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Technology

Computer Engineering Department

Archery Game

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Dedication

Our families deserve our heartfelt dedication for inspiring us to see our work through the end and motivating us to reach this stage.

We are also grateful to everyone who offered their support, even if it was just a single word.

Lastly, we extend our appreciation to ourselves.

Acknowledgement

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Abstract

Certain individuals may encounter heightened levels of stress, anxiety, or depression, while others may experience difficulty finding common interests and may become socially isolated.

Our project aims to develop an Archery game, that offer a unique form of entertainment and may act as a source of escapism and stress relief for individuals. it can also provide a social outlet for like-minded individuals to connect and build relationships. Moreover, playing shooting games can aid in the development of critical thinking and problem-solving skills, which may not be as readily enhanced in other areas of life. Additionally, shooting games can improve hand-eye coordination and reflexes, skills that can be beneficial in other aspects of life. Overall, shooting games, including archery games, have potential benefits that individuals may find appealing for various reasons.

1 Introduction

The report is present the design and implementation of a hardware Archery game capable of operating in two distinct modes: attack mode and defense mode. The game utilizes an Arduino Uno microcontroller along with various hardware components such as DC motors, Sharp IR distance sensors, PIR motion sensors, and a servo motor. The project aims to provide an engaging and interactive experience while showcasing the application of these components and their integration with the Arduino platform.

1.1 Problem

The project addresses the challenge of creating an automated defense system that can detect and respond to both stationary and moving targets. It aims to combine the functionality of target identification, tracking, and engagement into a single device while allowing for user control and interaction. In the attack mode, the project tackles the challenge of precise aiming and powerful shooting. By integrating servo motors, a shoot servo, and DC motors, the system enables the user to control the movement of the game apparatus and accurately shoot rubber darts in specific range.

1.2 Objectives

The objectives of the project are as follows:

- Design and construct an Archery game capable of rotating horizontally and vertically to aim at targets.
- Implement attack mode, enabling the user to detect targets using mobile application, adjust its position with a servo motor using joy stick, and fire rubber darts using shoot button.
- Implement defense mode, utilizing PIR motion sensors to detect potential threats and detect targets using Sharp IR distance sensors, adjust its position with a servo motor, and fire Nerf projectiles.
- Integrate an ESP8266 controller and the Blynk mobile app for remote control and monitoring in attack mode.
- Provide a user-friendly interface for controlling and configuring the game's settings.
- Showcase the project's technical aspects and highlight the potential for future enhancements.

1.3 Importance of the work

The development of a hardware Archery game with attack and defense modes offers a range of practical applications, including home security, interactive gaming, and educational demonstrations. By integrating the Blynk mobile app and ESP8266 controller, the project demonstrates the versatility of remote control and monitoring capabilities.

1.4 Organization of the report

The report is organized as follows:

- Section 2 discusses the constraints and earlier work related to the project.
- Section 3 presents a literature review of relevant studies and projects in the field.
- Section 4 outlines the methodology employed in the design and implementation of the game.
- Section 5 provides a detailed description of the hardware components used in the project.
- Section 6 presents the technical choices made during the design and implementation process.
- Section 7 discusses the design considerations and decisions.
- Section 8 outlines potential future work to enhance the turret's capabilities.
- Section 9 concludes the report, summarizing the project's achievements and providing recommendations for other students.

2 Constraints and earlier work

2.1 Constraints

- Dc Motor:

The choice of using a 12V DC motor for the game imposes a constraint on the power supply. It requires a stable and sufficient 12V power source to ensure optimal motor performance and torque. Deviating from the recommended voltage range may result in decreased motor speed or inadequate rotational force, affecting the game's aiming capabilities.

- Loading The rubber darts Shots:

To load the rubber darts shots, a servo motor is employed. The loading mechanism consists of a mechanical joint and a narrow opening through which a thin metal rod passes, as shown in the figure: This design restricts the range of motion for the servo motor, allowing it to move approximately 60 degrees. Specifically, it can move 10 degrees in the forward direction and 70 degrees in the backward direction.

- 3D-Printing Design:

Since we lacked experience in 3D printing designs, we performed thorough research and immersing ourselves in the subject matter, our minds became enriched with imaginative design possibilities. The insights gained from our extensive exploration served as a foundation for conceptualizing the project's form and functionality. This preparatory phase fueled our creativity and allowed us to envision a unique and innovative design that aligned with our project objectives., we collaborated with friend who was familiar with 3D printing he helped us by sharing our thoughts and ideas with him to design the structure of the final project.

2.2 Earlier Work

In the Computer Engineering Department, we have undertaken numerous courses that have contributed to our knowledge and aided us in the successful completion of this project. Some of these courses were essential for our comprehensive understanding, including:

- Microcontrollers and its lab: This course provided us with valuable insights into working with microcontrollers, understanding their configurations, and utilizing their functionalities effectively.
- Arduino course: The Arduino course proved to be instrumental as it familiarized us with the Arduino

IDE and its programming environment. the knowledge gained from this course assisted us in grasping the concepts and principles relevant to our project.

These courses have played a crucial role in equipping us with the necessary skills and knowledge to tackle the challenges presented by our hardware Archery game project.

3 Literature review

The literature review for the Archery game project reveals key insights from existing research and projects in the field. Studies have explored the design and implementation of Archery game, focusing on microcontroller selection, sensor integration, and target detection. Additionally, the use of mobile app integration and remote-control systems has been investigated, allowing users to control game movements and receive real-time feedback. Mechanical design and 3D printing techniques have also been explored to optimize the physical structure of Archery game. By examining the available literature, this review provides valuable knowledge and informs the methodology and design decisions for the hardware Archery game project.

4 Methodology

4.1 Overview

Initially, the individual components were learned separately, focusing on understanding their functionalities and how to connect them to the Arduino. Each component was programmed individually to ensure it functions according to the requirements of the system. Subsequently, all the components were combined and configured as a cohesive system. The subsequent section will provide a detailed illustration of this process.

4.2 Hardware Components

This section aims to provide a comprehensive description of the project's components. Each component will be concisely outlined, along with an explanation of its specific utilization within the project.

4.2.1 Arduino Uno

The Arduino Uno is a user-friendly microcontroller board for electronic projects. It has a versatile ATmega328P microcontroller, 14 digital I/O pins, 6 analog inputs, USB or external power options, and can be programmed with Arduino IDE (Which was utilized for programming it). It supports communication with other devices, using its built-in USB interface and various protocols.



Figure 1 : Arduino Uno

4.2.2 DC Motor

The mini-DC motor is a compact electric motor that operates on a 12-volt power supply. It consists of an armature and magnets, with the armature rotating when an electric current passes through it, generating a magnetic field. In our project, we utilized the mini-DC motor in conjunction with the Blynk app. By selecting the motor on the Blynk app, we were able to control the two motors to work in opposite directions. This setup was designed specifically to stimulate the rubber darts and enhance their shooting power. The opposing rotation of the motors created a force that propelled the darts vigorously, resulting in an exciting and effective dart-shooting mechanism.



Figure 2 : DC Motor

4.2.3 Servo Motor MG90S

The MG90S servo motor is a commonly used micro servo motor known for its compact size and precise control. It is widely utilized in various applications, including robotics, remote-controlled vehicles, and automation systems. The servo motor consists of a small DC motor, gears, and a feedback control system.

In our project, we incorporated three MG90S servo motors to enhance the functionality and control of the game. The first servo, servo 1, is dedicated to controlling the x-axis movement, enabling accurate targeting of the game. The second servo, servo 2, operates along the y-axis, allowing for vertical adjustment and fine-tuning of the target position. Together, these two servos help locate the target precisely within the designated area.

The third servo, servo 3, known as the shoot servo, plays a vital role in maximizing the power of the rubber dart shots. Its purpose is to move the rubber dart slightly forward, enabling the accompanying DC motor to shoot it more forcefully. By coordinating the movements of the three servos, we were able to create a dynamic and interactive gameplay experience.

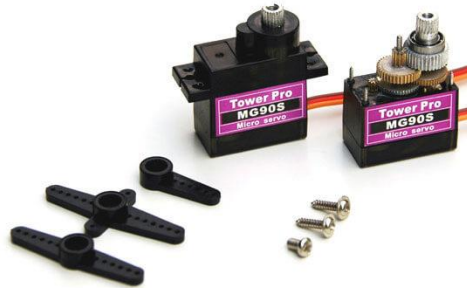


Figure 3 : Servo Motor Mg90s

Overall, the MG90S servo motors significantly enhanced the control and functionality of our project. Through the x-axis and y-axis servos, we achieved precise movement and positioning of the game, while the shoot servo contributed to the powerful and engaging dart-shooting mechanism. The integration of these servos added an extra level of excitement and interactivity to our project.

4.2.4 KY – 008 Laser Module

The KY-008 laser module is a small electronic device that emits a focused beam of laser light. It is commonly used in various applications, including laser pointers, distance measurement, and positioning systems. The module consists of a laser diode, a current-limiting resistor, and associated circuitry. In our project, we incorporated the KY-008 laser module to indicate the location of the target that the user intends to shoot at. By mounting the laser module on the game apparatus, we provided a visual reference point for the target. When the user aims at the target, the laser beam emitted by the module indicates the desired shooting location.

This integration of the KY-008 laser module adds an element of fun and excitement to the gameplay experience. It enhances the precision and targeting ability for the user, making the game more challenging and enjoyable. The laser module serves as a visual guide, allowing users to align their shots.

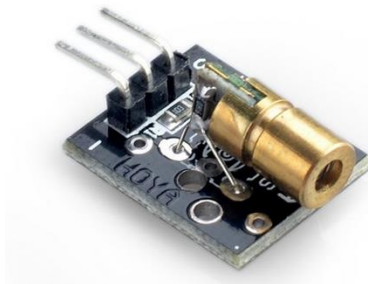


Figure 4 : KY - 008 Laser

Overall, the incorporation of the KY-008 laser module in our project enhances the interactivity and enjoyment for users. By indicating the location of the target, it adds an extra layer of engagement, making the gameplay more immersive and satisfying.

4.2.5 PIR Sensor

The PIR (Passive Infrared) sensor is a motion detection sensor that is commonly used in security systems and automation applications. It operates by detecting changes in infrared radiation emitted by objects in its field of view. The sensor contains pyroelectric materials that generate an electrical signal when exposed to variations in heat patterns.

In our project, we incorporated a PIR sensor as a crucial element in the defense mode. The PIR sensor continuously monitors the area and detects any motion that occurs within its range. When motion is detected, it triggers the activation of a radar system. The radar system relies on a sharp IR sensor, which will be explained in more detail later in the project report.

The utilization of the PIR sensor adds an essential layer of security and protection to our project. It ensures that any unauthorized movement within the designated area is promptly detected and responded to. By activating the radar system, we can gather further information about the detected motion and take appropriate action.

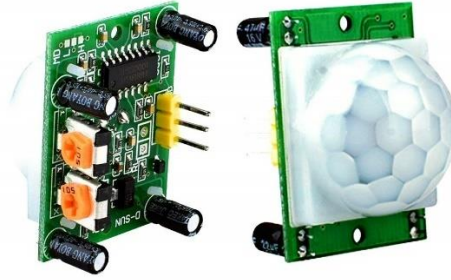


Figure 5 : PIR Sensor

In summary, the inclusion of the PIR sensor as a defense mode element enhances the security features of our project. Its ability to detect motion enables us to activate the radar system and provide an effective response to any unauthorized activity. The PIR sensor plays a vital role in maintaining the safety and integrity of our project.

4.2.6 Sharp IR Sensor

The Sharp IR (Infrared) sensor is a distance measurement sensor that utilizes infrared light to determine the distance between the sensor and an object. It emits infrared light and measures the time it takes for the light to reflect back to the sensor, allowing for distance calculation.

In our project, we integrated the Sharp IR sensor as a key component of the defense mode. When the PIR sensor detects motion, the game enters the radar mode. In this mode, the game moves along the x-axis within predefined parameters. Simultaneously, the Sharp IR sensor measures the initial distance between the sensor and the target.

During the radar mode, the Sharp IR sensor continuously reads the current distance to the target. It compares this value to the initial distance recorded earlier. If there is any difference between the two distances, indicating the target has moved, it triggers the activation of Servo No. 3, also known as the shoot servo.

The utilization of the Sharp IR sensor in this manner allows for precise monitoring of the target's movement. It enables the game to respond dynamically to any changes in distance, ensuring accurate shooting.



Figure 6 : Sharp IR Sensor

In summary, the integration of the Sharp IR sensor in our project's defense mode provides distance measurement capabilities and contributes to accurate target tracking. It allows the game to adapt to

target movements by comparing initial and current distances, resulting in enhanced shooting accuracy and overall gameplay experience.

4.2.7 DC Motor Driver (L298N Driver)

The L298N driver is a popular motor driver module used to control the direction and speed of DC motors. It is commonly employed in robotics, automation, and motor control applications. The L298N driver module consists of an H-bridge circuit that can control the rotation direction of two separate DC motors.

In our project, we utilized the L298N driver to precisely control the direction of two DC motors. By connecting the motors to the driver module, we were able to manipulate their rotation direction as required. This functionality was crucial in our project, as it allowed us to stimulate the rubber darts' shooting mechanism.



Figure 7 : L298N Driver

4.2.8 Buck Converter (XL4015)

The Buck Converter XL4015 is a compact and efficient DC-DC converter that steps down higher voltages to lower ones. It uses pulse width modulation techniques to regulate the output voltage, allowing for efficient energy transfer. With a wide input voltage range and built-in protections, it is commonly used in power supplies, battery chargers, and other electronic circuits.

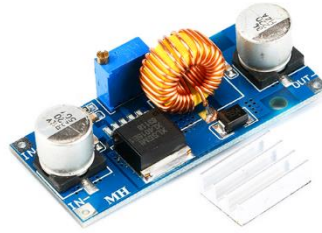


Figure 8 : XL4015

4.2.9 ESP 8266

The ESP8266 is a versatile Wi-Fi module widely utilized in Internet of Things (IoT) projects. It integrates a microcontroller and Wi-Fi capability, enabling seamless wireless communication with other devices. The ESP8266 module offers features such as a TCP/IP protocol stack and GPIO pins for interfacing with external components.

In our project, we integrated the ESP8266 module to establish control of the Blynk mobile app. By connecting the ESP8266 module to our project's microcontroller, we established a link between the physical components and the Blynk app's virtual interface. Through programming, we configured the ESP8266 module to communicate with the Blynk cloud platform.

This integration allowed us to remotely control and monitor our project using the Blynk mobile app. We could conveniently interact with various functionalities, such as motor control, sensor readings, and mode switching, directly from our mobile device. The ESP8266 module ensured reliable and real-time data transmission between the app and our project, facilitating seamless control and feedback.



Figure 9 : ESP8266

The integration of the ESP8266 module into our project provided wireless connectivity and enabled control via the Blynk mobile app. This integration enhanced the accessibility and convenience of operating our project, allowing for remote control and monitoring from a mobile device. The ESP8266 module served as a crucial component in establishing a seamless connection between our project and the Blynk app, empowering a user-friendly and interactive experience.

4.2.10 Wires

Jumper wires are flexible wires with connectors on each end used for making temporary electrical connections. They are commonly used in prototyping and circuit building to establish connections between various electronic components.

In this project, we utilized jumper wires to establish the necessary connections between different components. We connected the pins of the microcontroller, sensors, modules, and other electronic components by simply plugging the connectors of the jumper wires into the appropriate slots. The flexibility of the jumper wires enabled us to easily modify and rearrange connections as needed during the development and testing phases of our project.

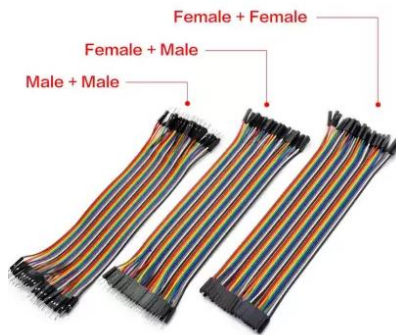


Figure 10 : Jumpers

4.2.11 IR Sensor

An infrared (IR) sensor is a device that detects and measures infrared radiation in its surroundings. Infrared radiation refers to the electromagnetic waves with wavelengths longer than those of visible light but shorter than those of microwaves. IR sensors are designed to respond to this specific range of wavelengths. They consist of an IR source, which emits infrared radiation, and an IR detector, which detects and converts the received radiation into an electrical signal. The sensor can be used to detect the presence or absence of objects, measure temperature variations, or monitor motion, among other applications. When an object is present, it emits or reflects infrared radiation, which is detected by the sensor. By analyzing the detected signal, the sensor can provide information about the object's distance, temperature, or movement.



Figure 11 : IR Sensor

4.3 Technical Choices

4.3.1 Mobile app

The Blynk app was created using the Blynk platform, which provides a user-friendly interface for building IoT applications. To design our specific app, we incorporated various buttons and elements to control and interact with our project. Firstly, we added a mode button, which functions as a switch button, allowing users to toggle between attack mode and defense mode. This button enables users to select the desired mode of operation based on their preference.

Next, we included a motor on button, also a switch button, to control the activation of the two DC motors. Users can turn the motors on or off by pressing this button, providing them with direct control over the motorized functions of the project. The button's state indicates whether the motors are currently activated or deactivated.

To enable precise control of servo motors, we integrated a joystick element. This joystick allows users to manipulate the x-axis servo and y-axis servo, providing them with real-time control over the positioning of the game apparatus. By moving the joystick, users can adjust the direction of movement along the respective axes.

Furthermore, we added a shoot button, which triggers the action of the shoot servo (servo 3). When pressed, this button activates the shoot servo, propelling the rubber dart forward and enhancing the shooting mechanism. Users can easily initiate the shooting action by tapping the shoot button, adding an interactive element to the project.

Overall, the Blynk app was designed to offer a seamless and intuitive user experience. By incorporating buttons and elements such as the mode button, motor on button, joystick, and shoot button, we provided users with convenient and direct control over various aspects of our project. These elements enhance interactivity and allow users to engage with and customize their experience with the project.

