Exploring the use of Android devices and LEGO Mindstorms in Children Color Learning Process

by

Muhammad Afiiq Bin Mohamed Ibrahim 12714

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Universiti Teknologi PETRONAS

Bandar Seri Iskandar

31750 Tronoh

Perak Darul Ridzuan

ABSTRACT

Students are becoming less and less interested to learn about science and technology which causes alert to the education industry. The lack of usage of technology itself in education causes the students to be uninterested to learn as they can only learn the theory but cannot see how it is implemented in the real world. The refusal and slow implementation of incorporating technologies into the education system is also not helping the situation. The reason of the students, the teachers and the system are not really ready to incorporate such technologies worsen the problem.This project mainly aims at introducing a learning approach using interactive technology which is attractive to children and hopefully develops into a new exciting learning pattern that matches the future generation desires. Given the recentness of the approach, the project is also developed with an intention to introduce the new technique involved whilst at the same time paves the way for future work to be conducted related to the incorporation of advanced technology into education process. Using Lego Mindstroms as a learning tools incorporate with an Android device by using a Bluetooth connection will allow children to learn while using technology to interact with the environments. By testing the project to a number of target users, feedbacks are collected and the result and effectiveness of the project are recorded. The objectives of the project are meet and the respondent of the project which are children from age of 3 to 5 give good respond to the prototype. Out of the 10 children tested with the prototype, majority like the project and was able to learn effectively. Parents tend to thinks that it is better for their children to learn from the surrounding than learn with virtual item like learning only using apps that show colors at the screen only. This project will hopefully be the first step in attracting children interest back to the science and technology fields which have been a problem in the last few years.

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND STUDY

The usage of technologies can help children to learn much more faster and at the same time make their learning process much more fun and attractive. Children have been exposed to many kind of gadget now days for example, the tablet PC, Smartphone, Computers and others. The introduction of this tabs, smartphones and others create a new opportunity for learning and education process to be more fun and attractive. In June 2007, Apple Inc. introduces the iPhone (Apple.com, 2007) which revolutionize the smartphone industry. Starting from that point, the number of smartphones users increase drastically and others manufacturer started to moves into the same direction as Apple Inc. The ability of the smartphones and its operating system such as iOS (iPhone Operating System), Symbian allow more and more functionality to be added into the smartphone. In October 2008, Android OS came into the picture where it is being launch as the operating system for a HTC smartphone known as HTC Dream (HTC.com). This is the first time ever the world sees the Android OS in action in a smartphones.

Android is a Linux-based operating system that is targeted for mobile devices such as mobile phones and tablet computers. This OS was developed by Open Handset Alliance and led by Google and supported by other companies.

According to news.cnet.com, at the end of 2010 Android has become the world leading smartphone platform. It is estimated that Android OS has been use by 61% of mobile phone worldwide during the first quarter of 2012. As Android is an open source platform, many developers opted to create many apps for the Android as according to spyrestudios.com Android OS has almost the same usability as the iOS. The apps that been created in iOS is also made available for the Android as its popularity begin to

skyrocket. This invention is then take to the next level and apps developers starting to create educational apps which allow children learning to be more less structured, handy and also much more fun. Apps like The Cat in The Hat created by Oceanhouse Media Inc. allow children to learn to read with or without the help of their parents. Apps like this help to facilitate children early education especially when they are at home. The popularity and the number of smartphones device in the market allow more developers to create more apps that can help the educational process of children.

The capability of the Android OS to use Bluetooth, allow Android powered devices to connect and interact with other Bluetooth enable devices. Wireless headphone or speaker is some of the example that can be connected with Android powered devices by using Bluetooth.

After the introductions of Android 2.1 (Éclair) The Lego Group create an apps called the MINDdroid which allow the Android powered devices to be connected and control one of its product called LEGO Mindstorms.

LEGO Mindstorm series is a product of LEGO that contain software as well as hardware which can be used to create, customize and programme the robots. This product is sold and use as an educational tools which originally created through a partnership between LEGO and MIT Media Laboratory. The default software that came with the package can be replace with any third party firmware or even it can be programme using common programming language use in the industries such as C and JAVA. The Mindstroms Kit has been used widely as one of the way to teach children the basic of programming a robot and how to build it. The parts inside the mindstorms kits allow the children to learn about basic mechanics plus Lego is already synonyms with kids building things with it.

Most children learn faster with the help of toys and other interesting gadget that can attract them instead of using old fashion books reading which might not be as attractive to children now days compare to the technologies that are available today. Children spend a lot of time playing and with these technologies children can have their play and learn at the same time.

1.2 PROBLEM STATMENT

1.2.1 Problem Identification

Mobile devices such as tablet PC and smartphones are becoming more and more popular nowdays to all people. We can say that almost everyone own a mobile devices either it is a smartphones, handphones or even a tablet PC. The technological advancement in these devices allows it to be used for many other purposes compare to the capabilities of these devices 5 years ago. The capabilities of these mobile devices allow it to be used as for many other usages such as for business, information gathering and also educations. The usage of technologies like these mobile devices allows learning to be more attractive and fun which could solve problem related to children becoming less and less attracted to learn through the traditional ways. The traditional ways also requires children to have high supervision and also facilitation from adults in order for it to be effective. Teachers at school are the only one that will be able to facilitate the children as now days most parents are both working and will have limited time to facilitate their children at home. Although using mobile devices to facilitate and encourage children to learn but there are people who oppose this by stating that too much of mobile devices like smartphones used as part of learning will causes negative effects also. There are effects like addiction, eye problem, and others. In order to counter this negative effect, using technologies like robots will be as an alternative as children will not be relying only on virtual simulation but will be able to see a physical simulation.

1.3 OBJECTIVES

1.3.1 Objectives

The objectives of this project are:

a) To explore the use of technologies in children educational process.
b) To develop an Android application used to remotely control LEGO Mindstorm NXT2.0
c) To develop a LEGO Mindstorm robot to be used as a color identification tool for children.

1.3.2 Scope of Study

- The scope of study for this project covers the area of communication, i.e Data Communication and Networking. The experimental model uses an Android device that connects directly to a Lego Mindstroms through a Bluetooth connection. The application for the Android devices will be developed throughout this project. The target user of this study is children between the age of 3 to 5 which are trying to learn colors.

1.4 RELEVANCE OF PROJECT

The project is relevance because:

a) Incorporating technology into education

Technology is one of the important core in today's learning process. The usage of technology have proven successful in making learning process much more attractive and enjoyable especially to children which learn a lot through playing.

b) Creating a standard system

Using Android as the platform of the controller, any user can use this app to control their LEGO Mindstorms Kit as it is also a standard platform.

CHAPTER 2

LITERATURE REVIEW

2.1 Children Education

For the past century, education remained largely unchanged. Students in a classroom accepting knowledge's from teachers, which many people believe will continue to be an accepted method of learning. Despite many technological advancement and many new learning concept, majority of children todays learn through traditional ways. Education is one of the most slowest in incorporating new things; it is so slow to change. This problem is describe as the paradigm paralysis, the delay or limit in our ability to understand and use new technology due to the past experience (Jukes & McCain, 1997). It need new experience in order to replace old ones which simply takes time. Unfortunately education now days can no longer wait and take all the time it wants. The technology is creating a future faster than the time for education to prepare for it.

Even though most people know that youth and children is the most number of audiences of technology such as computers but educators still resist in implementing it in education and instead opted to stick to the conventional ways of classroom learning.

Technology can help change how children think, what they learn, and even how they interact with peers and adults. That is not all; it can also teach "the same old stuff" in a new way which might be more acceptable to the children (Seymour, 1993). Children now show comfort and confidence in using computers. They can turn them on, follow pictorial directions, and use situational and visual cues to understand and reason about their activity (Clements, et al. 1995).

In addition to that, there is study that “games with rules” help children to learn faster and improve their reasoning ability (Hoover & Austin, 1986). This study also shows that children are more likely to get correct answers when they work cooperatively, rather than competitively, especially on educational computer games.

According to BBC news, using computers also allow children to learn without teachers. An experiment done by Professor Sugata Mitra, who introduces children in Delhi slums with computers, resulting in him finding that computers allow children to learn complex task quickly with minimal supervision.

The next evolution comes where Tablet PC is being introduced to the world. Tablet PC also shows that they can be used in improving how children learns and a large successful project in the late 1990’s which integrated early touch screen technology into students table (Hoppe, et al., 2000).

