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An Enhanced Context Aware Monitoring for Smart Learning using Internet of Things (IoT)

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ABSTRACT
Internet of things plays an important role in all domains like smart Home, smart cities, smart transport etc. It is also a promising field in academic domain also. It is useful for capturing the context of environment in learning environment. It helps the learner for the congenial environment to improve the learning experiences. For enriched knowledge the learner must be capable of listening to the learning in free environment. So there is a need for capturing the context of learning environment. Environment includes factors like Temperature, Humidity and Sound etc. These factors play a major role in learning environment for the learners for their improved learning. Learning at ease in a preferred environment will help learners for retention of learning content for a longer time.This work is proposed to monitor environmental parameters in learning context. This is achieved by providing an IoT solution with simple implementation using Arduino Uno software and ESP8266 hardware.

Key words: Internet of Things (IoT), DHT11, LM35, Sound Sensor, Arduino Uno, ESP8266, Thing Speak Cloud Platform.

I INTRODUCTION

Internet of things authorize things to be analyzed and controlled from anywhere through web by integrating the real worldwith digital world. Today Internet of things is demanded by everyone for their day to day living. So academic domain is also no exception to promote Integration of Internet of Things (IoT) technology with the learning environment. Today environment is very essential for student learning and retention of learning content. Learning and acquiring knowledge is difficult when the requisite learning environment context is not available. If it is high or low it prevents their learning and concentration. Context of environment is low or high affect the learner ability to learn. Decrease in memory ability, lack of energy, losing concentration and focus on the subject are the impact of environmental context. Context of environment is high or low students feel discomfort and distract from learning. This paper focus on capturing the learning environment context and is monitored using the affordable Arduino Uno software and ESP8266 hardware. This work is carried out with the existing efficient hardware and dynamic software.

2. Literature Survey

Hanna Ryan in [1] studied that an inadequate temperature levels can decrease students' competency in learning. Marian Cata in [2] Portrays a solution for monitoring temperature and humidity in the classroom environment using Google drive for data storage and chart presentation on a web site. Classroom environment is a vital major factor to improve student learning ability [3]. This study monitor the classroom environment to estimate the utilization of energy [4]. This work did not focus on the optimum environmental values that are conducive to the place of study [5]. In earlier work classroom monitoring system temperature and light level is measured for identifying the comfort of the students learning [6]. In addition this work also uses more number of sensors to perform their tasks. But proposed work measure the temperature, humidity and sound level in the learning space.

The proposed work measures the date wise and time wise sensor values. The live and average sensor data is uploaded to the web page for viewing the values from anywhere.

The cost of proposed work is feasible for any human at affordable price. But cost of installing temperature in all the tables in a classroom is costly depends upon number of tables. In that way this work is also suitable in home environment and for any other place. Cost of installing a single temperature sensor is cheap (approximately Rs. 150) compared to cost of installing sensor for all the tables in a classroom is costly depends on number of sensors installed in a room.

The energy consumption for carrying out the proposed work will be less because it operates between 0 to 5 volt. But for the existing work energy consumption will be more. Since power consumption for installing more sensors require more consumption. Thus proposed work is energy efficient.

To Estimate the relationship between the environmental parameters and students' experiences using crowd sourcing [7]. 4-tier model architecture is proposed to monitor noise and air pollution monitoring [8]. This [9] work proposed a power saving system to monitor fan and lighting in the

classroom for optimum performance. Design a wireless sensor network monitoring system using web server [10]. Environmental monitoring application using multi hop wireless network to collect sensor data and webrick server is used to display results [11]. Intelligent environment monitoring system was proposed to Secured laboratory [12]. RFID based indoor localization system is proposed to monitor location of a teacher in the classroom and it impact on student performance [13]. Innovation in the field of technology get context information to monitor the state of the environment [14]. TCP/IP network transfer environmental data to LCD display and monitor the biological influence [15].

