CCIoT Project

Remote Triggered Lab Simple Pendulum

Team 5 : Sigma

Knv Karthikeya (2020102003)

Agrim Rawat (2020102037)

Jewel Benny (2020102057)

Pallav Subrahmanyam Koppisetti (2020102070)

Mudit Gaur (2020112008)

Link for Project Presentation

https://youtu.be/kd041HNkZA8

Need for RTL

- RTL stands for “Remote-Triggered Lab” which means conducting lab experiments remotely.
- This allows us to do experiments without being physically present which has many advantages.
- People without access to physical labs can access remote labs over the internet to do the experiments and get real results unlike using simulations for the same.
- The ever-growing influence of the internet makes RTL more feasible to do.

Problem Statement

- To find the time period of a simple pendulum for various lengths and also calculating the value of the acceleration due to gravity and show it is constant for varying length.

Physics of the Experiment

- A simple pendulum under small oscillations follows simple harmonic motion.
- As the pendulum's angle from the equilibrium point increases, the restoring force, i.e., gravity acts in the opposite direction of motion and proportional to the displacement.
- We can derive and show that the time period of the pendulum is proportional to the square root of the length.
- With the experimental values of time period with a certain length, we can calculate the value of g acceleration due to gravity.
- NOTE: The values from the experiment will not be exact due to damping. This can be resolved by observing a small number of oscillations while the damping does not affect the time period much.

Derivation

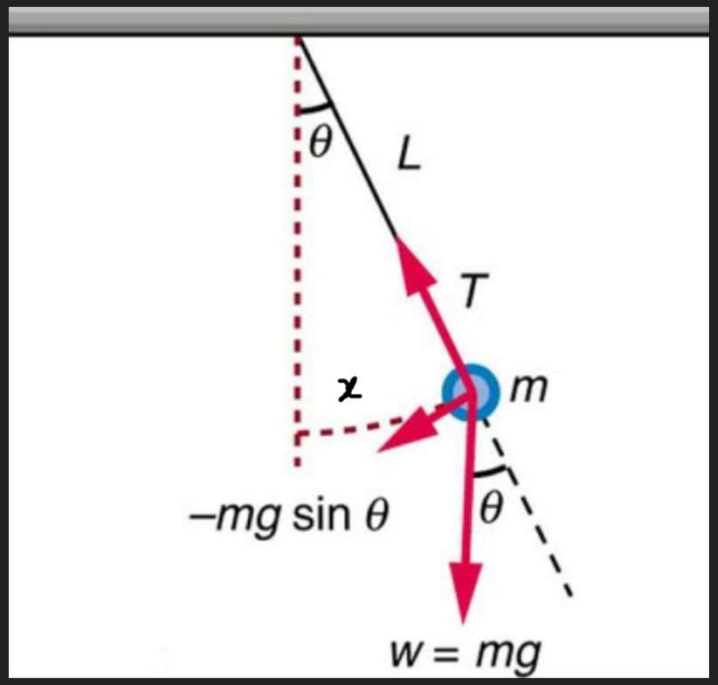
$$F = -mg\sin\theta \approx -mg\theta = \mathrm{mg}x/l$$