2.2 Importance of colors to children

Research done by Marilyn Read, an associate professor of design and human environment at Oregon State University, stated that attraction or impact of color goes far deeper than societal pressures and expectations. She also added that the presence of colors may also be necessary for mental health.

Read did a research on impact of color in preschool buildings, she discovered that between a red wall versus a white colored wall, children are more cooperative while near the red ones. She stated that, children at a very young age tend to use color and shape to identify things.

In a parenting website extension.purdue.edu, it stated that colors can be expressive for children and even for adults. As for examples, colors can be associated to weather and also sometimes mood of the children.

In a paper wrote by Kathie Engelbracht, an employee of Perkins & Will, stated that, color is important as the acceptance or rejection of certain colors mirror their development into adulthood. The acceptance of certain colors also mirrors their mood such as dark color shows sadness and bright color shows cheerfulness.

2.3 LEGO Mindstorms

LEGO Mindstorms was first introduced in 1998, as version 1.0 of the Robotics Invention System (RIS) kits. Since the introduction of Mindstorms, interest from numerous party including teachers, hackers and even programmers start to build up. Then Mindstorm started to be used as a tool to teach students in an introduction to programming class about good design and the concept of project management. Wolz, a lecturer is one of the first to adopt this method of teaching. They are also other who adopt this method and uses Mindstorms in the classroom which teach students on programming topics such as sequential control, variables, procedures, selection structures and arrays. Fagin, Merkle, and Eggers use the Mindstorms in class by developing instructional examples using language Ada and the Mindstorms.

The Mindstorms have since then been used to teach concept from object-oriented programming and also artificial intelligence (Klassner, 2002). The Mindstorms also has been used to introduce children to the world of computing (Weisheit, 2004). The LEGO robots is said to have a positive impact in increasing students interest in computing courses, as they make class become more fun and exciting.

There are project done by several people that use the Lego Mindstorms as a color detecting tools in helping them to educate their children. One of the projects uses the Lego Mindstorm color detector sensor to allow the Mindstorm robot to identify the color and do certain action based on it.

There is also LEGO Mindstorm Color Ball Sorter, a robots that is programme to separate 4 different color of ball accordingly. It uses the Mindstorms color sensor to identify the color of each ball and sort it to its respective area. The robots is code to retrieve information from the sensor and process it before sorting the color ball to its correct area. The codes are programme using NXC(Not eXactly C) Program which is a high level programming language for the LEGO Mindstorms.

These codes are then compiled into the Mindstorm Micro Computer that acts as the brain of the Lego Mindstorms. This Mindstorm Micro Computer will then control all of its motor and sensor according to codes that is been compiled into it so that it can achieve its objective.

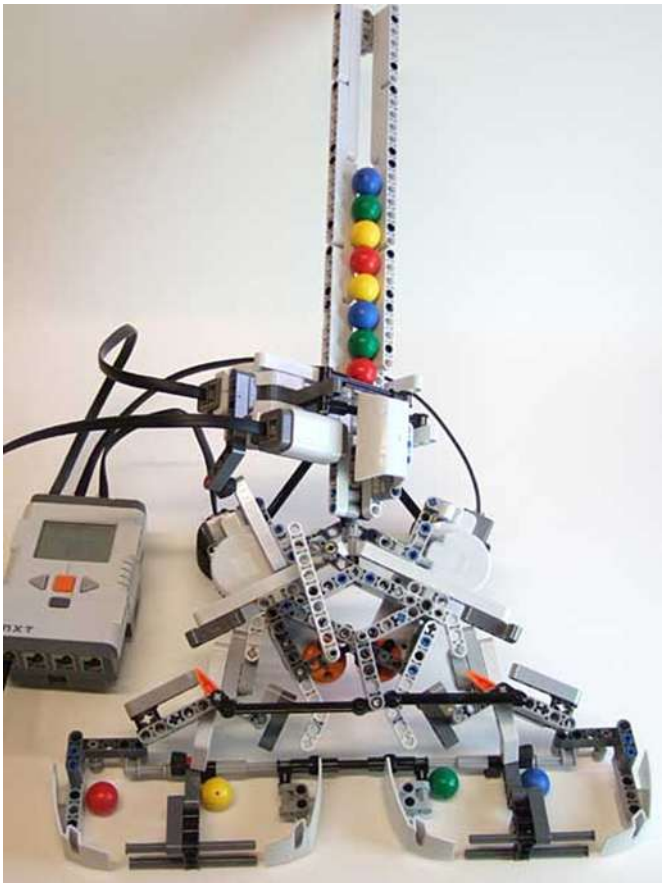


Figure 2.1: The Color Ball Sorter

There is also application of the Mindstorm color sensor, where they build a Mindstorm robot that can detect color which they use different type of Mindstorm color sensor and to test which one is the best one. This project objective allows the user to determine which color sensor can detect the most color accurately and determine which one is the best (philohome.com). During this test they use the default Lego Color Sensor which come with the Mindstorm Kit and compete it with a third party color sensor build by HiTechnic, another company that produce a third party sensor for the Mindstorm.

Figure 2.2 : Mindstorm Color Sensor

On the left is the original Lego Color Sensor and on the left if the HiTechnic color sensor. Both sensor uses different principle in detecting color. The Lego Color Sensor uses a RGB LED, that shines red, green and also blue to the object. The color will then be reflected by the object and will be captured by a light sensor that is sensitive to all wavelengths. On the other hand, Hi Technic color sensor has a white LED and a specialized color sensitive chip. The chips have three sensitive parts which covered by red, blue and green filters. The HiTechnic color sensor do have an advantage as the principle it is using allow it to detect the color of light sent on it (in passive mode, with the white LED shut off).

2.4 Android Operating System and related Android Application

According to Android Website, Google describe its platform as

> *"a software stack for mobile devices including an operating system, middle ware and key applications."*

Basically, Android consists of a UNIX-like operating based on the Linux kernel 2.6 series. The operating system has been filled with all necessary elements that provide basic function to its users like GSM/GPRS abilities, and also networking abilities. Google also offers a framework to the developers that contain rich set of Java methods, enabling them to create a wide range of software for mobile use on Android.

Android popularity is shown at the end of 2010 when they became the world's leading smartphone platform. Android manage to achieve 59% of market share worldwide in the first quarter of 2012 with an astonishing 331 million devices installed base and also 85 million of activations.

There are a numbers of Android apps that targeted the field of children education. Children will be able to learn alphabets, numbers, and simple mathematics with some of the apps available in the market. There are also apps designed for different stage of kids; from preschool up to secondary schools. As for example an app called Colors developed by Five Pumpkins, a developer that create an apps specifically for little children, allow parents to teach their children color more effectively. This app will show a large block with different color and also at the top of each screen shows the name of the color. These help children to learn effectively and interactively thus could speed up the child learning process.

There are also other apps that share the same objective as Colors such as DTT Colors Full, an Android app that uses the Android capabilities to help parents teach colors to slow learner children or children that have Autism. This app was

developed by DrBrownApps.com a developer that specifically develop their apps for the usage of Autism children learning.

2.5 Interfacing Android with Lego Mindstorms

2.5.1 MINDdroid

MINDdroid is an android app that allows you to remotely control you Mindstorms Kits. According to the official Lego Mindstorms website, it allows you to create a wireless connection directly to you Mindstorms kit using your Android phone. Stated in the androinica.com website

"*The MINDdroid app is a remote-control application that allows you to create a wireless connection directly with your NXT, and once a connection is established, you can tilt and turn your phone to make the robot move forward, turn to the sides, and by pressing an action button on the phone's screen, activate the Action motor. If you have a Shooterbot or other robot using two motors for motion and have a spare motor for actions, you are in for a lot of fun!"*

The current app allows you to control your Mindstorm movement only and you will need to programme any command into the Mindstroms kit itself. User will control their Mindstorm kit using this apps that utilize the accelerometer of the phone to allow the user to move the Mindstorm Kits just by tilting the phone to any direction and the robot will move accordingly.

This app however might be a bit difficult to be use by children that doesn't really understand the combination and movement that they need to do in order to move the robots around.

2.5.2 Cube Stormer II

One of the most successful projects is the CubeStormer II developed by Mike Dobson and David Gilday. This robot is build using the Lego Mindstorms Kits and incorporates a Samsung Galaxy S II as part of its sensor.

