

A Scientific Adventure with Mr. Bob the Green Blob

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ABSTRACT

A Scientific Adventure with Mr. Bob the Green Blob is an educational, find-and-seek type of game intended for the young disabled students of the Philippine Cerebral Palsy Institute in which the player is tasked to find or identify basic scientific concepts through images and words. Users have the option of using a standard mouse or a head mouse when playing the game in order to promote better posture, mobility, and dexterity. Depending on the level of impairment in a person with cerebral palsy, the rehabilitation one must go through varies a lot. The main objective of this game is to assist in the area of rehabilitation in addition to being a fun way of assessing the student's knowledge in science. During the testing of *A Scientific Adventure*, the patients generally sat with a proper sitting position in spite of their handicaps.

Categories and Subject Descriptors

K.8.0 [General]: Games

General Terms

Experimentation, Human Factors, Measurement

Keywords

Cerebral palsy, Children with Disabilities, Educational Games for Children

1. INTRODUCTION

Cerebral Palsy (CP) is a diagnostic term used to describe a group of motor syndromes resulting from disorders of early brain development. Although CP is often associated with epilepsy and abnormalities of speech, vision, and intellect, it is the selective vulnerability of the brain's motor systems that defines the disorder. CP is caused by a broad group of developmental, genetic, metabolic, ischemic, infectious, and other acquired etiologies that produce a common group of neurologic phenotypes. Furthermore, it is the most common disorder, with an estimated prevalence of 2/1,000 population. [1]

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In the Philippines, there is no non-stock and non-profit organization dedicated to helping CP patients other than the Philippine Cerebral Palsy Incorporated (PCPI). [6] As a result of being largely dependent on donations, the organization is always in need of ways to help its patients in all aspects of their lives. One of the more overlooked areas in their school is their computer education system. The computers in the school are currently only being used for leisure – browsing the internet or playing games. In partnership with the organization, we decided to develop a game that can aid in the rehabilitation of the patients in addition to providing a source of entertainment and knowledge.

In this paper, we will introduce the game *A Scientific Adventure with Mr. Bob the Green Blob* which is tailored for young students with CP. The target audience for this game is the pool of patients in the Philippine Cerebral Palsy Incorporated, namely those who have CP and have varying degrees of physical limitations such as tense arm muscles, bad posture, and learning disabilities. The main objective of this game is to assist in improving the posture of the user with CP in order to promote better mobility and dexterity. Through the use of a standard mouse or a head mouse, users will be able to focus their attention on their problem areas. Users who wish to practice their hand and arm dexterity may opt to use a standard mouse while those who want to improve their sitting position may use a head mouse.

2. RELATED WORK

There are currently other existing software and hardware products that address the several difficulties of CP patients. One such example was developed by Dunne, Do-Lenh, et al. [3] The game they developed made use of an accelerometer to monitor the user's trunk position and a multi-touch display to maximize the use of the user's upper limbs. Aside from that, they have created customized input mechanisms like a foam ball and a wand to improve the user's hand grip. Beyond the aforementioned intricately designed systems, mainstream consoles such as Nintendo Wii and Microsoft Kinect have garnered attention as possible devices to be used in physical therapy. [7]

In the Netherlands, a study has been conducted that used a low-cost video game to train the upper extremities of children with CP. [4] The study concluded by saying that the EyeToy device was a successful motivational training tool, and that its use has the potential to improve upper extremity function.

A similar study in the USA was also conducted on an adolescent with CP. [2] In that study, the researchers employed the use of a commercially available gaming console, namely the Nintendo Wii, as the main tool to facilitate rehabilitation. The outcome of the study was positive and the researchers concluded that the use of the system is feasible for a school-based setting.

There are also other video games used for physical rehabilitation, although not specifically designed for patients with CP. An example of which is a video game called *Jewel Mine* helps its users with balance training, upper limb reaching training, and mental simulation.

Overall, there have been various studies overseas regarding the area of video games used as a rehabilitation tool for patients with CP but none have been based in the Philippines.

