An-Najah National University

Faculty of Engineering & Information Technology

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Bachelor degree in Compute Engineering

Graduation Project 2

Ka-Chow

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Acknowledgment

With hearts overflowing with gratitude, we begin by thanking Allah, Most Gracious and Most Merciful, for without His divine guidance and blessings, this project would never have come to fruition. His favor illuminated our path and eased the journey. We then extend our deepest appreciation to Dr. Suleiman Abu Kharmeh, whose unwavering mentorship served as a beacon throughout. His expertise, unwavering support, and willingness to go the extra mile were instrumental in our success. His wisdom helped us navigate challenges, refine our skills, and ultimately achieve our goals. To our parents, our pillars of strength, we owe an immense debt of gratitude. Their unwavering love, unwavering support, and unwavering sacrifices fueled our determination and provided the foundation for our success. Their belief in our potential was a constant source of strength, especially during challenging times. And finally, to our dear friends, we express our heartfelt thanks. Your encouragement, unwavering support, and willingness to lend a helping hand were invaluable. Your presence enriched our experience and made this journey one we will never forget. To these exceptional individuals, we dedicate our deepest gratitude. Their unwavering support and guidance were the cornerstones of our success.

Disclaimer

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Abstract

Project Ka-Chow explores a novel approach to car racing by blending two distinct yet integrated experiences. We've built a high-tech system featuring the car with two modes: a self-driving car with autonomous obstacle avoidance and a remote-controlled counterpart. Participants can choose their racing thrill: navigate a challenging track through the car's independent decision-making in self-driving mode, or take the wheel (remotely) and engage in a dynamic, hands-on experience, The remote control comes in two shapes: a PlayStation controller and a custom design created with the App- Inventor program. The Project Ka-Chow system enhances the racing experience through an immersive environment that includes real-time race updates, dynamic LED lighting, pulsating music, and a timer that determines the winner. The system also includes a camera that shows the race and streams it to a laptop or mobile app. This allows participants to watch the race from different perspectives and share it with others, The system also includes a smart gate that opens when it senses a car in front of it. The car then enters the gate. At the end of the race, there is a simple parking area where the car can be parked. The car then stops and ends the race.

What is Ka-Chow? The phrase "Ka-chow" is a made-up onomatopoeia that is used to represent the sound of a car accelerating. It is first used by Lightning McQueen in the 2006 film Cars, and it quickly becomes his signature catchphrase. McQueen uses "Ka-chow" in a variety of contexts. He might use it to express excitement, like when he is about to race. He might use it to express determination, like when he is facing a challenge. Or, he might use it to express his competitive spirit, like when he is winning a race. [1]

Figure 1: Ka-Chow

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Chapter 1

Introduction

1.1 General background

As we stood on the precipice of graduation after five years of dedicated learning, we yearned for a project that would encapsulate the depth and breadth of our acquired knowledge. Our hearts were set on crafting something beautiful, something that would spark joy and engage players of all ages. This desire led us to the thrilling world of car racing.Our vision: one car with two modes, the first one is the champion of the race, challenges the second car that will be controlled by the opposing player through the remote, providing an experience that combines a remote-controlled car against Ka-Chow that sails on its way. We envisioned a game that would transcend generations, bringing laughter and excitement to families and friends as they competed in a race to the finish line.

1.2 Objectives

In a world of constant demands and obligations, free time is precious. It's a moment to step away from the pressures of everyday life and engage in activities that bring us joy and relaxation. Recognizing the importance of leisure, our project aims to add a touch of pleasure to that free time by focusing on the universal human desire for play. Whether it's seeking the quietude of sleep, indulging in an engrossing movie or book, or venturing out for a fun shopping spree, we all have our unique ways of occupying ourselves during downtime. Some of us, however, find particular enjoyment in the realm of play. It's a chance to unleash our imaginations, engage in friendly competition, or lose ourselves in a world of pure amusement. This project embraces the transformative power of play, aiming to create experiences that are not only enjoyable but also enriching and stimulating for the mind and spirit.

1.3 Significance

In an era dominated by work and obligations, "Ka-Chow" emerges as a beacon of hope, aiming to revitalize the importance of leisure and play for individual well- being. Recognizing the diverse spectrum of human preferences, our project goes beyond mere entertainment, crafting enriching experiences that cater to individual needs and desires. We understand that fulfillment can be found in moments of serene quietude, the thrill of playful competition, and a myriad of activities in between.

