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Pattern recognition on herbs leaves using region-based invariants feature extraction

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Abstract

As medicine, herbal plants have been widely used since ancient times, and are still used today. There are various types of herbal plants that can be used as medicine but due to the limited ability of communities to recognize the type of plants and the lack of information, both cause the limited use of plants as medicine. In this research, an herbal plants identification system based on leaves pattern was developed. This identification system is based on the shape of the herbal plants' leaves. Before identification, preprocessing stages should be performed such as conversion to grayscale image,

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***Abstract*— As medicine, herbal plants have been widely used since ancient times, and are still used today. There are various types of herbal plants that can be used as medicine but due to the limited ability of communities to recognize the type of plants and the lack of information, both cause the limited use of plants as medicine. In this research, an herbal plants identification system based on leaves pattern was developed. This identification system is based on the shape of the herbal plants' leaves. Before identification, preprocessing stages should be performed such as conversion to grayscale image, conversion to binary image, and image segmentation using Otsu's method. Feature extraction method used in this system is one kind of region-based invariant feature extraction, which is well-known as Hu's seven moments invariant and the Euclidean or Canberra distance as a recognition method. The research was conducted on 15 types of herbal plants. Based on the research, the percentage of recognition in this identification system using Euclidean Distance reached 86.67% with the lowest recognition rate is 40% for *mangkokan* leaf. While using Canberra distance for recognizing, the percentage of recognition is 72% and the lowest recognition rate is 20% for *keji beling* leaf. The best recognition rate of 100% for Euclidean distance similarity measure is reached when 9 (nine) types of leaves were implemented, i.e. banyan (*beringin*), *binahong, dolar, keji-beling, laos,* noni (*mengkudu*), papaya, red betel (*sirih merah*), and soursop (*sirsak*) leaves. When Canberra distance used, 100% recognition rate was reached by 5 (five) leaves types, i.e. *binahong, dolar, pecut-kuda,* papaya, and red betel (*sirih merah*) leaves.**

Keywords—Identification System, herbal plant, leaves pattern, Hu's seven moments invariant, Euclidean distance.

I. Introduction

Herbs as medicinal products have long been used, and is still used today. The use of herbs in curing the disease is more secure because it is natural and has side effects that are minimal when compared with the use of synthetic drugs. Besides being more secure, plants can also be found easily and the price is cheaper [1].

The limited ability of communities to identify types of herbs leaves, causing limited use of plants as medicines. So many types of plants, and properties variation also cause the complication of recognition. Community knowledge was limited to plants that are generally used as herbs such as turmeric, ginger, turmeric, and others while, in fact, there are many plants that can be utilized.

In this research, we designed a system that can be used to identify the type of plant and its benefit in curing the disease. Recognition is based on the plant leaf pattern plants to be identified. The method used for image feature extraction is a method Hu's Seven Moments Invariant [2],[3]. Before extracted, a process of image segmentation uses Otsu's method [4],[5]. After the characteristics of the images are extracted, the system will match the data extraction to a database that was created earlier. Data matching is done by calculating the Euclidean or Canberra distance [6].

II. Research Methodology

A. System Design

There are 3 (three) steps on herbal plant identification system, i.e. preprocessing; data training and registration; and image recognition. These 3 (three) stages can be depicted in Fig. 1 until Fig. 3. It can be noted that in process of image segmentation Otsu's method [5] was used.

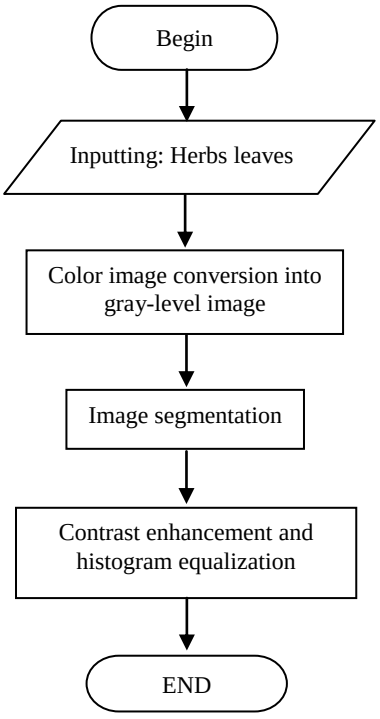

Fig. 1 Preprocessing flowchart

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Low Latency Network-on-Chip Router Using Static Straight Allocator