Table 1: Related works done on the Environment Monitoring using IoT

Existing Approaches	**Temp.**	**Humidity**	**Sound**	**Purpose**
A system for Classroom environment Monitoring Using the Internet of Things and Cloud Computing [6]	✓	X	X	Compare data suitable for studying
IoT based environmental weather monitoring and farm information tracking system [16]	✓	✓	X	Weather Forecasting for Agriculture System
An Intelligent Internet of Things (IoT) Sensor System for Building Environmental Monitoring [17]	✓	✓	X	Count occupant for energy-efficient buildings
IoT Based Environmental Monitoring System using Arduino UNO and Thingspeak [18]	✓	✓	X	Measure Water level in Environment
An inexpensive environmental monitoring system with IoT agents [19]	✓	X	X	Monitor Dust level in air
Design of an IoT based Real Time Environment Monitoring System using Legacy Sensors [20]	✓	✓	X	Environment Monitoring for healthy environment

The symbol '✓' in the table applies that specified feature to the specified system, and 'x' is otherwise. From the table, there is no systems that achieve all these features. The proposed system aims to meet all the features.

3. SYSTEM ARCHITECTURE FOR PROPOSED SYSTEM

Environmental factors like Temperature, Humidity and Sound context are captured through sensors. ADC is used for converting Analog to Digital converter. These pins are used for input only and all these digital pins produce 0v or 5v only. Figure-1 . Below shows the block diagram for capturing learner context through sensors and is controlled and monitored based on environment and results are sent to Google cloud and results are shown in LCD display screen. Power supply device convert AC input in to required voltage for the electronic gadgets. Based on the requirement of operation of required Power supply can be converted as to linear or switching mode. UART is a hardware built in to the microcontroller used for serial communication for receiving and transmitting the data.

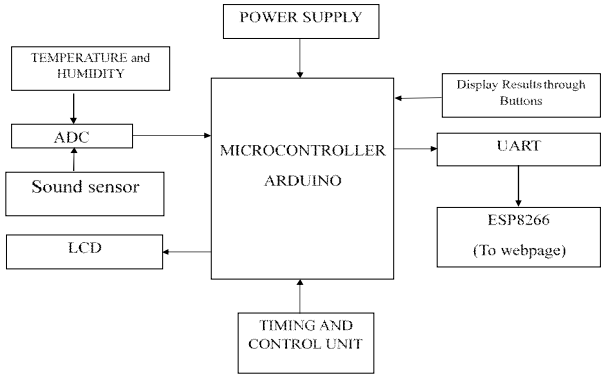

Figure 1: Block diagram

Microcontroller board used here is Arduino Uno shown in Figure- 2 below which consists of 14 digital input/output pins. Out of these 6 of them can be used for Pulse Width Modulation (PWM) is used to obtain the analog results through digital outputs. 6 pins are used for analog inputs.

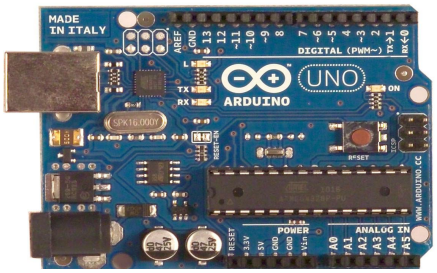

Figure 1: Arduino UNO

Table 1 : Arduino Configuration

Microcontroller	ATmega328P
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limit)	6-20V
Digital I/O Pins	14 (6 of them provide PWM output)
(Pulse Width Modulation)PWM Digital I/O Pins	6
Analog Input Pins	6
DC Current per I/O Pin	20 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328P) of which 0.5 KB used by bootloader
SRAM	2 KB (ATmega328P)
EEPROM	1 KB (ATmega328P)
Clock Speed	16 MHz
Length	68.6 mm
Width	53.4 mm
Weight	25 g

Table 1 above shows the Arduino Board configuration.

UART (Universal Asynchronous Receiver/Transmitter) is a chip used to receive and transmit data. It is an intermediary between parallel and serial interface to perform serial communications. It exchange data with serial devices. UART on the one end contains eight data lines and on the other end contain two serial wires RX and TX to receive and transmit data through serial communications. Sensor value received from sensors are sent to Arduino and the sensor value is displayed in LCD screen and the results received from environment are sent to the Arduino controller and this data is sent through UART to show the results through wi-fi enabled system on chip(SoC) module through webpage using ESP8266.

LCD Display

A 16x2 LCD display screen is an electronic display module used for displaying results. In LCD 16 characters per line are displayed and it consists of 2 such lines. Each character is displayed in 5x7 pixel matrix. LCD contains two registers Command and Data to read and write. LCDs is cost effective, programmable, and no limitation of displaying special characters.

