



Marmara Üniversitesi
Teknoloji Fakültesi
Mekatronik Mühendisliği

Bitirme Projesi Konu



İç Mekân Navigasyon ve Konum Kestirimi – Mobile Robot

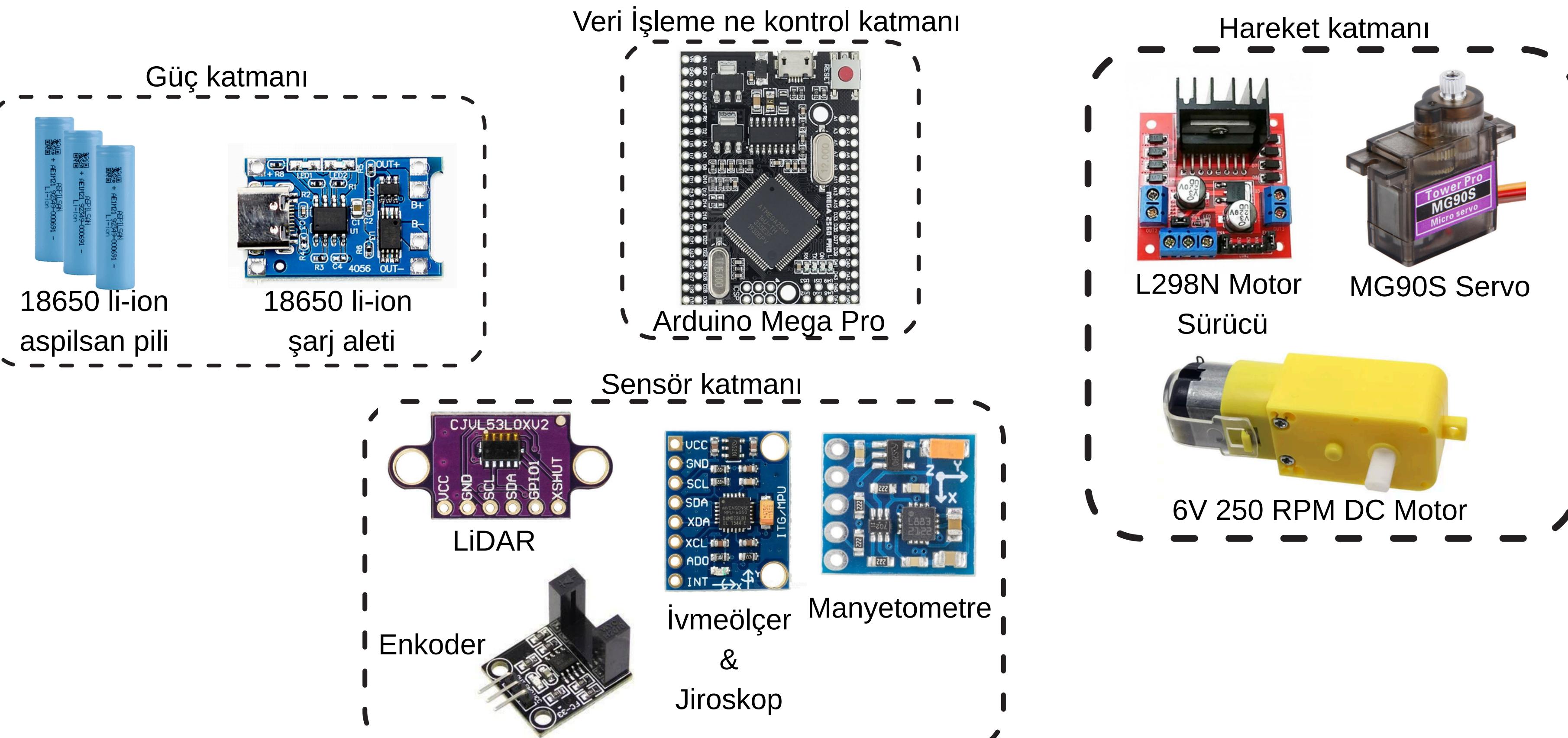
Ekip

170221924, İbrahim Hellı