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***Abstract*—One clock cycle is the ideal latency for a network-on-chip (NoC) router to pass the received flit in the current cycle to its requested destination output port when there is no contention with other flits. In order to achieve this goal, a newly arrived flit is required to go through all router's pipeline stages to the switch traversal stage. In this paper, we present a low latency synchronized NoC router micro-architecture that achieves single clock cycle latency for packets traveling to the same direction using a static straight VC/SW allocator (SSA). In comparison to existing single clock cycle latency routers which require more complex VC/SW allocator or crossbar switch architectures, our proposed SSA has simpler architecture and works in parallel with the previously proposed baseline VC/SW allocator. The simulation results using six different synthetic traffic patterns shows SSA reduces the communication latency of a 2-cycle latency baseline router by 24% in average.**

I. Introduction

Network-on-Chip (NoC) [1] provides a flexible and extensible inter-core-communication infrastructure for many-core system-on-chips. However, due to multiple number of routers a packet has to traverse between a source and destination cores, as well as each individual router buffering, NoC-based systems can suffer from high inter-core communication latency. Reducing NoC communication latency is important as many-core based applications are highly sensitive to inter-core communication latency. However, designing a low latency NoC router can be a challenge.

Modern NoC routers apply several virtual channels (VCs) on a single physical channel, for multiple proposes such as increasing network throughput, avoiding deadlock in fully adaptive routing [2], isolating resources for different message classes to prevent application level deadlock [3], and improving Quality-of-service (QoS) by generating virtual networks [4]. VC makes the router architecture to become more complex that requires additional VC allocation stage to the existing router pipeline stages.

A conventional VC based NoC router (e.g. [5]) requires four pipeline stages for route computation (RC), virtual channel allocation (VA), switch allocation (SA) and switch traversal (ST) to handle a newly arrived header flit and deliver it to its desired output port. In a conventional router, the result of each pipeline stage is required before the next stage can be executed. Hence, this feature prevents parallel computation and thus results in a 4-cycle latency router architecture as shown in Figure 1(a).

The RC control dependency can be removed using look-ahead route computation (LRC) [8]. LRC computes the output port of a packet, one router in advanced and tags the results to the packet header flit. As shown in Figure 1(b), LRC can be performed in parallel with VA that results in a 3-cycle latency router.

Combining the VC and switch allocation stages relaxes the dependencies between these two stages. In a combined VC/SW allocation (VSA), a VC is allocated only upon successful switch allocation. Compared to conventional NoC routers that allocate VCs before the switch allocation, the combined allocator starts with switch allocation either speculatively [9], [10] or non-speculatively [7]. Speculative combination assumes a successful VC allocation for all non-assigned VC requests and ignores the results of switch allocator in the case of speculation failure. Non-speculative architectures first check the availability of VCs for the requested port and only send the valid requests to the switch allocators. This combination results in a simple VC allocator architecture which can be implemented either using the queues of free VCs for each message classes [10] or by using one stage V:1 arbiter [7], where V is the number of VC per port. LRC and Combined VC/SW allocation results in a two-cycle latency router (Figure 1(c)).

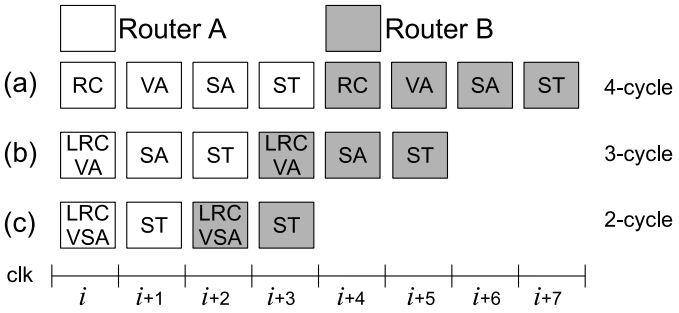

Fig. 1: Pipeline stages of various router architectures. a) Conventional 4-cycle latency router. b) 3-cycle latency look-ahead router. c) 2-cycle latency router using look-ahead routing and combined VC/SW.

