

# Proposing a New Approach to Applying Pervasive Computing in Agriculture Environments

Mohammadreza Mohammadrezaei<sup>†</sup>, Mahsa Fathi<sup>††</sup> and Nima Attarzadeh<sup>†††</sup>

<sup>†</sup>Mohammadreza Mohammadrezaei, Department of Computer Engineering, Ramhormoz Branch, Islamic Azad University, Ramhormoz, Iran

<sup>††</sup> Mahsa Fathi, Department of Computer Engineering, Ahvaz Branch, Islamic Azad University, Ahvaz, Iran

<sup>†††</sup> Nima Attarzadeh, Department of Computer Engineering, Mahshahr Branch, Islamic Azad University, Mahshahr, Iran

## Summary

The resource management in agriculture environments is very important. Using smart controls will be one of the most eminent ways of managing. These resources such as water and plant nutrition. In this paper researcher are going to present a special program in which provide necessary resources for growing plant by using data sensors based on environment conditions. Firstly, it is gained a few data from soil, climate and plant conditions by using sensors and made context by processing all the data. In next stage the presented approach will do its own calculations on the basis of conditions. It can be said that researchers are used fuzzy logic for calculations because of complex data. Then researchers by using actuators can make decision for environment. In this paper, because of injecting nutrition on the basis of its conditions in to soil and plant necessary, plants can frequently use suitable quanta of nutrition and ..., won't be on stress danger.

## Keywords:

pervasive computing; agriculture environment; sensor network; fuzzy logic

## 1. Introduction

The technology progress, improves its way whole the world and life. These progresses are affected in the forms of porches, relation with others, mobility from one place to another and other aspect of human life. In fact, human life is improved toward pervasive computing. This kind of calculations make an incredible situation for computers context in which while they are available and usable for people, are concealed and invisible.

For gaining this point, computers must be little in accounting tools shape and put them in walls, buildings and furniture's pervasive computing may be defined as the utilization of all the computers power in physical users area, in which are invisible from users viewer. It will be main point, using computers in human life without necessary to their presentation [1]. Pervasive computing context aware, are kind of this calculations in which are depend on context and automatically able to react and update itself with due to context.

Having information from context will automatically make active system and cause reducing the rate of user's disorder with program and intelligently assist them.

The context can be consisting of any information's in which are usable in order to create characters to a situation/presentation. A presentation can be a person, place or an object in which are depended to relate between user and program in which consist of their owns users and programs. In fact, the pervasive computing on the basis of basic conditions making decision without human's actions. There is needed to sensors and actuator in order to relate system to area. Sensors will be a group of tools in which are able to collect every comprehension from environments conditions and situations. They usually received qualities of environment and convert into digital amounts.

Actuator will be a group of tools in which are able to grant all the users wanted on the environment [2].

In this discourse reviewing the annals of research's struggles in pervasive computing on the context and also historical records of using sensors network in agriculture environments in section 2, we present fuzzy logic concepts in section3, then section4 describes methodology. In section5 we present our results and conclusions.

## 2. The Annals Of Researcher's Activity

### 2.1 Researchers Activity in Pervasive Computing Based on Context

Sensors, in fact are a part of pervasive computing system based on context, in which will use them in this system in order to collect data and we are able to use this kind of calculations in different ways.

In Aware-home project, researchers create an extraordinary home in which understand residents movements and assist them [3], Coal Town project, connected to... company, image a city in the future in which all the people, places, object, furniture, will introduce as the number one citizens of wireless and wire of global communications. In this visionary city, all the services and tools calculations will be context aware and available in communication network global [4]. In pervasive health care projects from Denmark Arouse university, general services will have created in or out sides hospital in order to assist patients and make

available all the patients and physicians wanted, automatically and wisely [5], it can be said that, suggestions have been propounded [6] graphic tools have been designed by human and computers cooperation group of Cornell university by using these tools, attaching text notes from one place to another will be feasible and possible [7].

