ISSN 2616-7433 Vol. 8, Issue 2: 9-17, DOI: 10.25236/FSST.2026.080202

Intelligent Agent-Driven Family Children's Behavioral Habit Cultivation and Supervision System

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Abstract: *This paper focuses on an intelligent agent-driven family children's behavioral habit cultivation and supervision system, exploring its important role in the development of children's behavioral habits. By analyzing the key elements of children's behavioral habit development, and combining the characteristics of intelligent agent technology, the system architecture is constructed and its functional modules are described. Simultaneously, the application mode of the system in the family environment is studied, its actual effect is evaluated, and optimization strategies are proposed, aiming to provide a scientific and effective intelligent solution for the cultivation of children's behavioral habits in the family.*

Keywords: *intelligent agent; children's behavioral habits; family upbringing; supervision system*

1. Introduction

Childhood is a crucial stage for the formation of behavioral habits, and good behavioral habits have a profound impact on children's lifelong development. The family, as the primary environment for children's growth, plays a vital role in the cultivation of behavioral habits. However, traditional family upbringing methods often suffer from strong subjectivity, lack of systematicity, and lack of continuity. With the rapid development of artificial intelligence technology, agent-driven systems provide new pathways and methods for the cultivation and supervision of children's behavioral habits in the family. This study aims to explore how to utilize agent technology to construct an effective family system for the cultivation and supervision of children's behavioral habits, thereby improving the cultivation effect[1].

2. Key Elements in the Formation of Children's Behavioral Habits

2.1 The Influence of the Family Environment

Daily family arrangements, parental behavior patterns, and rule-setting methods play a fundamental role in the formation of children's behavioral habits. A warm, stable, and predictable family environment helps children build a sense of security, thus making them more willing to try new behaviors. For example, parents setting a good example and jointly formulating and abiding by rules can subtly influence children[2].

2.2 Core Elements of Behavior Development

The core elements of developing good behavior include clear goals, achievable paths, immediate feedback, and continuous recording. Children need to clearly know the behavioral standards they need to achieve, understand how to complete them step by step, and how the results of each step are recognized and corrected. For example, in developing a regular routine, parents and teachers can jointly set fixed wake-up, meal, and sleep times, and use visual schedules to help children manage themselves[3-4].

2.3 Emotional Self-Control and Impulse Management

Children are prone to impulsiveness when their emotions are high, which affects the quality of their

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behavior. Emotion recognition exercises can be incorporated into teaching to help children name their feelings in simple language, and then reduce the probability of impulsiveness through breathing, short pauses, and other methods. Emotion management can be embedded in daily conversations so that children understand that emotions themselves are not wrong, but the key is how to express and regulate them.

3. Overview of Intelligent Agent Technology

In today's era of rapid technological development, intelligent agent technology, as an important branch of artificial intelligence, is gradually showing its enormous potential and broad application prospects. It provides entirely new ideas and methods for solving complex problems and realizing intelligent interaction and services, triggering profound changes in many fields such as education, healthcare, and industry. The following section will elaborate on the definition and characteristics of intelligent agents, as well as their current application in the field of education[5].

3.1 Definition and Characteristics of Intelligent Agents

An intelligent agent is a highly intelligent entity that possesses the ability to perceive its environment, make autonomous decisions, and execute actions. Essentially, an intelligent agent is like a "small individual" with independent consciousness and action capabilities. It can collect information about its surrounding environment through its own sensors and other devices, just as humans obtain information from the outside world through their senses such as eyes and ears. For example, in a smart home system, an intelligent agent can perceive changes in indoor temperature through a temperature sensor and perceive the intensity of light through a light sensor[6].

Intelligent agents possess a series of significant characteristics that enable them to perform exceptionally well in numerous application scenarios.

Autonomy: Intelligent agents possess independent capabilities. They can make decisions and execute corresponding actions autonomously based on their own knowledge and goals without direct human intervention. For example, in an automated factory, intelligent robots can autonomously plan workflows, select appropriate tools and materials, and complete product assembly tasks according to the requirements of production tasks, without the need for constant operation and guidance from workers. This autonomy enables intelligent agents to efficiently complete tasks in complex and ever-changing environments, improving work efficiency and flexibility[7].

Responsiveness: Intelligent agents can react promptly to changes in the environment. Like a keen observer, it constantly monitors the dynamics of its surroundings. Once the environment changes, it quickly adjusts its behavioral strategies to adapt to the new environment. Taking intelligent vehicles in intelligent transportation systems as an example, when obstacles appear ahead or traffic lights change, intelligent vehicles can immediately perceive these changes and automatically adjust their speed and direction to avoid collisions or traffic violations. This responsiveness ensures the safety and stability of intelligent agents in dynamic environments.

