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A NOVEL INTELLIGENT MODEL FOR LEARNING SYSTEM EFFECTIVENESS MONITORING AND DEFICIENCY PREVENTION

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ABSTRACT

Learner's presence is an important factor to measure the effectiveness of an educational system. Information and Communication Technologies use in learning influenced it positively during the last decades. Wireless Sensor Networks, WSN, is one of the successful and rapidly growing technologies with many advantages to be used in several fields. However we noticed that it is still neglected in the current educational models. Consequently, we suggest a novel intelligent and autonomous model for student's attendance real time monitoring through the use of a WSN. The proposed model allow tracking student's attendance without the use of any human intervention based monitoring systems (RFID systems for example). Also it allows to make decisions about the effectiveness of the educational system. In the first section, we discuss the importance of tracking student's attendance. In the second section, we propose the works that are related to our subject. Finally, in the third and fourth sections we expose, respectively, the architecture and the evaluating simulation of the suggested model.

Keywords- *E-Learning, WSN, Learner's Presence, Monitoring, Identification.*

I. INTRODUCTION

As stated in [6], one of the main factors that have a major impact on the learning quality is student's attendance. This factor can answer many questions about the quality of what is taught and to measure the satisfaction of the different learning system users. Also, it allows making conclusions about the scheduling of the classes and to react properly towards witnessed anomalies. However, having this information accurately is not easy and many solutions were suggested in order to automate this task, but there is always a lack of accuracy, difficulty of implementation or high time consumption as stated in [9].

In this paper, we suggest an approach to solve the problem of student's attendance tracking and improve its management by focusing on two main purposes that are attendance monitoring and forecasting. The suggested model is based on the use of WSN technology and decisional model tools for student's presence real time monitoring. It should be added that our proposed model, can be applied for both distance learning system (e-learning) as well as the conventional system.

II. Learners' attendance tracking

Learner's attendance tracking in learning environments takes place usually through the instructor that counts and validates the identity of present students during each class. This task is considered to be time consuming as stated in [9] especially when the number of students grows.

From another level, and as stated in [4] and [6] it was proved that student's attendance impacts positively their performance. Consequently, knowing the number of attending students have a main importance in studying the efficiency of the adopted learning policies. In addition to that, the ability of learner's attendance, and calculating the resulting percentage of learners inside classrooms have the following advantages:

- Managing wisely the availability of classrooms and learning tools.
- Having a real time overview over the actual attendance in the different classes and reacting to anomalies when observed.

- Having an accurate feed-back about every class for the evaluation of the quality of the adopted policy, measuring it impact on teacher's satisfaction, diagnosing problems and even forecasting the future trend of student's attendance.

III. RELATED WORKS

The work in [11] suggested the use of facial detection for the validation of student's presence in classes and connecting it to a Learning Management Tool. Fingerprint verification technique was proposed in [10] to register students. Even that those suggested solutions have an innovative aspect, but they lack the automaticity needed to not disturbing classes because facial recognition and finger prints based systems need to be under the supervision of the instructor. To overcome this problem, the work in [7] suggests taking advantage from the rapid growth use of smart-phones among students. It is a QR code based system that allows students to register their presence for every class with time and geolocation information. This work provides a new approach for solving the problem, however we see that the responsibility and attention was taken from the instructors to students in order to prove their presence and identity. Moreover, this method disturbs also the class, especially after the entrance of every new student.

Last of all, we discuss the work that took advantage of the use of Radio-frequency identification (RFID) systems that are widely used nowadays. The work in [9] suggests the use of RFID tags and RFID readers to allow students to register their presence for classes. This approach is very interesting and cost effective, however the use of cards that are equipped with RFID tags proved it inefficiency in multiple fields especially with false identity fraud or in case of damaged or stolen cards. Those challenges were not taking in consideration by the suggested solutions what leaves the problem of tracking student's attendance open for more efforts to be made.

IV. SUGGESTED SOLUTIONS

A) Wireless Sensor Network opportunities

Due to its capacity in presenting accurate information in real time about the physical world (temperature, humidity, pressure, motion…) Wireless Sensor Networks, made many tasks easier and attracted the attention in industry, health care, transportation, military and other fields. Those networks composed of tiny devices that collaborate wirelessly with each other in a form of an ad-hoc network, provide solutions that suit with today's trends for Internet of Things applications, future smart houses and much more potential applications.
In education we witnessed a lack of attention to this technology although it can resolve many problems. As a result to that we adopt it as the backbone of our proposed model. Consequently, we envision classrooms, after the integration of WSN, to take the following form:

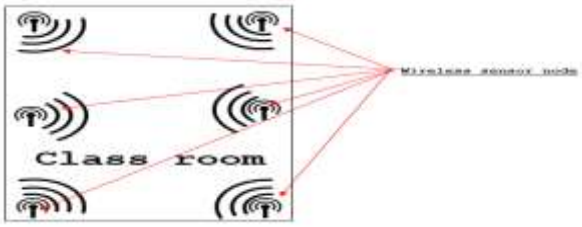

Figure 1.Wireless Sensor Network deployed in a class room

B) Suggested model architecture:

In order to have a live feed of information about attending students, we envision the deployment of presence detection sensors that widely exist in the market as stated in [5], [8], [12] and [13].These sensors are connected directly to a remote processing system. This system have access to the data base to which those sensors are connected. This system can be represented by the following figure:

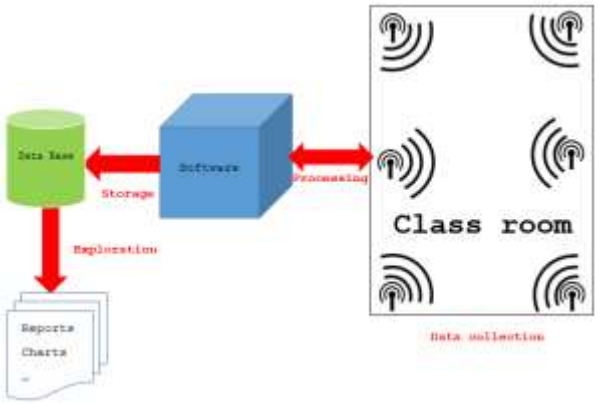

Figure2. WSN system for students attendance tracking and control

In this architecture we notice the existence of multiple actors that communicate between each other in order to prepare information for decision making:

- **Presence detection sensor:** They collect, in real time, information about the attending students inside the class room and after it processing by an intelligent software, the output will be sent by the software to be stored directly in a data base.
- **Intelligent system:** A software that takes the responsibility of communicating with the sensors, collecting data, processing it and storing it to a data base.
- **Database:** In order to use the collected data from any other system, whether it is a web, mobile or desktop application, we envision to store this data into a database for future data analysis and decision making.
- **Data exploration:** It can be in many forms such as the creation of reports, decision making or the different types of the potential applications that consumes the data.

V. Simulation and evaluation

In order to validate the suggested approach, we simulated the measured total number of present students in a class of 25 and analyzed the data in the scope of predicting the attendance for the next day. By applying the same approach, and adding more parameters data can be forecasted for any future period in condition to have enough data. The simulated data for 30 days are as follows:

Table 1. Student's attendance percentage

Day	Attendance percentage
Day 1	80%
Day 2	84%
Day 3	92%
Day 4	100%
Day 5	88%
Day 6	100%
Day 7	88%
Day 9	76%
Day 10	60%
Day 11	84%

Day 12	100%
Day 13	76%
Day 14	88%
Day 15	100%
Day 16	100%
Day 17	100%
Day 18	84%
Day 19	88%
Day 20	72%
Day 21	68%
Day 22	76%
Day 23	80%
Day 24	100%
Day 25	100%
Day 26	96%
Day 27	100%
Day 28	92%
Day 29	100%
Day 30	84%

The data take the form of a time series, where for each period of time t, there is an entry e as stated in [1]. Based on the different needs for decision making and using the work in [2] Time Series Analysis techniques can be used for data mining to extract inference. In our case, we study the prediction of student's presence in class rooms based on the collected data and we adopt the use of Exponential Smoothing algorithm in order to calculate the data for next days. This algorithm was chosen due to its efficiency, wide use its low implementation complexity and self-correctness with the increase of the available data.

As can be deduced from the work [3], Exponential Smoothing assume that the future value is the same as the forecast made for the present period plus a percentage of the forecasting error made in the past period, what can be summarized by the following formula:

$$F_{t+1}=F_t+\alpha\,(D_t-F_t)$$

Where:

α: is the smoothing factor, and $0 < \alpha < 1$

F_{t+1}: is the forecasted value.

D_T : the real value

F_t : the previously forecasted value

Noting that for t=1; $F_1=D_1$.

The smoothing factor α can be determined whether through the use of mathematical models or it can be found after trying many values between 0 and 1 and choosing the value that gives accurate results. In our case, we chosen the value 0.4 for this factor.
By applying the algorithm on the previous data we obtain the result bellow.

Table 2. The forecasted attendance percentage data

Day	Attendance	Forecasted data
Day 1	80%	
Day 2	84%	80%
Day 3	92%	82%
Day 4	100%	86%
Day 5	88%	91%
Day 6	100%	90%
Day 7	88%	94%
Day 9	76%	92%
Day 10	60%	85%
Day 11	84%	75%
Day 12	100%	79%
Day 13	76%	87%
Day 14	88%	83%
Day 15	100%	85%
Day 16	100%	91%
Day 17	100%	95%
Day 18	84%	97%
Day 19	88%	92%
Day 20	72%	90%
Day 21	68%	83%
Day 22	76%	77%
Day 23	80%	77%
Day 24	100%	78%
Day 25	100%	87%
Day 26	96%	92%
Day 27	100%	94%
Day 28	92%	96%
Day 29	100%	95%
Day 30	84%	97%
Next Day		92%

This data can be summarized in figure 3.

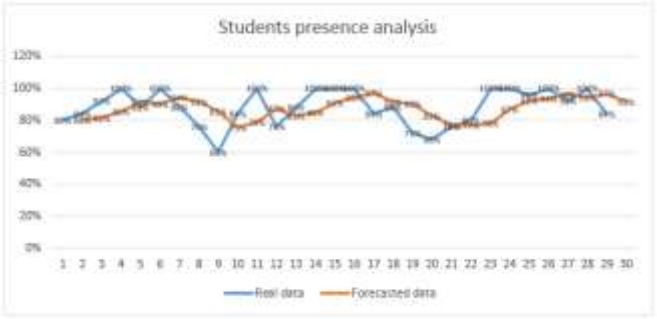

Figure 3: Real and forecasted student's attendance chart

As it can be concluded, the forecasted value for student's attendance percentage for the next day is 92%. This information can be used for decision making about the class room to allocate, the number of copies to make for the students, to intervene when a major drop in attendance is noticed and many other potential applications.

To summarize, the exploration of data through the use of a forecasting algorithm prove the benefits that the use of the suggested model can bring to education, especially to student's attendance monitoring and control. Additionally, it opens the door for many potential applications that can improve the whole process of education.

VI. CONCLUSION

Student's attendance is an important indicator to measure the efficiency of a learning strategy. Due to this importance, we proposed in this paper an original and novel approach to monitor learner's attendance percentage using Wireless Sensor Networks technology. This approach allow to monitor in real time, the attendance of students and make data available for future processing in order to evaluate the taught courses, to find the optimal time scheduling, to manage intelligently resources and also to predict future trends in student's attendance.

In addition to the case study presented in this paper, many potential applications can be obtained from this work and encourages conducting research at the level of merging the progressions of technology with education to go far beyond e-learning. However, it is only the beginning of automating time and efforts consuming tasks of today learning and the question remains about the optimal use of technology to improve the quality, comfort and performance of learners during an educational process.

REFERENCES

1. *E. Akin, I. Aydin and M. Karakose, "The Prediction Algorithm Based on Fuzzy Logic Using Time Series Data Mining Method", World Academy of Science, Engineering and Technology 51, pp 91-98, 2009.*
2. *P. J. Brockwell and R. A. Davis, "Time series: theory and methods". Springer, 2009.*
3. *R. G. Brown and R. F. Meyer, "The fundamental theorem of exponential smoothing", Operations Research, 9(5), pp 673-685, 1961.*
4. *M. A. Gottfried, "Evaluating the relationship between student Attendance and achievement in urban elementary and middle schools an instrumental variables approach". American Educational Research Journal, 47(2), pp 434-465, 2010.*
5. *K. Hashimoto, K. Morinaka, N. Yoshiike, C. Kawaguchi, and S. Matsueda. "People Count System using Multi-Sensing Application", In Proceedings of International Conference on Solid State Sensors and Actuators. TRANSDUCERS, pp 1291 –1294, volume 2, 1997.*
6. *J. H. Kirsten, C.J.S. Carrington, D.Lawrence and S.R. Zubrick, "Student Attendance and Educational Outcomes: Every Day Counts". A report prepared for the Department of Education, Employment and Workplace Relations. Telethon Institute for Child Health Research, Centre for Child Health Research, University of Western Australia, 2013.*

7. *F. Masalha, and N. Hirzallah, "A Students Attendance System Using QR Code", International Journal of Advanced Computer Science and Applications,Vol. 5, No. 3,pp 75-79, 2014.*
8. *T Murakita, T. Ikeda and H. Ishiguro, "Human tracking using floor sensors based on the Markov chain Monte Carlo method", In Proceedings of the 17th International Conference on Pattern Recognition, pp. 917–920, 2004.*
9. *S. Nainan, R. Parekh and T. Shah, "RFID Technology Based Attendance Management System", IJCSI International Journal of Computer Science Issues, Vol. 10, Issue 1, No 1, pp. 516-521, 2013*
10. *C. Saraswa, and A Kumar, "An efficient automatic attendance system using fingerprint verification technique". International Journal on Computer Science and Engineering, 2(02), pp. 264-269, 2010.*
11. *V. Shehu and A. Dika, "Using real time computer vision algorithms in automatic attendance management systems", 32nd International Conference on Information Technology Interfaces, IEEE, pp. 397-402, 2010.*
12. *T. Teixeira, and A. Savvides, "Lightweight People Counting and Localizing for Easily Deployable Indoors WSNs", IEEE Journal Of Selected Topics In Signal Processing, VOL. 2, NO. 4, pp.493-502. 2008.*
13. *P. Zappi, E. Farella, and L. Benini, "Enhancing the Spatial Resolution of Presence Detection in a PIR based Wireless Surveillance Network". In Proceedings of IEEE Conference on Advanced Video and Signal Based Surveillance, AVSS, pp. 295 –300, 2007.*