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A decision support model for task assignment in home health care

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Abstract

Task assigning to employee is a difficult process. A reduced efficiency due to absenteeism, lack of job satisfaction and other things can have consequences errors in such assignments. In this paper, we focused on a task assignment problem in Home Health Care (HHC).Home health care organizations provide coordinated health care services to patients at their homes. Due to the growing need for home-based care, the assignment of tasks to available health care staff is a common and complex problem in homecare organizations. Designing high quality task schedules is critical for improving worker morale, job satisfaction, service efficiency, service quality, and competitiveness over the long term. The desire is to maximizing schedule fairness in terms of workload assignments, avoiding task time window violation, and meeting management goals as much as possible. We provide a method for balancing health care staff's workload by scheduling tasks. This paper develops a decision support model approach for task assignment in a home health care. The proposed approach uses an optimization method for task assignment. Results from computational experiments show that the approach is promising.

Keywords: *decision support model, home health care*

1. Introduction

Home health care service is an ever growing service sector interested in the arrangement of coordinated health care solutions to people in their homes [1]. In providing home care services, for instance, health care staff could have to attend to post hospitalization therapy, post-operation therapy, acute illness, chronic disease, incurable illness, or irreversible disability [2].

The solutions supplied may consist of therapy tasks, medical and social services, house cleaning, nursing and also drug deliveries. This is demanded by the ever before enhancing aging population, chronic illness, stress from societies to improve health care service high quality, as well as stress of governments to have health care prices [3] Patient contentment and timely assistance are crucial concerns at Home health care solutions. To be able to satisfy on this, it does need to supply timely and also high quality services to patients. The goal of this paper is to offer high quality solutions without interruption by minimizing the requirement for man power in home health care organizations with the facility of a decision support system. The decision support system appears assuring for providing effective solutions with no disturbance, as well as reveals a crucial importance for task assignment to care givers [4-6] In this paper, a real-world application of a decision support system has actually been demonstrated in the case of task assignment in home health care solutions. Right application of the decision support system will provide benefit to big ventures in offering far better with much less resources. In this paper, a decision support model focused on using care workers and also various other human assets a lot more effectively is made via making use of best-suited artificial intelligence methods. The proposed system assures hope for providing a great benefit and also severe efficiency enhancements.

2. PROBLEM DEFINITION

When a senior requires assistance as well as care in their daily living, it is the lawful responsibility of the regional authorities to supply it. This can be done either by providing a location in a retirement community, or by giving help in the individual's home i.e. home health care. Today, there is a pattern to permit the customers stay at house for as lengthy as feasible rather than needing to move in to a retired life at home, and hence much more handles are needed in the home health care sector. The home health care task assignment problem is an established T = (1, …, n) of n tasks, where each task i is specified by a task duration P_i and also a time window $[E_i, L_i]$; E_i signify the earliest and also L_i denote the latest begin times of the task. Tasks could remain in kind of patient visits, management duties, and drug delivery [1] The tasks are to be performed by a readily available set S = (1, …, w) of w personnel, where each personnel j has a scheduled working time window $[E_j, L_j]$ Each task needs to assign to a qualified care worker, with skills represent by Q_j, according to the called for proficiency C_i. The workload allotment need to be stabilized by this study. This indicates that the variant of care workers' individual workloads from the average workload, while noting time window restraints defined by the customers. This optimizes the general schedule top quality. In creating the task assignment model, we make the following presumptions for the task assignment problem;

- Each task has a specific time window $[E_i, L_i]$ in which the assigned care giver must begin the task operation;
- Care worker skills are expressed as Q_j in the range [1,h], where 1 represent the lowest and h represent the highest skills;
- Each task must begin in pre-specified time window;

- Each task should only be assigned to a care worker with the required skills. All tasks are completed within the care worker working time of day, defined by [Ej,Lj];

The main objective of the health care task assignment problem is to minimize the variation of individual care workers' workloads from the average workload. The following constraints must be observed [1];

- Each task is assigned to only one care giver;
- Each task must begin within its respective time window [Ei,Li];
- Each care worker's workload must be within the lower and upper bounds, m and M, respectively;
- All tasks assigned to each care giver must be completed within the care giver's working time [Ej,Lj].

