The Application of Extended Weighted Tree Similarity Algorithm in Online Commodity Exchange of Agro Forward Auction Market in Central Java Province

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ABSTRACT

This research aims at providing an alternative solution to the market of agricultural products in the form of an online commodity exchange. Beside as an alternative market, this online commodity exchange is also hoped to be able to solve the problem of the lack of access to the information of prices, availability of agricultural products, harvest regions, and other information related to agricultural products that could affect the creation of market and the market practices that could bring disadvantages to the farmers. Therefore, this research conducts a thorough study towards the framework of the commodity exchange and the auto matching process using extended weighted-tree similarity algorithm is done automatically. With this, the auction processes between sellers and buyers could be implemented using this algorithm.

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1. INTRODUCTION

One of the problems faced by the farmers and the agricultural sectors as mapped in the Concepts of Agricultural Development year 2005-2009 is the lack of information, market problems and market practices. These weaken the bargaining power of the farmers compared to the buyers or brokers [1]. This lack of information related to planning, implementation and post production activities results in the fact that the farmers would not have the knowledge of what to plant, when to plant, how many to plant, price information, market access, stocks and necessity, and the long chain of the market practices that cause a little profit margins for the farmers [2].

The prices in wholesale and farmer levels are formed through bidding processes between each farmer and each buyer, where the bidding mechanism always puts the farmers at the low bargaining power due to the weak economic positions of the farmers and the lack of knowledge about the prices. One solution for this problem is to develop a market institution in the form of an auction market or Commodity Exchange that could assure the transparent price discovery that could bring benefits to both the farmers and the buyers [3]. There are still various problems occurred while- and post-transactions. During transactions, price discovery is only decided by the buyers and sellers available at the market location and the process of the price discovery is not as natural as the one in Commodity Exchange.

Based on the preliminary study conducted by Assistance Team for the Revitalisation of the Auction Market [4], it is recommended that the auction market institution needs to be improved and to make use of the information and communication technologies (ICT) for the transaction process in Argo Forward Auction Market, Central Java. This is in line with Hasibuan [2] who develops a strategic framework on the use of ICT for agriculture that is Indonesian E-Agriculture Strategic Framework (IESF) by using the approach of The Open Group Architecture Framework (TOGAF). Another research related to the use of ICT for agricultural products auction market is conducted by Tambotoh [5]. This study proposes a virtual model of agricultural

auction market (Virtual Agriculture Market - VAM) for the paddy farmers in Demak Regency, Central Java. The VAM model proposes is a development from the E-Market Place suggested by Hasibuan [2]. In relation to that, this research is a thorough study to the framework of commodity exchange and the auto matching process using the algorithm of extended weighted-tree similarity between buyers and sellers which is don automatically. This would help the auction process between sellers and buyers.

2. LITERATURE REVIEW

2.1 Forward Exchange Commodity

In this forward commodity exchange the prices are determined through auctions in an agreed time. With this assurance of the prices, quantity, quality, time and place of the commodity handover, farmers could do planning in their planting patterns to fulfil the forward contract. Each forward contract can be registered in the insurance company to get insurance for the payment and handover of the commodity.

Furthermore, with this contract insurance, bank institutions could provide financial supports to both sellers and buyers. The followings are the advantages of the commodity exchange [3][4]: (a). Farmers will have price assurance so they can plan their planting patterns. Therefore, farmers could concentrate more on quality and productivity, (b). Processing industries will get stock assurance of their raw materials in accordance to the capacity and production plans, and (c). Traders/exporters will be protected from distribution failures since there is assurance in production stocks.

2.2. Extended Weighted Tree Similarity Algorithm

Extended weighted-tree similarity algorithm is one of the algorithms to measure the level of similarity between two trees [6]. Tree-similarity algorithm for match-making is also applied in e-business field, where the product/service of seller and buyer is presented as node-labelled, arc-labelled, and arc-weighted tree. Similarity algorithm is also developed as a base for semantic match-making in virtual marketplace [7].