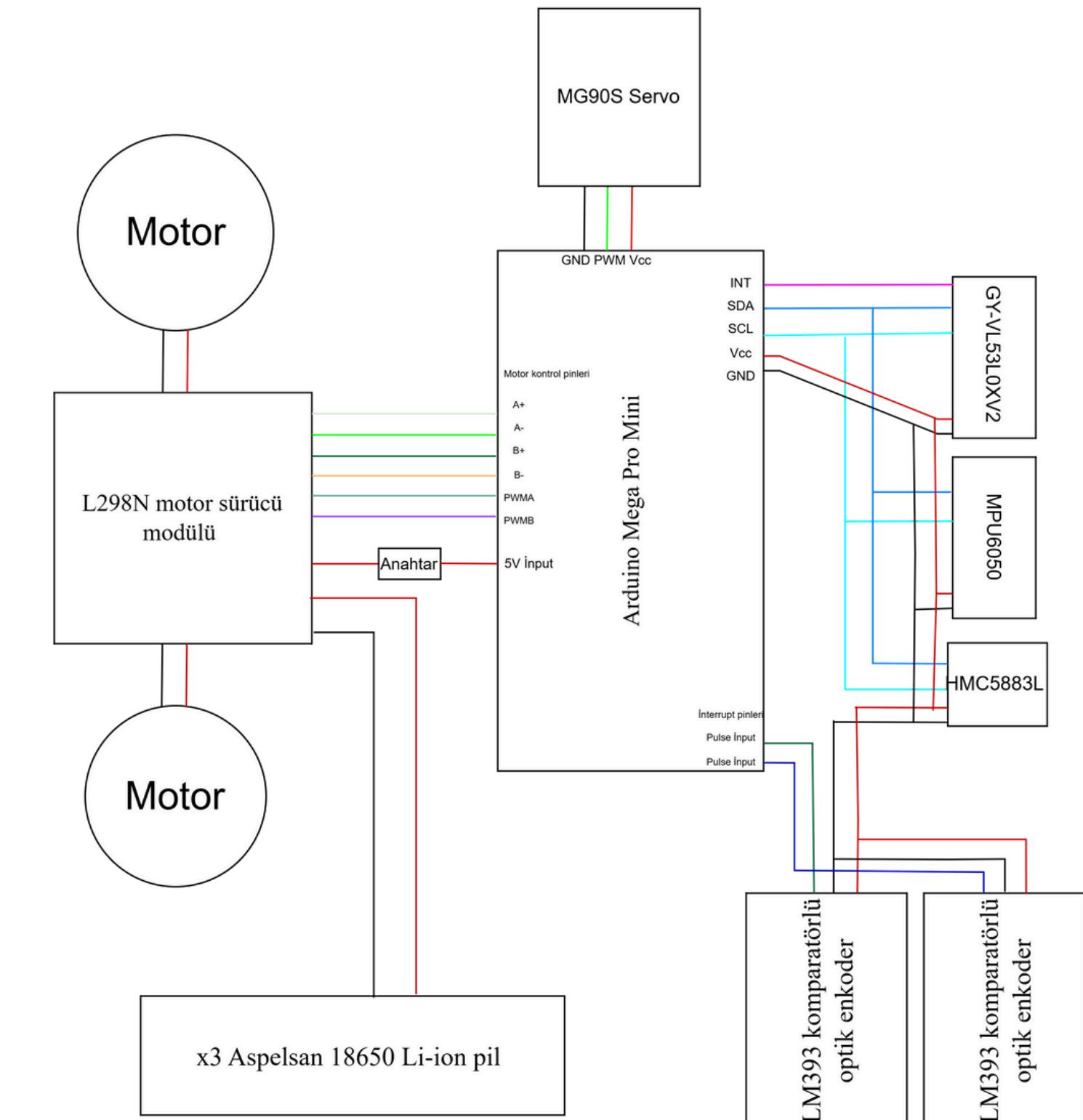
Giriş

- Projenin amacı:
Basit komponentlerden sensör füzyon ve konum kestirimi yapmak
- Çözüm bekleyen sorun
 - Jiroskop kayma hatası(drift) ve tekerlek kayma hatası (slippage)
- Kısaca sistemin genel mantığı