3. MATERIAL AND METHODS

A. Decision Support System (DSS)

A Decision Support System is a computer-based information system, which supports a decision maker by utilizing the information and also model to solve the unstructured issues. [7-13] The design of DSS is shown in Fig. 1.
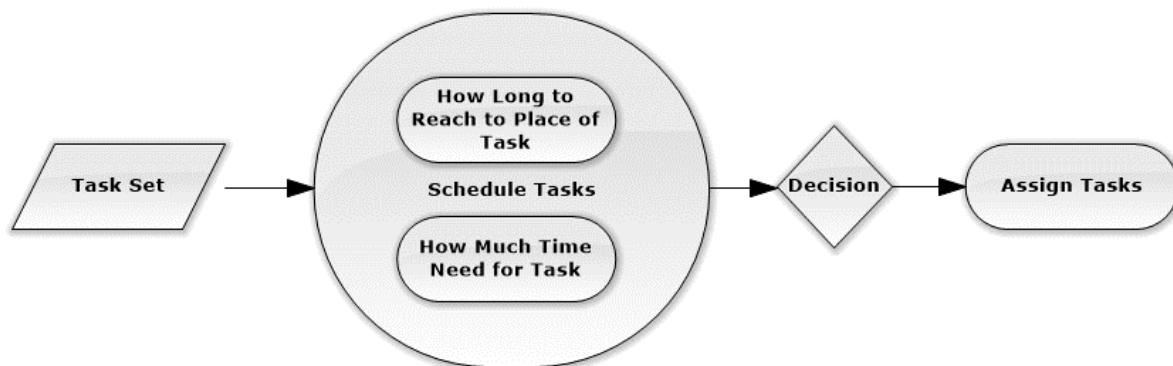

Fig. 1. Decision support system diagram.

As shown in Fig. 1, DSS makes use of the decision model as well as the tasks as inputs, and as a result, assigns tasks to the care givers. In the decision support system, Google geo-coding interface[14] is made use of for calculating time to get to the place of work and Artificial Bee Colony algorithm is utilized to assign the tasks on the basis that minimizes the workload on care workers [15]. For each and every care worker in the list, the algorithm will certainly arrange tasks by optimizing the complete work time with the transport time.

B. Artificial Bee Colony Algorithm

Artificial bee colony (ABC) algorithm suggested by Karaboga [16-20] In the ABC the foraging artificial bees are categorized into three groups. These groups named as, employed bees, onlooker bees, as well as scout bees. After the generation of first food sources in the population, the algorithm sends the employed bees to exploit the present food sources, and then the onlooker bees and also the scout bees are applied, respectively. Applying the ABC algorithm for the task assignment trouble is difficult, since the conversion from real domain to discrete domain is required because of the discrete characteristics of the scheduling trouble. For the permutation task assignment problem, a solution should be normally represented as a task permutation. Utilizing such a discrete solution representation technique, we recommend a discrete version of the ABC algorithm for the home health care task assignment problem in this paper. Let Pbest represent the very best solution located until now in the DABC algorithm and also Allow S_k (k = 1, 2, · · · NP) signify the method made use of by each employed bee each food resource. In the iterating procedure, when the solution located by an onlooker bee is worse compared to the matching incumbent solution in the population, the matching strategy switches over to one more one arbitrarily. The pseudo code of DABC is given in Fig. 2. Using the new schemes for employed bee, onlooker bee and scout bee, the algorithm is expected to attain a balance of exploration as well as exploitation as well as solve the home health care task assignment issue successfully and also efficiently.

```
procedure DABC
    set parameter Np, and randomize Sk for each food source;
    generate the initial population;
    Pbest := the best solution in the population;
    while (not termination)
        for each employed bee:
            find a new food source according to its strategy;
        endfor;
        for each onlooker bee:
            apply local search to the food source found by its employed bee;
            if the food source found by local search is worse than the current solution
                switch to another strategy;
            else
                update the current solution and update Pbest if possible;
            endif;
        endfor;
        for each scout bee;
            produce a food source from Pbest;
            the produced food source replaces the worse one in tournament selection;
        endfor;
    endwhile;
end
```

Fig. 2. Pseudo code of DABC

4.   COMPUTATIONAL EXPERIMENTS

In our experiments, we adopt an illustrative example from Bachouch et al. [1] as in Table 1 and 2. The data consists of task and care worker information. Task information comprises task duration, time window and the competence requirement. The care giver information comprises working time and qualification ranking.

Task	Duration	Ei	Li	Ci
1	15	0	30	1
2	20	0	30	2
3	23	30	90	3
4	32	30	90	4
5	35	90	150	5
6	46	150	210	1
7	51	210	330	2
8	63	330	450	3
9	75	450	570	3
10	38	570	690	5

Table 1. Task information

Care worker	Ej	Lj	Qj
1	30	630	4
2	0	300	2
3	30	630	5

Table 2. Care worker information

Further problem examples of sizes 10 to 20, and 25 tasks, with 3 to 15 care givers were generated randomly and tested using the artificial bee colony algorithm approach. The next section provides the results and discussion.

