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Smart Classrooms with Wireless Sensors and an Intelligent System Design Approach

G. Sathish Kumar[1], R. Benschwartz[2], K. B. Kishore Mohan[3], K. R. Shanthy[4], D. Jennifer[5]

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Abstract: Classrooms need to be advanced these days and that will give an effective learning environment for the students. Therefore in order to change the traditional classrooms to the normal one the intelligent system design is proposed in this paper. This is the method that will give good advanced interaction for the students and teachers in the classroom. The sensors and the machine learning technology are used for the smart experience that too in a short period of time. Initially, the technology can use wireless sensors to observe fluctuations in the classroom's light and temperature while courses are in period, permitting teachers to make the appropriate adjustments on time. Second, it could keep a watchful eye on how learners interact in the education environment process the data collected via machine learning, and immediately inform the teachers of the results. Because of this, the trainer will be able to get back to the students' class status in an effective way. The findings reveal that by employing an intelligent teaching system, administrators can more rapidly govern alterations to the classroom setting, students' behavior in the classroom, and other obstacles to boost the performance of their teaching.

Keywords: *Wireless sensors; Internet of Things; Intelligent System Design; Smart classrooms*

1. Introduction

A classroom is a compact space specialized for education and instruction. It is an extremely significant component of an educational atmosphere that makes it simple for a teacher to convey knowledge to a bunch of students. By integrating technical advancements in various fields of signal processing, web technologies, hardware, and software, an intelligent classroom accelerates this data transfer. The main objectives of a smart classroom's design are to enhance learning and teaching performance, decrease the gap between students and teachers, and give students an improved atmosphere. An engaging whiteboard, projectors, tools for students to interact with the educator and other students, automated assessment and feedback tools, cameras to record and store lectures, and a sensor-enabled intelligent physical atmosphere that governs the temperature, humidity, air quality, and acoustics are all functions of a typical smart classroom setup. A switched-off technology-assisted atmosphere for learning that promotes teaching and learning is termed a smart classroom. A conventional smart classroom is furnished with innovations that enhance interaction, presentation, and the physical environment along with student engagement. Furthermore, it may have functions for an assortment of managerial roles like attendance tracking, appraisal, and rapid feedback. The classification of smart classrooms is indicated in Figure 1. We found four primary facets of the teaching and learning method in the literature:

- Smart content: This implies the manner of producing, disseminating, and offering interactive, rich multimedia content.
- Clever engagement and interaction: This involves
- Student engagement during presentations along with interactions between students and teachers.
- Smart evaluation: This comprises an examination of students learning (quiz etc.) and feedback to the professor (lecture quality).
- Smart physical condition: In addition to smart teaching and learning equipment, an intelligent classroom ought to incorporate a positive physical setting (temperature, humidity, etc.) [1].

[1]*Assistant Professor, Department of ECE,*
P.T.Lee Chengalvaraya Naicker College of Engineering and Technology, Kancheepuram.
Email: sathish14@gmail.com
[2]*Associate Professor,*
Department of Electronics and Communication Engineering,
Mar Ephraem College of Engineering and Technology, Kanyakumari.
Email: rbenschwartz87@gmail.com
ORCID: 0000-0002-2710-2504
[3]*Professor and Head, Department of Biomedical Engineering,*
Sri Shanmugha College of Engineering and Technology, SSCET, Sankari, Salem.
Email: kishorekbmtech@yahoo.co.in
ORCID: 0009-0002-6305-1457
[4]*Associate Professor, Department of ECE,*
Loyola Institute of Technology, Palanchur, Chennai.
Email: jenefa.christ@gmail.com
ORCID: 0000-0002-0681-2881
[5]*Assistant Professor, Department of CSE,*
Panimalar Engineering College, Chennai.
Email: jenniferg.cse@gmail.com
ORCID: 0000-0003-3362-4242

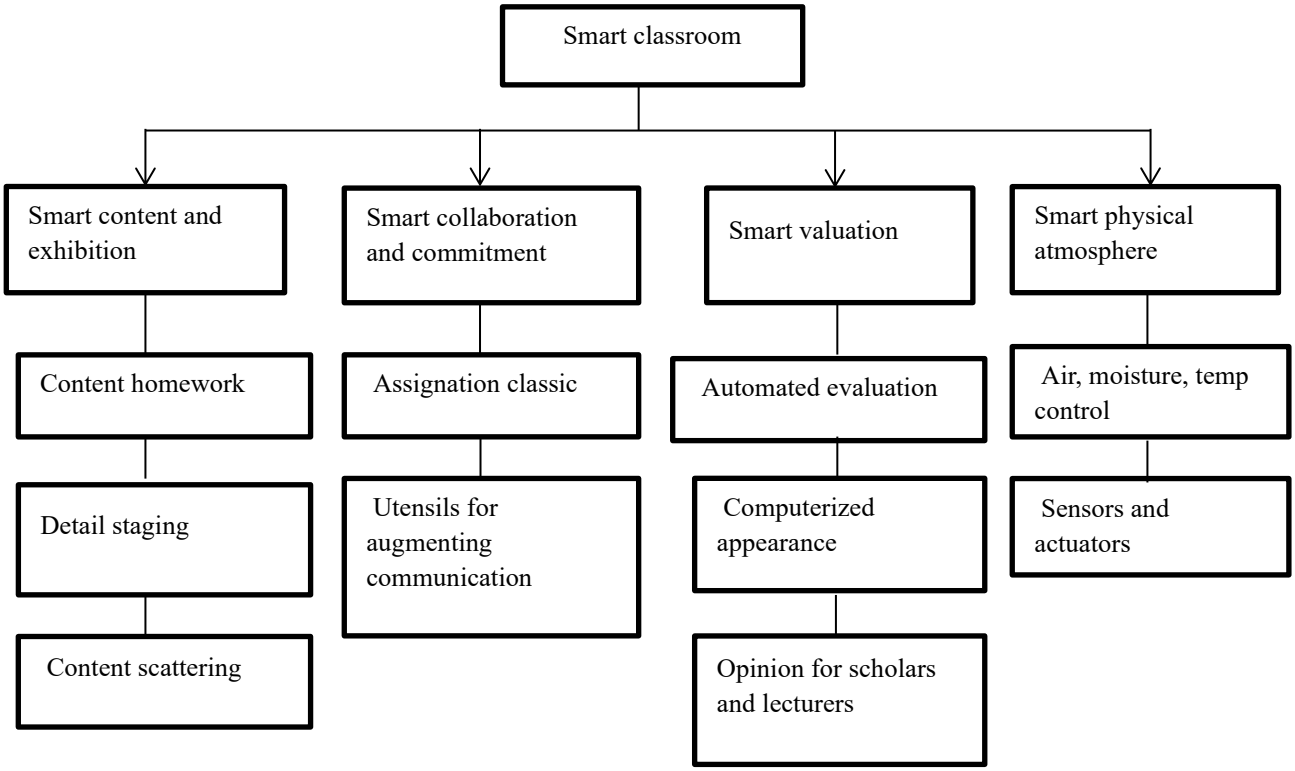

Fig. 1. Study on smart classroom classification

In the structure of intelligent education, learning is described by a combined education with an autonomous learning methodology, alongside intelligent learning support, to generate an unusual intelligent learning paradigm. Developing an adequate intelligent learning environment is the fundamental move in achieving intelligent learning. The main areas of research in intelligent educational settings are how to produce intelligent learning situations that promote different activity modes and how to make full use of the latest version of information technology to promote an understanding of the key characteristics of intelligent learning [2].

Both pupil and instructor participation constitute components of classroom attendance. Alongside revealing students' learning actions may also indicate the efficiency and authenticity of teachers' education in the classroom and provide vital context for trainers. The establishment of an RFID and face recognition-based educational settings attendance monitoring system inside of an IoT framework represents the second part; test and the results analysis of the RFID and face recognition-based educational institutions participation management system is considered the third. The items that follow are contributions made through research and innovation: An RFID-based intelligent educational facility management system can accurately record a student's absence and substitution. Its low cost and swift reaction time are advantages. An automated system to control classroom attendance that employs facial recognition devices can accurately log and identify whenever students come and go from the classroom, and it can also identify episodes of punctuality early leaving inactivity, and alternative classes [3].

IoT combines machine learning and artificial intelligence (AI) to render data collection enjoyable and safe. Children who enjoy better health are also happier and work with greater clarity as a result of the Internet of Things. IoT is a necessity for intelligent gadgets to control smart classes and various other sectors [4].

Below is an explanation of the multiple components that all together compose the paper. In Section 2, the summary of the significant earlier research is presented. This final section investigates the recommendation for intelligent design system that involves the techniques, the fulfillment starting point, graph-based workflow fields, and data analysis. In Section 4, several graphs and examples are employed to examine IDS in smart classes to locate objects in video streaming. Section 5, which includes the conclusion, handles the ultimate issue.

2. Related Works

Abraham et. al [5] HIS application independent versions are constructed up of discrete programming components that have no interaction with other components. The building of stand-alone systems may fulfill multiple purposes. In the beginning, they present a straightforward way to figure out how effectively different strategies resolve problems in connection to a certain application.

Employing multiple approaches in a parallel scenario gives a loose integration approximation. Stand-alone models are often used to develop a first version quickly while a more intricate application is under construction. The convenience and ease of the universe utilizing commercial software packages are just two of the pros. On the flip side, stand-alone techniques never strengthen the flaws of the other techniques and are not easily portable.

Aguilar, J. et. al [6] An intelligent environment for assisting software engineering students in accomplishing assignments is the concept that the AARTIC project hints at. The software improves the student's conceptual understanding. They advise employing two agents: the first monitors what the students accomplish throughout the structure, and the second enables the teacher to evaluate both the class and each student individually. A pervasive classroom was put forward in an alternate paper to aid students with their coursework. It is endowed with the knack to spot actual things in the space around it and then provide decisions based on those results. Students may interact, collaborate, and participate in other student engagements to meet learning objectives. It recommends two ordinary devices for an intelligent learning environment: the iBand, a wearable bracelet-like device holding information about learners, and the Experience Recorder, an embedded system that records a student's activities in a classroom.