By embracing the transformative power of play, we aim to create experiences that spark joy and laughter while simultaneously stimulating cognitive and emotional growth. This focus on holistic development elevates play beyond simple amuse- ment, adding a layer of positive impact that extends far beyond the individual. Ultimately, "Ka-Chow" seeks to build stronger communities and contribute to a happier, healthier world, fueled by the joy and connection fostered through mean- ingful play experiences.

1.4 Organization

This report follows a structured format, guiding the reader through the project journey. The introduction establishes context with background, objectives, and significance, followed by a chapter exploring relevant previous work. The method- ology dives into technical choices and constraints, while the results and analysis present and evaluate the project's outcomes. A discussion delves deeper, reflecting on the development process and lessons learned. Finally, a conclusion summa- rizes key findings and outlines avenues for future research, and references provide comprehensive source attribution. This structure ensures clarity and facilitates understanding of the project and its impact.

Chapter 2

Theoretical Background and Previous Work

2.1 Theoretical Background

Although our combined expertise provided a strong foundation, achieving flawless execution of this project necessitated further development. Recognizing the need to bridge knowledge gaps, we diligently engaged in comprehensive research. Immersed in tutorials, scholarly articles, and invaluable consultations with trusted colleagues, we strategically sought efficient shortcuts and honed our understanding. The journey documented in this video stands as a testament to the profound impact of collaborative learning, and it serves as a highly recommended resource for any aspiring novice embarking on their own Arduino adventure.[2]

2.2 Previous Work

In the face of a landscape saturated with conventional automotive projects, our vision dared to be different. We envisioned a car that transcended the boundaries of mere transportation, one that carved its path on racetracks, a living canvas of speed and precision. This absence, this void, became our catalyst, a call to action to rewrite the narrative of automotive innovation. Fueled by unwavering passion, we embraced the challenge, becoming pioneers in uncharted territory, etching our path with the wheels of our groundbreaking project.

Chapter 3

Methodology

Our project was not born out of thin air, but rather built with meticulous care and in-depth research from the very beginning. We consulted with our trusted colleagues and our supervisor, delved into similar past projects, from line-following cars to fire-fighting vehicles, and drew on endless ideas from the internet. In order to master the handling of electronic components and connect them easily, we learned from an Arduino beginner's course, read the manual for each component carefully, and used "Uncle Google" for anything that confused us.
When we reached the electrical side, vigilance and caution were essential. We used tightly wrapped wires and cables, soldered the components accurately, and ensured that the correct voltage reached each component in a safe manner. To further increase safety, we installed a battery switch to avoid manual disconnection and prevent damage to our fingernails.

3.1 Technical choices

Delve deeper with us to discover the components employed and the essential ingredients, both software and hardware, required to bring this project to fruition.

3.1.1 Microcontrollers

In our project, we needed to use 3 types of Arduino, Nano, Uno, and Mega. We use Nano for the remote-car, Uno for the self-driven car, and Mega for the track.

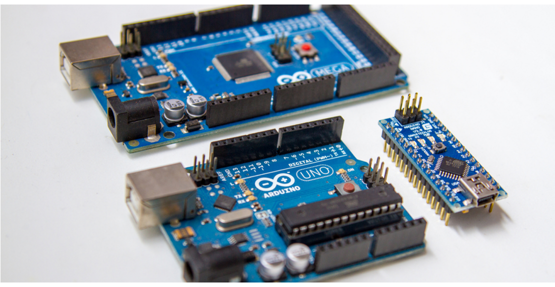

Figure 3.1: Arduino

3.1.2 Power sources

Lightweight operation was paramount. Thus, we chose qoop batteries to power the car, enabling the car to navigate freely. We used a battery holder with a switch to easily connect and disconnect power from the battery.

Figure 3.2: qoop batteries

Figure 3.3: Battery Holder+switch

We used two rechargeable batteries, so we needed a charger for these batteries.It is easy, just put the batteries and connect the device to a power source. We used a laptop in our project.

Figure 3.4: Battery Charger

3.1.3 Libraries

Library	Used For
<AFMotor.h>	to control motors with the Adafruit Motor Shield.
<Wire.h>	for general I2C communication.
<Adafruit_TCS34725.h>	to interface with the TCS34725 color sensor.
<Servo.h>	Controls servo motors in Arduino projects.
<LiquidCrystal.h>	Interacts with Liquid Crystal Displays (LCDs) in Arduino projects.
<PS4Controller.h>	Allows communication with a PS4 controller in Arduino projects.