According to cbnews.com the CubeStormer II uses the Samsung Galaxy S II camera to:

"capture images of each face of the Rubik's Cube which it processes to determine the scrambled [colors]. The solution is found using an advanced two-phase algorithm, originally developed for Speedcuber, enhanced to be multi-threaded to make effective use of the smartphone's dual-core ARM Cortex-A9 1.2GHz processor. The software finds an efficient solution to the puzzle which is [optimized] specifically for the capabilities of the four-grip mechanism. The app communicates via Bluetooth with software running on the ARM microprocessors in the LEGO NXT Intelligent Bricks which controls the motors driving the robot. During the physical solve, the app uses OpenGL ES on the phone's ARM Mali-400 MP GPU to display a graphical version of the cube being solved in real time."

The CubeStormer II holds the record of the fastest 3x3 Rubik's cube solver in just 5.35 seconds beating a human record of 3.66 seconds. The CubeStormer II uses its Bluetooth capability to connect to the Samsung Galaxy S II.

Figure 2.3 : The CubeStormer II

2.5.3 Motivation of study

As far as all the projects have been done, incorporating the android with the Mindstorms Kits for the purpose of children learning has not been done widely. As stated above the Mindstorms has been able to attract children and make their playing process much more fun and educational. So by incorporating the Android device to be used with the Mindstorms kit will allow the children to play and interact with the Mindstorms kit instead of just watching it. This allow the children to be expose to real world situation, instead of just playing in a virtual world which might give negative impact to the children social skills. The prospect of the Mindstorm to be incorporate in many other part of education which allows educators to ensure that their teaching process would make student learn and understand better on certain concept is another big plus to start this project.

CHAPTER 3

METHODOLOGY

3.1 RESEARCH METHODOLOGY

This project will be developed according to the methodology below:

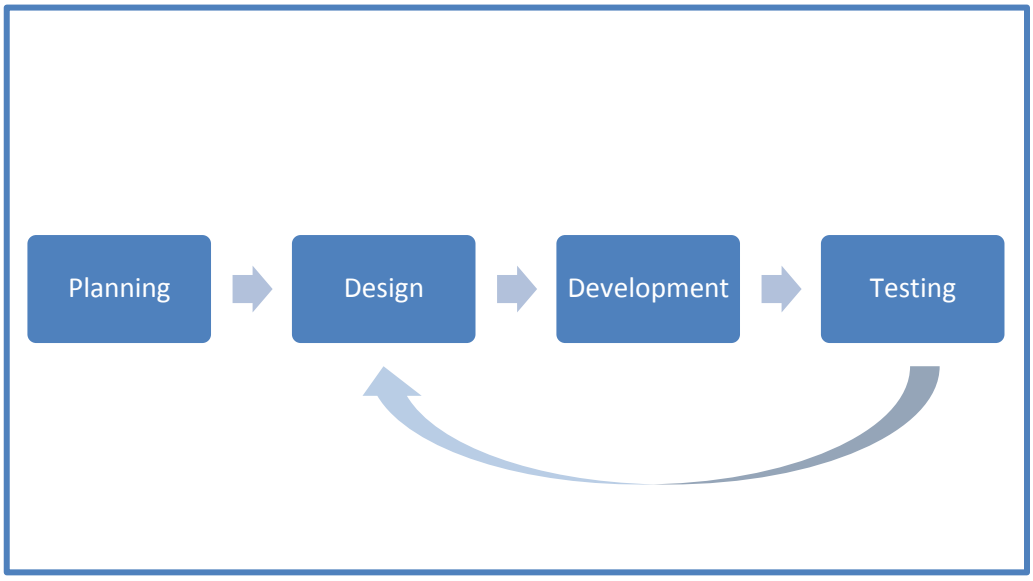


Figure 3.1: Methodology of the project

3.2 PROJECT ACTIVITIES

3.2.1 Planning stage

During this phase all the requirement will be identify. As for example, which software will be used and what is the type of language will be used. During this phase also any weaknesses and limitation on the project will be identify. As in this project is on color so identification of which color sensor is the most suitable for this project will be done. Either using the original Lego color sensor that come with the kit or the third party color sensor would be better. At this phase

also the suitable software for this project will be evaluate and what is each and the other advantage and disadvantages.

That is not all during this phase also data gathering will be done. Reading on book related to LEGO Mindstorm programming allows better understanding on the concept of robots programming. Research is being done by viewing videos and research papers that related to LEGO Mindstrom. Gathering data from forum that interact with experience LEGO Minstorm programmer is also one of the data gathering activities that are done.

In this phase also identification of the Mindstorm parts requires for the project will be done.

Figure 3.2: The Mindstorms kit main components

In this project, the focus is on the color sensor which allows the Mindstorm to detect colors around it. These are the several important parts and will be used in the project:

Table 3.1: Mindstorm parts and components

Components	Description
	The Mindstorm Micro-computer - Act as the brain of the Mindstrom - Process all the command send or programme into the Mindstorm - Control the motors, sensors and others.
	The Mindstorms Motors - These motors are the one that moves the Mindstorms Kit. - Attached to the moving parts such wheel, leg and others to allow the Mindstorm to moves. - Required one for each moving parts
	The Mindstorm Color Sensor - These sensors are the one that allow the Mindstorms to be able to interact with the surrounding. - It allow the Mindstorms to detect color and send the information straight to the Mindstorm brain.
	The Mindstorms Parts - These are the parts that needed in order to build the Mindstorms. - Used to attach each of the other including the main parts to form a robot or other models.

3.2.2 Design staged

During the design stage, there are 3 main activities to be done. The first activity is designing the Graphical User Interface (GUI) of the android app. The 2nd activity is to draft the algorithm of the app to match the command that needed to move the Mindstorm kit as well as activate the color sensor. The last activity for this stage is to draft and evaluate the suitable Mindstorm design to be used for the project.

3.2.2.1 Designing GUI

The activity to design the GUI of the app will be made using the App Inventor. The App Inventor allows the GUI of the app to be developed faster than using common Android App compilers. The usefulness of the App Inventor also allows the basic GUI to be developed by drag and drop command which similar to Visual Basic GUI design page. The App Inventor also allow the button to be customize into certain shape or even replace the button with another picture.

