

# Performance Measurement of esMOCA Biomechanics V2 for Biomechanics analysis

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**Abstract**—This research intends to know the usability of esMOCA in terms of ease and speed of use by measuring the performance of instrument compared to the photographic method on doing biomechanics analysis. Respondents will be given the task of analyzing biomechanics using both methods and the performance will be measured by comparing the time on task and task success. Comparison of time on task can be done with paired t test, and got the result that biomechanics analysis using esMOCA V2 still not better than using photographic method. In this research, the task success is presented with bar chart, to know the percentage of success rate from 20 respondents in carrying out the given task. To increase the usability of esMOCA, it can be done by redesign the instrument, improve the user interface, reduce the number of cables, and create a detail usage procedure.

**Keywords**—esMOCA; Usability; Performance Measurement.

## I. INTRODUCTION

Biomechanics analysis is important to understanding the effects and conditions of bone tissue and joint muscle tissue of workers in performing their duties[1][2][3]. Analyzing the actual working conditions of body tissue is not an easy task. Various approaches and objectives are used by many researchers to understanding this phenomenon [2][4][5]. esMOCA biomechanic is three-dimensional biomechanical instrument built from MPU6050 sensor and the ESP8266 wifi controller. It is and can be applied to calculate angles in upper limbs (lower spine, spine, head, hand, forearm, and upper arm)[6]. Second generation of esMOCA research has resulted in the statement that the tested instrument is valid, because the result of posture test using esMOCA instrument approaches the value of calculation data using mathematical model manually[6]. Development of ESMOCA instruments from the research that has been done is to know the performance of esMOCA, whether esMOCA is really - can be used easily by prospective users[7].

## II. EXPERIMENT SETUP AND METHOD

This research is attempt to test the usability of esMOCA instrument by comparing the biomechanics analysis using esMOCA and photographic method using performance measurement method The preparation of instrumen starts from preparing the sensor, applying the sensor to the upper limbs, and opening the simulink program to execute operator body movements.



**Fig.1 esMOCA Instrument**

The data to be taken are the speed of the respondent in performing the tasks (time on task) and the success of doing the task (task success. The tasks the respondent will undertake are:

- Task 1.** Biomechanical assessment using camera and biomechanical worksheet (Photographic Method).
- Task2.** Biomechanical assessment using esMOCA instrument.

The data of time on task between task 1 and 2 obtained will be compared and tested using paired sample t-test. The hypothesis of performance measurement testing are:

H0: There is no significant difference between the mean time of the biomechanics analysis assessment using photographic method and esMOCA instrument.  
 H1: There is a significant difference between the mean time of the biomechanics analysis assessment using photographic method and esMOCA instrument.

Decision-making :

If the probability (sig)  $\geq \alpha$  then fails reject H0

If the probability (sig)  $< \alpha$  then reject H0

The success rate is divided into three, namely no problem, some problem, fail[7]. in this research, the task success is presented with bar chart, to know the percentage of success rate from 20 respondents in carrying out the given task.

### III. RESULT AND DISCUSSION

#### A. Time on Task

Data on completion of task 1 and task 2 will be compared using paired sample t-test because the focus of the study is to compare the average time of task 1 and task 2 with the same set of assessors, where an assessor will sense the two tasks that will be searched for the difference in the average time between two tasks. The data to be compared is as follows:

Table 1. Data of time on task

NO.	TASK 1	TASK 2	NO.	TASK 1	TASK 2
RES-01	589.14	491.07	RES-11	808.1	896.58
RES-02	759.21	730.9	RES-12	859.7	1329.96
RES-03	586.89	650.31	RES-13	545.66	831.17
RES-04	624.22	622.49	RES-14	577.09	545.83
RES-05	611.14	610.65	RES-15	740.84	635.37
RES-06	641.41	1039.23	RES-16	659.02	786.79
RES-07	718.95	749.88	RES-17	703.84	654.89
RES-08	744.65	659.75	RES-18	663.82	1238.47
RES-09	731.28	653.19	RES-19	528.97	519.79
RES-10	700.27	561.43	RES-20	592.88	890

Table. 2 Paired sample t-test

	TASK 1	TASK 2
Mean	669.354	754.887
Variance	7985.431	52112.208
Observations	20.000	20.000
Pearson Correlation	0.415	
Hypothesized Mean Difference	0.000	
Df	19.000	
t Stat	-1.841	
P(T<=t) one-tail	0.041	
t Critical one-tail	1.729	
P(T<=t) two-tail	0.081	
t Critical two-tail	2.093	

Table 2. shows that the sig value. (P (T <= t) two tail) of 0.081 which means greater than the value of  $\alpha$  (0.05), so it can be concluded failed to reject H<sub>0</sub> which means there is no significant difference between the mean time of biomechanics analysis using photographic method and esMOCA instrument. Based on the average working time, task 2 has a longer time than task 1 with a difference of 85.53 s.

#### B. Task Success

Success in completing the task is divided into three levels, first (1.0) means the assessor successfully performs the task with no problem, the second (0,5) means the assessor is successful in doing the task but there are some problems in the process, and third (0) means the assessor fails doing task.

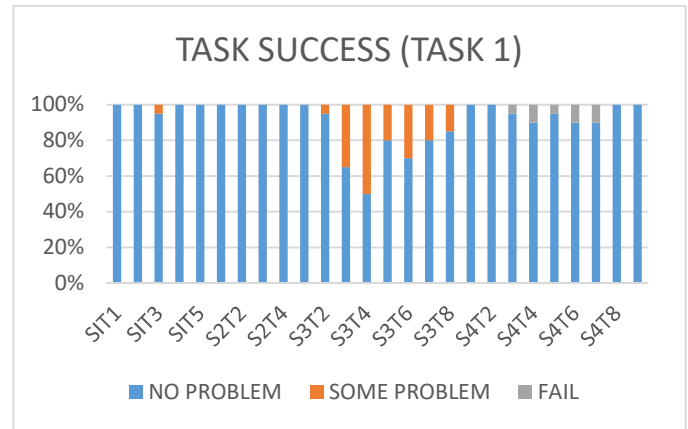


Fig. 2 Task success (Task 1)

Figure 2 shows that in scenario 3 task 4 (displaying angle on head) from 20 respondents 50% successfully completed task, 50% able to complete task but there are problems in the middle of work, and 0% unable to complete the task.

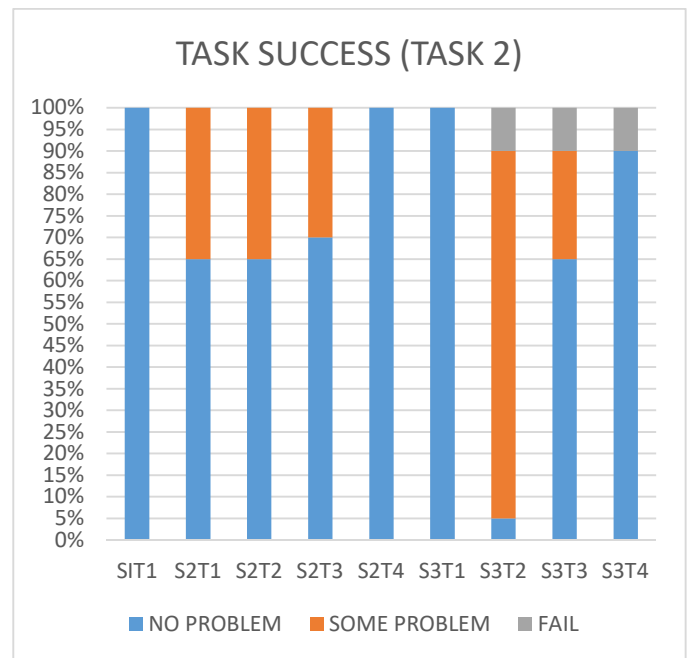


Fig. 3 Task success (Task 2)

Figure 3 shows that in the scenario 3 task 2 (run the program) of 20 respondents there are 5% successfully completed the task, 85% able to complete the task but there are problems in the middle of the work, and 10% did not complete the task.

#### IV. CONCLUSION AND FUTURE WORK

The performance of the esMOCA gives the result that based on the time-on-task there is no significant difference between the mean time of the biomechanics analysis assessment using esMOCA and photographic method. Based on the test variables the success rate of completing the tasks found that in both methods there are tasks that are completed smoothly, the task successfully done but the assessor has some problems in the middle of the work, and there are assessors who did not successfully complete the task, in general the task of biomechanics analysis using the esMOCA instrument has percentage of completing task with some problems beyond biomechanics analysis using photographic method.

The improvements of instrument are really needed to make esMOCA more usable in the future. According to the respondents there are some improvements that can make esMOCA be more easier to use, such as redesign the instrument for easy installation, improve the user interface of the program improving the user interface for easy user access, reducing cables where possible, and making procedures of using the instrument as detail as possible.

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