## 2.2 Historical Records of Using Sensor Networks in Agriculture Environments

Firstly, sensors used in military applications but by time passing, their utilization improved. Sensor network are a group of small sensors in which insist and cooperate together in order to collect information's [8]. These kinds of network are powerful and organized and also able to guard soil and etc. sensor networks are used in agriculture environments in order to resources management, pest controls and etc. Zhouho.Zhang could develop wireless sensor for golden house monitoring. In this network sensors are used in order to collect soil, wet, and environment temperature [9]. Aline Baggio has presented a design in order to utilize sensor network for controlling pests and used it for potato yield [10].

## 2.3 Fuzzy Logic

Fuzzy logic is a form of many-valued logic; it deals with reasoning that is an approximate rather than fixed and exact. In contrast with traditional logic theory, where binary sets have two-valued logic: true or false, fuzzy logic variables may have a truth value that ranges in degree between 0 and 1.

Fuzzy logic has been extended to handle the concept of partial truth, where the truth value may range between completely true and completely false [11, 13, 14]. Furthermore, when linguistic variable are used, these degrees may be managed by specific functions.

## 3. THE PROPOSED METHOD

Methods having different information from soil will be one of the most important factors in order to make discussion about changing soil characteristics. But enabling to obtain information about cheap and fast characteristics of soil in one of the greatest limitations in agriculture part. In order to solve this problem, researchers will present a new approach for applying pervasive computing context aware in agriculture environments (PCAE).

The approach for applying pervasive computing context aware in agriculture environments will be an understanding from soil and water conditions in order to grow plant.

In this part, utilizing pervasive computing context aware would be explained. The utilizing pervasive computing context aware in agriculture environment and its model are showed in figure 1 and figure 2 respectively.

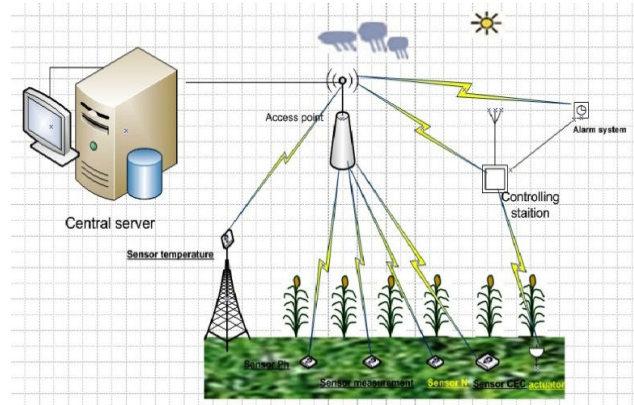


Figure 1 .Views of pervasive computing context aware in agriculture environments

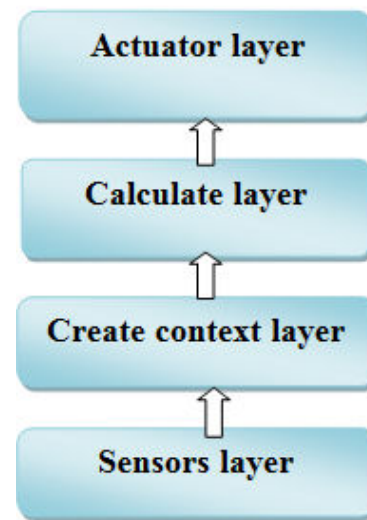


Figure 2. A model from pervasive computing context aware in agriculture environments

Generally, using pervasive computing context aware in agriculture environments has four layers constructions.

### 3.1 The layer of sensors

In this layer, hardware sensors are placed in to layer in order to create context. It can be said that, researchers need lot of information's about soil, water and plant conditions. For that reason, sensors are classified in three groups.

### 3.2 A layer for creating context

A system pervasive computing context aware needs some information's about context in order to change behavior according to information's, in order to make available context in every time. It can be assume that a compilations as the context manager will be presence by sensors.