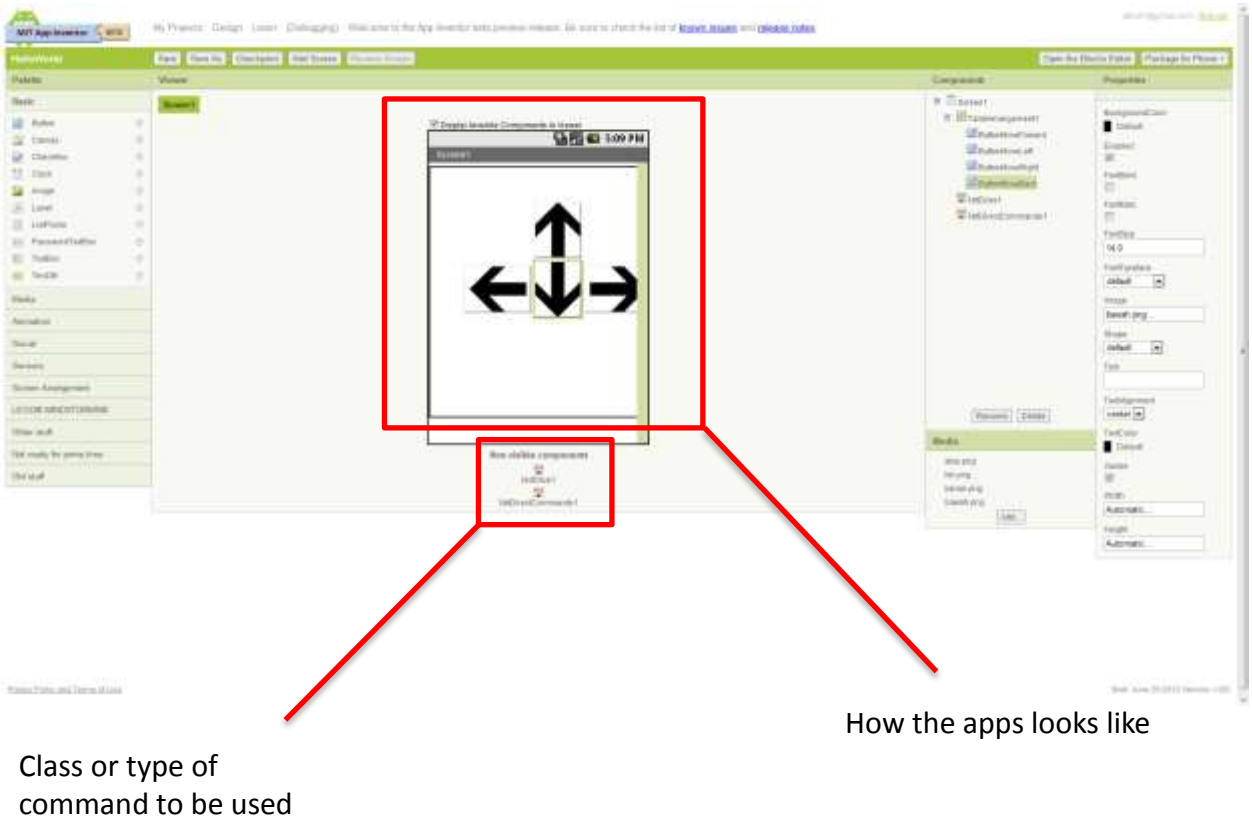


Figure 3.3 : Drafting the app using App Inventor

3.2.2.2 Drafting Algorithm

```
task main ()
{
  SetSensorColorFull(IN_1); // initialize the color sensor
  OnFwd (OUT_A, 100); // Start splitter motor
  while (true)
  {
    long time=CurrentTick ();
    // Wait for detection of a colored ball
    while( (Sensor(IN_1) == INPUT_WHITECOLOR) || (Sensor(IN_1) == INPUT_BLACKCOLOR))
    {
     if(CurrentTick()-time > 800)  // No ball detected for some time
     {
       Off(OUT_ABC);  // Stop all motors and play end tune
       PlayToneEx (TONE_A5, 100, 3, false);
       Wait(100);
       PlayToneEx (TONE_C5, 100, 3, false);
       Wait(100);
       PlayToneEx (TONE_E5, 100, 3, false);
       Wait(100);
       PlayToneEx (TONE_G6, 100, 3, false);
       Wait(100);
       Stop (true);
     }
    }
    int Color = Sensor(IN_1);
    if(Color ==  INPUT_YELLOWCOLOR) // If yellow color, confirm a bit later, could be a red ball.
    {
     Wait(15);
     if(Sensor(IN_1) == INPUT_REDCOLOR) Color = INPUT_REDCOLOR;
    }
    ClearScreen();
    PlayToneEx (400, 100, 4, false);
    // According to detected color, flip the switch points and display color name
    switch(Color)
    {
    case 2:
      OnFwd (OUT_C, 100);
      OnFwd (OUT_B, 100);
      TextOut (0, LCD_LINE3, "Blue");
      break;
    case 3:
      OnFwd (OUT_C, 100);
      OnRev (OUT_B, 100);
      TextOut (0, LCD_LINE3, "Green");
      break;
    case 4:
      OnRev (OUT_C, 100);
      OnFwd (OUT_B, 100);
      TextOut (0, LCD_LINE3, "Yellow");
      break;
    case 5:
      OnRev (OUT_C, 100);
      OnRev (OUT_B, 100);
      TextOut (0, LCD_LINE3, "Red");
      break;
    }
    Wait(100); // the switch point motors run for 100ms
    Off(OUT_BC);
  }}
```

Figure 3.4: Color detection algorithm

The algorithm below shows the color detection algorithm from another project. It is coded in NXC(Not eXactly C). As for this project this code is made as a reference and will be translated to command block of the App Inventor. The command block in the App Inventor is used to replace the need of traditional codes programming. This allows the user to drag and drop the command block into the block editor and pair it to certain command or buttons on the GUI.

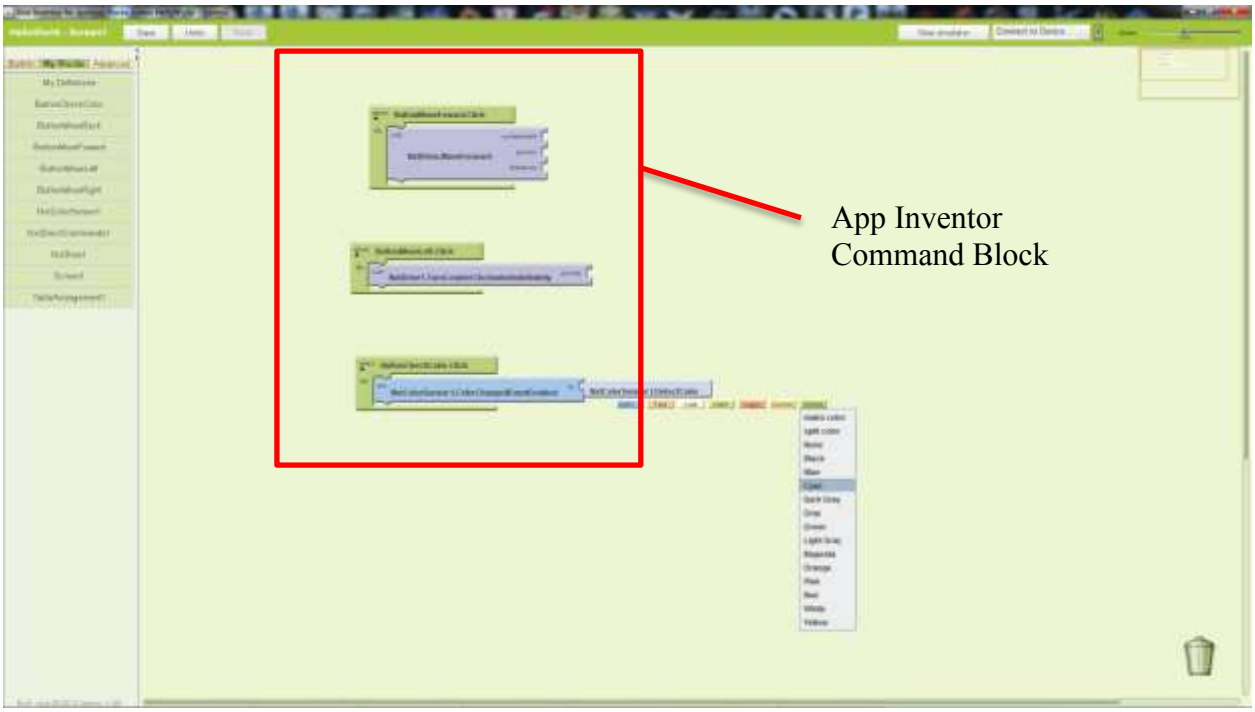
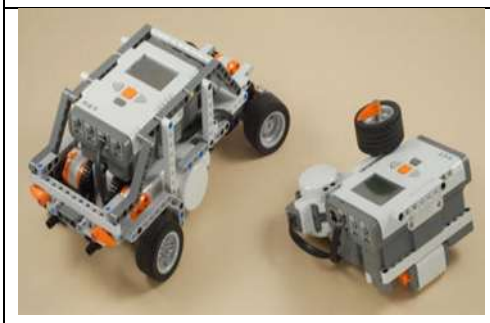


Figure 3.5: App Inventor Command Blocks

3.2.2.3 Drafting and evaluating suitable Mindstorms design

During this activity the evaluation of the most suitable Mindstorm design is being done. The advantage and disadvantages of each design is taken into count and also the suitability of the design to be used by children by taking count the nature of curiosity and safety.

Table 3.2: Potential Mindstorm Model

Model	Advantages	Disadvantages
	1. Solid built 2. Stable 3. Have a front bumper to protect the other components	1. Wires are exposed which is not suitable for children 2. Sharp edges which also not suitable for children
	1. Solid built 2. Stable 3. the micro-computer are well protected	1. Required 2 micro-computers. 2. Complicated for children to use the controller.
	1. Solid built 2. Stable. 3. The micro-computer is well protected. 4. There are spaces for the color sensor.	1. A bit complicated to be built without manual.

The third model will be the most suitable choice for this project. It is stable which make it harder to turn turtle and make it a better design than the first model. The important components such as the micro-computer are also well protected from any direct contact that might happen if the model is to accidently bump into solid objects. The wires that connect the micro-computers to the motors and sensor also are well placed inside the body of the model which makes it safer for children.

3.2.3 Development stage

The development phase consists of 2 main activities which are app developing and also Mindstorm development.

3.2.3.1 App Development

The app development is a continuation of the GUI design and algorithm drafting. During this activity the complete app will be created and all the buttons function will be associated to its specific command blocks to make it functional.

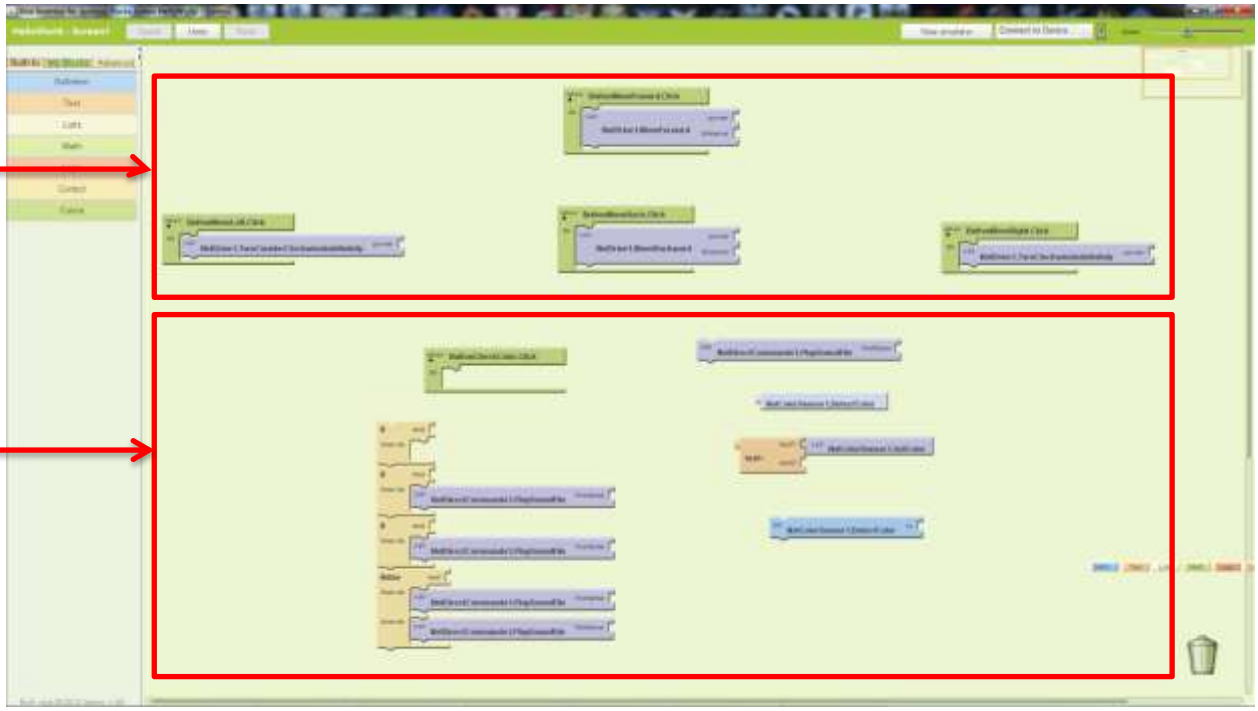


Figure 3.6: The app command block

The logic for color detection

Basic Command for Mindstorm movement

3.2.3.2 Mindstorm Development

The Mindstorm Kit will then be assemble according to the chosen model according to the manual. Below are some of the steps to build the Mindstorm model.

Figure 3.7: Mindstorm Kit development instruction

3.2.4 Testing and completion stage

The testing phase consists of only two activities which are the app testing and also the Mindstorm model testing. Both activities have its frameworks which allow the testing to be done efficiently.

3.2.4.1 App Testing

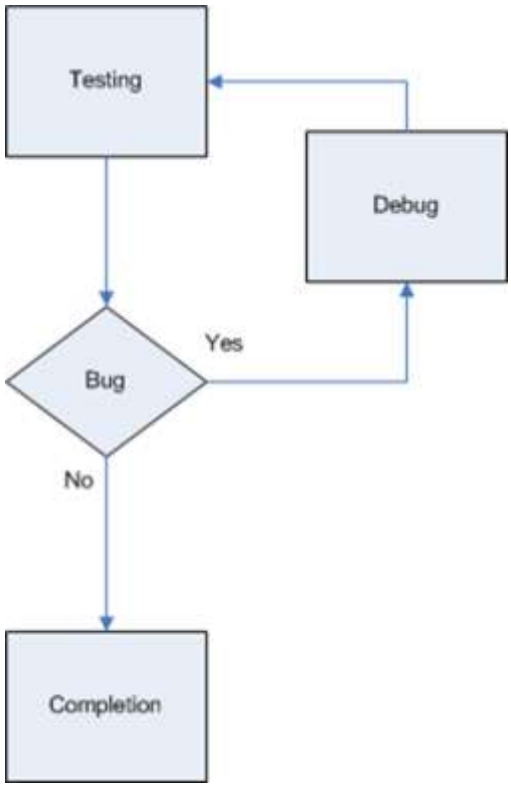


Figure 3.8 : Framework of App testing

The app testing will start with the testing of the app itself. All the functions will be tested and during the testing, and bug found will be debug immediately and the test will be resume with the above framework. Any bug will again be debug until every functions is free of bug and then the testing activities can be completed.

3.2.4.1.1 Experimental Model

There are several version of the application that has been developed throughout this project. Table 4.1 shows the different version of the application and the purpose of each version.

Table 3.3 : Versions of the Android Application

Version	Purposes
Mindstorms color learning apps v1.0	To test the Bluetooth connections from the Android device to the Mindstorms robot.
Mindstorms color learning apps v1.1	To test the basic functionality of the robot control which in this term the basic movement of the motor such as moving the robot forward, backward and also turning sideways.
Mindstorms color learning apps v1.2	Added a stop button to the apps in order to stop the robot movements
Mindstorms color learning apps v1.3	Added a disconnect function to the application in order to solve the problem of the application crashing due to force disconnect when the application is being close or the robot is being switch off

3.4.1.2 Mindstorms Model Testing

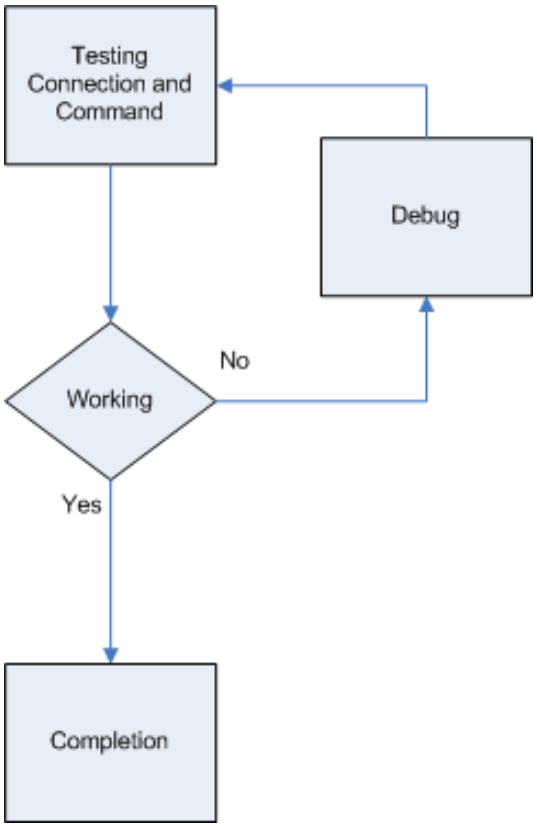


Figure 3.9 : Framework of Mindstorms testing

In this activity, the Mindstorm model will be tested. The basic functionality such as the movement, the ability of the color sensor and also the overall interaction between the android device with the Mindstorms kit will also be evaluate. Any function that failed to works will be debugged. After the debugging has been done, the test will resume and until all the functionality is correct and working.

