International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878 (Online), Volume-2 Issue-1, March 2013

Design of Minimal States Deterministic Finite Pattern Using the Concept of Regular Expression

Syed Asif Ali

***Abstract*: the purpose of this paper is to design a minimal states deterministic finite automaton for Sign language pattern using the concept regular expression. Deterministic finite automata are a practical approach used for designing a computational model. This paper also emphasis on minimization of Sign language DFA using the concept of contraction (or merging) of equivalent states algorithm.**

***Index Terms*: Sign Language pattern, Deterministic Finite Automata (DFA), Minimization of DFA.**

I. INTRODUCTION

Automata theory provides the methods and techniques to construct abstract machines for any problem. Based on this concept automata of Sign Language pattern can be developed. This research work proposed an approach to relate the deterministic finite automata with the Sign Language pattern. The proposed method is cheap and less complex than many other systems that are currently in use by different local and international organization.

II. DETERMINISTIC FINITE AUTOMATA

A deterministic finite automata (DFA) is a quintuple M= (Q, ∑, δ, q_0, F), where Q is a finite set of states, ∑ a finite set called alphabet, $q_0 \in Q$, a distinguished state known as the start state, F a subset of Q called the final or accepting states, and $\delta: Q \times \sum \rightarrow Q$, known as the transition function.

The extended transition function can be defined. Let M= (Q, ∑, δ, q_0, F) be a DFA, we define the function $\delta^*: QX\sum^* \rightarrow Q$ as follows:

1. For any q$\in Q$, $\delta^*(q,\lambda) = q$.
2. For any q$\in Q$, $y \in \sum^* and a \in \sum \quad then \delta^*(q,ya) = \delta(\delta^*(q,ya))$.

A string is accepted by M if$\delta^*(q_0,x) \in F$. Thus the language recognized by the DFA M is the set we have referred to as a deterministic finite automata as an abstract machine. The operation of a DFA is described in terms of components that are present in many familiar computing machines. A computation of an automaton consists of the execution of a sequence of instructions where the execution of an instruction alters the state of the machine to some new state. The objective of a computation of an automaton is to determine the acceptability of the input string. An input string is accepted if the computation terminates in an accepting state; otherwise it is rejected. At any point during the computation, the result depends only on the current state and the unprocessed input. This combination is called a machine configuration and is represented by the ordered pair [q_i, w], where qi is the current state and $w \in \sum^*$ [1], [2].

III. SIGN LANGUAGE LITERACY

Signed languages are as old as history. They are not new languages recently invented. Like spoken languages, they developed naturally. Deaf people needed to communicate with those around them. Certain gestures became commonly understood and in time, as with spoken languages, a rich vocabulary and grammar structure developed. Like spoken languages, signed languages are living languages. They change as the people who use them change. Figure 1 show symbols of Sign language.

Figure 1: Sing Language for Deaf Persons

In spoken language, the different types of sounds created by words and tones of voice are the most important devices used to communicate. Sign language is based on the idea that sight is the most useful tool a deaf person has to communicate and receive information. Thus, American Sign Language (ASL) uses hand shape, position, and movement; body movements; gestures; facial expressions; and other visual cues to form its words.

American Sign Language is used in America; it is a language completely separate from English. It contains all the fundamental features a language needs to function on its own--it has its own rules for grammar, punctuation, and sentence order.

American Sign Language evolves as its users do, and it also allows for regional usage and jargons. Every language expresses its features differently; American Sign Language is no exception. English speakers often signal a question by using a particular tone of voice; American Sign Language users do so by raising the eyebrows and widening the eyes.

There is not just one international signed language in the world. There is a different signed language in every country. Some countries have several signed languages.

People did try to invent an international spoken language, called Esperanto. But few speak Esperanto. The naturally evolved spoken languages are used, but not the invented ones. Signed languages are no different.

Revised Manuscript Received on 30 March 2013.
* Correspondence Author
Associate Prof. Syed Asif Ali, Department of Computer Science, SMI University, Karachi, Pakistan.

People tried to invent an international signed language, called Gestuno. But even though the attempt was admirable, no one really signs Gestuno. The naturally evolved signed languages "won".

American Sign Language (ASL) is used in the USA and in English-speaking Canada. There are many dialects of ASL. Because of Gallaudet University in Washington D.C, and other fine schools for the Deaf, most ASL dialects are understood by Deaf people all over the country. ASL is remarkably standardized, considering the size of the USA and Canada, and considering that up until now, there was no written form for the language. It is possible that Sign-Writing will help to preserve ASL and will contribute to its standardization.

