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Spectrum Utilization using Genetic Algorithm in Cognitive Radio Technology Multiple primary and multiple secondary

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Abstract: With rising technologies and with the increasing number of wireless devices, the radio spectrum is becoming increasingly crowded every day. Wide ranges of the spectrum are not often used most of the time, while other bands are heavily used. Depending on the position, time of the day, and frequency bands, the spectrum is actually found to be underutilized. However, those unused portions of the spectrum are licensed and thus cannot be used by systems other than the license users, for utilizing these idle portion of spectrum cognitive radio technology is arise. We can think of a cognitive radio as having three basic parts, the ability to sense the channel, management and spectrum sharing. Including at a minimum sensing the RF spectrum, environmental surroundings, and the user's needs; the capacity to learn preferably in both supervised and unsupervised modes; and finally, the capability to get used to within any layer of the radio communication system. This paper presents the genetic algorithm technology which is used to generate high quality solutions to optimization in spectrum sensing. A set of solutions for optimization is called chromosome. The GA can find chromosomes that optimize the radio for the user's current needs. At the end of this paper, we present experimental results on software simulation.
Keywords: cognitive radio, genetic algorithm, sensing, spectrum allocation, fitness, chromosome.

I. INTRODUCTION

In wireless communication the fixed frequency bands are allocated to different applications which are called as static spectrum allocation method. The number of users utilizing the spectrum is increased due to the attractive services provided by it, which leads to the spectrum congestion and spectrum scarcity that cannot be solved by the fixed spectrum allocation. In order to better utilize the licensed spectrum the CR technology is coined to satisfy the users desire by accessing the spectrum which is underutilized by sensing the spectrum periodically and offers the spectrum opportunistically to the unlicensed users called secondary users or cognitive users[5][6]. The rest of the paper is organized as follows: system model, and proposed techniques are discussed in section II and III, while the results and conclusion of the paper are discussed in section IV and V respectively.

The concept of cognitive radio was first planned by Joseph Mitola III in a seminar at KTH (the Royal Institute of Technology in Stockholm) in 1998 and published in an article by Mitola and Gerald Q. Maguire, Jr. in 1999.Cognitive radio (CR) is a form of wireless communication in which a transceiver can detect which communication channels are in use and which are not. Transceiver can sense which channels are free and next move into vacant channels while avoiding occupied ones. This technology uses available RF spectrum opportunistically and transmits information to other users.

A Cognitive Radio can be programmed and configured dynamically to use the best wireless channels. CR automatically detects available channels in wireless spectrum, then accordingly changes its transmission or reception parameters to allow more concurrent wireless communications in a given spectrum band at one location.

II. SYSTEM MODEL

Transmitting information of secondary user by using primary user channel first secondary user can sense the primary channel, whether it is free or busy. If channel is busy without interfering primary user, the secondary user send zeros instead of data. If channel is free secondary user transfer his data. Secondary user must follow the following steps for transferring his data.

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The primary user channel is divided into time slots. Each time slot consist n bits.
By using k bits(sensing bits) in each time slot he can check the status of the channel.
If the channel is free transfer the sensing bits i.e. k bits as zeros and n-k bits are data.
If the channel is busy transfer the sensing bits i.e. k bits as ones and n-k bits are zeros.

While sensing if the SU detect the channel as Free where actually the PU is present i.e., the channel is shown as free where the channel is Busy, because of this Missed Detection, the SU starts sending its data which leads to interference, by this Missed detection we calculate the "Transmission Interference (TI)".

$$\% TI = \frac{\text{Number of Missed Detection states}}{\text{Total number of Time Periods}} \times 100$$

While sensing when the SU detect the PU where actually the PU is not present gives False-Alarm i.e., the channel is shown as busy where actually the channel is free. because of the False Alarm it lost the opportunity by this we calculate the "Transmission Loss (TL)".