One-cycle latency is an ideal latency for a NoC router. It

Brainwave-Controlled Applications with the Emotiv EPOC Using Support Vector Machine

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***Abstract*—Electroencephalography (EEG) which is the electrical signal recorded by the sensors attached on the human scalp to detect brain activities has been the emerging trends in digital signal processing. As compared to processing other types of digital data such as speech or audio signals, EEG signal processing is more challenging. However, EEG signals have practically found a wide range of important applications. In this paper, we propose a design of a brain-computer interface (BCI) using EEG's P300 component to a control application. First, we use the Emotiv EPOC headset to capture the raw EEG signals. Then, we adopt a classification algorithm by invoking support vector machine along with the selected extracted features to classify the two-class EEG trials (with and without P300 component). The algorithm is developed to help people express their selection of one among four commands. The experimental results are provided evaluate the classification accuracy.**

***Index Terms*—EEG signal processing, P300 brain-waves, brain computer interface, brain-wave-controlled application.**

I. Introduction

Brain-computer interface (BCI) systems are designed for people with difficulties in communication or with severe motor disabilities to express the thoughts by using their bare EEG signals. On top of that, the P300 wave, which is an event-related-potential (ERP) of EEG or say in another way, a specific component of our brain signals, is used in many BCI systems thanks to its clear distinctively observable characteristics among the noisy background of EEG signals. The P300 is an endogenous component of EEG signals elicited by human's brains in the process of decision making. P300's clearly positive voltage peak usually occurs typically approximately at 300 milliseconds after stimulus onset presented by the so-called 'oddball paradigm', in which the low-probability target stimuli are mixed with high-probability non-target ones. Each stimulus is implemented on the computer screen by visual flashing (or intensification) its symbol image. Four images corresponding 4 controlled devices are shown in the screen, on which the subject would focus their eyesight at only one image as their intention, and it is implicitly known as his or her target stimuli, while the other 3 images are the non-target ones. The subject is presented with two categories of stimulus (target and non-target), and he or she is instructed to visually focus on the target stimuli to determine his or her intention.

In 1988 Farwell and Donchin [1] developed a P300-related BCI system called "P300-Speller" as it soon gained the popularity from the EEG community thanks to its wide range of application. In this BCI, a 6-by-6 matrix of 36 letters (24 alphabetical characters and 10 decimal digits) is presented on the computer screen on which the subject focuses their eyesight. During one spelling session, each row or column (which contains 6 letters) is flashed sequentially and randomly in a set of 12 flashes corresponding to 12 rows and columns. Each flash, or saying in another way, each intensification of a row or a column is called a stimulus. A flashing block therefore consists of 12 stimuli. Ideally, there should be only two target stimuli, or two target responses over the total of 12 stimuli. The others are called non-target. Determining which two of the twelve stimuli responses contain P300 component is interestingly enough to determine the letter intended to be spelled out by the subject. However, due to the noisy background of EEG signals which heavily affect the classification results, a single spelling session for the purpose of eliciting one specific letter is composed of multiple blocks, usually 15 to 20, to eliminate the noisy other effects such as the crowding problems [2]–[5], the human errors and subject's tiredness [6], or repetition blindness problems [7].

Some modifications on the original P300-Speller were made in order to improve the quality of P300 peaks in epochs and to decrease the spelling time for a single session. The original row/column paradigm (RCP) can be tuned into similar counterparts which deal on single letter flashing or region-based flashing paradigm. In RCP, two out of twelve stimuli are the target ones, thus resulting in the target rate of 1/6. Several researches have shown that lowering this rate necessitates the appearance of clearer P300 components in EEG epochs [1]. A novel paradigm called region-based paradigm (RBP) [8] was designed not only to decrease this rate to 1/7 but also to increase the number of letters which can be expressed. The matrix of letters is replaced by the presence of 7 zones on the screen, with each zone contains 7 different letters. Among the original 36 letters of the conventional P300-Speller, 13 more symbols (@, #, %...) were introduced in this paradigm to increase the total number of symbols to 49. The flashing scheme is divided into 2 phases, for zones, or regions, and for letters in one zone. First, 7 regions are intensified as the subject only needs to focus their eyesight on a specific zone. After determining that region, the second flashing phase comes as 7 different letters in that region are flashed in the same way. It should be noted that the other 6 non-target regions are excluded and disappear from the screen for the purpose of

