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How to Use Low-Cost Devices as Teaching Materials for Children with Different Disabilities

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1. Introduction

This chapter focuses on how to use assistive technology to help children with disabilities. The real situation is that many classes do not have enough resources to buy much equipment for children with different needs. We will introduce how to use low-cost devices to make a simple interactive whiteboard, a low-cost AirMouse and interactive feedback for rehabilitation treatment. Some research has combined the use of a Wii hand controller and infrared (IR) emitter to create a low-cost interactive whiteboard; we applied and extended the relative issues in this chapter that utilizes the Wii hand controller as a key of assistive technology. The contents are applied in Flash software or PowerPoint, so that resource teachers could design the teaching materials without any training.

Computer-aided instruction is widely used in special education and assistive technology. In fact, teachers sometimes may have trouble when teaching their students to use different computer tools (Shimizu & McDonough, 2006), but advances in computer technology have meant replacing translation of traditional paper questionnaires with novel display versions (Hung et al., 2010). Although with the progress of technology the functions of interface have become more complicated day by day, the purpose of this chapter is not only to help children through new teaching materials to enhance their motivation, but also to consider teachers' work load and feelings.

Through the assistance of assistive technology and multimedia design, teachers have enough ability to produce the learning materials of custom-made design in order to support learning by disabled students (Kawate et al., 2009). User-friendly design is defined as a structural design of an interface (Cho et al., 2009; Kim, 2009) and teaching interaction procedure is a systematic form of teaching used by teachers to gauge behaviour (Leaf et al., 2010). The important aspect of the resource for teachers is taking care of the children, technology is a method to help children. The first thing we want to promote is that the content is easy to create and flexible for the teachers, providing positive motivation to join the activities.

Interface design exists at the junction of computing sciences, design arts and social sciences. Human-computer interaction (HCI) is a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use (Rosinski et al., 2009). The purpose of interactive design in HCI is to improve the experience for students with

disabilities of direct feedback. Computer-mediated communication facilitates the understanding of communication patterns, forms, functions and subtexts, which can in turn engender an understanding of how to derive meanings within such contexts (Bower & Hedberg, 2010). Patterns or figures are increasingly being used not just in education, but also in many other areas such as software engineering, engineering and business management, and are also frequently advocated for teaching HCI principles (Kotze´ et al., 2008). Interactive whiteboard systems comprise a computer linked to a projector and a large touch-sensitive electronic board displaying the projected image. Children or teachers can operate the content from projector directly by an IR device (Warwick et al., 2010). Because intuition is an operating feature of assistive technology, it is not necessary for operators to use a tool, such as a mouse or keyboard, to learn how to control it. Therefore, it is easier for users to touch the low-cost assistive technology. In this way, information and communication technology is a powerful tool for learning and rehabilitation, which has prominent influences on helping teachers explain difficult concepts, giving access to a huge range of examples, resources and inducing pupils to engage in learning easily (Waite et al., 2007).

This chapter focuses on making some interactive devices at a low price to help children. In studies related to the interactive whiteboard, it is indicated that the interactive whiteboard technology has the potential of supporting teaching and learning (Tataroglu & Erduran, 2010). This assistive technology of interactive design describes a new design for teaching materials developed in the frame of a research project supported by information interface tools (Lin et al., 2010). The introduction of basic education or special education-based computer-aided tools in the routine development process of education is truly important. The display of multimedia teaching materials relies on the operation of a mouse; however, for students with disabilities, a PC mouse is not a good tool, because it is a load for children in the process of learning.

One solution was to explore the application of devices used in contemporary gaming technology, such as the Nintendo Wii or AirMouse (López, 2010). An IR camera was generally used in tracking systems, which lead often to unaffordable costs; particularly, Wii remotes used as IR cameras (Shih, 2011). Some research combined a Wii hand controller and IR emitter to create a low-cost interactive whiteboard, so that teachers were enabled to design teaching materials that enhanced learning for children with developmental disabilities. The interactive technology consisted of a Wii hand controller, IR emitter, a laptop and a projector. This kind of customized design is low-cost at less than US$35. Combined with low-cost materials to create a cheap device, the laptop could be controlled by the wireless IR emitter device that functioned much like a PC mouse (Lee, 2008; Lopez, 2010). The application of an IR emitter is similar to a normal screen update to touch screen.

The application of a low-cost AirMouse through the Wii hand controller was similar to putting a PC mouse in the participant's hand; the design of the low-cost AirMouse and virtual interfaces adopted an interactive method, while the design of teaching materials adopted Flash software that could invent interesting displays in order to raise children's curiosity and increase the rate of use (Lin et al., 2011).

Recent advances in assistive technology have resulted in the mass production of the low-cost Wii hand controllers, which incorporate a small IR camera capable of tracking light

sources and transferring their pixel position via Bluetooth to a computer (Clark et al., 2011). Using Wii as a tool in the teaching carried out in the practical results of the promotion has been very effective (Amici et al., 2010). Interactive technology to promote the ability of understanding via the teaching materials, links the experience of learning styles (Lin et al., 2011).

The design of learning interfaces adopts an intuitive design, while the design of teaching materials adopts Flash software to invent interesting animations in order to raise students' learning motives. In addition, students can not only truly experience the vivid teaching materials, but are also impressed by them.

This chapter also tried to develop a low-cost and doable way to make an AirMouse and interactive virtual interface, especially for people wishing to utilize a low-cost device to help children with disabilities.

The virtual interface design had an advantage in that the application was able to make corrections to the teaching materials, while the assistive technology may also be transferred to other training courses. However, through the low-cost AirMouse, the process became uncomplicated for the children; they could operate the tool by intuition. This chapter focused on the equipment in helping children with disabilities and tried to enhance the quality of the equipment which could be tailored to people's different needs.

