

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

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Vol. 7, Issue 5, May 2018

Behavioral Analysis of Cognitive Radio Sensor Networks for Intra Cluster and Inter Cluster Data Transmission

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ABSTRACT: The main objective of this system is to maximize energy efficiency of nodes and improve the lifetime of network. To apply an effective Sleep-Awaken Procedure, which achieves promising performance in throughput, efficiency, and other performance metrics? A cognitive radio wireless sensor network is one of the candidate areas where cognitive techniques can be used for opportunistic spectrum access. Research in this area is still in its infancy, but it is progressing rapidly. The aim of this study is to classify the existing literature of this fast emerging application area of cognitive radio wireless sensor networks, highlight the key research that has already been undertaken, and indicate open problems. This system describes the advantages of cognitive radio wireless sensor networks, the difference between ad hoc cognitive radio networks, wireless sensor networks, and cognitive radio wireless sensor networks, potential application areas of cognitive radio wireless sensor networks, challenges and research trend in cognitive radio wireless sensor networks. The sensing schemes suited for cognitive radio wireless sensor networks scenarios are discussed with an emphasis on cooperation and spectrum access methods that ensure the availability of the required QoS.

KEYWORDS: Cognitive Radio Network, CRN, Wireless Sensor Network, Quality of Service, QOS, Clustered Network Scenario, Energy Efficiency, Throughput Maximization, Dynamic Channel Accessing.

I. INTRODUCTION

Efficient and Fault free data transmission is one of the fundamental problems in Wireless Sensor Networks, since the energy of sensor nodes is limited and they are usually in active state. In the proposed approach, an efficient Sleep-Awake Procedure is implemented, which activate only the required nodes and preserve other nodes energy level as it is. The purpose of Sleep-Awake scheduling is to save the energy of each node by keeping nodes in sleep mode as long as possible (without sacrificing packet delivery efficiency) and thereby maximizing their lifetime. Along with this an Energy Detection and Node Sensing methodologies are designed for the on-demand data transmission needs, which maximize the energy efficiency and prolongs network lifetime. Node Sensing Algorithm is handled to identify the energy inefficient nodes and provides respective energy over communication.

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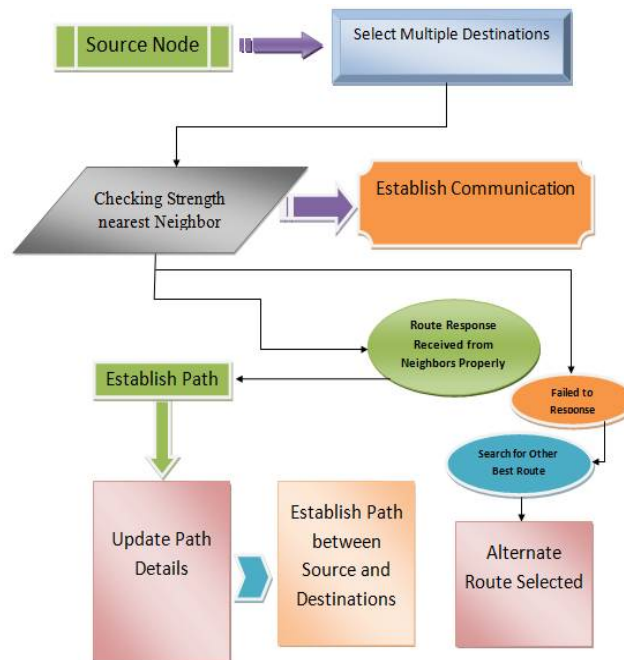


Fig.1 System Block Diagram

Due to recent technological advances, the manufacturing of small, low power, low cost and highly integrated sensors has become technically and economically feasible. These sensors are generally equipped with sensing, data processing and communication components. Such sensors can be used to measure conditions in the environment surrounding them and then transform these measurements into signals. The signals can be processed further to reveal properties about objects located in the vicinity of the sensors. The sensors then send these data, usually via a radio transmitter, to a command center (also known as a “sink” or a “base station”) either directly or via several relaying sensors.

A large number of these sensors can be networked in many applications that require unattended operation, hence producing a wireless sensor network (WSN). Currently, there are various applications of WSNs, including target tracking, health care, data collection, security surveillance, and distributed computing. Typically, WSNs contain hundreds or thousands of sensors which have the ability to communicate with each other. The energy of each sensor is limited and they are usually unchargeable, so energy consumption of each sensor has to be minimized to prolong the life time of WSNs. Major Sources of energy waste are idle listening, collision, overhearing and control overhead. Among these, idle listening is a dominant factor in most sensor network applications. There are several ways to prolong the life time of WSNs, e.g., efficient deployment of sensors, optimization of WSN coverage, and sleep/wake-up scheduling. In this system, we focus on sleep/wake-up scheduling. Sleep/wakeup scheduling, which aims to minimize idle listening time, is one of the fundamental research problems in WSNs.

Specifically, research into sleep/wake-up scheduling studies how to adjust the ratio between sleeping time and awake time of each sensor in each period. When a sensor is awake, it is in an idle listening state and it can receive and transmit packets. However, if no packets are received or transmitted during the idle listening time, the energy used during the idle listening time is wasted. Such waste should certainly be minimized by adjusting the awake time of sensors, which is the aim of sleep/wake-up scheduling. Recently, many sleep/wake-up scheduling approaches have been developed. These approaches roughly fall into three categories: (a) on-demand wake-up approaches; (b) synchronous wake-up approaches and (c) asynchronous wake-up approaches, as categorized. In on-demand wake-up approaches, out-of-band signaling is used to wake up sleeping nodes on-demand. For example, with the help of a paging signal, a node listening on a page channel can be woken up.

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A. Asynchronous Wake-Up Approach

In asynchronous wake-up approaches, each node follows its own wake-up schedule in the idle state. This requires that the wake-up intervals among neighbors are overlapped. To meet this requirement, nodes usually have to wake up more frequently than in synchronous wake-up approaches. The advantages offered by asynchronous wake-up approaches include easiness of implementation, low message overhead for communication, and assurance of network connectivity even in highly dynamic networks. Most current studies use the technique of duty cycling to periodically alternate between awake and sleeping states. Here, duty cycle is the ratio between the wake up time length in a predefined period and the total length of that period.

For example, suppose a period is 1 s and a node keeps awake for 0.3 s and keeps asleep for 0.7 s in the period. Then, the duty cycle is 30% (or 0.3). The use of duty cycling incurs a tradeoff between energy saving and packet delivery delay: a long wake-up time may cause energy waste, while a short wake-up time may incur packet delivery delay. However, in WSNs, both energy saving and packet delivery delay are important. Because each node in WSNs is usually equipped with an un-rechargeable battery, energy saving is crucial for prolonging the lifetime of WSNs. Because delay is unacceptable in some applications of WSNs, e.g., fire detection and tsunami alarm, reducing packet delivery delay is crucial for the effectiveness of WSNs. An intuitive solution to this tradeoff is to dynamically determine the length of wake-up time. The solution proposed in earlier systems can dynamically determine the length of wake-up time by transmitting all messages in bursts of variable length and sleeping between bursts.

B. Self-Adaptive Sleep-Awake Systems

In this system, a self-adaptive sleep/wake-up scheduling approach is proposed, which takes both energy saving and packet delivery delay into account. This approach is an asynchronous one and it does not use the technique of duty cycling. Thus, the tradeoff between energy saving and packet delivery delay can be avoided. In most existing duty cycling based sleep/wake-up scheduling approaches, the time axis is divided into periods, each of which consists of several time slots. In each period, nodes adjust their sleep and wake up time, i.e., adjusting the duty cycle, where each node keeps awake in some time slots while sleeps in other time slots. In the proposed self-adaptive sleep/wake-up scheduling approach, the time axis is directly divided into time slots.

C. Existing System

The energy of each sensor is limited and they are usually in active state, so energy consumption of each sensor has to be minimized to prolong the life time of Wireless Sensor Networks. Major sources of energy waste are idle listening, collision, over hearing and control overhead. Listening time is more and more for each nodes in the WSN, so the energy level is wasted sequentially. In past approaches, a mobile sink is used for data gathering to alleviate the hotspot problems. Besides the whole network is divided into clusters where Cluster Heads perform data collection from their member nodes and wait until the mobile station arrives and then forward data to the mobile sink. But when the network size is larger, the complexity and support goes down, which reduces the network lifetime.