3. GAME DESCRIPTION

One of the main goals of this game is to help improve the posture of the user, and this is through the use of the head mouse which is already available in the computer systems of the organization. Furthermore, the intended audience for this game typically has trouble navigating with a mouse because of their tendency to have tense hands. Therefore, the user has the option to choose between using the standard mouse or the head mouse, which allows the user to also work with improving the hand and arm muscles through the use of the former. This option allows the user to progress through the levels of the game while promoting better use of their problem areas.

The game will have three basic levels: easy, medium, and hard. Each level will consist of 10 stages having one question each, with each stage to be done incrementally. All levels will cover scientific topics formally included in the current Philippine K-12 curriculum, with focus on the Science curriculum for third graders. [5]

3.1 Topics to be Included

The topics to be included in the game, with sample questions, are listed as follows.

1. Parts of the Human Body
 - a. What part of your body do you use to see?
 - b. Which organ helps deliver oxygen from the body?
2. Plants
 - a. Which of the illustrated plants would grow best in a desert?
 - b. What makes food for the plant?
3. Animals
 - a. A colt is the baby of a what?
 - b. Which of the illustrated animals is cold-blooded?
4. Outer Space
 - a. What is at the center of the Solar System?
 - b. What does Saturn look like?
5. General Science Topics
 - a. Which of the items is magnetic?
 - b. Choose the odd one out: winter versus summer objects.

The aforementioned concepts covered will be presented through illustrations, but on the premise that the user already has previous knowledge of such topics. Therefore, the game will immediately dive into the topics without introduction.

3.2 Required Devices

This game will not require any unusual devices in order to run properly. The user will need a web cam should they prefer to use a head mouse when interacting with the game. Otherwise, a mouse will be sufficient enough. No other devices are required to run this game.

3.3 Difficulty of the Game

The difficulty of the levels will primarily be determined by the size of the images, the maximum number of hints allowed, and the introduction of time pressure for latter stages. Furthermore, the more difficult stages will have smaller images and will require higher dexterity from the player. A typical stage would have a collection of images which may be related or unrelated with each other and the task of the user is to locate what is being asked of them. An instruction panel will display the question throughout the duration of the stage. Depending on the difficulty, the user may be asked to simply click on what is being asked or may be required to draw around the image using the mouse.

3.4 Game Mechanics

As previously mentioned, the game will have three main levels and each level will consist of multiple stages. The game will also keep track of progress by recording the amount of time it takes for them to accomplish a stage. The number of hints that the player will ask from Mr. Bob, the game mascot, will also be recorded. The game's scoring system will make use of the following elements: stage, hint, and time. It will follow a specific scheme depending on the game difficulty. A table containing high scores will be available for viewing at the end of the game.

Easy: No time pressure, only clicks will be required when asked to locate something. Mr. Bob can only give a maximum of three hints per stage. Each stage completed will be equivalent to 10 points. Unused hints in every stage will amount to one point each.

Medium: No time pressure, involves more mouse movement by asking the user to "draw" around what is being asked for. Mr. Bob can only give a maximum of two hints per stage. Each stage completed will be equivalent to 15 points. Unused hints in every stage will amount to two points each.

Hard: Introduction of time pressure, and will alternate between clicks and "drawing", depending on the instruction. Mr. Bob can only give a maximum of one hint per stage. Each stage completed will be equivalent to 20 points. Unused hints in every stage will amount to three points each. The amount of time left for each stage will also be added to the overall score, with each second equivalent to one point each.

3.5 Look and Feel

This game has a minimalistic, cartoon-like interface with huge icons and letters to facilitate easy navigation for the player. Levels will be presented screen by screen. Throughout the whole game, the image of the game mascot, Mr. Bob, will be present. He is a green amoeba who will be located in the upper left corner of the screen. Instructions for every stage can be found right beside Mr. Bob.

The game will be primarily controlled by a standard mouse or a head mouse, depending on the preference of the user.

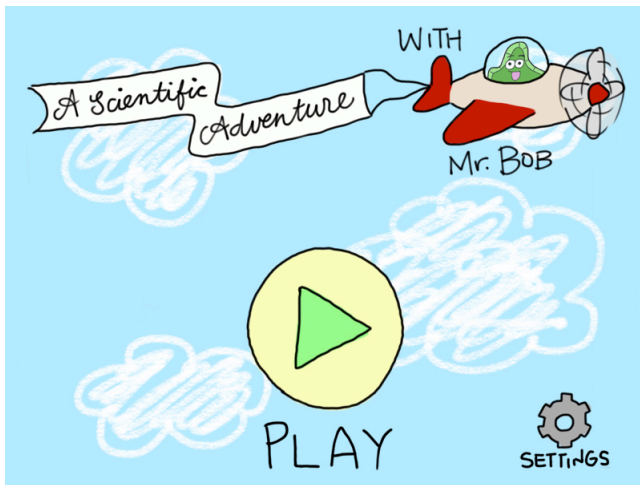


Figure 1: The start screen.



Figure 4: A screen of one of the medium stages.



Figure 2: Level select screen.

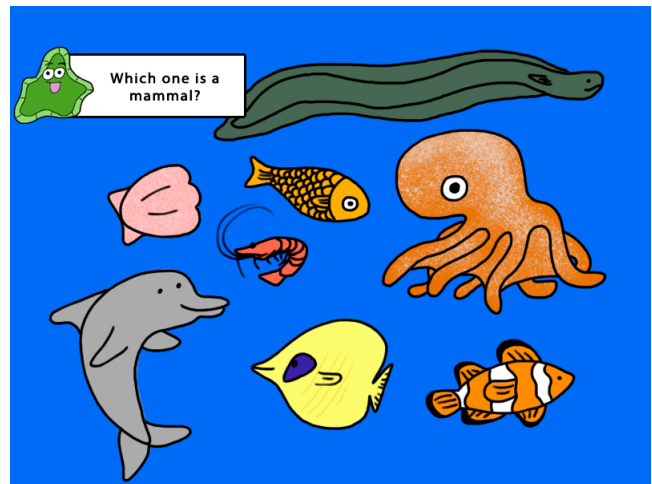


Figure 5: A screen of one of the hard stages.

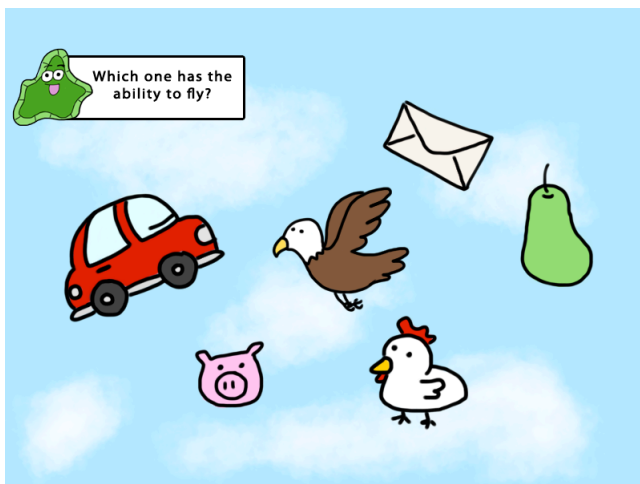


Figure 3: A screen of one of the easy stages.

4. IMPLEMENTATION

In developing *A Scientific Adventure with Mr. Bob the Green Blob*, we will be using the following:

Allegro 5 – an open source C/C++ library for game programming

Code::Blocks – a free C, C++, and Fortran IDE

Photoshop CS3 and CS5 – a paid image manipulation program for textures

Procreate – a paid iPad application for creating digital paintings and images

Head mouse – a free software from Indra Company that provides users with an alternative means to interact with a computer

The initial division of labor will consist of Corinne handling graphics-related work and game code writing while Myreen will handle sound-related work and game code writing. C++ is the preferred programming language to build the game itself.

5. TESTING

5.1 Goal of the testing

The aim of the user test is to check for program errors and bugs alongside determining whether or not the game is challenging, helpful, and fun for the patients. Furthermore, the user test is also performed in order to assess the suitability of the questions for the users.

5.2 Profile of test subjects

The test subjects will be selected solely based on their current educational level as assessed by the Philippine Cerebral Palsy Incorporated. The subjects must at least be in the third grade in order to be considered for testing. This is because the subject matter in the game tackles science questions tailored for first to third graders.

During the initial testing, five students were selected: three (3) boys and two (2) girls – all of whom have varying degrees of impairment.

5.3 Testing methods

Each test subject will be required to answer all the questions from the easy stage of the game. Every student will be given five (5) minutes to accomplish the ten (10) stages. The testers will be supervised, starting with a brief introduction before the test begins to explain what they will expect when playing the game. Since one of the goals of this game is to provide an alternative source for therapy, the test subjects will be allowed to choose between the use of a head mouse or a standard mouse depending on their needs.

The test subjects will be observed as they play the game, while the game results will be automatically recorded by the program.

Observations will be focused on the following:

- Choice of head mouse versus standard mouse
- Sitting posture while playing the game (proper versus improper)
- If the user is using a standard mouse, hand movements
- If the user is using a head mouse, improvement in posture while sitting

For the posture to be classified as proper, the test subject must sit without slouching. His or her back must either be parallel to or making use of the back rest of the chair. The arms and elbows must not be too far away from the body and the legs and feet should be positioned relatively close to each other.

5.4 Test Results

5.4.1 Test Subject #1

Test Subject #1 had minor difficulties relaxing his hand when clicking and moving the mouse. Most of the questions needed to be translated into Filipino for him, and needed a lot of help arriving at the correct answer. Since he was confined to a wheelchair, his posture did not significantly change when he was playing the game. Overall, he seemed to enjoy the game but found the questions too hard.

Table 1: Observations for Test Subject #1

Choice of input device	Mouse
Posture while playing the game	Proper
Hand movements	Jerky, stiff

5.4.2 Test Subject #2

Test Subject #2 had a hard time controlling her arm to move the mouse around, but did not have much difficulty in clicking. The questions also needed to be translated into Filipino for her, and she also needed help to find the right answer. Her posture was hunched over, as if to look closer to the screen while playing the game. However, her arm and hand appeared to be relaxed while handling the mouse and she sits normally when not engaged in the game.

Table 2: Observations for Test Subject #2

Choice of input device	Mouse
Posture while playing the game	Slightly improper
Hand movements	Relatively relaxed

5.4.3 Test Subject #3

Test Subject #3 excelled while playing the game; she had no difficulty answering the questions. Her sitting position was normal, and she needed no assistance at all. However, she preferred to use her left hand instead of her right for using the mouse.

Table 3: Observations for Test Subject #3

Choice of input device	Mouse
Posture while playing the game	Proper
Hand movements	Normal

5.4.4 Test Subject #4

Test Subject #4 was mostly uninterested while playing the game. Confined to a wheelchair, he did not change his sitting position when playing. He had trouble concentrating while playing and also needed a lot of help answering the questions.

Table 4: Observations for Test Subject #4

Choice of input device	Mouse
Posture while playing the game	Proper
Hand movements	Slightly stiff

5.4.5 Test Subject #5

Test Subject #5 had eyesight problems and therefore, had a lot of difficulty distinguishing the pictures in the game. He needed supervision because of this impairment and asked for the questions to be translated into Filipino. He needed minimal help to answer the questions once he understood what was being asked. His hand movements were relaxed, but since he could not see very well, the way he moved his mouse was unsure.

Table 5: Observations for Test Subject #5

Choice of input device	Mouse
Posture while playing the game	Proper
Hand movements	Slow, steady

5.4.6 Summary of Results

Most of the test subjects required a lot of supervision, mostly because most of them did not understand the questions in English. None of the students used the head mouse, but almost all of them

sat properly. Their hand movements varied from jerky to normal, but it was clear that most of them need to improve in that area.

5.5 Post-game debriefing and evaluation

We were unable to conduct a survey after the testing period because of lack of time. However, based on our observations, we found that there were some bugs that needed to be addressed such as the game being unable to detect some mouse clicks and that some of the stages loaded incorrect images.

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