of the human-robot boundary as it offers a natural and effective way of exploring expressions [12]. Previous study has been developing a simulated system to train the humanoid robot to perform sign languages by replicating the information of human hand-arm motion using depth sensors [13]. However, previous study used manufactured-humanoid robot with high cost. In this research, the hand-robot is design directly with low cost and presents a method of integrating text and voice signal to move the hand robot model as the sign language display system through an Android-based application on a smartphone. Hand-robot sign language translator occupied with microcontroller-based voice recognition that could make easy for deaf people to communicate with other people. This sign language translator hand-robot uses 11 Servo motors as movers or actuators on robot fingers.

![Block diagram system](image)

**Figure 1.** Block diagram system.

2. Materials and method

2.1. System architecture

This Android-based Indonesian sign language model using a robot hand was a prototype that designed and developed which consist of two main part included hardware and software system as shown in figure 1. There was three part in the hardware, namely input, controller, and output. In the input, consists of two section. First, the text generated from an Android-based application created using MIT App Inventor 2 software. In this application, interfaces were alphabet A to Z and 1 to 9 which function as senders of alphabetical finger commands in languages signal. The second input was EasyVR Voice Recognition module to move the sign language to hand robot using voice. In the controller section, Arduino Mega 2560 is used to process input signals in the form of text and voice that have been in accordance with the signal section with Bluetooth interfaces and serial communication. Then in the output section is a servo motor with the driver as a finger on the robot arm and the LCD Display module functions as the alphabet viewer. The design and development of software were performed on Arduino Mega and Android-based
MIT App Inventor 2 as a controller by compiling program algorithms for each controller as described in the following section.

2.2. Robot hand design

The sign language robot hand was designed by developing the open source 3D printed humanoid robot “InMoov” as shown in Figure 2 [14]. However, the InMoov robot hand only have 1 DoF for each finger. So it is necessary to add a servo motor to increase the flexibility of the movement of the robot's fingers. In this study, a hand robot was designed using 11 servo motors as shown in Figure 3, which consisted of 5 servo motor on the finger and 5 servo motor placed on the robot finger joints, and 1 servo on the robot wrist. While the connection between fingers and servo is connected using a rope. The servo motor used in the robot is an MG996R type servo motor. MG996R servo is one type of servo motor that has a rotation up to 180 degrees and has a metal gear, this servo has a large torque that is a maximum up to 10 kg.

![Figure 2. Front side view of the hand robot.](image1)

![Figure 3. Hand robot with 11 servo motors.](image2)

2.3. Software system design

The software used in this sign language robot hand is Arduino IDE, EasyVR Commander, and MIT App Inventor. Arduino IDE software is used to program and run servo motors, and send data to LCD modules. While EasyVR Commander software is used to create, save a program that can process a signal in the form of letters and numbers and also human voice which will be sent to Arduino and then processed into output, and the last is MIT App Inventor 2, MIT App Inventor 2 is an online tool to create an android application on a website and then convert it to the form of Apk, Apk which is one of the file formats used to distribute and install software to an Android smartphone with the development process was shown in Figure 4. The following is the overall system algorithm that shows the system work process.
Figure 4. Android-based application development process.

2.3.1. System algorithm

- Initialization system
- Select the input mode whether using Voice or Android-based application
- If the voice mode was selected, then read the voice signal from the voice recognition module and move the finger of the robot hand based on the command input.
- If the Android application mode was selected, then connect the Bluetooth communication system between Arduino and Smartphone.
- Read the text file signal from the serial communication module via Bluetooth module and move the finger of the robot hand based on the command input.
- Send the alphabet character to the LCD display.

3. Results and discussion

The results of the hardware system were implemented in a prototype with a three dimension (3D) hand robot model equipped with all the system functions as shown in Figure 5. While the developed software system on smartphones through the Android application was shown in Figure 6. By testing the system that has been integrated both hardware and software showed that the system was working properly according to the planned algorithm.
The next step is to test whether the Robot Hand Sign Language can be made in accordance with the Indonesian sign language dictionary and to determine the success of the movement of letters and numbers. Voice is used as an input in the voice recognition module has repeatedly recorded three times for each alphabet. In the Android application, just need to touch the symbol on the screen. Figure 7 and Figure 8 shows that the hand-robot can demonstrate the alphabet such as A, B, C, D, E, F as ISL.

To verify whether the results of the test has a good accuracy between the hand-robot movement and real human gesture, we perform the three-time test for each alphabet and number. If the test shows the same movement, then we count it as 1 (means correct). After that, we calculated a percentage of correctness for each alphabet or number performance using Equation (1), the sum of correctness divided the total test (3 times) multiply by 100%. If the result is more than 50%, then we assumed that the hand-robot movement and human gesture shows good accuracy.
The total percentage of accuracy for the whole characters of the alphabet was obtained from the sum of correctness between instructions and performance divided by total instruction. The results show that only 28 out of 35 alphabets demonstrated good accuracy, means that the systems were build up to 80%.

\[
Accuracy = \frac{\text{correctness of each characters}}{\text{total test}} \times 100\% \quad (1)
\]

The results of this study show that the systems were built up until 80%, means could not perform all alphabet characters. There is some limitation movement on the wrist due to lack of servo motor. Further study is needed to add motor servo in the wrist to enable hand-robot move more freely, thus can demonstrate the others alphabets (G, H, J, M, N, P, Q, and Z).

4. Conclusion
The results show that the right side hand robot with five fingers can display the alphabet (A to Z) and numbers (0-9). However, due to the limitation of the robot hand movement, these alphabets (G, H, J, M, N, P, Q, and Z) cannot be displayed as the model. So as the hand robot has been able to display letters and numbers according to the instructions given by an Android-based application on a smartphone with an 80% accuracy rate.

Acknowledgments
The authors would like to express their appreciation and extremely grateful to the student in running this study for their gracious participation.

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CERTIFICATE

This certificate is awarded to

Taryudi, Pitoyo Yuliarmojo and Muhammad Angga Paripurna

as Presenter

Android-based Indonesian Sign Language Model Using Robot Hand

in the 4th Annual Applied Science and Engineering Conference (AASEC) 2019
"Integrating Innovations in Science and Engineering among Young Researchers"
Bali, Indonesia, April 24, 2019.

Co-host:

Prof. Dr. Dewi Putu Widjana, DAP&E/Sp. Park.
Rector of Universitas Warmadewa

Vice Rector for Research, Partnership, and Business
Universitas Pendidikan Indonesia

Prof. Dr. Djatnika, MA

Number: 4414/UN40.R4/PB/2019

AASEC 2019

The 4th Annual Applied Science and Engineering Conference
Bali, 24 April 2019
RUNDOWN
ORAL, ROUNDTABLE, AND
POSTER SESSION
# AASEC 2019 Program

## Wednesday, April 24, 2019

| TIME          | EVENT                                                                 | VENUE                        |
|---------------|-----------------------------------------------------------------------|------------------------------|
| 07.00-08.00   | Registration                                                          | Grand Ballroom               |
| 08.00-09.40   | Oral Session I, Round Table Session I, Poster Session I               | Room 1-6, Room 7, B1 Floor Corridor |
| 09.40-10.00   | Coffee Break                                                          |                              |
| 10.00-10.30   | Opening Ceremony, Chairman of AASEC 2019, President of Warmadewa Foundation, Rector of UPI | Grand Ballroom               |
| 10.30-12.00   | Plenary Session, Keynote Speaker 1, Keynote Speaker 2, Invited Speaker 1, Invited Speaker 2, Discussion, Grand Ballroom | Grand Ballroom               |
| 12.00-13.00   | Lunch Break                                                           | Room 1-6, Room 7, B1 Floor Corridor |
| 13.00-14.30   | Oral Session II, Round Table Session II, Poster Session II            |                              |
| 14.30-16.00   | Oral Session II, Round Table Session II                               |                              |
|               | Closing                                                               |                              |

**NOTES**

- Registration Counter: Grand Ballroom (3rd Floor)
- Oral Presentation: Room 1 = Grand Ballroom (3rd Floor), Room 2-6 = B1 Floor
- Roundtable: Room 7 = Batur Room (B1 Floor)
- Poster Presentation: B1 Floor Corridor = North and South Corridor
- Coffee Break & Lunch Break: Grand Ballroom (3rd Floor)

**Organized by:**

- Universitas Warmadewa
Oral presentation rooms are located on B1 Floor and Ballroom, Aston Denpasar Hotel and Convention Center (see the timetable). The discussion will be held in 3 (three) sessions. Each session consists of 60 (sixty) presenters and divided into 6 (six) rooms (see the timetable).

There are ten presenters in each room, and each session lasts for 90 minutes including presentation and discussion. Each session will be led by a moderator appointed by the Committee.

Each presenter must prepare five ppt slide shows which consist of Title and Abstract, Introduction, Method, Results and Discussion, and Conclusion. The ppt file(s) must be submitted to the assigned moderator 5 minutes before the presentation. Each moderator is equipped with a laptop which can be used by the presenters.

Presentasi lisan dilaksanakan di Hotel Aston Denpasar, Lantai B1 dan Ballroom (lihat jadwal).

Presentasi lisan dilaksanakan dalam 3 (tiga) sesi dan masing-masing sesi terdiri dari 60 peserta yang akan dibagi ke dalam 6 ruangan. Dalam setiap ruangan, terdapat 10 pemakalah dengan total waktu selama 90 menit, termasuk presentasi dan diskusi (tanya jawab).

Setiap sesi dipimpin oleh seorang moderator yang telah ditunjuk panitia.

Pemakalah menyiapkan power point berisi 5 (lima) slide show yang terdiri dari Title and Abstract, Introduction, Method, Results and Discussion, and Conclusion.

File slide show agar diserahkan kepada moderator max. 5 menit sebelum setiap sesi dimulai.

Moderator menyiapkan laptop yang dapat digunakan oleh pemakalah untuk presentasi lisan.
1. Presenters must be ready in the designated room 10 minutes before the discussion. Use this time to get to know each other. Mobile phones and laptops are not allowed during the discussion session.
2. Smoking and toilet-break are not allowed during the discussion session.
3. Each member opens the discussion in a polite manner and listens carefully to the discussion. No interruptions are allowed.
4. Discussion is a consensus-meeting (no one should dominate).
5. Each member participates voluntarily and actively in the discussion.

1. Peserta berada di ruangan masing-masing 10 menit sebelum diskusi dimulai. Gunakan waktu untuk berkenalan dengan peserta lain di ruangan.
2. Tidak menggunakan telepon seluler dan laptop pada saat diskusi.
3. Tidak diperkenankan merokok atau pergi ke toilet.
4. Membuka diskusi dengan sopan, menyimak dengan seksama saat peserta lain memberikan paparan, dan tidak melakukan interupsi.
5. Diskusi dilaksanakan secara consensus (tidak ada yang mendominasi).
6. Berpartisipasi sukarela dan aktif dalam diskusi.
**ORAL PRESENTATION**

**SESSION I**  
(08.00-09.40 WITA)

| ROOM 1 (Mechanical Engineering) | ROOM 2 (Biology) | ROOM 3 (Industry Engineering) | ROOM 4 (Electrical Engineering) | ROOM 5 (Computer Science) | ROOM 6 (Chemistry) |
|--------------------------------|------------------|-------------------------------|--------------------------------|---------------------------|------------------|
| ABS-188                        | ABS-367          | ABS-436                       | ABS-1127                       | ABS-711                   | ABS-635          |
| ABS-533                        | ABS-665          | ABS-1082                      | ABS-368                        | ABS-291                   | ABS-420          |
| ABS-336                        | ABS-966          | ABS-877                       | ABS-333                        | ABS-451                   | ABS-292          |
| ABS-338                        | ABS-47           | ABS-629                       | ABS-200                        | ABS-381                   | ABS-253          |
| ABS-242                        | ABS-320          | ABS-385                       | ABS-703                        | ABS-351                   | ABS-415          |
| ABS-615                        |                  | ABS-387                       | ABS-698                        | ABS-383                   | ABS-719          |
| ABS-30                         | ABS-309          | ABS-319                       | ABS-592                        | ABS-363                   | ABS-603          |
| ABS-409                        | ABS-176          | ABS-857                       | ABS-257                        | ABS-267                   | ABS-619          |
|                                |                  |                               | ABS-721                        | AB1038                    | AB515            |
| ABS-950                        | ABS-938          | ABS-699                       | ABS-80                         | ABS-1046                  | ABS-664          |
# ORAL PRESENTATION

