RBNV 3 Dec 2024 Meeting Summary

This summary focuses on the three main topics discussed in the Robot Builder Night Virtual meeting on December 3, 2024: the RoboRemo app, GPS accuracy and RTK solutions, and brushless DC motor selection.

RoboRemo App

Paul introduced the group to the **RoboRemo app**, a user-friendly tool for designing custom GUIs for robots on Android devices. The app facilitates both sending commands to and receiving status updates from robots using visually-designed phone-based interfaces. You can learn more about the app and its features on the RoboRemo website: https://roboremo.app/. [1, 2]

Paul highlighted the app's versatility by demonstrating its connectivity options: Bluetooth, network protocols (TCP and UDP), and serial connections. [3] He showcased its functionality using an **ESP32** microcontroller, controlling a variable on the ESP32 from his phone using a slider, and exchanging data via a text log widget. [4, 5] Paul also mentioned the ability to import and export GUI designs, simplifying interface sharing and reuse. [6]

Paul intends to incorporate RoboRemo into his ongoing **Mowbot** project, particularly for convenient control within Bluetooth range – for example, moving the robot to and from the competition area. [7] RoboRemo would interface directly with the ESP32, providing a reliable and readily available control mechanism. [7]

GPS Accuracy and RTK Solutions

The conversation transitioned to GPS accuracy when Tom C. presented a scatter plot visualizing his robot's GPS positional drift. The plot, generated from data collected using a **Ublox Neo M6 GPS receiver** during a stationary test, revealed a drift of 3 meters horizontally and 4 meters including the north-south component over a 2.5-minute timeframe. [10, 11]

This level of drift was unexpected considering the relatively good satellite reception (6 satellites) and a Horizontal Dilution of Precision (HDOP) of 1.7. [12] Tom's intention in creating this visualization was to gain a deeper understanding of GPS capabilities and limitations. [10] The group analyzed the plot, observing the serial wandering behavior of the readings. [13] This prompted a discussion about improving GPS accuracy, focusing on **Real-Time Kinematic (RTK) GPS**. [14]

Tom, located in Ontario, Canada, mentioned **CANET**, a government organization that maintains a list of base station providers. [15] However, the three base stations closest to his location were commercial services with undisclosed costs, making them less attractive. [15]

The discussion shifted to exploring DIY RTK base station possibilities. Paul suggested using the **National Geodetic Survey (NGS)** website to identify precisely surveyed markers that can serve as reliable reference points for setting up a base station. [16] He provided the link to the NGS map: https://noaa.maps.arcgis.com/apps/webappviewer/index.html?id=190385f9aadb4cf1b0dd87598%2093032db. [17]

Paul emphasized that RTK positioning is relative to the base station, which means the accuracy of the base station's position directly impacts the rover's absolute accuracy. [18] The group then explored potential discrepancies in absolute positioning depending on the chosen base station, even with high RTK accuracy. [19]

The potential use of GPS as a compass emerged as a topic, but inherent drift presented challenges. Paul proposed comparing regular GPS readings to RTK readings for ground truthing heading accuracy. [20] Tom highlighted the importance of antenna grounding for GPS accuracy by sharing a **Ublox white paper** on the topic: https://cdn.sparkfun.com/assets/learn_tutorials/8/1/4/AntennasForRTK_WhitePaper__UBX-160%2010559_.pdf. [21, 22]

Brushless DC Motors and Controllers

Paul asked the group for recommendations on selecting **brushless DC motors** and controllers for his new robot. He specifically needed a sensored motor capable of delivering full torque at low speeds to replace a **Titan 550** brushed motor included in his robot kit. [23]

The conversation touched upon the differences between brushless and brushed DC motors, highlighting the advantages of brushless motors for precise speed control and torque management. [24, 25] However, they acknowledged the higher cost associated with brushless motors. [26] The importance of **encoders** for accurate odometry and feedback to the controller was also emphasized. [27, 28]

Carl noted that some brushless motors come equipped with built-in **Hall effect sensors**, simplifying wiring and providing a more streamlined solution. [29]

Mickey raised the possibility of using RTK GPS instead of encoders. [25] The group clarified that while RTK offers position information, encoders remain valuable for odometry and for detecting scenarios where motors are turning but the robot is not moving, such as being stuck. [30]

Field Oriented Control (FOC) emerged as another topic. FOC enables precise speed and torque control but involves more complex algorithms and hardware. [31, 32]

Carl highlighted **gimbal motors** commonly used in phone stabilizers as examples of brushless motors with high torque and precise control. [33] These motors, often featuring built-in sensors, showcase the capabilities of sensored brushless technology.

Carl shared a link to a **ChatGPT discussion** on sensored brushless motors, which provided helpful insights into terminology and concepts: https://chatgpt.com/share/67467890-ca3c-800e-b539-206222a79115. [34] The importance of selecting motors and controllers tailored to the specific application and performance needs was reiterated throughout the conversation. [35]