

Retraction

Retracted: Internet of Things Application of Intelligent and Innovative Learning Strategies in the Higher English Education System

Security and Communication Networks

Received 10 November 2022; Accepted 10 November 2022; Published 27 November 2022

Copyright © 2022 Security and Communication Networks. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Security and Communication Networks has retracted the article titled “Internet of Things Application of Intelligent and Innovative Learning Strategies in the Higher English Education System” [1] due to concerns that the peer review process has been compromised.

Following an investigation conducted by the Hindawi Research Integrity team [2], significant concerns were identified with the peer reviewers assigned to this article; the investigation has concluded that the peer review process was compromised. We therefore can no longer trust the peer review process, and the article is being retracted with the agreement of the Chief Editor.

References

- [1] J. Shi, Z. Hou, and K. Mojtahed, “Internet of Things Application of Intelligent and Innovative Learning Strategies in the Higher English Education System,” *Security and Communication Networks*, vol. 2022, Article ID 2213207, 11 pages, 2022.
- [2] L. Ferguson, “Advancing Research Integrity Collaboratively and with Vigour,” 2022, <https://www.hindawi.com/post/advancing-research-integrity-collaboratively-and-vigour/>.

Research Article

Internet of Things Application of Intelligent and Innovative Learning Strategies in the Higher English Education System

Jingxiu Shi,¹ Zhongkun Hou,¹ and Kaza Mojtahe ²

¹Sichuan College of Architectural Technology, Deyang, Sichuan 618000, China

²Department of Computer Engineering, Kyrgyz-Turkish Manas University, Bishkek, Kyrgyzstan

Correspondence should be addressed to Kaza Mojtahe; kaza.mojtahe@mail.cu.edu.kg

Received 12 March 2022; Accepted 31 March 2022; Published 21 April 2022

Academic Editor: Muhammad Arif

Copyright © 2022 Jingxiu Shi et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

In order to improve the effect of higher English teaching, this paper builds a higher English education system based on Internet of Things technology. The optimization aim of this study is to provide an online DRX parameter optimization technique that is compatible with the RRC protocol architecture. This work employs algorithms based on reinforcement learning to accomplish parameter optimization and dynamic control by selecting optimal DRX parameters and dynamically configuring them via decision-making processes. Furthermore, this article enhances the Internet of Things algorithm and applies it to the higher English education system that this study constructs. Furthermore, this study combines the real demands to develop the functional structure module of the higher English education system, constructs the higher English education system based on the Internet of Things system, and tests the performance of the system constructed in this paper. Finally, the system structure performance verification is carried out through mathematical statistics. The research results show that the system constructed in this paper has a good teaching effect.

1. Introduction

With the development of intelligence, mankind is on the way to fully enter the era of intelligence. While the Internet of Things has had a huge impact on human production and life, it has also gradually been integrated into education. The Internet of Things has injected new ideas into education and teaching, provided new teaching methods, and improved the quality of teaching. Research on the application of the Internet of Things in college English teaching is of positive significance in improving students' interest in learning, enriching English classrooms, promoting teaching and learning, improving teacher teaching, improving teaching management, and teaching evaluation. Moreover, it has certain theoretical and practical significance for improving the allocation of teachers, promoting the sharing of educational resources, and realizing educational equity [1].

According to constructivist learning theory, students need to construct their own knowledge system in the process of English learning. In this process, the constructivist

learning theory emphasizes that students should have a certain degree of autonomy in the process of learning, solve problems through collaboration between teachers and students, and further construct knowledge. The traditional English classroom has a single form and is mainly manifested as teachers teaching and students listening, and its use in modern teaching aids is less. As a result, students' lack of learning autonomy makes it impossible for them to develop a complete knowledge system. Despite the fact that contemporary teaching tools are becoming common in today's English classrooms, the majority of pupils are still weak in the classroom. Not only can the Internet of Things aid instructors with preclass preparation and classroom instruction, but it can also help students with self-inquiry and open learning, as well as identify, analyse, and solve issues in a range of task settings. As a result, the Internet of Things study may provide a theoretical foundation for greater Internet of Things use in college English classrooms. Using the Internet of Things in college English classes, on the other hand, may help professors and students better

understand each other and themselves. In summary, the use of the Internet of Things in college English teaching gives specific technological assistance for modernising and future-oriented college English education [2].

In terms of reality, through the interpretation of the new curriculum standards, we can know that the Internet of Things, as a modern information technology, can be applied to college English teaching to improve students' learning methods and make students willing to devote more energy to realistic and exploratory learning activities [3]. The Internet of Things is like a bridge, which plays a role in communication and connection between teachers and students. Teachers use the Internet of Things to further enrich the teaching content and teaching methods to further improve themselves. Moreover, the Internet of Things can also push relevant information and resources to students through the analysis and processing of data. Therefore, the application of the Internet of Things in college English teaching has greatly assisted teachers in teaching and improved students' ability to learn independently.

2. Related Work

The Internet of Things refers to a network that connects any item to the Internet through RFID, infrared sensors, GPS, laser scanners, and other information sensing devices according to an agreed protocol to exchange and communicate information to achieve intelligent identification, positioning, tracking, monitoring, and management [4].

The literature [5] used a software-defined radio platform to control the tag identification delay and studied the RFID readers at the media access layer and physical layer of the Internet of Things architecture. In the literature [6], in order to solve the problem of balancing the performance and economic cost of the selected platform in the Internet of Things, a model of abnormal diagnosis mechanism and production performance analysis is established, and a type of intelligent manufacturing system of the Internet of Things with real-time tracking performance is studied.

The investigation of a centralised relay selection system is the subject of the literature [7]. Centralized relay selection is a reasonably simple to deploy selection strategy from a technological standpoint. The simplest exhaustive search strategy may be used to find the best relay. The literature [8] suggests a distributed relay selection system as a research path. The distributed relay selection technique, as opposed to the centralised relay selection strategy, spreads the relay selection calculation procedure to each relay node. The information is then combined at the destination terminal. The literature [9] presented a multirelay selection technique based on the suboptimal signal-to-noise ratio criteria in the half-duplex relay selection scheme. The study shows that it performs quite similarly to the SNR-based relay selection technique, although its computation is more complex. The system's computational load is substantially reduced when compared to exhaustive search techniques since the complexity grows linearly with the number of relay nodes. The literature [10] suggests using the principal-agent model to pick relays while also using partial channel state information

to lower the bit error rate and extend the frequency range while maintaining diversity gain, based on the knowledge asymmetry between the source and destination nodes. Efficiency: the literature [11] investigated the strategy of relay selection under the criteria of the total rate of the receiving end signal-to-noise ratio, block error rate, cumulative distribution function, and outage probability in the full-duplex relay selection scheme. The study in the literature [12] is based on the DF forwarding technique and developed a closed-form expression to increase the system's average capacity and bit error rate multirelay selection strategy.

