# Next Generation Programming for Chinese Kids' Education

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*Abstract*

*Based on the comparative analysis of children's programming games/toys, this paper explores the design of children's programming games/toys for Chinese kids' education. This research on the following four contributions: 1. designing children's programming games with Chinese characteristics; 2. strengthening interaction to increase children's interest; 3. avoiding visual impairment to children; 4. designing children's programming games/toys based on artificial Intelligence. These make use of the existing children's programming environment, design programming tool for Chinese children. In addition, this study has designed the basic functions and opened them to GitHub, which is expected to attract more study and work together to create a more better tool for kid programming .*

*Keywords: Children programming games; Computer thinking; computer education; UI of Chinese characteristics; Traditional culture; Programming statement module; Artificial intelligence; Linear regression model; Convolutional neural network; Image recognition.*

## 1. Introduction

With the rapid popularization of computer and mobile phones, computer science and technology has become an indispensable part of modern education. Many foreign countries carried out computer-related education for children many years ago. Even in recent years, some very good graphical programming tools have emerged, these tools take computer thinking as the theory of guiding children's programming, and put computer programming into children's way, help children to program. Children could learn how to use programming tools to make children's games/toys by themselves, which is very popular with children and parents. Comparatively, our children's computer education is still in the initial stage in China. This paper focuses on how to use the existing programming

environment for children to research and design suitable programming games/toys for Chinese children. Based on the comparative analysis of domestic and international children's programming games/toys, this paper trys to find out suitable programming games/toys for Chinese children. The primary research focuses on the following four aspects: first, design children's programming games with Chinese characteristics, the second, strengthen interaction to increase children's interest, third, try best to avoid visual impairment to children, the last designing based on artificial intelligence.

According to above four design directions, this paper mainly designs and studies two types of children's programming games: the first type is about the design of children's toys/games with Chinese characteristics, focusing on the core - learning computer programming thinking, introducing traditional Chinese culture and customs which are closely related to Chinese children's life, and also add two important factors which are derived from the results of children's toys research: "strengthen interaction to increase children's interest" and "try best to avoid visual impairment to children", which are the basic design criteria to design children's programming games for Chinese children. First choose a Chinese traditional festival - Dragon Boat Festival, work out the useful knowledge and data about Dragon Boat Festival, extract and design many UI elements with Chinese characteristics and the cartoon image, let our children's game design and develop with the positive and healthy cultural elements with Chinese characteristics, expect that the culture and values embodied in these games will have a subtle impact on children. Again with the resource of the traditional Dragon Boat Festival and traditional customs, as well as some useful knowledge, to develop three children's programing games, our target is to learn and understand knowledge in the game way. These three separate children programming game projects, implemented within Google Blockly programming environment, but has different themes, such as: Festival tips, Dragon boat racing, and Realgar wine, and each game projects have different forms, but all are basically with familiar programming statement modules such as "If else" statements , Switch statement, the While loop statements and so on, to achieve with connecting these programming modules in logic way, especially the game of "Festival tips" invokes a popular API to implement voice synthesis technology to increase speech recognition, speech output features. This paper work on research within Google Blockly programming environment, design the different useful programming statement modules, logically stitch these encapsulation programming statement module, in order to improve children's logical reasoning ability, and hands-on ability to solve problems, let the children start from playing a game, learn how to use programming tools to make their own games or toys, to train the children's programming concepts, as well as enjoy the experience of studying computer programming thinking.

The second type of children's games is based designing with Artificial Intelligence technology. The part introduced a popular computer technology - artificial intelligence,

with the deep learning library - TensorFlow, in children's games to achieve automatic image recognition, let children could better interact with the games or toys. In this children's game, we compared the Linear Regression Linear Regression model and the Convolutional Neural network model, through importing a handwritten digital data set that contains more than hundred thousand samples and labels, and carried these samples and labels into the training and test model, and adjust the best parameters such as learning rate, the training times, and looking for the best learning rate by compare the loss function values, as well as the final value – the test precision, at last, the Convolutional Neural network algorithm after tuning parameters takes the advantage of image reorganization in the children's game.

Eventually, convince that using the existing children's programming environment, make the programming games/toys for children in China have a lot of education value, this paper is based on analysis of children's programming games/toys at home and abroad, analysis and explore suitable programming games for Chinese children, explore the research from four aspects as above mentioned, and the four children's games that designed in this paper also are fully reflected these four aspects, of course, how to optimally show these goals is a very difficulty and worth exploring question, we expect more children's game designers to study and carry more discussion on this, work together to create a better solution.

