An Improved Fuzzy Method for Ambient Intelligence:A learning environment Perspective

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Abstract

Abstract—Sensing is becoming more and more pervasive. New sensing modalities are enabling the collection of data not previously available. Artificial Intelligence (AI) and cognitive assistance technologies are improving rapidly. Learning systems are making significant progress in utilizing AI and Machine Learning (ML). This confluence of tools is giving rise to the possible to achieve the idea of ambient intelligence. Ambient Intelligence builds on three current technologies: Ubiquitous Computing, Ubiquitous Communication and Intelligent User Interfaces. The key objective of this study is to enable context aware and pervasive interaction education in the technicallyimproved learning environment.

Keywords: —Ambient Intelligence, Fuzzy logic,Learning Assistance, Intelligent Systems.

1. INTRODUCTION

The notion of personalization has been applied to various domains especially when the goal is to enhance a service or a product that closely fits the corresponding requirements of a human user. Personalizing education is perhaps the goal of every educator to ensure that each learner experiences a learning scenario that perfectly fits the background, academic needs and interests of the same learner [2]. With the advent of computer and communication technology, students in distance learningvand online learning programs can receive learning materials online, join televised lectures attend videoconference classes that link students and instructors from numerous geographic locations and participate in chat room discussions [9].

Ambient Intelligence (AmI) is about sensitive, adaptive electronic environments that respond to the actions of persons and objects and cater for their needs. This approach includes the entire environment–including each single physical object–and associates it with human interaction. [6], [11]

Ambient intelligence is influenced by usercentered design where the user is placed in the center of the design activity and asked to give feedback through specific user evaluations and tests to improve the design or even co-create the design together with the designer(participatory design) or with other users (end-user development). In order for AmI to become a reality a number of technologies are required:

1. Unobtrusive hardware (Miniaturization, Nanotechnology, smart devices, sensors etc.)

2. Seamless mobile/fixed communication and computing infrastructure (interoperability, wired and wireless networks, service-oriented
3. architecture, semantic web etc.)

4. Dynamic and massively distributed device networks, which are easy to control and program (e.g. service discovery, auto-configuration, end-user programmable devices and systems etc.)
5. Human-centric computer interfaces (intelligent agents, multimodal interaction, context awareness etc.)
6. Dependable and secure systems and devices (self-testing and self-repairing software, privacy ensuring technology etc.)

2. LITERATURE SURVEY

Ambient Intelligence (AmI) technologies in the context of classroom education, and presents the methodology and preliminary results of the development of an augmented school desk which integrates various AmI educational applications. The overall objective is to assess how AmI technologies can contribute to support common learning activities and enhance the learner’s experience in the classroom. Young learners were involved from the first phases of the design of the desk and its applications using scenario-based techniques [1].

Ambient Intelligence builds on three recent technologies: Ubiquitous Computing, Ubiquitous Communication and Intelligent User Interfaces. Ambient Intelligence is characterized by systems and technologies that are: Embedded: many networked devices are integrated into the environment. Adaptive: these devices can recognize you and your situational context. Personalized: they can be tailored to your needs. Context Aware: they can change in response to you. Anticipatory: they can anticipate your desires without conscious mediation. The introduction of AmI in a home environment will have an impact on personal lives in several ways. The time gained will allow people to spend more time with their family and friends. Convenience, money, time savings, security, safety and entertainment reduce the stress leading to an overall higher quality of life [4].

Ambient intelligence is an emerging discipline that brings intelligence to oureveryday environments and makes those environments sensitive to us. AmI researchbuilds upon advances in

- Sensors and sensor networks
- Pervasive computing
- Artificial intelligence

The basic idea behind AmI is that by enriching an environment with technology(e.g., sensors and devices interconnected through a network), a system can be builtsuch that acts as an "electronic butler", which senses features of the users and theirenvironment, then reasons about the accumulated data, and finally selects actions to
take that will benefit the users in the environment. [7]
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3. PROPOSED MODEL

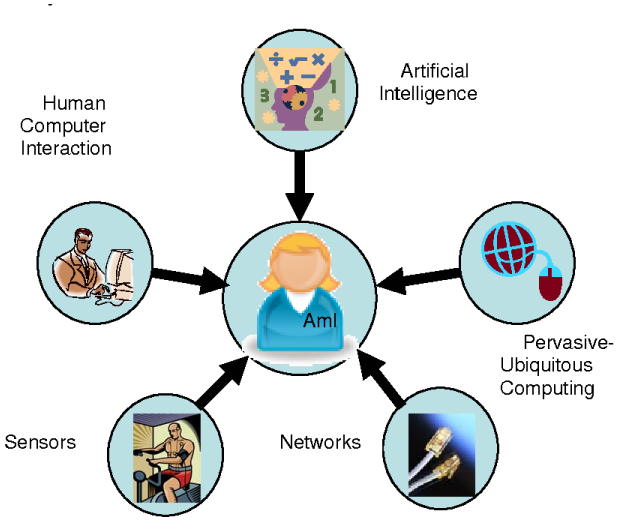

Fig. 1 Proposed model for Ambient Intelligence in learning perspective

Methodology:

In Learning environment, the students are monitored by the screen using eye tracking, conversation and smile. These techniques ensure whether the students are listening the class or passing notes, tapping out texts or even sneaking in quick conversations. The students and teachers inside the campus are mapped and tracked with global positioning system in case during the absence of student, the IM(Instant Messaging) and collaboration tools are used to communicate with them online.

Fuzzy Logic:

The fuzzy logic is the most suitable tool to deal with vague knowledge and the process ofdecision making in the educational system. It can deals with the kind of uncertainty that isinherently human in nature [Yen &Langari, 1999]. Decision making is not always a matter of trueand false or black and white, it often involves gray areas. Fuzzy logic can be used in dealing withlearner knowledge and instructor experience. It is an effective and accurate way to describe humanperceptions of decision making problems[12]. In online learning systems,the fuzzy set theory concepts can be used for solving problems related to the:

- Modeling of the learner.
- Modeling of the instructor experience.
- Identification of the learner knowledge level during each educational unit.
- Modeling of real world environments.
- Algorithms for on-line 3-D graphic generation.
- Algorithms for creating virtual environments.
- Real-time control of the changing virtual reality.
- Decision making for learning path selection.
- Overall evaluation of the learner.

In fuzzy sets, a linguistic variable takes on words or sentences as values. For example, let thevariable $\boldsymbol{x}$ be the linguist variable “learner average result”, then the following term{Excellent, Very Good, Good, Pass, Fail, Unsatisfied} can be constructed as shown in Fig.(2). Each term in the set is a fuzzy variable. Now, if $\boldsymbol{x}$ in an element of a fuzzy set, then theassociated grade of x with it’s fuzzy set is described by a membership function$\mu(x)$, whichtakes values between zero and one.

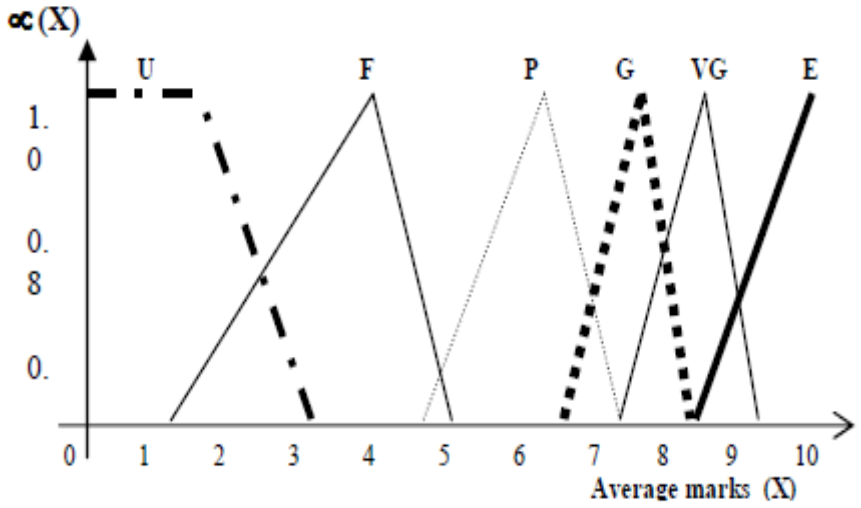

Fig. 2 The fuzzy notation of the variable 'test result'.

Rule-based Decision Making:

The knowledge related to the decision making process can be represented by a set of rules. Ingeneral, a rule is an implication statement expressing the learning level, test result andlearning path in the next educational unit. For example, the rule;

IF CLB AND TVG THEN NLA

This means that if the current learning path (CL) is path (B) and the test (T) is very good(VG) then the next learning path (NL) is path (A). In this system, a set of 18 fuzzy rules, thatcombine the current learning path and test result are used, as given in table 1.

4. EXPERIMENTAL RESULTS

	CLA	CLB	CLC
TE	NLA	NLA	NLB
TVG	NLA	NLA	NLB
TG	NLA	NLB	NLC
TP	NLB	NLC	NLC
TF	NLB*	NLC*	NLC*
TU	NLC*	NLC*	OUT

Table 1: Rules for fuzzy decision making.

Learner Number	Current Learning Level	Educational Unit Test	Total Contact Time (min)	Next Learning Level
1	A	Pass	210	B
2	A	Good	255	A
3	A	Good	240	A
4	B	Good	405	B
5	B	Good	390	B
6	B	Pass	375	C
7	B	V.Good	425	A
8	C	Good	455	C
9	C	VGood	520	B
10	C	Excellent	590	B

Table 2 : Learners Records.

```
function testBehaviorWhenStudentDistracted() {
  $executor.trigger($camera1, "DetectUserStatus",
                    ["George", "Distracted"],
                    //Artifact promises passed as argument (array).
                    [$deskOfTeacher, $context]).then(function() {

    $tester.test("Camera detects George is distracted.", function() {
      $teacherNotifications = $deskOfTeacher.getNotifications();
      $tester.expect($teacherNotifications).toContain("George is distracted.");
    }).run();

    //Definition of SLE's reaction to student's distraction
    $executor.invoke($deskOfTeacher, "StartGame",
                     [$deskOfGeorge,  "TheSubtractionGame", "Easy"],
                     [$deskOfGeorge,  $context]).then(function() {

      $tester.test("Starting game for George:", function() {
        $gamesOnDeskOfGeorge = $deskOfGeorge.getGamesRunning();
        $tester.expect($gamesOnDeskOfGeorge.getKeys()).toContain("TheSubtractionGame");
      }).run();
    });
  // Expect for the tests to be executed properly within 5000 ms.
  }, 5000).onAnyFailure(function() {
    $tester.fail("Test failed! Could not start game to address George's distraction.");
  });
};
```

In order to verify the performance of the proposed improved and enhanced fuzzy-based decision making module, the learning system has been implemented and tested.

5. CONCLUSION

The improved and enhanced fuzzy decision making of the proposed learning system has been implemented and tested to demonstrate its effectiveness. Pupils and graduates through a form have evaluated the system. The result shows that such a system is effective for both pupils and graduates for continuous learning. On the other hand, learners must be disciplined and well organized, and must have effective time scheduling.

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