3.3 KEY MILESTONE

Final Year Project 1

Submission Date:

27 June - Extended Proposal

25 July - Viva: Proposal Defense

25 July - Literature Review Done

7 Aug - Interim Report

10 Oct - Progress Report

26 Nov - Dissertation

5 Dec - Viva

19 Dec - Final Dissertation and Technical Report

3.4 GANTT CHART

No.	Task	Duration	Weeks																											
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
	System Initial Study																													
1	Analyse the details of Lego Mindstorm and Android	1 week																												
2	Define the problem face and constraints	2 weeks																												
3	Define Obejctive of the projects	1 week																												
4	Define scope and limitation	2 weeks																												
	Analyse requirement of the project																													
5	Collecting Data	2 weeks																												
6	Analysing the Data collected	1 week																												
7	Define the function of the project	1 week																												
8	Relevance of the project	1 week																												
	System Design & Development																													
9	Create Conceptual Design	2 weeks																												
10	Tools Selection	2 weeks																												
11	Graphical Interface Design & Development	9 weeks																												
12	Lego Mindstorms Design & Development	8 weeks																												
	Testing																													
13	Doing Usability Testing	2 weeks																												
14	Alpha & Beta Testing	2 weeks																												
15	Acquiring Feedback	1 week																												
16	Implemantation & Evaluation																													
17	Implemantation of project	2 weeks																												
18	Getting Feedback About the project	3 weeks																												
19	Evaluate project performance in real situation	3 weeks																												
20	Modification of project	4 weeks																												
21	Documentation																													
23	Presentation	1 week																												
24	Final Report & Documentation	3 weeks																												
25	Uploading into Online storage to be used	1 week																												

3.5 TOOLS REQUIRED

1. Eclipse Helios

An open source compiler used to do the LEGO Mindstrom programming. Its ability to use multiple plugins makes it one of the easiest as well as customizable compilers to be used.

2. Apps Inventor

Apps Inventor is a product of MIT Media Lab. It allows quick and easy Android Apps to be design and also programme. This tool allow me to create the interface as well as simplify the process of creating the Android Apps

3. LEGO Mindstorm Kit

LEGO Mindstorm is the core of this project. It's a product of the famous LEGO Company. By using this as a platform it creates a uniform platform and eliminates the hardware variable which allows this project to be easily continued or improved in the future by anyone.

One factors that LEGO Mindstorm are being use in this project is that the Lego Mindstorms will provide a standard platform which people all over the world can use and improve the project for future use. By using the Mindstorms hardware and software compatibility won't be a problem because all of the users will be referring to a standardize product and this will make it easier for codes to be reuse and improve.

The next factor is that the Mindstorms has a huge community which information and knowledge to be easily gain and spread. Mindstorms has a community of up to professional programmers down to little children that about to start learning in robotics, so by using the Mindstorms it would give or impacts a larger community all over the world.

CHAPTER 4

RESULT AND DISCUSSIONS

4.1 System Architecture

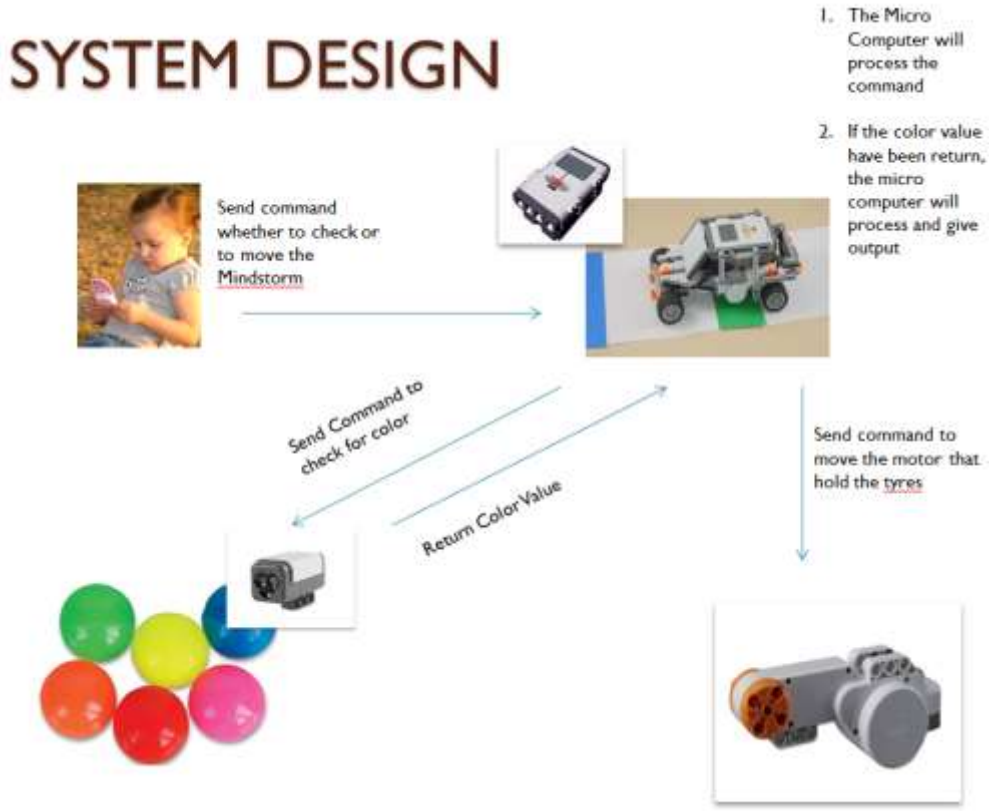


Figure 4.1 : System Architecture of the project

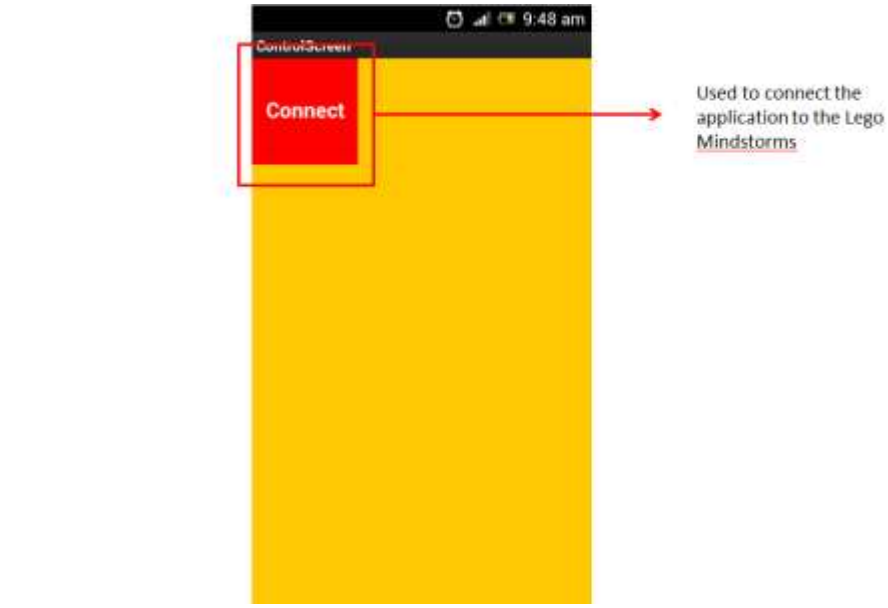
The whole project is an integration of a device and a Lego Mindstorms robot. An Android device is needed as a platform for the users to interact with the Lego Mindstorms. As the figure above, 3 main components of the Mindstorms will be used, which are the Mindstorms Micro Computer, the Mindstorms Color Sensor and the Mindstorms Motors.

4.2 The Application

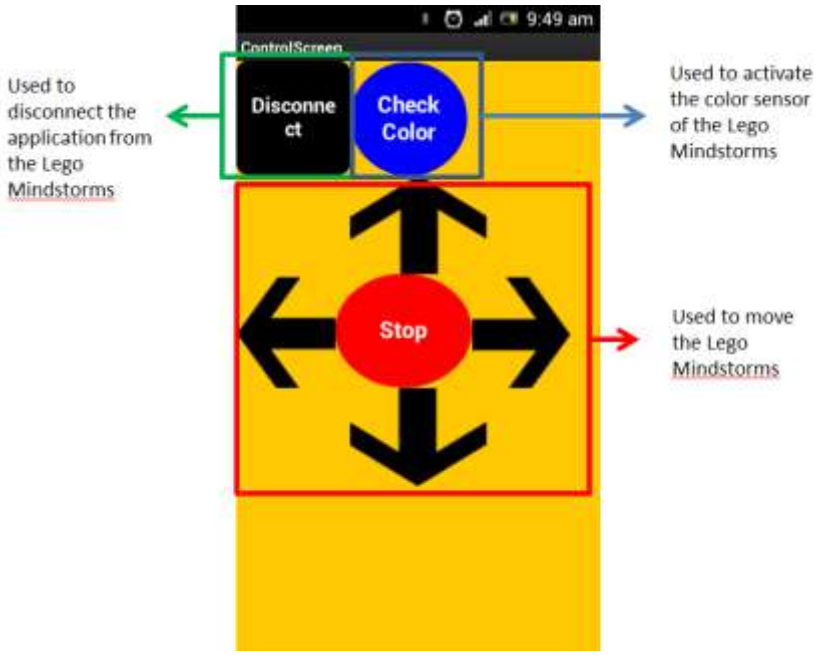
Figure 4.2 shows the start screen of the application. The screen act as a welcome screen, where the user can press the Start button to start the application and move to the next screen.