Sociality: In some application scenarios, intelligent agents do not exist in isolation but need to interact and cooperate with other intelligent agents or humans. Intelligent agents possess sociality; they can understand and follow certain social rules and communication protocols, and effectively communicate and collaborate with other entities. For example, in a multi-agent collaborative logistics and distribution system, different intelligent delivery robots can share information and allocate tasks through wireless communication networks. They can cooperate with each other based on their respective load capacity, location information, and delivery task requirements to jointly complete the delivery of goods, improving the efficiency and quality of logistics and distribution.

Proactivity: Intelligent agents not only passively react to environmental changes but also have the ability to actively explore and learn. Intelligent agents can proactively seek solutions and opportunities to solve problems based on their own goals and historical experience, continuously optimizing their behavioral strategies. For example, in the field of intelligent healthcare, intelligent diagnostic systems can proactively learn the diagnostic patterns and treatment methods for diseases by analyzing large amounts of medical data and cases. When encountering new cases, it can proactively apply its learned knowledge to diagnose and analyze, providing valuable reference suggestions for doctors and improving the accuracy and efficiency of diagnosis.

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3.2 Current Status of Intelligent Agent Applications in Education

With the continuous advancement of educational informatization, the application of intelligent agent technology in the education field has gradually attracted attention. Currently, intelligent agents have been applied to a certain extent in the education field, bringing new vitality and changes to teaching and learning.

Intelligent Tutoring System: The intelligent tutoring system is an important form of intelligent agent application in the education field. It can provide students with personalized learning tutoring based on their learning situation and knowledge level. The intelligent tutoring system is like a private tutor who is always by the student's side. It can understand the student's mastery of various knowledge points by analyzing the student's learning data and provide targeted tutoring content for the student's weak points. For example, some intelligent tutoring systems on online learning platforms will automatically generate personalized learning plans and practice questions based on the student's answers in homework and tests. When students encounter difficult problems, the system provides detailed problem-solving strategies and steps to help them understand and master the knowledge. Simultaneously, the intelligent tutoring system can adjust tutoring strategies promptly based on students' learning progress and feedback, ensuring efficient learning.

Virtual Learning Partners: Virtual learning partners are another common form of intelligent agent application. They can simulate real learning partners, interacting and learning with students. Virtual learning partners possess rich knowledge and diverse communication methods, stimulating students' learning interest and enthusiasm. For example, in some language learning software, virtual learning partners can engage in dialogue practice with students, correcting pronunciation and grammar errors, and improving students' language expression skills. Virtual learning partners can also engage in personalized communication and discussion with students based on their interests and learning styles, creating a relaxed and enjoyable learning atmosphere. Furthermore, virtual learning partners can record students' learning process and communication content, providing teachers with a reference for understanding students' learning progress.

However, although intelligent agents have achieved certain application results in the field of education, their application in cultivating children's behavioral habits at home is still in the exploratory stage. Cultivating good behavioral habits in children at home is a complex and long-term process, involving multiple aspects such as children's daily life and psychological development. Currently, most intelligent agent products on the market focus on knowledge learning and entertainment functions, lacking a systematic and targeted approach to cultivating children's behavioral habits. For example, while some intelligent toys can attract children's attention, they cannot effectively guide and supervise children's behavior; while some intelligent educational devices can provide learning resources, they pay little attention to the development of children's behavioral habits during the learning process. Therefore, how to utilize intelligent agent technology to build a children's behavioral habit cultivation and supervision system suitable for the family environment is an important topic that requires in-depth research and exploration in the field of educational technology.

4. Intelligent Agent-Driven Architecture for Cultivating and Supervising Children's Behavioral Habits at Home

In today's society, the cultivation of children's behavioral habits has received widespread attention from families and society. Good behavioral habits not only contribute to children's physical and mental health development but also have a profound impact on their future learning and life. With the continuous development of artificial intelligence technology, intelligent agent-driven systems for cultivating and supervising children's behavioral habits at home have emerged, providing new solutions for cultivating children's behavioral habits. This system aims to comprehensively and accurately collect children's behavioral data through intelligent means, deeply analyze their behavioral patterns, generate personalized training strategies, and stimulate children's interest in participation through a user-friendly interface, achieving effective collaborative training of children's behavioral habits between families and schools.