Al-Sharhan, S. et. al [7] A smart board is an interactive whiteboard that operates as a computer monitor and enables visitors to interact with the screen utilizing a finger, a special stylus pen, or a keyboard. This component is particularly significant since it allows students to get involved and archives the content in a video or flash format, resulting in the instructor subsequently uploading it to the learning gateway for the students to refer to at a later time. These videos can be employed to develop a thorough online course that promotes e-learning and delivers students a better educational experience. As an actual part of several ideas about learning, notably constructivism, whole-class guidance, and active learning, smart boards are vital for maximizing student engagement. Each of these theories acknowledged that learning necessitates active student participation. It has been revealed that combining smart boards into smart classrooms enhances student engagement.

Gerami, M. et. al [8] Networked devices and electronic devices can be readily connected with standard networks via the Internet of Things (IoT) and associated technologies. Since its beginnings, IoT has assumed a vital part in everything from standard tools to simple household equipment. There is a beautiful vision in which all things can immediately controlled and noticed can identify themselves automatically, can communicate with each other via the internet, and are even suited to making decisions independently. Numerous analysis technologies are being integrated into IoT to make systems smarter; data mining is one of the most important ones in this vein. Discovering fresh, captivating, and significant patterns in enormous collections of data whilst employing algorithms to uncover hidden information remains the two primary goals of data mining. Information analysis techniques are applied in data mining to find significant and formerly undiscovered patterns in massive quantities of data. A smart class's information process tends to generate better results when assessed as an entire entity, but when several connected smart classes with Internet of Things characteristics are investigated as a complete more result are retrieved.

Li, Q. et. al [9] In regards to teaching and learning executives, the Internet of Things (IoT) technology has been used to develop an extensive system for improving educator organization, assessment, and evaluation systems for students, securing and watching the quality of education. In addition, professors can monitor student performance, custody attendance, and analyze students' learning via IoT technology. The foundation of the Internet of Things is the capacity for smart chips to establish a connection with varied goods via communication methods along with different devices to connect to the Internet by way of sensors, which allows automated control. The intelligent classroom is a case study of how Internet of Things (IoT) technology is being applied in instruction. It utilizes radio frequency identification technology in conjunction with a wide range of sensors to construct an intelligent learning setting where every device has digital, networked, and intelligent features. As a result, this system could provide intelligent educational environments by constantly reviewing classroom info and applying appropriate changes.

Pingxiao, W. et. al [10] An intelligent educational setting comprises one that provides wireless internet access everywhere. The pupils can use wireless internet connections, suffer from group conversations and collaborative studies to their specific educational requirements, and interact with experts or distant pupils to encourage individual, cooperative, and distance learning in the classroom in addition to outside of it. Introduce the prospect of a multimedia environment in the smart classroom. This is a classroom with an everyday reinforced interface that functions as a teaching and remote education system. Teachers can use this space to eradicate the requirement for a keyboard, mouse, monitor, voice, gestures, body language, as well as other conventional teaching techniques while tutoring remote students. Teachers can educate both in-person and remote learners mainly because the lines dividing conventional instruction and distant education are dissolved. Future classroom design is a progressive area of educational technology in

which a lot of exploratory research is currently taking place simultaneously both domestically and internationally.

Vetrivel, S. et. al [11] Any smart environment may be successfully divided into four essential layers, suggested by: physical, communication, information, and decision. Nevertheless, this paper shrinks layers—that is, information retrieved from the field—into three. Each structure in the environment offers a unique purpose that it performs to assist with multiple processes and to take care of certain requirements. Consequently, to create ambient intelligence in a classroom, multiple states' fundamental requirements are required to be delighted using smart environment architecture. Based on its physical architecture, the AmI environment is broken down into three sections in this paper. The physical layer functions as a connection for input as well as output. This layer collects input from the environment or users and produces the same. the layer of interaction that conveys data from the physical layer to the decision layer. The decision layer is the primary element of the system because it analyses user input, calculates what to do based on data patterns, and ultimately delivers the outcomes to the physical layer with the help of the communication layer.

3. Methods and Materials

3.1 Architecture of smart classroom

Three aesthetic factors are aimed at create the whole structure of the English learning system of the smart educational system: the main end structure, the sub-end structure, and the overall structure. The intelligent access portal and its distributed wired system have been included to the system, and this is a robust IoT sharing platform assembled on the highest of the wireless switch. All equipment systems are connected to the integrated platform of the smart classroom teaching system via regular wireless module equipment or programmed through smart access gateway, with reference to their specific performance features and purposes of the smart classroom field equipment system as shown in figure 3.1. It enables the unified and centralized management of the system architecture using the server in this way. The integrated foundation of the savvy classroom instructional system is envisaged to be implemented in the form of a cascading stack. This is portrayed in figure 3.2 very effectively. Each smart classroom's sub-end platform is located at the base of the comprehensive platform. The middle stratum is the secondary main-end framework that can be structured and divided based on to the teaching different fields of the school. The highest layer is the primary-end foundation of the school level. The dispatch, maintenance, application workstation, front communication, database, streaming media, and Web server compose the fundamental end of the combined platform of the smart classroom teaching system. Through the network switch connection, it is constructed. Using a common communication protocol managed by the front communication server, the integrated platform's main end connects to each smart classroom's sub-end systems and retrieves data from each device subsystem. The wireless switch, smart access terminal, video and audio system components, and sub-end platform software make up the sub-end of the integrated smart classroom teaching system. The smart access gateway connects via a variety of interfaces other than wireless to the device terminal, which needs wired access to finish various data collection and output control on the device subsystem of the smart classroom. The wireless switch is connected to the device terminal via WiFi access. It is clearly illustrated in the below figure 3.3.