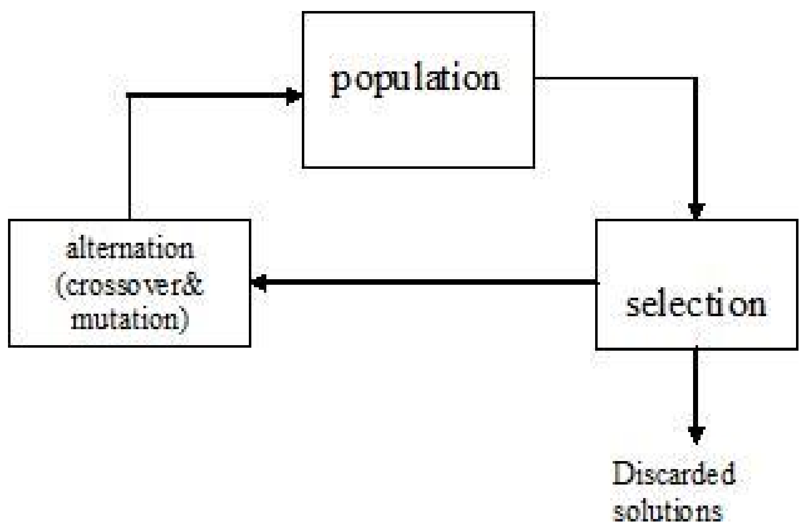
$$\% TL = \frac{\text{Number of False} - \text{Alaram states}}{\text{Total number of Time periods}} \times 100$$

III. PROPOSED METHOD

In cognitive radios while sensing the channel to overcome the optimization problem we go for Genetic algorithm.

Genetic algorithms (GA) were first introduced by John Holland in the 1970s

A genetic algorithm is a biological evolution process that computationally simulates. GA evolutionary cycle starts with a initial population by selecting randomly. based on the fitness value the selection of population changes will be occur, for this one we can use crossover and mutation.



A. Genetic algorithm Evolutionary Cycle

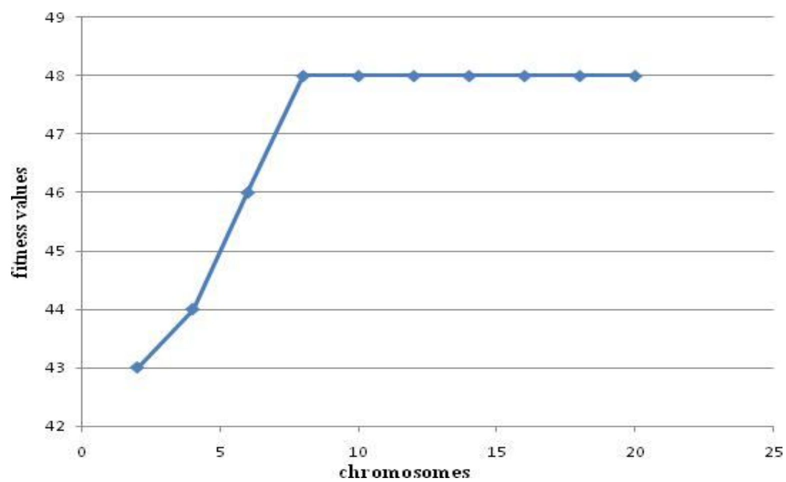
The smallest unit of a genetic algorithm or solution for optimization problem is called a gene, a set of genes is known as chromosome. A group of chromosomes in called a population. based on the fitness value(i.e. highest priority) the initial population which is selected randomly among all chromosomes is called parent. by performing crossover and mutation on parents the next generation will be produced that is called children. The most common form of representing a chromosome is a string of binary digits. Each bit in this string is a gene. Coding is a process of converting the solution from its original form into the bit string.

B. Algorithm

The initial steps involved in GA shows the following algorithm.

1) Initialize the population of chromosomes.
2) Compute the fitness level of each chromosome to rank them.
3) Select the best chromosomes in terms of their fitness.
4) Perform the crossover operation on selected chromosomes.
5) Perform the mutation function on selected chromosomes.
6) If stopping criteria is achieved terminate the GA otherwise move to step 2 of the algorithm.

IV. RESULT



A. Fitness vs Chromosome

In Fig 4.5 fitness value is plotted against the chromosomes. As can be seen from the figure fitness value is increased to 1 the chromosomes are increased from 2 to 6. When the chromosomes are increases from 6 to 25 the fitness value is increases. So when the chromosome are increases the fitness value is increases.