For the half-duplex mode, the full-duplex mode can improve the spectrum efficiency by nearly one time, and the current full-duplex working mode with a very scarce spectrum has greater practical significance than the half-duplex mode. According to the number of selected relays, it can be divided into single-relay and multirelay selection schemes: the optimal single-relay selection scheme is to select the best relay node among a large number of candidate relay nodes for cooperative traffic. The literature [13] proposes to simply use the distance between the relay node and the source node for optimal single-relay selection. This method is easy and low-complexity. You only need to calculate the distance between each relay node and the source base station. Following the collaborative transmission, it is obvious that this selection strategy is not the optimal selection criterion in most scenarios. The literature [14] proposes that channel state information is used as the standard for selecting relay nodes. The CSI-based selection strategy is currently a research hotspot. This scheme can significantly improve the signal-to-noise ratio of the receiving end and reduce the bit error rate, but the prerequisite is that the system in each relay node in the CSI must accurately know the CSI of each channel. The literature [15] studied the optimal relay selection strategy based on the outage probability and bit error rate criteria. The literature [16] studied the switching of working modes based on the instantaneous channel state information under the amplifying and forwarding protocol. This scheme measures the cost of the system to achieve the optimal performance to perform the best relay selection and suboptimal relay selection. Mutual conversion: the literature [17] studied a partial relay selection method based on the half-duplex mode, selecting the first single relay node with the best channel for cooperative transmission to improve the performance of the system. The literature [18] proposed a greedy algorithm to solve the problem of large interruption probability when the source transmission power is limited, so as to achieve the expected value of the system's allowable interruption probability with the minimum power consumption, which saves the system to a certain extent. Energy consumption: the literature [19] selects multiple relays for cooperative transmission based on the criteria of suboptimal bit error rate and suboptimal signal-to-noise ratio through the relay ranking function algorithm. The literature [20] proposed an adaptive relay selection method, which continuously increases the number of cooperative relays under given conditions during the cooperation process to reach the SNR threshold predetermined by the receiving end, thereby saving relay nodes.

3. Problem Description and Model Introduction

This paper proposes a DRX parameter dynamic control scheme based on reinforcement learning, as shown in Figure 1.

The UE periodically enters the sleep state under the DRX mechanism of the cellular Internet of Things, and the UE is in the RRC IDLE state in the sleep state. Any downlink data coming at the base station may be delivered straight when the UE is connected. In the sleep state, however, the data must wait until the DRX sleep period is through before entering the active state to monitor the NPDCCH channel for downlink service information.

Figure 2 depicts the DRX mechanism process once the UE data bearer is established using the architecture described above. The following DRX parameters are used in its control process.

The inactivity timer, also known as the deactivation timer, specifies the amount of time the UE must wait between the last data transfer in the connected state and entering DRX mode. The timer is immediately restarted when the UE successfully receives the downlink data indication from the NPDCCH channel.

DRX cycle (T_c): it defines the length of each DRX cycle after the UE starts the DRX mode.

Activation time timer (T_{on}): it defines the time during which the UE is active in a DRX cycle. The UE can monitor the NPDCCH to detect the time ($T_{on} \ll T_c$) when a new data packet arrives. During this period of time, if the UE can successfully receive a paging message on the NPDCCH, it will immediately end the DRX mode and the inactivity timer will start again.

DRX start offset (T_{so}): it is used to define the start position of the activation time in the DRX cycle; that is, the activation timer is started when the following formula is satisfied:

$$(n_f * 10 + n_{sf}) \bmod T_c = T_{so}. \quad (1)$$

In the previous formula, n_f and n_{sf} , respectively, represent the current frame number and subframe number.

The abovementioned parameters are selected and configured by the RRC layer protocol on the base station side. In the solution proposed in this paper, in order to ensure the consistency of the number of terminal service characteristics used for analysis in each decision period, the window length executed by the DRX parameter decision algorithm is defined as N_d , which represents the number of downlink arriving data packets in this window. After each window is over, the base station re-decides the DRX parameters of the UE based on the DRX decision algorithm. If the result of the decision is different from the current DRX parameter configuration, RRC reconfiguration is performed on the UE during the first DRX activation period after the decision is completed to update the DRX parameters. Otherwise, the current configuration remains unchanged.

The DRX mechanism in Figure 2 includes four different UE states S_0, S_1, S_2 , and S_3 , and the corresponding UE power is P_0, P_1, P_2 , and P_3 , respectively. In the S_0 state, the UE receives downlink data and the power consumption is high.

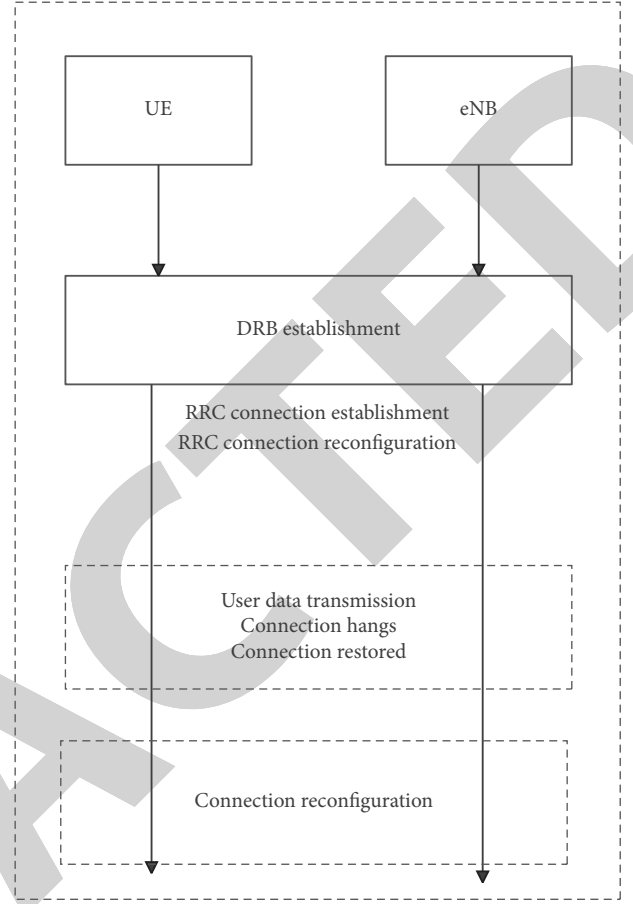


FIGURE 1: DRX parameter dynamic control algorithm scheme.