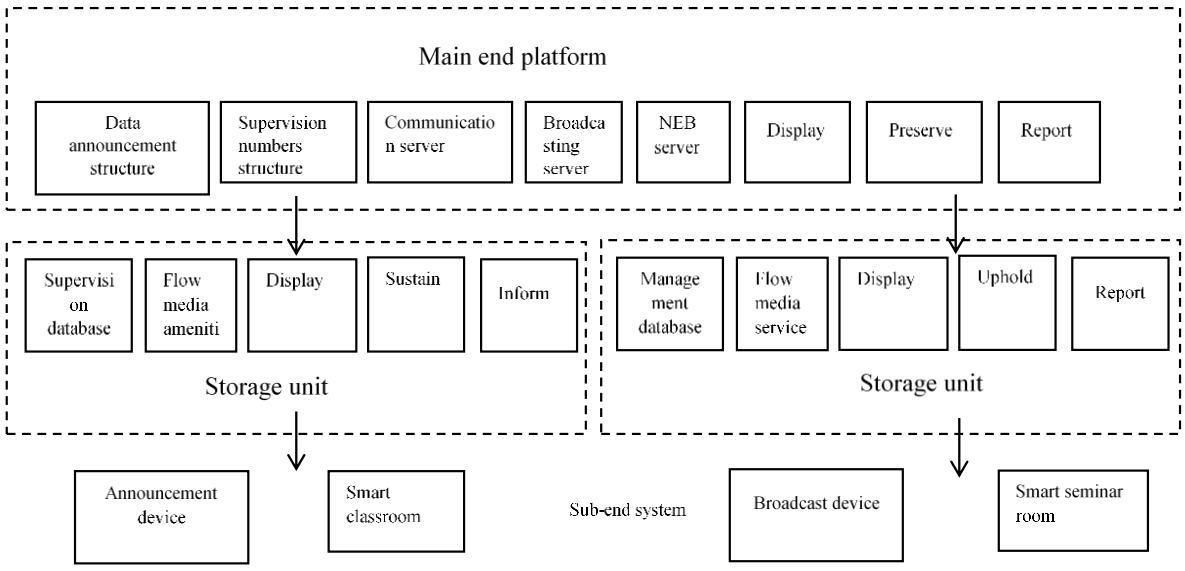

Fig. 3.1. Integrated platform of Smart Class Room Architecture

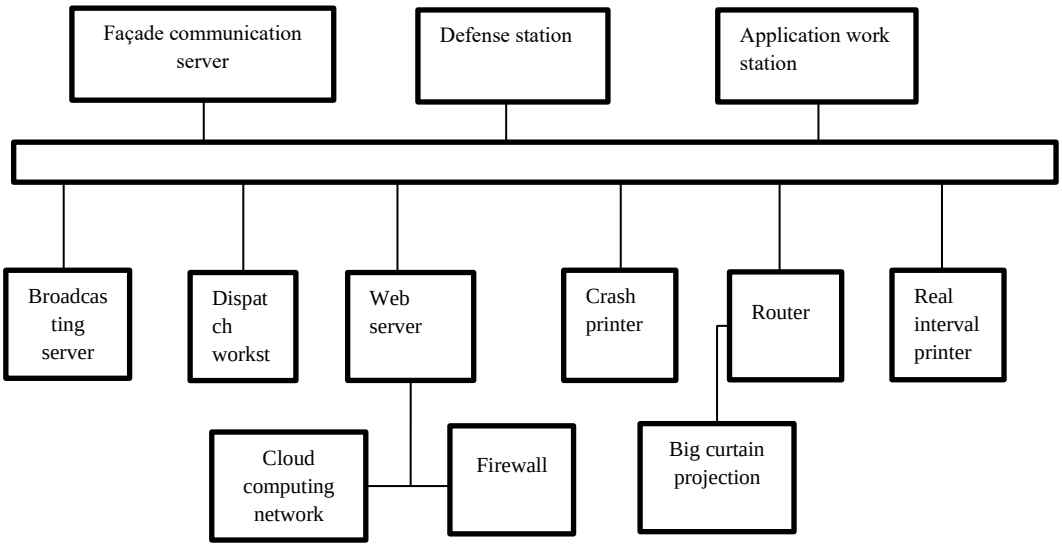

Fig. 3.2. Main-end Architecture of Integrated Platform of Smart Class Room

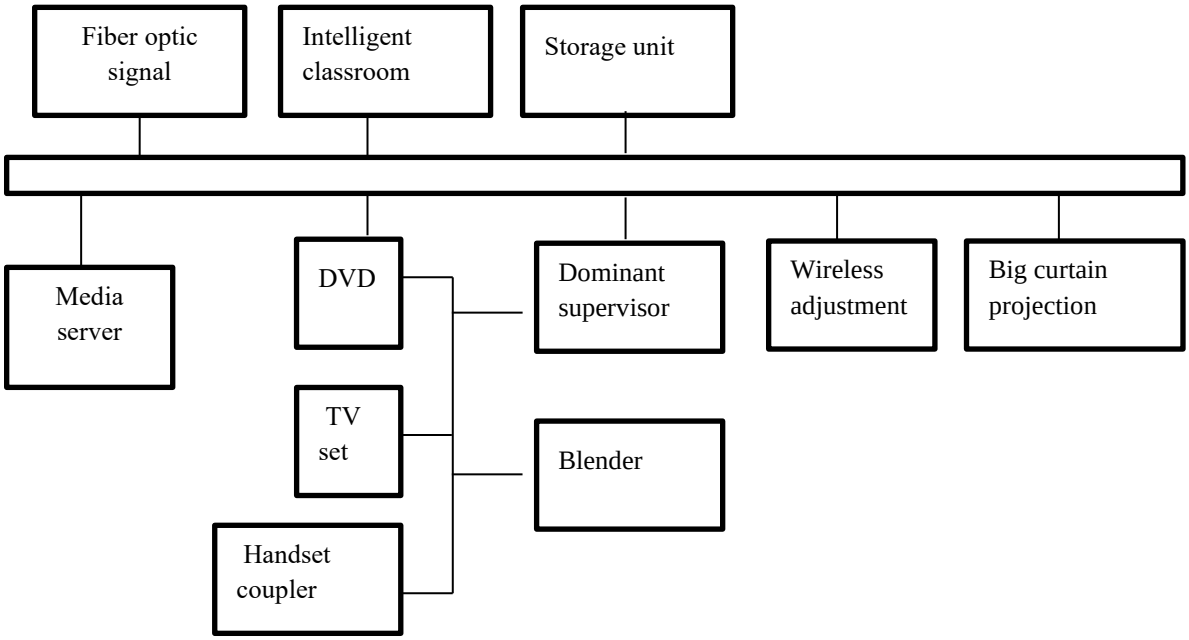

Fig. 3.3. Sub-end architecture of integrated platform of Smart Class Room

3.2 Implementation of Smart Classroom System

First, the link occurs between the client and the server. The platform provides the user's name and password, which are input by the user and communicated to the server over the hypertext transfer protocol (HTTP) for legal certification. The user's name and password are encrypted utilizing MD5 encryption and recorded in a server-side database to avert exposure during transmission. The connection that exists between the computing device and the client computer can be effectively established whenever the server has successfully demonstrated the login credentials. The process can be viewed in Figure 3.4A. Figuring out client services is the second level. A program functioning on the Web client accepts the database record whenever the server transmits. The get function under HTTP is used to obtain the command. The value of the command will be entered into the suitable column in the MySQL database whenever the database record has been fetched. The participant will be notified when the procedure is finished by a Notification status bar that comes after the operation is successful. The method is illustrated in Figure 3.4B. The gadget monitoring module is required to be put in place in the third step. The app collects the user-selected device

identification (ID) through the GetDeviceId() purpose. Based on the device ID, the server collects data from the device information table and delivers the device system's status. InformationManager presents, handles, and retrieves the user-selected device subsystem's interface under the ProvisionDeviceInfo. EditDevice() and DelDevice() can be employed to update and erase the device, correspondingly. The specific methodology is given in Figure 3.5A. The knowledge management module is then put into practice. Using the knowledge base ID that was received, the application requests the knowledge base information database and returns knowledge_code, knowledge_type, catalog, and label as a response. Figure 3.5B illustrates the specific technique [12].

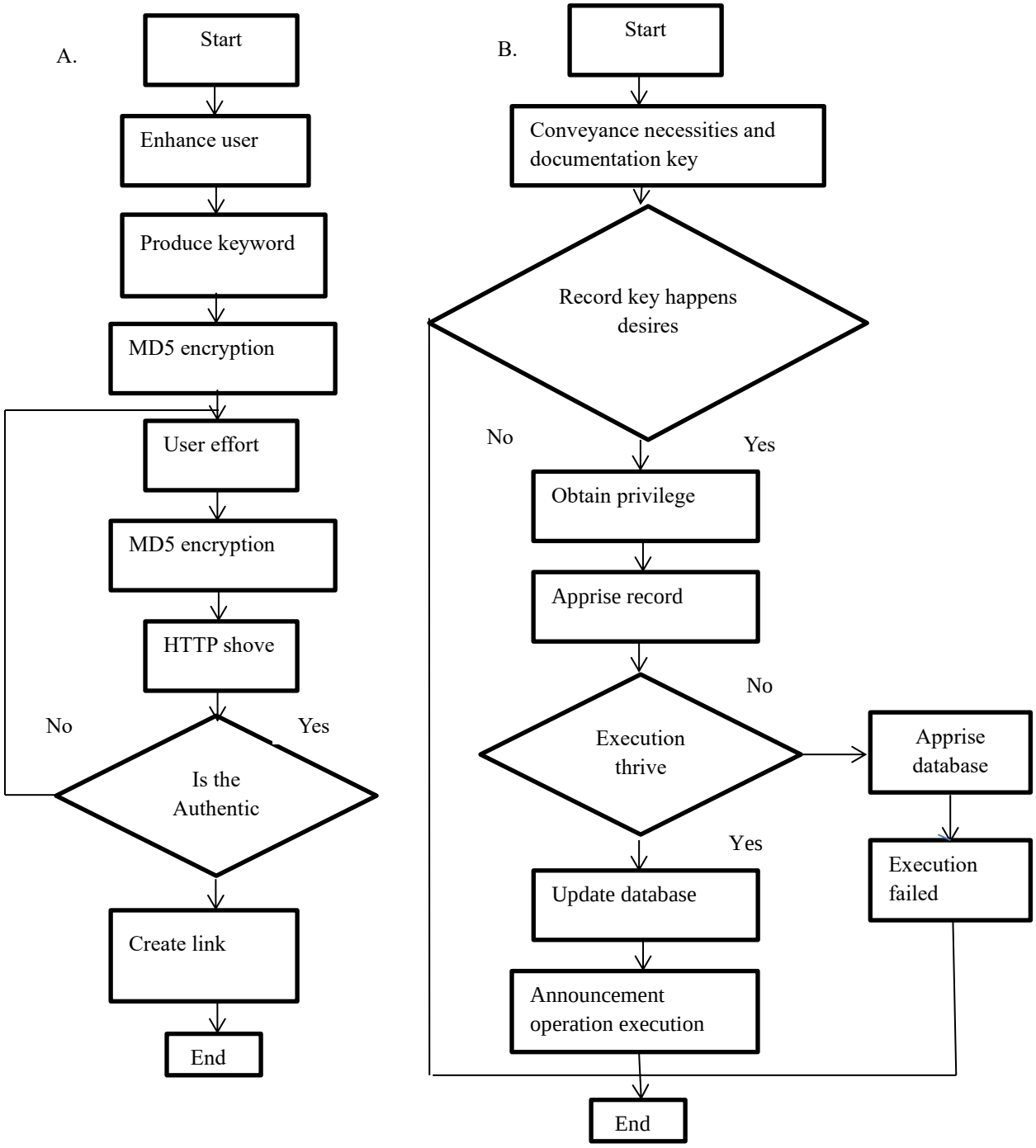

Fig. 3.4. Connection between Server and Client

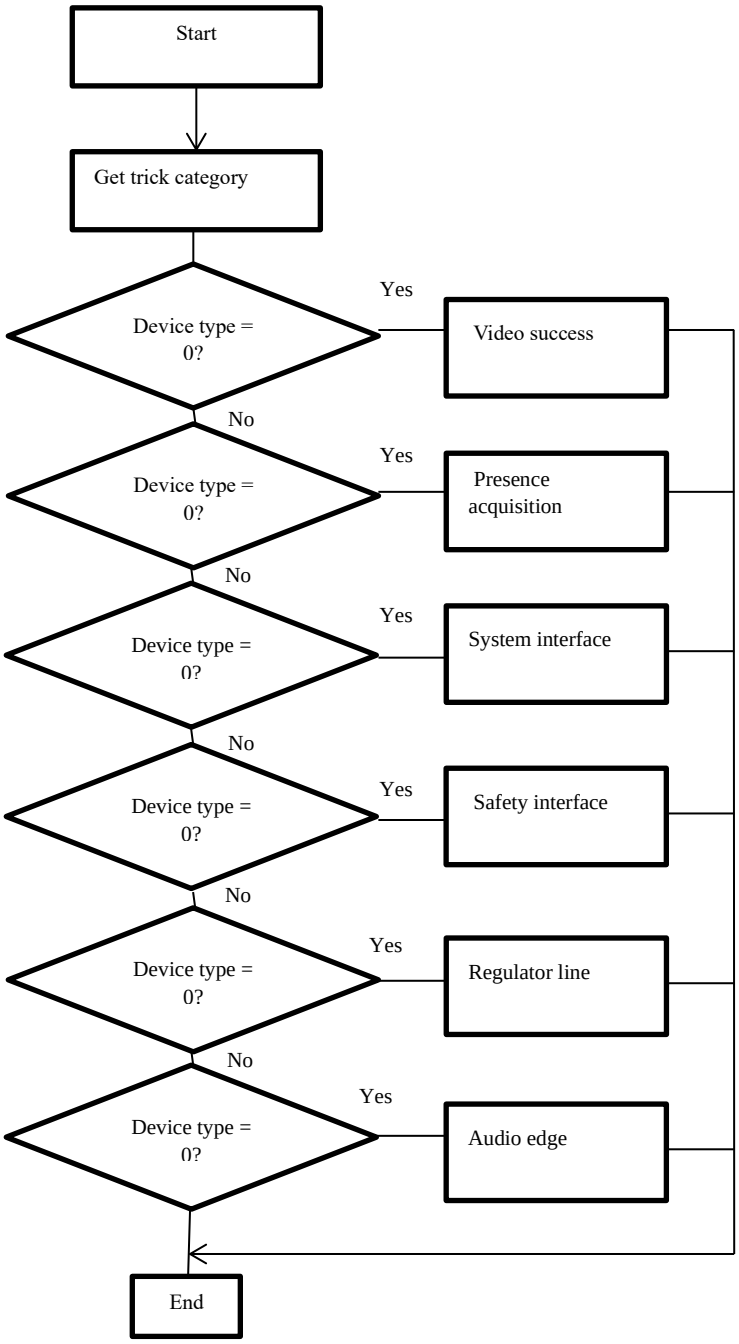

Fig. 3.5 A. Flow Chart of Equipment List and Knowledge Management Module

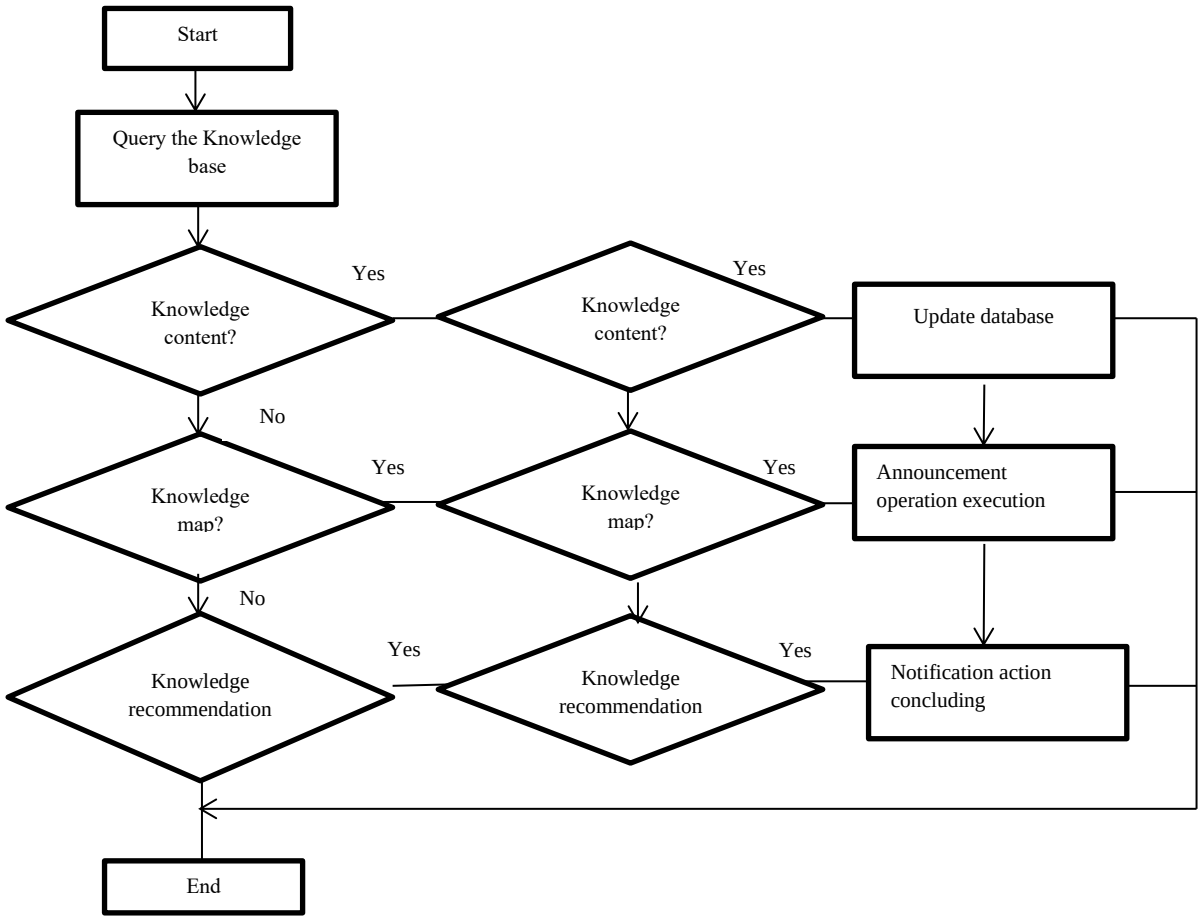

Fig. 3.5 B: Flow Chart of Equipment List and Knowledge Management Module

4. Implementation and Results

4.1 Awareness of intelligent management structures by students

Table 1 demonstrates that most students typically hold an excellent view of this system. 69.0% of students agree that this system can assist enhance teaching efficiency, according to data in the teaching efficiency column. It's not readily apparent where the dissidence is in this subsequent column. As indicated by 78.8% of students in the "To improve the academic effect of this subject" column, this class aesthetic is higher than the usual lecture mode. Figure 4.1 shows a clear comparison of student, teacher, and university satisfaction.