V. CONCLUSION

Experimental results show the validity of this approach. It cannot only find good solutions to the radio channel allocation problem but also obtain the optimal solution in a logically short execution time, with high-quality solutions.

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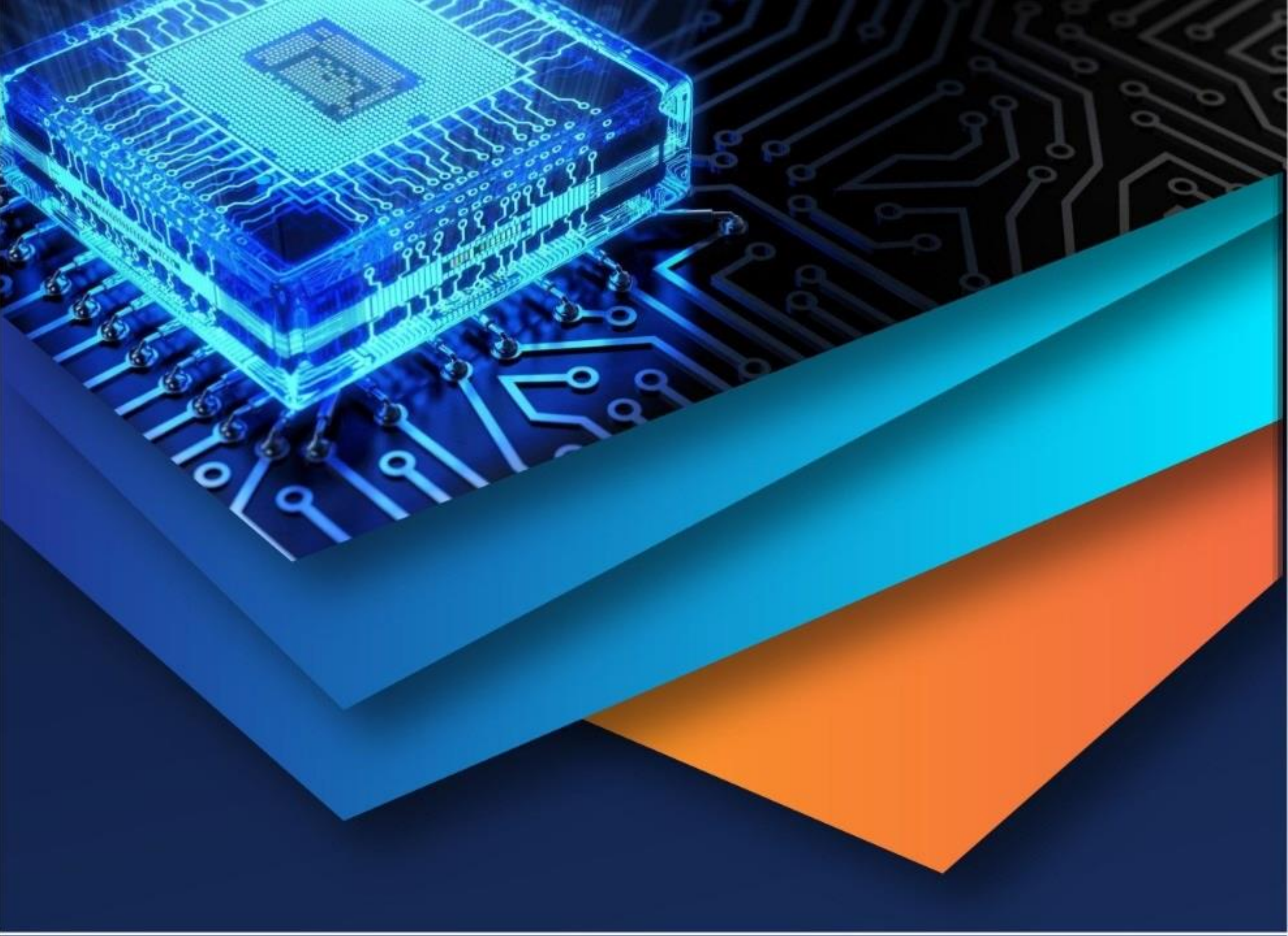

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