Context manager will control available situations, time by time and update different context and finally, the present material in environment will provide on intelligent atmosphere and give service more than olden time. This form of communications and calculations will be available in environment in which can be named host. In order to create context, researchers will study and research the kind of plant and climate conditions.

TABLE 1.the static and dynamic conditions of created materials of context

<i>Agent</i>	<i>Soil Tissue</i>	<i>Particulate Air Pollution</i>	<i>Weather Condition</i>	<i>Nutritional substances in the soil</i>	<i>Soil's PH</i>
<i>Condition</i>					
Static	X	...	...	...	...
Dynamic	...	X	X	X	X

### 3.3 The layer of calculations

In this layer, in which resolution subject will be available, all the calculations must be done on context aware. In this section, because of data intricate, researchers utilize fuzzy logic in order to calculate during process. After creating context, presented plan or context aware and laws, in which have been explained, the rate of necessary materials of plants are calculated and sent to actuator layer. In fact, in this layer a fuzzy logic are placed in which will control the rate of necessary materials in external and context aware (figure.3). when context enter in to fuzzy controller , all the conditions will check and select, according to lows and selected lows will calculate the rate of injecting materials in to fuzzy block and send to next layer.

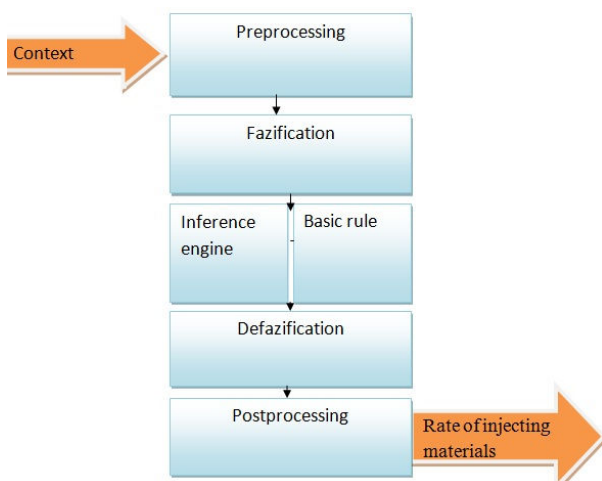


Figure 3 .Fuzzy controller

### 3.4 Actuators layer and alarm system

Actuators layer in which are connected to external environment. In this layer a hardware actuators will be available in which can be use it in order to exert calculations environment. This pare include irrigation systems, spraying systems, injecting chemical fertilizer digital systems. In which will be able to inject nutritive materials in to soil and also on alarm system will find in this layer. Alarm system is used in emergency situations and conditions when plant will be at danger and orders can network harmoniously. When critical conditions threat a plan, alarm system will work and operate.

## 4.Simulation Results

The proposal requires the data to simulate real conditions for growing a particular plant. This data is used to grow corn in a laboratory. Table2 [12] shows the corn-fed conditions under which the parameters are defined by fuzzy logic.

TABLE 2. Elements needed to grow corn

Corn	Nitrogen	PH	Conductivity of Soil	
			Low	> 6
Bad	< 39000	< 9	-----	-----
Good	37000	5.5 – 7	-----	-----
Critical	> 35000	> 4	High	< 10

For corn, the third parameter has been studied in three favorable, unfavorable and critical shown are Figures 4, 5 and 6.