In the S_1 state, the UE is waiting to transmit data but is still in the connected state, and the power consumption is lower than the S_0 state but higher than the S_2 and S_3 states. The S_2 and S_3 states, respectively, indicate that the UE is in the active and dormant state after entering the DRX mode. In the active state, the UE needs to open the receiver NPDCCH channel. However, the UE enters deep sleep in the sleep state. At this time, only a few modules such as the clock are still working and the power consumption is extremely low.

Based on the above description, the power consumption of the UE is equal to the cumulative sum of its time and power in each state; namely,

$$P_{\text{total}} = \sum_{i=1}^4 P_i \cdot t_i. \quad (2)$$

The power of the communication module in different states varies with the access type and device, but for the device, the longer the total time the UE is in the S_3 state, the lower its power. Taking into account the versatility of the algorithm in different types of CIoT terminal devices and the lack of reliable measured power data of UE devices, this paper simplifies the UE's energy efficiency measurement indicators and uses the ratio of the time that the UE enters the DRX sleep state during the decision interval to the total time of the decision cycle to define the UE's energy efficiency coefficient α .

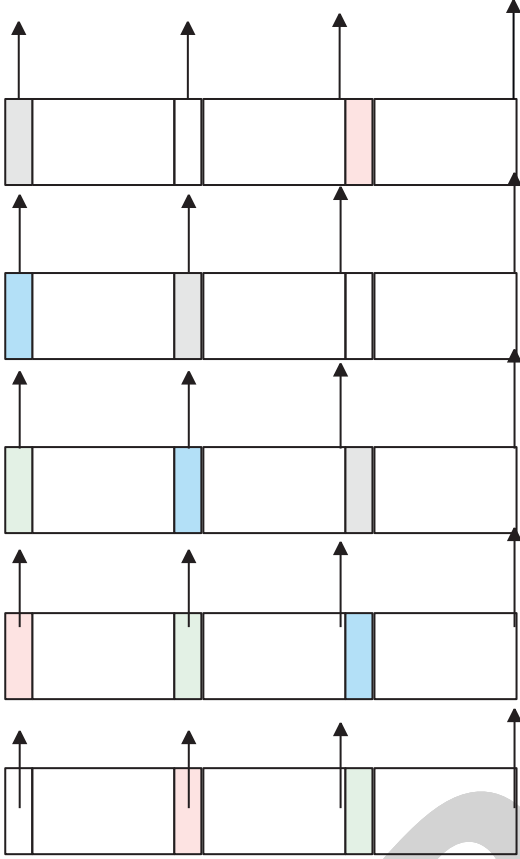


FIGURE 2: DRX mechanism workflow.

$$\alpha = \frac{T_{\text{offset}} + N_c (T_c - T_{\text{on}})}{T_d}. \quad (3)$$

Here, T_d is the time interval for DRX decision-making in this design, which is related to the arrival of UE downlink data. T_{offset} represents the length of the first DRX sleep phase in the decision interval. The length is related to the frame number, subframe number n_f^{start} , n_{sf}^{start} , T_c , and T_{so} that enter the DRX mode.

$$T_{\text{offset}} = (0.1 * L) \text{ ms}. \quad (4)$$

Here, L is the smallest positive integer that satisfies the following formula:

$$(n_f^{\text{start}} * 10 + n_{sf}^{\text{start}} + T_{\text{offset}} L) \bmod T_c = T_{\text{so}}. \quad (5)$$

Here, N_c is the number of complete DRX cycles in the DRX decision interval.

The average transmission delay β of the UE data packet is expressed by the following formula, where the transmission delay of the i -th downlink data packet is the time difference between the arrival of the data packet and the actual transmission, namely,

$$t_{\text{delay}}^i = t_{\text{trans}}^i - t_{\text{arrive}}^i. \quad (6)$$

Compared with the DRX cycle, the transmission processing time of each data packet is very short and can be ignored. Therefore, this paper assumes that when the UE is

in the S_0 , S_1 , and S_2 states, its downlink transmission delay is zero.

$$\begin{aligned} \beta &= \frac{\sum_{i=1}^{N_d} t_{\text{delay}}^i}{N_d} \\ &= \frac{\sum_{S_i=S_3} (t_{\text{trans}}^i - t_{\text{arrive}}^i)}{N_d}. \end{aligned} \quad (7)$$

In response to the delay and energy efficiency requirements of different CIoT terminal services, an ED index (Energy Efficiency and Delay) is defined to measure the UE's energy efficiency and delay matching degree. The index is defined as follows:

$$f_{ED}(\lambda, T_{\text{max}}) = \lambda \alpha + (1 - \lambda) \left(1 - \frac{\beta}{T_{\text{max}}} \right). \quad (8)$$

Here, λ is used to measure the UE's demand for low power consumption and used in the ED indicator to balance the UE's preference between power consumption and delay. When the value of λ is large, the UE prefers to pursue high energy efficiency, and when the value of λ is small, the UE prefers to pursue low latency. T_{max} represents the maximum average delay that the UE can accept. When the average delay of the UE exceeds T_{max} , the delay part of the measurement index has a negative impact on the overall index.

The problem to be solved in this paper is to find the appropriate DRX parameter configuration (T_c , T_{on} , T_{in} , and T_{so}) for the UE to maximize the ED index of the terminal while meeting the transmission delay requirements. The problem can be abstracted into the following formula:

$$DR X_p(T_c, T_{\text{on}}, T_{\text{in}}, T_{\text{so}}) = \arg \max(f_{ED}(\lambda, T_{\text{max}})). \quad (9)$$

In the mathematical model, the arrival time of all data packets is observable and the state of the UE when it arrives is not fixed and is affected by parameters such as the DRX cycle; that is, different DRX parameters (T_c , T_{on} , T_{in} , and T_{so}) may affect the status of the UE when the downlink service arrives and further affect the power consumption and delay of the UE. In this process, the selection of certain DRX parameters (T_c , T_{on} , T_{in} , and T_{so}) will generate some rewards, which are reflected by reducing power consumption. At the same time, it will affect the state of the UE when the downlink data arrives, which can be regarded as a state change caused by the impact on the environment after the base station makes a decision.

The problem involved in this paper is an order-inertial decision-making problem in the multidimensional discrete state space and multidimensional discrete action space, which can be modeled as MDP and defined as $M = \langle S, A, T, R \rangle$. Among them, S , A , T , and R , respectively, represent the set of the state, action, transition probability, and reward function of the system. The time step of the system action is the DRX decision interval. After the end of each decision interval, the system executes action $a \in A$ to transition from state $s \in S$ to state $s' \in S$ and obtains a reward $R(s, a)$.

