MICROBIT
Report

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Objective:

The objective of this project was to create a directional navigation system using the microbit. The system allows the user to input source and destination GPS coordinates via a Bluetooth connection. It then calculates the bearing between the two points and uses the built-in magnetometer to continuously point toward the destination, acting as a real-time directional guide.

Implementation Details:

The key components of the project include:

- **Bluetooth UART Communication**: The microbit receives input coordinates through a paired Bluetooth device using UART. The format includes latitude and longitude along with a tag (Source or Destination).

- **Coordinate Parsing**: The received coordinates are parsed and converted into float values by managing the decimal places based on provided data.

- **Bearing Calculation**: The system uses spherical trigonometry to compute the bearing (forward azimuth) from the source to the destination.

  The bearing β from point A to point B can be calculated using the formula:

  $\beta = \tan^{-1}(X / Y)$

  Where:

  $X = \cos(\theta_b) \times \sin(\Delta L)$

  $Y = \cos(\theta_a) \times \sin(\theta_b) - \sin(\theta_a) \times \cos(\theta_b) \times \cos(\Delta L)$

  Here:

  θ_a and θ_b are the latitudes of points A and B, respectively.

  ΔL is the difference in longitude between points B and A (i.e., $L_b - L_a$).

- **Compass-Based Guidance**: Using the built-in magnetometer, the microbit continuously compares the current heading to the calculated bearing and displays an arrow (Left, Right or Straight) to guide the user toward the destination.

- **User Controls**:
    - Pressing Button A resets coordinates to a default source and destination (which is from Bhaskara to Ramanujan).
    - Pressing Button B triggers compass recalibration. (If we are unsure if the readings are correct).

Challenges:

Implementing the project posed several significant challenges, particularly with the Bluetooth functionality and bearing calculations.

Bluetooth Communication: Bluetooth-based serial communication in assembly was difficult to debug and test reliably, especially when parsing complex input strings. Due to these limitations, we requested and received permission from the professor to write the program in Python instead. This allowed for better flexibility & easier debugging.

Bearing Calculations: Achieving accurate bearing computation using latitude and longitude required multiple iterations and debugging. Understanding how the calculated bearing relates to the compass heading was challenging.

Results and Future Improvements:

Results:

- The program successfully receives coordinates over Bluetooth.
- Calculates and displays the direction toward the destination in real-time.
- Allows for simple user interaction and calibration.

Possible Future Improvements:

- Adding distance calculation and display.
- Creating a mobile app to send coordinates more easily (Improving user experience).
- Integrating an API to consider actual road paths(instead of just directions) for more accurate navigation.

Video and Screenshots:

GitHub Link: https://github.com/Vedant-Savani/CA-Microbit

Demonstration Video: https://drive.google.com/drive/folders/1n5TNLMTI67_k4WXXOVVilvT_wc2CaMeY

Screenshot of the Bluetooth terminal app: