JUSIKOM PRIMA (Jurnal Sistem Informasi dan Ilmu Komputer Prima)
Vol. 6 No. 1, Agustus 2022 E-ISSN : 2580 - 2879

IMPLEMENTATION OF FINITE STATE AUTOMATA ON THE DATE TO SEASON CONVERSION ENGINE BASED ON PRANATA MANGSA SEASON CALENDAR

Rahmat Satria Buana[1], Windu Gata[2], Achmad Bayhaqy[3], Okky Robiana Sulaeman[4], Nita Merlina[5]
Program Ilmu Komputer Universitas Nusa Mandiri
Jalan Margonda Raya No. 545, Pondok Cina Depok, Jawa Barat.
Email : windu@nusamandiri.ac.id

ABSTRACT- The world is now starting the trend of going green or back to nature. The slogan goes green or back to nature can also be interpreted as living in harmony with nature. Our beloved country of Indonesia has implemented a harmonious life with nature, we can find it in the Javanese planting season calendar called *Pranata Mangsa*. In the *pranata mangsa*, we are taught the method of living in harmony, especially in an agricultural system. Harmony with nature means harmony between seasons, weather, living things, and types of plants. If everything is applied, there will be harmonization between all elements both from outside and inside so that additional elements such as chemical fertilizers and pesticides in agriculture, which essentially eliminate the harmonization of nature itself, are not needed. The implementation of Finite State Automata on the farming season calendar is expected to be able to educate and make it easier for farmers in particular and the Indonesian people, in general, to able to recognize the farming time and apply it to daily life. The final result of this research is the calendar system that can convert the date and month in the masehi calendar into the period or season of the *pranata mangsa* system.

Kata kunci : FSA, DFA, calendar, *pranata mangsa*, season

1. INTRODUCTION

Many people do not know that many regions in Indonesia have traditional planting calendars existed from the time of their ancestors and have been passed down from generation to generation. This traditional planting calendar is used as a reference in planting, harvesting, and using certain commodities [1]. One of the traditional planting calendars is *Pranata Mangsa* which comes from the Java area. Writings about *Pranata Mangsa* have been published in the book The History of Java (Raffles, 1817). It is said that *Pranata Mangsa* has lived for centuries before the arrival of the Hindus. Knowledge about *Pranata Mangsa* was spread through a speech from generation to generation and implemented in 1856 by Sunan Pakubuwana VII[2].

Pranata mangsa [3] (derived from the Javanese tribal language: pranåtåmångså, can be interpreted as "seasonal provisions") means a kind of calendar system related to agricultural activities, including farming or fishing. The *pranata mangsa* system is a calendar system that refers to the circulation of the sun. *Pranata mangsa's* cycle (a year) is 365 days or 366 days and contains various fields of phonology and other environmental phenomena that are useful for guidance in the agricultural sector, as well as support and threats in the form of preparation for disasters (drought), disease outbreaks, crop nuisance attacks, or floods) that may occur at certain times.

The implementation of Finite State Automata is expected to make it easier for farmers to know the seasons in the *pranata mangsa* system [4]. It also preserves our love for indigenous Indonesian culture, and encourages humans to pay more attention to nature and live in harmony with nature. *Pranata mangsa* avoid crop failure due to season mismatch or dependence on chemical fertilizers [5].

Finite State Automata (FSA) is part of the information science component that has several functions from digital computers. The stage is to receive input, then produce output. FSA also has temporary storage and can make decisions in processing inputs into outputs. Automata is a system consisting of a finite number of states, where each state represents information about the previous input, and can also be considered as machine memory. Automata theory is essentially a theory of abstract machines and is closely related to formal language theory[6].

Automata are non-physical machines that function to recognize, accept, or generate a sentence in a particular language. The input on the automata machine is considered a language that the machine must recognize. Then a decision will be made by the automata engine regarding whether the input is accepted or not so that the automata engine can be used to produce a language whose rules can be determined by that language [7].

FSA is a mathematical model that can accept input and output. FSA has a finite number of states and can move from one state to another based on input and transition functions. FSA has no storage or memory, it can only remember the current state [8]. FSA is divided into two: deterministic finite state automata

(DFA) and non-deterministic finite automata (NFA). The basic difference is that in the DFA, the state that receives the input will go exactly to one state, while in the NFA one input state can go to the next several states [9].