In the decision model of dynamic parameter configuration proposed in this paper, there are N_d downlink data packets arriving within a decision interval, the arrival time is, respectively, $\{t_1, t_2, \dots, t_{N_d}\}$, and the length of the decision interval is T_d . When each data packet arrives, the UE must be in one of four states S_0, S_1, S_2 , and S_3 , defined as $S_i^n, i \in \{0, 1, 2, 3\}$, which represents the sequence number of the data packet in the decision interval. Therefore, we define the set of states the UE is in when all data packets arrive in a decision interval as an environmental state $s^k = \{s_1^1, s_2^2, \dots, s_{N_d}^{N_d}\}^k \in S$ in the sequence. Based on this environmental state, the RRC sublayer makes an action decision $DRX_p(T_c, T_{on}, T_{in}, \text{ and } T_{so})$, and its action space satisfies the following equations:

$$\begin{aligned} T_c &= 256n_c T_{sf}, \quad n_c \in \{1, 2, 4, 6, 8, 12, 16, 18, 24, 30, 32, 36\}, \\ T_{on} &= n_{on} T_{pp}, \quad n_{on} \in \{1, 2, 3, 4, 8, 16, 32\}, \\ T_{in} &= n_{in} T_{pp}, \quad n_{in} \in \{0, 1, 2, 3, 4, 8, 16, 32\}, \\ T_{so} &= \frac{n_{so}}{256} T_c, \quad n_{so} \in \{0, 1, \dots, 255\}. \end{aligned} \quad (10)$$

In the above expressions, n_c represents the number of groups containing 256 subframes in the DRX cycle and n_{on} and n_{in} represent the number of PDCCH cycles contained in the activation time timer and the inactivity timer, respectively. n_{so} represents the interval number of the starting position of the active state after dividing the DRX cycle into 256 subintervals. T_{sf} represents the time length of a single subframe and the length of a subframe in the cellular Internet of Things is 1 ms. T_{pp} represents the time length of an NPDCCH cycle. In order to simplify the calculation, this paper uniformly sets a NPDCCH cycle length to 16 ms.

Since the abovementioned four parameters jointly affect the UE's ED indicators, in order to reduce the action space of the algorithm and promote the rapid convergence of the algorithm in actual application scenarios, this paper takes the following operations to reduce the dimensionality of the above action space based on the characteristics of the small data volume of a large number of Internet of Things UEs in CIoT and the working mode of DRX:

- (1) For the T_{so} parameter used to characterize the start offset position of the DRX activation state, the reconfiguration offset algorithm is simplified as follows:

$$T_{so}^{k+1} = \frac{1}{N_d} \sum_{i=(k-1)N_d+1}^{i=kN_d} (((10n_f^i + n_{sf}^i) T_{sf}) \bmod T_c^{k+1}). \quad (11)$$

That is, the T_{so} parameter is calculated according to the offset of the arrival of the last service data in the previous decision period and the T_c decision value of the next decision period. The basis of this approach is that when the business model does not change significantly, if we always configure according to the average optimal offset in the previous week, we can minimize the average distance between the arrival

time of the downlink service and the active state time of the DRX mode.

- (2) Regarding the T_{in} parameter used to indicate waiting for downlink transmission in the RRC_CONNECTED state, its effect in the Internet of Things service is limited to a large number of downlink data packet services in a short period of time.

Therefore, this paper will only consider the action space A of the decision jointly formed under the combination of two parameters T_c and T_{on} .

For the strategy of action selection in state s^k , $\pi_\theta(s^k, a^k)$ is used to represent the strategy function of action a^k in this state and θ is the strategy parameter. After selecting and executing an action, it will cause the state of the environment to transition to s^{k+1} .

The reward generated by the system after the action is completed is defined as follows:

$$R = f_{ED}(\lambda, T_{max}). \quad (12)$$

The Q-learning algorithm uses the Q function as the evaluation function. This function is used to represent the maximum discount cumulative reward obtained after performing an action in the corresponding state. It is not only related to the instant reward brought by performing the current action in the state but also related to the future long-term reward. The Q function is defined as follows:

$$Q_{(s,a)}^\pi(s, a) = R(s, a) + \gamma \sum_{s' \in S} P_{ss'}(a) V^\pi(s'). \quad (13)$$

Here, γ is the discount rate, $P_{ss'}(a)$ is the probability of transitioning to state s' after taking an action in the state, and $V^\pi(s')$ is the corresponding value function. $Q(s, a)$ reflects the prediction of rewards. Therefore, the optimal action selection strategy is to maximize the expected value of the reward for executing the action in the current state; namely,

$$\pi(s) = \arg \max_a Q(s, a). \quad (14)$$

The agent selects actions based on querying the Q-value table. After multiple iterations of learning, it can finally find the corresponding optimal strategy $\pi^*(s)$ in each state to maximize the long-term cumulative reward value.

Aiming at the problem of DRX parameter dynamic control, the algorithm has made the following improvements to the traditional Q-learning algorithm:

- (1) According to the discrete characteristics of DRX parameters T_c and T_{on} , it is encoded and mapped to the corresponding action space. As the starting offset, since T_{so} is not a typical discrete variable and is changeable in real time, it cannot be obtained and changed through learning. Therefore, the configuration is only based on the new DRX cycle and the data arrival time in the last decision cycle.
- (2) A measurement criterion $f_{ED}(\lambda, T_{max})$ that can reflect the energy efficiency and transmission delay of the Internet of Things UE is defined, and the goal of the algorithm is to maximize this parameter.

- (3) In the real-world cellular IoT situation, man-made or unique environmental changes, such as rapid updates of road sign data owing to traffic congestion, generate frequent changes in data patterns. To assess the attenuation of real-time feedback under the same condition and action in a situation where the learning target varies dynamically, a feedback value detection module is introduced to the algorithm. If a specific level of decrease is identified, it means the UE's business model has changed significantly and the anticipated reward value must be revised, as well as exploration and learning to adapt to the new business model.
- (4) Construction of a higher English education system based on the Internet of Things system.

According to the Internet of Things technology, this paper constructs a higher English education system based on the Internet of Things system. The main applicable objects of this system are college students, teachers, subject leaders, and system administrators. Functional requirements analysis is mainly used for business process analysis in the form of use case diagrams. Various permissions are assigned to different role settings by the system. The topic leader and the instructor collaborate to create the course material, while the teacher maintains the case content, ensures the case's quality, and controls the students' learning situations. Students use the system to study, access resources, and complete activities. The system administrator is in charge of the system's operation and maintenance, as well as preventing and resolving different system issues.

According to the needs of users for system functions, it is divided into five modules: course management, case management, learning management, student management, and system management, as shown in Figure 3.

