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Myocardial Infarction Diagnosis: Pattern Analysis of ECG Report Images using Machine Learning Techniques

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***Abstract*—The ECG machine data is utilized to diagnose cardiac conditions, specifically focusing on identifying myocardial infarction rates by analyzing pattern variations within ECG report images. Variations in the output of electrodes 2 and 3 are noted as indicative of a heart attack. The authors employ various image processing techniques like thresholding, contrast enhancement and machine learning methods like SVM, GBC, k-neighbors to process these patterns, aiming to enhance accuracy. After extracting four features, the most effective classifiers are employed, with the Gradient Boosting Classifier (GBC) with set of features exhibiting the highest accuracy at 76.60%. This paper emphasizes effective preprocessing methods crucial for obtaining structured and refined data, facilitating better feature selection and extraction from ECG graph images. It underscores the extraction of distinctive features to aid in myocardial infarction rate prediction. The paper evaluates several machines learning classifiers, highlighting their efficiency in simplifying and expediting the diagnosis process. Furthermore, the research suggests that incorporating additional features could potentially improve accuracy.**

***Keywords*—image processing, classifier, feature extraction, gbc, myocardial infarction, principal component analysis**

I. Introduction

The heart, a vital organ, pumps blood throughout the body, facilitating the circulation to and from various organs. Monitoring this function is achieved via an ECG machine, which tracks the heart's operation using electrodes externally attached to the body. This machine records distinctive features within the ECG wave, crucial for identifying potential heart diseases. These distinct features are carefully selected and extracted to facilitate the detection of specific abnormalities.

In the past, medical professionals would manually analyze the ECG wave and communicate the findings to patients, a process that was time-consuming and occasionally less precise. To address this, machine learning algorithms are now being implemented to enhance accuracy and streamline consultations. Each type of heart disease manifests unique variations in the ECG wave. Researchers capture these variations by analyzing ECG graph images, refining them by eliminating background noise and gridlines. The cleaned images are then segmented into 12 distinct electrodes, each containing up to 4 pulses. Features such as pixel count, image differentiation, edge detection, and baseline projection are extracted from these segmented electrodes. These features are subsequently input into various classifiers to evaluate the model's accuracy.

As heart disease poses a significant threat to human health, the medical field grapples with copious amounts of data that require effective interpretation for early prediction and classification of different heart disease types, crucial for optimal medical treatment. Leveraging learning-based techniques from machine and deep learning, including supervised and deep neural networks, researchers have endeavored to develop automatic models for heart disease. These approaches simulate heart disease management and extract essential features from intricate datasets. This survey systematically examines various heart disease prediction models, categorizing the learning-based techniques, datasets, and contexts employed, while analyzing the performance metrics of each contribution [1].

This paper presents a novel approach to myocardial infarction detection by leveraging domain-inspired neural network models. Through a comprehensive analysis of ECG leads, the study identifies v6, vz, and ii leads as crucial contributors to accurate identification. The adaptation of the ConvNetQuake model, originally designed for earthquake detection, achieves state-of-the-art results with 99.43% accuracy on record-wise splits and 97.83% accuracy on patient-wise splits, demonstrating cardiologist-level performance after processing only 10 seconds of raw ECG data [2].

This study addresses the global health challenge posed by myocardial infarction by introducing domain-inspired neural network models. Through a groundbreaking analysis of 15 ECG leads, we identify the pivotal role of v6, vz, and ii leads in accurately detecting myocardial infarction. Leveraging this insight, our adaptation of the ConvNetQuake neural network model achieves state-of-the-art classification results, reaching 99.43% accuracy on record-wise splits and 97.83% accuracy on patient-wise splits. [3].

Utilizing the ConvNetQuake neural network model classifier, the author successfully identified myocardial infarction, achieving a remarkable record-wise split classification accuracy of 99.43% and a patient-wise split classification accuracy of 97.83% [4].

In this study, a computerized diagnosis system utilizing a Rough Set classifier from multilead ECG signals effectively detected and classified five different types of myocardial infarction (MI) with a high degree of accuracy (99.8%) and sensitivity (99.75%). The proposed approach, validated through a five-fold cross-validation technique, demonstrated superior performance compared to existing methods, highlighting its potential for robust and reliable MI diagnosis [5].

The study highlights the promising role of Artificial Neural Networks in combating heart disease by enabling early detection and risk prediction, and it suggests a path forward

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MAC Design and Performance Improvement using 64-Bit VMultiplier Based on UTS

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Abstract— **The proposed model focuses on the design and performance enhancement of a 64-bit VMultiplier by utilizing the UTS, one of the 16 ancient sutras of VM. A modified architecture is proposed to achieve improved performance compared to a recent journal on 32-bit VMultiplier. Additionally, a 64-bit VMultiplier is designed according to the reference journal. The proposed 64-bit VMultiplier comprises three stages: the first stage consists of four 32-bit VMultipliers, the second stage incorporates a 96-bit CSA and a 95-bit modified CSKA, and internal stages include 8-bit and 16-bit Sklansky adders.**

Keywords — **Vedic Mathematics (VM), 64-bit Vedic multiplier (VMultiplier), Urdhva Tiryagbhyam sutra (UTS)**