With the FSA, it is hoped that there will be an easy way for farmers in particular and the wider community to be able to know the seasons in the *pranata mangsa* system from the masehi calendar through a conversion machine [10].

2. RESEARCH CONTENT

In this research, a machine is made to convert the entered date into the appropriate season group. This study aims to apply the concept of FSA which is the type of DFA in the application of date conversion to the *pranata mangsa* season calendar

.

2.1 Method

A. Analysis Method

The method of analysis used is by referring to the literature on current and past agricultural concepts that pay attention to the farming season. Farming systems directly or indirectly depend on the diversity of climate between seasons and between years. The application of Finite State Automata is expected to help farmers determine the season that is suitable for their crop type. The *pranata mangsa* has defined the seasons of the year as well as the activities that farmers must carry out as follows:

Tabel 1. Distribution of Mangsa in Pranata Mangsa Season

No	Mangsa	Period	Season	Activity
1	Kasa (kartika)	June 22nd - August 1st	Early dry	Burning hay, growing crops such as beans and corn
2	Karo (pusa)	August 2nd - August 24th	Dry summer	Preparing Gogo Rice
3	Katelu (manggasri)	August 25th - September 18th	End of Dry	Start harvesting palawija
4	Kapat(sitra)	September 19th - October 13th	Early winter/ rain	harvesting secondary crops and cultivating land for gogo rice
5	Kalima (manggakal)	October 14th - November 9th	Winter	Making ditches in the fields Spreading gogo rice
6	Kanem (naya)	November 10th - December 2nd	Winter rain	Spread the seeds in the nursery
7	Kapitu (palguna)	Desember 23rd- February 3rd	Winter rain	Transferring seeds to the fields
8	Kawulo (wasaka)	February 4th- February 28/29th	The peak of winter and rain	Cultivating paddy fields.
9	Kasanga (jita)	March 1st- March 25th	End of winter	Rice planting season.
10	Kasapuluh (srawana)	March 26th- April 18th	Spring/ humid	Caring for rice plants.
11	Desta (padrawarna)	April 19th- May 11th	Summer humid	Early harvest (short-lived plants) Planting beans
12	Sada (asuji)	May 12th- June 21st	Early summer	Planting secondary crops: cotton, soybean, nila working on the moor to plant corn

The table above divides *mangsa* or the first season that starts on June 22nd different from the masehi calendar which starts on January 1st. Likewise, the number of days in each *mangsa* varies from a minimum of 23 days and a maximum of 43 days.

B. Formal Method

The formal method is mathematical modeling that can be used to bridge the manufacture, development, and verification of hardware and software, including state diagrams and theoretical automata models. State diagrams are used as a design framework for a state machine and can facilitate the development process and understanding the functions when using the machine. In applying the formal method, a research framework is needed to determine the research flow in a structured and comprehensive manner [11]. The steps of this research framework can be seen in the following figure:

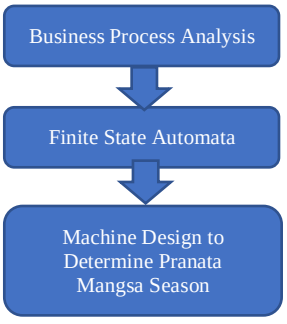

Fig.1. Stages of Research Methods

2.2 Analysis and Result

A. Business Process Analysis

The calendar of *pranata mangsa* is currently only found in books or pictures that are rarely accessed or used by farmers or individuals. Therefore, this conversion machine is made so that it is easy to access and obtain information quickly and precisely. Users simply enter the date and month, and the season will be displayed according to the pranata mangsa's calendar.

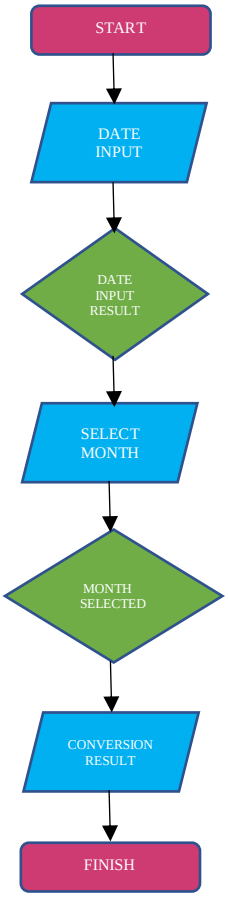

Fig.2. Activity Diagram

B. System Design with FSA implementation

Finite State Automata (FSA) is not a physical machine, but a mathematical model of a system that accepts discrete inputs and outputs. FSA is the automata engine of the regular language. An FSA has a finite number and can move from one state to another. This state change is represented by a transition function. This type of Automata does not have a storage area, so the ability to remember is limited[12].