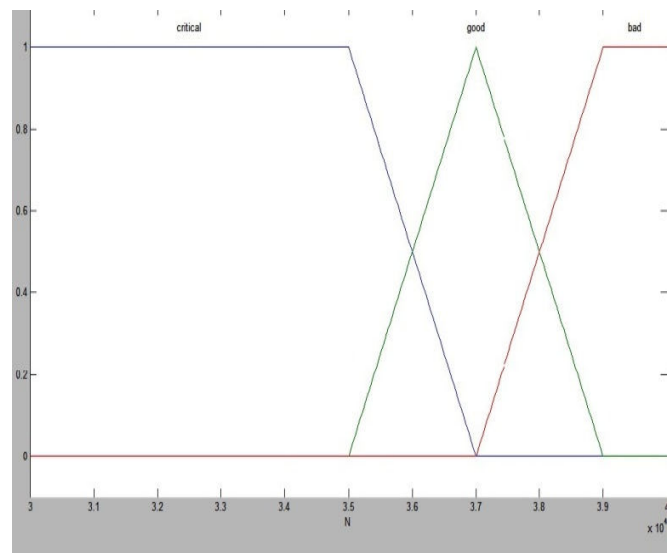


Figure 4 .Membership function of nitrogen's corn

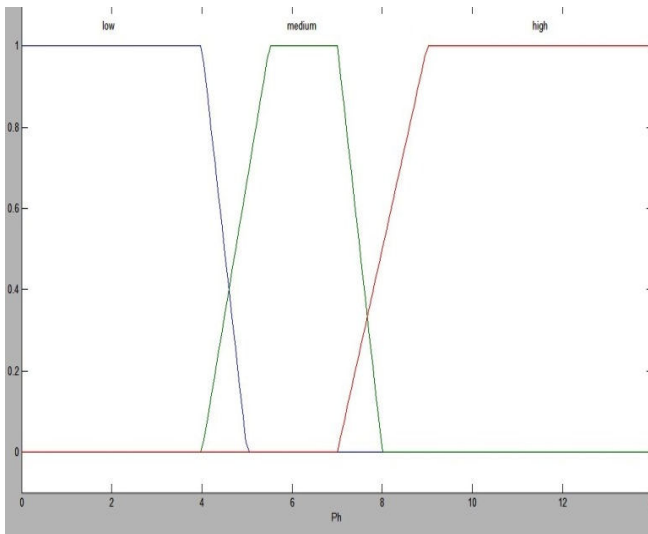


Figure 5. Membership function of PH's grow corn

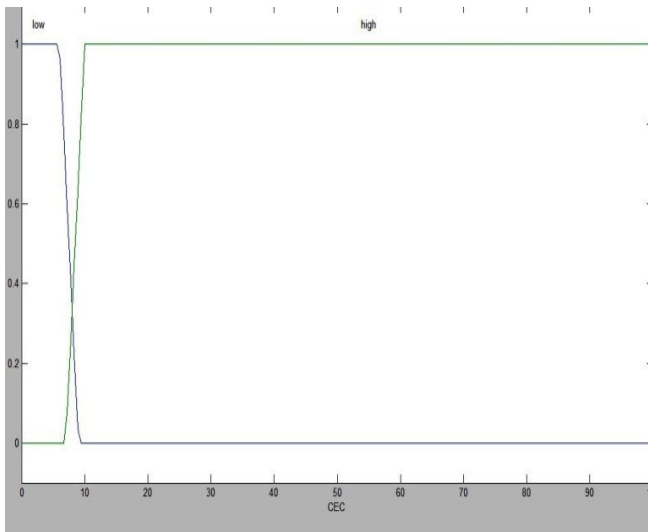


Figure 6. Membership function of conductivity's soil

Fuzzy rules for adjusting the soil nitrogen is presented in Figure 7. In these rules, depending on soil's PH used of three types of fertilizer for regulate the soil nitrogen. If PH is low, the ouse is used, but if PH is medium, the nitrate ammonium is used, and if PH is high, the sulfate-ammonium is used.

The Context-Aware is shown in Figure 8, 9 and 10. As Figure 8 shows membership value for Good Fuzzy set and critical fuzzy set will be 0.25 and 0.75 respectively for input of 35500 ppm. As figure 9 shows membership value for high fuzzy set will be 0.5 for input of 8 and as figure 10 shows membership for low fuzzy set will be 0.66 for input of 7.