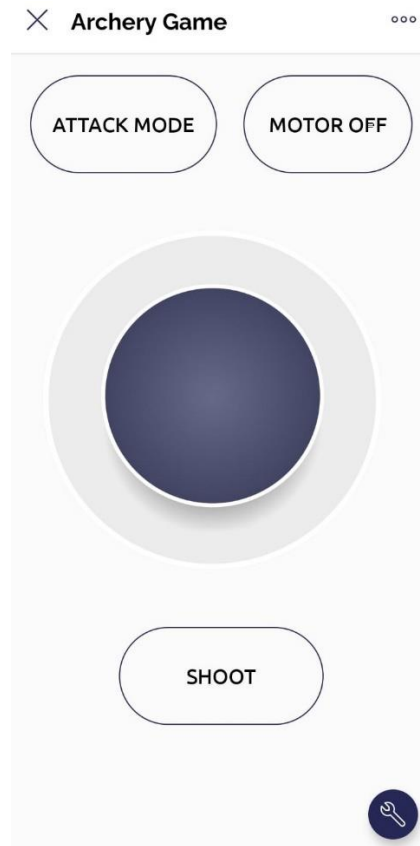


Figure 10 : Mobile App

4.3.2 Server-side Database

In our project, we utilized a server-side database in conjunction with the Blynk app. The server-side database served as a centralized storage and management system for our project's data, ensuring data consistency and accessibility. It offered advanced features such as indexing and query optimization, enhancing data retrieval efficiency. With robust security measures in place, the server-side database protected sensitive user information. Its integration into our Blynk app enabled seamless and reliable user experiences, enhancing project functionality and data management.

4.4 Process of work

In the initial stages of our project, we focused on devising a precise design that would meet our requirements. Achieving the desired outcome necessitated careful consideration, and we explored various options. Among the possibilities, 3D printing emerged as the most suitable and accurate solution. So we embarked on an extensive research journey, scouring the internet to find ideas that resonated with our vision. This meticulous exploration led us to a wealth of diverse designs that sparked

inspiration and enabled us to visualize the ideal form of our project. These invaluable discoveries served as the cornerstone for shaping our design concept and fine-tuning our understanding of the desired outcome. By drawing upon these findings, we commenced the design process by creating 3D models based on the measurements of the key electronic components, namely three servo motors and two DC motors. Utilizing these measurements as our foundation, we proceeded to print the necessary pieces, which were then assembled to form the project's structure. This crucial step marked the first milestone in our project's development.

Once we completed the design and assembly of the project's structure, our focus shifted to establishing the connection between the mobile application and the electronic components. This involved programming the Arduino Uno using the Arduino IDE. After ensuring each component was correctly connected to the Arduino Uno, we proceeded to program the X and Y servo motors in coordination with the joystick. The Arduino Uno received the X and Y values from the Blynk application and transmitted them to their respective servo motors. Similarly, we programmed the shoot servo, which received a signal from the mobile application to activate. The Arduino Uno then directed this signal to the designated servo. Prior to shooting, the user needed to activate the DC motor, which provided the necessary power for propelling the rubber dart. The shoot servo delivered a brief impulse to the rubber dart, to utilize the power of the two DC motors for a forceful shoot. Notably, when the DC motors were activated, the laser was synchronized with their movement, allowing the user to aim at the desired target. These operational details pertained to the attack mode.

In defense mode (the user could switch from attack to defense by toggling the game mode button) In this mode, both the laser and the two DC motors were simultaneously activated. The PIR sensor detects any movement, triggering the radar mode with the assistance of the X-Axis servo motor. The sharp IR sensor played a crucial role in this mode, comparing the initial distance value recorded upon activating defense mode with the real-time distance values obtained during radar operation. When a difference was detected, the launch servo would engage, shooting out the rubber dart.

This comprehensive integration of various components and functionalities exemplified the versatility and effectiveness of our project in both attack and defense modes.