Some of the related research focuses on a Wii balance board to help people to train their activities (Bateni, 2011; Young et al., 2011). In this chapter, we also discuss the issue of rehabilitation. With rehabilitative work users do it by their willpower, but do not use feedback, in fact, the process of rehabilitation is so boring, people do not have the motivation to do the work. Especially for children with cerebral palsy and the repeated action needed to train for physical activity [c1]. Cerebral palsy is one kind of series of obstacles caused by an immature brain cell injury, including psychological and social adjustment, active function, walking function and daily living etc. Because the plasticity of the brain is high, with the relevant medical rehabilitation for children with cerebral palsy as soon as possible, early training and learning could promote the ability of children (Valencia, 2010). The final cases of this chapter make an application of the Wii hand controller to help children with cerebral palsy using interactive work during the process of rehabilitation. Children with cerebral palsy might not have the ability to control the computer well, but custom-made alternative devices are always more expensive; one kind of solution is to explore the application of devices used in contemporary gaming technology, such as the Wii (López, 2010) or Xbox (Xynos et al., 2010). An IR camera is generally used in tracking systems and often leads to unaffordable costs, particular the Wii hand controller which is used as an IR camera (Shih, 2011) so that teachers are enabled to design interactive custom-made materials for children with cerebral palsy, enhancing learning interest for children with developmental disabilities.

Through the Wii hand controller and IR emitter, the process becomes uncomplicated for the children. Although traditional interactive teaching materials may be suit normal children, there is some burden for children with different disabilities; this chapter focuses on using the advantageous parts of the interactive effect and on creating a cheap device to help children with disabilities to enhance and improve their activities.

2. Method

Interactive whiteboard to promote the ability of understanding in the teaching materials links the experience of learning styles (Lin et al., 2011). Children with disabilities were unable to use base computer control devices, but custom-made alternative devices were always more expensive. Thanks to Johnny Chung Lee (Lee, 2008) a program about low-cost multi-point interactive whiteboards using the Wii hand controller was created and shared freely on his website tp://johnnylee.net/projects/Wii/. The fore part of a Wii hand controller is equipped with an IR camera which enables receiving IR light, while its interior provides Bluetooth for communication purposes; that is to say, it is available to connect with other computers possessing by Bluetooth apparatus. Therefore, the chapter is able to integrate the outcome of Flash and to develop teaching materials for children.

This chapter is based on the Wii hand controller and attempts to design an application of a low-cost interactive virtual interface. The Wii hand controller is a handheld device just like a television remote, with a high-resolution high speed IR camera and wireless Bluetooth connectivity. When the Wii hand controller added an IR filter lens, the Wii hand controller camera was sensitive only to bright sources of IR light emitter. Moreover, the tracked objects must emit a significant amount of near IR light to be detected. Other IR video cameras can obtain this function, but the Wii hand controller was the cheapest. That met the research's goal which was to make the equipment as cheap as possible so that children with disabilities could be helped in a very easy way.

The extended interaction concept enabled the user to stand in front of the screen to operate using the IR emitter pen. This concept was similar to the AirMouse idea. This design will help some children who have difficulties in using a mouse. The Wii hand controller was Wii's remote controller and it was fixed in this research design. The interactive virtual interface device in this research needed a laptop, Wii hand controller, IR emitter pen and cursor calibration software. Besides the laptop, all the cost would be under US$35. A Wii hand controller camera was sensitive only to bright sources of IR light emitter and tracked objects must emit a significant amount of near IR light to be detected.

It would be hard for the children with disabilities to learn to find a position where the sensor of the Wii hand controller would not be blocked. For children with disabilities, they needed to come close to the screen and operate. In the experiments, the children with disabilities took the IR emitter pen near the screen and they covered the IR emitter easily. That made the Wii hand controller unable to receive the message from the IR emitter successfully, so that interactive activities could not work smoothly. It would be easy for normal children to be asked to hold the IR emitter pen as a PC mouse using a hand, and at the same time, pay attention to not blocking the Wii hand controller and the IR emitter pen transmission direction. However, for children with disabilities or even multi-developmental disabilities, they have more difficulties in the learning process of using an IR emitter pen.

In this chapter, the Wii hand controller-based, interactive design build interesting applications. The Wii hand controller makes a simple interactive device and in recent years many people and researchers in the relevant studies have opened up their programme codes free of charge to download [c13]. For the purpose of this chapter to be applied to help more children with disabilities, the price of equipment is the key consideration.

The device in this chapter is easy to use; what participants have to do is to operate the IR light, using a prototype which relies on designing to the specification of users. In addition, the apparatus can adjust the size and scope of projection.

2.1 Low-cost interactive whiteboard

The theory that this chapter applies is making use of Bluetooth to connect a computer and a Wii hand controller. By means of an IR emitter, a Wii hand controller can track the accurate launching location of IR light and then generate a simple whiteboard. According to the course design of participating teachers, image projection based on low-cost interactive whiteboard is divided into two categories.

The first category: a projector shows images on the wall or the projector screen, letting the Wii hand controller point to the projection position. Based on the requirement of students, the range of exhibition can be adjusted. For students with extreme short sight, for instance, we can make use of amplification displaying a larger size in order to improve inconvenience for short-sighted students because the presentation on normal computer monitors is too small, as Fig. 1 illustrates. The second category: letting the Wii hand controller point to a computer monitor which originally merely has the display function. With the assistance of Wii hand controller, the computer monitor thus becomes a touch screen, as Fig. 2 illustrates.

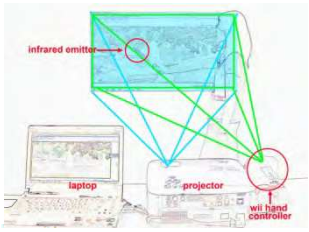

Fig. 1. How to use the low-cost interactive whiteboard on a wall

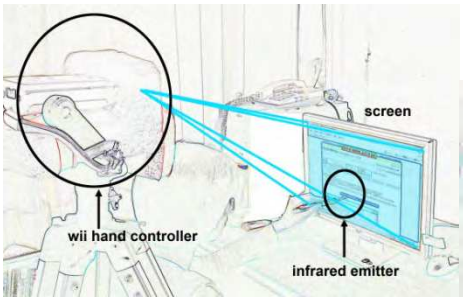

Fig. 2. How to upgrade a screen to a touch screen

The display mode of these two methods is an intuitive learning tool. The operator does not need to use a mouse as a tool, which is especially useful for children with learning disabilities who therefore do not have to learn the use-pattern of the PC mouse. Students will raise their interest towards learning and lessen the generation of frustration during their learning processes.

