IMPLEMENTATION OF QUEING THEORY AND HEURISTIC METHOD FOR SHCEDULING SYSTEM OF XYZ AUTO SERVICE CENTER

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ABSTRACT

Customers queue up at the XYZ Auto Service Center at the service assessment process and auto service process without information on how long they should wait for the service. this problem could lead to customers, decreasing on satisfaction and loyalty to the company service. this queuing service problem is related to scheduling on the auto service technician. this paper proposed an integrated framework of queuing theory and forward-chaining heuristic method of the proposed automatic scheduling system. The proposed system performs satisfactorily on helping the service advisor to arrange technician scheduling, yield a reliable record and increase efficient use of resources.

Keywords*: Queuing theory, forward-chaining, heuristic method, automatic scheduling system*

1. INTRODUCTION

The XYZ Auto Service Center is one of vehicle service center that's located in Manado. Like others business in service industries, customer trust and loyalty is a core element in this company. So in order to enhance its service and to sustain in this competitive business, ZYX Auto service center have commitment to always improving their service performance.

Today, the ZYZ Auto Service Center faces two main problems. The first problem is how to give the costumer regarding to when the service start and end. And the second problem is on how to give a better and a balancing technician scheduling. In the first problem, in order to perform auto service, the customers can make bookings by contacting (by phone) one of the branch of service center or come directly to make an appointment. Customers booking status will be higher priority than walk-in customers. For booking costumer, a company's service advisor could make scheduling and give information regarding certain time for the start and end of service. But for booking costumer, the service advisors require a long process, starting from the match type of service with the time available, the availability and the expertise of the technicians, and the availability of stalls. This information crucial needed by service advisor to make scheduling for technician and for a time of service for the costumer. This process sometime makes the walk-in costumer has to wait in a long queue. While waiting, the customer does not receive information on how long they should wait until they could get service by service advisors. Because of the long queue and the incomplete information, the customers become dissatisfied with the services provided by the XYZ Auto Service.

The second problem is the company also experienced problems in determining the technician who will be working on the car service. To be able to determine the time of service for walk-in customers and technician scheduling, service advisors should ensure the availability of technicians. To ensure the availability of technicians, service advisors should know the work schedule of each technician and their expertise. In today technician's scheduling process, the service advisor does it by pointing randomly on the technician that is not on duty. These lead to another problem, which is the unbalance

workload for each technician and overtime payment. As a result of unbalance workload and work on overtime, there are possibility the technicians are not optimal when completing their work.

We address this issue in this paper by presenting an integrated framework for the automatic scheduling system by using queue theory and heuristic method. In this paper the analysis focused on designing a model of system to overcome the problems and the implementation. The proposed system will use the forward chaining method of the heuristic methodology to help finding the most suitable and balancing workload of the technician schedule automatically. The rules composed as the basic logic of the system will incorporate all the constraints. Finally the system will help the XYZ Auto Service Center to schedules and give service optimally.

2. RESEARCH METHOD

2.1. Problem Analysis

The Automated Scheduling System for XYZ Auto Service Center will help user (service advisor) to generate the timetable schedule automatically by referring to the constraints, which are :

1. Types of the Auto Service, in this case, the types are general repair with three degree of severity (high, medium or low) or miles auto service;
2. Stalls availability;
3. Technicians availability. Expert technician for high severity of general repair and ordinary technician for others type of auto service;
4. Max car service on each day, this information is dynamic and based on queue theory;
5. Time duration of service. This information based on type of auto service.

This proposed system will generate timetables for each technician to work on certain stall and certain car. Service Advisor will manage the schedule scheduling for any required changes in two methods, which are one-by one input of technician availability, or by period of service on each day. With the proposed system, we also developing the services logic that controls the concepts of managing the complexity of generate techinican scheduling automatically. In this research we used queue theory, forward chaining and decision tree to formulate the algorithm for the proposed automatic scheduling system.