The Extended Weighted Tree Similarity algorithm has 3 main functions, which are treeism, treemap, and treeplicity. The function call consists of parameters positioned between square brackets "[]" and arguments between brackets "()". Moreover, tree in this method is divided into several main parts, which are: node-labelled, arc-labelled, and arc-weighted tree, where node-labelled is the label, name or identity in each node, arc-labelled in each branch node, whereas arc-weighted is the weight in each branch node. In general, arc may have various weight, where the value is between 0 to 1. The average weight can be calculated with $(w_i + w'_i)/2$. Recursively, we can get the similarity s_i of tree t_i and t'_i which is later adjusted on $A(S_i)$ with a function of arc A, and multiplied with the average weight. Therefore, the sum on each level of all the similarity is $A(Si)(w_i + w'_i)/2$, divided by the sum of the average weight:

$$\sum (A(S_i)(w_i + w'_i)/2) / \sum (w_i + w'_i)/2 \quad \text{.....(1)}$$

In certain cases, where the weight in each level of all tree summed equals 1, then equation (1) can be simplified into:

$$\sum (A(S_i)(w_i + w'_i)/2) \quad \text{.....(2)}$$

Recursively, this function can be used to measure the simplicity level of a tree, ranging from 0 to 1. The value approaching 1 means that the tree is getting simpler, and the value approaching 0 means that the tree is getting more complex. This value will be decreasing as the arc is getting more and the level is getting deeper (breadth and depth). The next thing is to meet the needs of buyer and the existing product/commodity, where the buyer has had specification for the wanted agricultural products, for instance the type of the commodity, amount, price, ready stock or prepaid, when the product can be achieved, etc. This will make the specification demanded by the buyer could meet the product specification informed to the farmer.

3. RESEARCH METHOD

This research using extended eighted-tree similarity algorithm as an architecture application of AgentMatcher for similarity, pairing, and negotiation is used to optimise the transactions in virtual markets. The determination of the similarity level is generally done by determining the distance or the similarity level. Two objects are said to have a high degree of similarity is marked with a distance value approaching 0 (zero) or the similarity value approaching 1 (one). In this research, the method used to determine the similarity level between two trees is Extended Weighted-Tree Similarity algorithm, where the similarity level is symbolised by the numbers 0 and 1. Similarity will have a 0 value if both objects do not have similarity at all and a 1 value if they have similarity.

4. RESULTS AND ANALYSIS

As described in the flowchart in Figure 1, the calculation process of the similarity or levels (degree) of similarity between the tree of seller and tree of buyers/bidders can be done to determine the auction process. As in the modelling stage, the whole tree formation of the commodity exchange/auction market as in

Figure 2. Therefore, when implemented, for example the seller tree, as in Figure 3, and the buyer tree, as in Figure 4, will be formed. Next is the determination of weight on the formed trees. On the seller tree, the weighting is based on the number of branches in each level, started from level 0, as shown in Table 1.

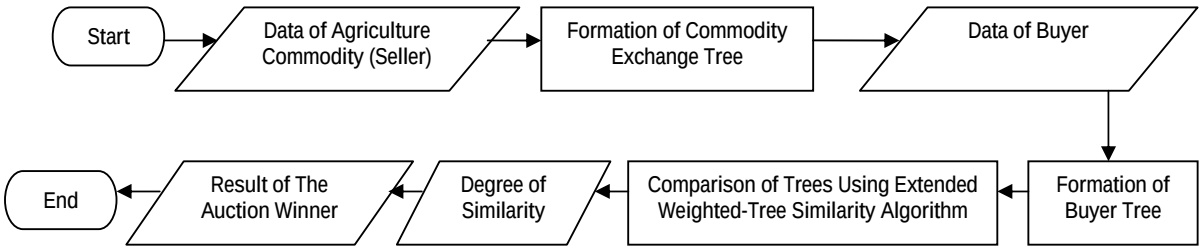

Figure 1. Flowchart of Auction Market Modelling

In the figure 2, there are classification or categorization tree based on the type of commodity that has attributes, such as location, price, quantity and date. Next on the seller shall obtain information, eg commodities IR64, A Warehouse Locations in Magelang, at a price of 849 550, the quantity of 3 tons, 31-07-2012 date available (as in Figure 3). While on the buyer side of the tree obtained, the type of commodity IR64, location in All warehouse, at a price of 850,000, quantity 2 ton, dated 31-07-2012 available (as in Figure 4). The next will be calculated using weighted extended tree similarity algorithm to obtain the level of similarity of the second tree.

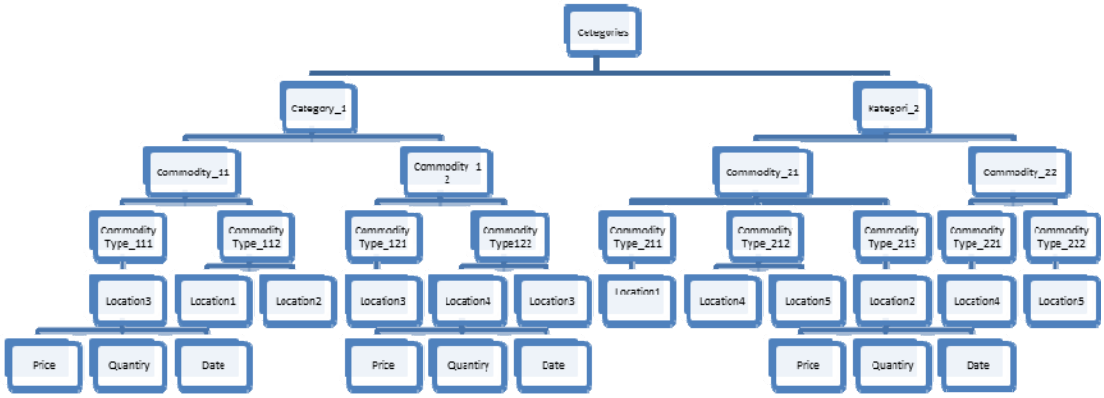

Figure 2. Commodity Tree of Whole Auction Market

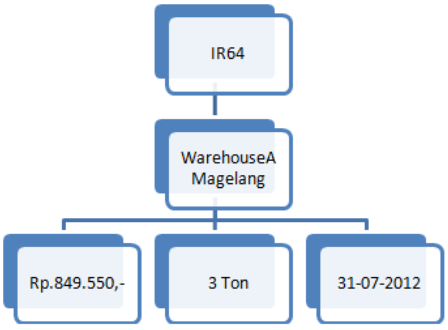

Figure 3. Seller tree

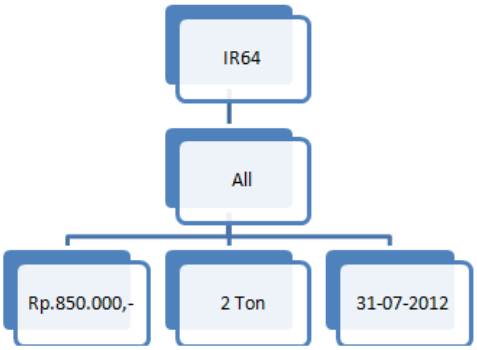

Figure 4. Buyer/Bidder Tree

Table 1. Seller Weight

Level...	Level 4	Level 5	Level 6	Weight
	IR64			0.5
		Warehouse A		0.5
			IDR849,550.-	0.33
			3 Ton	0.33
			31-07-2012	0.33
		Warehouse B		0.5
			IDR825,000.-	0.33
			5 Ton	0.33
			31-07-2012	0.33
	C4			0.5

Table 2. Buyer/Bidder Weight

Level...	Level 4	Level 5	Level 6	Weight	Bidder
	IR64			0.5	1
		all		0.5	
			IDR850.000,-	0.33	
			2 Ton	0.33	
			31-07-2012	0.33	
	IR64	all		0.5	2
			IDR890.000,-	0.33	
			4 Ton	0.33	
			31-07-2012	0.33	

In the process of calculating the similarity levels between the sell tree and buy tree, the following method is used:

1. Conducting weighting process.
2. Assessment process (calculation of *similarity* levels).

With the assumption that the buyer has chosen from the category level to the commodity, the weighting process for the tree example above is determined on the following items:

- Commodity Type
- Price
- Quantity
- Ready Date
- Warehouse Location

Sellers	
Commodity= IR64 Sell Price=IDR849,550.- Quantity=3 ton Ready Date= 31-07-2012 Location= Warehouse A	Commodity = IR64 Sell Price =IDR825.000,- Quantity =5 ton Ready Date = 31-07-2012 Location= Warehouse B

Bidders	
Commodity= IR64 Bid Price=IDR850.000,- Quantity=2 ton Ready Date= 31-07-2012 Location= All	Commodity=IR64 Bid Price=IDR890.000,- Quantity=4 ton Ready Date= 31-07-2012 Location= All

Process of BID1

Weighting Process of Warehouse A Location

price=(bid price)/(bid price + sell price)
= 850,000/1699550
=0.5

Ready Date=1/[[Sell ready date –Buy ready date]+1]
=1

To determine Quantity Weight, if Sell Quantity>=Buy/Bid, the equation:
Quantity= sell quantity/sell quantity + buy quantity,
If Sell Quantity < Buy/Bid, then Quantity Weight = 0
Therefore, in that case the equation used the first one, and it becomes:
Quantify =sell quantity / sell quantity + buy quantity
=2/5=0.4

Therefore, the calculation of the similarity level is conducted based on the following equation:

$$\sum (A(S_i)(w_i + w'_i)/2)$$

Warehouse A Location:

Similiraty(sell,buy) = Sim("price","price")*((weight "price"sell + weight "price"buy)/2)) +
Sim("quantity","quantity")* ((weight "quantity"sell + weight "quantity"buy)/2)) +
Sim("date","date")*((weight "date"sell + weight "date"buy)/2))
= 0.5*((0.33+0.5)/2)+0.4*((0.33+0.3)/2))+1*((0.33+0.2)/2)
=0.5985

Similarity(sell,buy) = Sim("location","location")*(((weight "location"sell + weight "location"buy)/2))
=0,5985*((0,5+0,5)/2)
=0,29925

Calculation Process in Warehouse B Location

Commodity = IR64
Sell Price=IDR825,000.-
Quantity=5 ton
Ready Date= 31-07-2012
Location= Warehouse B

Calculating Weight:

Price=(price tawar)/(price tawar+price sell)
= 850,000/1675000
=0.5075

Date siap=1/[[Date siap sell-Date Siap Buy]+1]
=1

Quantity= quantity buy/quantity sell+quantity buy
=2/7=0.2857

Similirity(sell,buy)=Sim("price","price")*((weight "price"sell + weight "price"buy)/2)) +
Sim("quantity","quantity")* ((weight "quantity"sell + weight "quantity"buy)/2)) +
Sim("date","date")*((weight "date"sell + weight "date"buy)/2))
= 0.5075*((0.33+0.5)/2)+0.2857*((0.33+0.3)/2))+1*((0.33+0.2)/2)
=0.5611205

Similarity(sell,buy)=Sim("location","location")*(((weight "location"sell + weight "location"buy)/2))
=0.5611205*((0,5+0,5)/2)
=0.28056025

Process of BID II

Calculating the weight in Warehouse A Location:

Price=(price tawar)/(price tawar+price sell)
= 890,000/ 1,739,550
= 0.5116
Ready Date=1/[[Date siap sell-Date Siap Buy]+1]
=1
Quantity= quantity buy/quantity sell+quantity buy (Quantity buy<=quantity sell)
=0 jika (quantity buy>quantity sell)

Similarity(sell,buy) = Sim("price","price")*((weight "price"sell + weight "price"buy)/2)) +
Sim("quantity","quantity")* ((weight "quantity"sell + weight "quantity"buy)/2)) +
Sim("date","date")*((weight "date"sell + weight "date"buy)/2))
= 0.5116*((0.33+0.5)/2)+ 0*((0.33+0.3)/2))+ 1*((0.33+0.2)/2)
= 0.212314 + 0 + 0.265
= 0.477314

Similarity(sell,buy)=Sim("location","location")*(((weight "location"sell + weight "location"buy)/2))
= 0.477314*((0.5+0.5)/2)
= 0.238657

Process in Warehouse B Location

Commodity= IR64
Sell Price=IDR825.000,-
Quantity=5 ton
Ready Date= 31-07-2012
Location= Warehouse B
Calculating weight:
Price=(bid price)/(bid price+sell price)
= 890,000/1,715,000
= 0.51895
Ready date =1/((ready date Sell-ready date Buy)+1)
=1
Quantity= quantity buy / (quantity sell+quantity buy)
=4/9 = 0.444

Similirity(sell,buy) = Sim("price","price")*((weight "price"sell + weight "price"buy)/2)) +
Sim("quantity","quantity")* ((weight "quantity"sell + weight "quantity"buy)/2)) +
Sim("date","date")*((weight "date"sell + weight "date"buy)/2))
= 0.51895*((0.33+0.5)/2)+ 0.444*((0.33+0.3)/2))+ 1*((0.33+0.2)/2)
= 0.21536425 + 0.139986 + 0.265
= 0.62035025
Similarity(sell,buy)=Sim("location","location")*(((weight "location"sell + weight "location"buy)/2))
=0.62035025*((0.5+0.5)/2)
=0.310175125

The result of the calculation of the similarity between sellers and buyers is **Bidder 1=0.29925 (warehouse A location) and 0.28056025 (warehouse B location),** whereas **Bidder 2=0.238657 (warehouse A location)** and **0.310175125 (warehouse B location).** With this result, the system will decide that **bidder 1 in warehouse A** and **bidder 2 in warehouse B** will win the auction.

The system then could give recommendation from the auction process occurred between the seller and the buyer based on the weight of each item. The weight can be determined by the seller and the buyer/bidder/ auction participants. It is the weight that determines to what extent the items have the priority in the auction decision.

5. CONCLUSION

Finally, it can be concluded that extended weighted tree similarity algorithm can be used in helping the process in the auction market of the commodity exchange. Some other things need to be considered is the weighting of each item from the perspectives of both the seller and buyer/auction participants. This weighting is the key factor in determining the similarity degree which in turn will decide the winners of the auction process.

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