## 2. Implementation

This paper designs and studies suitable programming games for Chinese kids. Training from elementary to more professional , Chinese children can learn and understand computer thinking well. The first stage of game UI design needs more, in order to attract children's interest in this children's game and win their experience, a good set of UI can play an important role, with the theme of this programming game: Chinese traditional festival - Dragon Boat Festival Interplay, Chinese game UI and cartoon image design can help children understand the entire programming game. First of all, it is necessary to collect, learn and organize a large number of Chinese characteristic elements. Of course, we must collect and organize the popular, high-quality and creative UI design materials. The author has designed a set of Chinese characteristics through understanding these materials. The children's game UI, as the children's programming toy/game UI studied in this topic, will be shown in the specific introduction of the following children's programming game. The second stage of the game is based on the learning understanding of the previous stage of the game to carry out deeper computer thinking learning. The "handwritten digit recognition" game is introduced through the application of linear regression Linear Regression model and Convolutional Neural Networks model, including more than 100,000 Handwritten

digital data sets of samples and labels, as well as training and testing thereof, comparing parameters such as learning rate and training times, and comparing the loss function values to find the optimal learning rate, and the final value-test Accuracy comparison, by visualizing the linear regression and CNN algorithm to optimize the parameters, the handwritten digit recognition in the children's game, and finally realize the visualization of the CNN structure to help understand the artificial intelligence thinking.

## 2.1. The main screen for Children's Game

This paper implemented this children's game with four sub-games. The completed main UI interface of the programming game is as followed Figure 1 (a), including the main interface of the children's programming game and the main cartoon image, as well as the game theme "Dragon Boat Festival" and four game project names. They are "Festival tips", "Dragon boat racing", "Realgar wine", and "Handwriting picture recognition", and the traditional elements about this traditional festival are displayed with the game UI, which clearly clarifies the game theme.



|         (a)          |          (b)          |

*Figure 1 (a) The main screen for Children's games, (b) The 5$^{th}$ level scene for Realgar wine game*

## 2.2. "Realgar wine" Game

The "Realgar wine" game totally has 5 different levels game scenes,this game uses different maps from level 1 to level 5. The types of programming modules that can be used range from one to many, guiding children to think about using different programming module combinations, and even finding the best. The combination of modules to achieve the game goals, such as the game level 2 only provides three programming modules "turn left", "turn right" and "fire", children need to think about which programming modules to use to achieve the purpose of the game, is there still Other splicing module mode, and the game level 5 as shown in Figure 1 (b), adding a loop-like module "repeated () times to execute XX" command, does not limit the number of programming modules used, guiding children

to learn different splicing methods to achieve the game goal,train children to think logically.

## 2.3. "Dragon boat racing"Game

The "Dragon boat racing" game totally has 6 different levels scenes,this game uses different rivers from level 1 to level 6. There are also a variety of programming modules that can be used to guide children to think about using different programming modules and even find the most. Excellent module combination to achieve the game goal, such as level two only provide two programming modules "forward" and "turn right", can only reuse these two modules, guide children to think whether there is a more concise and quick splicing module The way to achieve the goal of the game, let them form the expectation of a similar "loop statement" function module, and then introduce a new module of this function "repeated XX () times) in the later game level, thus training the child's programming logic. In the implementation of level 6, add a similar if else statement module "if (front / left / right) has a way to execute XX", limit the use of up to 4 programming modules to achieve the game goal, strengthen children's programming logic thinking, as shown in Figure 2 (a).
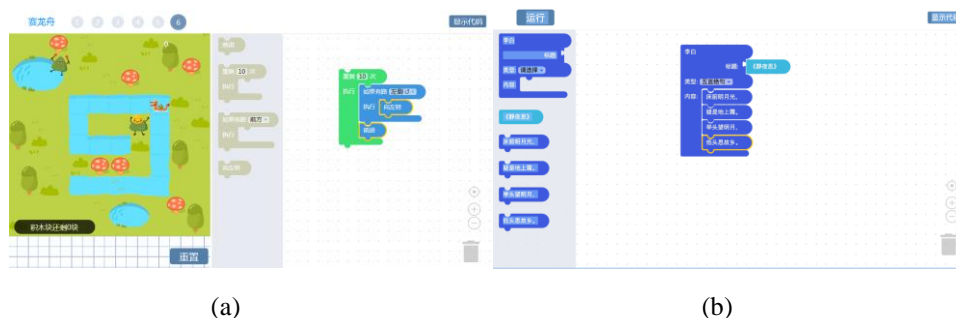


|           (a)           |           (b)           |

*Figure 2 (a) The 6$^{th}$ level scene for Dragon boat racing game, (b) 1-4 The main scene for Festival tips game*

## 2.4. "Festival tips"Game

There are two areas in the game as Figure 2 (b), the tool area and the work area. Select the appropriate programming module from the tool area and drag it to the work area, and splicing it correctly,then press the "Run" button on the game UI. The game uses the text content in the form of text data. Send it out, and then return the audio file and play it back in the cloud. This paper hopes to use this game to help children experience the smart technology which is commonly used in life.

## 2.5. "Handwriting picture recognition"Game

This"Handwriting picture recognition" game, kids can use the mouse to draw any number in the drawing area, then the game will apply the recognition model of two different algorithms and judge the result of the recognition probability of the input number. The two examples have different probability as Figure 3, such as random hand-painting "1" in the game, the probability that CNN is recognized as 1 is 0.803, and the probability of linear regression being recognized as 1 is 0.534, try other hand-painting, hand-painted in the game. "4", the probability that CNN recognizes as 4 is 0.450, and the probability that linear regression is recognized as 4 is 0.033. as shown in Table 1 below, The handwritten digit recognition is recognized in children's games after visually comparing linear regression and convolutional neural network algorithm tuning parameters.
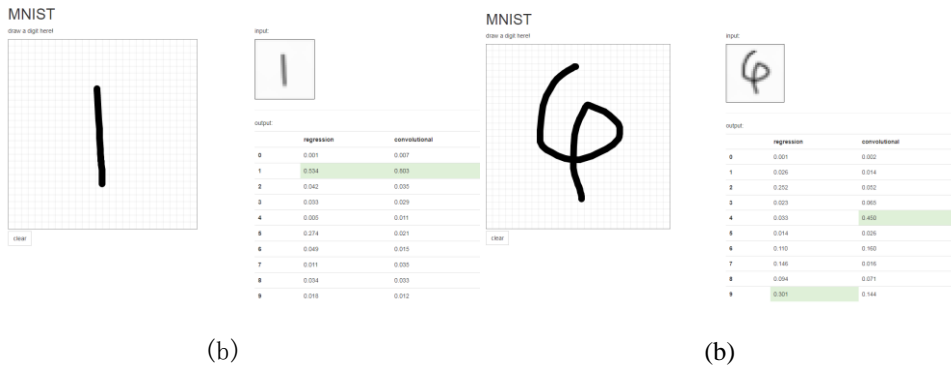


(b)                                        (b)

*Figure 3. Handwriting picture recognition example, (a) The picture is recognized as 1, (b) The picture is recognized as 4*

**Table 1 Comparation for Handwriting picture recognition**

| Input(draw a digit) | base | Line Regression | CNN |
|---|---|---|---|
| draw a "*1*" | 0 | 0.001 | 0.007 |
| draw a "*1*" | 1 | 0.534 | 0.803 |
| draw a "*1*" | 2 | 0.042 | 0.035 |
| draw a "*1*" | 3 | 0.033 | 0.029 |
| draw a "*1*" | 4 | 0.005 | 0.011 |
| draw a "*1*" | 5 | 0.274 | 0.021 |
| draw a "*1*" | 6 | 0.049 | 0.015 |
| draw a "*1*" | 7 | 0.011 | 0.035 |
| draw a "*1*" | 8 | 0.034 | 0.033 |
| draw a "*1*" | 9 | 0.018 | 0.012 |

## 3. Conclusion

From the aspect of our games' architecture, we have created the Game base class for these four children's games studied in this paper, which is used to manage the initialization of all games and define some common methods:

(1) Blockly's toolbar (toolbox) and namespace (workspace) are created during initialization, and the dialog display (showDialog) and hidden (hiddenDialog) methods are defined to display the prompts at the beginning of the game and to display the game. result. The load resource method loadImages is used to load the image resources required for each game.

(2) We also created four game-related classes, namely Dragon Boat, Realgar Wine, Festival Tips, and Handwritten Picture Recognition AI. These four classes are inherited from the Game base class. The initialization of all games is managed by the Game base class. The four game classes define their own methods, such as executing the game play and resetting the game reset. Among them, the handwritten picture recognition AI The class has a getResult method that is used to call the model interface to get the result of the recognition. The method of getVoice in the poetry game Festival Tips is used to retrieve the interface and get the text-to-speech audio file.

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