5 Design

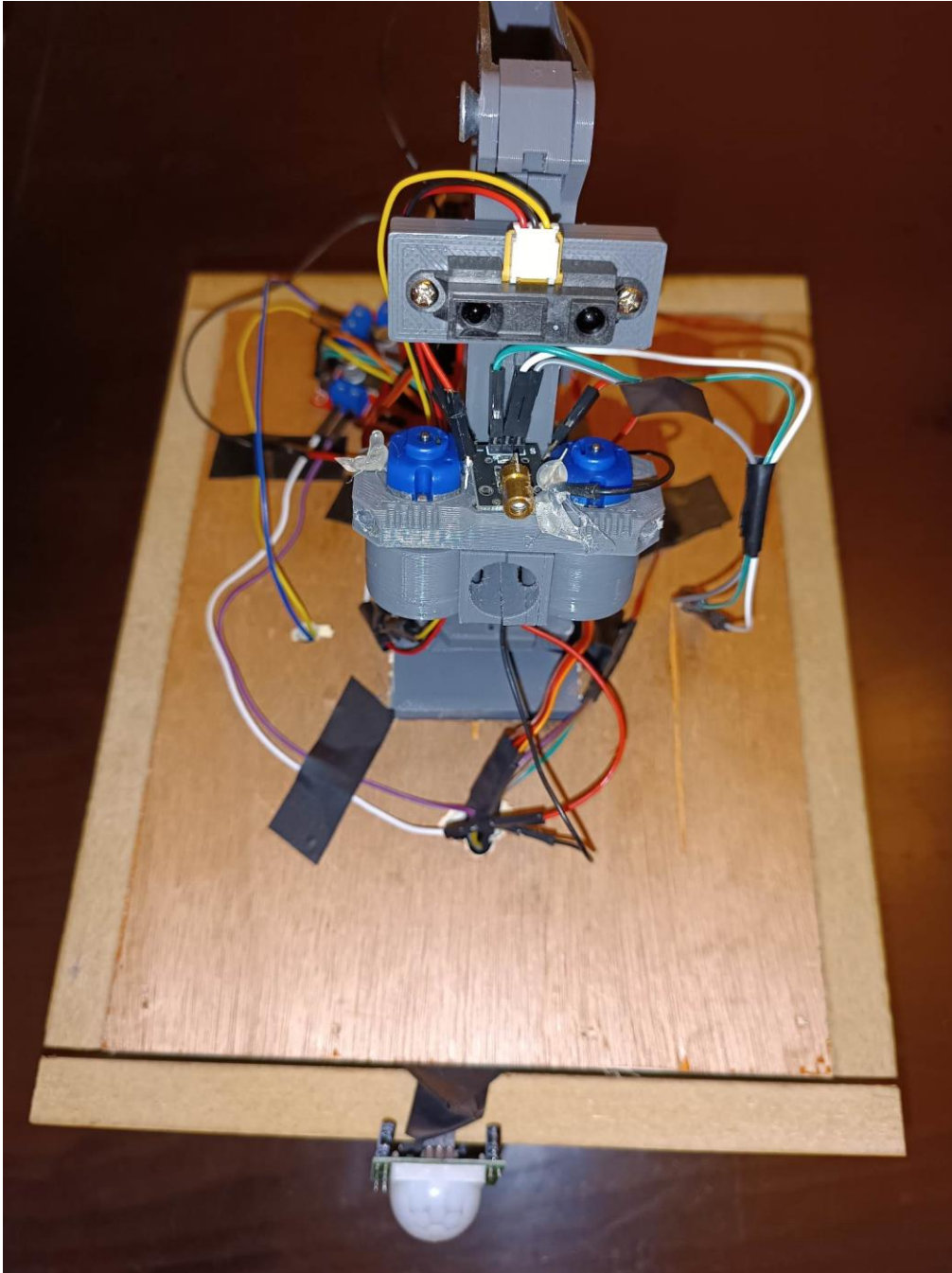


Figure 12 : Design 1

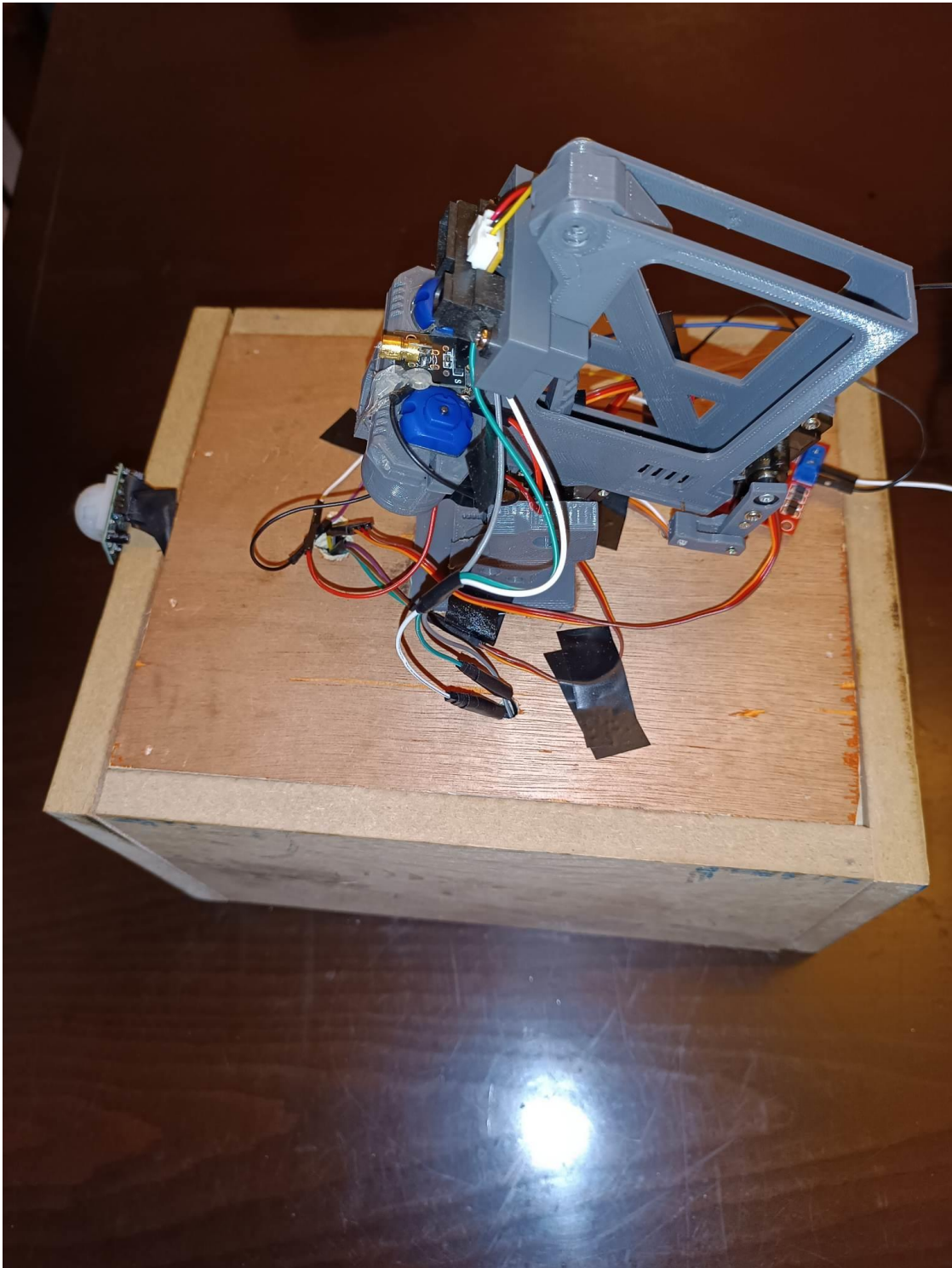


Figure 13 : Design 2

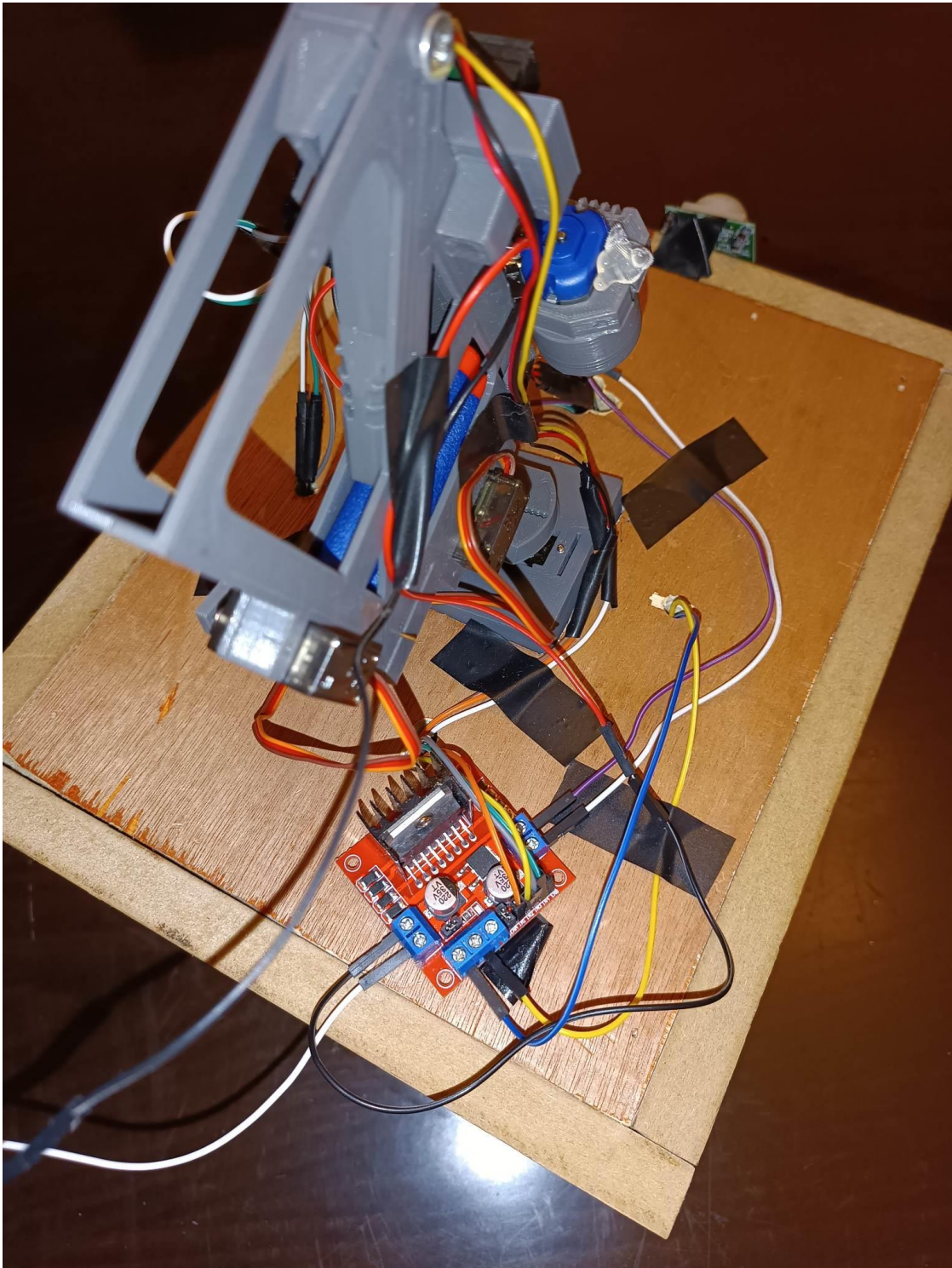


Figure 14 : Design 3

6 Future Work

In terms of future work, we have several ideas that aim to enhance and expand the capabilities of our project. One idea is to enhance the game experience by enabling a full 360-degree coverage instead of the current 180-degree range. This modification would provide players with a more immersive and dynamic gameplay environment.

Another exciting concept is to increase the level of enjoyment in the game by incorporating movement capabilities similar to that of a car. By implementing this feature, users would have the ability to control the game apparatus in all directions, adding a new dimension of interactivity and excitement to the gameplay.

Furthermore, we envision improving the defense mode by introducing a Raspberry Pi into the system. This addition would enable a higher level of accuracy by allowing the Raspberry Pi to selectively target specific objects rather than responding to any detected movement. This enhancement would enhance the precision and efficiency of the defense mode, making it more effective and reliable.

Exploring these ideas for future development would elevate the overall experience of our project, pushing the boundaries of gameplay and performance. By incorporating a 360-degree coverage, introducing multi-directional movement, and enhancing the accuracy of the defense mode with a Raspberry Pi, we aim to provide users with a more immersive, engaging, and captivating gaming experience.