The type of FSA that used by the author in this study is the Deterministic Finite Automata (DFA) method or often known as Deterministic Finite-State Automaton (DFSA). In DFA a state has exactly one exit arrow [13]. DFSA was first published by Warren McCulloch and Walter Pitts as the first researchers to apply a concept similar to finite automata in 1943.

DFA is a finite automata which has 5 tuples which are represented as follows:
Q,himpunan state, example: q0, q1, q2}
Σ, input alphabet, example {a, b}
δ, transition function
q0, first state
F, last state
DFA season determination
Q ={q0, q1, q2, q3, q4, q5, q6, q7,q8,q9,q10, q11, g}
∑ = {a, b, c, d, e, f, g, h, I, j, k ,l }
q0 = {q0}
F = {q1, q2, q3, q4, q5, q6, q7,q8,q9,q10, q11, q12

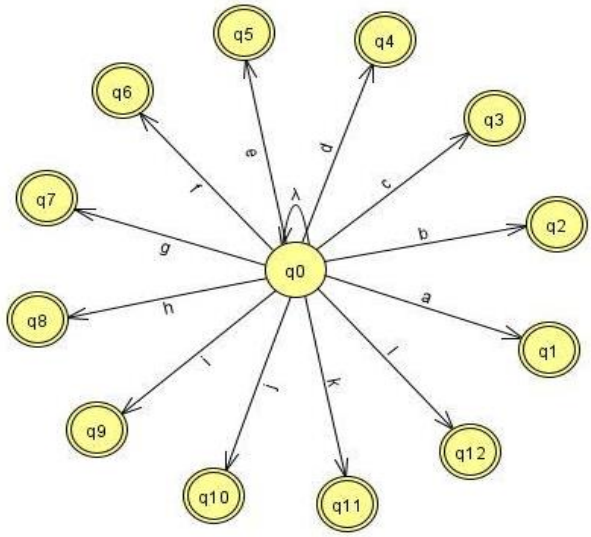

Fig.3. FSA
Describes the transition diagram from the first state to the final state

C. Machine Design to Determine Pranata Mangsa Season

The FSA method is applied to the date conversion application using the Hyper Text Markup Language form or better known as HTML [14].

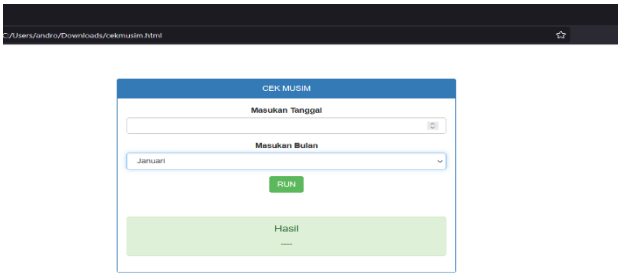

Fig. 4. Initial View of Season Check Engine Form

This is the initial view to convert masehi date to season calendar in pranata mangsa.

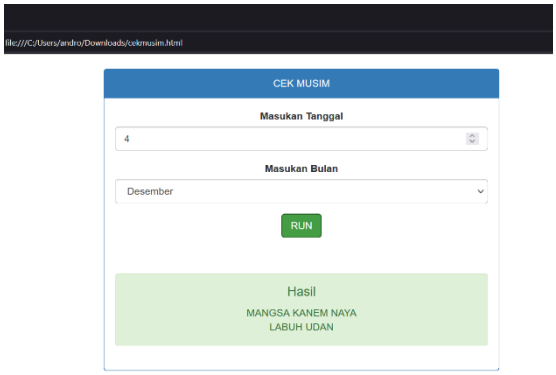

Fig.5. Result view of the conversion of masehi date to season calendar in pranata mangsa with the season check engine

After receiving input from the text box, it will be processed with javascript [15] embedded in the HTML form. The form will issue a conversion result that informs the season and appropriate agricultural activities and environmental conditions in that season.

D. Result

From the test results, it was found that the DFSA machine can convert arbitrary date inputs into certain mangsa or season categories.

