EFFECTS AND RELATIONSHIPS OF RECEIVING INFORMATION AMOUNT ON EYE-MOVEMENT FEATURES

A THESIS

Submitted in Partial Fulfillment of the Requirement for the Degree of Bachelor of Engineering in Industrial Engineering

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INTERNATIONAL INDUSTRIAL ENGINEERING PROGRAM

DEPARTMENT OF INDUSTRIAL ENGINEERING

FACULTY OF INDUSTRIAL TECHNOLOGY

UNIVERSITAS ATMA JAYA YOGYAKARTA

YOGYAKARTA

2021

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Tugas Akhir Berjudul

EFFECTS AND RELATIONSHIPS OF RECEIVING INFORMATION ON EYE-MOVEMENT FEATURES

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KEREN KERVIONA

171409362

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Yogyakarta, 27 April 2021

Universitas Atma Jaya Yogyakarta

Fakultas Teknologi Industri

Dekan

ttd

Dr. A. Teguh Siswantoro, M.Sc

DECLARATION OF ORIGINALITY OF RESEARCH

I certify that the research entitled “Effects and Relationships of Receiving Information Amount on Eye-movement Features” in this thesis has not already been submitted for any other degree.

I certify that ti the best of my knowledge and belief, this thesis which I wrote does not contain the works of parts of the works of other people, except those cited in the quotations and bibliography, as a scientific paper should.

In addition, I certify that I understand and abide the rule stated by the Ministry of Education and Culture The Republic of Indonesia, subject to the provisions of Peraturan Menteri Pendidikan Nasional Republik Indonesia Nomor 17 Tahun 2010 tentang Pencegahan dan Penanggulangan Plagiat di Perguruan Tinggi.

Signature : 

Student name : Keren Kerviona
Student ID : 1714 09362
Date : April 29, 2021

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My praise and gratitude I deliver to God Almighty for His blessings and grace so that I can complete this Thesis punctually and very well. This Thesis is completed as a requirement to graduate as Bachelor's Degree in International Industrial Engineering Faculty of Industrial Technology Atma Jaya University Yogyakarta.

My gratitude is also expressed to all parties who have taken part in the process of completing the project:

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2. Ririn Diar Astanti, S.T., M.MT., Dr.Eng. as the Head Department of Industrial Engineering.
3. Lenny Halim, S.T., M.Eng. as the Head Study Program of Industrial Engineering.
4. Kristanto Agung Nugroho, ST., M.Sc. as the Writer's Faculty Supervisor and Ririn Diar Astanti, S.T., M.MT., Dr.Eng. as the Co-Faculty Supervisor from Universitas Atma Jaya Yogyakarta.
5. Prof. Ray F. Lin B.S., M.S., Ph.D. as the Writer's Faculty Supervisor and Twin Yosua Raharjo P, ST., M.Sc. as the Co-Faculty Supervisor from Yuan Ze University, Taiwan.
6. All lecturers in Industrial Engineering Universitas Atma Jaya Yigyakarta who are always generously provide knowledge, guidance, and share experiences to the Writer.
7. All parties that the Writer unable to mention one after another, who always support the Writer.

As a final point, I realize that there are still many shortcomings in writing this Thesis. Constructive criticisms and suggestions are welcomed for continual improvements in the future. Hopefully, this Thesis can be implemented well and can also be beneficial to readers.

DEDICATION PAGE

I everlastingly be grateful in Jesus Christ for what has happened and what had not happened yet in my life.

My Family,

This Thesis is dedicated to both my parents and my big sister who always support, help, encourage, and love me, always providing the best out of the best for me and my future, and will always be in my life in every kind of situation that I faced.

Prof. Ray F. Lin B.S., M.S., Ph.D.,

As my supervisor who always give the best knowledge, support, and guidance in completing this Thesis, who always being considerate towards his students.

Pak Twin,

As my supervisor who always give the best knowledge, support, and guidance in completing this Thesis, who always help me in so many ways that I am thankful for.

Kezia, Indah, Annice, Ivan, Karina, Richo, Jude, William, Yosefine, Natty, and Linh

As my biggest support system, source of happiness, the people who always be there for me, encouraging, and accompanying me in completing this Thesis.

