Operator’s Manual
Go-Kart for Shane Davis

Team #3:
Steven Kapinos
Brian Lewis
Anthony Vessicchio

Client Contact:
Shane Davis
6 Sunrise Drive Columbia, CT
(954)-850-5448
quarrion1227@Gmail.com
Important Safety Instructions

When Not in Use:
- This go-kart should be driven in optimal weather conditions. Avoid rain and snow as water damage can occur.
- Do not store the go-kart in any extreme weather conditions, as damage to the electrical system can occur.
- Never immerse any part of the go kart in water as damage to the electrical system is possible.
- The weight capacity of the single seat go kart should never exceed 220 pounds as this can change the performance of the go-kart.
- To ensure safety and performance of the go kart, it should be wiped down after each use.
- Ensure that the rocker switch is in the “Off” position to limit the use of the battery when not turned on.
- Be sure to understand how to use all components of the go-kart before driving.
- Be sure to charge the battery after each use.
- Proper maintenance is required as it is a gasoline powered vehicle. Be sure to check the fluid levels frequently before and after each use.
- Check tire pressure frequently; should be in the range of 10-12 psi.
- Do not remove the lid on the weather-proof box as it can cause damage to the electrical circuit within.

When in Use:
- This go kart is intended for outdoor use only.
- The go-kart is made to be driven both on-road and off-road. While off-road, be careful for extreme terrain as damage can occur to the go-kart.
- Be aware of your surroundings at all time.
- Avoid public roads, public streets, and public property. The driver should never use this product near other moving vehicles.
- Avoid driving near people and animals as injuries can occur to both the driver and the audience.
- While driving, the driver should avoid mud, slush, water, and puddles as water damage can occur to the electrical system.
- During use, components of the engine will get hot. Keep hands and other body parts away from the engine.
- Never use with more than a single person in the go kart.
- Always wear a helmet, and proper clothing to ensure safety.
- Always make sure the harness is fastened.
- Never shift the drive gear while go kart is in motion. Be sure to come to a complete stop before shifting gears (i.e. forward to reverse, reverse to forward).
- Treat the joystick with respect, do not push or pull too hard on the joystick because it can break.
- If dark, turn on the switch for the headlights.
Parts and Accessories

Figure 1: 110cc Dune Buggy

Figure 2: 110cc Engine

Figure 3: All-Terrain Tires

Figure 4: Headlights Switch
Figure 5: Electrical Ignition Switch

Figure 6: Larger Seat with Armrests

Figure 7: Brake Pedal and Brake Cable System

Figure 8: Weather-Proof Box and Fuel Tank
Figure 9: Joystick

Figure 10: Steering Knob
Features

Mechanical Components

- Gas powered, four-stroke 110cc Engine with a fully automatic transmission
- High strength steel frame with roll cage
- Front and rear disc/cable brakes
- Headlights and horn for safety
- 1.8 gallon fuel tank
- Single seat with two armrests
- All-terrain tires with full suspension
- Electrical ignition
- Throttle cable and brake cable
- Weather-proof box containing electrical components

Unique Electrical Components

- Microprocessor
- 2 Linear actuators
- Motor drivers
- Perf Board
- Joystick for controlling the throttle and brake
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1 Introduction

1.1 General Overview

110cc Go Kart Dune Buggy

The vehicle being used by our client is an 110cc Single Seat Dune Buggy (Figure 1). This go-kart comes equipped with a fully automatic transmission and an 110cc single cylinder, 4-stroke engine (Figure 2). The go-kart has a weight capacity of 220 pounds and a height of 47.2 inches; both of which are optimal for our client. The tires for the go-kart are all terrain tires (Figure 3); the front tires have a diameter of 5” and the rear tires have a diameter of 6”.

Dashboard

The dashboard panel of the go-kart contains the key buttons and switches of the vehicle, which include the key ignition, on/off motor switch, headlights switch, and the electrical starter switch.

![Dashboard of the go-kart. From left to right: headlights switch, electrical ignition button, engine on/off switch, and key ignition.](image)

Electrical System

The electrical system added the go-kart allows for the acceleration and braking of the kart to be controlled by a joystick, which is mounted to the right armrest of the kart’s seat. The complete electrical system can be found in the black case, mounted atop a platform behind the seat and next to the fuel tank. This system includes a microcontroller, two linear actuators, two motor drivers, a perf board, and a rocker switch to power the system on and off.
For the user, however, the system should not be tampered with whatsoever and will be completely covered up, besides the on/off rocker switch.