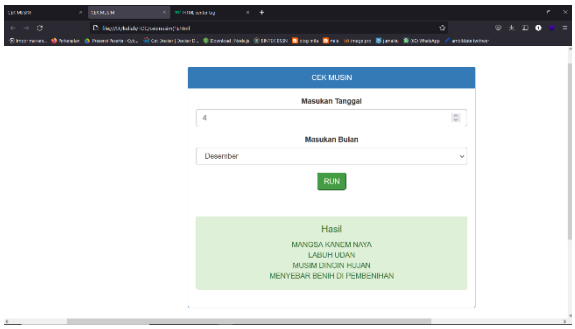

Fig.6. Experiment 1

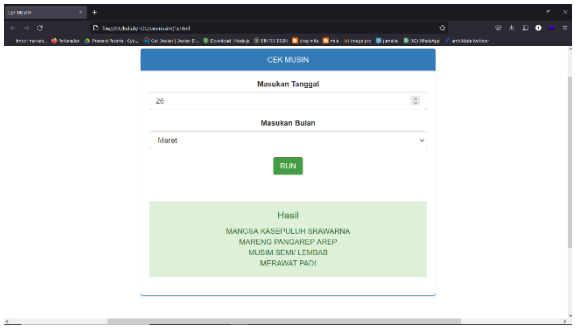

Fig.7. Experiment 2

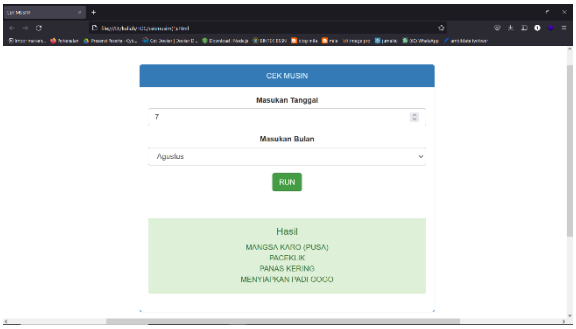

Fig.8. Experiment 3

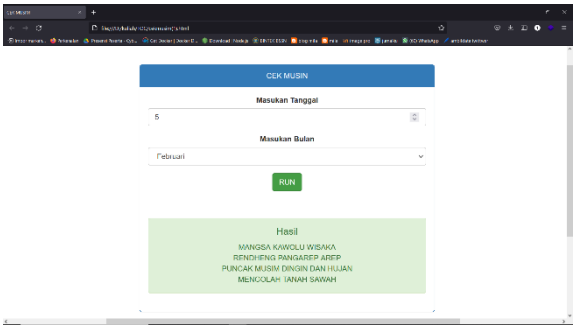

Fig.9. Experiment 4

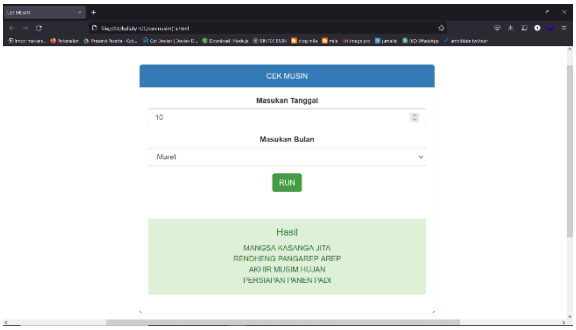

Fig.10. Experiment 5

Table 2. Experiment Result

No	Input	Result	Season	Acivity
1	Desember 4th	Mangsa: 6	Winter Rain	Spread the seeds in the nursery
2	Maret 26th	Mangsa: 7	Spring Humid	Caring for Rice Plants
3	August 17th	Mangsa: 2	Summe r Dry	Preparing Gogo Rice
4	February 5th	Mangsa: 8	Peak season winter and rain	Cultivating Rice Field
5	March 10th	Mangsa: 9	End of winter	Rice Harvest Preparation

3. CONCLUSION

The DFSA engine can work properly and precisely to convert masehi date into mangsa forms in the pranata mangsa system. This can help farmers, in particular, to determine strategies in farming, for example choosing crops that are suitable for the season and no longer need chemicals to fertilize the soil, because the elements needed are obtained from plants of the previous season [16]. Besides, people can know the seasons, especially on the island of Java, to adjust their lifestyle, and choose suitable food and clothing according to the season.