$$\Rightarrow \frac{d^2x}{dt^2} = -\left(\sqrt{\frac{g}{l}}\right)^2 x$$

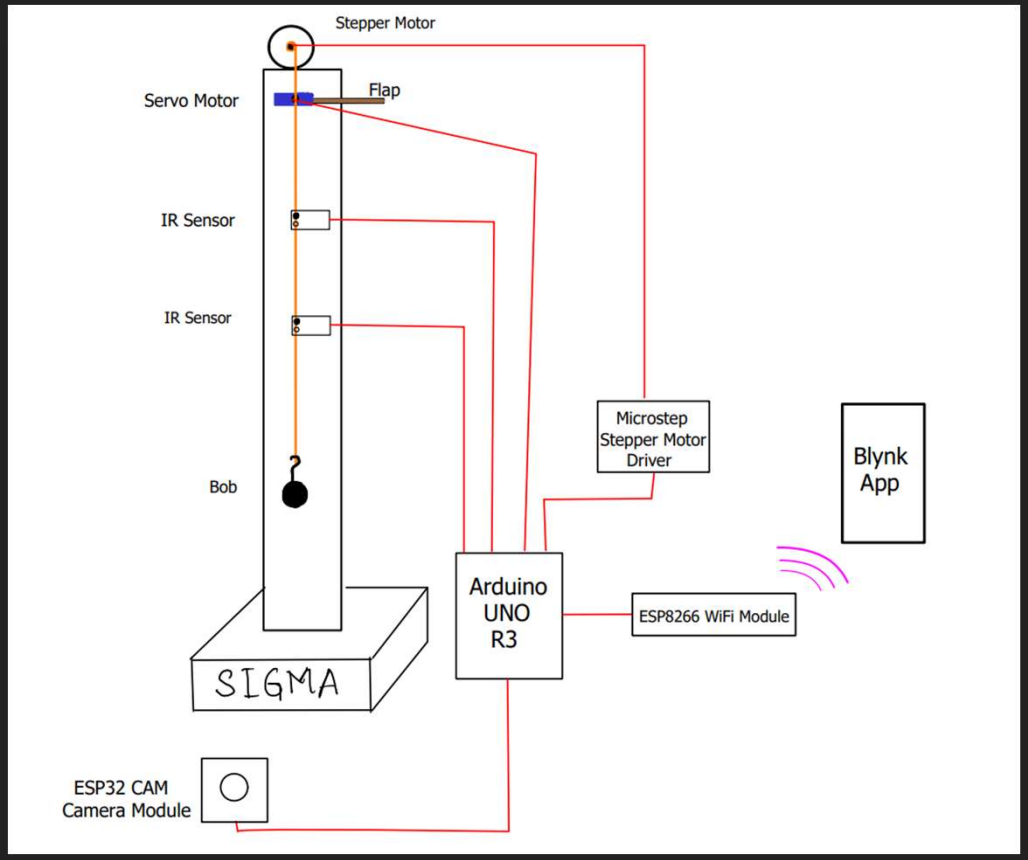
$$\Rightarrow \omega = \sqrt{\frac{g}{l}}$$

$$\Rightarrow \boxed{T = \frac{2\pi}{\omega} = 2\pi\sqrt{\frac{l}{g}}}$$

$$\Rightarrow \boxed{g = \frac{4\pi^2 l}{T^2}}$$



Schematic Diagram



Components Used

Arduino UNO R3

- The **Arduino Uno** is an open-source microcontroller board.
- It is based on the **Microchip ATmega328P @ 20MHz** microcontroller and developed by Arduino.cc.
- We use it to control the following:
  - Wi-Fi Module ESP8266
  - Camera Module ESP32-CAM
  - IR Sensors
  - Stepper Motor
  - Servo Motors

BLYNK App

- Sensor data is displayed on Blynk app
- It uses TCP/IP protocols
- It provides sliders to adjust the lengths which our stepper motor maintains.
- It was chosen for its user friendly interface of buttons, sliders and digital displays along with the video streaming option.
- It supports authentication.

ESP8266 Wi-Fi Module

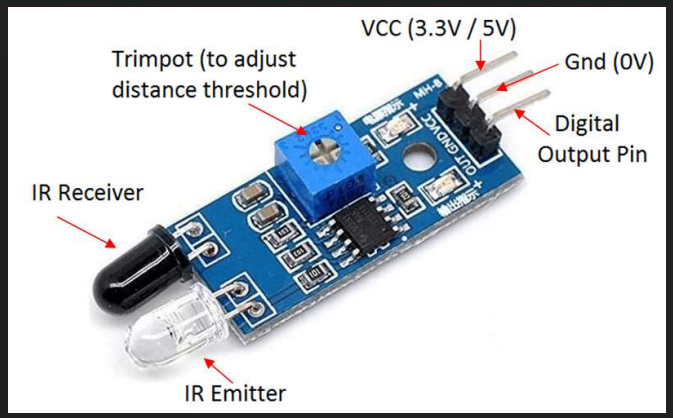
- The **ESP8266** is a low-cost Wi-Fi microchip, with built-in TCP/IP networking software, and microcontroller capability.
- It has the **L106 32-bit RISC microprocessor core @ 80Mhz**.
- It provides **IEEE 802.11 b/g/n Wi-Fi**.
- We use it to connect to the Blynk App via the internet.

