FORMALISM OF COMMUNICATION BEHAVIOR ON HANDSHAKE CIRCUIT USING TRACE THEORY

A THESIS

By

JULIA M. DAMA
00013030

INFORMATICS ENGINEERING DEPARTMENT
FACULTY OF ENGINEERING
DE LA SALLE CATHOLIC UNIVERSITY
MANADO

2004

FORMALISM OF COMMUNICATION BEHAVIOR ON HANDSHAKE CIRCUIT USING TRACE THEORY

A THESIS

Presented as a Partial Fulfillment of the Requirements in obtaining *Sarjana Teknik* Degree in Informatics Engineering Department

By

JULIA M. DAMA
00013030

INFORMATICS ENGINEERING DEPARTMENT
FACULTY OF ENGINEERING
DE LA SALLE CATHOLIC UNIVERSITY
MANADO

2004

To the greatest mom in the whole world
and my beloved one

DE LA SALLE CATHOLIC UNIVERSITY
MANADO - INDONESIA

Name	:	Julia M. Dama
NIM	:	00013030
Faculty	:	Engineering
Department	:	Informatics Engineering
Title of Thesis	:	Formalism of Communication Behavior on Handshake Circuit Using Trace Theory
Supervisor	:	Dr. Benny Pinontoan, M.Sc.

Approved,
Manado, 16 September 2004

Supervisor,

Dr. Benny Pinontoan, M.Sc.

Acknowledged,

Dean,

Ir. Noldi Watuna, MM.

Head of Department,

Ir. Simon Patabang, MT.

ABSTRACT

A handshake circuit is a network of asynchronous components connected by point-to-point channels along which components interact by means of handshaking signaling. Handshake circuit is formed from some connectable handshake processes. Handshake process itself is a mathematical object that describes a handshake communication behavior. The communication behavior of handshake circuit can be observed by formalize handshake processes. This thesis is about to formalize two handshake processes in order to prove whether they are connectable from each of their communication behavior using trace theory and shows a handshake circuit that are constructed from connectable handshake processes to describe the communication behavior.

Keyword : Handshake circuits, trace theory, parallel process

ABSTRAK

Handshake circuit adalah suatu jaringan yang terdiri dari komponen-komponen asinkron yang terhubung oleh channel point-to-point dimana komponen-komponen tersebut berinteraksi melalui signal handshake. Handshake circuit dibentuk dari beberapa handshake proses. Handshake proses itu sendiri adalah objek matematika yang mendeskripsikan perilaku komunikasi handshake. Perilaku komunikasi dari handshake circuit dapat di observasi dengan cara memformalisasi handshake proses. Dalam tesis ini, penulis akan memformalisasi dua handshake proses untuk membuktikan apakah kedua proses dengan masing-masing perilaku komunikasinya saling berhubungan dengan menggunakan teori trace dan menunjukkan sebuah handshake circuit yang dibentuk dari beberapa handshake proses untuk menjelaskan perilaku komunikasinya..

Kata kunci : Handshake circuits, teori trace, proses parallel

ACKNOWLEDGEMENTS

Praise the name of the Lord! I am so grateful for His blessing and grace during the progress of this thesis especially in the difficult situation.

I would like to give my very special thank to Dr. Benny Pinontoan, M.Sc, my great supervisor, for introducing me in the world of parallel computing. He has patiently taught me most of what I know about parallel computing and its application during the last six months, sharing ideas, experiences and even valuable advices for my life. His achievement in life, enthusiasm and willingness to work closely with his students has been an invaluable source of inspiration and spirit during my years of study.

I also would like to give my special thank to the other examiners Ir.Armien Langi, M.Sc., Ph.d and Dr. Rajesri Govindaraju, M.Sc. I am so proud and honor to have you in my thesis presentation, and thank you so much for the valuable comments and suggestions.