Figure 3.5: Libraries

3.1.4 ICs

First, the car.

We used a set of components to match the expected performance of the car.[3]

Mode 1:

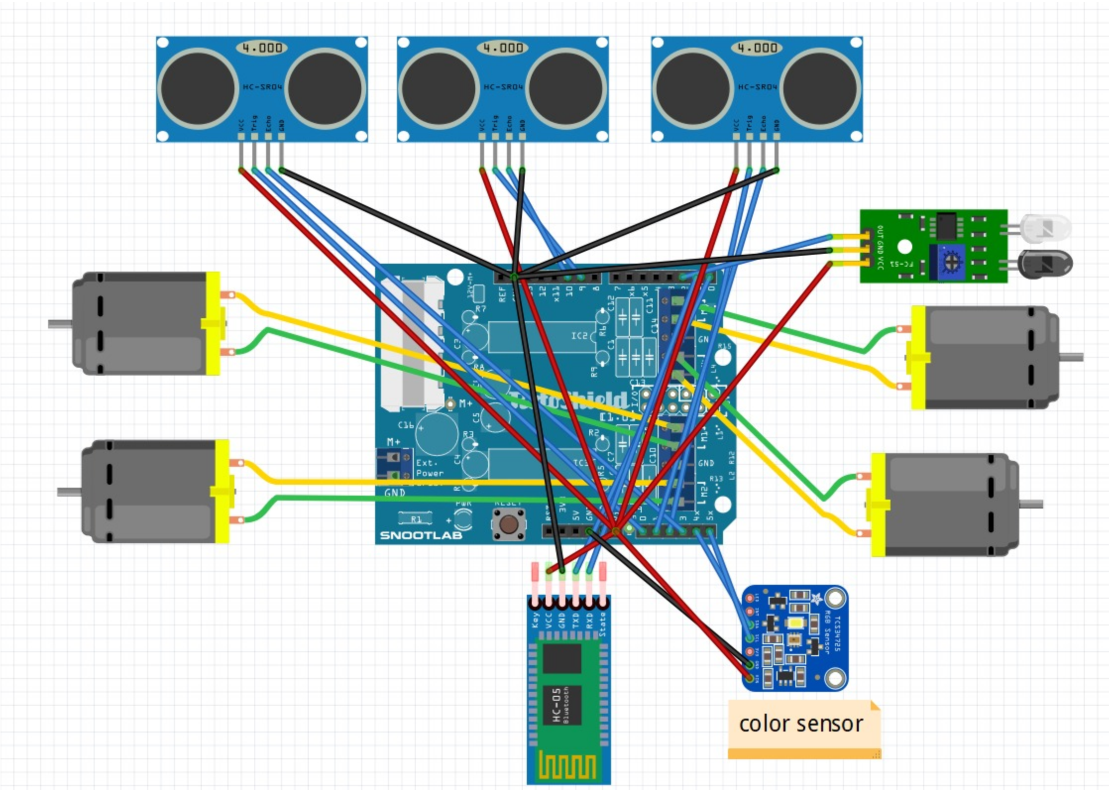

Figure 3.6: Mode 1

We used a L293D motor driver board to connect all of the components to it, which were the wheels, DC motors, ultrasonic sensor, IR sensor, Color sensor, HC-05, battery, and switch.We then connected it directly to the Arduino Uno. [4]

Notes on this wiring:

- First, 4 wheels were connected to 4 DC motors to move these wheels, thus moving the car in the correct and desired direction.
- We used 3 distance sensors instead of one with a servo motor to save time. Our goal is a fast car. When using one ultrasonic sensor with a servo motor, some time will be wasted when the servo moves. The ultrasonic sensor will move left and right to sense the distance around it. However, when using 3 ultrasonic sensors, the ultrasonic sensors are always ready to sense the distance at all times. They do not need the servo to move, thus reducing the time.[3][5]
- We used a switch with the battery so that we can easily disconnect and connect the battery from the car.
- We used HC-05(a Bluetooth module)to connect the remote control with the mobile app and start the car through it in the second mode of our car.[6]

- As for the color sensor(Tcs3472 RGB), we used it to detect the yellow color at the end of the race. The car stops and the race ends.[7]
- We used a IR sensor to detect the presence of a bump, and then the car took appropriate action.

Mode 2:

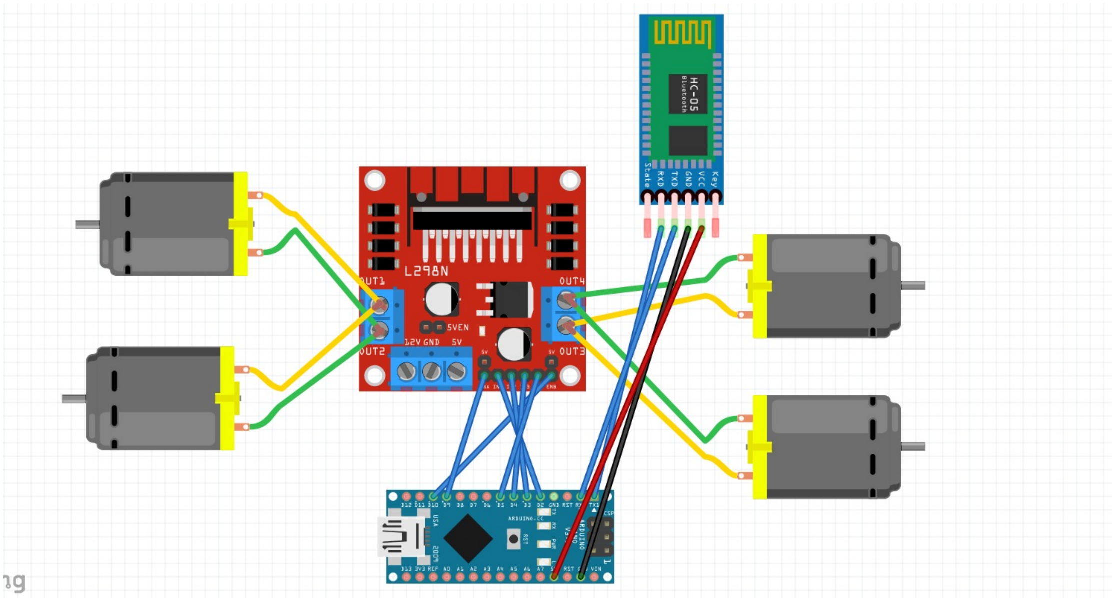

Figure 3.7: Mode 2

Notes on this wiring:

We used a L298N motor driver board to connect all of the components to it, which were the wheels, DC motors, HC-05, battery, and switch.We then connected it with the Arduino Nano.[8]

- We used the same parts as in the first mode, except for the sensors.
- In this mode, the controller is the remote control behind the human, not the car itself.
- We also used Arduino Nano because we don't need a large Arduino in this case.

Second, the remote:
We used a PlayStation remote and programmed it to give us the desired performance. We did this by taking the MAC address of the ESPand giving it to the remote using ”sixaxispairtool” program.
we use esp32 for this remote.

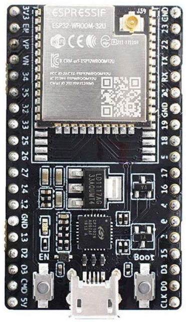

Figure 3.8: esp-32

The last part, which is the track
To enter the track, the car must first pass through the gate. Then, the journey begins with obstacles inside the track, such as: bumps, trees, walls, and more. It doesn't matter what the obstacle is, the car is designed to overcome it all. We used the following ics for this: an IR-sensor and a servo motor for the Gate, We will attach a picture of the wiring. For the obstacles, we placed wooden obstacles or toy trees, and so on. [9] [10]

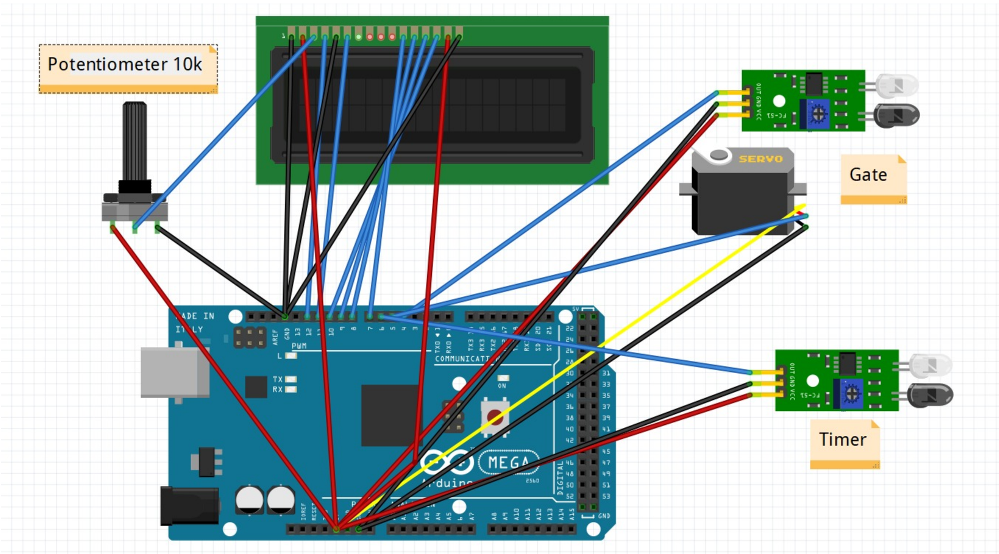

Figure 3.9: Track Wiring

Our project orchestrates a dynamic entryway using the harmonious collaboration of a sensor and a servo motor. The sensor, our watchful sentinel, scans the path ahead. When it detects any obstruction, it relays the information to the servo motor, acting as the door's diligent servant. In response, the servo motor smoothly swings the door open, granting the car free passage into the exciting journey that awaits. This teamwork between sensor and servo ensures a seamless and safe entry, setting the stage for an obstacle-filled adventure.

For the timer, we used two IR sensors. When the race starts and the IR sensor senses the car, the timer starts counting. Then, at the end of the race, the last IR sensor senses the car and the timer stops counting. This is how we calculated the time it took the car to complete the race.

Figure 3.10: IR+Servo

We also used a sound system, lighting line, and a camera for the track to add a contextual atmosphere to the game. We added a sound system to have exciting sounds in the game, as well as the lights, so the game would be exciting and complete with the presence of sounds and lights. As for the camera, it is for filming the race broadcasting it on the application, and watching it live or later.

For the sound device, we used the following parts:

mp3:Dfplayer mini mp3.

Figure 3.11: Dfplayer mini mp3

Cable: aux cable.

Figure 3.12: aux cable

Speaker.

For lighting, we used a simple light line cable (RGB LED).

Figure 3.13: LED

Finally, for the camera part, we used: an esp32-cam.

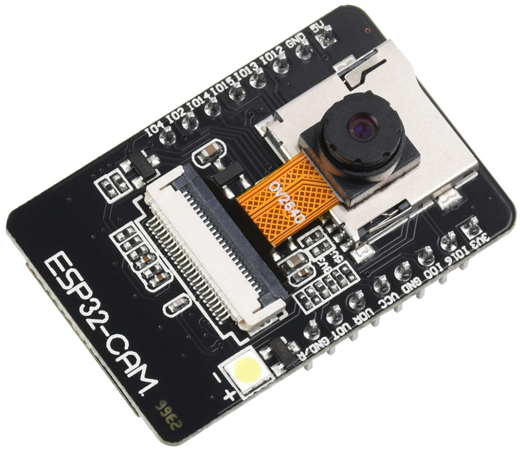

Figure 3.14: esp32-cam

Figure 3.15: esp32-cam-usb

3.1.5 Apps

To make the project easy to use(User-friendly), we added two applications to the project. The first is to view what the camera captures, and the second is a remote control for the car. The two applications were designed using the "MIT App Inventor" program. We had some design experience from what we had learned previously. With research and reaching what we wanted, the two applications were completed.[11] [12][13]

