International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2020): 7.803

Interactive Digital Color Board Game

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Abstract: ***The project aimed to designed and developed an Interactive Digital Color Board Game purposely for relaxation and entertainment. The Arduino Uno was used as the main controller of the project. It controls the activities of all the components integrated in the design board. It consists of analog and digital pins capable of reading inputs and turn it into an output digitally. Proteus Software was primarily used in the simulation, designing, and drawing of the project design circuit. The AutoCAD software was used in generating the lay - out and the pictorial views of the design. The project design outputs were represented by two colors: red and blue where each player may choose from as his color preference during the game. The player will select and press the buttons of his choice and triggers the signal high to be reflected in the board through a Light Emitting Diode (LED) which is a semiconductor that converts electrical energy into light energy. The result showed that the winner of the game is the first to complete the six LEDs with the same color based on either of the following arrangements: horizontal, vertical, and diagonal. It was concluded that the project design could be an alternative to online games and emits less radiation because it is cell phone less and very easy to use. It can be brought anywhere because of its portability feature.***

Keywords: Digital color board game, Arduino, Proteus, online game

1. Introduction

Interactive games are available not just in various online platforms but even offline. These capture the interest and time of various age groups specifically those schooling children. Many engaged not just for fun and leisure but to earn a living. In fact, in UK, thousands of people specially those video game enthusiasts gathered every September in the National Exhibition Center in Birmingham to witness the biggest annual trade fair for video games [10]. On the other hand, majority of Psychologists made various research relative to negative and positive benefits of gaming. Among the negative effects were possible harm of depression, violence, and addiction. However, besides this negative impact, gaming has also its positive impact on cognitive, social, emotional, and motivational aspects of a certain individual [1].

In the Department of Education (DepEd) YouTube Channel specifically on their project #BECYBERSAFEPROJECT, it was given emphasis that online gaming leads to addiction [6]. This was also supported in the study of Lemmens, J. & Hendriks, S. J. F. that spending much time in online gaming can be associated to an Internet gaming disorder (IGD). They were able to explore the nine video game genres and was found out to have a potential addiction effect or relationship to the players with sample of 13–40 - year - old [9]. Another study proved that playing computer games could lead to addiction as purported by Conrad from Clinical Psychologist for TechAddiction. He defined Computer game addiction as excessive and unhealthy amount of playing computer games [7]. One of the very alarming effects of Computer gaming to students was found out in the study of Cortes, M. D., et al that the probability of a computer gamer to fail is 39%. They also concluded that computer gaming, when measured by number of hours spent playing, greatly contributes to the probability of a certain student to fail in the subjects and has also the tendency to drop out of school either repeat one academic year or stop schooling [8]. As a graduate of a computer related degree program, these research results and findings found it to be very alarming because various technology development exists every year.

2. Problem or Gap

In this new normal, playing online or offline games were inevitable. This is because the means of students' learning requires the use of gadgets such as mobile phones, laptop, tablet, and personal computer that are internet connected. This is also because during the COVID 19 pandemic, asynchronous and synchronous modes of learning were currently implemented by majority of schools in the Philippines. This had been the avenue of students to access vast number of games available online. Some opted to download the games so they can access and play offline. This gives an implication that playing games really help people in this time of pandemic specifically those students suffering from mental health problems due to less exposure to places that will give them comfort and relaxation. Students who were bombarded with modules to read and activities to answer would eventually feel exhausted all day long. Thus, they would tend to eventually engage to online video games as well as other interactive games available offline just to stay away from exhaustion and boredom. In fact, as observed even adults were also great players of known online games such as Mobile Legends, DOTA, call of duty, Minecraft, etc. and more so with teenagers, they were engaging with online games as their means of relaxation so they can stay away from stresses especially now that all are still experiencing global crisis.

Nevertheless, playing online games generally affects the physical health of players because of the emission of radiation. Cell phone uses electromagnetic radiation particularly in a microwave range [4]. As cited in the study of Repo 2020, it was found out that using of cellular phones could be linked to sickness. Many students were wearing eyeglasses because of blurry and cloudy vision due to excessive use of cellular phones [5].

With this observation, the researcher was determined to design a project that is cell phone less and can be an alternative means to patronizing online games. Moreover, an interactive digital color board game could be built to give comfort and entertainment to students and other individuals who were experiencing boredom, anxiety and other related mental health problems brought about by pandemic specially on school related activities and tasks.

3. Methodology

The conceptualization of the project started with the determination of the problems of the people in the community based on the observation and initial interview conducted by the researcher to some students living in Kidapawan Cityin which majority of them were coming from Junior and Senior High Schools. Thus, the researcher came up with an idea and was guided with the research question "How to design an Interactive Digital Color Board Game?". Also, the project was developed and designed in the City of Kidapawan, North Cotabato, Philippines.

a) Project Details

The project was implemented through an experimental method wherein it undergone trial and error as well as testing stage of both the hardware and software components. The Arduino was the main controller of the design. It serves as the microcontroller of all the design components. The Arduino board has the capability of reading inputs such as light on a sensor, a finger on a button, and turn it into an output [2]. The project was intentionally designed for a two - player per game only. The playing rules were the same just like you play a real time tic - tac - toe because the concept of this project was patterned and anchored from a tic tac toe game. In this design, the input will always be a digital "high" as the player press the button of his desired input to be activated or enabled. The project contains 36 buttons specifically the 7.7mm tactile switch which serves as the input options of both players. The schematic diagram of all the hardware components of the design were built using Proteus Software, a software invented by Labcenter Electronics. This circuit designing software is normally used by electronic design engineers and technicians in creating and drawing schematics and printing the manufactured electronics printed circuit boards. It was also used to simulate different circuits [3]. Also, simulation was done in Proteus Software. There were two possible color inputs: the red and blue. Each player will choose one color during the game. The player will make use of the buttons to enter the input and it will be processed by the microcontroller and received it using the Light Emitting Diode (LED) in the project board. The project contains a total of 36 LEDs specifically the 5mm WS2812which serves as display board to both players reflecting their inputs when they play. The player to first complete the entire six (6) LED vertically, horizontally, and diagonally in the board game will be the winner. The project has a built in Liquid Crystal Display (LCD) to display the congratulatory message to the winner. It also displays the player's turn to enter the input. In the instance of no winner, the project displays the message "Game Over" in the LCD and players can start a new set of game to enjoy. Meanwhile, if the tile has already been chosen, a display message will also be displayed in the LCD. A 5v voltage supplies the entire circuit of the project. The project used an I2C general purpose I/O as expander for the two - line bidirectional I2C bus. Components used in the project were all soldered and assembled and mounted in a Printed Circuit Board (PCB). The 6x14 inches PCB was placed inside the acrylic board for security and safety of all the electronic components. The acrylic board has two compartments: the first one is where the PCB was mounted and the second one which serves as the front cover of the Interactive Digital Color Board Game. Moreover, the AutoCAD software was used in drawing the pictorial views of the board.

The figure 1 shows the conceptual diagram of the project. It presents the interplay of both the hardware and software components of the project design. It simply implies, that simulation process was done for the circuit to function successfully and accurately.

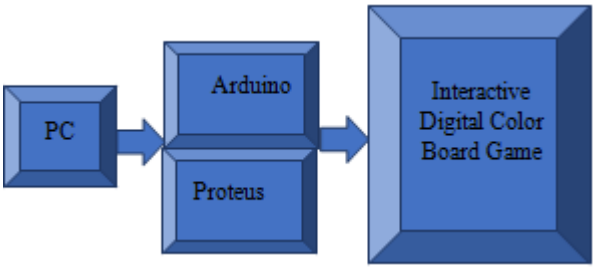


Figure 1: Conceptual diagram of the project

b) Definition of Terms

LED – Light Emitting Diode which display the output color chosen by each player. In this design, the WS2812 was used.
LCD – Liquid Crystal Display which display the textual data that guides player to have better interaction in every game.
Tactile switch – it refers to the button used as input of the players in playing the Interactive Digital Color Board Game.
Arduino UNO – the main controller of the project's entire circuit.
Proteus – a tool used for simulation, designing, and drawing of electronic circuit.
Interactive Digital Color Board Game – a simple and portable color board game primarily designed for two - player only.

4. Results and Conclusion

4.1 Results

The design of the Interactive Digital Color Board Game was indeed challenging because of its complexity in the development of programming codes. More so, with the schematic diagram because the hardware components really require compatibility with the language the Arduino Uno microcontroller supported. Moreover, the skills and patience of the designer in using Proteus tool had also been tested throughout the duration of the project construction and implementation because various errors were found out during the verification or compilation and simulation processes. Some components were not functional, and some do not function based on its expected characteristics and functionality.

The construction of the board game also requires thorough planning and preparation with consideration on the comfortability of the users who are the players. The placement of the hardware components was also given much consideration to ensure that the size of the board is not too big and heavy to make the project portable. The project's circuit was placed inside the board to ensure safety of all the electronic components of the design. The board size was measured 8x16 inches, it weighs 3 kgs., and it is a foldable board made of acrylic glass which is a light and weather - resistant material. It has also handled for portability purpose. Further, the project's board was anchored in the concept of a chess board where in the board can be opened when somebody want to play and closed the board after playing. The middle part of the board where the PCB was mounted, and the board top covercontains magnet at both ends purposely for comfortability in opening and closing of the board. There were twelve Arduino UNO digital pins that were utilized and connected to the input buttons and four analog pins that were connected to the display components which are the LED and LCD.

Figure 2 shows the image of the Interactive Digital Color Board which was made of acrylic glass.

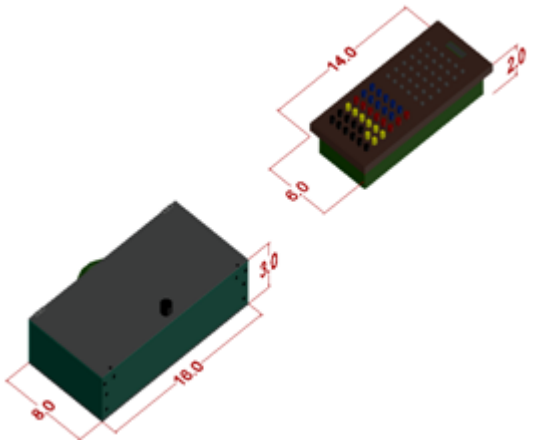


Figure 2: Image of Interactive Digital Color Board

The figure 3 shows the experimental setup of the project from the players to the display components: LED and LCD. It denotes that players' inputs through pressing the buttons were processed by the Arduino UNO wherein the programs were simulated and loaded before it displays the output through its display components. As reflected in the figure, the players will make use of the buttons to enter their inputs. In the actual circuit, there was a single button at the center which serves as option of the players to start a new game.

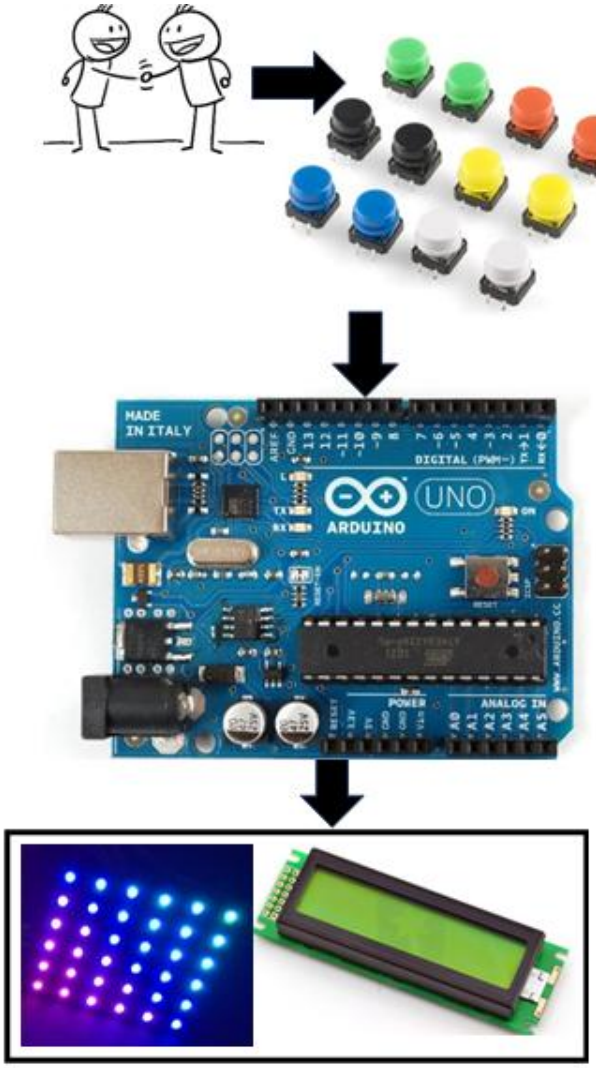
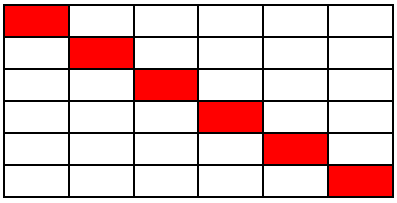


Figure 3: Experimental setup

In starting the game, the design will undergo an initialization process for 30 seconds. During the initialization, the LCD displays the word "Ready". After the initialization process, the LCD displays the message "Start New Game". The default color assigned to player 1 was "red", it simply means that the "blue" color as default assigned to player 2. The player 1 would be the first to select the button of his choice which shall be followed by player 2 and vice versa. If "player 1" which by default assigned to "red" wins, the next player to first press the button for a new game would be the "player 2" which by default assigned to "blue" color and vice versa. The players were given options to finish the game, or they may opt to start a new game even there are still buttons that were not yet pressed. The player would be aware on his turn to select and ready to press the button through the LCD display message: "Player 1 turns" or "Player 2 turns". In an instance where the button had already been taken, the player would be notified with the message displayed in LCD stating, "Already taken". When the button has already taken, the player will lose his turn, meaning each player will press the button one at a time only. Further, declaration of winner was through an LCD stating the display message "Congratulations" when the six LEDswith the same colors were filled horizontally, vertically, and diagonally as shown in Figures3a, 3b, 3c, and 3d.