When we take the exam management module as an example, its entire process is shown in Figure 4. When the teacher organizes an online test, firstly, it is necessary to see whether the questions in the system meet the needs. The teacher can also add exercises manually, select a certain number of questions to form the paper, and determine the time when the test paper takes effect. After that, the system generates a PIN code. The teacher informs the PIN code in the class, and the student enters the online test. The system can obtain the student's real-time answering information, and the answer report will be automatically generated after the test is over. The teacher can receive an additional answer report for the class as a whole.

The system uses Maven for system project management and SVN version manager for project code version management. The overall architecture diagram is shown in Figure 5.

Based on the results of the demand analysis, the functional module design of the case teaching system based on the Internet of Things can be determined. The overall functional design diagram is shown in Figure 6.

This article creates a relationship model focused on the curriculum entity based on the domain model, based on

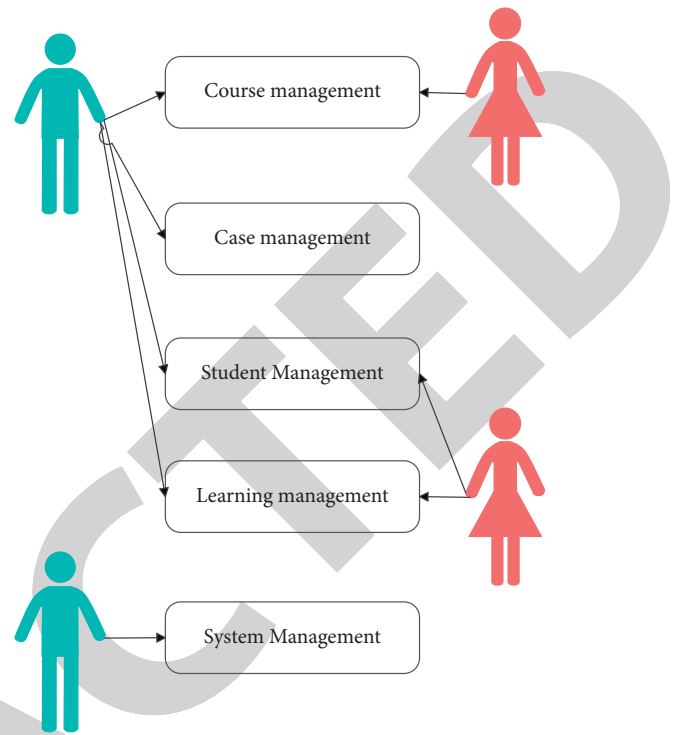


FIGURE 3: General use case diagram.

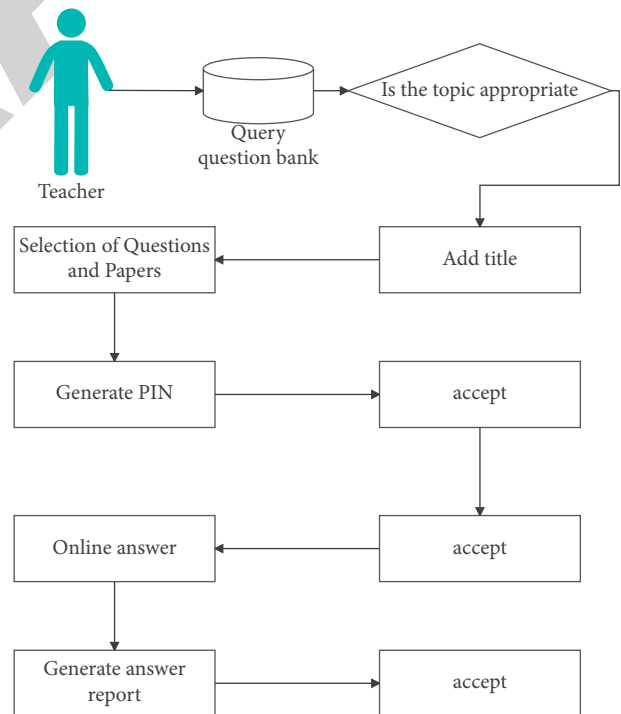


FIGURE 4: Exam management activity diagram.

the user roles in the system to extend the entities of instructors and students. The course has ability points, and the resources and subjects associated with the course correlate to the ability points. Tasks are present in the scenario, and tasks and ability points have a many-to-

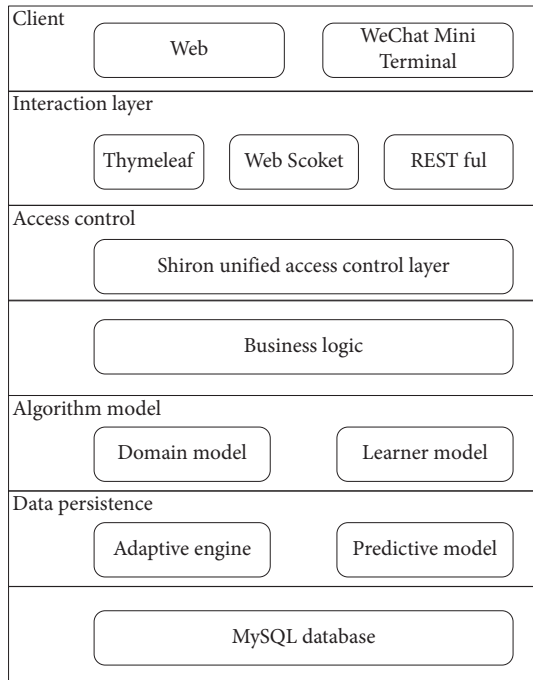


FIGURE 5: Architecture design diagram.

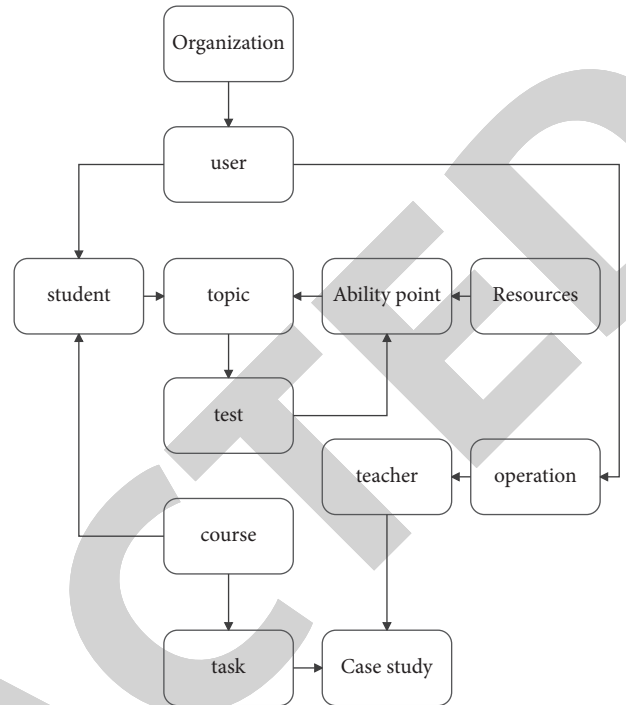


FIGURE 7: System E-R diagram.