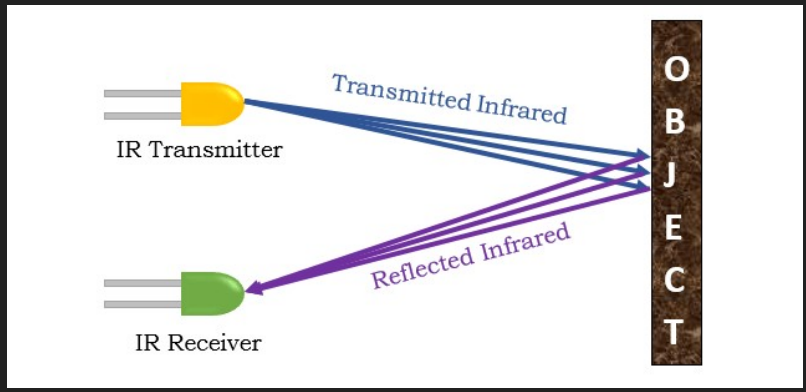
ESP32-CAM Camera Module

- The **ESP32-CAM** is a small size, low power consumption camera module based on ESP32.
- It comes with an **OV2640 camera** and provides onboard **TF card slot**.
- We use it to stream the remote experiment on a web server.

IR Sensor

- An **infrared sensor** is an electronic device, that emits in order to sense some aspects of the surroundings.
- We use it to detect the crossing of the pendulum from its mean equilibrium point.





Stepper Motor

- A **stepper motor** is a brushless DC electric motor that divides a full rotation into a number of equal steps.
- We use the stepper motor to vary the length of the pendulum with precision.

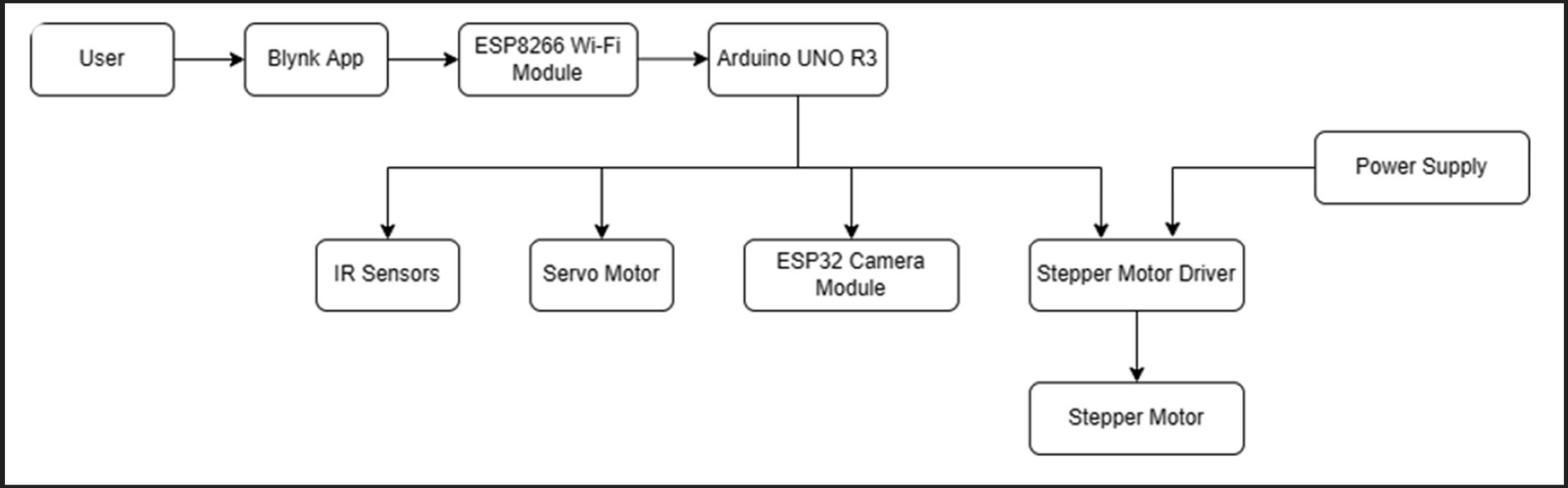
Servo Motor

- A **servo motor** is a rotary actuator that allows for precise control of angular or linear position, velocity and acceleration.
- We use servo motors to move flaps which initiate the motion of the bob.