**SESSION II**  
(13.00-14.30 WITA)

| ROOM 1  | ROOM 2        | ROOM 3      | ROOM 4      | ROOM 5          | ROOM 6   |
|---------|---------------|-------------|-------------|-----------------|---------|
| (Mathematics) | (Pharmacology & Sport Science and Technology) | (Management Science) | (Computer Science) | (Electronics Engineering) | (Physics) |
| ABS-68  | ABS-512       | ABS-855     | ABS-337     | ABS-218         | ABS-460 |
| ABS-668 | ABS-236       | ABS-931     | ABS-220     | ABS-350         | ABS-930 |
| ABS-936 | ABS-261       | ABS-284     | ABS-223     | ABS-342         | ABS-786 |
| ABS-802 | ABS-737       | ABS-162     | ABS-520     | ABS-341         | ABS-324 |
| ABS-560 | ABS-269       | ABS-433     | ABS-339     | ABS-73          | ABS-312 |
| ABS-948 | ABS-232       | ABS-275     | ABS-126     | ABS-582         | ABS-440 |
| ABS-1028| ABS-42        | ABS-697     | ABS-82      | ABS-455         | ABS-21  |
| ABS-872 | ABS-24        | ABS-464     | ABS-1052    | ABS-487         | ABS-171 |
| ABS-524 | ABS-325       | ABS-247     | ABS-26      | ABS-764         | ABS-28  |
| ABS-1128| ABS-413       | ABS-300     | ABS-9       | ABS-567         | ABS-386 |
## ORAL PRESENTATION

### SESSION III

(14.30-16.00 WITA)

| ROOM 1 (Biology) | ROOM 2 (Civil Engineering & Architecture) | ROOM 3 (Computer and Communication Engineering) | ROOM 4 (Computer Science) | ROOM 5 (Environmental Engineering) | ROOM 6 (Chemical Engineering) |
|-----------------|------------------------------------------|-----------------------------------------------|---------------------------|-------------------------------------|--------------------------------|
| ABS-598         | ABS-64                                   | ABS-16                                        | ABS-812                   | ABS-847                             | ABS-852                        |
|                 | ABS-65                                   | ABS-77                                        | ABS-303                   | ABS-120                             | ABS-879                        |
| ABS-602         | ABS-900                                  | ABS-372                                       | ABS-530                   | ABS-750                             | ABS-671                        |
| ABS-296         | ABS-858                                  | ABS-276                                       | ABS-943                   | ABS-684                             | ABS-739                        |
| ABS-727         | ABS-707                                  | ABS-277                                       | ABS-148                   | ABS-621                             | ABS-382                        |
| ABS-548         | ABS-1033                                 | ABS-725                                       | ABS-234                   | ABS-641                             | ABS-380                        |
| ABS-29          | ABS-315                                  | ABS-401                                       | ABS-393                   | ABS-571                             | ABS-384                        |
| ABS-662         | ABS-651                                  | ABS-823                                       | ABS-13                    | ABS-1086                            | ABS-962                        |
| ABS-274         | ABS-378                                  | ABS-33                                        | ABS-166                   | ABS-937                             | ABS-388                        |
| ABS-81          | ABS-318                                  | ABS-554                                       | ABS-940                   | ABS-783                             | ABS-379                        |
ROUNDTABLE
SESSION
ROUNDTABLE DISCUSSION

Roundtable Discussion aims to:

- Share research findings,
- Get feedback of the research findings from other members, and
- Build network with other colleagues in the same area of research.

The discussion room is located on B1 Floor, Room Batur, Aston Denpasar Hotel and Convention Center.

The discussion will be held in three sessions. Each session consists of 100 presenters who will be seated in ten roundtables (see the timetable).

There are ten presenters in each table, and each session lasts for 90 minutes including presentation and discussion. Each session will be led by a moderator appointed by the Committee.

Each presenter must prepare one-page extended abstract which consists of Title, Authorship, Affiliation, Introduction, Method, Results/Findings and Discussion, Conclusion, and References.

The abstract is written on an A4-size paper, using Times New Roman (12 pts), and 1.5 space.

Each presenter must prepare ten (10) copies of the abstract for each member of the discussion.

DISKUSI MEJA BUNDAR

Diskusi Meja Bundar bertujuan untuk:

- Berbagi hasil penelitian,
- Mendapatkan umpan balik dari penelitian yang telah dilakukan, dan
- Membangun jejaring dengan kolega yang memiliki bidang kajian yang sama.

Diskusi meja bundar dilaksanakan di Hotel Aston Denpasar, Lantai B1, Ruang Batur.

Diskusi dilaksanakan dalam tiga sesi, dan masing-masing sesi terdiri dari 100 peserta yang akan dibagi ke dalam 10 meja bundar. Dalam satu meja bundar, terdapat 10 pemakalah dengan total waktu diskusi per sesi selama 90 menit, termasuk presentasi dan diskusi (tanya jawab).

Setiap sesi diskusi dipimpin oleh seorang moderator yang telah ditunjuk panitia. Pemakalah menyiapkan satu lembar extended abstract yang terdiri dari Title, Authorship, Affiliation, Introduction, Method, Results/Findings and Discussion, Conclusion, dan References.

Abstrak dituliskan dalam kertas A4, menggunakan font Times New Roman, ukuran huruf 12, dan spasi 1,5.

Pemakalah menyiapkan salinan abstrak sebanyak 10 eksamplar untuk diberikan kepada pemakalah lain dalam satu meja.
Presenters must be ready in the designated table 10 minutes before the discussion. Use this time to get to know each other. Mobile phones and laptops are not allowed during the discussion session. Smoking and toilet-break are not allowed during the discussion session. Each member opens the discussion in a polite manner and listens carefully to the discussion. No interruptions are allowed. Discussion is a consensus-meeting (no one should dominate). Each member participates voluntarily and actively in the discussion.

Peserta berada di meja bunda 10 menit sebelum diskusi dimulai. Gunakan waktu untuk berkenalan dengan peserta lain di satu meja. Tidak menggunakan telepon seluler dan laptop pada saat diskusi. Tidak diperkenankan merokok atau pergi ke toilet. Membuka diskusi dengan sopan, menyimak dengan seksama saat peserta lain memberikan paparan, dan tidak melakukan interupsi. Diskusi dilaksanakan secara consensus (tidak ada yang mendominasi). Berpartisipasi sukarela dan aktif dalam diskusi.
## ROUNDTABLE