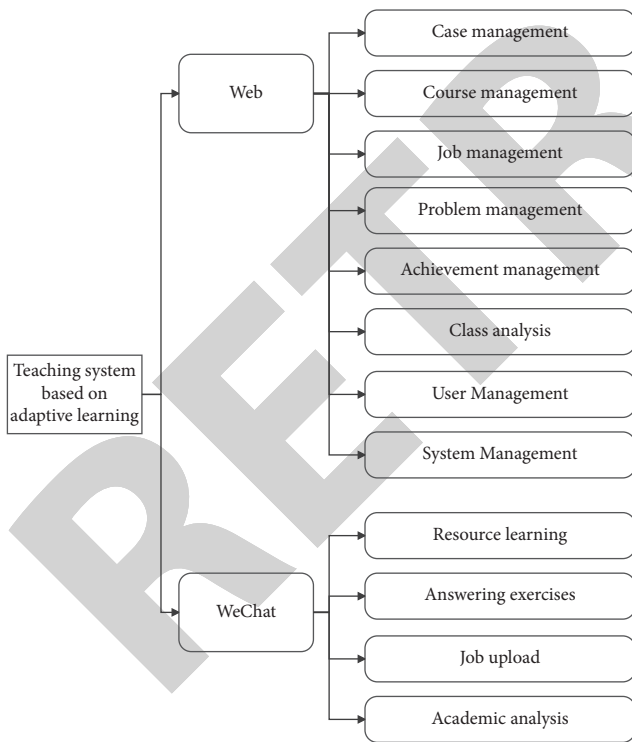


FIGURE 6: System function diagram.

many connection. Figure 7 depicts the system’s relational pattern design.

The IoT module of the higher English education system based on the Internet of Things constructed in this paper is the focus of this paper’s data processing. The core

network part is connected to the PDN through some specific interfaces, so as to realize the upload of data to the third-party application server. The network architecture of NB-IoT has been modified and optimized for its business characteristics. The significant change in the network architecture lies in the new service capability opening network elements. The overall network architecture is shown in Figure 8.

(5) Performance test of the higher English education system based on the Internet of Things system

The performance test of the system built in this article is conducted after the construction of a higher English education system based on the Internet of Things system. With the use of Internet of Things technologies, the system built in this study must gather and analyse data. As a consequence, this research examines the system’s greater English data processing impact first, and the findings are shown in Table 1 and Figure 9.

From Figure 9 and Table 1, it can be seen that the higher English education system based on the Internet of Things system constructed in this paper has a good data processing effect. That is, the higher English education system based on the Internet of Things constructed in this paper performs better in English data processing. On this basis, this paper evaluates the teaching effect of the higher English education system based on the Internet of Things system, as shown in Figure 10 and Table 2

From the above statistical results of teaching effect, it can be seen that the higher English education system based on the Internet of Things system constructed in this paper has a greater advantage than the traditional teaching model.

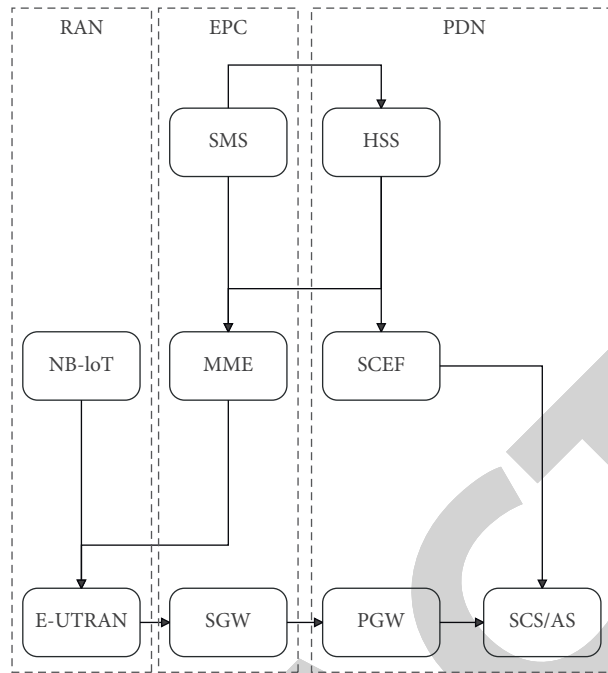


FIGURE 8: Overall network architecture.

TABLE 1: Statistical table of English data processing effect of the higher English education system based on the Internet of Things system.