a)



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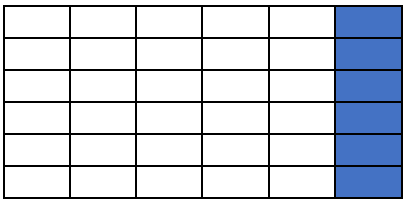

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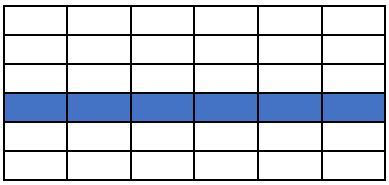

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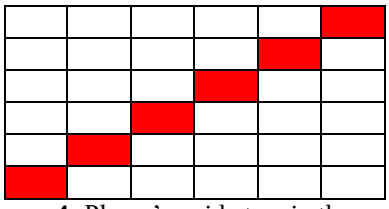

Figure 4: Player's guide to win the game

The figures 5, 6, 7 and 8 shows the project's front, rare, top, and bottom views respectively. These generally presents the pictorial views of the Interactive Digital Color Board Game designed using the AutoCAD software.

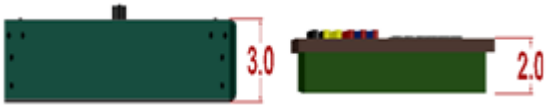

Figure 5: Front view

Figure 6: Rare view

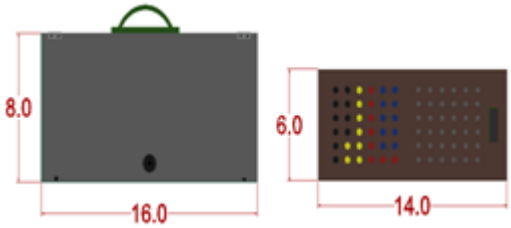

Figure 7: Top view

Figure 8: Bottom view

The testing stage of the design for both software and hardware components were conducted several times to ensure that the expected overall functionality of the project was generally realized and achieved. During the compilation and simulation processes, problems greatly arise. In fact, the programming implementation was a very challenging part of the project making because the designer needs to consider the correct syntax during the program development. Various compilation programs were encountered and debug properly. The program needs to be verified correctly and successfully before it was loaded to the Arduino UNO microcontroller. Loading of programs to the microcontroller were done several times due to malfunctioning of some components in the circuit such aswrong pins connections. The designer also experienced problems after loading the program in the microcontroller because some buttons and LEDs were not functioning well. It was found out that there were problems in mounting the said components in the PCB due to the sensitivity issues. Another problem encountered was the display text in the LCD where various checking and testing were done before it became reliably functional. Sensitivity of some electronic components in the circuits contributes challenging problems during the testing stage. In fact, during the soldering of the components, it was found out that the WS2812 LEDs were very sensitive and fragile maybe because of its tiny size. Thus, it can easily be damaged.

Part of the testing stage of the project was letting various individuals whose age ranges from 6 to 55 - year - old to play the Interactive Digital Color Board Game. Players' comfortability in pressing the buttons and guessing the right button to press were observed. The designer observed that it was not the project simplicity and how it waseasy to use that matters to the players but how the game gives comfort, relaxation, enjoyment, and entertainment to them.

4.2 Conclusion

The project was concluded as one of the alternatives to online games, very easy to use, and a cellphone less color board game that serves as entertainment for individuals who opted to relax and enjoy in the comfort of their homes during this time of pandemic. Despite of the project's simplicity and simpleness, the designer concluded that the project could stimulate the metacognition and critical thinking of the players when they play because they were thinking on which button to press just to block the opponent's possibility of winning the game while also thinking of strategies on how to win. This gives an implication that the project could developed the thinking skills and strategies of the players while having fun. This conforms to Brown, S. & Vaughan, C. 's claims in their book entitled "Play: How It Shapes the Brain, Opens the Imagination, and Invigorates the Soul" that play is not just for fun, but it is an essential component of learning [11].

Generally, the project was portable where it can be carried anywhere and everywhere. The project was concluded to be for players from varied age brackets.

5. Recommendation

Based on the results of the project, the following recommendations were drawn:

1) Instead of using the WS2812 LED, try making use of the Tri - Color RGBLED with 4 pins which are durable, less sensitive, less fragile, and easy to mount in a PCB.
2) Consider to increase the distance between each LED and each button in the PCB to ensure the durability of the components during the soldering process and to stay away from the possibility of damage to every single component of the circuit.

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