**Braking System**

The braking system of the kart has been modified, such that a cable was connected to the back of the pedal while the other end is pulled by a linear actuator. There is a custom mount located in the front of the kart for the cable to attach to the modified pedal. This is shown in Figure 7.

**Joystick**

The joystick, which controls both acceleration and braking, is mounted to the right armrest of the seat. The shaft of the joystick has been modified as well, being much thinner than the original part purchased. The joystick is shown in Figure 12.

![Joystick](image.jpg)

Figure 12: Joystick and its encasement. Attaches to the right armrest of the seat.

**Seat and Harness**

To increase the overall safety of the kart, a more comfortable and better fitting seat has been added to the kart. This seat also contains a harness for safety, which prevents any operator
from falling out of the kart while in use. The seat also consists of a headrest and leather exterior. The replacement seat can be seen in Figure 6.

**Lighting**

The kart is equipped with a rear braking light and two front headlights which can be turned either on or off.

![Image of lighting system](image)

Figure 12: Top depicts the rear brake light which illuminates red. Bottom shows the front headlights.

**1.2 Instructions for Use**

**Starting the Go-Kart:**

1. Make sure you are in a safe, open area.
2. Do not wear any loose clothing, as it could get stuck while operating the kart.
3. Ensure that there is gasoline in the fuel tank and oil in the engine.
4. Turn the switch to the gas tank to the on position.
5. Turn on the switch to electrical system, located on top of the weatherproof case.
6. Choke the engine.
7. Place the key in the ignition and turn to the on position.
8. Move the red engine switch to the on position.
9. Set the drive lever located on the left side to N for neutral.
10. Fasten seat belt.
11. Apply the brake. This will allow for power to be delivered to the kart.
12. While applying the brake, press and hold the yellow, electrical ignition button until the kart turns over.
13. Open the throttle to the engine by moving the joystick forward as the yellow ignition button is pressed.
14. Once you hear the engine turn over and start, you may let go of the brake. (Note: if the engine shuts off from insufficient throttling, start over from step 11).
15. Apply appropriate throttle movement in order to allow the kart engine to idle.
16. Once you can let go of the throttle and the engine does not bog down, it is sufficiently warmed. This may take several minutes.
17. The kart is now correctly started and ready for use.

**Driving the Go-Kart:**

1. After properly starting the vehicle, turn the engine’s choke off.
2. Make sure you have a clear path in front of you and that the steering wheel is in the straight position.
3. Put the kart into drive by moving the left lever into the D position.
4. Move the joystick forward to accelerate. The longer pressed forward, the faster the kart will move.
5. Move the joystick backwards to slow down and stop the kart.
6. By returning the joystick to the neutral position, the kart will slow down quickly, however brakes are recommended whenever needing to slow down.
7. Control the steering of the kart by using the wheel’s modification knob, or the wheel itself.
8. If stuck, the kart can be put in reverse by moving the left drivetrain lever to the R position.
9. If dark, the headlights can be turned on through the button located on the dashboard.

**Turning the Go-Kart off and Storage:**

1. Once stationary, move the kart’s left lever to the neutral position.
2. When finished riding, the kart’s engine may be shut off by moving the red switch back to the off position.
3. Turn the key ignition to the off position and remove the key from the dashboard.
4. If used, turn off the headlights.
5. Unfasten the seat belt and remove yourself from the vehicle.
6. Turn off the electrical system by pressing the rocker switch on the top of the case.
7. Turn the gas to the engine off.
8. Store the kart in a cool, dry place as it will help the longevity of the vehicle.

**2 Maintenance**

**2.1 Electrical**

**Engine**

The modified go-kart now contains several electrical components that need to be kept in proper condition in order to for the go-kart to operate properly. At the rear of the go-kart is the 110cc engine, this engine needs to be treated like any other engine in a vehicle. The owner needs to make sure that the fuel tank is not empty; if the fuel tank is empty then fill it up with gasoline. The oil within the engine should be changed every 30 hours or so; each time the oil is changed, air filters and oil filters should be changed as well.