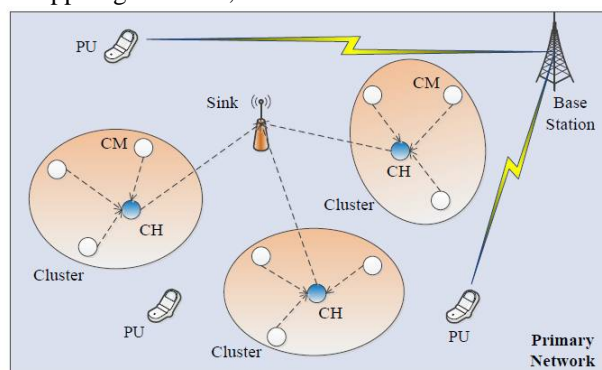


Fig.2 System Model

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II. LITERATURE SURVEY

In the year of 2010 the authors "J. Mitola and G. Maguire" proposed a paper titled "Cognitive radio: Making software radios more personal [2][4]" in that they described such as: Software radios are emerging as platforms for multiband multimode personal communications systems. Radio etiquette is the set of RF bands, air interfaces, protocols, and spatial and temporal patterns that moderate the use of the radio spectrum. Cognitive radio extends the software radio with radio-domain model-based reasoning about such etiquettes. Cognitive radio enhances the flexibility of personal services through a radio knowledge representation language. This language represents knowledge of radio etiquette, devices, software modules, propagation, networks, user needs, and application scenarios in a way that supports automated reasoning about the needs of the user. This empowers software radios to conduct expressive negotiations among peers about the use of radio spectrum across fluent of space, time, and user context. With RKRL, cognitive radio agents may actively manipulate the protocol stack to adapt known etiquettes to better satisfy the user's needs. This transforms radio nodes from blind executors of predefined protocols to radio-domain-aware intelligent agents that search out ways to deliver the services the user wants even if that user does not know how to obtain them. Software radio provides an ideal platform for the realization of cognitive radio.

In the year of 2012 the authors "Y. Zou, Y.-D. Yao, and B. Zheng" proposed a paper titled "Cooperative relay techniques for cognitive radio systems: Spectrum sensing and secondary user transmissions [4]" in that they described such as: Cognitive radio is a promising technology that enables an unlicensed user (also known as a cognitive user) to identify the white space of a licensed spectrum band (called a spectrum hole) and utilize the detected spectrum hole for its data transmissions. To design a reliable and efficient cognitive radio system, there are two fundamental issues: to devise an accurate and robust spectrum sensing algorithm to detect spectrum holes as accurately as possible; and to design a secondary user transmission mechanism for the cognitive user to utilize the detected spectrum holes as efficiently as possible. This article investigates and shows that cooperative relay technology can significantly benefit the abovementioned two issues, spectrum sensing and secondary transmissions. We summarize existing research about the application of cooperative relays for spectrum sensing (referred to as the cooperative sensing) and address the related potential challenges. We discuss the use of cooperative relays for the secondary transmissions with a primary user's quality-of-service (QoS) constraint, for which a diversity-multiplexing trade-off is developed. In addition, this article shows a trade-off design of cognitive transmissions with cooperative relays by jointly considering the spectrum sensing and secondary transmissions in cognitive radio networks.

In the year of 2008 the authors "J. Ma, G. Zhao, and Y. Li" proposed a paper titled "Soft combination and detection for cooperative spectrum sensing in cognitive radio networks [5][6]" in that they described such as: we consider cooperative spectrum sensing based on energy detection in cognitive radio networks. Soft combination of the observed energies from different cognitive radio users is investigated. Based on the Neyman-Pearson criterion, we obtain an optimal soft combination scheme that maximizes the detection probability for a given false alarm probability. Encouraged by the performance gain of soft combination, we further propose a new softened hard combination scheme with two-bit overhead for each user and achieve a good tradeoff between detection performance and complexity.