I. INTRODUCTION

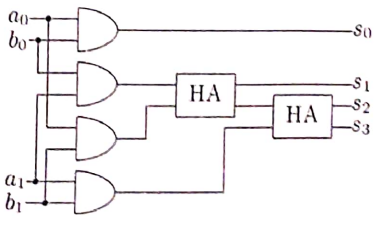
The MAC operation is extensively utilized in applications like filtering and signal conditioning which led to the design of MAC units even in general-purpose microprocessors. These units often include dedicated Multiply and Accumulate Units. Multiplication is a vital operation in the MAC unit as it lies in the critical path of data processing. The MAC unit consists of a Multiplier, Adder, and Accumulator, with the result stored upon the application of a single clock pulse. Power consumption and delay greatly impact the throughput of combinational circuits, thus minimizing them enhances circuit efficiency. Multipliers play a crucial role in processors and computational systems, significantly influencing their speed. To further improve system performance, faster and more space-efficient multipliers are sought after. Implementing VMultipliers, which exclude unnecessary steps in the multiplication process, offers a solution for achieving faster multiplications. Power dissipation and circuit area are essential constraints that cannot be drastically reduced. This project presents a high-speed Vedic multiplier built using the UTS. Architectural optimization is employed to obtain an optimum design, aligning with the low-power trend in VLSI design. Optimization involves algorithm selection, circuit style implementation, topology considerations, and technology choices for digital circuits. The choice of multiplier based on the application's current requirements and considers trade-offs like circuit area, delay, complexity, and power consumption. Multipliers hold significant importance as essential components in any processor.

A. Vedic Multiplier

The multiplier is a critical component in digital system design, and various models have been used in literature to implement fast multipliers. One promising option is the Vedic multiplication algorithm, known for its efficiency. This work focuses on discussing the Vedic multiplier. In VM, there are 3 techniques for implementing multiplication. Among these, one method is a generic approach used in models, while the other two sutras used for special cases. The main algorithm in Vedic multiplication is called Urdhva Triyakbhyam, which is a versatile multiplication formula applicable to all scenarios. The term "Urdhva Triyakbhyam" translates to "Vertically and Crosswise," capturing the essence of this method.

The Vmultiplier performs product of two operands by utilizing the Vertically and Crosswise method, followed by adding all the intermediate results. To illustrate this algorithm, let's consider two operands: 46 and 33. We can represent 33 as (3 × 10 + 3) and 46 as (4 × 10 + 6). The product of 46 and 33, denoted as (46 × 33), can be expressed as (3 × 6 + 40 × 3 + 30 × 6 + 30 × 40). Figure 1 depicts the step-by-step process of this multiplication.

```
    4 6
  × 3 3
  -----
    1 8   ← 3 × 6
  1 2 ×   ← 3 × 4
  1 8 ×   ← 3 × 6
1 2 × ×   ← 3 × 4
---------
1 5 1 8
```



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ZigBee Empowered Wireless Paging for Seamless WPAN Communication

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***Abstract*—This paper introduces a novel method for implementing paging networks, specifically focusing on Wireless Personal Area Networks (WPANs). Unlike traditional wide-area paging systems reliant on wired data transfer, the proposed architecture utilizes IEEE 802.15.4 based ZigBee technology. This ZigBee-based solution offers a cost-effective and unidirectional approach to communication within Personal Area Networks.The conventional approach often involves leased landlines for transmitting pages from the paging network controller to base stations across the country. However, the associated costs can be prohibitive, necessitating alternative solutions. The ZigBee-based architecture provides an efficient and economical alternative, boasting a longer ZigBee lifespan and lower power consumption compared to other wireless technologies such as Bluetooth and IEEE 802.11a/b. The proposed architecture is inherently unidirectional, serving as an effective means for short message communication within a Personal Area Network. Additionally, the system can be designed to be bidirectional by interfacing the Paging Transmitter/Receiver with an Alphanumeric Keypad and LCD screen, eliminating the need for a PC in the architecture and enhancing device compactness. To further enhance paging capacity, the network is optimized for efficient routing. Overall, this novel approach leverages ZigBee technology to revolutionize paging networks, offering a cost-effective, energy-efficient, and versatile solution for communication within Wireless Personal Area Networks.**

Keywords—ZigBee, PIC16F873, LCD, WPAN (Wireless Personal Area Network), IEEE 802.15.4, Personal Computer (PC).

I. INTRODUCTION

In today's intensely competitive professional landscape, the swift communication of information among employees has become imperative. PAGING emerges as a highly effective solution for intra-office communication, employing wireless technology to transmit text messages to users equipped with receiving modules.

Despite being a technology with a long history, paging systems continue to thrive due to their notable advantages. These systems offer superior and more reliable in-building radio coverage, feature compact and cost-effective devices like pagers, and often incur lower service costs compared to alternatives like cellular radio. Pagers persist in various environments, particularly for rapid short-text messaging and peer-to-peer communication, where conventional mobile phones may face limitations. Additionally, in settings such as expansive hospital complexes where cellular coverage is inadequate and the operation of mobile phone transmitters is problematic, pagers find continued relevance.

Paging services come in various types, including tone, numeric, text (alpha), and voice, with one-way or two-way paging systems delivering these messages. One-way systems allow messages only from the paging system to the pager, while two-way systems enable confirmation and responses from the pager to the system.

Messages within paging systems can be numeric, alphanumeric, or voice-based, serving purposes such as notifying subscribers to call a specific number or visit a designated location for further instructions. Modern paging systems even facilitate the transmission of news headlines, stock quotations, and faxes. The process involves sending a message, referred to as a page, to a paging subscriber via a toll-free access number using a telephone keypad or modem. The paging system then disseminates the page across its service area through base stations broadcasting on a radio carrier.

Figure (a) Pager.

II. WORKING PROCEDURE

The 'Wireless Paging System' is constructed using various hardware interface blocks, as illustrated in figures (c) and (d). The block diagram can be elucidated as follows:The primary objective of this paper is to establish a wireless communication system centered on Wireless Paging within a Wireless Personal Area Network (WPAN), utilizing the PIC microcontroller and ZigBee technology. In the depicted block diagram (figures b & c), comprising both the Wireless Paging Transmitter and Receiver, the PC interfaces with the

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