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ABSTRACT

Abstract: The vast development of technology in this era encourages researchers to study about the interrelationship of the amount of information with human cognitive functions. This study was aimed to test the hypothesis of whether the amount of information can affect human cognitive function analyzed from the responses of human eye-movement features, as well as the relationships between information amount and eye-movement features. Six students from a Yuan Ze University were involved in playing a game that stimulated a different amount of information. The participants' eye-movements were recorded using a screen-based eye-tracker (GP3 HD GazepointTM Canada) while playing ZType game. There were nineteen generated traditional features from the experiment. These traditional features were then being processed as complexity features. The analysis of variance (ANOVA) was done to know which features that were affected by the amount of information. The results showed that there were four traditional features comprising left and right pupil diameter, amount of blink, and saccade magnitude that were significantly affected by the amount of information. Moreover, the amount of information also affected the thirteen complexity features from fixation (duration and coordinates), pupil (diameter and coordinates), and saccade (magnitude and direction) elements. The linear regression analysis was done to know which features are the critical features, which later can be used to build the AI model. The results showed that there were three traditional features comprising left and right pupil diameter, and amount of blink that have negative and positive correlation respectively, with the information amount. This study indicates that the amount of information is influencing the eyes' response that is related to the human cognitive function. Moreover, the complexity analysis can help researchers to generate more eye-movement features from the traditional features.

Keywords: amount of information, eye-movement features, feature selection, information processing.

CHAPTER 1
INTRODUCTION

1.1. Background

Information acquisition skills, which can be included as both information-processing functions as well as cognitive functions, are essential to be developed, especially in the era of Industry 4.0 (Barzilai & Zohar, 2008; Kaber, Wright, Prinzel III, & Clamann, 2005). It is supported with the study found by Keisler (2014) about the advantage of understanding the value of a scarce information for the decision makers to decide the right time to expand the resource areas to acquire certain information. The vast development of technology in this era encourages researchers to study about the interrelationship of the amount of information with human cognitive functions. Among them, information acquisitions have begun to arise in regards to eye-tracking technologies, and many studies obtained good results in information acquisition activities (Slykhuis, Wiebe, & Annetta, 2005). However, most studies focus on the consumer behavior and decision-making-related (Jacoby, Szybillo, & Busato-Schach, 1977; Lurie, 2004), and several studies focus on information acquisition patterns and purchasing-related activities (Berning & Jacoby, 1974). On the other side, the use of eye-tracking to study the observation of text and graphics have been studied by many researchers (Slykhuis et al., 2005).

Slykhuis et al. (2005) stated that fixations indicate the perceived points of interest, while the length of a fixation indicates the cognitive complexity of the information acquired. However, among various studies mentioned above, the research in the eye-tracking area does not deliver the insight of the likelihood effect of narration to the eye fixations between text and graphics. Thus, the fixation between text and graphics are divided to prevent any alteration of the attention (Slykhuis et al., 2005). Therefore, those limitations need to be addressed to face the challenges in this research area in the future.

This research is aimed to test the hypothesis of whether the amount of information can affect human cognitive function analyzed from the responses of human eye features. Thus, laboratory experiments using eye-tracking technologies and analysis of variance (ANOVA) of the original (traditional) features and the complexity features will be conducted to examine and verify the above hypothesis. Moreover, this study will also cover the relationships between the amount of

information and the human eye-movement features analyzed by linear regression analysis.

Other than previous studies about the amount of information with various outcomes, to the best of our knowledge, studies about the effect of amount of information to the eye movement, or complexity-related, are none to be found. Therefore, this experimental research is aimed to discover the significances and relationships of information amount towards human eye-movement features. Later, the results can be utilized for an input of Artificial Intelligence (AI) model of cognitive-related activities in regards to the amount of information in the future.

1.2. Research Problems

Based on the background that has been discussed previously, the problems faced in this study is that there are still deficiency in information and evidences of the significances and relationships of information amount towards human eye-movement features. Thus, the problems that can be formulated in this experimental research are as follow:

a. What are the significances of information amount towards human eye-movement features?

b. What are the relationships of information amount represented by score towards human eye-movement features?

1.3. Research Objectives

The objectives of this experiment and research are as follow:

a. to test whether information amount affects eye-movement movement features;

b. to see the trends of the results from the ANOVA and linear regression analysis;

c. to interpret the trends formed from the results of the analysis;

d. to discover the compatibility between the results from the analysis and the literature reviews.

1.4. Research Limitations

The research limitation of this experiment and research are as follow:

a. The correlation between the amount of information and other factors that may affect the eye-movement features.

CHAPTER 6
CONCLUSION

The results indicated that both the traditional and complexity eye-movement features were affected by the amount of information. However, the results in our study may also be impacted by the speed of the information shown up in front of the participants. The more numbers of information with the faster speed will increase the complexity of the eyes' to response the information. In the future, the speed for showing the information needs to be considered to know whether any interaction effect between the speed and the amount of information.

The results also indicate that the complexity analysis is a helpful method to generate the significant eye-movement features. There were certain traditional features that were not significantly affected by the amount of information and became significant after being processed into complexity analysis. These significant features can be a powerful feature to help Artificial Intelligence models to do a prediction for the human cognitive workload related to the amount of information.