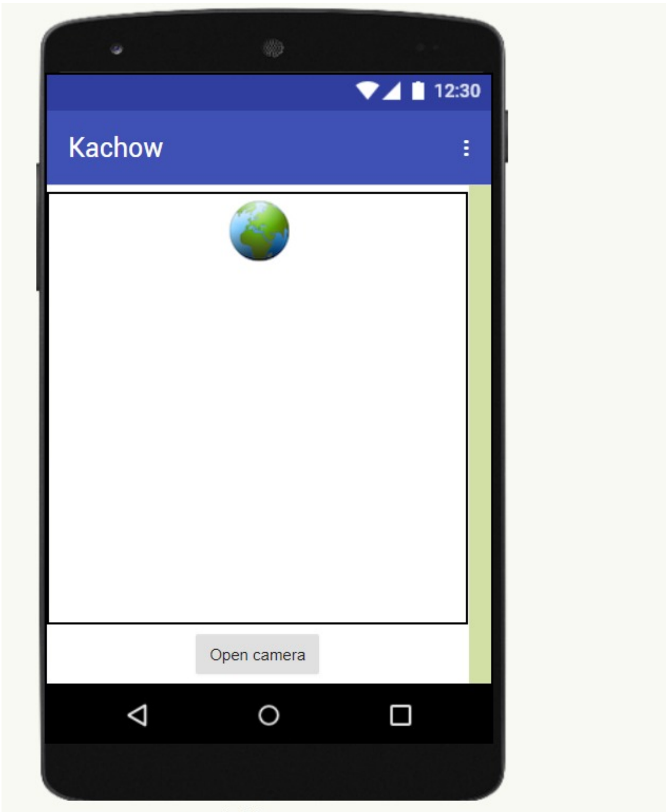

Figure 3.16: Camera App

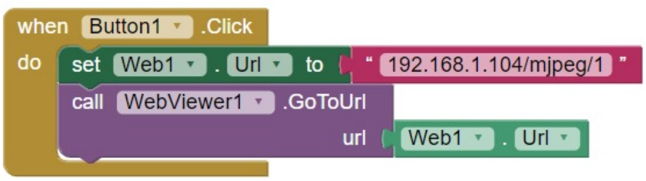

Figure 3.17: Camera App Block

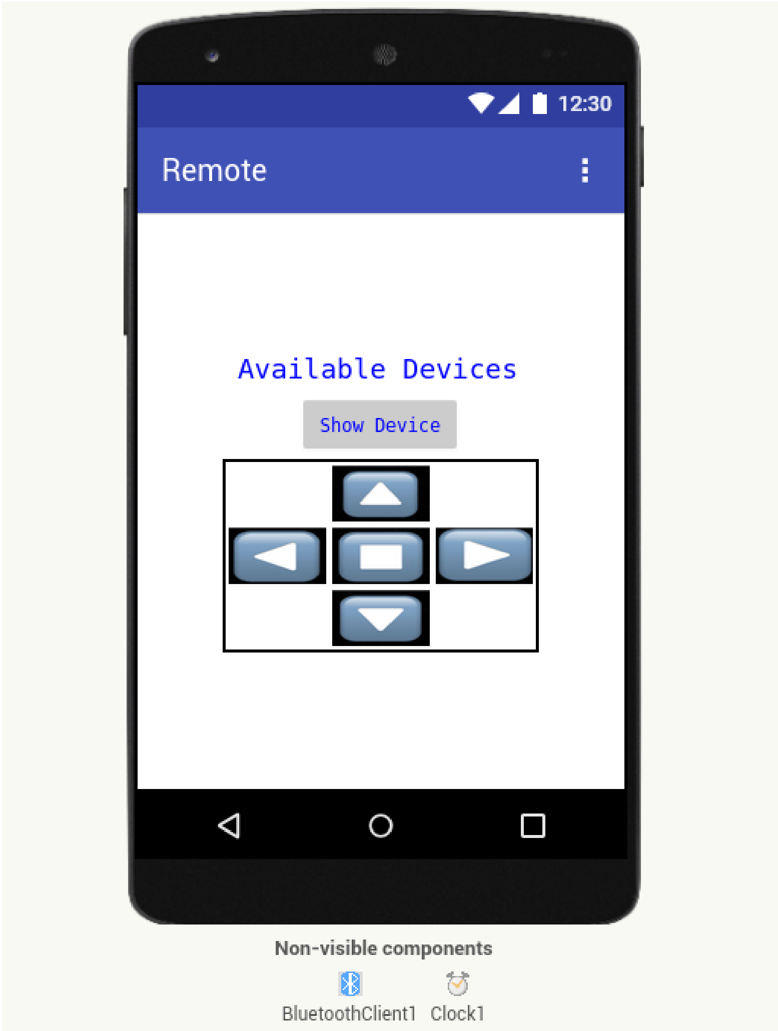

Figure 3.18: Remote App

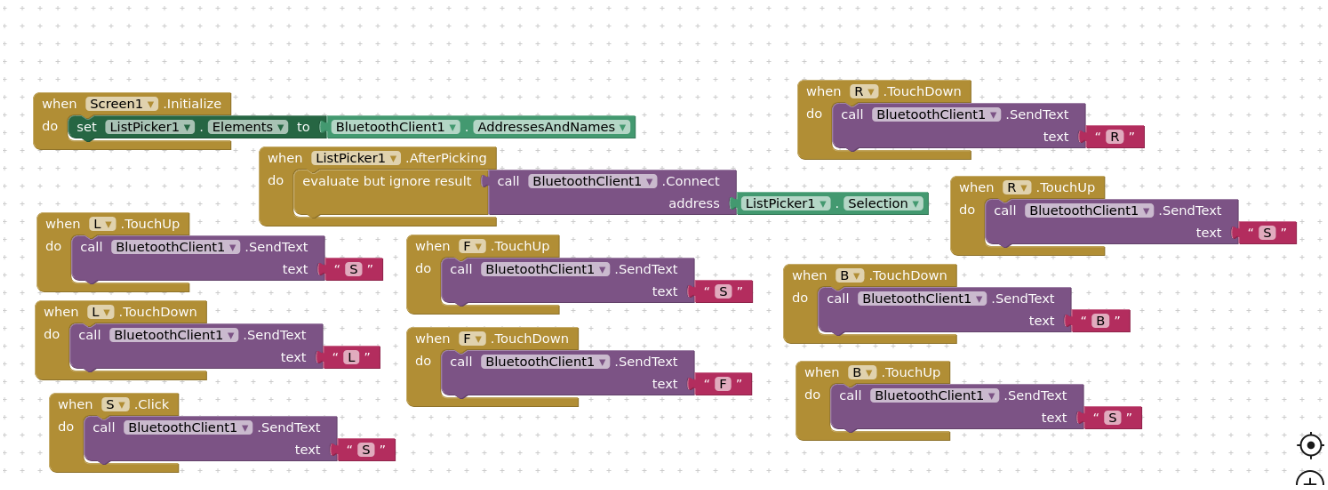

Figure 3.19: Remote App Block

3.2 Constraints

- The biggest problem we faced was the current situation and conditions that the country is experiencing from the war on our brothers in Gaza. Our inability to reach the university was our biggest challenge, which affected the nature of our work on this project.
- We also faced difficulty in purchasing the necessary ics for us, as it was difficult to reach the stores, so we were always looking for the best available parts for our project.
- There were some ics that we bought that were defective. By the nature of electronic stores, they do not accept returns. So, we were not lucky with some of the parts that were defective. A lot of time was wasted in trying to figure out what the problem was, and it was just that the ics were defective, unfortunately.
- One of the problems we faced at the beginning of our journey to complete this project was finding the right voltage source to supply the battery. It had to be light, meet the requirements, and provide the car with the right amount of power. After a long search and after consulting with Dr. Suleiman, we tried a Tesla battery and it was the perfect solution for us.
- Battery charging: It was one of the challenges because low-charged batteries indirectly affect the car's performance, so it was necessary to make sure the batteries were charged.

Chapter 4

Discussion