4. CLOSING

The implementation of Finite State Automata on The Date to Season Conversion Engine Based On Pranata Mangsa Season Calendar can combine past technology in the form of local wisdom with today's technology. The combination of the two can bring mutually supportive benefits to create harmonization between humans and nature.

REFERENCES

[1] E. Runtunuwu *et al.*, "Sistem informasi kalender tanam terpadu: Status terkini dan tantangan kedepan Information system of integrated cropping calendar: current status and future challenges," *J. Sumberd. Lahan*, vol. 6, no. 2, pp. 67–78, 2012.

[2] A. Rimanang, *pranata mangsa astrologi jawa kuno*, Cetakan pe. yogyakarta: kepel press, 2016.

[3] I. W. Rif'ati Dina Handayani, Zuhdan Kun Prasetyo, *Pranta mangsa dalam tinjauan sains*, vol. 53, no. 9. 2019.

[4] S. Yeli and S. Elza, "Penggunaan Prakiraan Musim untuk Pertanian di Indonesia: Status Terkini dan Tantangan Kedepan," *J. Sumberd. Lahan*, vol. 12, no. 1, pp. 33–48, 2019, [Online]. Available: http://124.81.126.59/handle/123456789/8174.

[5] H. Beberapa, V. Tanaman, and B. Merah, "pengaruh waktu penanaman terhadap pertumbuhan dan hasil beberapa varietas tanaman bawang merah (Allium ascalonicum L.)," *Agromix*, vol. 4, no. 1, pp. 38–46, 2013, doi: 10.35891/agx.v4i1.777.

[6] E. Erni, F. Titiani, S. A. Putri, and W. Gata, "Penerapan Konsep Finite State Automata Pada Aplikasi Simulasi Vending Machine Jamu Tradisional," *J. Inform.*, vol. 7, no. 2, pp. 141–147, 2020, doi: 10.31294/ji.v7i2.8151.

[7] R. Suharsih and F. Atqiya, "Penerapan Konsep Finite State Automata (FSA) pada Aplikasi Simulasi Vending Machine Yoghurt Walagri," *Edsence J. Pendidik. Multimed.*, vol. 1, no. 2, pp. 71–78, 2019, doi: 10.17509/edsence.v1i2.21778.

[8] Fergie Joanda Kaunang, "Penerapan Konsep Finite State Automata (FSA) pada Mesin The Implementation of Finite State Automata in an Automatic Ice cream Maker Machine," *Penerapan Konsep Finite State Autom. pada Mesin Pembuat Ice cream Otomatis*, vol. 9, no. 2, pp. 129–137, 2019.

[9] S. Sinurat, "Simulasi Transformasi Regular Expression Terhadap Finite State Automata," no. 338, pp. 1–8, 2013.

[10] T. Hariono *et al.*, "Hari Dan Konversi Dari Tahun Masehi Ke Tahun," vol. 6, no. 1, pp. 39–53, 2013.

[11] P. Issn *et al.*, "penerapan konsep finite state automata pada simulasi mesin pelipat pakaian otomatis," vol. 7, no. 2, pp. 33–38, 2021.

[12] U. Firrar, *teori bahasa dan otomata*, Cetakan pe. yogyakarta: j & j learning, 2001.

[13] D. Robyanto, A. Priyatna, E. Heni, and D. Robyanto, "Implementasi Deterministic Finite Automata (DFA) Pada Perancangan Aplikasi Perhitungan Uang Harian Perjalanan Dinas Kementerian," 2021.

[14] J. McPeak and P. Wilton, "HTML Forms," *Begin. JavaScript®*, pp. 335–389, 2015, doi: 10.1002/9781119209423.ch11.

[15] Q. H. Mahmoud, W. Dobosiewicz, and D. Swayne, "Redesigning Introductory Computer Programming with HTML , JavaScript , and Java," pp. 120–124, 2004.

[16] E. Surmaini and H. Syahbuddin, "Kriteria Awal Musim Tanam: Tinjauan Prediksi Waktu Tanam Padi Di Indonesia," *J. Penelit. dan Pengemb. Pertan.*, vol. 35, no. 2, p. 47, 2016, doi: 10.21082/jp3.v35n2.2016.p47-56.

Contac person Author: Rahmat Satria Buana
Hp 0895-1595-7809
Wa 0838-0603-0727