The results indicated that the linear regression analysis shows strong correlations between left and right pupil diameters in pixel and the amount of information; as well as between blink numbers in the last 60 second and the amount of information. These critical eye-movement features can be essential features to build Artificial Intelligence models for prediction purposes regarding amount of information and its affect towards human cognitive workload.

Moreover, further experiments and researches need to be done to cover the correlation between the amount of information and other factors that may affect the information received by the participants such as English ability, game speed, etc.

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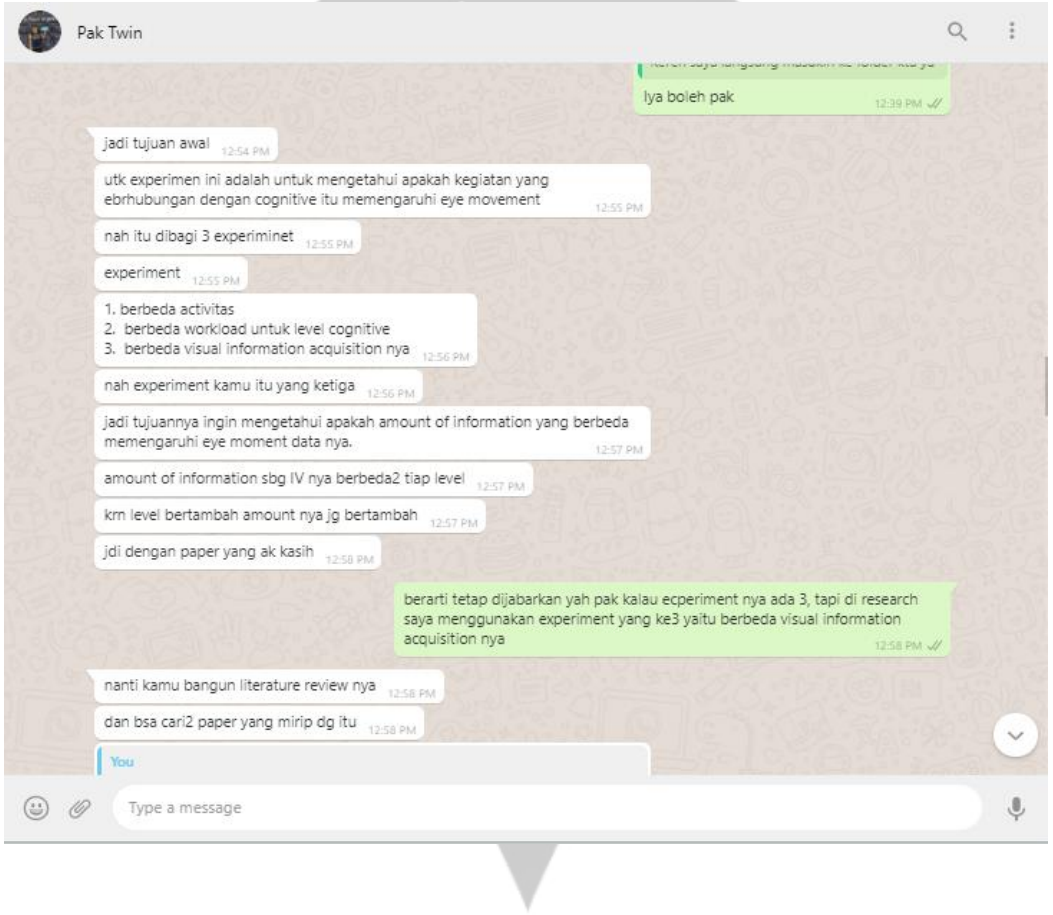
Appendix 1

