Aim

To simulate and visualize the spread of COVID-19 using a polar coordinate system, demonstrating the dynamics of infection, recovery, and mortality rates.

Objective

1. Model the transmission dynamics of COVID-19 based on established epidemiological parameters.
2. Visualize the spread of the virus over time, highlighting the number of infected, recovered, and deceased individuals.
3. Demonstrate the impact of different recovery and fatality rates on the progression of the pandemic.

Summary

This project simulates the spread of COVID-19 using Python libraries such as Matplotlib and NumPy. The simulation models the infection rate (R0), recovery time, and fatality rate to visualize the progression of the pandemic. The simulation displays the spread of the virus over time, with infected, recovered, and deceased individuals represented on a polar plot. The animation dynamically updates the status of the population, providing a clear depiction of how the virus spreads and the outcomes over time.

Tools and Libraries Used

- **Python**
- **Matplotlib** (for plotting and animation)
- **NumPy** (for numerical calculations)

Procedure

1. **Define Constants:** Establish colors for different states (uninfected, infected, recovered, deceased) and set COVID-19 epidemiological parameters.
2. **Create Virus Class:** Implement a class to handle the simulation, including methods to initialize the population, spread the virus, assign symptoms, and update the status of individuals.
3. **Initialize Population:** Generate an initial population and infect a single individual (patient zero).
4. **Spread Virus:** Simulate the spread of the virus by increasing the number of infected individuals based on the reproduction number (R0) and update their state over time (recovered, deceased).
5. **Assign Symptoms:** Randomly assign mild or severe symptoms to newly infected individuals and determine their recovery or death.
6. **Update Status:** Track and update the number of infected, recovered, and deceased individuals, and visualize these changes on a polar plot.
7. **Animate:** Create an animation to visualize the progression of the pandemic, showing the spread, recovery, and mortality over time.

Highlights

- **Polar Coordinate System:** The use of polar coordinates for visualizing the spread offers a unique and intuitive view of the pandemic progression.
- **Dynamic Animation:** The animation feature updates the plot in real-time, effectively demonstrating how the virus spreads and impacts the population over time.
- **Parameter-Based Simulation:** The simulation is based on real-world epidemiological parameters, making it a valuable tool for understanding the dynamics of infectious disease spread.

Conclusion

This project successfully demonstrates how a viral pandemic like COVID-19 can spread through a population, visualizing the process in a dynamic and engaging manner. By simulating the infection, recovery, and death rates, the project provides insights into the factors that influence the course of a pandemic. The visual and interactive nature of the simulation makes it a powerful tool for educational purposes and further analysis of epidemiological models.