Command register is used to store command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD.

IV Hardware Used:

1. Arduino Uno
2. Temperature sensor
3. Humidity Sensor
4. Sound Sensor
5. ESP8266 (To internet)
6. 16*2 LCD Display
7. USB cable
8. Bread Board

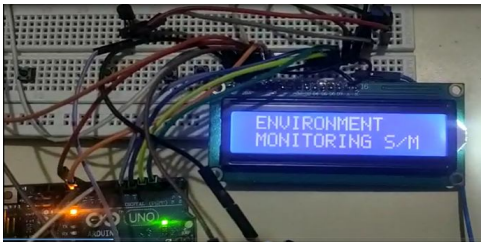

Figure 2: Hardware Setup

Figure 3 above shows the hardware setup for monitoring the learning environment using Temperature, Humidity and Sound sensors.

Table 2: LCD Pin Description

Pin No	Function	Name
1	Ground (0V)	Ground
2	Supply voltage; 5V (4.7V – 5.3V)	Vcc
3	Contrast adjustment using a variable resistor	V_{EE}
4	SelectCommand-low; Data register- high	Register Select
5	High - Read from Register Low - Write to Register;	Read/write
6	Data is sent to data pins when a high to low pulse is given	Enable
7	8-bit data pins	DB0
8		DB1
9		DB2
10		DB3
11		DB4

12		DB5
13		DB6
14		DB7
15	Backlight V_{CC} (5V)	Led+
16	Backlight Ground (0V)	Led-

Table 2 above shows the LCD pin description used in the Learning Environment Monitoring.

Table 3: Parameters Used

Sensor	**Parameter**
Lm35 Sensor	Temperature
DHT11 Sensor	Humidity
Sound Sensor	Sound level

Table 3 describes the sensors, parameters used to monitor the learning environment.

LM35 Temperature Sensor

To measure the temperature LM35 Sensor is used in the learning environment is connected to pin 8 for Temperature of the Arduino Uno module. This sensor display the variation in the Temperature.

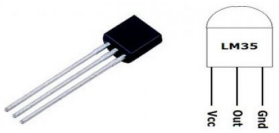

Figure 3: LM35 Temperature Sensor

DHT11 Humidity Sensor

To measure the HumidityDHT11 Sensor is used in the learning environment is connected to pin 9 for Humidity of the Arduino Uno module. This sensor display the variation in the Humidity.

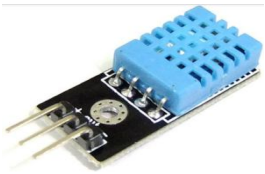

Figure 4 : DHT11 Sensor

Sound Sensor

The sound sensor detects the sound in the environment. The sound pressure level is measured using this sensor. Pressure levels up to 90 dB is measured. Variations as to high or low in sound is measured using this sensor.

Figure 6: Sound Sensor

4. ALGORITHM-1 ENHANCED CONTEST AWARE MONITORING(ECAM)

Import necessary libraries
Attach humidity sensor using pinmode function
Attach sound sensor using pinmode
Include Liquid Crystal header file
Initialize t, h and s variable with zeros
Initialize liquid crystal libraries with values
Setup the pinmode for temperature, humidity and sound as input mode
Invoke the predict() function for looping the input reading for temperature, humidity and sound
Setup the serial communication
Transmit data using baud rate 9600
Print the reading values in lcd screen
Print the values in webpage.
predict()
Import necessary libraries
Initialize temp, hum, sound variables
fetch the values using http get request method
compare the values using if condition
predict the values as low, typical and high based on threshold values
end

Figure 7 below shows the Arduino code for temperature, Humidity and Sound sensors which are uploaded to Think Speak platform using Arduino IDE.

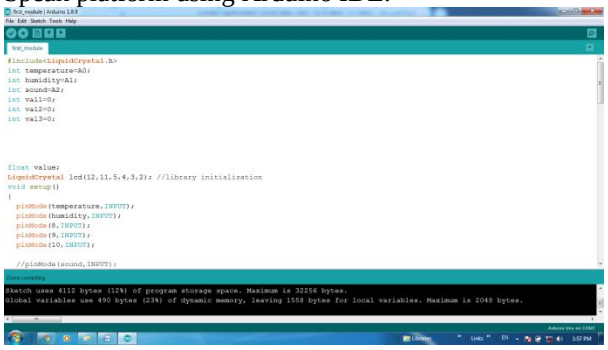

Figure 6 : Arduino code

5. RESULTS

The result are shown in the LCD Display screen. Figure 8 below shows the result in LCD after running the script to capture environment values.

