D&T: An Euclidean Distance Optimization based Intelligent Donation System Model for Solving the Community’s Problem

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Abstract. The trust is a main difficulty to propose a donation system to the community. A specific information system is scientifically estimated able to escalate the trust level of one community in donating; where, their donation can reinforce them to solve the socioeconomic problem in one region. The concept of fuzzy-logic has been practically embedded in measuring an inequality index of socioeconomic aspect, particularly for health and education sectors. Moreover, the concept of the Euclidean distance measurement is operated to measure the distance value of two parameters (geographical location and inequality). The hill-climbing optimization method that can recommend the most recommended donation recipient is embedded into system model to meet donor and recipient of donation. Here the intelligent donation system model is scientifically constructed. The proposed system model undoubtedly can solve the socioeconomic problem in one community. In this study, the urban village Sawah, Ciputat, Indonesia was taken as an object of the research where the empirical data coming from.

1. Introduction

Commonly in urban village in Indonesia, exclusively in health and education sectors, the socioeconomic inequality is still wide-ranging. It touches the inequality index value 0.65 approximately [1], where the value 1.00 illustrates the poorest condition of socioeconomic gap. Several government programs have been implemented to answer the problem, however much effort needs to be conducted well.

One way to decrease the socioeconomic inequality is to increase the power of community donation role. Nevertheless, the other challenge appears. The trust is a main dilemma to encourage the community to donate. The research problem to answer “how to increase the community trust to donate” is an interesting question to be responded.

Several researches surrounding donation term, by this time, have been conducted in many countries. [2] conducted a research regarding the analysis and expectation of negative impact of food insecurity. They analyzed the uncertainty connected with in-kind food donation. The uncertainty term here was extended to the donor, product, and supply chain structure. They also developed the model to predict the quantity of in-kind donations. [3] was doing a study to identify the factors affecting consumer...
This paper is explaining the proposed donation system model based on the measurement concept of Euclidean distance of parameters geographical location and inequality index that is combined with optimization process. It can facilitate the donor and recipient of donation intelligently. To deliver it, the introduction section is followed by sections research methodology, results and discussion, and conclusion and further works.

2. Research Methodology
The concept of fuzzy-logic method [6] that combined with Williamson idea [7] particularly used to develop the model of inequality index measurement [1]. Where here, it becomes a part of the proposed system model. It was combined with Euclidean distance notion then to find the objective distance between donor and recipient of donation. Indeed, inequality index of [1] portrays the index socioeconomic gap in two sectors, health and education. It (called fuzzy-Williamson index) is an extended version of Williamson index that only consider socioeconomic gap in general.

Furthermore, the concept of hill-climbing optimization [8] used to find the recipient’s shortest distance among lots alternatives to be recommended to get the first donation before others. The recommendation used by donor to act. The hill-climbing itself is a heuristic optimization method to find the parameters that give a near-best value of objective function. And the final one, the object oriented method coming from [9] operated to configure the proposed system model. Basically, two diagrams usecase and class are functioned to depict the relation between system and actors and the relationship among classes in the system model respectively. The steps of the research is universally depicted in Figure 1.

3. Results and Discussion
3.1. The Constructed System Model
Fundamentally, the constructed system consist of three human actors; Admin, Agent, and Donor. The whole system is managed by administrator (Admin), where practically the administrator validates (usecase Validating) all register process of agent and openly access the report (usecase Reporting). Furthermore, the agent is practically placed in urban village. The actor is responsible to register all recipients (usecase Registering), validate all donors’ donation (usecase Validating),
and can access the report (usecase Reporting) as well. The complete usecase diagram of the constructed system is described in Figure 2.

The actor Donor has the important role here. Besides the actor can register directly (via usecase Registering, and then validated by administrator), he/she can select the recommended recipients (that have been processed through usecase Optimizing) to give donation (usecase Donating) and trace the donation (usecase Tracing) directly, and also see the report. In detail, the actor Donor can trace by communicating directly with the recipients regarding the donation.

Generally, all entity relationships in the constructed system is configured by class diagram (Figure 3). There are fifteen classes fundamentally. Specifically for geographical location, in Indonesia, one location is divided into four levels: province, district, sub-district, and urban village. The urban village itself can have more specific attributes i.e. hamlets and neighborhood.

![Figure 2. Schematic View of the Constructed System](image)

Moreover, the recommended recipient is proposed by process of hill-climbing optimizing based on the computation process of real geographical location and inequality index distance combination. Where purposely, the optimization model is described in Figure 4. The objective function is determined by considering the real geographical location distance and socioeconomic gap distance (both health and education parameters). In general, it is described in equation (1); where \( x \) and \( y \) are parameter examples, and \( D_x \) and \( D_y \) are distance of parameters \( x \) and \( y \) respectively. All distances are calculated from zero point. This formula is coming from the Euclidean distance measurement [10], generally it is formulated in equation (2).

To normalize the Euclidean distance value for the real geographical location distance (\( D_{LN} \)), the equation (3) is used. It is the equation to normalize a value in the condition when the highest value is representing the best. On the other hand, to normalize Euclidean distance value for the parameter inequality index (\( D_{IN} \)), the equation (4) is used. The equation (4) is used to find the normal value when the most minimal value describes the best [11]. Thus, explicitly, the objective function for the constructed optimization model in this study is defined in equation (5).
3.2. Empirical Measurement and Optimization Experiments

In the urban village Sawah, there are 385 family cards for empirical sample size. The value of Euclidean distance for each family card (based on the distance of both real geographical location and inequality index) to the donor is drawn in hill-valley graph (Figure 5). The graph was arranged by sorting all

\[
\min f(x, y) = \sqrt{(D_x)^2 + (D_y)^2}
\]

(1)

\[
|x - y| = \sqrt{(x - y)^2}
\]

(2)

\[
D_{LN} = \frac{D_c}{\max(D_1, D_n)}
\]

(3)

\[
D_{IN} = \frac{\min(D_1, D_n)}{D_c}
\]

(4)

\[
\min f(D_{LN}, D_{IN}) = \sqrt{(D_{LN})^2 + (D_{IN})^2}
\]

(5)
numbers of family card. Thus, the graph is a representation of all families’ distance (from both parameters geographical location and gap).

In addition, for the purpose of the laboratory experiment, the data example of the geographical location distance is practically randomized based on one randomized virtual location (as a donor point example). Afterward, by using the hill-climbing method with ten experiments, the recommended recipient who get the donation firstly is the recipient with Euclidean distance value 0.03 (the lowest one, see Figure 6). It means the donor is suggested to donate that family (the nearest recipient candidate) first.

![Figure 5. The alternatives of Recipient based on Empirical Data](image)

![Figure 6. The Most Recommended Recipient Alternatives based on Hill-Climbing Optimizing](image)
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5. Concussion and Further Works
The constructed system model is able to recommend the most recommended donation recipient from more than 350 family cards (based on empirical sample) by using the concept of hill-climbing optimization. The recommendation is proposed by minimizing the combination of both parameters geographical location (between donor and recipient) and the inequality index (that merges the health and education gaps). The optimization model of donation recipient is embedded into donations system.

Other aspects can be taken into account to make the recommendation of donation recipient more objective; such as family condition. Or the potency of the donation power also can be examined, both regular or irregular donation.

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