An interactive whiteboard is an interactive display interface that connects to a computer and a projector. A projector projects onto a board's surface where children can control the display using a pen or other devices, but it is very expensive so teachers cannot use them in many places. Since the Wii hand controller can track sources of IR light, it can track IR light from theled in the tip. In this research, teaching materials are designed using Flash software and the interactive whiteboard is used to develop children's abilities. According to the requirements and preferences of students, participating junior and elementary teachers devised and adjusted the design of the IR emitter.

Fig. 3. IR emitter design 1 (demonstration by Te-Hsiung Chen)

Fig. 3. is designed by teacher Te-Hsiung Chen. Because children with disabilities are generally lack the ability to manipulate operational tools and their action sensibilities are also not nimble enough, teacher Chen therefore makes use of micro switch to launch the IR emitter. In addition, with regard to the IR emitter, in order to prevent the Wii hand controller receiver from being interrupted by the location of the body, teacher Chen extends the launching section. This improved design creates distance between the hand and the launching section, and the effect is better than before.

2.2 Application of the low-cost AirMouse for children with physical disabilities

The AirMouse is a device for people to control a computer. The motion-sense technology inside the AirMouse delivers precise in-air cursor control and convenience. The principle is through motion-sense technology which translates your hand movements into on screen cursor motion for in-air operation. The AirMouse not only works on the desk, it also can work in the air or anywhere else. It is more comfortable for users to use and compact and portable enough to be easily used, using natural and comfortable wrist movements to take in-air control of your computer.

This part will show how to use the Wii hand controller and IR emitter not only to make a low-cost interactive whiteboard, but also a low-cost AirMouse. Just like many videos shown on YouTube, the low-cost interactive whiteboard was good for children to use, but the light of the projector would be a burden for people who used it. It would be good for a teacher to start the cursor calibration software, fix the IR emitter pen position and tracking utilization for children. If tracking utilization was lower than 50%, the Wii hand controller position should be adjusted and relocated. By doing so, people could upgrade their normal screen to a touch screen. The participant could sit in a chair, holding an IR emitter pen as a PC mouse in the learning process. It is easy to make a virtual interface; forgetting the method of how to make a low-cost interactive whiteboard, face the IR receive of the Wii hand controller toward the user and prepare an IR emitter.

Just as Fig. 3 shows, follow these steps to set up the virtual interface. Step 1: double click the executable file of Wiimote or Wiimote smoothboard than make sure you go into the

situation of "Quick calibration" (Wiimote button A). Step 2: you can see the first red point of calibration, don't let your IR emitter touch the screen, just think of a virtual interface behind you, and push the micro switch of the IR emitter at the corresponding position. Step3: when the second red point of calibration shows on the screen, just like step 2, think of a virtual interface again, and push the micro switch of the IR emitter at the corresponding position. Step 4: follow step 3 and finish the four red points; when the four red marks have been calibrated, you have created a virtual interface. So, the users do not approach the screen or the wall that the projector projects upon, the user is only sitting on the chair, using the IR pen like an AirMouse. The Wii emitter needs to face the user.

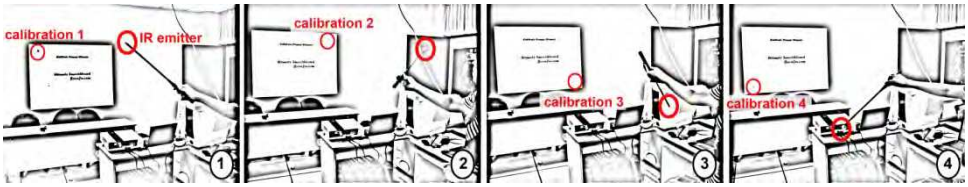

Fig. 4. How to calibrate the virtual interface

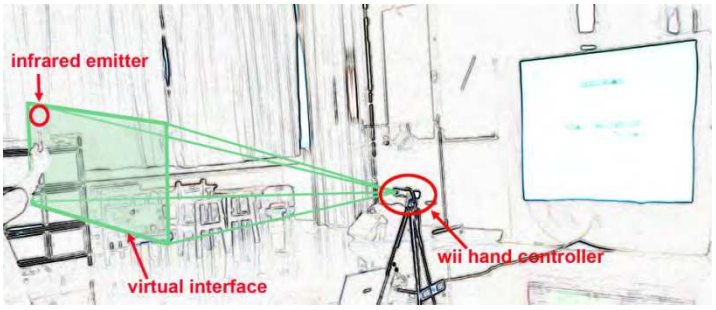

Fig. 5. Low-cost AirMouse and virtual display

The purpose of this chapter was to help children with disabilities to enjoy their learning process. Assistive technology was a helpful method for learning, which had prominent influences on helping teachers explain difficult concepts and giving access to a huge range of examples and resources. This low-cost AirMouse could also help children with disabilities to learn easier; the principle is illustrated in Fig. 5.

This chapter benefited greatly from many experts who devoted their interactive whiteboards technology using the Wii hand controller. Using the IR emitter and Wii hand controller an AirMouse-like system was created - a low-cost and custom-made tool. Therefore, it was able to integrate the real-time feedback via Flash software and PowerPoint, and also contribute to developing teaching materials for children with disabilities.