5.   RESULTS AND DISCUSSION

Table 3 supplies the optimal remedy of the trouble offered in [1]. The task assignment solution shows the beginning time of each task in addition to the care giver designated to each task. Further experimentations that incorporates large numbers of tasks as well as treatment providers demonstrated that artificial bee colony algorithm can perform big range task assignment problems within an affordable calculation time of a few seconds or minutes, while valuing all capability and also time window restrictions. As shown in Fig. 3. Workload on care workers stabilized efficiently.

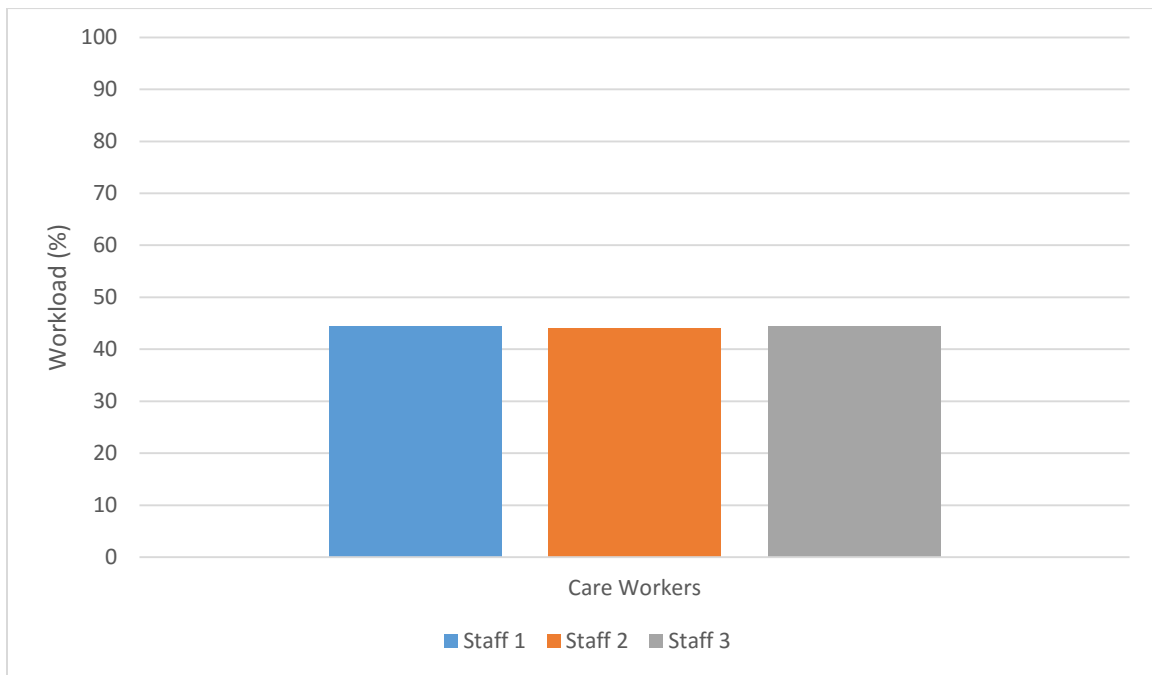| Task	Care worker	Bi	Fi
1	2	0	15
2	2	15	35
3	1	30	53
4	3	30	62
5	1	90	125
6	2	150	196
7	2	210	261
8	3	330	393
9	1	450	525
10	3	570	608

Table 3. Computational results

Fig. 3. Workload on Care Workers

6. CONCLUSION

The design of decision support systems that should manage homecare task assignment issues where workload must be stabilized is essential. Task assignment schedule top quality is necessary to improve worker morale as well as prevent absenteeism and attrition. In an environment where the choice on workload is imprecise, using decision support system ideas is helpful. This paper suggested an artificial bee colony algorithm optimization technique for to resolving task assignment problems in a homecare environment, where a collection of tasks are to be executed by a set of available care workers. An illustrative instance was taken on from the

literature, showing the effectiveness of the method. The recommended technique offers beneficial payments to scientists, academicians as well as practitioners in the home health care service sector[21-24]. The proposed method supports the Industrial design as well as design management community as it supplies decision encourage to task assignment problems when the preferred administration goals as well as worker preferences are inaccurate. The method offers a lot more realistic look to the decision making in unclear environments. Unlike direct shows approaches, the algorithm can taking care of large troubles, while providing beneficial options in a reasonable calculation time. For that reason, the recommended approach is useful for developing choice support systems for the home health care companies. In general, the proposed method is an efficient and also sensible system for establishing decision support system for resolving homecare task assignment troubles. Additional research around is appealing. As an example, we intend to model the task assignment issue from a multi-objective view factor, to consider maximization of solution high quality, complete satisfaction of management as well as decreasing expense of service goals. Additionally, to satisfy personnel, individuals, and also administration expectations, making use of satisficing approaches may be better. We look for to check out these areas in the future.

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