III. PROPOSED SYSTEM SUMMARY

In the proposed approach, powerful Sleep-Awake Procedure is implemented which determines a set of data points from different clusters and calculates the maximal advantages of active sensors. Establishes a data routing dynamically and provides support to networks via route request and route response methodologies. As well as the proposed approach are considered to select a set of evaluator nodes to avoid the communication interruptions. Each sensor node is calculated weight considering the hop count and the number of forwarded packets and the highest energy of a node. Hence, a set of selected node is considered to construct the travel path for data gathering and forwarding, which can reduce the number of transmissions, and thereby reduce the energy consumption. The proposed system has several advantages, some of them are listed below: (a) The purpose of Sleep-Awake scheduling is to save the energy of each node by keeping nodes in sleep mode as long as possible, (b) Maximizing the Network Lifetime and (c) Low Power Consumption because of dynamic active nodes, low cost and highly integrated.

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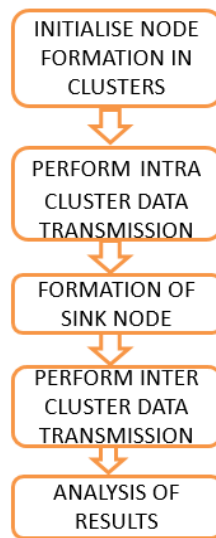


Fig.3 Proposed Methodology Flow Design

IV. EXPERIMENTAL RESULTS

The following table illustrates the input parameters of the proposed system.

TABLE.1 INPUT PARAMETERS

PARAMETER	SETTINGS
CM's power for intra-cluster data transmission	20mW
CM's power for inter cluster data transmission	40mW
Power amplifier efficiency	0.9
Circuit power	5mW
Energy consumption for data receiving	5nJ/bit
Per-node energy consumption for sensing licensed channel	7J
Data amount per sensor node	3Kb
Aggregation rate at CHs	70%
No. of cooperative sensor nodes	3

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The following figure illustrates the Node initialization scenario of the proposed work.

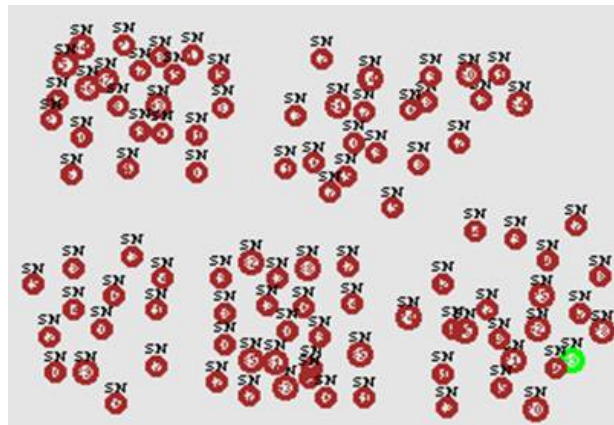


Fig.4 Node Initialization Scenario

The following figure illustrates the Sink Node Creation of the network scenario.

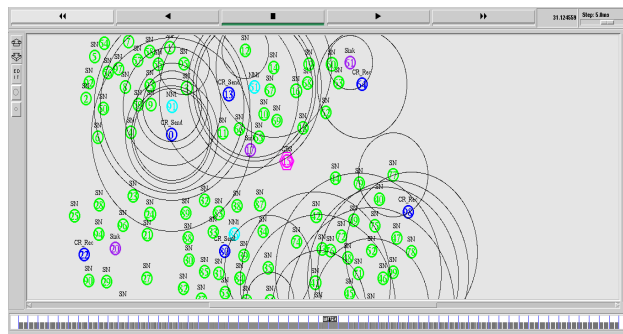


Fig.5 Sink Node Creation

The following figure illustrates the Inter-Cluster Communication over the communication environment.