2.2. Queue Theory and Heuristic Method

In this section we will discuss the use of Queue theory and heuristic method for the proposed system. The mechanism of the queue system in this proposed system is costumers arriving for service ,then if it is not immediate, costumer will wait for service, and the leaving the system as soon as they are served. In XYZ Auto Service Center, there are two sets of the queue line. First costumer waits to be served by service advisor in order to get an auto service appointment and information. Second, the custumer wait for when their auto service is complete.

There are six basic characterisic of the queueing processes which provide and adequate description of the queuing system, which are: the arrival pattern of customers, service patterm of servers (in this proposed system, service advisor and technician), number of service channels (in this proposed system , the numbers of service advisors on duty and numbers of stall), system capacity and and queue disipline. I usual queung system the arrival pattern of costumers is stochastic. Queue disipline refer to the manner in which customers are selected for service when queue has formed [a]. In the proposed system we will adopt Multi server, Multiple-phase system type of queuing system. It is because this type of system has numerous queues and complex network of multiple phases of service involved [b]. as describe on previous section, XYZ Auto Service Center has two possibility of queuing system, customer firs form the queue for service registration and assesment on service advisor, then car service. the main function of the implementation of the queuing theory is to determine the maximum customer system could served, and best server utilization that can serve both maximum and minimum numbers of customers [c].

1. Probability that there are no customers in the Auto Service Center

$$P_0 = \frac{1}{\left[\sum_{n=0}^{n=c-1}\frac{1}{n!}\left(\frac{\lambda}{\mu}\right)^n\right]+\frac{1}{c!}\left(\frac{\lambda}{\mu}\right)^c\left(\frac{c\mu}{c\mu-\lambda}\right)} \quad (1)$$

2. The avarage number of customers in the system :

$$L=\frac{\lambda\mu(\lambda/\mu)^c}{(c-1)!(c\mu-\lambda)^2}P_0+\frac{\lambda}{\mu} \quad (2)$$

3. The avarage time a customers spends in line waiting for service:

$$W_q=\frac{L_q}{\lambda} \quad (3)$$

Forward-chaining heuristic search is a well-established and popular paradigm for domain-independent planning. Forward-chaining planning used for this scheduling proposed system because it's one of the most intuitive planning approaches: beginning with the initial state, traverse through state-space by applying actions to the states encountered until a state is found that satisfies the goal condition. The plan used to reach each state can be determined by tracing the path of actions applied to move from the initial state to the state in question:these actions, in sequence, from the plan leading to that state [d]. Forward chaining means using a set of condition-action rules. Operation of a forward chaining system starts by inserting a set of known facts into working memory, and then lower the new facts based on the premise rules match with known facts. This process is continued until reaching a goal or no longer rules the premise fits the known facts. Defining the structure of data control rules written in the structure of If - Then and given a number of rules to distinguish the rules with each other. The scheme of forward chaining rules in this proposed system describe on Fig 1. As we can see from Fig 1. We used a decision tree for forward chaining rules sequentially in order to obtain a schedule. The first thing to do is started by checking whether the customer have already gotten a service appointment (by booking method). Then we check type of service, the availability of technicians, the availability of stalls, then if all complete, system will print schedule and give service information.