### SESSION I
(08.00-09.40 WITA)

| TABLE 1 (Industry Engineering) | TABLE 2 (Biology) | TABLE 3 (Mechanical Engineering) | TABLE 4 (Physics) | TABLE 5 (Material Engineering) | TABLE 6 (Management Science) | TABLE 7 (Computer and Communication Engineering) | TABLE 8 (Chemistry) | TABLE 9 (Electrical Engineering) | TABLE 10 (Material Science) |
|--------------------------------|-------------------|----------------------------------|-------------------|-------------------------------|-------------------------------|-----------------------------------------------|-------------------|-------------------------------|-------------------------------|
| ABS-371                        | ABS-283           | ABS-430                          | ABS-153           | ABS-932                       | ABS-1010                      | ABS-1084                                      | ABS-465           | ABS-346                        | ABS-1000                       |
| ABS-700                        | ABS-271           | ABS-175                          | ABS-751           | ABS-999                       | ABS-118                       | ABS-352                                       | ABS-159           | ABS-488                        | ABS-231                        |
| ABS-901                        | ABS-649           | ABS-618                          | ABS-726           | ABS-708                       | ABS-244                       | ABS-821                                       | ABS-299           | ABS-490                        | ABS-263                        |
| ABS-771                        | ABS-653           | ABS-230                          | ABS-518           | ABS-867                       | ABS-402                       | ABS-921                                       | ABS-226           | ABS-946                        | ABS-537                        |
| ABS-23                         | ABS-657           | ABS-138                          | ABS-221           | ABS-444                       | ABS-1072                      | ABS-151                                       | ABS-317           | ABS-129                        |                                |
| ABS-1073                       | ABS-308           | ABS-645                          | ABS-605           | ABS-282                       | ABS-152                       | ABS-459                                       | ABS-604           | ABS-482                        |                                |
| ABS-544                        | ABS-3              | ABS-449                          | ABS-820           | ABS-822                       | ABS-12                        | ABS-486                                       | ABS-461           | ABS-483                        |                                |
| ABS-760                        | ABS-545           | ABS-78                           | ABS-86            | ABS-785                       | ABS-710                       | ABS-448                                       | ABS-1013          | ABS-362                        | ABS-475                        |
| ABS-498                        | ABS-566           | ABS-723                          | ABS-1116          | ABS-132                       | ABS-235                       | ABS-1066                                      | ABS-549           | ABS-454                        | ABS-219                        |
| ABS-565                        | ABS-746           | ABS-1104                         | ABS-501           | ABS-916                       | ABS-728                       | ABS-902                                       | ABS-56             | ABS-18                         | ABS-866                        |
| TABLE 1 (Material Engineering & Mechanical Engineering) | TABLE 2 (Civil Engineering) | TABLE 3 (Industry Engineering) | TABLE 4 (Information Engineering) | TABLE 5 (Management Science & Mathematics) | TABLE 6 (Environmental Engineering) | TABLE 7 (Biology) | TABLE 8 (Pharmacology & Sport Science and Technology) | TABLE 9 (Electrical Engineering) | TABLE 10 (Sport Science and Technology) |
|--------------------------------------------------------|----------------------------|--------------------------------|----------------------------------|---------------------------------------------|-----------------------------------|-----------------|-----------------------------------------------|-------------------------------|----------------------------------|
| ABS-590 | ABS-54 | ABS-187 | ABS-215 | ABS-46 | ABS-917 | ABS-392 | ABS-435 | ABS-345 | ABS-250 |
| ABS-614 | ABS-55 | ABS-240 | ABS-228 | ABS-160 | ABS-677 | ABS-391 | ABS-445 | ABS-357 | ABS-102 |
| ABS-913 | ABS-111 | ABS-361 | ABS-112 | ABS-646 | ABS-689 | ABS-713 | ABS-229 | ABS-648 | ABS-493 |
| ABS-514 | ABS-143 | ABS-663 | ABS-113 | ABS-806 | ABS-920 | ABS-396 | ABS-691 | ABS-1117 |  |
| ABS-7 | ABS-121 | ABS-787 | ABS-891 | ABS-170 | ABS-815 | ABS-494 | ABS-502 | ABS-1071 | ABS-458 |
| ABS-125 | ABS-610 | ABS-178 | ABS-347 | ABS-133 | ABS-1112 | ABS-716 | ABS-811 | ABS-366 | ABS-630 |
| ABS-706 | ABS-807 | ABS-179 | ABS-314 | ABS-833 | ABS-181 | ABS-5 | ABS-349 | ABS-768 | ABS-438 |
| ABS-1 | ABS-611 | ABS-903 | ABS-71 | ABS-889 | ABS-214 | ABS-588 | ABS-762 | ABS-782 | ABS-457 |
| ABS-1114 | ABS-370 | ABS-859 | ABS-555 | ABS-443 | ABS-709 | ABS-406 | ABS-1054 | ABS-485 |  |
| ABS-1108 | ABS-1057 | ABS-280 | ABS-473 | ABS-432 | ABS-804 | ABS-327 | ABS-1092 | ABS-290 | ABS-809 |
| TABLE 1 (Computer Science) | TABLE 2 (Information Engineering) | TABLE 3 (Civil Engineering & Environmental Engineering) | TABLE 4 (Industry Engineering & Chemical Engineering) | TABLE 5 (Computer Science) | TABLE 6 (Material Science) | TABLE 7 (Computer Science) | TABLE 8 (Electronics Engineering & Electrical Engineering) | TABLE 9 (Computer Science) | TABLE 10 (Biology) |
|----------------------------|-----------------------------------|-------------------------------------------------------|------------------------------------------------------|---------------------------|--------------------------|--------------------------|--------------------------------------------------------|---------------------------|----------------|
| ABS-40                     | ABS-51                            | ABS-48                                                | ABS-97                                               | ABS-122                   | ABS-1002                  | ABS-101                   | ABS-123                                               | ABS-52                     | ABS-685           |
| ABS-117                    | ABS-626                           | ABS-114                                               | ABS-194                                              | ABS-128                   | ABS-131                   | ABS-105                   | ABS-124                                               | ABS-83                     | ABS-748           |
| ABS-88                     | ABS-1024                          | ABS-195                                               | ABS-115                                              | ABS-58                    | ABS-682                   | ABS-191                   | ABS-334                                               | ABS-568                    | ABS-453           |
| ABS-139                    | ABS-165                           | ABS-237                                               | ABS-116                                              | ABS-301                   | ABS-636                   | ABS-192                   | ABS-609                                               | ABS-834                    | ABS-481           |
| ABS-353                    | ABS-67                            | ABS-246                                               | ABS-672                                              | ABS-376                   | ABS-817                   | ABS-49                    | ABS-185                                               | ABS-519                    | ABS-434           |
| ABS-1064                   | ABS-107                           | ABS-835                                               | ABS-906                                              | ABS-272                   | ABS-1115                  | ABS-50                    | ABS-355                                               | ABS-348                    | ABS-570           |
| ABS-763                    | ABS-416                           | ABS-96                                                | ABS-862                                              | ABS-803                   | ABS-472                   | ABS-204                   | ABS-596                                               | ABS-265                    | ABS-581           |
| ABS-767                    | ABS-189                           | ABS-6                                                 | ABS-521                                              | ABS-286                   | ABS-431                   | ABS-601                   | ABS-754                                               | ABS-735                    |                 |
| ABS-791                    | ABS-190                           | ABS-93                                                | ABS-462                                              | ABS-513                   | ABS-784                   | ABS-523                   | ABS-654                                               | ABS-810                    |                 |
| ABS-238                    | ABS-59                            | ABS-84                                                | ABS-828                                              | ABS-492                   | ABS-935                   | ABS-742                   | ABS-2                                                 | ABS-717                    | ABS-61            |
POSTER PRESENTATION INFORMATION