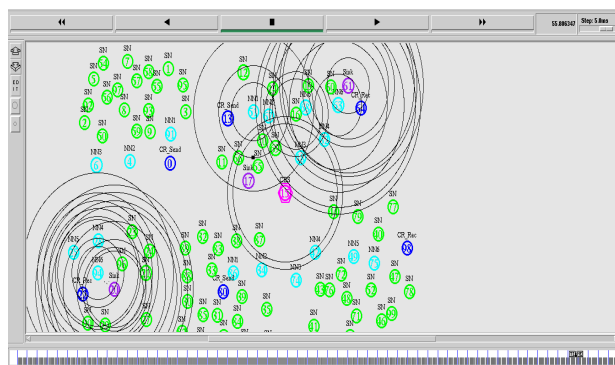


Fig.6 Inter-Cluster Communication

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The following figure illustrates the intra-cluster transmission by assigning a specific-licensed channel analysis of the proposed work.

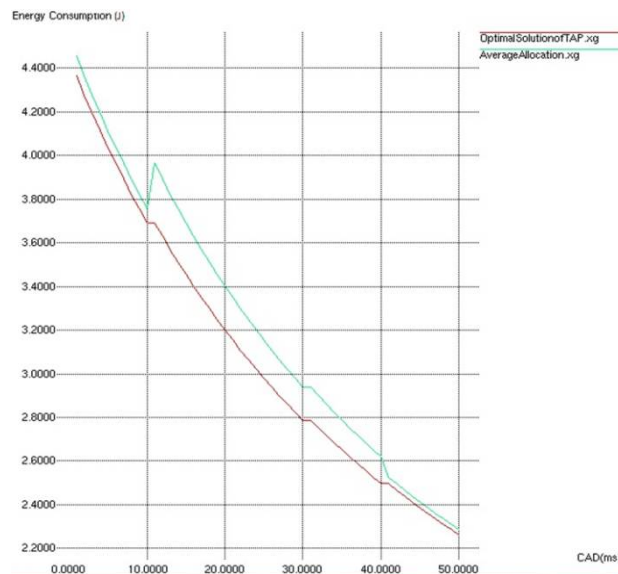


Fig.7 Intra-Cluster Transmission By Assigning A Specific-Licensed Channel

The following figure illustrates the energy consumption comparison for intra cluster data transmission under different packet loss rate.

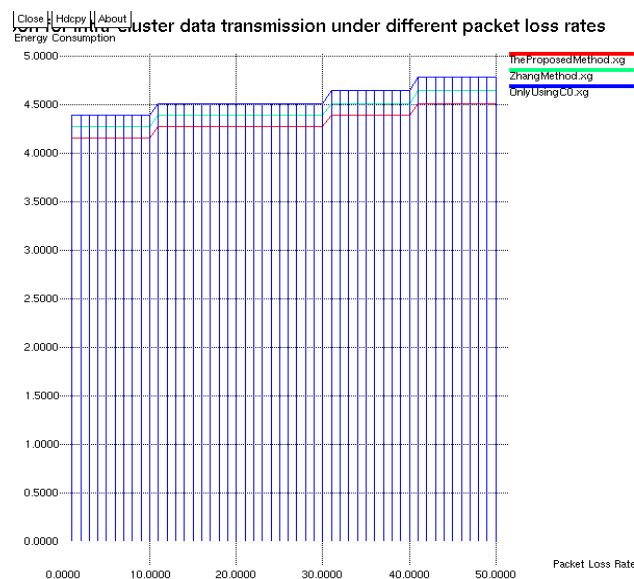


Fig.8 Energy Consumption Comparison for Intra Cluster Data Transmission under Different Packet Loss Rate

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The following figure illustrates the Convergence Speed of ACS based algorithm.