The main goal of the project is to create a self-driving car that is fast and able to handle difficult situations on the track. The car should be able to overcome obstacles and win the race. The presence of another car controlled by a remote control will add a competitive atmosphere and allow us to compare the performance of Ka-Chow to the remote-controlled car. Based on our expectations, Ka-Chow should always be the faster car.

- Upon start button press, the race initialization protocol commences. Guided by automated systems, the track configures itself to the designated layout. MP3 enters operational mode. cameras activate, to capture the race.
- Then, the car must enter the track, and this can only be achieved when the gate opens for the car. This gate is designed to work when it senses something in front of it, and then the gate opens and the car enters.
- As soon as the car enters the track, the timer starts working so that we can calculate the time it takes for the car to complete the race.
- Now the adventure with the car has begun. It will move and act according to what it finds in its way until it reaches the end and sees the yellow line. It will then stop and the race will be over.

**The race environment is a series of challenges for the car to test its ability to overcome these challenges with the required speed and efficiency. For example, there are bumps, and obstacles such as trees or walls, etc.

- The race is over. We can now determine the time it took the car to complete this race. We will see that on the LCD screen.

It's time to know the result.Who will win? Ka-Chow or the remote control car? After studying the performance of the two models, we noticed that Ka-Chow always wins by a time difference of almost half.
Ka-Chow: 23 seconds.
Remote control car: 38 seconds.