1. If (N is critical) and (PH is low) and (CEC is low) then (oure is very high)
2. if (N is critical)and(PH is medium)and(CEC is low) then(nitrate ammonium is very-high)
3. if (N is critical) and(PH is high)and (CEC is low) then(sulfate-ammonium is very high)
- 4.if(N is critical)and(PH is low)and(CEC is high)then(oure is high)
5. if (N is critical) and(PH is medium) and(CEC is high) then(nitrate-ammonium is high)
6. if (N is critical)and(PH is high) and (CEC is high) then (sulfate-ammonium is high)
7. if (N is good) and (PH is low) and(CEC is low) then(oure is high)
8. if (N is good) and (PH is medium) and (CEC is low) then (nitrate-ammonium is high)
9. if (N is good) and (PH is high) and(CEC is low) then (sulfate-ammonium is high)
10. if (N is good) and (PH is low) and (CEC is high) then (oure is medium)
- 11.if (N is good) and (PH is medium) and (CEC is high) then (nitrate-ammonium is medium)
- 12.if (N is good) and(PH is high) and (CEC is high) then (sulfate-ammonium is medium)
13. if (N is bad) and (PH is low) and(CEC is low) then (oure is medium)
14. if (N is bad) and(PH is low) and ( EC is high) then (oure is low)
15. if (N is bad) and (PH is medium) and (CEC is low) then (nitrate-ammonium is medium)
16. if (N is bad) and (PH is medium) and (CEC is high) then (nitrate-ammonium is low)
- 17.if (N is bad) and (PH is high) and (CEC is low) then (sulfate-ammonium is medium)
- 18.if (N is bad) and (PH is high ) and (CEC is high) then (sulfate-ammonium is low)

Figure 7 .Fuzzy rules foradjusting the soil nitrogen

According to these input's the rule three is selected, Regarding the minimum Mamdani's rule, membership degree of sulfate-ammonium will be 0.5 for the very-high fuzzy set (fig.11) and after defuzzification the injection value nitrogen will be achieved.

This computed injection value will be sent to the actuator layer. This sensed procedure is repeated over and over until we reach qualified nitrogen level.