7 Conclusions and Recommendation

7.1 Conclusion

In conclusion, our project successfully combined various electronic components, software programming, and mechanical design to create an interactive and engaging Archery game. By utilizing the Blynk app, we were able to control the game apparatus and execute different functionalities, including motor control, servo movement, and shooting mechanisms.

We leveraged the capabilities of mini DC motors, servo motors (X-axis, Y-axis, and shoot servo), the KY-008 laser module, PIR sensor, sharp IR sensor, L298N driver, and ESP8266 module to realize our project's objectives. Through careful design and precise measurements, we constructed a sturdy and functional structure using 3D printing technology.

The integration of the Blynk app allowed for seamless control and interaction with the game apparatus using a mobile device. The inclusion of a server-side database ensured data consistency and facilitated a reliable user experience.

Overall, this project showcases our ability to merge various technologies and components to create an enjoyable and interactive game. It highlights the importance of careful planning, precise execution, and continuous innovation in achieving desired outcomes. Through this endeavor, we have gained valuable knowledge and experience in electronics, programming, and project management. We believe our project serves as a foundation for further exploration and development in the field of interactive gaming.

7.2 Recommendation

Prior to commencing our project, a significant amount of time was dedicated to learning the Arduino language and familiarizing ourselves with the required electronic components. This process involved extensive research and understanding of how these components function. We believe that acquiring this foundational knowledge before embarking on any hardware project is crucial, and we strongly recommend other students to do the same.

The design phase of the project structure consumed a substantial amount of time as well. Therefore, we emphasize the importance of meticulousness during the design process and the accurate consideration of measurements. Even a minor error in measurements can lead to significant time loss and potential setbacks. Students should exercise caution and attention to detail during this phase.

Furthermore, we advise against wasting any time and encourage students to work on their projects consistently and regularly. Consistent effort and progress prevent the accumulation of problems and challenges, fostering a smoother and more efficient development process.

In summary, our experience has taught us the importance of pre-project preparation, careful design, and consistent work. By dedicating time to learning, being meticulous in measurements, and maintaining regular progress, students can maximize the efficiency and success of their hardware projects.

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