LOCATION
North and South Corridor, Floor B1, Aston Denpasar Hotel & Convention Center

POSTER SESSION
2 Sessions of Poster presentation
Session I (08.00-12.00 WITA)
Session II (13.00-16.00 WITA)

DURATION
Wednesday, 24 April 2019 (See the Rundown of AASEC 2019)

POSTER DISPLAY
Poster must be displayed on the designated board 15 minutes before the presentation.
Poster must be stuck using double tape or blu tac (the committee will not prepare the double tape and the blu tac)

POSTER DISMOUNTING
Poster must be dismounted after the presentation is completed by the committee

INFORMASI PRESENTASI POSTER

LOKASI
Koridor Utara dan Selatan, Lt. B1, Aston Denpasar Hotel & Convention Center

PELAKSANAAN
Presentasi poster dilaksanakan dalam 2 sesi
Sesi I (08.00-12.00 WITA)
Sesi II (13.00-16.00 WITA)

DURASI
Rabu, 24 April 2019 (Sesuai Rundown AASEC 2019)

PEMASANGAN POSTER
Poster harus dipasang maksimal 15 menit sebelum jadwal presentasi poster dimulai
Pemasangan poster dilakukan oleh peserta dengan menggunakan double tape (Panitia tidak menyediakan double tape)

PENCABUTAN POSTER
Pencabutan poster dilakukan setelah jadwal presentasi poster selesai dan dilakukan oleh pihak panitia
The size of poster is *Portrait with the size of 84.1 cm in height and 59.4 cm in width.*

All texts, diagrams, and figures must be legible at the distance of seven feet or 2 meters.

Poster must include the AASEC and Affiliation Logo.

Poster must be written in English, and consist of:

- Title (exactly the same as the one submitted to the committee)
- Sub-title (if any)
- Author name(s)
- Affiliation
- Introduction
- Method
- Findings/Results and Discussion
- Conclusion
- Acknowledgement (if any)
- References (cited on the poster)

The fonts for sub-title must be larger than the body text (or using bold).

The content of the poster must be legible and written systematically.
### SESSION I

**08.00-12.00 WITA**

| 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 |
|----|----|----|----|----|----|----|----|----|----|
| ABS| ABS| ABS| ABS| ABS| ABS| ABS| ABS| ABS| ABS|
| 686| 790| 1041|1042| 224| 239| 145| 928| 836| 422|
| 182| 600| 1008|1039| 225| 410| 161| 1087|850| 295|
| 837| 543| 1032| 793| 447| 412| 251| 1089|861| 620|
| 841| 1031|1034| 643| 183| 915| 243| 403| 311| 947|
| 974| 896| 1043|1062| 427| 897| 99 | 627| 206|1020|
| 1003| 503| 1044| 694| 712| 773| 616| 369| 298| 516|
| 956| 506| 1035| 419| 480| 532| 217| 399| 222| 676|
| 959| 922| 1049| 452| 172| 66 | 137| 425| 661| 203|
| 377| 924| 1047| 553| 856| 69 | 32 | 184| 489| 796|
| 197| 911| 1048| 365|1079| 72 | 826| 886| 531| 818|
| 680| 628| 144 | 106| 103| 85 | 134| 546| 202| 779|
| 330| 417| 149 | 168| 633| 441| 119| 775| 1074|923|
| 136| 252| 322 | 1091|241| 104| 95 | 466| 268|
| 279| 57 | 259 |     |    |    |    |    |    |    |

### NOTES

1. Management Science
2. Physics
3. Computer Science
4. Computer and Communication Engineering
5. Mathematics
6. Chemistry
7. Environmental Engineering
8. Material Science
9. Industry Engineering
10. Chemical Engineering