APPENDIX



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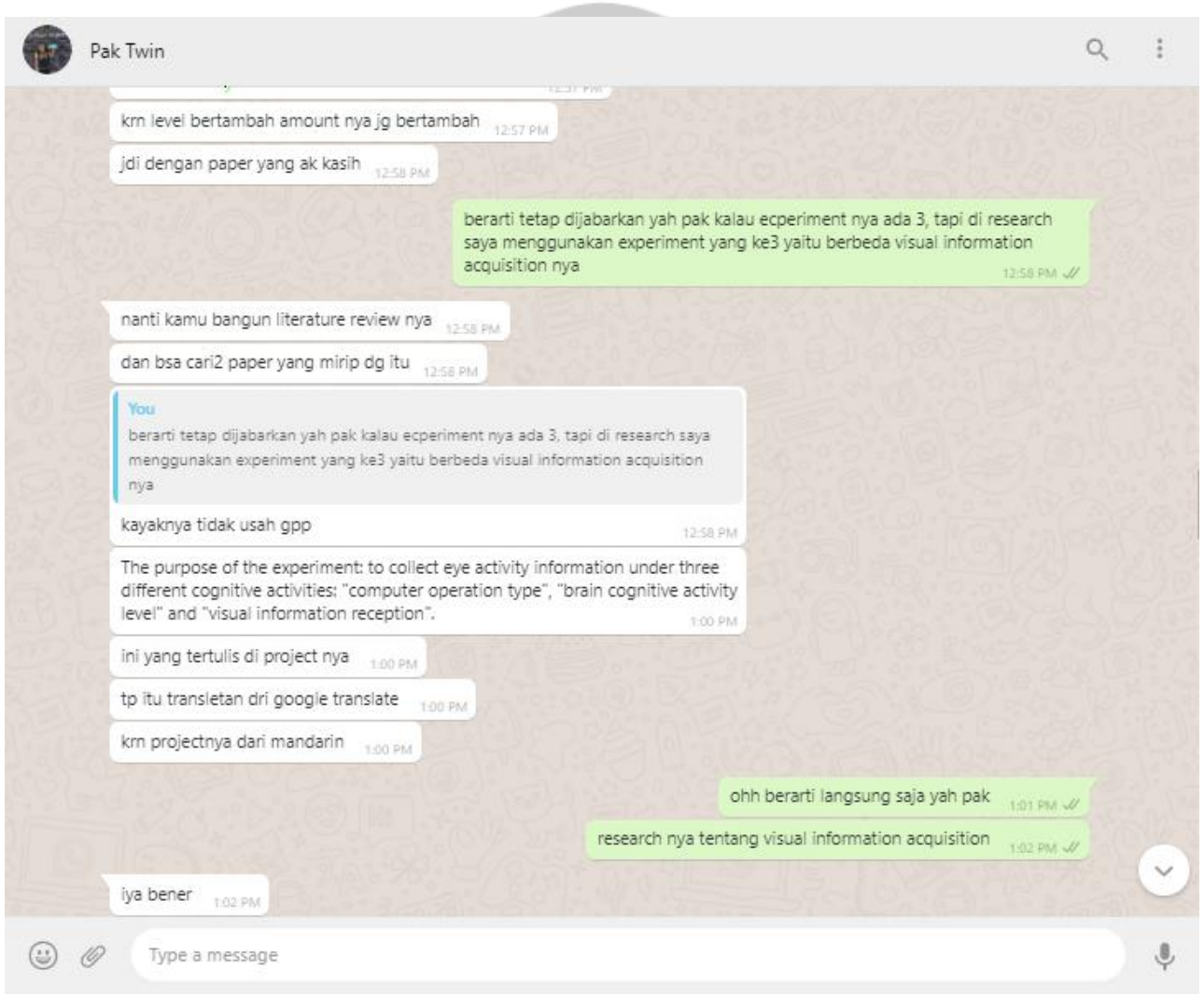
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dan bsa cari2 paper yang mirip dg itu 12:58 PM
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The purpose of the experiment: to collect eye activity information under three different cognitive activities: "computer operation type", "brain cognitive activity level" and "visual information reception". 1:00 PM
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Appendix 4