The theory was applied using Bluetooth to connect the computer, the Wii hand controller and the IR emitter. Through the IR emitter, the Wii hand controller could track the location of the IR emitter. The function of the IR pen was just like an AirMouse, and the children with disabilities could use it easier with a pen instead of an AirMouse as a controller. In order to suit the needs of children, the weight of the device held was only that of a simple

pen with a micro switch. The display mode of this method is an intuitive learning tool and better than an AirMouse; children with disabilities would raise the sense of achievement. In virtual display, whenever the children pressed the micro switch in this area, the IR emitter could control a system just like an AirMouse. The virtual display showed the function of the IR receiver. It is like a pen for children to control via the micro switch, and the teaching material could be modified for other courses.

It is a simple tool for children to control the micro switch and the teaching material could be modified for other courses. In the research, the researcher used Flash software to design interactive teaching materials. When the researcher set up the device in the classroom, only the children with developmental disabilities who took an IR pen behind the virtual interface could make use of the interactive effect. Participants from the resource classroom could recognize how to operate this virtual interface, because it only took one object just like a pen which could be waved to see the content.

2.3 Application of low-cost interactive rehabilitation

An IR light array and reflected band could make a low-cost interactive rehabilitation tool.

Reflected band is one kind of flexible tape, it could be tied on the different part of children's body then do to rehabilitation .A projector projects onto a wall where children can control the display using the relative devices, but is very expensive and not portable, so it is not convenient for teachers to use the device in different places. By means of an IR light array and Wii hand controller via reflected band, it could track the relative position of the reflected band and then became an interactive teaching material. A projector shows images on the wall, letting the reflected band reflect from the IR light array to transfer information to the camera sensor of the Wii hand controller. The weight of the device which is held by the children is only a few grams, which is sufficient for the children's requirements. The display method of this part is an intuitive learning tool. The operator does not need to use a PC mouse as a tool and the children will raise their interest and lessen their frustration during the learning process. Since the Wii hand controller could track a source of IR light array, as Fig. 6 shows, so the research could apply this technology to make a low-cost device. A reflected band on the leg or other parts of the body are good examples that could benefit from minimizing tracking instrumentation, as Fig. 7 illustrates.

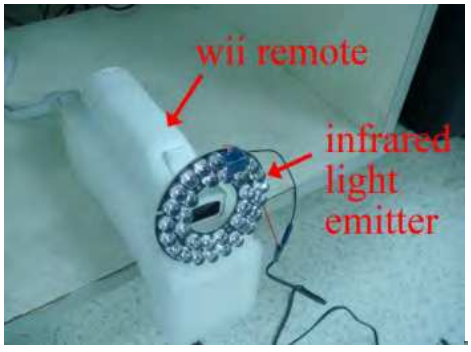

Fig. 6. Simple IR emitter

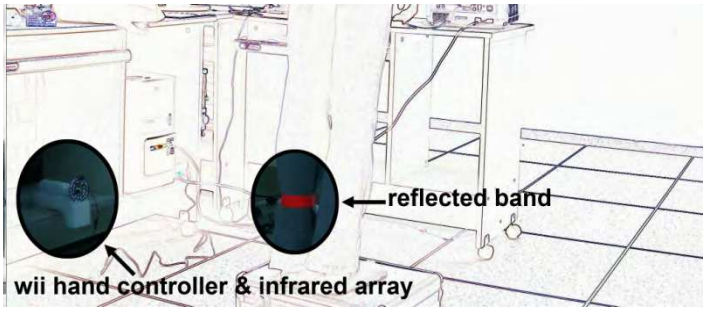

Fig. 7. Simple IR emitter

The Wii hand controller is the Wii's control, from the training process, this chapter illustrates making the Wii hand controller point to IR emitter by which it can detect the IR emitter signal. If the participant achieved the action, the screen will show the contents from PowerPoint next page. The interactive design needs a laptop, a Wii hand controller, an IR emitter, all costing under US$ 35. As teachers design teaching materials, they need to consider the funding constraints which prevent providing interactive teaching materials. Therefore, using a Wii hand controller as a connecting tool, the normal projected screen could upgrade to an interactive device. For teachers to prepare teaching materials depends not only on low-cost, but also easy ways to learn, and an effective interactive interface is a good way to help this process. In the resource classroom or special classroom, teachers care for children with different disabilities, and particularly children with cerebral palsy need physical rehabilitation.

We modified the method connected with the Wii hand controller and IR emitter. With the IR emitter we simplified the emitter bulb and button cell battery, and the weight is no burden for children who need to exercise different parts of muscles according to their different situation. It is easy to process this modification, as shown in Fig. 8.

Fig. 8. Simple IR emitter

The theory applied making use of Bluetooth to connect to the computer, the Wii hand controller and the IR emitter. Via the IR emitter, the Wii hand controller could track the location of the IR emitter, so, the IR pen functioned just like a PC mouse. The children with disabilities could use the pen easier than a mouse controller. Based on the requirements for the children, the weight of the device held is only that of a simple pen with a micro switch. The display mode of this method is an intuitive learning tool. Children with disabilities will raise the sense of achievement. Since the Wii hand controller can track sources of IR light emitter, so the research makes a virtual interface and there is a virtual operating range. When the children press the micro switch in this area the IR emitter acts just like a mouse to control to system, as shown in Fig. 9.

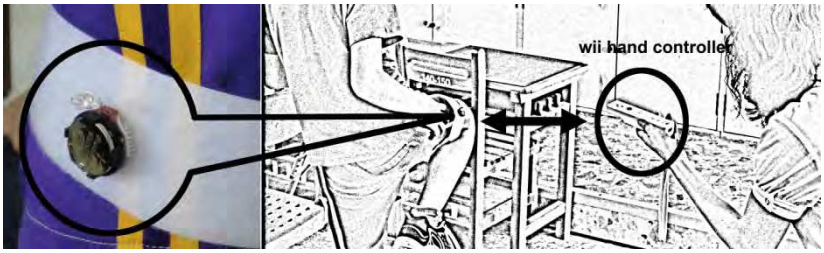

Fig. 9. Simple IR emitter

2.4 Participants

All the participants in this chapter are Taiwanese children. This chapter focuses on two parts. Firstly the design of the digitized teaching materials is examined and then when we experimented in the lab and test it inor resourse classelementary, we revised the ideas on the low-cost interactive whiteboard so that teachers could better participate in the research. The first step is to select teachers from elementary and junior high schools, and make sure they have experience in basic computer skills. Then we discussed how to design the contents for children with disabilities. The teachers designed interactive teaching materials, according to the needs and ages of the students they teach in their schools. The second step focused on how to make the relevant device to suit their children. All the children who participated were from Taiwanese elementary and kindergarten schools.