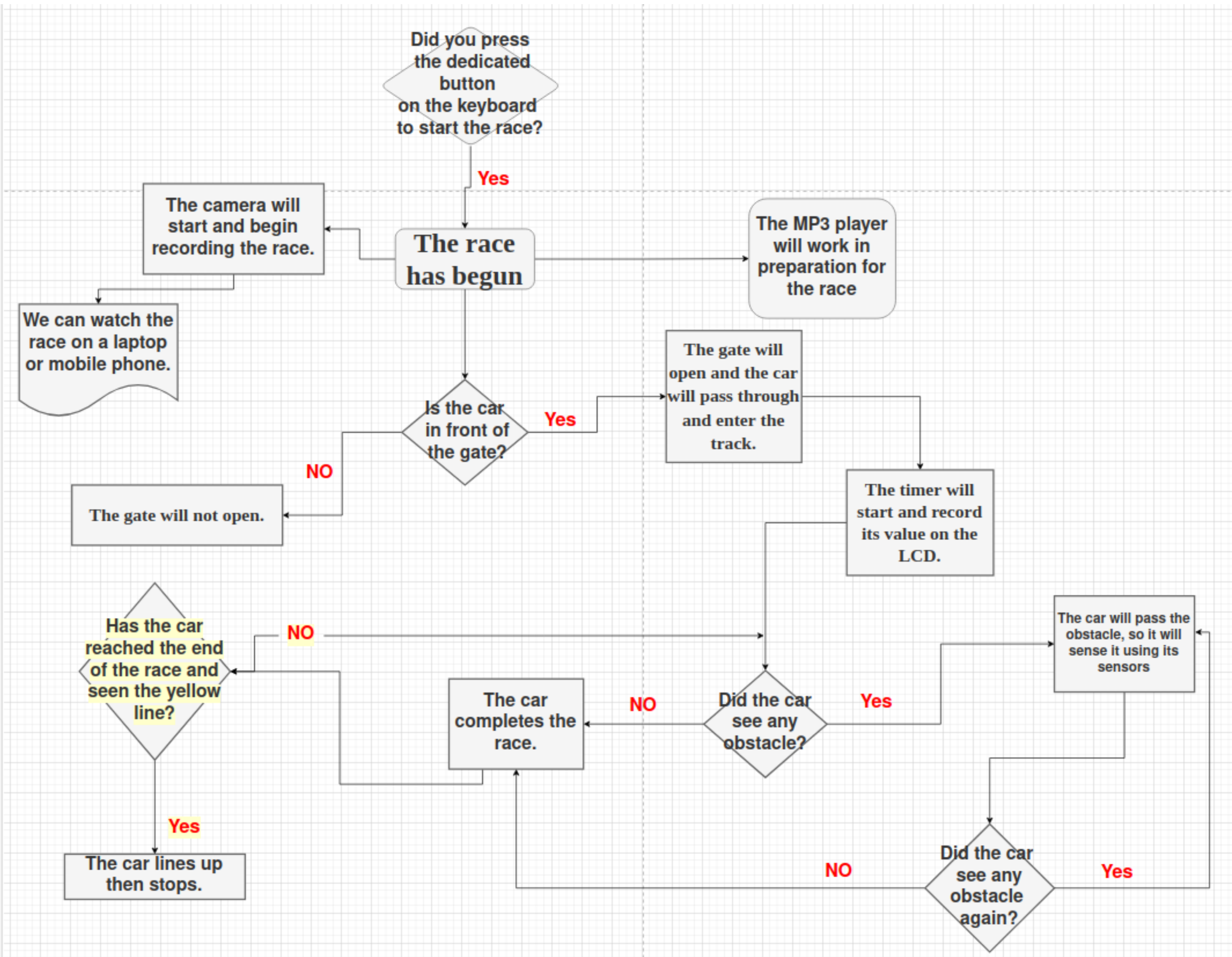

Figure 4.1: Flow Chart

Chapter 5

Conclusion and Future Work

Our project surpasses the mere creation of a fun toy car; it builds a captivating racing experience with the potential to blossom into something truly spectacular. Beyond providing playful interaction for children and adults alike, it lays the groundwork for a complete racing system brimming with excitement and competition.

Our current prototype serves as the first step on this ambitious journey. It showcases the core elements of the system – the car, responsive remote control, and immersive environment – and paves the way for future iterations that push the boundaries of imagination. We dream of a vibrant raceway where passion ignites, rivalries unfold, and the spirit of speed takes center stage. This is the path we envision, and with each innovation, we inch closer to making it a reality.

Imagine a larger racetrack teeming with intricately sculpted corners and challenging obstacles. Instead of miniature models, envision sleek, life-sized vehicles inspired by the iconic "Ka-chow" and its real-world counterparts, propelled by advanced technology. Immersive screens display race stats and breathtaking visuals, while dedicated spectator areas buzz with the energy of enthusiastic fans. This is not just a playful diversion; it's a vision for the future of interactive racing, drawing inspiration from beloved sporting events like the World Cup and infusing it with the thrill of close-quarters competition.

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