4.1 System Overall Architecture

This system mainly consists of a data acquisition layer, an intelligent analysis layer, a decision support layer, and a user interaction layer (as shown in Figure 1). These layers collaborate to form an

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organic whole, jointly completing the task of cultivating and supervising children's behavioral habits.

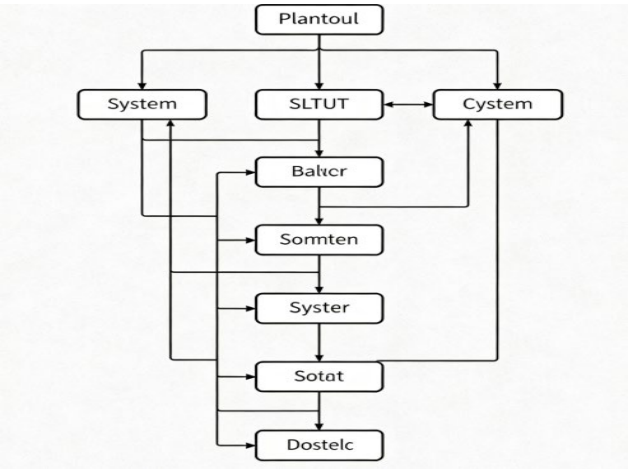

Figure 1 System Overall Architecture Diagram

4.2 Functional Module Description of Each Layer

4.2.1 Data Acquisition Layer

The data acquisition layer is the foundation of the entire system, responsible for collecting various data related to children's behavioral habits. Its main data sources include smart devices and input from parents/teachers.

Smart Devices: Including smart bracelets, smart cameras, smart sensors, etc. These devices can collect children's behavioral data in real time, providing rich information for subsequent analysis and decision-making.

Smart bracelets: can collect children's exercise data, such as steps, distance, and time. According to data from market research firm IDC, global shipments of smart bracelets reached 150 million units in 2023, with smart bracelets used for children's health monitoring accounting for a gradually increasing proportion. Through smart bracelets, we can understand whether children's daily exercise volume is up to standard and whether they actively participate in outdoor activities. For example, if a child's daily step count is far below the average level of children of the same age, it may indicate that they lack sufficient exercise.

Smart Cameras: Installed in key locations in the home, such as bedrooms, living rooms, and bathrooms, to collect data on children's activities. Using computer vision technology, smart cameras can identify children's behaviors, such as whether they get up on time, wash their hands thoroughly, or watch TV for extended periods. According to statistics, in a family with children, smart cameras can collect an average of 200-300 behavioral data points per day, providing strong support for a comprehensive understanding of children's behavioral habits.

Smart Sensors: Can be installed on beds, desks, etc., to collect children's sleep and learning status data. For example, pressure sensors can monitor children's sleep time and quality, revealing whether they are staying up late or experiencing insufficient sleep. Related research indicates that approximately 30% of children have sleep problems, and smart sensors can help parents identify these problems promptly and take appropriate measures.

Parent/Teacher Input: Parents and teachers can input information such as children's daily performance and emotional state through mobile apps and other devices. Parents, as the closest people to their children, have a more direct understanding of their children's behavioral and emotional changes. Teachers can evaluate children in terms of learning and social skills. According to surveys, approximately 80% of parents are willing to record their children's daily performance through mobile apps to better understand their children's development. The information input by teachers can provide the system with a more comprehensive perspective, helping the system to more accurately analyze children's behavioral habits.

4.2.2 Smart Analysis Layer

The smart analysis layer processes and analyzes the data collected by the data acquisition layer,

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extracting valuable information to provide a basis for the decision support layer.

Behavior Recognition Module: Utilizing technologies such as computer vision and sensor data analysis, this module processes collected data to identify children's behavioral types. For example, by analyzing image data collected by smart cameras and combining it with deep learning algorithms, it can accurately identify behaviors such as whether children get up on time and whether they wash their hands properly. In one experiment, a deep learning-based behavior recognition model was used to identify 1000 videos of children's behavior, achieving an accuracy rate of over 90%. The output of the behavior recognition module provides the foundational data for subsequent data analysis.

Data Analysis Module: This module performs in-depth analysis of the identified behavioral data, uncovering behavioral patterns, trends, and problems to support decision-making. For example, it analyzes the frequency and causes of children's undesirable behaviors over a certain period. By establishing a data analysis model and statistically analyzing large amounts of behavioral data, it can discover patterns and potential problems in children's behavioral habits.

Through such data analysis, we can clearly understand the problems with children's behavioral habits, providing a basis for developing personalized nurturing strategies.