The engine being used needs to be kept in ideal weather conditions. The owner should not store the vehicle in any extreme temperatures as it can cause the engine to break down or to malfunction. This go-kart was built to ride in any weather conditions, however it is advised the
go-kart is not driven in any wet conditions because puddles, rain, and snow can allow ruin the engine.

**Weather Proof Box**

In addition to the engine, there is a weather-proof box (Figure 8) at the rear of the vehicle. This weather proof box contains multiple electrical components that are all vital for operating the vehicle. The lid on the box should be securely placed on top of the base and screwed on at all times. Do not remove the lid unless there is a significant reason. If the owner does remove the lid, then the go-kart should be inside to reduce any environmental factors that can disrupt the electrical system. To ensure that this electrical system does not break down or malfunction, the owner should not drive the vehicle in any wet conditions. Rain and snow increase the risk of water disrupting the electrical components within this box. Atop of the weather proof box is switch to turn on and off the electrical system. It is highly recommended to turn off the switch after each use to limit the risk of battery drainage. After each use, the box should be wiped down to limit any environmental factors from seeping into the box.

**Joystick**

Connected to the weather-proof box is the joystick. The joystick controls this whole system and is the most important piece on this go-kart. The owner needs to be careful when using the joystick; no extreme movements or thrusts. Also, when entering the vehicle make sure that the armrests are raised to confirm that the joystick will not be hit or damaged. While driving, do not put extreme amounts of pressure on the joystick for it can cause the joystick mount to break off the armrest. Connected to the joystick are several cables, to ensure that the joystick keeps operating correctly, the owner should not drive the vehicle in any wet conditions.
Battery

In the rear of the go-kart is a 12 volt battery that the engine and electrical system runs off of. This battery is important for the go-kart and needs to be taken care of properly. The battery terminals should be securely fastened, if the cables to the terminals are loose then the owner should tighten the terminals before use. The battery should not be kept in any extreme weather conditions to limit the risks of corrosion and erosion. If the battery becomes drained, then connect to a 2 Amp battery charger and charge for a couple of hours.

Dashboard

The dashboard contains a few switches, all of which have been weather-proofed by the manufacturer. After each use, the owner should wipe down the switches to limit any erosion or electrical malfunctions.

2.2 Mechanical

Frame

The go-kart is built to be driven on all terrains, but it is highly recommended that the owner does not drive the vehicle on extreme terrains. If driven on extreme terrains, this increases the risk of damage to the frame. If the frame is damaged or broken, the owner should not drive the vehicle.

Brake Pedal

In front the go-kart is a brake pedal apparatus that is connected to the joystick (Figure 7). This system should not be tampered with in any circumstances. The owner should not touch or move the cable connected to the system as it can disrupt the object of the braking system.

Seat

The seat has been securely mounted to the frame of the go-kart. The frame of the seat should not be tampered with. After each use, the owner should wipe down the seat to reduce wear on the fabric. No sharp objects should be near the seat as they can cause damage to the seat.

Tires
The tires should be checked for wear and tire pressure before each time the owner uses the vehicle. If the tires appear too worn, replace them. Also if the air pressure of the tires drop too low, fill the tires to maintain proper tire pressure.

2.3 Environmental

The environmental maintenance of this go-kart design has the same maintenance as all vehicles. Before each use, oil levels and tire pressure needs to be determined optimal before driving. After driving, all components of the vehicle should be wiped down to eliminate any environmental factors while being stored. The vehicle should be store in optimal weather conditions to limit the risk of moisture, heat, water, and extreme cold.

3 Technical Description

The microprocessor used in controlling this vehicle is the Arduino Mega 2560. The goal of the microprocessor is to control the linear actuators which will then control the pulling of the brake and throttle cables. Below is a picture of the basic flowchart that dictates how this vehicle will operate.

Figure 13: Arduino Mega 2560 used to process the joystick’s signals.
Along with the use of an Arduino Mega 2560 microcontroller, two Pololu DC Motor Drivers are used in the system. These drivers take outputs from the Arduino, and treat them as their inputs. They allow the actuators to retract and extend according to the joystick’s position by amplifying the signal being processed through the Arduino. The motor driver contains the following pins which were used: INa, INb, PWM, +5V, and a GND.

Figure 14: Pololu Motor Driver Schematic. Amplified signals from the Arduino to power the linear actuators.
The linear actuators used to pull the throttle and braking cables were L-12 micros by Firgelli Automations. The brake used a 1-inch stroke length while the throttle used a 2-inch length since it had to be pulled a greater distance.

Figure 15: Firgelli Automations L-12 micro linear actuator.

The electrical joystick used was a 4-way switch, which contained 3 pins: NC for normally closed, NO for normally open, and COM for common. The signal used in this system is NC.

Figure 16: Competition joystick used to control the acceleration and braking of the kart.
A perf board was customized for this system in order to run correctly. The board contained four 1.1k resistors, which filtered the signals from the Arduino to the motor drivers. There were also two 5V voltage regulators. One was used to power the Arduino, while the other served as a source for the 5V pins on the drivers as well as the PWM pins.

![Figure 17: Perf Board Set-Up](image)

The overall system involves a series of signal movement and processing. The switch on the joystick is first triggered when moved either forwards for backwards. From here, the Arduino processes the signal according to the coding programmed to the board. These signals are then outputted to the driver through the use of four signals, two for each driver. The motor drivers then amplify the signal and according to the combination of HIGH versus LOW signal, either extend or retract the linear actuators. This actuation then causes either the brake or throttle cables to move and subsequently accelerate or stop the go-kart. It is important to note that the actuators are in a constant extension to allow for a neutral state when the joystick is not touched forward or backward.
4 Troubleshooting

Low Battery Voltage

- Battery Low on Voltage
  - Owner is not turning off switch after each use
  - Owner needs to charge battery with a 2A battery charger for a couple hours
  - If after charging battery for several hours and still no voltage
    - Owner should replace battery

Gas Engine Problems

- Will Not Start:
  - Not start in the correct manner
    - Check proper steps list previously in starting the go-kart
  - Check gas and oil
    - Change and refill as necessary
  - Choke is improperly set
  - Engine is flooded
    - Give the engine some time to recover
  - Faulty start switch or battery (electric start units)

- Will Not Stay Running:
  - Loose spark plug wire or bad plug
  - Clogged or wet air filter
    - Talk to expert, and change respectively
  - Choke is improperly set
  - Carburetor not functioning properly
    - Talk to expert
  - Engine is not functioning properly
    - Talk to expert
• Engine Seems Low On Power:
  o Throttle cable not properly adjusted
  o Binding or dragging brake, bearings or axle
  o Unlubricated, loose or worn chain
  o Incorrect tire pressure
  o Check the amount of gasoline in the fuel tank
    ▪ If low, add gasoline

**Electrical System Problems**

• Joystick Does Not Work
  o Low battery voltage
  o Broken wire, or faulty connection
  o Joystick wires disconnected from protoboard
  o Owner broke joystick

• Throttle Does Not Work
  o Low battery voltage
  o Broken wire, or faulty connection
  o Check electrical components in weather-proof box
    ▪ Throttle cable is disconnected from linear actuator
    ▪ Disconnection of cables from protoboard
    ▪ Joystick connection is disrupted
  o Owner broke joystick

• Brake Does Not Work
  o Low battery voltage
  o Broken wire, or faulty connection
  o Owner broke joystick

• Headlights Do Not Work
  o Low battery voltage
  o Broken wire, or faulty connection
  o Headlight burnt out, change bulb
  o Switch is broken
Mechanical/Driving Problems

- Slow Acceleration
  - Low battery voltage
  - Check electrical components in weather-proof box
    - Throttle cable is disconnected or disrupted from linear actuator
    - Disconnection of cables from protoboard
    - Joystick connection is disrupted

- Braking System is not Optimal
  - Low battery voltage
  - Check braking system in the front of the go-kart
    - All cables and parts should resemble Figure 7
    - Make sure brake pedal is not broken
  - Check electrical components in weather-proof box
    - Brake cable is disconnected or disrupted from linear actuator
    - Disconnection of cables from protoboard
    - Joystick connection is disrupted

- Steering is not Optimal
  - Check the tightness on the steering knob
    - If lose, just bolt tighter
  - Ensure nothing is blocking steering apparatus
  - Check tire pressure
    - If low tire pressure, fill tires with air
  - Ensure axels are not bent or loose