Organized by:
## SESSION II
(13.00-16.00 WITA)

| 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 |
|----|----|----|----|----|----|----|----|----|----|----|----|
| ABS-39 | ABS-78 | ABS-74 | ABS-868 | ABS-456 | ABS-527 | ABS-154 | ABS-954 | ABS-1109 | ABS-313 | ABS-76 | ABS-70 | ABS-1005 | ABS-302 | ABS-613 | ABS-563 | ABS-975 | ABS-882 | ABS-952 | ABS-961 | ABS-994 | ABS-428 | ABS-584 | ABS-944 |
| ABS-792 | ABS-1093 | ABS-607 | ABS-904 | ABS-644 | ABS-209 | ABS-155 | ABS-578 | ABS-1106 | ABS-522 | ABS-22 | ABS-53 | ABS-1014 | ABS-198 | ABS-398 | ABS-564 | ABS-976 | ABS-888 | ABS-781 | ABS-963 | ABS-995 | ABS-389 | ABS-738 | ABS-892 |
| ABS-816 | ABS-749 | ABS-579 | ABS-905 | ABS-759 | ABS-254 | ABS-156 | ABS-491 | ABS-1110 | ABS-919 | ABS-45 | ABS-163 | ABS-1015 | ABS-305 | ABS-394 | ABS-838 | ABS-977 | ABS-990 | ABS-949 | ABS-965 | ABS-998 | ABS-207 | ABS-577 | ABS-893 |
| ABS-586 | ABS-909 | ABS-439 | ABS-255 | ABS-157 | ABS-14 | ABS-1111 | ABS-193 | ABS-573 | ABS-249 | ABS-941 | ABS-196 | ABS-659 | ABS-839 | ABS-687 | ABS-968 | ABS-953 | ABS-970 | ABS-1001 | ABS-395 | ABS-639 | ABS-894 |
| ABS-617 | ABS-310 | ABS-167 | ABS-776 | ABS-572 | ABS-79 | ABS-201 | ABS-715 | ABS-679 | ABS-1056 | ABS-426 | ABS-840 | ABS-853 | ABS-978 | ABS-958 | ABS-972 | ABS-569 | ABS-400 | ABS-504 | ABS-895 |
| ABS-266 | ABS-278 | ABS-169 | ABS-714 | ABS-1076 | ABS-180 | ABS-306 | ABS-1075 | ABS-595 | ABS-281 | ABS-701 | ABS-842 | ABS-1004 | ABS-960 | ABS-957 | ABS-980 | ABS-574 | ABS-288 | ABS-740 | ABS-778 |
| ABS-270 | ABS-216 | ABS-801 | ABS-674 | ABS-1113 | ABS-91 | ABS-744 | ABS-20 | ABS-375 | ABS-702 | ABS-849 | ABS-880 | ABS-871 | ABS-987 | ABS-981 | ABS-273 | ABS-722 | ABS-495 | ABS-752 |
| ABS-1105 | ABS-92 | ABS-199 | ABS-881 | ABS-421 | ABS-983 | ABS-969 | ABS-979 | ABS-876 | ABS-989 | ABS-982 | ABS-358 | ABS-496 | ABS-146 |
| ABS-1101 | ABS-213 | ABS-985 | ABS-971 | ABS-557 | ABS-878 | ABS-986 | ABS-984 | ABS-344 | ABS-730 | ABS-497 | ABS-147 |
| ABS-988 | ABS-973 | ABS-547 | ABS-860 | ABS-992 | ABS-993 | ABS-360 | ABS-622 | ABS-925 | ABS-758 |
| ABS-593 | ABS-404 | ABS-405 | ABS-158 | ABS-212 | ABS-248 | ABS-1025 | ABS-770 | ABS-795 | ABS-724 |

### Notes:
- 1 = Civil Engineering
- 2 = Sport Science and Technology
- 3 = Electronics Engineering
- 4 = Material Engineering
- 5 = Pharmacology
- 6 = Physics
- 7 = Architecture
- 8 = Mechanical Engineering
- 9 = Information Engineering
- 10 = Computer and Communication Engineering
- 11 = Electrical Engineering
- 12 = Biology

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Organized by:

[Logo Images]

**AASEC 2019**
The 4th Annual Applied Science and Engineering Conference
Bali, 24 April 2019

**POSTER PRESENTATION**