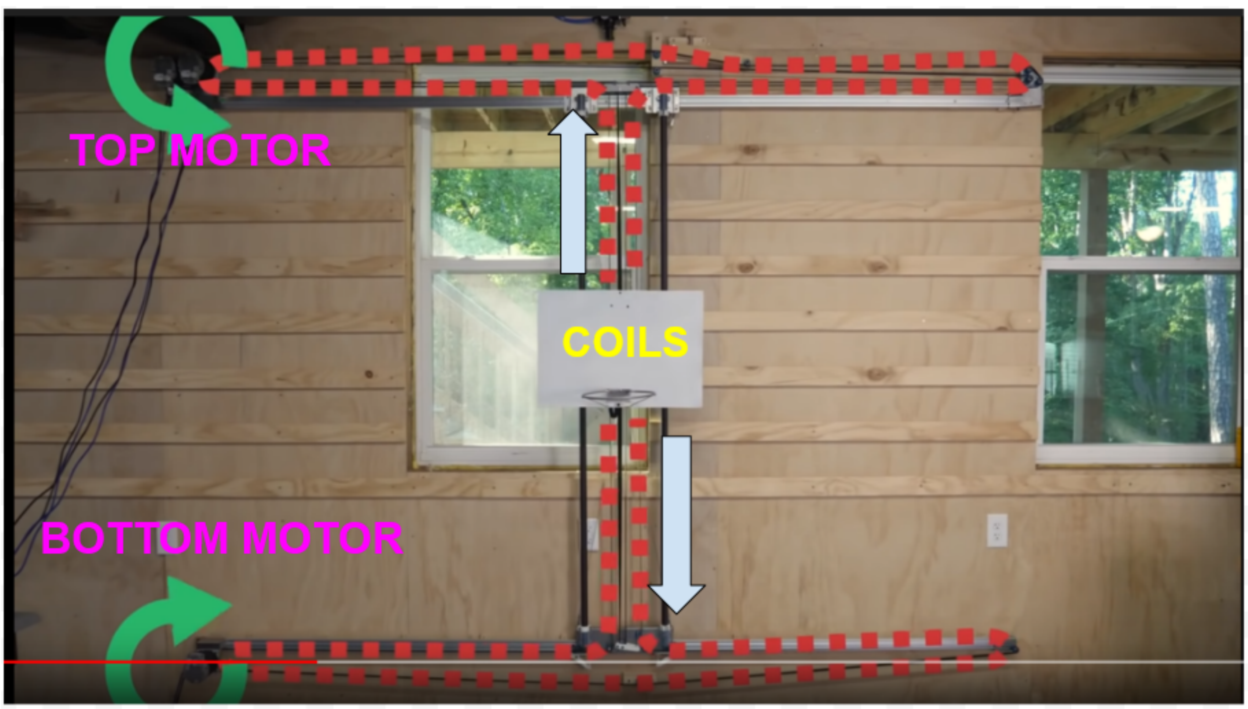
# Overview

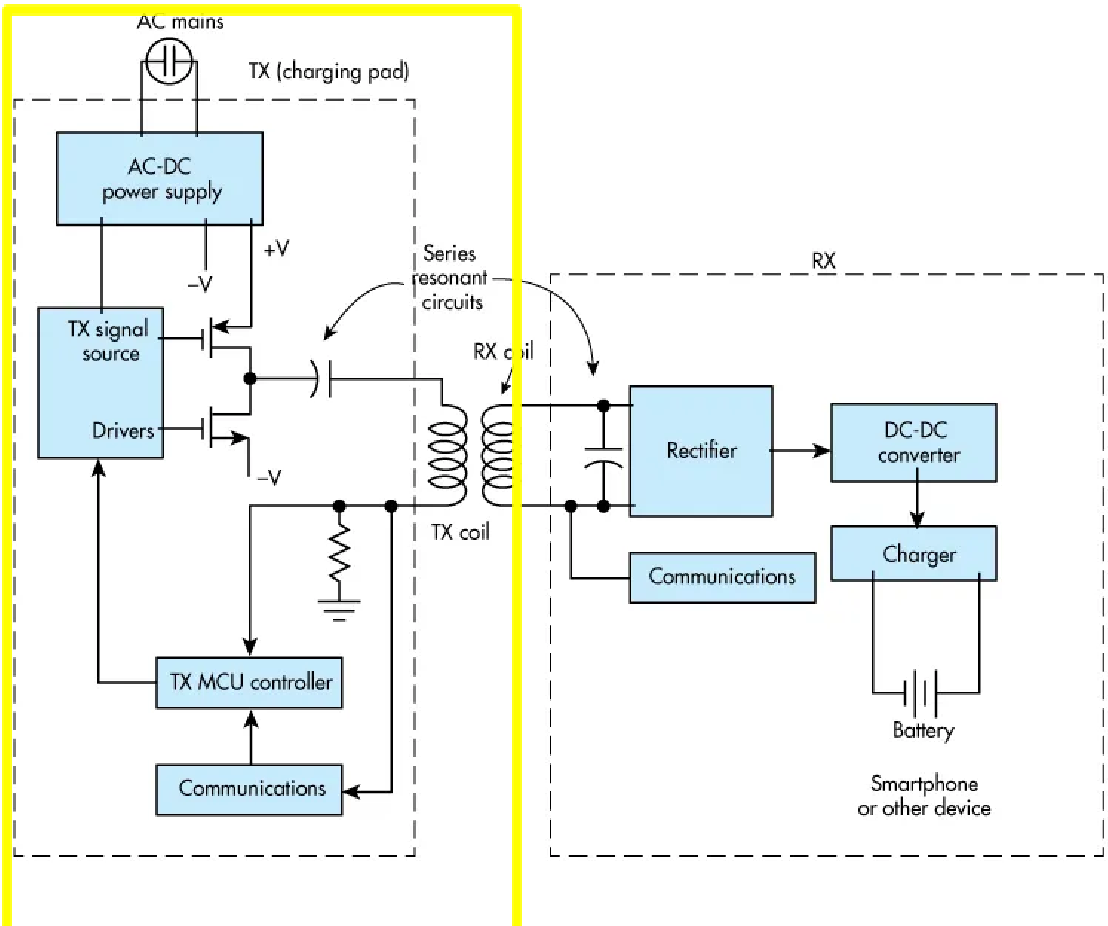
Our design will contain a two axis rail system. It will consist of two motors, both along one edge of our pad, with a belt system connecting them to the coil. To move the coil up or down, both motors move clockwise or counterclockwise respectively. To move the coil to the left, the top motor moves clockwise while the bottom motor moves counterclockwise. To move the coil to the right, the top motor moves counterclockwise while the bottom motor moves clockwise. The coil will be resting on top of a “sled” platform in the center of the belt system. The wireless charger will have an arduino microcontroller that will read the current of the coil as it looks for the phone on top of the wireless charger. When the current readings reach its peak, the microcontroller will then control the motors to move the coil to the optimal position to charge the phone.




A preview of the rail system we will be using.

# Detailed Design and Visuals

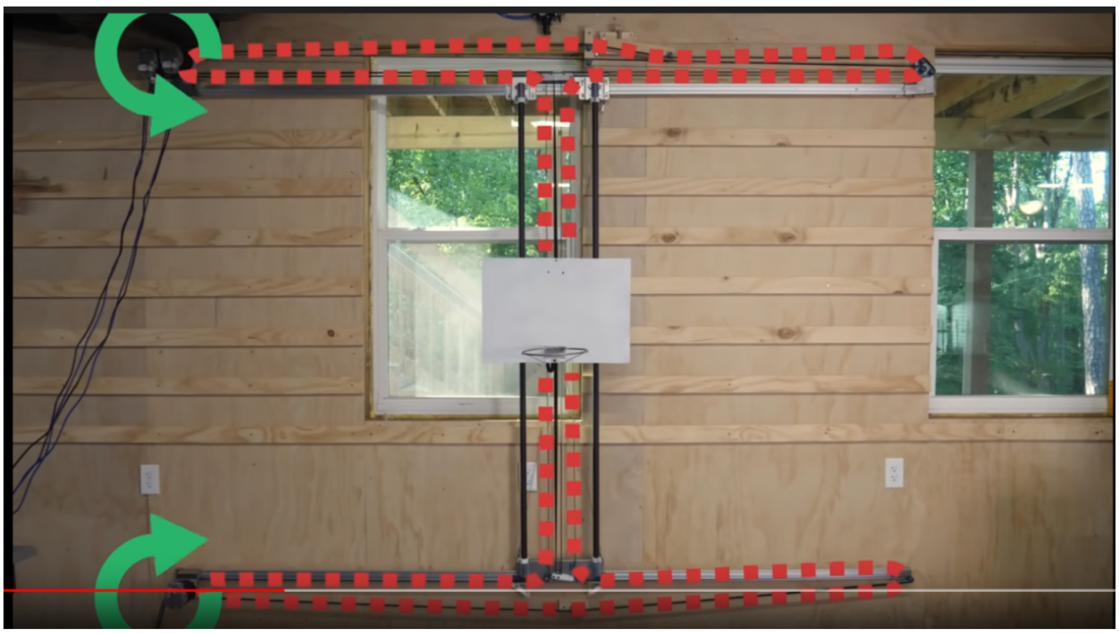
## Electrical Components




The block diagram above shows a full wireless charging system with the transmitter circuit and receiver circuit. Our focus will be on the transmitter portion (Tx).

## Mechanical Components

The mechanical components implemented in this design are a rail system that will allow our coil to move across a 2D plane. The charging coil will be automatically aligned by two stationary motors located at the left corners of the charger with a belt system connecting them to the coil (see image below). To move the coil up or down, both motors move clockwise or counterclockwise respectively. To move the coil to the left, the top motor moves clockwise while the bottom motor moves counterclockwise. To move the coil to the right, the top motor moves counterclockwise while the bottom motor moves clockwise.



## Software Components

We plan to use an Arduino microcontroller to program our motors and current sensors. The microcontroller will first detect when the phone is placed on the wireless charger. Then, the sensors will scan the current readings from the coils, while simultaneously moving the coils across the charger. Once the microcontroller determines the optimal charging location, it will tell the motors to move the coils into that specific position.

## Design Components

- Twin motors
- Belt (Most likely rubber or plastic)
- Small Pulleys
- Charging coil
- Arduino MCU
- Tabletop Surface (Thin layer of plastic is most likely material)
- Various IR sensors

# Functionality

The user will place their phone anywhere on the wireless charger. This will initiate the coil to begin scanning the 2D plane. The coil will begin by scanning the vertical axis to find the maximum current output. Afterwards, the coil will then scan along the horizontal axis and find the maximum current output. The coils will then automatically move to the most optimized location based on the current readings, and the user’s phone will charge efficiently.

# Areas of Concern and Development

Our design will meet all user requirements. It will optimize charging for the user's devices, and will be user-friendly. Our primary concerns would be that the charger will need to initialize the scanning feature; however, we are still working on a feasible solution. We are also concerned with the final design of our product. With the moving parts and increased capabilities, we want to make sure that we optimize the space such that our product is not too bulky. To address these concerns, we are planning on using an IR sensor that will detect if a device is on the charging pad. This will allow the charger to initialize the scanning feature. When it comes to a solution for the bulkiness of our design, we will try to use passive design methods to optimize the space. Things such as having stationary motors will allow us to use very light, small moving pieces inside the charger. We are also going to need to fit an arduino inside the charger, so in order to keep the design attractive, we are considering simply increasing the size of the base of the charger which can improve the stability.

Questions:

- Would there be a better approach for initialization instead of an IR sensor?
- Where should we set the default starting position of the coils?
- Would it be better to read current output or voltage from the coil to find the optimized position?

# Technology Considerations

**Charging coil**

- Strengths:
  - Charging no matter the orientation.
  - Only one coil is necessary to charge a device oriented in either portrait or landscape. (As opposed to two coils in most current devices)
  - Having one coil could allow us to more efficiently allocate the power and could solve the problem of having a thicker charger.
- Weaknesses:
  - Charging may not be completely optimized due to volatile sensor readings
  - Depending on the coils’ height relative to the phone or the case of the phone on the charger, the wireless charger may not charge efficiently or at all.
- Alternatives:
  - Adjust size of wireless coils by adding loops and perhaps thicker wire
  - Use a thinner surface for phone to rest on
  - Design a larger charging coil if feasible.

**Motors**

- Strengths:
  - Can scan an entire 2D plan
  - Do not have to be one of the moving parts (Allows other, lighter parts to be the only moving parts)
- Weaknesses:
  - Could wear down due to repeated use
- Alternatives:
  - Could have an app that displays the orientation of the coil within the charger

# Design Analysis

We have reverse engineered the INIU wireless charger and have performed a current output reading using a multimeter. So far we have discovered that the relationship between the displacement of the coils and the current output produced a bell curve. This was what we expected and hoped we would find. This makes it fairly easy to find the general center of the coil within the user's device. One thing we also noticed was that the voltage readings were fairly volatile, so our sensor may produce a moderate percent error. We are also in the process of procuring parts for the 2D scanning function. We know that the design will work; however, we need to put it together and troubleshoot within the near future. In order to keep our design as feasible as possible, we are researching effective/cost efficient methods of sensing the current or voltage output. So far we are leaning towards using a current output.