I would like to thank to Ir. Noldy Watuna, MM as The Dean of Engineering Faculty and Ir. Simon Patabang, MT as The Head of Department of Informatics for their contribution during the progress of this thesis. I also would like to thank to Ir. Haris Ontowirjo and Inneke Victor, ST, M.Eng.Sc as my co-supervisors for their help in literatures and thesis presentation and also for their time spent to discuss this research with me and their willingness to hear my problems.

I would like to give special thanks to the great people under the supervising of Dr. Benny Pinontoan, M.Sc for their support and spirit during this research, for being such good friends and for all the fun events they brought me into: Retzy Lewu, Lisa Wong, Wenny Pramanto, Meidy Neghe, Ruland Rantung, Yeyen Thadete, Yuniarty Halim, Inggrid Ulaan and Lanny Sitanayah.

Very Special thanks to my great mom for everything, your support both materially and spiritually have been giving me the courage to move on, and my beloved Acus who always be there for me. To all my family for their support: Sr.Laurentia, OCD., Ou Erly and No Tiu.

Thank you so much to Puput and Thyteen for the laptop, and also to all of my friends that have supported me in their prayer: Baby, Joice, Inda, Allo, Randy and others. Finally, thanks a lot to those who have given valuable contribution for me, may God bless you.

"I have the strength to face all conditions by the power that Christ gives me"
Philipians 4:13

TABLE OF CONTENT

LIST OF SYMBOLS

Notations	*Meaning*	*Page*
Set Theory		
{…}	set	12
∅	empty set	16
∈	is a member of	16
∉	is not a member of	16
A ∩ B	A intersects B	18
A ∪ B	A union B	19
A ⊆ B	A is contained in B	21
A \ B	set of subtraction from A and B	20
A ÷ B	difference (A ∪ B) \ (A ∩ B)	20
Logic		
=	equals	12
≠	is distinct from	13
◥	end of an example, proof, property, and definition	17
P ∧ Q	P and Q (both true)	17
P ∨ Q	P or Q (one or both true)	25
P ⇒ Q	if P then Q	12
∀x : x ∈ P(x)	universal quantification of P(x)	11
∃x : x ∈ P(x)	existential quantification of P(x)	11
Traces		
Ω	set of universe	16
X*	set of all finite-length sequences of elements X	16
ε or < >	empty trace	16
	projection	16

Notations	*Meaning*	*Page*
$\ell(t)$	length of *t*	17
$s \leq t$	*s* is prefix of *t*	17
pref(X)	prefix-closure of a trace set X	17
pref-»	prefix-closed of a trace set X where X = *pref*(X)	17
aT	alphabet of T	18
tT	trace structure of T	18
w	weaving	19
b	blending	19
after (*t*, T)	symbols that follow a defined trace	
	$< \mathbf{a}T, \{ u \mid u \in \mathbf{a}T^* \wedge tu \in \mathbf{t}T\} >$	18
suc (*t*, T)	set of one symbol follow a defined trace	
	$\{a \mid a \in \mathbf{a}T \wedge ta \in \mathbf{t}T\}$	18
$BUF_1(a, b)$	a process of one-place buffer	2

Handshake Processes

0p	request symbol	25
1p	acknowledgement symbol	25
A°	passive port	25
A’	active port	25
iA	input symbols of port structure A	26
oA	output symbols of port structure A	26
if .. fi	condition statement	26
[]	else symbol	26
▌	then symbol	12
pS	port structure of S (S is handshake structure)	27
tS	set of handshake traces	27
$A^{\mathbf{H}}$	set of handshake traces with port structure A	26
rB	reordering in B (B is port structure)	28
(**r**) . T	reorder closed of T	28
$\mathbf{x}_B$	input extension in B	28

Notations	*Meaning*	*Page*
(x) . T	input extension closedness	28
||	parallel composition	36
ÐÏ	connectable	34
div.<A,T>	divergences of handshake structure <A, T>	35

Handshake Circuits

$\mathcal{Z}$	activation port of handshake circuit	2
a?x	on channel a, input a value of x	3
b!x	on channel b, output a value of x	3

LIST OF FIGURES