Final Project_Keren Kerviona

Keren Kerviona
Sun 9/27/2020 9:38 AM
To: 林瑞豐
Cc: Twin Yoshua Raharjo Destyanto

Good Morning Prof. Lin,

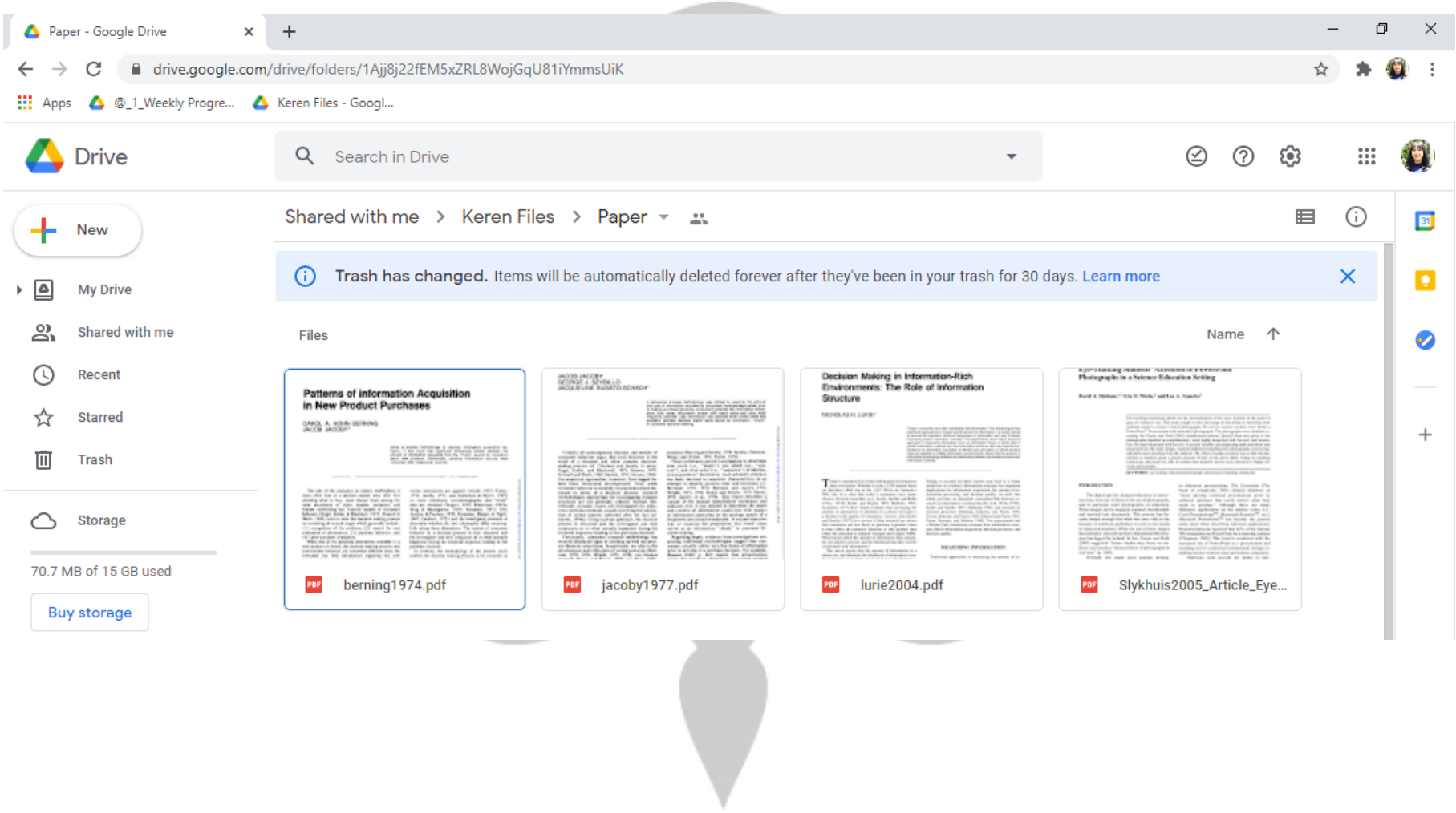
How are you? Hope this email found you in a good health. I am Keren Kerviona, UAJY student who join Bachelor Leading to Master Program in YZU. I got your contact from Mr. Twin.

I am writing this email to inform you that I have communicated with Mr. Twin and he already explained me the research direction (eye-tracking related research). I have decided that I will accept the offer to join your project related to eye-tracking.

I am currently taking a course that requires me to write Chapter 1 until Chapter 3 for the Undergraduate Thesis in UAJY (Final Project in YZU). Therefore, I need to have the topic for the Undergraduate Thesis. Chapter 1 is about Introduction, Chapter 2 is about Literature Review, and Chapter 3 is about Methodolody, while the Data and Data Collection will be in Chapter 4. In UAJY, Chapter 1 until Chapter 3 need to be done in this semester (until the end of December 2020), while for the rest of the chapter need to be done in the next semester (starting from February 2021 until June 2021), which for next semester (if the pandemi is over) I will be continuing the research in YZU. One of Mr. Twin's friend said that if the experiment design is ready and good enough, then the data collection will be conducted in the next semester.

I hope that my Master Thesis later will continuing the research of my Final Project, so I hope by joining your research will later support my Master Thesis. I also hope that I can do and finish it inline with the timeline and time limitation for my study in Taiwan (1.5 years).

Appendix 5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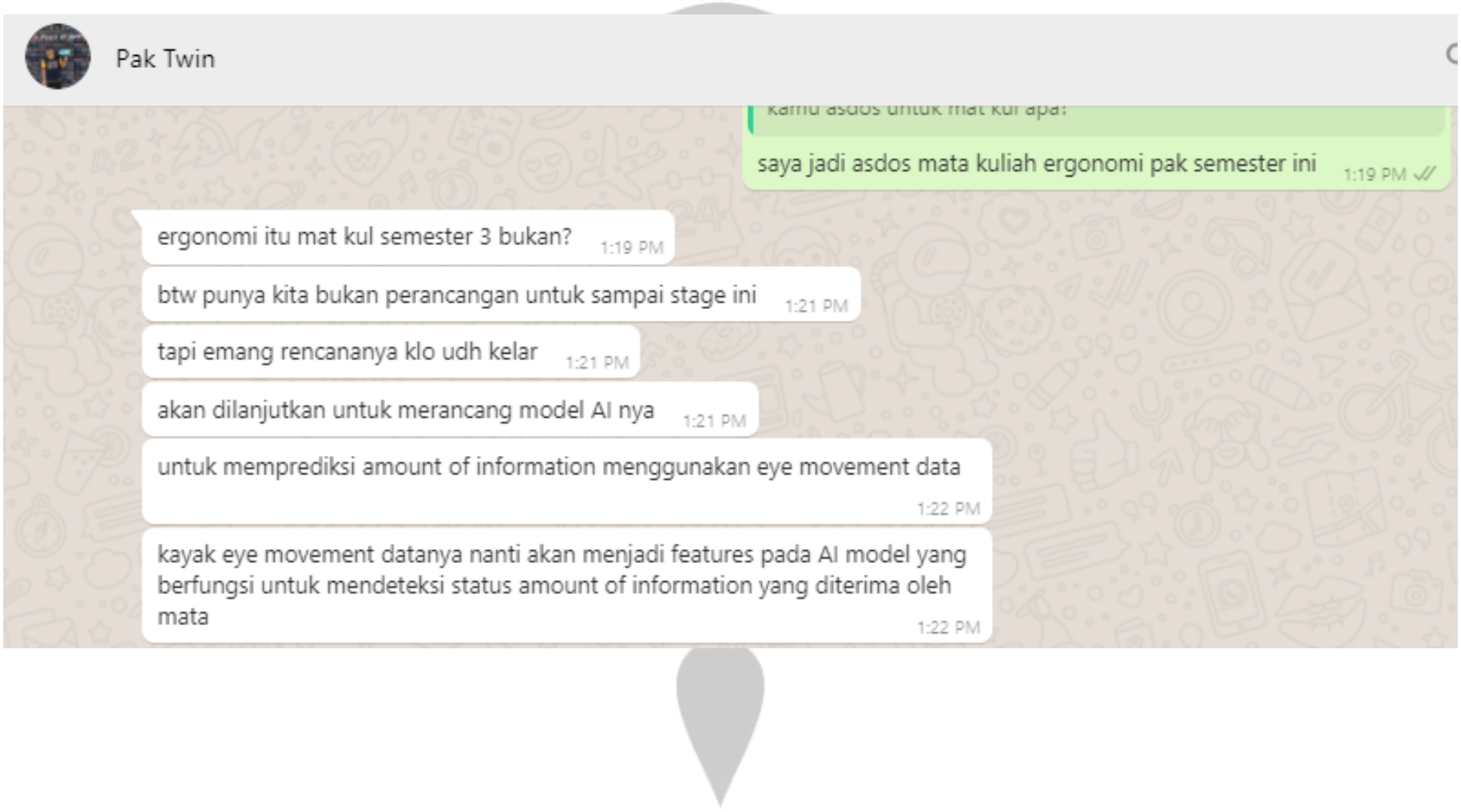
Appendix 6


Pak Twin
saya jadi asdos mata kuliah ergonomi pak semester ini 1:19 PM
ergonomi itu mat kul semester 3 bukan? 1:19 PM
btw punya kita bukan perancangan untuk sampai stage ini 1:21 PM
tapi emang rencananya klo udh kelar 1:21 PM
akan dilanjutkan untuk merancang model AI nya 1:21 PM
untuk memprediksi amount of information menggunakan eye movement data 1:22 PM
kayak eye movement datanya nanti akan menjadi features pada AI model yang berfungsi untuk mendeteksi status amount of information yang diterima oleh mata 1:22 PM

Appendix 7

09362_Mid

ORIGINALITY REPORT

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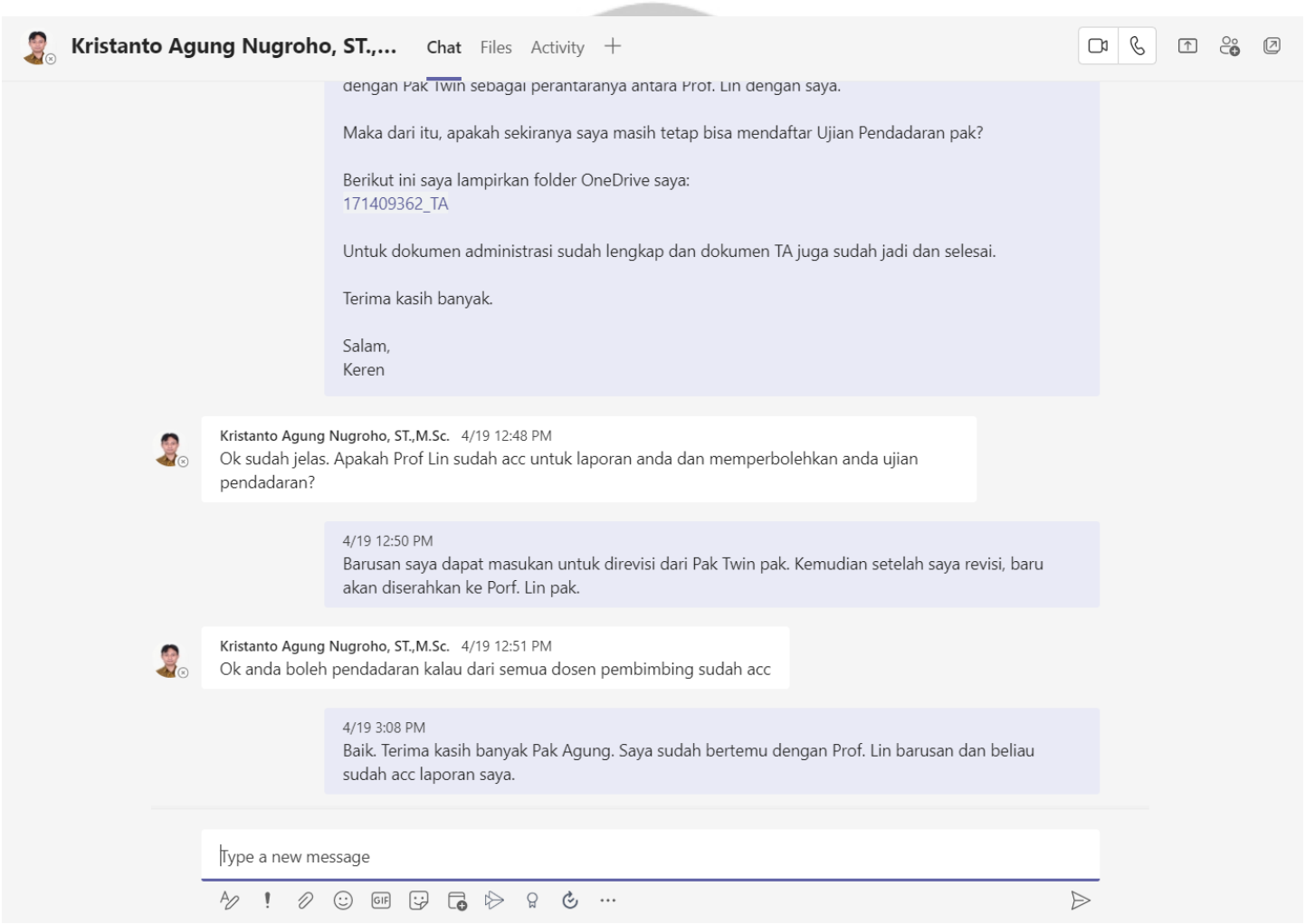
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	imotions.com Internet Source	5%
2	www.slideshare.net Internet Source	3%
3	Pramodini A. Punde, Mukti E. Jadhav, Ramesh R. Manza. "A study of eye tracking technology and its applications", 2017 1st International Conference on Intelligent Systems and Information Management (ICISIM), 2017 Publication	3%

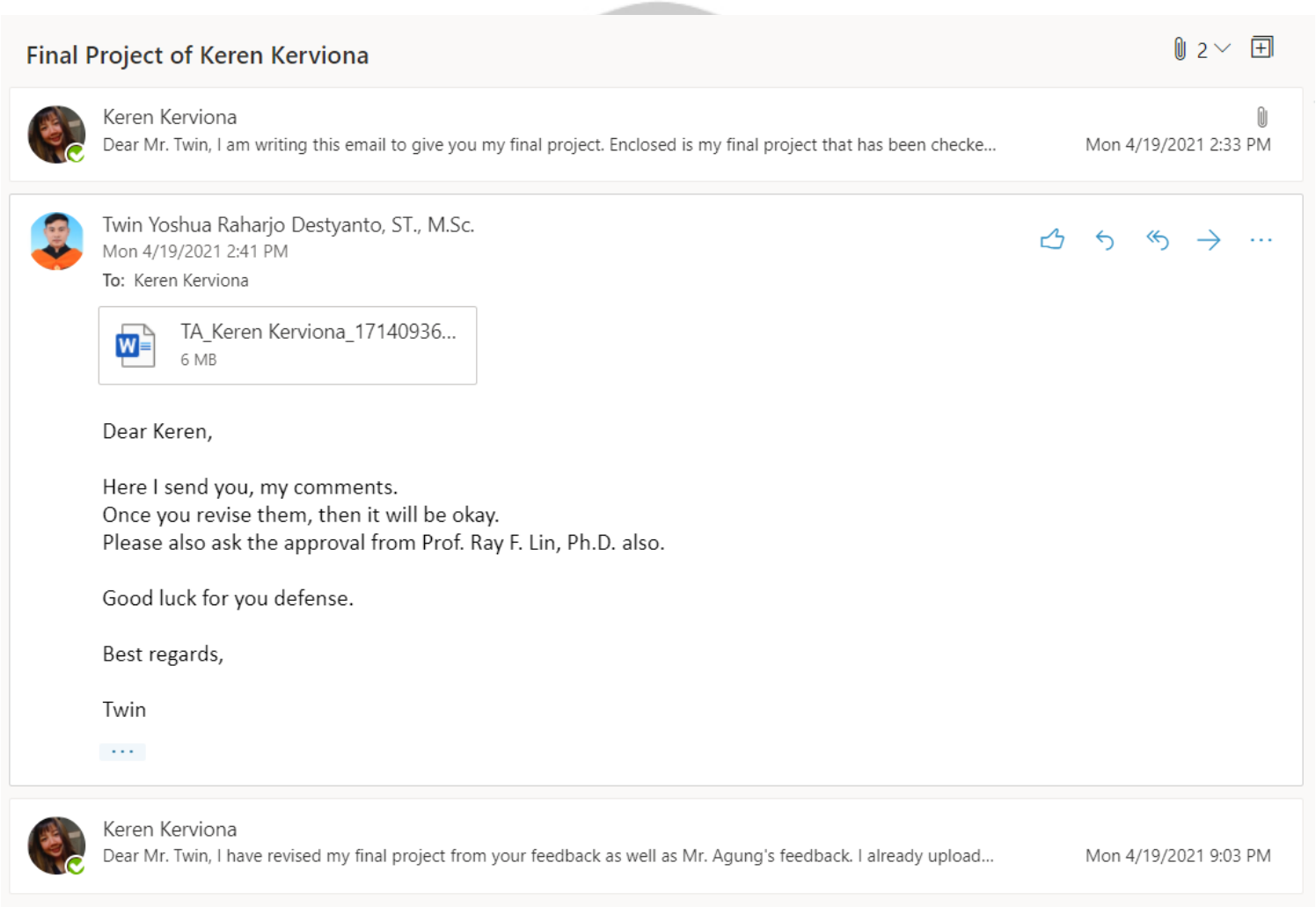
Appendix 8


Kristanto Agung Nugroho, ST.,...
Chat
Files
Activity
dengan Pak Twin sebagai perantaranya antara Prof. Lin dengan saya.
Maka dari itu, apakah sekiranya saya masih tetap bisa mendaftar Ujian Pendadaran pak?
Berikut ini saya lampirkan folder OneDrive saya:
171409362_TA
Untuk dokumen administrasi sudah lengkap dan dokumen TA juga sudah jadi dan selesai.
Terima kasih banyak.
Salam,
Keren
Kristanto Agung Nugroho, ST.,M.Sc. 4/19 12:48 PM
Ok sudah jelas. Apakah Prof Lin sudah acc untuk laporan anda dan memperbolehkan anda ujian pendadaran?
4/19 12:50 PM
Barusan saya dapat masukan untuk direvisi dari Pak Twin pak. Kemudian setelah saya revisi, baru akan diserahkan ke Porf. Lin pak.
Kristanto Agung Nugroho, ST.,M.Sc. 4/19 12:51 PM
Ok anda boleh pendadaran kalau dari semua dosen pembimbing sudah acc
4/19 3:08 PM
Baik. Terima kasih banyak Pak Agung. Saya sudah bertemu dengan Prof. Lin barusan dan beliau sudah acc laporan saya.
Type a new message

Appendix 9


Bu Ririn
4/20/2021
Selamat pagi Bu Ririn.
Berarti Bu Ririn sudah acc ya bu?
Saya daftar hari ini ya bu untuk ujian 27 April 2021 pukul 7 WIB?
11:05 AM
You
Selamat pagi Bu Ririn.
Berarti Bu Ririn sudah acc ya bu? ...
Ya
11:17 AM
Tgl.27 pk 7 pagi WIB
11:17 AM

Appendix 10


Final Project of Keren Kerviona
2
Keren Kerviona
Dear Mr. Twin, I am writing this email to give you my final project. Enclosed is my final project that has been checke...
Mon 4/19/2021 2:33 PM
Twin Yoshua Raharjo Destyanto, ST., M.Sc.
Mon 4/19/2021 2:41 PM
To: Keren Kerviona
TA_Keren Kerviona_17140936...
6 MB
Dear Keren,
Here I send you, my comments.
Once you revise them, then it will be okay.
Please also ask the approval from Prof. Ray F. Lin, Ph.D. also.
Good luck for you defense.
Best regards,
Twin
Keren Kerviona
Dear Mr. Twin, I have revised my final project from your feedback as well as Mr. Agung's feedback. I already upload...
Mon 4/19/2021 9:03 PM