3. Case study

Children always need to repeat training and students with learning disabilities have difficulty concentrating on teaching materials; this chapter therefore attempts to introduce the concept of custom-made learning for teaching materials. The learning materials are customized for students themselves so as to improve their learning interest. The range of custom-made applications is considerably extensive, including attire, architecture, medical care, rehabilitative instrument etc. This chapter begins from assistive teaching, which provides diverse learning methods in the design of teaching materials. Using an IR emitter and interactive whiteboard can link to corresponding information, which is able to increase the attraction and intimacy of teaching materials. Here are six cases and explanations of this.

3.1 Case study 1 (based on a low-cost interactive whiteboard)

This teaching material could be used as an intuitive class resource. The teaching materials made using PowerPoint, so there is no burden for teachers. In this teaching and learning activity, the teacher introduces and demonstrates how to operate first, and then the student operates it on his/her own, but in this way, it is also easy in a normal class where the children could handle a PC mouse without any working load. Fig. 10 shows the teaching materials in Chinese. In Fig.10 the Chinese words mean MRT(Mass Rapid Transit) and the teacher demonstrates how to put the IR emitter appliance on his finger. When he touches the wall, the macro switch will let the IR emitter work, so the Chinese word can be moved. This design of digital teaching material offers an intuitive way of learning for students when they learn new words. Teacher Huang considers children are not good at holding a pen, so

putting the IR emitter on just the ring finger is easier and furthermore, teacher Huang has also devised an IR emitter in glove form.

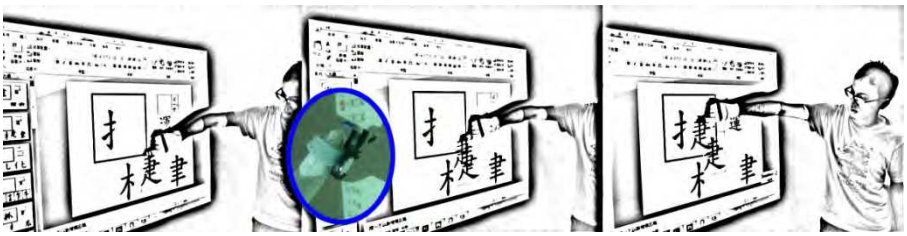

Fig. 10. Application of Chinese teaching materials designed by Kenendy Huang

The tool is in a start up state when the child's palm presses on the wall, which seems as though the machine responds once their hands touch the wall. It has certainly humanized the design for children to absorb knowledge because it is not necessary to teach them how to operate learning tools.

3.2 Case study 2 (based on low-cost interactive whiteboard)

Case 2 is the teaching of Chinese characters. The teaching material of Chinese characters is divided into categories, just like stationery, fruit, transportation, sport, furniture, animals and kitchen appliances, respectively, that are basic words for children with disabilities. In the content of Fig. 11 there are the nine Chinese words within the category of stationery, including "pencil", "crayon" , "ruler", "textbook", "exercises", "school bag", "scissor", "glue" and "tape". Therefore, the teacher used a multi-media teaching method of Chinese characters, which is different from the traditional style of learning, and used pictures and sounds to help him memorize phrases. When clicking on a particular word, a picture and sound will appear accordingly.

Fig. 11. Course of space training

Particularly in the lesson of recognizing words, the teacher recorded the pronunciation of the corresponding word and used the connection between the word, the pronunciation and the picture, so that the children could receive indirect feedback when only touching the wall. The teacher makes use of the good interactive speciality of the Wii hand controller to design this lesson. The teacher is able to understand students' cognition of left and right, and concepts of extensity. Students show that it is very novel to use a Wii hand controller, as shown in Fig. 11.

3.3 Case study 3 (application on a low-cost AirMouse)

Many children didn't control their posture when using a PC mouse with the participants leaning toward the screen closely. Another problem is that the PC mouse should be used on a platform like a desk, but with the image projected on the wall, they are not on the same axis, so the PC mouse is not suitable for children for disabilities. Now by the advance of technology, the AirMouse could be used in the air to control the computer, it could be through try-and-error process before use regular AirMouse, that will reduce their motivation and increase their burden for children with disabilitiesbut it maybe suit for normal student but for students with disabilities, it could be take more trainings to use it, for children with disabilities ,it will reduce their motivation and increase their burden. This case suggested that a PC mouse and a regular AirMouse were not convenient to use for some children with disabilities. Therefore we developed other equipment for these children, so that they could interact more easily in the learning process. Thus, we designed a low-cost interactive interface to act as a substitute for a PC mouse.

The participant was a child studied at resource class. With the use of this low-cost AirMouse, it could train the ability of hand-eye coordination. When the child operated the low-cost AirMouse in the virtual interface range, the screen showed the relative image. The do-it-yourself AirMouse was very easy to use. There was a micro switch on the IR emitter pen, when the child pressed on it, it came on. On the other hand, when the child did not press on the switch, it stayed off. The size of the virtual interface is adjustable, so depending on the participant's hand-eye coordination, the appropriate virtual interface size could be made for different users. The content was designed using Flash software - teachers could easily change the content via updating different pictures. It is no burden for teachers to prepare the teaching materials thereby supplying more motivation to use this low-cost AirMouse to help their children. Teachers could use this device to train their students' activities, as illustrated in Fig. 12. In addition, the operating method of this low-cost AirMouse is easier than the regular AirMouse; the method allows the child to hold in the style of a pen and press the micro switch then wave, as such the child could erase the blank area and see more parts of the picture. This way, teachers could change different pictures to attract children to do hand-eye coordination training.

Fig. 12. A participant's posture when operating a PC mouse

In the research process, the research demonstrated how to use the assistive tool to help the child with disabilities, and the child was asked to hold the IR emitter pen in her hand. Then

the child used the IR emitter pen to do work shown by the researcher. The child only needed to hold the IR pen, press the micro switch, move the pen in the air in any direction, thereby the child could see the movement of the low-cost AirMouse reflected on the screen. In this case, the participant sat on a chair and held a low-cost AirMouse in the virtual interface range, when the child pressed the micro switch of the low-cost AirMouse, it was just like she was operating a real AirMouse.

In the teaching of using this low-cost AirMouse, the child learned how to use it very quickly since it was similar to how she used a normal pen. After observing the child in this research, the researcher found that using this low-cost AirMouse allowed the child to interact with the computer learning programme with appropriate gestures, additionally, it allow the training of hand-eye coordination.

3.4 Case study 4 (application on a low-cost AirMouse)

These cases are custom-made for children with disabilities in kindergarten to increase their attention. Using a virtual interface and low-cost AirMouse could make an interactive design, which is able to increase the attention on the contents of teaching materials. This case demonstrates how we use interactive effects to help a child who is five years old in kindergarten. In this case the researcher showed how to use the low-cost assistive tool and then the young child was asked only to hold it in the style of a pen to control the computer. When he pressed the micro switch of the pen, it was just as if using an AirMouse and the child could see the images that the projector projected on the wall.

The teaching materials in this case were custom-made by Chang Ling-Wei, using the low-cost AirMouse to help her to communicate with the child. Because the child has developmental disabilities and did not want to talk, she used this device to attract his attention. She show the slides page by page and asked for the child follow her in reading the relevant words and doing the relevant actions - when he finished, he could use the low-cost AirMouse. The child did not talk during his class or even at home, he just said a few words when doing this activity.

The case is not only a custom-made teaching materials design, but also a real-time feedback. Fig. 13 shows the teaching materials. Because their curriculum is focused on how to brush teeth the care about themselves, a volunteer, Chen, made the relative teaching materials as assistive materials to help him. This case focused on how using low-cost assistive technology could have an interactive effect; children are offered a digital presentation of designing and learning concepts for easier ways to operate, in this way, children can train their body ability by virtual interface design with interaction.

In the experience of many experiments, the children with disabilities took the IR emitter pen near the screen, they covered the IR emitter, making the Wii hand controller not able to successfully receive the IR emitter of the message, so that interactive activities could not work smoothly.

Normal children were asked to hand hold an IR emitter pen as a PC mouse and at the same time pay attention to not covering the Wii hand controller and the IR emitter pen transmission direction. For normal children's understanding it should be a simple command and also very easy to implement, but for children with disabilities or children with multi-

developmental disabilities, the learning process could potentially cause a lot of trouble with the learning load.

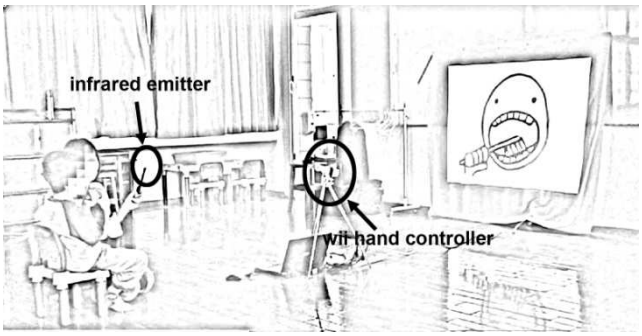

Fig. 13. A boy participant in a custom-made course

3.5 Case study 5 (application for rehabilitation)

The teacher makes use of the good interactive speciality to design this lesson. The exercise of step test is to step up with one foot and then step down via a box, the height of this box is approximately 10 cm. This is a basic exercise for children to train their bodies. In this case, the researcher used a tool box with a height of almost 10 cm, then put a reflected band on one of the participant's legs. There are four steps in the exercise, children must follow the steps when asked. Step 1 lifts the left foot on the tool box, step 2 lifts the right foot on the tool box, step 3 puts the left foot down from the tool box, step 4 puts the right foot down from the tool box, the projector will project the relevant number to encourage the participant. So, in case 5, the participant could learn two skills at one time, one is the skill of counting and the other is training his physically abilities - it is a win-win strategy, as shown in Fig. 14.

Fig. 14. A participant's tie a reflected band as posture of operatinga pc mouse

The strategy of case 5 is to design different physical activities to help children with disabilities and help them enjoy their rehabilitation process. Through the use of assistive technology participants have a positive attitude toward rehabilitation. The contents are only designed through the use of PowerPoint. Teachers or parents could make the contents more interesting than this case, preferably the contents could be connected to the participant's life to attract the users to do the routine rehabilitation. This case 5 was appreciated by many experts who devote their technology to interactive technology using the Wii hand controller. With IR array, reflected band and Wii hand controller the contents could be custom-made and flexible. Therefore, case 5 is able to integrate the real-time feedback of PowerPoint to develop different teaching materials for children with disabilities.

3.6 Case study 6 (application for rehabilitation)

Case 6 is not only focused on a low-cost device, but also paid attention to easy design and application. This case aimed at promoting and redesigning the process of interactive rehabilitation, so we used the simplest method to do the process of rehabilitation. Because being low-cost and easy to follow are very important factors for teachers and parents, low-cost assistive technology could make interactive effective. Children with disabilities are offered digital presentations of designing and learning concepts for easier ways to operate. Children have cerebral palsy due to different injuries and many often have other barriers, including visual impairment, hearing impairment, speech impairment, mental retardation, learning disorders and so on. For development and life, children with cerebral palsy need a lot of help and practice, but they lack motivation and also a lack spontaneous interaction with the external environment. Children can do the rehabilitation for their coordination. The participant in this case is a child with cerebral palsy in elementary school, she must do rehabilitation everyday to keep the abilities of her hand-eye coordination. We hope to keep the basic body motion using digital technology. Daily and routine rehabilitation for training the energy of her body is her basic work, but there is no immediately feedback from traditional rehabilitation and the child found it difficult to give full effort to her exercises. Case 6 wanted to use a low-cost and do-it-yourself interactive tool to enhance the rate of her daily rehabilitation. In case 6, we only put an IR light with one button cell to make sure the IR emitter is at the working position. Because the button cell is a small single cell battery shaped as a squat cylinder like a button on a garment, they are used to power small portable electronics devices. Therefore, it has enough power for IR light in the working state, so we can control the weight as light as we can. We put the low-cost and do-it-yourself device on her wrist, when she put her hand up, the Wii hand controller received the signal of the IR emitter and gave an instruction via Bluetooth to let the contents of PowerPoint jump to the next page. Because the teaching materials are custom-made for the child, case 6 designed the interactive contents from her pictures, therefore, the contents will attract her and the child will have strong motivation to see the next page. She made efforts to raise her hand high again to let the PowerPoint go to next page, it is a special experiment for us to make this light device to help a child under no weight burden, as shown in Fig. 15.

Fig. 15. The experimental process

In the whole experimental process, step 1 connected the Wii hand controller and the laptop, step 2 let the child put on the low-cost and do-it-yourself device, wherever that she wanted to do the rehabilitation. Step 3 made sure the Wii hand controller was toward the direction of the IR emitter and made sure the mode of PowerPoint was in play state. When that was complete the child could do the real-time interactive activity.

Extension of the concept of interaction allows the operator to wear with IR emitter of the tool, depending on which parts of child's body needs to be trained. The IR emitter could be affixed to their hat, wrist, knee etc. The concept of the IR emitter is as the left button of

mouse and for children with cerebral palsy it can work different areas of the physical training. With regard to software, teachers only designed teaching materials using PowerPoint. For teachers, because it is the basic software used in class, teachers do not require additional software training, making it a better way for teachers prepare the content of teaching materials for children and as such they could pay more attention and motivation on the training process for children with cerebral palsy.

In case 6, the child was very happy to finish the activities and completely finished her daily rehabilitative work for her arms. When she finished the repeated practice, she was sweating and felt very tired. Her teacher also participated with case 6 and observed all the procedures; the teacher pointed out that the real-time interactive feedback is an important effect for her, so she paid attention to her rehabilitation and really stretched her arms for full effect.

4. Conclusion

The chapter used case studies to discuss low-cost interactive devices to help children with different disabilities. From the processes of this chapter, the obvious differences between the traditional and the custom-made design of teaching materials could be observed when children needed different help. Children also enjoyed the custom-made and custom-teaching materials. Therefore, according to the outcome of the six cases, the goals of the research were achieved. We focused on using cheap devices with assistive technology to create directly interactive effects; children were offered digital presentations of designing and learning concepts for easier ways to operate. In this way, children could improve their gestures when using a computer as an interface.

Using assistive technology as a tool to enhance the variety of teaching materials is a trend. So, the assistance of the Wii hand controller and IR emitter could support teachers and students with disabilities giving more chance to improve their situation. Particularly for children with disabilities, they can obtain real-time feedback via low-cost devices that increases their motivation toward learning processes or rehabilitation. Our conclusion is divided into three parts. The first part is a conclusion about the low-cost whiteboard, the second part is conclusion about the application of the low-cost AirMouse, the last part is a conclusion about the application for rehabilitation.

4.1 Conclusion about the low-cost interactive whiteboard

For teachers who work with children with disabilities, designing teaching materials and interface design of the learning process could be user-friendly. Some skills are very spectacular, but not easy to understand and one must have a programming background. We found it was too difficult for teachers to learn so the purpose of our topic was easy learning that will create interest for teachers and their students. Some of the topics in designed teaching units make interactive interface design of assistive technology as their learning goals. Technology-based learning focuses on content learning in order to explore more user-friendly and collaborative approaches in their active learning aspect.

From case 1 and 2, the children concentrated on the interactive content during the operating process. Most of the children were very interested in digital teaching materials. It was found using multi-media to teach and learn is easier and gives rise to greater

student motivation than general activities which use books or pencils and papers. With pictures and sounds as hints, the scaffold of learning is built up. From the children who used the interactive teaching materials, some children felt that the learning process was no longer so difficult.

This multi-media teaching material is presented through multi-senses, which makes the content more vivid and adds interest to the process of learning. Students can also choose learning methods (visual approach, auditory approach) which is suitable for them to learn, this creates a deeper impression and the effect of learning is better; moreover, it saves time. Furthermore, thanks to the application of an information interface, students are inclined to absorb knowledge actively and aggressively. They can learn independently with no need of assistance. The interactive media interface for children with learning disabilities has become an important and helpful computer-aided design for teaching materials. The interface arrangement also gives students assistance when they attempt to learn different units. There is a close link between assistive technology, special education and communication design research, as well as studies that examine how interactive design of teaching materials can influence learning. HCI is a valuable issue for disabled students' learning in the future. By using the Wii hand controller to develop an interactive whiteboard, this made it cost-low and easy to carry. It was also good for the classroom with a limited budget. However, the eyes of the user could not avoid the light of the projector. Although people could use a short-focus projection machine to solve the problem, for teachers who needed to teach from one school to another, it would be hard for them to carry the equipment. This difficulty was a common problem for people who used a low-cost interactive whiteboard or normal interactive whiteboard. This chapter focused on children with disabilities and tried to upgrade a normal screen into an interactive whiteboard using a Wii hand controller. This only cost under US$3540. In this chapter, the researchers made the Wii hand controller face the user and the user did not need to point the IR emitter pen close to the screen or the wall. By doing so, the user did not need to face the light of the projector; in addition, it could correct the user's inappropriate gestures.