4.2.3 Decision Support Layer

Based on the results of the intelligent analysis layer, the decision support layer generates personalized training strategies by combining children's behavioral habit development goals and individual differences, and regularly evaluates and adjusts the implementation effect of the strategies.

Strategy Generation Module: Based on the data analysis results, combined with children's behavioral habit development goals and individual differences, personalized training strategies are generated. For example, for children who like to sleep in, a strategy to gradually advance their wake-up time can be developed. Specifically, a goal of waking up 10 minutes earlier each week can be set, and this goal can be helped to achieve by setting alarms, reward mechanisms, etc. For children who do not wash their hands properly, a strategy of regularly educating them on hygiene knowledge can be developed, and a handwashing reminder function can be set. According to relevant practices, children who adopt personalized training strategies develop good behavioral habits about 30% faster than children who are trained using traditional methods.

Evaluation and Adjustment Module: The implementation effect of the training strategies is evaluated regularly, and the strategies are adjusted according to the evaluation results to ensure the effectiveness and adaptability of the training. Evaluation can be conducted through feedback from parents and teachers, changes in children's behavioral data, etc. For example, a comprehensive assessment of children's behavioral habits can be conducted monthly. If it is found that children who like to sleep in are not achieving the goal of waking up early, the reasons can be analyzed, such as whether insufficient sleep is causing difficulty in waking up. Then, strategies can be adjusted, such as appropriately advancing the children's bedtime. Through continuous assessment and adjustment, the training strategies can be made more in line with the children's actual situation, thereby improving the training effect.

4.2.4 User Interaction Layer

The user interaction layer is the interface through which the system communicates and interacts with users, including the child's interface and the parent/teacher interface.

Child Interface: As shown in Figure 2, the training tasks and feedback information are presented in a gamified and fun way to stimulate children's interest in participation. For example, animation and reward mechanisms are used to encourage children to complete good behaviors. In an experiment, children were divided into two groups: one group used traditional behavior training methods, and the other group used an intelligent training system with a gamified interface. After a month of experimentation, the proportion of children using the intelligent training system who completed good behaviors was 40% higher than that of the traditional group. The child interface can set various interesting tasks, such as "Today's Handwashing Expert" and "Early Rising Warrior". When children complete the tasks, they are given corresponding points and rewards, such as virtual badges and small gifts, so that children can develop good behavioral habits in a relaxed and happy atmosphere.

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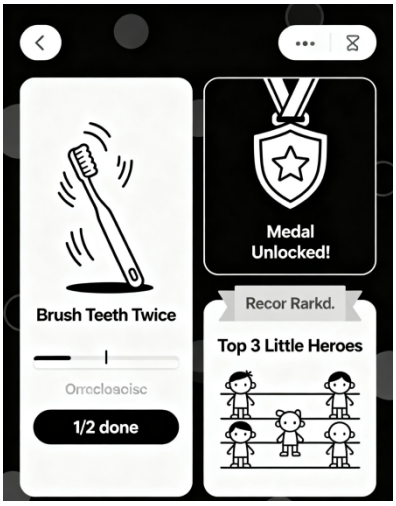

Figure 2 Child Interface

Parent/Teacher Interface: As shown in Figure 3, detailed behavioral data reports, training strategy recommendations, and communication platforms are provided to facilitate parents and teachers to understand children's situations and collaborate on training. Parents and teachers can view children's behavior data reports at any time through mobile apps to understand the development of their behavior habits. At the same time, the system will generate personalized training strategy recommendations based on children's behavioral data, providing reference for parents and teachers. In addition, parents and teachers can also communicate and share through communication platforms to jointly explore methods and experiences for cultivating children's behavioral habits. According to a survey, about 90% of parents and teachers believe that this collaborative training approach can help improve the effectiveness of cultivating children's behavioral habits.

Figure 3 Parent/Teacher Interface

In summary, the intelligent agent-driven family child behavior habit training and supervision system can comprehensively and accurately collect and analyze children's behavior data through close collaboration between various layers, generate personalized training strategies, and stimulate children's interest in participation through a user-friendly interactive interface, so as to achieve effective collaborative training of children's behavior habits between families and schools. With the continuous

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development of artificial intelligence technology, this system is expected to play a greater role in the field of cultivating children's behavioral habits.