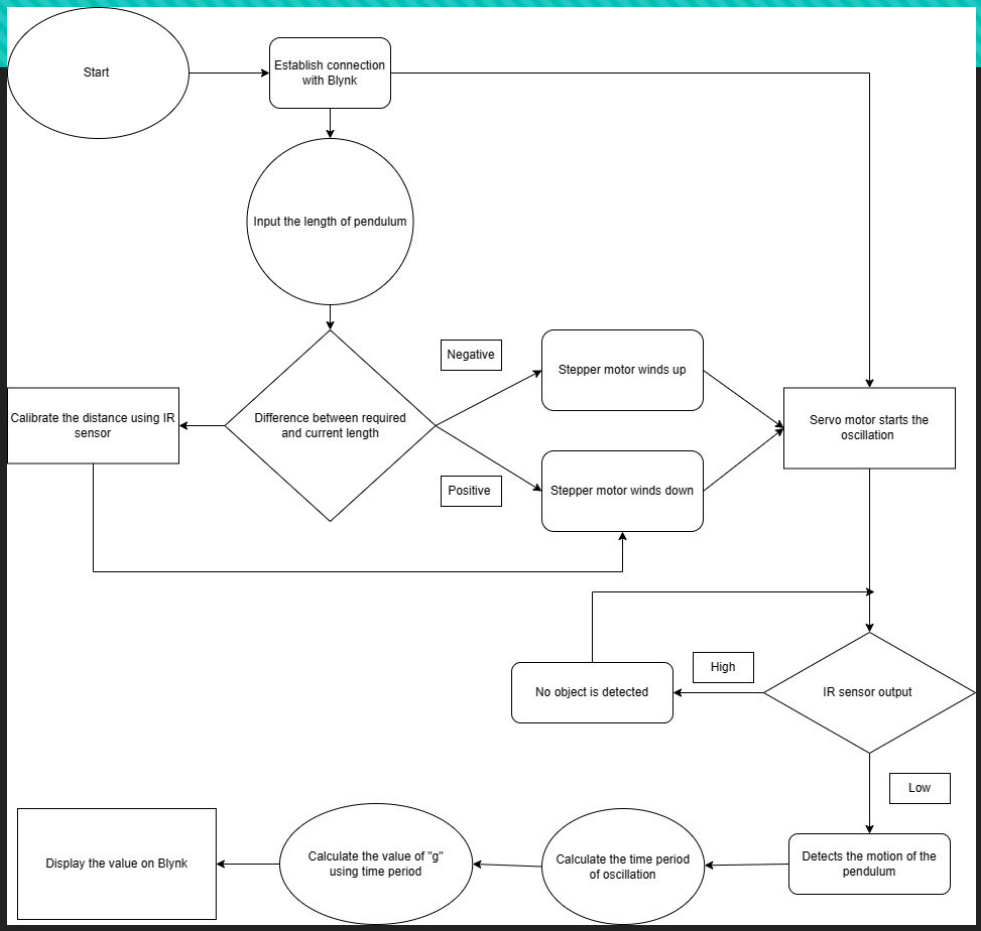
Diagrams and Pictures

Model

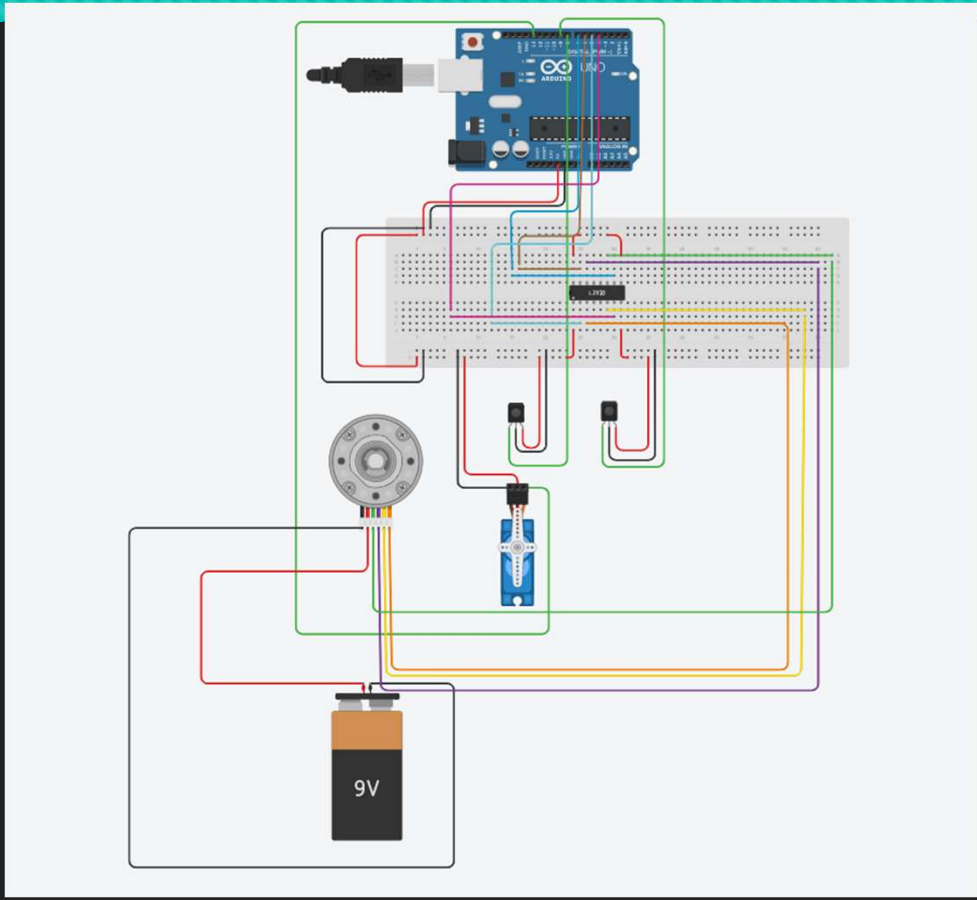
Block Diagram of the Project



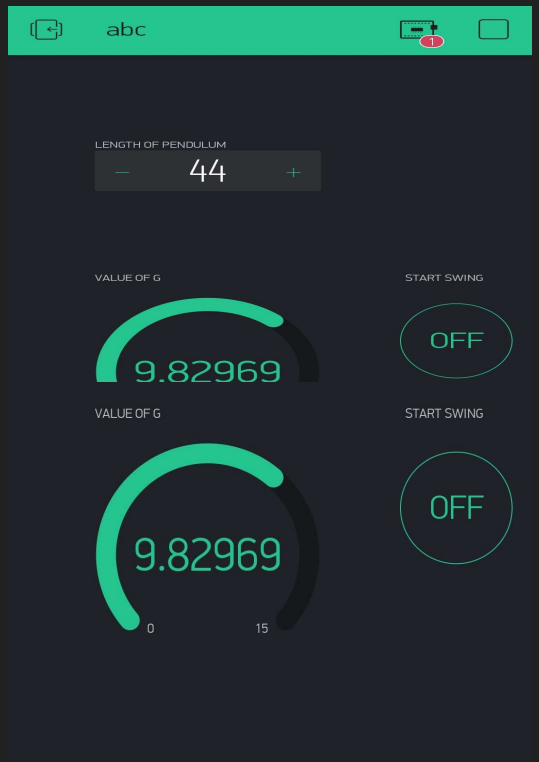
Flowchart of Code



Circuit Diagram



Dashboard


abc
LENGTH OF PENDULUM
44
VALUE OF G
9.82969
START SWING
OFF
VALUE OF G
9.82969
0
15
START SWING
OFF