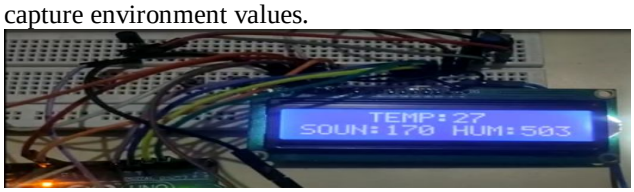

Figure 7 :LCD Display

The goal of learning environment monitoring system is to predict the learning context by capturing the environmental values through sensors.

The data from Temperature, Humidity and Sound sensors are sensed. These sensor values will be sent to the Think speak continuously after establishing suitable connection. Then the uploaded results are visualized.

The values arrived from sensors are analysed based on the values as low, typical and high. When it reaches the threshold values it is calculated as low, typical and high based on the values from sensors. The table 5 below show the comparison for these values.

Table 5 : Comparison of sensor values

Sensor Used	**Low**	**Typical**	**High**
Temperature	<30	>=30 and <35	>=35
Humidity	<30	>=30 and <35	>=35
sound	<30	>=30 and < =35	>35

This work is carried out to capture the learning environment context to monitor learning environment. Here learning environment ambience includes Temperature, Humidity and Sound context.

This is necessary to capture the values from the environment so that the learner can learn in an efficient, pleasant environment for the learner. So the results captured from the environment helps in making the environment comfortable and convenient for the students to stay focused anytime. It is monitored how the learner is learning in the learning space.

Advantages:

This system is user friendly, highly reliable and consumes less power.

6. CONCLUSION

This work helps to capture the learning environment context and predict required learning context. So it provides the learning efficient and successful. It also enhance the learning ability of the learner, improves the concentration of the learner in a healthy environment. In future feedback from students will also be synchronized to make the environment more suitable to all the stake holders in the environment. Smart learning environment monitoring safeguard the learning environment by monitoring the sensors. Observing the sensor values in the real time environment enables the sensors to communicate through the network with other devices. This will be useful for further analysis. This model can be further extended for other domains like industries, healthcare etc. Monitoring learning environment provides an cost effective IoT solution with simple implementation using Arduino Uno software and ESP8266 hardware.

REFERENCES

[1].Hannah, Ryan "**The Effect of Classroom Environment on Student Learning**", Western Michigan University Honors Theses 2013.

[2] Marian cata, **"A cloud solution for monitoring classroom environmental conditions in a smart university"** *Naval Academy Scientific Bulletin*, Volume 18,Issue-2, (2015),pp.209-211.

[3] Medaglia, C.M., Serbanati, A, **An overview of privacy and security issues in the internet of things**, *The Internet of Things*, pp. 389–395. Springer, New York (2010).

[4] W. Rattanongphisat, A. Suwannakom and A. Harfield, "**Indoor weather related to the energy consumption of air conditioned classroom: Monitoring system for energy efficient building plan**", *IOP Conference Series: Earth and Environmental Science*, volume 40, Beijing , 2016.

[5] P. Spachos, J. Lin, H. Bannazadeh and A. Leon-Garcia, "**Indoor air quality monitoring though software defined infrastructures**," *13th IEEE Annual Consumer Communications & Networking Conference (CCNC)*, Las Vegas, NV, 2016, pp. 288-289.

[6] Runathong W.,Wongthai w., Panithansuuuwan S, "**A system for Classroom environment Monitoring Using the Internet of Things and Cloud Computing**", In Kim K. Joukov N. (eds.*), Information Science and Applications ICISA . Lecture Notes in Electrical Engineering,* volume 424 Springer, Singapore, 2017.

[7] Konstantin Simic, Marijana Despotovic-Zrakic, Igor Duric, Aleksandar Milic, Nikola Bogdanovc, "**A Model of Smart Environment For E-Learning Based On Crowd Sourcing"**, *Journal of Universal Excellence*, Appendix, year 4, number 1, 2015,pp. A1–A10.

