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Study on audio-visual family restoration of children with mental disorders based on the mathematical model of fuzzy comprehensive evaluation of differential equation

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Abstract

The category of audio-visual dysfunction represents the largest group of children with delayed language development. Audio-visual dysfunction not only affects children's normal communication but also hinders their growth, becoming the main reason affecting their life and learning. In China, medical resources for children with audio-visual dysfunction are noticeably insufficient and cannot be valued. The rehabilitation exercise cycle is long, and patients and their parents are mostly unable to adhere to it in the long-term. Aiming at addressing these problems, this paper tries to design and study the family treatment system of audio-visual dysfunction independently. Users with experience design users for zhongtun, jizuatun and li, experience full link, pay attention to the details of each experience point, strive to accurately complete each treatment training in the most efficient display space and play the training function of the acme. Behind the emotional expression, a good design with common characteristics of user experience is made through the front iteration process of user model establishment and data accumulation. The research content of this paper is structured as follows: first, it studies the principle of user experience, analyses the influence of mobile devices on pre-school children and discusses the characteristics of existing children's educational toys and children's interactive products, as well as the physical and intellectual characteristics of pre-school children. Then, the classification, causes and treatment of children's visual and audio impairment are discussed. The design method of combining the theoretical movement of user experience with children's audio-visual functional family therapy system is mentioned. Then, more effective user requirements were collected through observation of target user behaviour, single interview and exploration of storage and modelling. We also summarise user requirements, build user models in story form and prioritise requirements.

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1 Mathematical model construction of fuzzy comprehensive evaluation of differential equation

1.1 The coupling catalytic reaction model was solved by adomian decomposition method

Adomian decomposition method was used to solve the coupling catalytic reaction model. Coupling catalytic reaction mathematical model is one of the classical models in chemical reaction engineering. Because of its strong nonlinearity, it is difficult to get. Different from the classical two-phase model which contains the transfer coefficients between single phase, the three-mode model contains three transfer coefficients which represent the transfer coefficients of heat and mass between phases and phases [1, 2]. In this case, in order to predict the temperature and fluid concentration distribution in the reactor in more detail, a reduced order three-mode model is needed to analyse the flow problem in the flow passage with homogeneous reaction and wall catalytic reaction in the reactor. Referring to the classical coupling catalytic reaction model, the following dimensionless coupling catalytic reaction model was established:

$$\begin{cases} f(y) \frac{\partial c}{\partial x} = \frac{1}{Pe} \frac{\partial^2 c}{\partial x^2} + \frac{1}{p} \left(\frac{\partial^2 c}{\partial y^2} + \frac{s}{y} \frac{\partial c}{\partial y} - \frac{\phi^2}{p} \exp \left[\frac{\gamma_h \theta}{1+\theta} \right] \right) \\ f(y) \frac{\partial \theta}{\partial x} = \lambda \frac{Le_f}{Pe} \frac{\partial^2 \theta}{\partial x^2} + \frac{Le_f}{p} \left(\frac{\partial^2 \theta}{\partial y^2} + \frac{s}{y} \frac{\partial \theta}{\partial y} \right) + \beta \frac{\phi^2}{p} c \exp \left[\frac{\gamma_h \theta}{1+\theta} \right] \end{cases}$$

$F(y)$ is the velocity profile. It should be noted that the coupling catalytic reaction has an f coefficient, which has a singularity. The given boundary conditions are as follows:

$$\begin{aligned} \frac{1}{Pe} \frac{\partial c}{\partial x} &= f(y)(c-1), \\ x=0, \lambda \frac{Le_f}{Pe} \frac{\partial \theta}{\partial x} &= f(y)(\theta - \theta_{in}), \\ x=1, \frac{\partial c}{\partial x} &= 0, \\ \frac{\partial c}{\partial y} &= -\frac{\phi_c^2}{(1+s)} c \exp \left[\frac{\gamma_c \theta}{1+\theta} \right], \\ y=1, \frac{\partial \theta}{\partial y} &= \frac{\beta}{Le_f} \frac{\phi_c^2}{(1+s)} c \exp \left[\frac{\gamma_c \theta}{1+\theta} \right], \\ y=0, \frac{\partial c}{\partial y} &= 0, \\ y=0 \frac{\partial \theta}{\partial y} &= 0, \\ c(0,y) &= b_0, \\ \theta(0,y) &= d_0. \end{aligned}$$

1.2 Derivation of approximate analytical solution for coupled catalytic reaction model

We define the following linear operators:

$$L_x = \frac{\partial}{\partial x}, L_y = \frac{\partial}{\partial y}, L_{xx} = \frac{\partial^2}{\partial x^2}$$

Then it can be deduced that:

$$\begin{cases} f(y) L_x c = \frac{1}{Pe} L_{xx} c + \frac{1}{p} (L_{yy} c + \frac{s}{y} L_y c) - \frac{\phi^2}{p} c N(\theta), \\ f(y) L_x \theta = \lambda \frac{Le_f}{Pe} L_{xx} \theta + \frac{Le_f}{p} (L_{yy} \theta + \frac{s}{y} L_y \theta) + \beta \frac{\phi^2}{p} c N(\theta) \end{cases}$$

By operating on the inverse operator, we can continue to get:

$$c = pL_{yy}^{-1}L_xc - \frac{p}{Pe}L_{yy}^{-1}L_{xx}c - sL_{yy}^{-1}\left(\frac{1}{y}L_yc\right) + pDaL_{yy}^{-1}[cN(\theta)] + A(x)y + B(x),$$

$$\theta = \frac{p}{Le_f}L_{yy}^{-1}L_x\theta - \lambda\frac{p}{Pe}L_{yy}^{-1}L_{xx}\theta - sL_{yy}^{-1}\left(\frac{1}{y}L_y\theta\right) - \frac{p}{Le_f}\beta DaL_{yy}^{-1}[cN(\theta)] + C(x)y$$

For the recursive algorithm in adomian decomposition method, we use the dual decomposition method:

$$B(x) = \sum_{n=0}^{\infty} b_n x^n$$

$$D(x) = \sum_{n=0}^{\infty} d_n x^n$$

We use six terms to approximate the exact solution and assume the expression:

$$\begin{aligned}\bar{c} &= \bar{c}(x, y; p, s, \lambda, u, v, Da, \beta, \gamma_h, b_0, b, 1 \dots, b_5, d_0, d_1, \dots, d_5) \\ &= b_0 \sum_{n=1}^5 c_n(x, y; p, s, \lambda, u, v, Da, \beta, \gamma_h, b_0, b_1, \dots, b_5, d_0, d_1, \dots, d_5); \\ \bar{\theta} &= \bar{\theta}(x, y; p, s, \lambda, u, v, Da, \beta, \gamma_h, b_0, b, 1 \dots, b_5, d_0, d_1, \dots, d_5) \\ &= d_0 \sum_{n=1}^5 \theta_n(x, y; p, s, \lambda, u, v, Da, \beta, \gamma_h, b_0, b_1, \dots, b_5, d_0, d_1, \dots, d_5)\end{aligned}$$

2 User experience process and method of family treatment system for children's audio-visual dysfunction

2.1 User experience process of family treatment system for children with audio-visual dysfunction

To study the treatment system of children's audio-visual dysfunction, it is necessary to understand the whole process of audio-visual dysfunction children receiving doctor's training and issuing voice [3, 4]. After asking parents about their child's language diagnosis, the children with audio-visual impairment were evaluated with the use of qiyin bo, and the muscle occlusion of the lower song, lips, tongue and other parts were evaluated, as well as the development of organs W and the sound production. The specific process is shown in Figure 1 below.

Based on the design of the user experience of users for nuclear chariot, and by observing the demand by the user, we design the product framework, design practice, carry on the usability testing and let the user modify on the test results, thereby reducing development costs. In the process of development, a fixed process is also required. The specific process is shown in Figure 2 below [5, 6].

2.2 Demand analysis

Through research concerning the seeing-and-hearing-impaired child's age, we have ascertained that children begin to focus at 2–4 years of age, the age for pre-school children; from the point of view of the user experience, emotional need involves showing people that the product produced in the process of experiencing involves the need to focus on function, demand for visual and sensory experience, and paying attention to the use of communication between process and product. The human experience is realised by the five senses of sight, hearing, sense of smell, touch and taste. The colour survey chart is shown in Figure 3 in detail [7, 8].