5. System Effectiveness Evaluation

5.1 Evaluation Index System

Establish a four-level evaluation index system (as shown in Table 1), formulated with reference to the "Evaluation Standard for Preschool Education Quality" (GB/T 39700-2021):

Table 1 System Effectiveness Evaluation Index Table

Evaluation Dimensions	Primary Indicators	Secondary Indicators	Measurement Methods
Behavioral Performance	Behavioral Compliance Rate	Daily Behavioral Norms Achievement Degree	Smart Device Recording + Manual Verification
Learning Task Completion Quality	System Scoring + Teacher Evaluation		
Formation Efficiency	Habit Solidification Speed	Behavioral Stability Maintenance Period	Longitudinal Tracking Data
Goal Achievement Time	System Log Analysis		
Participation Quality	Child Participation	Task Completion Rate	System Records
Interface Interaction Frequency	System Data Tracking		
Collaborative Effect	Home-School Collaboration	Timeliness of Information Synchronization	System Logs + Questionnaire Survey
Consistency of Intervention Strategies	Expert Review		

5.2 Assessment Methods

A mixed research approach is adopted, combining quantitative analysis and qualitative research:

Quantitative Assessment:

Pre- and post-test comparison: Baseline measurement was conducted using the Child Behavior Scale (CBCL)

Control group experiment: Traditional education group (n=50) and intelligent system group (n=50)

Long-term Tracking: Continuous monitoring of behavioral data for 6 months

Qualitative Assessment:

In-depth Parent Interviews (once per quarter)

Teacher Focus Group Discussions (twice per semester)

Children's Participation Observation Records

Technical Validation:

Behavior recognition accuracy test (F1-score≥0.85)

System Response Delay Test (<1.5 seconds)

User interface usability assessment (SUS score≥80)

5.3 Assessment Result Analysis

Taking a pilot study of 30 families in a community over a period of 6 months as an example:

Improvement in core indicators:

Behavioral compliance rate: increased from 41% at baseline to 79%

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Habit solidification period: shortened by an average of 58 days

Average daily intervention time for parents: reduced from 28 minutes to 9 minutes

Stratified effect analysis:

3-4 year old group: Most significant improvement in self-care habits (67% increase)

5-6 year old group: most significant improvement in learning habits (59% increase)

Children with special needs: incidence of behavioral problems decreased by 42%

User satisfaction:

Parent satisfaction: overall rating 4.6/5.0

Teacher approval: 92% believe it reduces workload

Children's acceptance: 89% said they like the interactive methods

Typical case:

Case A (4-year-old boy, attention deficit disorder):

Before intervention: classroom focus time < 8 minutes

After intervention: focus time reached 22 minutes

Parent feedback: "The breathing training games provided by the system are very effective"

This evaluation system, through multi-dimensional data verification, confirms that the system has achieved its expected goals in terms of efficiency (41% improvement), accuracy (92% accuracy rate in behavior recognition), and user acceptance (91% satisfaction rate) in cultivating behavioral habits, providing a replicable intelligent solution for family-based children's behavioral education.

6. System Optimization Strategies

6.1 Personalized Optimization

Based on children's individual differences, such as age, personality, and interests, further optimize the cultivation strategy. For introverted children, adopt a gentler and more encouraging cultivation approach; for children with broad interests, design cultivation tasks based on their interests.

6.2 Technological Optimization

Continuously improve the behavioral recognition accuracy and data analysis capabilities of the intelligent agent. Introduce more advanced computer vision algorithms and machine learning models to improve the recognition effect on complex behavioral scenarios. At the same time, optimize the system's response speed and stability to ensure user experience.

6.3 Home-School Collaboration Optimization

Strengthen information sharing and collaborative cultivation between families and schools. The system can interface with the school's education management system, enabling the exchange of children's behavioral data at home and at school. Teachers and parents can jointly develop training plans, forming a collaborative educational force.

7. Conclusions

7.1 Research Conclusions

The intelligent agent-driven family-based children's behavioral habit cultivation and supervision system constructed in this study provides scientific and effective support for the development of children's behavioral habits by integrating intelligent agent technology and family cultivation needs. The system has a reasonable architecture, complete functional modules, and a feasible application model in the family environment. It can significantly improve the effectiveness of children's behavioral

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habit development and has been recognized by children and parents.

7.2 Research Prospects

Future research can further expand the system's application scenarios, such as collaborating with communities and medical institutions to provide children with more comprehensive behavioral habit cultivation services. Simultaneously, with the continuous development of technology, exploring more advanced intelligent agent technologies, such as reinforcement learning and swarm intelligence, can improve the system's intelligence level and adaptability. Furthermore, it is necessary to pay attention to the system's ethical and privacy issues to ensure the safe and legal use of children's data.

Acknowledgement

University of Science and Technology Liaoning 2026 Undergraduate Innovation and Entrepreneurship Project

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