[8] Bulipe Srinivas Rao , Prof. Dr. K. Srinivasa Rao , Mr. N. Ome, "**Internet of Things (IOT) Based Weather Monitoring system",** *International Journal of Advanced Research in Computer and Communication Engineering*, Volume 5, Issue 9, September 2016,pp. 312-319.

[9] Bhushan K Patil, Ravindra D Badgujar, Nilesh L Nil, Satish N Suryawanshi, Dinesh C Patel, Pratima P Bagul, **Energy Efficient Smart Classroom**, *International Journal for Research in Applied Science & Engineering Technology* (IJRASET) ISSN: Volume 6 Issue VI, 2018 pp. 85-89.

[10] Gauri Sahoo, Pankaja Pawar, Kiran Malvi , Aarti Jaladi, Karishma Khithani, **Environment Monitoring System based on IoT**, *International Journal of Innovative Research in Computer and Communication Engineering*, Volume 5 Issue 1,2017,pp.1083-1091.

[11] N. P. Sastra and D. M. Wiharta, **"Environmental monitoring as an IoT application in building smart campus of Universitas Udayana**," 2016 *International Conference on Smart Green Technology in Electrical and Information System*s (ICSGTEIS), Bali, 2016, pp. 85-88.

[12] L. Zhai and W. Jiang, "**Intelligent Environment Monitoring System for University Laboratories**," *Future Internet*, volume 10 Issue 11,2018,pp. 1-10.
[13] R. Bdiwi, C. de Runz, S. Faiz, and A. A. Cherif, "Smart learning environment: Teacher's role in assessing classroom attention", Research in Learning Technology, volume 27, 2019, pp. 1-14.
[14] Sriyanka, Dr. Siddarama R Patil, **Smart Environmental Monitoring through Internet of Things (IoT) using RaspberryPi 3**, *International Conference on Current Trends in Computer, Electrical, Electronics and Communication (ICCTCEEC)*, Mysore, 2017, pp. 595-600.
[15] Wen-Tsai Sung, Chia-Cheng Hsu**, IOT system environmental monitoring using IPSO weight factor estimation**, *Sensor Review* Volume 33 Issue 3 ,2013, pp. 246–256.
[16] Arun Chakravarthy R, Bhuvaneswari M, Arun M, **IoT based Environmental Weather Monitoring and Farm information Tracking System**, *Journal of critical reviews*,Volume 7, Issue 7, 2020.pp 307-310.
[17] Qian Huang, Kyle Kieffer, "**An Intelligent Internet of Things (IoT) Sensor System for Building Environmental Monitoring"**, *Journal of Mobile Multimedia*, Volume 15 Issue 1 & 2, 2019,pp. 29-50.
[18] Mr. R. Deekshath, Ms. P. Dharanya, Ms. K. R. Dimpil Kabadia, Mr. G. Deepak Dinakaran, Mrs. S. Shanthini, **IoT Based Environmental Monitoring System using Arduino UNO and Thingspeak**, *International Journal of Science Technology & Engineering* Volume 4 Issue 9 2018,pp. 68-75.
[19] Dariusz Czerwinski, Marek Milosz, **An inexpensive environmental monitoring system with IoT agents**, *ITM Web of Conferences*, Volume 15, Poland, 2017,pp.1-6.
[20] Aparajita Das1, Manash Pratim Sarma, Kandarpa Kumar Sarma and Nikos Mastorakis**, Design of an IoT based Real Time Environment Monitoring System using Legacy Sensors**, *MATEC Web of Conferences*, Volume 210, Spain, 2018, pp. 1-4.
[21] Mochammad Haldi, Ranny, Nathasia Florentina Thejowahyon**,** Seto Benson Handoyo**, Smart Mirror Technology on Internet of Things to Enhance Interacive Learning**, *International Journal of Emerging Trends in Engineering Research*, Volume 8, Issue 8, 2020, pp. 4318-4324.
[22] [Khushboo H. Saglani , Dr. Nitin J. Janwe**, Machine Learning Based Sentiment Analysis on Twitter Data**, *International Journal of Emerging Trends in Engineering Research*, Volume 8, Issue 8, 2020, pp. 4414-4419.