Figure 4.2 : The start screen of the application

Figure 4.3 (a) shows the connect screen of the application which allow the user to connect the application to the Mindstorms device. As figure 4.3 (b) on the other hand shows the control screen which allow the user to control the Mindstorms.



(a)



(b)

Figure 4.3 Screenshot of the application and its functions

4.3 The Lego Mindstorms components

Table 4.1 shows the main components of Lego Mindstorms that is being incorporated into the projects. It also stated the functions of each component.

Table 4.1 Main components of the project

Components	Functions
	The Mindstorm Micro-computer - Process the inputs and outputs as well as coordinating the movement of the motors. - Process the inputs from the color sensor and determine what is the color as well as playing the sound that identify the colors.
	The Mindstorms Motors - Coordinated by the Mindstorms Micro Computer. - It movement speed will be control by the Mindstorms Micro Computer such as when turning the speed of the wheel between left and right will not be the same.
	The Mindstorm Color Sensor - Detect the colors that appear in front of it and send the inputs to the Mindstorms Micro Computer.
	The Mindstorms Parts - Used to combine all the other parts to form the specific models. - Consist of parts such as tyres, building block and others.

4.4 The Project

Based on figure 4.4, when the user clicks on the connect button, the application will show all Lego Mindstorms device that has been paired with the android device and are available to be connected with the application. After clicking the connect button, the user will be prompted to choose the Lego Mindstorms to be connected from the list. If the application and the Lego Mindstorms are successfully connected, the screen on Figure 4.5 will be shown on the screen.

Figure 4.4 : The application connecting to the Mindstorms Micro Computer

Figure 4.5 will be the main screen after the application successfully being connected to the Lego Mindstorms. The control screen consists of several button to give command to the Mindstorms. There are move forward, move backward, turn right and left button as well as the check color button. There are also a disconnect button which allow the users to disconnect the application with the Mindstorms.

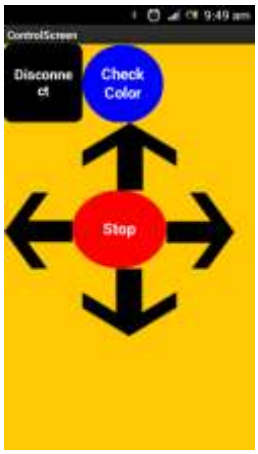


Figure 4.5 : The application control screen

There are three motors used in this model, two are located at the back of the model and another is located at the front. These motors are used to control the movement of the Mindstoms. The move forward button will send command to the Mindstorms motor to start move forward. The Mindstorm model uses two motors to move forward and also backward.

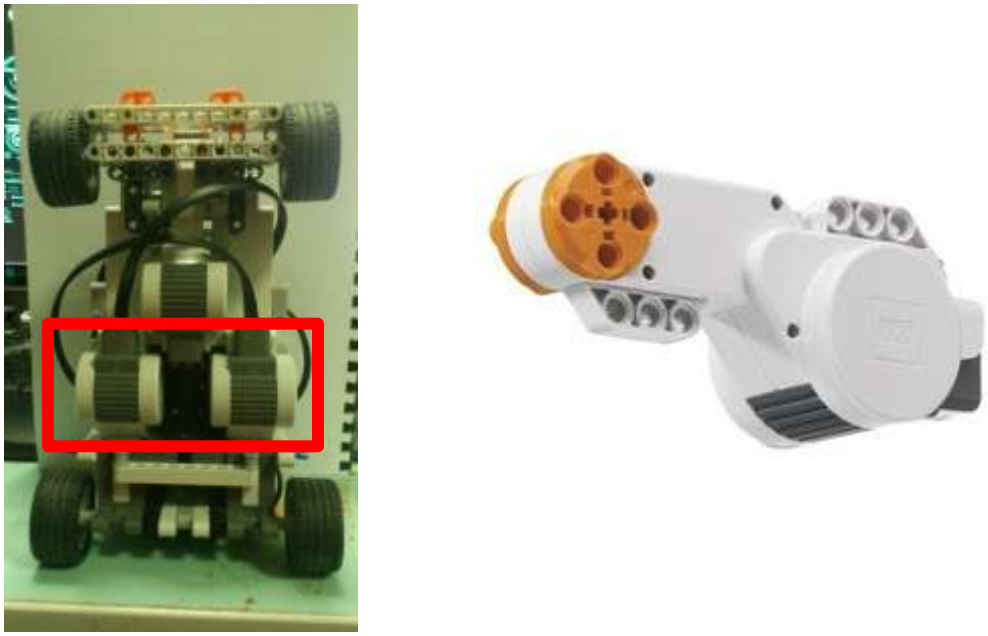


Figure 4.6 : The view from under the Mindstoms model and the actual picture of the motor

On the other hand, Figure 4.7 shows the front motor which control the movement of the front tires and allow the Mindstorms to turn to left and right as shown in figure 4.8. These commands are send by the user when they press the movement button on the application, then the application will send command to the Mindstorms Micro Computer to be process before it send command to the motor to moves as instructed.

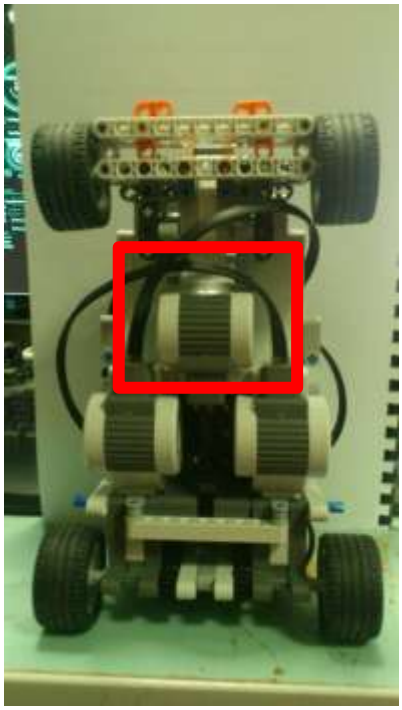


Figure 4.7 : View of front motor of the Lego Mindstroms model

Figure 4.8 : The Mindstorms model turning

The stop button on the other hand will send command to the Mindstorms to stop the movement of the two back motors which will result in the Mindstorms to immediately stop moving.

Figure 4.9 shows the color sensor that is placed on the front end of the Mindstorms model. This color sensor will be activated once the user presses the check color button. The color sensor works by emitting RGB light to the surface and identify the color by capturing the light that reflecting from the surface.

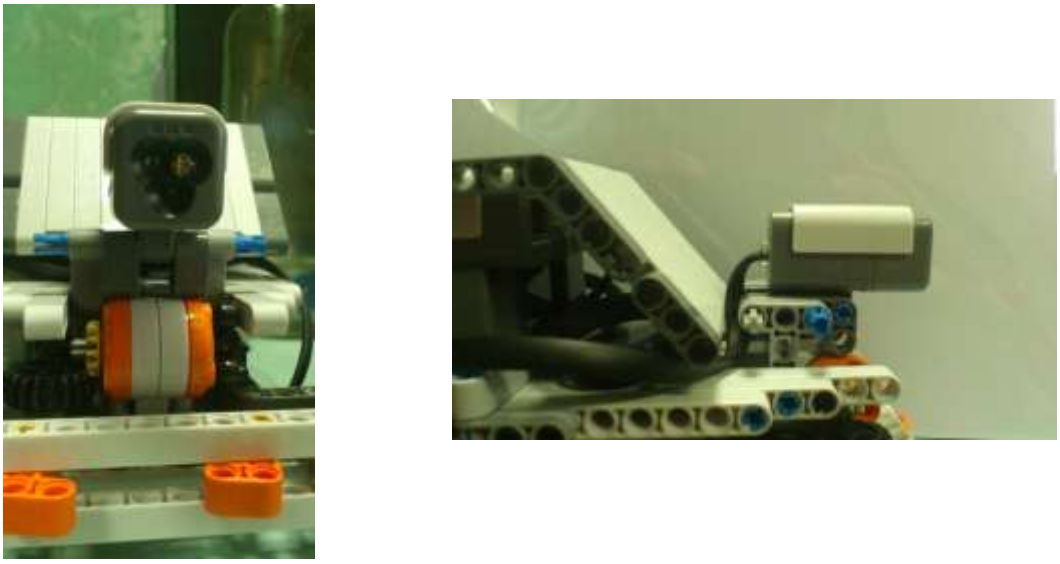


Figure 4.9 : Lego Mindstorms color sensor at the front end of the model

After capturing the light that was reflected by the surface, the color sensor will send the data to the Mindstorms Micro Computer to be processed. The Micro Computer will then identify the color and pronounce the name of the color that has been detected.