Table 1. Student's Recognition Of Intelligent Teaching System

Item depiction	Strongly dissatisfied	Not satisfied	No opinion	Satisfied	Strongly satisfied
To advance the productivity of classroom instruction	3.3	5.5	25.5	41	29.0
To have extra occasions for language practice	3.3	25.4	29.0	25.5	21
To be further fulfilled with the education real of this type	1	7.8	16.7	54.4	25.5

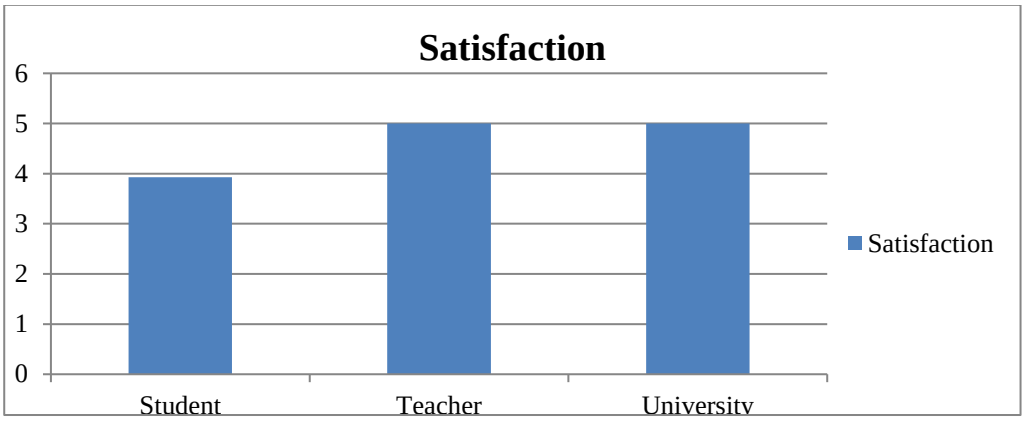

Fig. 4.1. Comparison of satisfaction

4.2 Contentment with the Intelligent Management Framework

Table 2 demonstrates that the degree of satisfaction up to 68.9% suggests the pupils are extremely satisfied with this method of teaching. This establishes the basis for the progress of intelligent systems of schooling.

This system can only be broadly utilized when it successfully fits the expectations of pupils along with additional users.

4.3 Satisfaction Comparison

It is obvious from Figure 4.2 above that the university, students, and instructors are all extremely satisfied with this intelligent teaching organization. As a consequence, it may be feasible to derive a few conclusions about this system's viability and utility, which will allow smart English classrooms to accept it.

4.4 Disparities in the level of fulfillment amongst genders

Based on Table 3, the typical satisfaction degree for men is 4.13, the median contentment degree for women is 3.66, and the T-value is 1.45. We can deduce from the result that men are more delighted than women are.

4.5 Satisfaction with the Network Connection

Table 4 discloses that students are very information with the existing campus network rate, which serves and 71.2% of students are extremely delighted with the existing network rate. The development of a network is the necessary guarantee for the setting up of our intelligent classroom, and the advancement of network frequency supplies professional assistance for our Intelligent Management System [13].

Table 2. Satisfaction of intelligent management system

Item description	Strongly dissatisfied	Not satisfied	No opinion	Satisfied	Strongly satisfied
Grade of approval	3.3	12.2	18.9	41	29.0

Fig. 4.2. Fulfillment Graph for Dealing Classrooms with IDS

Table 3. Bond between gender and Fulfillment

Dependent variable	Independent variable	Average value	T-value
Degree of fulfillment	Male	5.14	=1.56**
	Female	3.77	

*p<.05

Table 4. Satisfaction of Network Rate

Item description	Strongly dissatisfied	Not satisfied	No opinion	Satisfied	Strongly satisfied
Gratification of network rate	3.3	5.5	23.3	36.7	36.7

5. Conclusion

The data indicates that students' scores grow drastically as long as the teaching methodology experiment is performed. As a consequence, the experiment greatly contributes to enhancing the normal level of learning. However, as a result of restraints regarding time and conditions, there are still certain problems. First of all, it works entirely on research and practice concerning educational units' innovative classroom equipment systems and fundamental teaching operations. In this paper, an intelligent education framework is investigated and addressed. Trials indicate the sustainability and trustworthiness of this system of leadership. In an ideal educational setting, learners feel free to focus and can quickly communicate with teachers and other students. Tragically, the behavior recognition sensors utilized in this research are acceleration sensors, which are confined to collecting data on gestures performed by students. We believe that machine learning, face recognition technology, and trustworthy transmission systems should all be taken into consideration to better comprehend the relationship between children's behavior and teaching status. More technologies are anticipated to be employed, especially during the teaching mode when multiple pupils take part at once, to investigate whether or not students are exhausted or distracted and to estimate students' behavior based on units per second. The intelligent system design for the management of education necessitates wireless network transmission technology along with sensor and artificial intelligence programming technology.

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