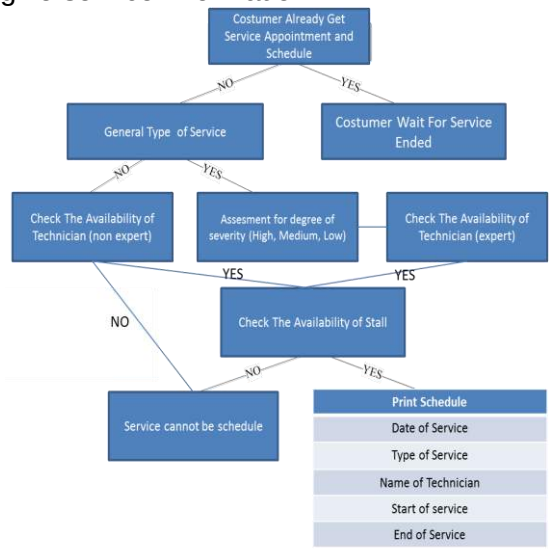

Fig 1. Forward Chaining Decision Tree for Proposed Scheduling System

2.3. Architecture of Proposed System

In this research in order to develop the integrated framework for scheduling system, we proposed the adoption of queuing theory and heuristic forward-chaining method. The architecture of the proposed system illustrates on figure 2.

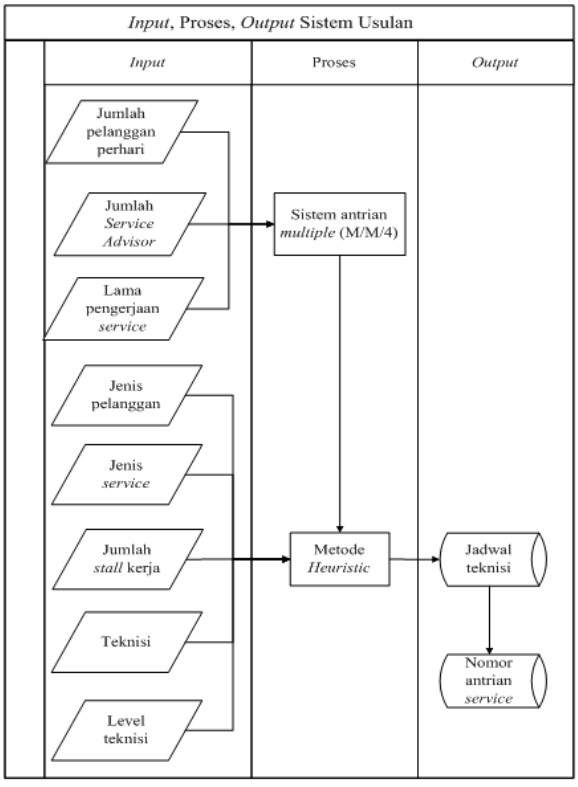

Fig. 2. Architecture of Proposed System

Finally, as illustrate from figure 2, scheduling with heurustic method gain information from from queuing theory and transaction data. In order to gain knowledge for forecast service need, the proposed system will use dashboard system to visualization customer characters and type of service.

3. RESULT AND DISCUSSION

In this section we will describe the design and implementation of the proposed system based on the heuristic algorithm and architecture as explained in the previous section. This process includes not only the actual writing programming code and train data set, but also the preparation of requirements, the system design, and confirmation that the proposed marketing intelligent system has met the research objectives.

Based on the architecture of proposed systems we build a UML use case diagram (figure 3) to illustrate how the system operates.Based on the use case as shown on figure 3, there are several features that are available to address issues that have been defined, namely the queuing, booking service and schedulling. In addition, there are some additional features that are used by systems such as report management system.

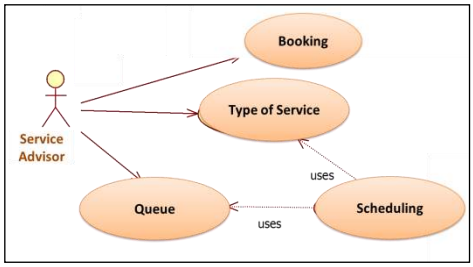

Fig 3. Use case Diagram

Figure 4 shows the user interface for the home page of the system. This home page have identification, queue and schedule menu.

Fig. 4. Home Page of Auto Service Scheduling System

Figure 5 show the queue menu of proposed system. This menu give information regarding queue attributes based on selection date. User can input date on the form in this menu.

Fig. 5. Queue Menu

Figure 6. displaying scheduling information for technician.

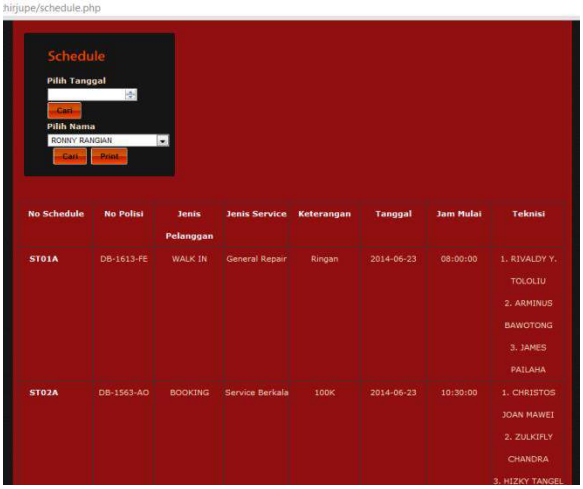

Fig. 5. Schedule Menu

Service advisor could also get information regarding to un-scheduling event or blank scheduling in the form our daily menu. The user could also get service data as illustrate on Fig 6.

No Service	No Polisi	Jenis Pelanggan	Jenis Service	Keterangan	Tanggal	Jam Mulai	Jam Selesai
ST088A	DB 4554 AA	WALK IN	General Repair	sedang	2014-07-15	08:00:00	10:30:00
ST089A	DB-1613-FE	WALK IN	Service Berkala		2014-07-15	08:00:00	10:30:00
ST090A	DB 2650 G	WALK IN	Service Berkala	100k	2014-07-15	08:00:00	10:30:00
ST091A	DB 1489 AO	BOOKING	General Repair	sedang	2014-07-15	08:00:00	00:00:00
ST092A	DB 1187 EA	BOOKING	General Repair	ringan	2014-07-15	08:00:00	00:00:00
ST093A	DB-1212-RT	BOOKING	General Repair	berat	2014-07-15	08:00:00	00:00:00
ST094A	DB 1649 AM	BOOKING	General Repair	ringan	2014-07-15	08:00:00	00:00:00
ST095A	DB 1182 EF	WALK IN	General Repair	berat	2014-07-15	08:00:00	10:30:00

Fig. 6. Data Service Menu

In the Figure 7. User could also get visualize information in the dashboard system menu. This menu could give information on frequency type of service and numbers of customers (booking and walk-in). This information could help managers and decision maker regarding their future business strategy.

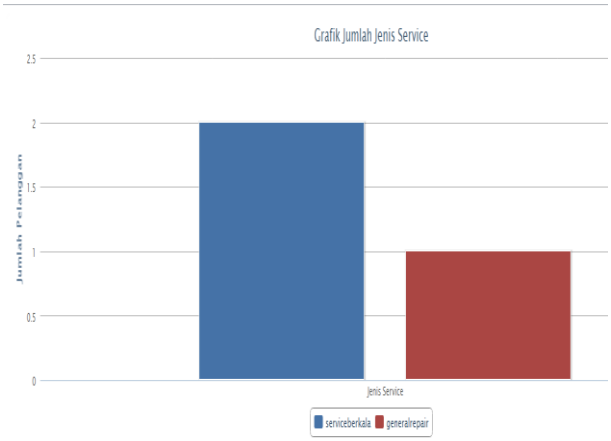

Fig. 6. Dashboard Menu

4. CONCLUSION

This study utilize queuing theory and heuristic method as integrated framework to give solution on technician scheduling on XYZ Auto Service Center. The main constraints are necessary to be fulfilled in the scheduling system with a heuristic method that's based on computation with queuing theory (M/M/4) are: the maximum limit of service for each day, utilization of service, waiting time and length of the queue. To make scheduling with forward chaining method, wherein the method is implemented through a sequence of constraints and rules in a certain order.

5. REFERENCES

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