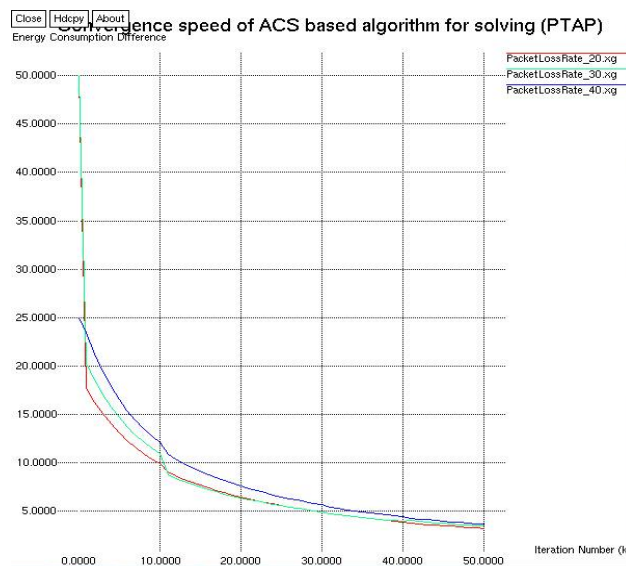


Fig.9 Convergence Speed of ACS based algorithm

The below figure represents energy consumption comparison with respect to different packet loss rate for inter-cluster data transmission.

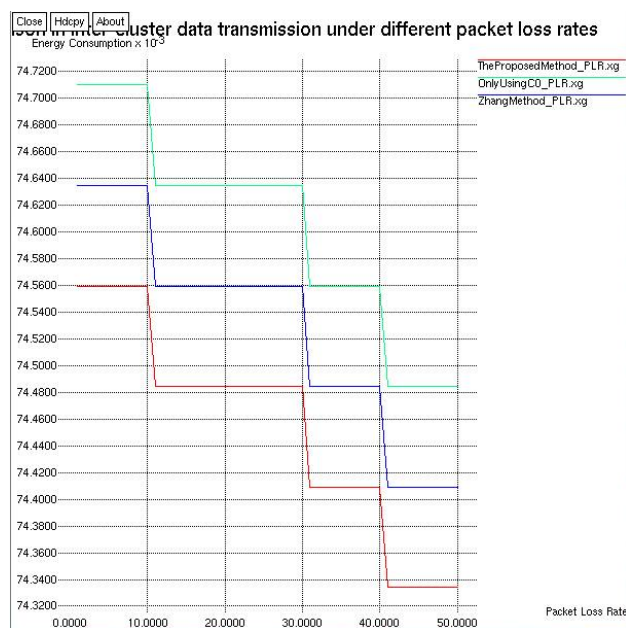


Fig.10 Energy for inter cluster data transmission under different packet loss rate.

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The next figure illustrates the throughput Analysis of the proposed work.

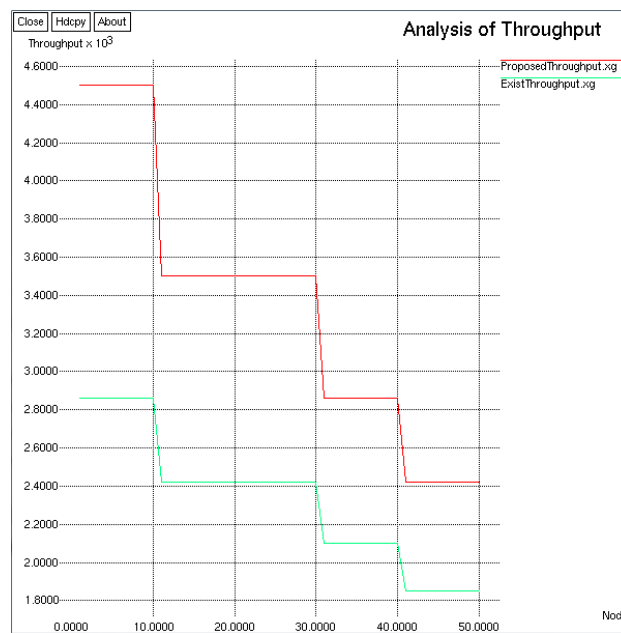


Fig.11 Throughput analysis.

V. CONCLUSION

The proposed system introduces new Sleep-Awake network strategy to avoid energy wastages and preserve network lifetime. By using Node detection methodology, node failures are identified easily. By using Evaluator Node strategies, the failure node can be recovered immediately without any delay and allow the node to transmit data further. Node energy preservation is highly concentrated via Sleep-Awake principles, so that the performance of entire system is highly improved. With the help of the proposed logic, node failures and energy wastages are highly eliminated and prove the experimental result is better than all other existing approaches.

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