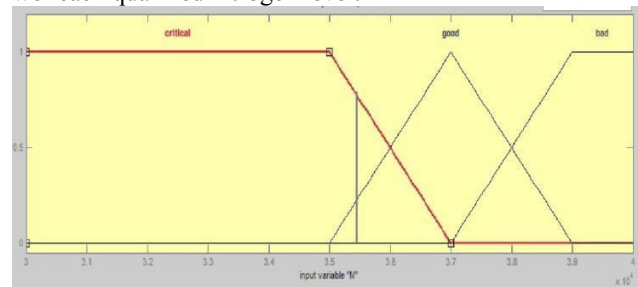


Figure 8 .Input membership function with measured soil's Nitrogen

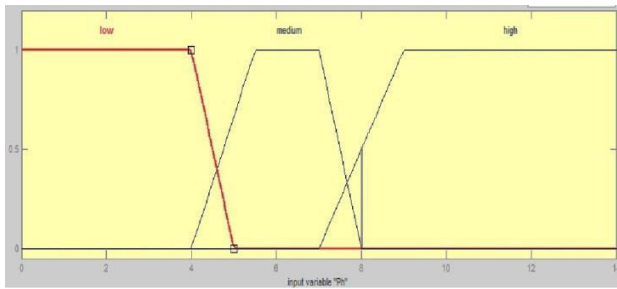


Figure 9. Input membership function with measured soil's PH

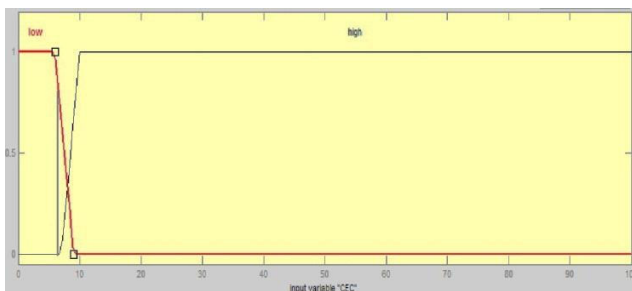


Figure 10 .Input membership function with measured soil's conductivity

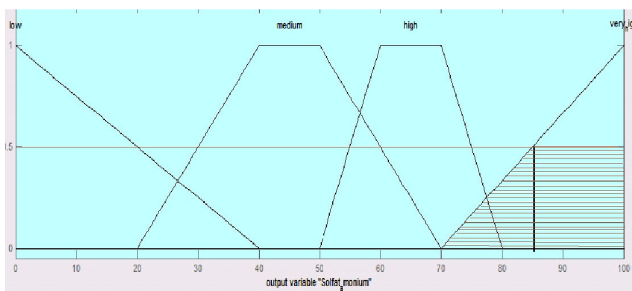


Figure 11. Implied fuzzy set with membership function for rule (3)

## Result

In this research a new approach has been presented in order to apply pervasive computing context aware in agriculture environments. In this approach sensors are used in order collect data about soil, water, plant and climate conditions and send to layer of creating context and after that send to layer of calculation, then, the rate of injecting materials in to soil are calculated by fuzzy logic and context aware. After that are exerted on environment by actuators in the last projects, researchers have utilized sensors in agriculture environment but in primary form such as designing Drip irrigation in primary sensor networks form. But in this paper approach, sensors are generally used in order to collect data of environment and all the next decisions will be on the basis of collected data.

## References

- [1] Weiser, M., "The Computer for the 21st Century", Scientific American, 94-104, September 1991.
- [2] Walker, K., kabashi, A., Abdelnour, J., Ngugi, K., Underwood, J., Elmighani, J., and Prodanovic, M., "Interaction design for rural agricultural sensor networks", Internal Environmental Modeling and Software society( iEMSs) , 2008 .
- [3] Lun, W.Y and Lau, F.C.M., "A Context-Aware Decision Engine for Content Adaptation", IEEE Pervasive Computing Vol.1., no.3, pp.41-49., jul-sep-2002.
- [4] Saha, D., Mukherjee, A., "Pervasive Computing: A paradigm for 21st Century".
- [5] Judd, G., Steenkiste, "providing contextual Information to Pervasive Computing Applications", Proc, IEEE International Conference on Pervasive Computing, March 2003.
- [6] Chi, Ed.H., Borriello, G., Hunt,G., Davies,N., "Pervasive Computing in Sports Technologies", IEEE PERVASIVE computing, JULY-SEPTEMBER 2005.
- [7] Burrell, J., Gay, G., "E-Graffiti: Evaluation Real-World use of a Context-Aware system", Integrating with Computers : Special Issue on Universal Usability, 4. 301-312 , 2003.
- [8] Walker, K., kabashi, A., Abdelnour, J., Ngugi, K., Underwood, J., Elmighani, J., and Prodanovic, M., "Interaction design for rural agricultural sensor networks", Internal Environmental Modeling and Software society( iEMSs) , 2008 .
- [9] Zhang, Z., "Investigation of wireless sensor networks for precision agriculture", American Society of Agricultural and Biological Engineers, 2004.
- [10] Baggio, A., "Wireless sensor networks in precision agriculture", In Proc.ACM Workshop Real-Word Wireless Sensor Network, 2005.
- [11] Novak, V., Perfilieva, i., And mocker, j."mathematical principles of fuzzy logic dodrecht", Kluwer academic. ISBN 0-7923-8595-0.
- [12] "Corn starters",available at <http://www.agtest.com/articles> , 2000.
- [13] Fuller, R., Carlsson, C., "Fuzzy multiple criteria decision making", Recent developments, Fuzzy Sets and Systems 78(2) 139-153., 1996.
- [14] Grabisch, M., Fuzzy integral in multicriteria decision making, Fuzzy Sets and System 69(3) 279-289,1995 .