The signs listed in the Sign-Writing dictionary help signers learn to "spell" or write ASL signs. As with all dictionaries, individual words or signs do not teach grammar. Learning to write proper ASL sentences in Sign-Writing requires time and practice. Even native ASL signers, who grew up with sign language, must learn how to put their grammar on paper [3], [4].

IV. DFA FOR RECOGNIZE SIGN LANGUAGE PATTERN

Abstract computing devices usually known as finite-state machines and the computations of such machines determine whether a string satisfies a set of conditions or matches a prescribed pattern. Finite State Machines share properties common too many real life mechanical machines when given input; they process input and generate output. The set of strings that are accepted as input defines the language of machine or input-out system. We are interested in introducing a class of abstract machines computations that can be used to determine the acceptability of input strings of Sign language [5].

Concept of regular expression can be used to express pattern/token in a language. In Automata theory machine receive regular expression in stream (on-by-one) and check its validity on the basis of their syntax and semantic analysis then accept it [6], [7], [8], [9].

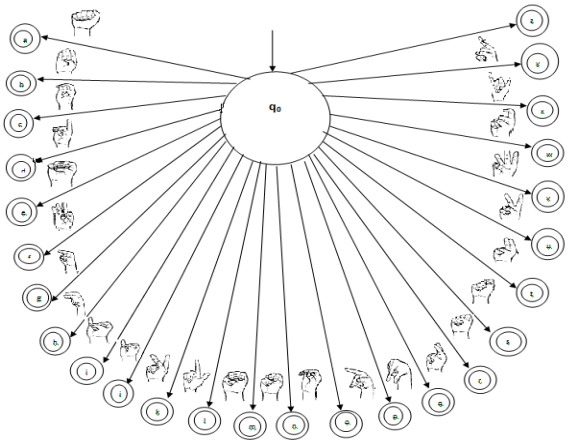


Figure 2: Deterministic Finite Automata for Sing Language

Pattern of sign language based on the mother language or culture language of deaf persons where they stay. The ASL is basically mapped on the American language (see III). But the sign language not fully based on the grammar of American Language so it is different from American written and spoken language. The general Automata for American Sign Language which follow the alphabets of American language are as below:

In above Finite State Automata of Sign patterns

Q→Total numbers of State(s)

Q= {q_0, a, b, c, d, e, f, g, h, i, j, k, l, m, n, o, p, q, r, s, t, u, v, w, x, y, z}

The total number of states = 27

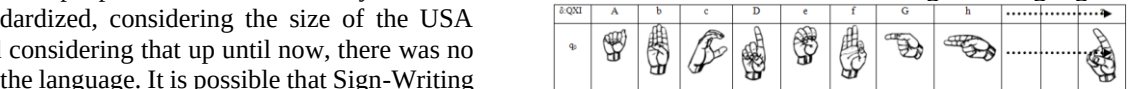
q_0 → Initial state(s)

qo= {qo}

q_f→Final State(s)

q_f={a, b, c, d, e, f ,g ,h , i ,j, k ,l, m , n, o, p, q, r, s, t, u, v, w, x, y, z}

Table 1: Transition table for Signed Language

δ:QXI	A	b	c	D	e	f	G	h	.....	.....	.....
q_0											
a	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥
b	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥
c	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥
.....	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥
z	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥	⊥

On observance of the different combinations of the finger positions which recognize the Sign patterns of in American Sign Language .All the five fingers can bend at three different positions therefore with various arrangements of fingers will make the language of the said Automata as follow:

I → Index finger
F → Fore finger
M → Middle finger
S → Small finger
T → Thumb
W → Wrist
G → Gap
Mo → Movement
B → Bend
Tw → Twist
P_1 → Thumb at side of Index finger
P_2 → Thumb at side of Middle finger
P_3 → Thumb at side of Small finger
P_4 → Thumb at side of fore finger
P_5 → Thumb at Index finger
P_6 → Thumb at fore finger
P_7 → Thumb at Middle finger
P_8 → Thumb at Small finger
P_9 → Thumb in index finger
P_{10} → Thumb over Small finger