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RESEARCH ON POSITIVE NARROW BIPOLAR EVENTS IN PADANG

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***Abstract*— In this study, we have examined electric field records from 10 thunderstorm days containing 13 positive narrow bipolar pulses (PNBPs). It was found that PNBP occurrences have a strong relationship with thunderstorm activities. The mechanism of the NBPs was very different from intracloud (IC) and cloud-to-ground (CG) flashes. We also found that the AM values of rise time, full width at maximum time, zero crossing time, overshoot time, pulse duration and overshoot to peak amplitude ratio of the PNBPs were 1.64 µs, 1.32 µs, 9.38 µs, 15.06 µs and 0.31 µs, respectively. The pulse duration range was from 8.45 to 29.06 µs. Comparison with values from previous studies reported by other researchers showed that the mentioned parameters had no strong relationship with latitude or geographic location.**

Keywords—narrow bipolar pulse; cloud flash; ground flash; thunderstorm; lightning

I. INTRODUCTION

Narrow bipolar pulses (NBPs) are identified as one of the intracloud (IC) lightning discharge activities inside thunderclouds. However, the physical mechanism of NBPs remains a mystery. Many researchers have reported that there were two types of NBPs, namely positive narrow bipolar pulses (PNBP) and negative narrow bipolar pulses (NNBP). NBPs have strong radio frequency radiation at several MHz and a short duration with zero crossing (initial positive half cycle) and overshoot (negative half cycle) within several microseconds, followed by or not followed by any other signals [1-4]. NBPs may not be related to ground and cloud flash activities and originate inside the most active thundercloud areas [2]. PNBPs usually occur at lower latitudes than NNBPs. In addition, PNBP occurrences are rare compared to NNBP events [5]. This study is to clarify the relationship between thunderstorm activity and PNBP occurrence. We examined an electric field change data set with 13 PNBPs that were recorded during thunderstorm days in 2015. The characteristics of the PNBPs were statistically analyzed based on electric field change as presented in this paper. All data were also compared to previous researches at different locations and latitudes.

II. OBSERVATION AND DATA

The electric field records containing the PNBPs presented here were recorded from January to December 2015 in Padang, Indonesia (0° N) on 10 thunderstorm days using an electric field mill and a broadband electric field fast antenna. Both electric field sensors on the rooftop of the Electrical Engineering Department Building of Andalas University were located at 13 km from Padang Beach, Indian Ocean at an altitude of 317 m above sea level. The fast antenna with parallel flat-plate configuration was used to detect electric field changes in the thunderclouds. The fast antenna was connected to an amplifier and integrator with a time constant of 100 ms. Furthermore, all signals sensed by this antenna were recorded by a digitizer with a sample rate in the range of 1-4 MS/s and a record length of 250 ns - 1 s. To ensure that the strong electric field of lightning was recorded, the digitizer was set to window trigger mode at a trigger level of 1 V and a pretrigger time of 30% of the record length. The electric field measurement system used was similar to the one used in Hazmi et al. [6-7].

III. RESULTS AND DISCUSSION

In this study, 13 PNBP occurrences were analyzed. A summary of the PNBP events can be seen in Table 1. There are two types of PNBP events; for convenience, type A is called isolated PNBP to indicate that there are no other IC lightning occurrences, while type B is called non isolated PNBP which indicates that the occurrences are preceded or followed by other IC lightning occurrences, as displayed in Figures 1 and 2. The occurrence percentage of type A (46%) was slightly smaller than that of type B (54%). From Table 1, the PNBPs occurred during day and night time with the duration of the thunderstorms varying from 126 to 844 minutes. The background electric field changes of the thunderstorms recorded by an electric field mill sensor for negative and positive polarities varied between 0.284-4.096 kV/m and 0.364-4.094 kV/m, respectively. This indicates that the PNBPs occurred inside the most active thundercloud areas with high electric field. Our observation results were a good agreement with observation of Smith et al. [2]. However, PNBPs also occurred when the thunderstorms detected had a lower electric field, for example thunderstorm numbers 8 and 11 in Table 2. This may be due to the different distance between the PNBPs

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