4.2 Conclusion on the application of the low-cost AirMouse

There could be more applications in the field of virtual interface because the virtual interface focused on easy operation and easy use, moreover, the virtual interface provided not only real-time feedback, but also a lower price to execute the experiment. It was real and helpful to design interactive teaching materials for teachers, especially for resource and supply teachers. Based on the fundamentals of making the operating interface simpler and burden-free, the assistive technology used by elementary school students and kindergarten children to produce fun learning.

The main theme of the project was the assessment of the application of a virtual interface for the design of interactive teaching materials; Flash was used as the main application software to produce the interactive contents such as videos and animations. The main concern was to induce the interest of the elementary teachers who have participated in the first stage to use the easy-to-learn software. Since they were already equipped with basic skills to use the software while formulating the teaching materials, the teachers would be able to focus their energy on designing the teaching materials. In terms of the hardware, the IR emitter was modified so that the projected images were interactive in real-time, relieving the burden of

using keyboard and mouse for the children. Furthermore, the introduction of interactive, assistive technology also facilitated the children's learning process.

When teaching children from resource classes, the teaching materials were modified according to their needs. The development of case 3 and 4 may cater to children with more diverse needs; by introducing Wii's interactive technology into the project, the project was not only academically sound, innovative and flexible, it also had significant influence on the design and development of teaching materials. During the children's learning process, instead of employing creed-oriented teaching, knowledge was obtained via interaction, a process less onerous for children. The development of digitization possessed high potential; as far as children were concerned, not only was the application of digital content refreshing, since the teaching materials emphasized methods such as interaction and coordination, the children also became more interested while learning, which in turn generated a sense of accomplishment. Therefore, the development of an interactive interface to assist the children's learning is imperative.

By using the application of low-cost interactive technology, the emphasis was placed on aspects such as ease of learning by resource class teachers, low equipment costs and ease of promotion. The sensor from the IR emitter could transmit the signals to the computer and the screen at the same time. To put it simply, we used an IR emitter pen as a mouse, therefore, for continuing research different teaching materials could be designed. The main purpose was to instruct children in the application of physical activities. This chapter tried to design different courses for children with different disabilities.

This type of AirMouse could be developed as an assistive device for children with different disabilities, plus be used by teachers when developing the design of teaching materials. Particularly for students with special needs, via the application of interactive appliances, they could train themselves in an interesting way.

4.3 Conclusion on the application for rehabilitation

Rehabilitation can reduce some problems associated with cerebral palsy. Case 5 and 6 used a Wii hand controller to assist physical therapy for child with cerebral palsy. In this case, by the arm training to explore rehabilitative activity by interactive design, observe the results about the assistive technology applied for child with cerebral palsy.

Just as with the application of low-cost interactive technology, the emphasis is placed on aspects such as ease of learning by resource class teachers, low equipment costs and ease of promotion. The sensor from the IR emitter could transmit the signals to the computer and the screen at the same time. To put it simply, we used an IR emitter pen as a mouse, therefore the continue researchers could design different teaching materials. The main purpose is to instruct children in the application of physical activities. The chapter tried to design more different course for children with different disabilities.

There will be more application on the field of virtual interface, because the virtual interface focus on easy operate and easy use, moreover ,the virtual interface provide not only real-time feedbacks but also lower price could execute the experiment. It is real and quite assistance to design interactive teaching materials for teacher, special for the resource teacher and itinerant teachers. Based on the fundamentals of making the operating interface

simpler and burden-free, the assistive technology is applied on elementary school students and kindergarten children to produce fun learning.

In this chapter, in the application of tools to improve rehabilitative methods for children with cerebral palsy, we found that concentration can be increased. By training it can improve hand-eye coordination and improve short attention span, lack of patience and the problem of low concentration. Children with cerebral palsy need to receive long-term rehabilitation and, as with case 5 and 6, interactive real-time feedback is needed so that children are motivated to participate in the process. The interactive process was designed to link the interactive effect to rehabilitation and to positively support the child.

In support of this, in case 5 and 6 the participant only needed to raise her hands and then see the exchange of images. The child's expression was very excited and the child made great effort to raise her hand high to see the interaction of different images. In particular, the content is closely related to the child, as the dynamic characters in the images are all about her real life so she knew the content was custom-made. The interactive feedback is related to her daily life. This is the cause of motivation for rehabilitation. The application of the simple design of assistive devices and materials to the process of rehabilitation means there is two-way feedback.

4.4 Final conclusion

In this era of advanced technological assistive tools, students with special needs have a more convenient life even in the process of learning or exercises.

The primary direction and the main goal for schools and teachers is the efficiently promote the learning process. Teaching materials as well as teaching methods have been continuously developed and innovated, especially in technological assistive tools.

The importance of information and communication skills in interface design in the future has been asserted to support the development of these skills and tools in schools. Students need to possess the capability to use technology and information. Teachers therefore can integrate information technology into teaching activities.

By changing the application of equipment, the results offered children with disabilities different ways of learning, as well as enhanced their ability to pay attention. Since this chapter defined that the teacher should redesign and create the developments, the teaching materials used Flash and PowerPoint software. This chapter focused on using easy software, because if the software is too complex teachers would lose their momentum. The results obtained in this chapter can be extended to different types of activities, especially for children with cerebral palsy, making it very attractive in rehabilitation programmes.

This chapter focus on As material designed to beusing simple materials and software to make an interactive environment, power point can be execute basically, so, it is easy to share and promote in in the applicative fieldon and very suitable for promotion. The design of teaching materials uses common software which can be used to exchange different content easily; it is a great interactive interface for the physical activity of training. This chapter relates to different age categories of children with different disorders and can be adjusted to expand to the scope of services.

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Assistive Technologies

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This book offers the reader new achievements within the Assistive Technology field made by worldwide experts, covering aspects such as assistive technology focused on teaching and education, mobility, communication and social interactivity, among others. Each chapter included in this book covers one particular aspect of Assistive Technology that invites the reader to know the recent advances made in order to bridge the gap in accessible technology for disabled or impaired individuals.

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