The disconnect button on the other hand is used to disconnect the Android phone from the Mindstorms. When the user click the disconnect button and the device manage to successfully disconnected, the connect button will be once again visible and all the other button will be invisible.

4.5 Surveys Results

In order to measure the effectiveness of the project in achieving its goals and objective, surveys have been done to 10 children in the age range of 3 to 5 years old and their parents.

4.5.1 Ease of use and User Friendly

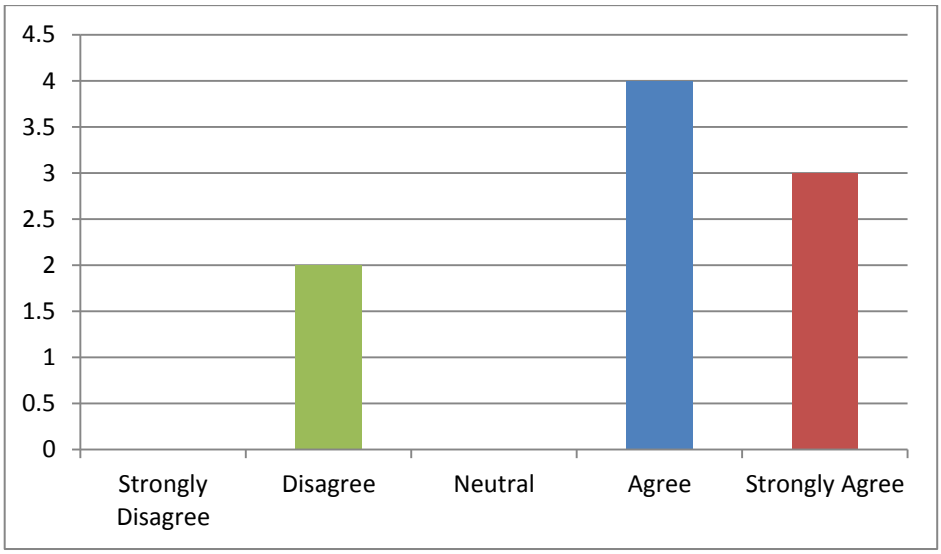


Figure 4.10 : User agreeableness of the project ease to use and user friendliness

Figure 4.10 shows the results of the survey conducted to the respondent. Most of them agree that the application is very easy to be used as the button did what it should do and it is very easy for the parents to teach their children on how to play with the application and the Mindstorms. 2 people disagree as some says its better if the button can be press physically instead on a touch screen.

4.5.2 Suitability of using Lego Mindstorms as tool for learning colors

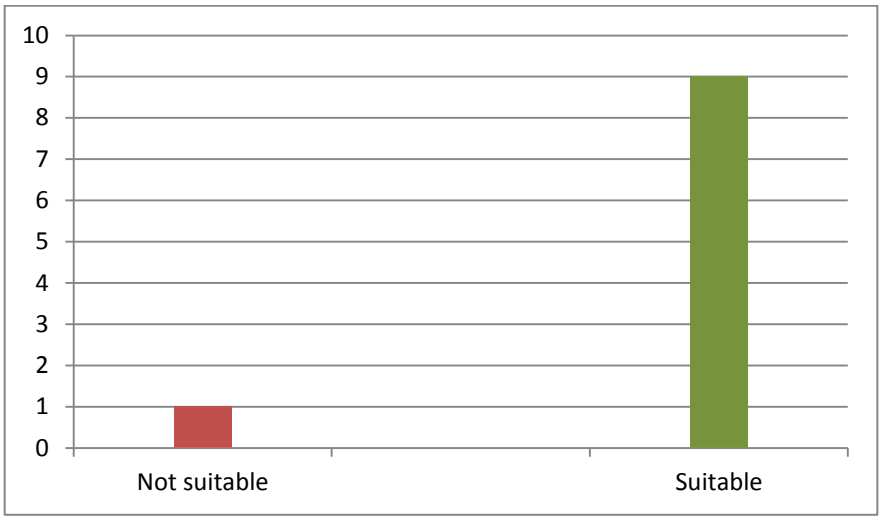


Figure 4.11 : User agreeableness on the project suitability to be used as a color learning tool

The Figure 4.11 shows the opinion of the respondent on the suitability of using Lego Mindstorms as a color learning tools. 7 respondent says that it allow children to interact with the real world which is different from other learning ways while being interesting at the same time.

4.5.3 Effectiveness of the project

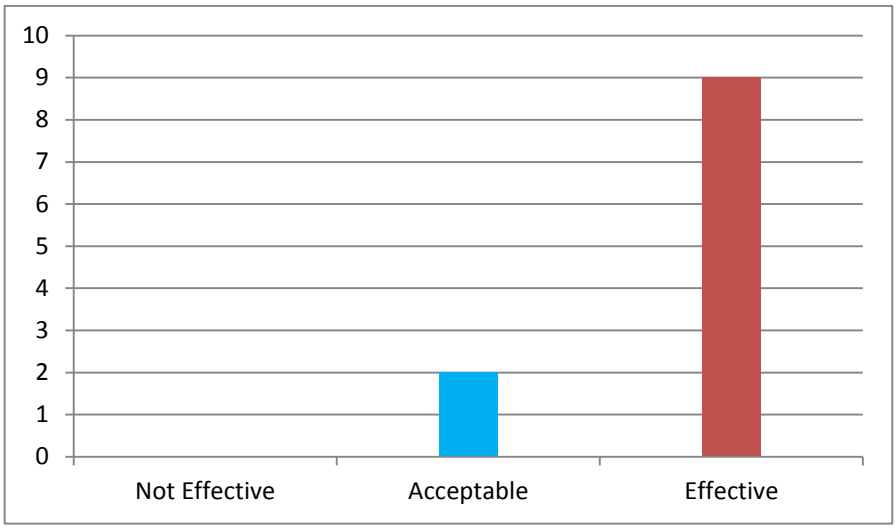


Figure 4.12 : User agreeableness on the effectiveness of the project

The Figure 4.12 shows the result of surveys done to the respondent regarding the effectiveness of the project. A total of 9 people agree that the project give significant impact on their children learning and agree that this project gives another new dimension to the way of learning. They also agree if this kind of project continued to further the scope such as use for learning mathematics, shape and other basic stuff.

CHAPTER 5

CONCLUSION

This project focuses on introducing technologies into learning by focusing the usage of technologies in early stage of education. Introducing technologies into children early education such as color learning process allow children to adapt to technologies at an early age thus accustoming themselves to new technologies. This project also focuses on tackling the problem of slow implementation and technology usage into current education system. By adapting children to technology at such an early stage, it will allow the children who will be the future students to well equip and adapt themselves to the education system of using technologies such as mobile devices and robots in their daily learning and education process. This project serves as an early platform for technologies to be incorporated into educations. In the future, it is hope such project in this field can be developed and expanded using this project as its take off point. The enormous potential of the Lego Mindstorms is still wide open for future project to explore its usability such as improving this project from just color detection to perhaps involving shape detection which can be used to help slow learner children to learn. As for this prototype, several limitations have been encountered as the components of the Mindstorms lack of some technology. As for future modification can be done to the project, when the components such as the color sensor of the Mindstorms can detect color from a larger range and also further from the object then this project can be improve and be more suitable to be commercialize.

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