Thus the language is

L = {I, F, M, S, T, W, G, Mo, B, Tw, P_1, P_2, P_3, P_4, P_5, P_6,P7}

As

a → TP_1
b → $IFMSTP_7$
c → IBFBMBSBTBWMo
d → ITP_7
z → ITP_7Mo

Published By:
Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP)

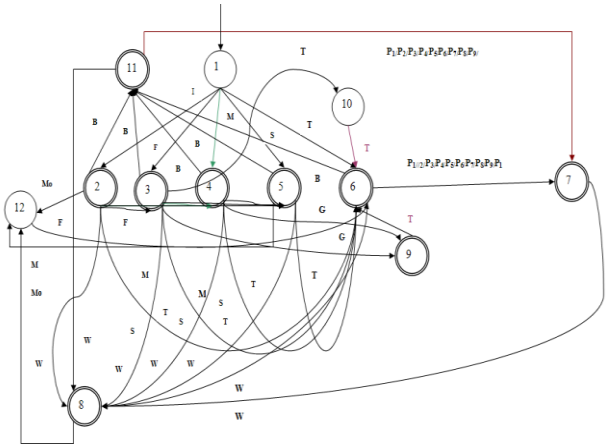


Figure 3:Deterministic Finite Automata for Sin Language after minimization

V. CONCLUSION

Modern technologies play an important part and for communicating deaf persons with normal persons. Assistive technology is important because, without assistive technology they will have no access or be able to benefit from their educational program and other matter of their life.
By the use of ICT, it is easy to develop an interactive communication system for them. Automata concept provides us the methods and techniques to construct abstract machines for Sign Language pattern .Based on this, I have developed automata that take the English text as input and convert this into Sign language pattern using the concept of minimization which reduced the size of actual automata. In proposed DFA of Sign language pattern, I used the position of fingers instead of complete hand. The proposed approaches cheap and less complex than many other systems that are currently in use by different local and international platform.

ACKNOWLEDGMENT

The author wish to thanks SMI University Karachi, Pakistan and Meritorious Prof. Dr. S.M.Aqil Burni research supervisor of author.

REFERENCES

1. John C Martin, “Introduction to languages and Automata Theory”, 3rd Edition, 2003.
2. A. Thomas Sudkamp, ‘Automata Theory, Languages, and Computation’, Third Edition.
3. ASL II American Sign Language Thesaurus by Don Cabbage Ph.D. Published by International Communication Publishers PO Box 371007, E1 Paso, TX79937 (915)855-7575 doncabbage@juno.com
4. Martin L.A. Sternberg, ‘American Sign Language Dictionary, Third Edition’, Third Edition.
5. Vegas, NV, USA, May 14-May 17, ISBN: 0-9785699-0-3, Minjun Wang, Indiana University, U.S.A, Geoffrey Fox, Indiana University, U.S.A, Marlon Pierce, Indiana University, U.S.A
6. Lucas, S.M.; Reynolds, T.J.; , "Learning deterministic finite automata with a smart state labeling evolutionary algorithm," Pattern Analysis and Machine Intelligence, IEEE Transactions on, vol.27,no.7,pp.1063-1074,July2005,doi:10.1109/TPAMI.2005.143 , URL: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=1432740&isnumber=30890
7. Ong, S.C.W.; Ranganath, S.; , "Automatic sign language analysis: a survey and the future beyond lexical meaning," *Pattern Analysis and Machine Intelligence, IEEE Transactions on* , vol.27, no.6, pp. 873-891, Jun 2005 doi: 10.1109/TPAMI.2005.112 URL:
8. http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=1432718&isnumber=30761
9. Automatic Sign Language Analysis: A Survey and the Future beyond Lexical Meaning,June 2005 (vol. 27 no. 6),pp. 873-891,Sylvie C.W. Ong,SurendraRanganath
10. Lucas, S.M.; Reynolds, T.J.; , "Learning deterministic finite automata with a smart state labeling evolutionary algorithm," Pattern Analysis and Machine Intelligence, IEEE Transactions on , vol.27,no.7,pp.1063-1074,July2005,doi:10.1109/TPAMI.2005.143 URL: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=1432740&isnumber=30890

Associate Prof. Dr. Syed Asif Ali , hold his Ph.D, MCS ,MIBM and MSc. degrees from University of Karachi .He has more than fifteen years experience of teaching and research in the field of computer science. He has an author of books published internationally. He is member of Editorial Board of various International Journals. He is also fellow member of various international bodies including IACSIT, CSTA, ISTE, IAENG etc.

Published By:
Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP)