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Selection of Notification Based on Priority Scale with Fuzzy Algorithm

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Abstract: Notification is one method that works as a marker that there is information waiting to be read. But along with the times, notifications are increasingly filled with information that is considered less important for device users. So there needs to be a breakthrough to overcome this. This study aims to design a system that can help users to sort out notifications that are considered important and not. It is proven that the system can sort notifications based on the given metrics.

Keywords: Fuzzy, Notification, Sorting, Defuzzification, Fuzzificcation

1. Introduction

Notifications are a device's way of notifying the user that there is information that needs attention. However, the previous notification signaled the arrival of very important information and seemed very limited in use. As in the fence device which can only display a limited number of characters, the sender of the message must place and select the information to be conveyed in the device. However, because modern devices can now contain very large characters, often information is sent such as social media conversations, advertisements, and other notifications. Moreover, statistical data, regarding user discomfort with notifications, collected by businessofapps.com proves that notifications arising from the various information received seem disturbing and also tend to be detrimental.

Notifications can appear on various devices and operating systems and can be accepted by anyone. Until now, there are many kinds of research and products that discuss notifications. There are also various methods from the proposed ideas ranging from Natural Language Processing (NLP) [4], Machine Learning [1], Finite State Machine (FSM) [2] to controlling with databases.

Several previous studies have discussed the use of fuzzy algorithms for prediction or scheduling. For example, in Rifki and Wayan's research discusses the application of the Tsukamoto fuzzy algorithm to predict the number of items interested in. Where the research is able to predict the amount of interest in goods at a time. This method is able to produce an optimal value in terms of predicting or forecasting demand for cement goods of 80-120 pop size.

Also, in the Dhony and Indiati's research, it's an inspiration discusses the Implementation of Fuzzy K-Nearest Neighbor (FK-NN) for the Selection of Interests of Informatics Engineering Students [6]. They use a fuzzy logic algorithm to generate predictions of student interest sorting in determining major. In this study, an accuracy value of 87.5% was obtained through the values of k=2 and K=3 with a total of 160 training data.

The contribution of our research is research on the use of fuzzy algorithms to speed up execution time and sort notifications by prioritizing notifications that are considered to have the highest

urgency. The purpose of this research is that users are no longer disturbed by message notifications that are considered less important.

2. Related Works

In the previous research, Rozyyev, Hasbullah, and Subhan use technique K-Nearest Neighbors (KNN) which combine with fuzzy logic to find many localization technique for Wireless Sensor Network (WSN) [11]. The accuracy of KNN will improved by combining with fuzzy logic, because the fuzzy logic will allow the algorithm complexity stay low. In their research proved that the localization technique can show high accuracy, the multilateration and fuzzy logic indoor positioning system fuzzy KNN give better performance in terms of accuracy, and the algorithm have complexity.

Furthermore, Arboleda et all were applied the fuzzy logic and K-Nearest Neighbors for improvement in image processing, especially in the recognition currency system. They present monetary transaction and proved daily transaction use an artificial intelligence to come up with determination and classification method [12]. The research has divide into two section, their present template matching technique for extraction and, the result will be proved with comparison of accuracy between fuzzy logic algorithm and KNN. The fuzzy logic give accurate value, and the KNN shows it flaws to identify the features resulting to big errors unlike the first method.

For both research, show that the fuzzy logic can solving the problems in the many field accuaretly. Hence, in this research will use fuzzy logic and combined with K-Nearest Neighbor to solve selection of notification based on priority scale.

3. Experiment and Analysis

3.1. Methodology Experiment

Fuzzy logic is a problem-solving control system methodology, which is suitable to be implemented in the system. Starting from simple systems, small systems, embedded systems, computer network architecture, multi-channel or workstation-based data acquisition, and control systems [3]. Fuzzy logic is a component forming soft computing.[5] Fuzzy logic is an improvement in Boolean logic regarding the concept of truth to group data with very membership degrees of 0 or 1. Fuzzy logic can also be used to measure linguistic language targets, for example measuring vehicle speed with outputs in the form of slow, fast, rather slow, fast. The fuzzy value has two possible outputs that designate a set company. Where 0 is not a member of the set and 1 is a member of the set.

In fuzzy logic, a logical logic of thinking is needed from the inference that underlies decision making, the basic logic concepts are generally represented in the form of a set. A fuzzy set is the development of a concept in thematic science, which has certain values. Where these values have a membership degree between 0 and 1. In the Boolean expression, it produces a value in the form of true and false. Meanwhile, fuzzy is used to produce a certain value output, for example in the form of information: very slow, slow, very fast, and fast for rainfall intensity. An illustration between fuzzy and Boolean membership can be seen in the image below:

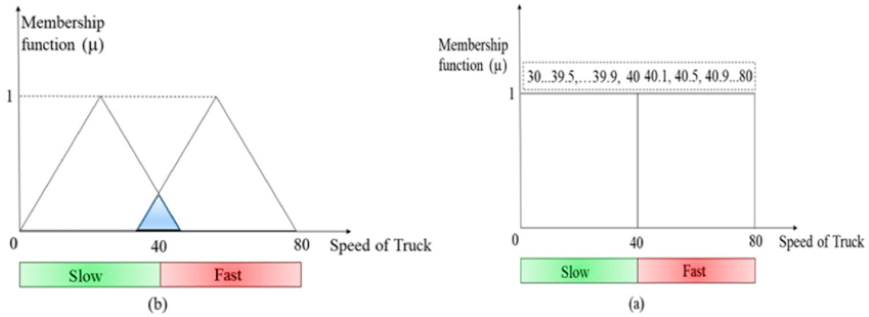

Figure 1. Velocity Illustration between Fuzzy Logic and Boolean Logic

Fuzzy logic uses rules to describe its behavior. The rule is in the form of an IF or THEN statement to describe the desired condition. The statement is a fuzzy set A in the universe of sets which is expressed by the membership function A, which has a value in the value interval [0,1]. Mathematically this is stated using the equation:

$$\mu A = U[0,1] \quad (1)$$

The fuzzy set A in U talk is expressed as a pair or u and the magnitude of its element membership is as follows [10]:

$$A = \{(u, \mu A(u))/u \in U\} \quad (2)$$

The '/' sign is used to connect elements with their degree of membership. If U is discrete then A can be expressed by:

$$A = \mu A(u_1)/\, u_1 + \ldots + \mu A(u_n)/\, u_n \text{ or}$$
$$A = \sum_{n=1}^{n}(\mu_1) \,/\, \mu_1 \quad (3)$$

And if U is continuous, then the fuzzy set can be expressed by:

$$\int_u \mu A(u)/u \quad (4)$$

The signs ' + ', '$\sum$ ', and '$\int$ ' can be expressed as union or union operators.

The prioritization logic that we use is a dynamic approach logic of a priority scheduling algorithm. This algorithm focuses on the determination process based on the specified priority rules. In contrast to other scheduling algorithms, the scheduling sequence focuses on arrival time (FCFS), and the shortest job (Short Job First). This scheduling priority algorithm prioritizes the process that has the highest priority. Each process has its own priority. These priorities can be determined through several characteristics, including: Time limit, Memory requirements, File access, Comparison between I/O Burst and CPU Burst, and Process importance.

Priority algorithms can also be run preemptively or non-preemptively. In preemptive, if there is a new process that has a higher priority than the currently running process, then the currently running process is stopped first, then the CPU is diverted to work on the newly arrived process. Meanwhile, in non-preemptive, the newly arrived process cannot interrupt the running process, but only put it in the queue.

3.2. The Result and Discusses

Overall, the system is divided into four successive stages, namely: preprocessing, fuzzification process, data processing by the inference engine, and de-fuzzification process as shown in Figure 2. These four stages will change the character of the notification media output command to make notifications to devices users. in the form of ringing tones, vibrating, or silent according to the results of fuzzy processing.

When these four processes are started, they will initially be stored in the dataset which will then be used as a reference at the next start.

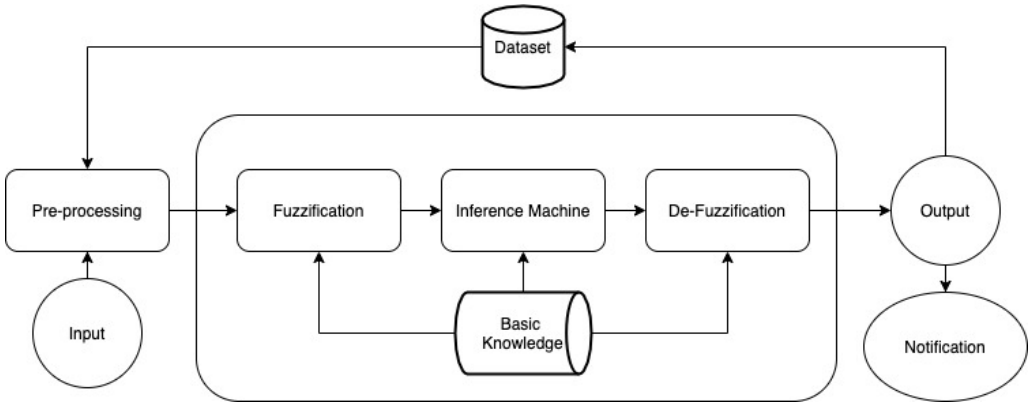

Figure 2. Flowchart Scheme Process

The flowchart process begins with character input from notifications both social media, web and android ads, as well as system state notifications, the characters that will be displayed first, are prepared with the references contained in the dataset. If there is a match in the dataset, it will be converted into a numerical value that corresponds to the related data listed in the dataset. Then these numerical values become initial data which will then be processed using a fuzzy algorithm. This process can be called preprocessing and produces an output of numeric type as follows:

1. Summarize of words (between 0-50)
2. Numerical value of main words in Dataset (between 1-10)
3. Interaction of Frequency which uses by users with submit box (between 0-50)
4. Numerical value of tagging which ready in submit box (between 1-10)

Dataset has consisted words data which each have priority value. **T**he dataset used was from subjective research because it was not related. Preliminary data that will be used can be very diverse, some examples can be seen in table 1.

Table 1. Table Words of Scale Priority

Number	Words	Scale
1	Darurat	8
2	UTS	7
3	UAS	8
4	Dosen	6
5	Pak	5
6	KRS	8
7	Pengumuman	7
8	Kebakaran	9
9	Meninggal	10
10	Sidang	9
…	…	…
n	Ruang	4

After the initial data has been obtained, the next process is fuzzification. This process serves to change the initial value of the crisp type to fuzzy. However, this process requires some desire that is obtained from the knowledge base on the previously implanted system. In this study, the knowledge base for changing the initial data used from the assessment because there is still no related research can be divided into three as follows:

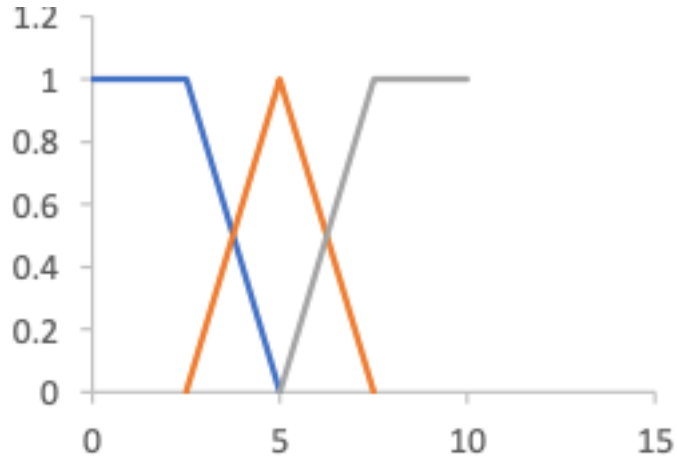

Figure 3. Rule of Fuzzy about main word of scale and tagging sender box.
Note for Figure 3: Blue-line : Incidental, Orange-line : Ordinary, Grey : Urgent

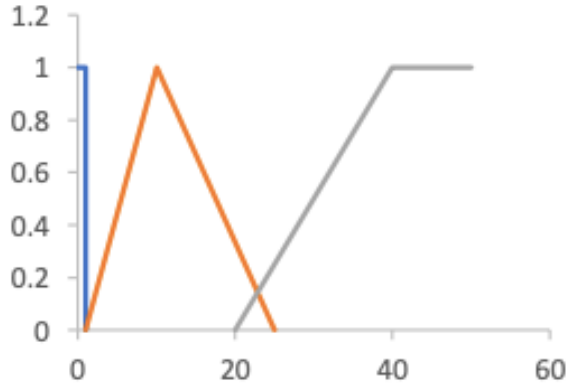

Figure 4. Rule of Fuzzy about interaction scale frequency with sender box.
Note for Figure 4: Blue-line : Never, Orange-line : Rarely, Grey : Often

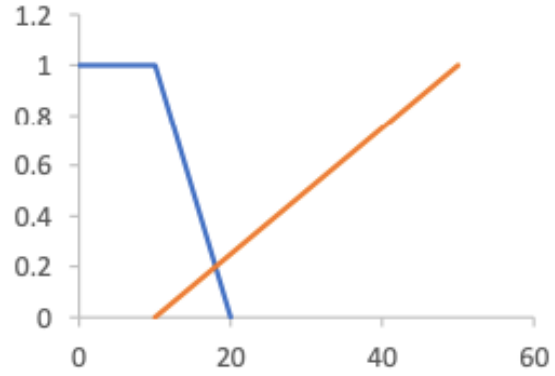

Figure 5. Rule of Fuzzy about summarize of words in the list.
Note for Figure 5: Blue-line : Short, Orange-line : Complicated

Fuzzification will process the data with the basic reference of fuzzy rule knowledge as depicted in Figures 4 to 6. After getting the results of the fuzzification process, the next step is processing with an inference engine. The following is the rule set in the inference engine:

1. When has important condition and high interaction frequency thus appearing notification
   Important (main) ^ High (frequency) → Notification (active)
2. When has important condition and complicated thus appearing notification
   Important (main) ^ Rarely (words) → Notification (active)

3. When has not important condition and high interaction frequency thus vibration active
   Not Important (main) ^ High (frequency) → Vibration (active)
4. When has not important condition and rarely interaction frequency or never thus vibration non-active
   Not Important (main) ^ Rarely (frequency) v Never (frequency) → Silent (active)

A series of rule sets on the inference engine provides limits and formula so that the machine can consider which outputs are needed to achieve the goals, especially in this study, namely notification sorting, from the system. It is clear the metrics used as the basis for thinking inference engines to make decisions. It doesn't stop there, the data type resulting from the inference engine output still has to be converted to be easier to understand by defuzzification. Defuzzification serves to change the type of fuzzy data into crisp which can be translated into a language that is easier to understand. However, a rule is needed to convert the fuzzy value back into a crisp.

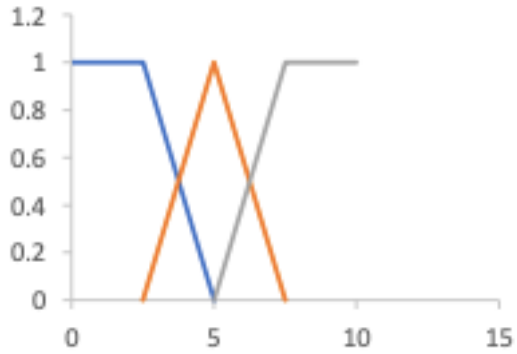

Figure 6. Rule of Fuzzy for Defuzzification

Note for Figure 6: Blue-line : Not Important, Orange-line : Ordinary, Grey : Urgent

Similar to fuzzification, defuzzification only reverses the fuzzification process and does it from front to back. The expected output from the defuzzification process is the crisp data type. However, the results of the process data will be stored in the dataset so that it can be used as a reference for further considerations.

4. Conclusions

Notification is one method that not only works as a marker that there is information waiting to be read. But along with the times, notifications are increasingly filled with information that is considered less important for device users. So there needs to be a breakthrough to overcome this. This study aims to design a system that can help users to sort out notifications that are considered important and not.

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