| No. | Data transmission | Data processing | No. | Data transmission | Data processing | No. | Data transmission | Data processing |
|-----|-------------------|-----------------|-----|-------------------|-----------------|-----|-------------------|-----------------|
| 1 | 85.8 | 83.5 | 31 | 88.3 | 79.2 | 61 | 85.3 | 80.4 |
| 2 | 87.2 | 88.5 | 32 | 88.5 | 81.3 | 62 | 91.7 | 78.5 |
| 3 | 82.7 | 81.3 | 33 | 89.5 | 82.1 | 63 | 88.7 | 81.1 |
| 4 | 91.3 | 87.4 | 34 | 83.1 | 82.1 | 64 | 90.9 | 81.0 |
| 5 | 90.3 | 83.5 | 35 | 82.3 | 87.3 | 65 | 88.0 | 83.9 |
| 6 | 81.7 | 82.8 | 36 | 82.4 | 80.7 | 66 | 91.3 | 80.9 |
| 7 | 86.0 | 81.8 | 37 | 87.0 | 79.7 | 67 | 85.1 | 86.1 |
| 8 | 81.5 | 85.8 | 38 | 89.8 | 84.6 | 68 | 91.2 | 83.2 |
| 9 | 91.1 | 86.2 | 39 | 85.2 | 78.2 | 69 | 91.1 | 86.3 |
| 10 | 83.6 | 79.4 | 40 | 84.9 | 84.7 | 70 | 87.2 | 84.7 |
| 11 | 89.5 | 80.3 | 41 | 83.5 | 86.1 | 71 | 84.0 | 81.0 |
| 12 | 84.9 | 88.7 | 42 | 86.2 | 88.2 | 72 | 90.9 | 79.2 |
| 13 | 85.3 | 86.0 | 43 | 89.5 | 84.5 | 73 | 89.4 | 85.0 |
| 14 | 82.9 | 80.6 | 44 | 91.5 | 88.4 | 74 | 90.5 | 80.0 |
| 15 | 88.8 | 79.7 | 45 | 89.1 | 82.8 | 75 | 86.5 | 83.9 |
| 16 | 82.0 | 84.1 | 46 | 88.8 | 81.6 | 76 | 86.8 | 83.9 |
| 17 | 85.5 | 84.8 | 47 | 90.0 | 80.1 | 77 | 90.4 | 83.5 |
| 18 | 85.8 | 84.1 | 48 | 83.3 | 83.0 | 78 | 81.7 | 85.4 |
| 19 | 85.9 | 82.3 | 49 | 90.5 | 79.7 | 79 | 86.6 | 84.9 |
| 20 | 87.4 | 85.4 | 50 | 91.1 | 84.4 | 80 | 88.5 | 78.5 |
| 21 | 81.9 | 79.3 | 51 | 87.1 | 86.9 | 81 | 81.3 | 78.1 |
| 22 | 81.2 | 81.8 | 52 | 83.2 | 83.3 | 82 | 87.9 | 82.1 |
| 23 | 81.8 | 87.3 | 53 | 90.4 | 79.3 | 83 | 89.8 | 80.3 |
| 24 | 86.6 | 88.7 | 54 | 85.4 | 78.8 | 84 | 84.4 | 85.6 |
| 25 | 90.9 | 78.5 | 55 | 82.0 | 85.3 | 85 | 86.2 | 85.7 |
| 26 | 90.0 | 88.9 | 56 | 91.2 | 83.8 | 86 | 89.5 | 88.5 |
| 27 | 86.3 | 78.4 | 57 | 82.4 | 88.9 | 87 | 85.9 | 87.8 |
| 28 | 83.9 | 82.1 | 58 | 82.2 | 81.3 | 88 | 86.4 | 78.4 |
| 29 | 86.7 | 88.0 | 59 | 88.5 | 84.6 | 89 | 88.0 | 88.3 |
| 30 | 81.6 | 82.4 | 60 | 91.5 | 81.8 | 90 | 90.6 | 88.4 |

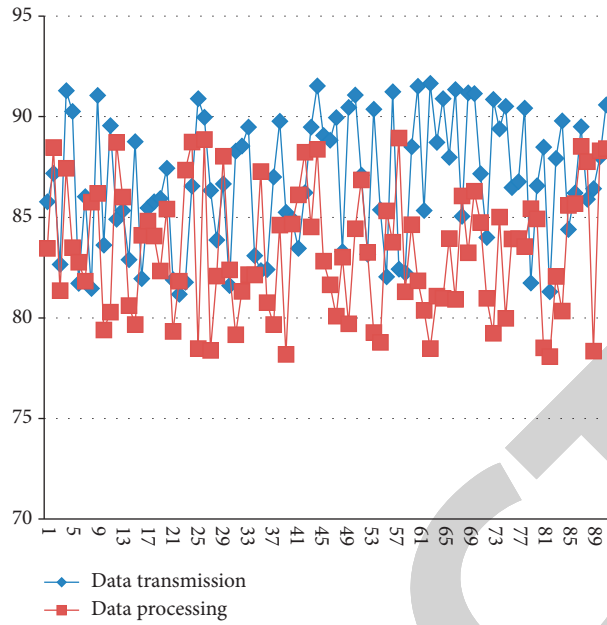


FIGURE 9: Statistical diagram of English data processing effect of the higher English education system based on the Internet of Things system.

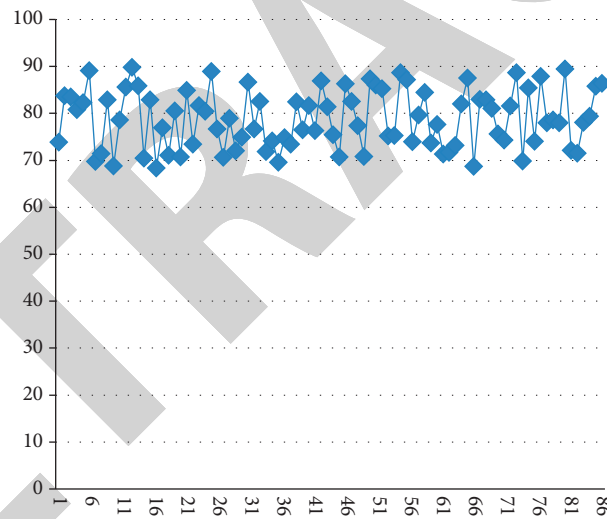


FIGURE 10: Statistical diagram of the English teaching effect of the higher English education system based on the Internet of Things system.

TABLE 2: Statistical diagram of the English teaching effect of the higher English education system based on the Internet of Things system.

| No. | Teaching effect | No. | Teaching effect | No. | Teaching effect |
|-----|-----------------|-----|-----------------|-----|-----------------|
| 1 | 73.9 | 31 | 75.0 | 61 | 84.5 |
| 2 | 83.8 | 32 | 86.7 | 62 | 73.8 |
| 3 | 83.5 | 33 | 76.7 | 63 | 77.7 |
| 4 | 80.8 | 34 | 82.6 | 64 | 71.4 |
| 5 | 82.3 | 35 | 71.9 | 65 | 71.7 |
| 6 | 89.1 | 36 | 74.1 | 66 | 73.2 |
| 7 | 69.8 | 37 | 69.6 | 67 | 82.1 |
| 8 | 71.5 | 38 | 74.8 | 68 | 87.6 |
| 9 | 83.0 | 39 | 73.4 | 69 | 68.8 |
| 10 | 68.9 | 40 | 82.5 | 70 | 83.0 |
| 11 | 78.7 | 41 | 76.6 | 71 | 82.9 |
| 12 | 85.6 | 42 | 81.7 | 72 | 81.1 |
| 13 | 89.8 | 43 | 76.4 | 73 | 75.7 |

TABLE 2: Continued.