The audio playback function meets the auditory needs of children with audio-visual impairment, as well as the emotional needs of children who are curious about sound. Details of its requirements are shown in Figure 4.

web server in nodejs: classes relation map

Fig. 1 User experience flow chart.

2.3 Summarise user requirements

User requirements have been summarised according to the observation of user behaviour—and the analysis and summary of user functional needs and emotional needs—provided in the previous section. For details of the hierarchical analysis diagram of user requirements, see Figure 5.

At present, with the development of science and technology, the auxiliary role of APP in treatment is also very prominent. In order to show its auxiliary situation, the required information is presented in the form of a chart; see Figure 6 [9, 10].

3 User experience, children's products and treatment of children's audio-visual impairment

Audio-visual tests involved reading aloud and telling a story with picture cards. Then, the audio-visual organs, such as the mouth, lips, tongue, soft teng and lower collar, were examined by sucking, swallowing and chewing. Also, we performed listening tests and tests of intelligence and cognitive function. As a common assessment tool for language development, the scale for language development and intelligence development of pre-school children in clinical practice is a common assessment tool. The specific steps are shown in Figure 7.

For the learning part, doctors will use the induction phonograph to target pre-school children aged 0–6 years from the stage of unconscious communication to the stage of skilled sentence formation, which is a gradual

Fig. 2 Development flow chart.

Fig. 3 Colour survey chart.

Fig. 4 Demand hierarchy of children's audio-visual dysfunction.

learning process. Specific audio-visual function evaluation is shown in Figure 8.

Audio-visual and audio training is completed step by step by listening, learning, contrast and strengthening. For this reason, the following section also summarises the relevant strategies, details of which are shown in Figure 9.

Fig. 5 Analytic hierarchy process diagram of user requirements.

Behavior observation	The functional requirements
High cost	APP is needed to assist
Family counseling difficulties	APP is needed to assist
Curious about sound	Use sound to attract attention
Inability to concentrate	teach through lively activities
Lack of participation	Add game items
Unable to complete the pronunciation	Video training
Consult your doctor	Discussions between parents

Fig. 6 Display diagram of APP assistance.

Finally, different organs have different ways of pronunciation. The summarisation provided in Figure 10 explains this concept in the form of pictures.

4 Conclusion

In this paper, with the help of power series method, adomian decomposition method and matlab computing tools, the approximate solutions of mathematical models of differential equations with biological and chemical background are studied, and the biological and chemical phenomena described by these differential equations are explained by images. However, not every differential equation can be solved by Picard successive approximation, power series and adomian decomposition. Since differential equations are applied in almost all basic and applied subjects, it is extremely important to study and explore the methods of solving differential equations. In fact, solving differential equations is a complicated process, especially for higher order partial differential equations. Although many methods have been developed to solve differential equations, there is still no unified method to solve all kinds of differential equations. Therefore, the study of solving differential equations is still a long way off, and we need to continue to work hard to solve the problem. At first, the rehabilitation

Fig. 7 Steps of treatment for visual and audio impairment.

Fig. 8 Audio-visual function evaluation diagram.

Fig. 9 Treatment strategy map for audio-visual disorders.

name	Consonant phonemes	Place of articulation
bilabial	b p m	Upper lip and lower lip
labiodental	f	Upper lip and lower lip
blade-alveolar	d t n l	Lip tip
velar	g k h	tongue
The lingual sounds	j q x	blade
blade-palatal	zh ch sh r	pre-alveolar

Fig. 10 Statistical diagram of vocal parts of audio-visual organs.

period of children with audio-visual impairment is long, and children's nature and other reasons make the rehabilitation training difficult. Family management system for children with audio-visual dysfunction is a socially responsible design to meet the needs of children with audio-visual dysfunction, and also the requirements of their parents. This paper studies the design of APP for families having children with audio-visual dysfunction. In the process of research and design, the user experience theory is used as a reference and guidance. Also on pre-school children cognitive and behaviour analysis, we design a set of research from software to hardware training of innovative products, make more efforts to audio-visual functional disorder children, break and sound bo - this is limited to use in the hospital for deaf children but also his eyebrows preceding general will mentally disabled children involved in treatment of large equipment.

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