| No. | Teaching effect | No. | Teaching effect | No. | Teaching effect |
|-----|-----------------|-----|-----------------|-----|-----------------|
| 14 | 85.9 | 44 | 87.0 | 74 | 74.3 |
| 15 | 70.5 | 45 | 81.4 | 75 | 81.6 |
| 16 | 82.9 | 46 | 75.5 | 76 | 88.7 |
| 17 | 68.4 | 47 | 70.7 | 77 | 69.9 |
| 18 | 77.0 | 48 | 86.3 | 78 | 85.5 |
| 19 | 71.1 | 49 | 82.5 | 79 | 74.1 |
| 20 | 80.6 | 50 | 77.4 | 80 | 87.9 |
| 21 | 70.7 | 51 | 70.8 | 81 | 78.0 |
| 22 | 84.9 | 52 | 87.4 | 82 | 78.7 |
| 23 | 73.5 | 53 | 86.1 | 83 | 78.0 |
| 24 | 81.7 | 54 | 85.3 | 84 | 89.4 |
| 25 | 80.5 | 55 | 75.2 | 85 | 72.2 |
| 26 | 89.0 | 56 | 75.3 | 86 | 71.6 |
| 27 | 76.7 | 57 | 88.7 | 87 | 78.1 |
| 28 | 70.6 | 58 | 87.2 | 88 | 79.4 |
| 29 | 79.0 | 59 | 74.0 | 89 | 85.8 |
| 30 | 72.1 | 60 | 79.7 | 90 | 86.4 |

4. Conclusion

In the context of the rapid development of information technology, the education informatization has promoted the construction of English teaching systems. Among them, the integration of IoT environment monitoring, teaching management, and resource integration creates a better learning environment for students, provides strong technical support for the classroom, and effectively improves the quality of classroom teaching.

Based on the mathematical model and the basic principles of the Q-learning algorithm, this paper designs an algorithm for dynamic configuration of DRX parameters in the RRC sublayer. In order to adapt to changes in the business model of the Internet of Things, the feedback value fading detection is added to the algorithm. When the feedback caused by the originally converged DRX parameters is greatly reduced due to the business model change, the learning process is re-triggered. In addition, this paper combines the actual needs of higher English education to construct the functional modules of the higher English education system and conducts experimental analysis. The research results show that the English teaching system constructed in this paper has a certain effect.

Data Availability

The data used to support the findings of this study are included within the article.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Acknowledgments

This work was funded by the 2020 Research Project on Education and Teaching Reform of Colleges and Universities in Hainan Province, "Research on the Application of China's Standards of English Language Ability in English Formative Evaluation in Higher Vocational Colleges" (Hnjg2020-150).

References

- [1] W. Tushar, N. Wijerathne, W.-T. Li et al., "Internet of things for green building management: disruptive innovations through low-cost sensor technology and artificial intelligence," *IEEE Signal Processing Magazine*, vol. 35, no. 5, pp. 100–110, 2018.
- [2] J. H. Abawajy and M. M. Hassan, "Federated internet of things and cloud computing pervasive patient health monitoring system," *IEEE Communications Magazine*, vol. 55, no. 1, pp. 48–53, 2017.
- [3] D. He, R. Ye, S. Chan, M. Guizani, and Y. Xu, "Privacy in the internet of things for smart healthcare," *IEEE Communications Magazine*, vol. 56, no. 4, pp. 38–44, 2018.
- [4] P. P. Ray, "Internet of things for smart agriculture: technologies, practices and future direction," *Journal of Ambient Intelligence and Smart Environments*, vol. 9, no. 4, pp. 395–420, 2017.
- [5] Y. A. Qadri, A. Nauman, Y. B. Zikria, A. V. Vasilakos, and S. W. Kim, "The future of healthcare internet of things: a survey of emerging technologies," *IEEE Communications Surveys & Tutorials*, vol. 22, no. 2, pp. 1121–1167, 2020.
- [6] B. H. Dobkin, "A rehabilitation-internet-of-things in the home to augment motor skills and exercise training," *Neurorehabilitation and Neural Repair*, vol. 31, no. 3, pp. 217–227, 2017.
- [7] J. Yao and N. Ansari, "Caching in energy harvesting aided Internet of Things: a game-theoretic approach," *IEEE Internet of Things Journal*, vol. 6, no. 2, pp. 3194–3201, 2018.
- [8] J. E. Siegel, S. Kumar, and S. E. Sarma, "The future internet of things: secure, efficient, and model-based," *IEEE Internet of Things Journal*, vol. 5, no. 4, pp. 2386–2398, 2017.
- [9] M. A. Abd-Elmagid, N. Pappas, and H. S. Dhillon, "On the role of age of information in the Internet of Things," *IEEE Communications Magazine*, vol. 57, no. 12, pp. 72–77, 2019.
- [10] A. Sheth, U. Jaimini, and H. Y. Yip, "How will the internet of things enable augmented personalized health?" *IEEE Intelligent Systems*, vol. 33, no. 1, pp. 89–97, 2018.
- [11] G. J. Joyia, R. M. Liaqat, A. Farooq, and R. Saad, "Internet of Medical Things (IOMT): applications, benefits and future challenges in healthcare domain," *Journal of Communications*, vol. 12, no. 4, pp. 240–247, 2017.

- [12] N. Kshetri, "The evolution of the internet of things industry and market in China: an interplay of institutions, demands and supply," *Telecommunications Policy*, vol. 41, no. 1, pp. 49–67, 2017.
- [13] S. Siboni, V. Sachidananda, Y. Meidan et al., "Security testbed for Internet-of-Things devices," *IEEE Transactions on Reliability*, vol. 68, no. 1, pp. 23–44, 2019.
- [14] Y. Yang, M. Zhong, H. Yao, F. Yu, X. Fu, and O. Postolache, "Internet of things for smart ports: technologies and challenges," *IEEE Instrumentation and Measurement Magazine*, vol. 21, no. 1, pp. 34–43, 2018.
- [15] Z. Li, Y. Liu, A. Liu, S. Wang, and H. Liu, "Minimizing convergencast time and energy consumption in green Internet of Things," *IEEE Transactions on Emerging Topics in Computing*, vol. 8, no. 3, pp. 797–813, 2018.
- [16] P. P. Ray, "A survey on Internet of Things architectures," *Journal of King Saud University-Computer and Information Sciences*, vol. 30, no. 3, pp. 291–319, 2018.
- [17] M. Mayer and A. J. Baeumner, "A megatrend challenging analytical chemistry: biosensor and chemosensor concepts ready for the internet of things," *Chemical Reviews*, vol. 119, no. 13, pp. 7996–8027, 2019.
- [18] M. Saez, F. P. Maturana, K. Barton, and D. Tilbury, "Real-time manufacturing machine and system performance monitoring using internet of things," *IEEE Transactions on Automation Science and Engineering*, vol. 15, no. 4, pp. 1735–1748, 2018.
- [19] V. Jagadeeswari, V. Subramaniaswamy, R. Logesh, and V. Vijayakumar, "A study on medical Internet of Things and Big Data in personalized healthcare system," *Health Information Science and Systems*, vol. 6, no. 1, pp. 1–20, 2018.
- [20] S. Smys, A. Basar, and H. Wang, "Hybrid intrusion detection system for internet of Things (IoT)," *Journal of ISMAC*, vol. 2, no. 4, pp. 190–199, 2020.