Genel Sistem Mimarisi

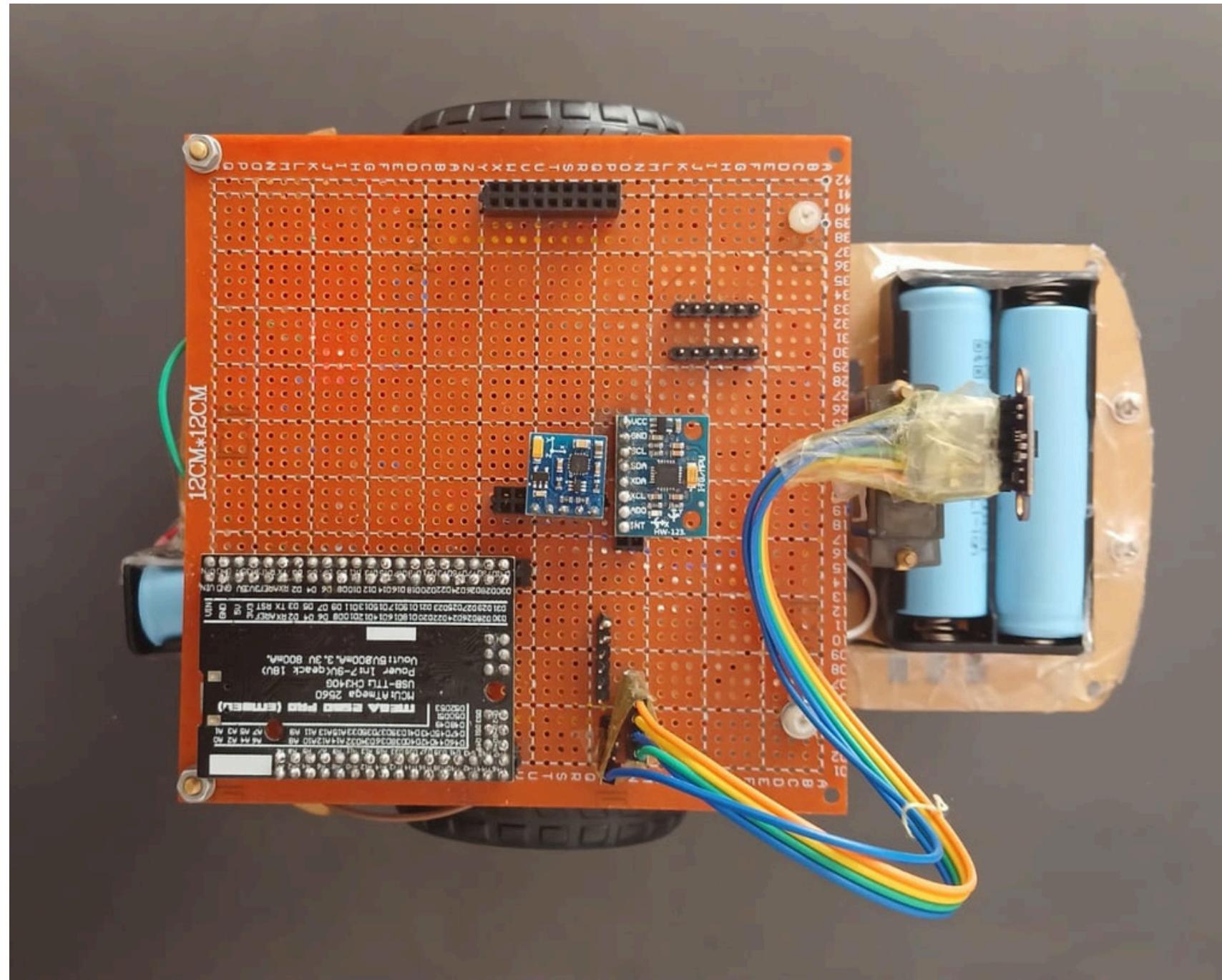


Sistem Mimarisi Bağlantı Şeması

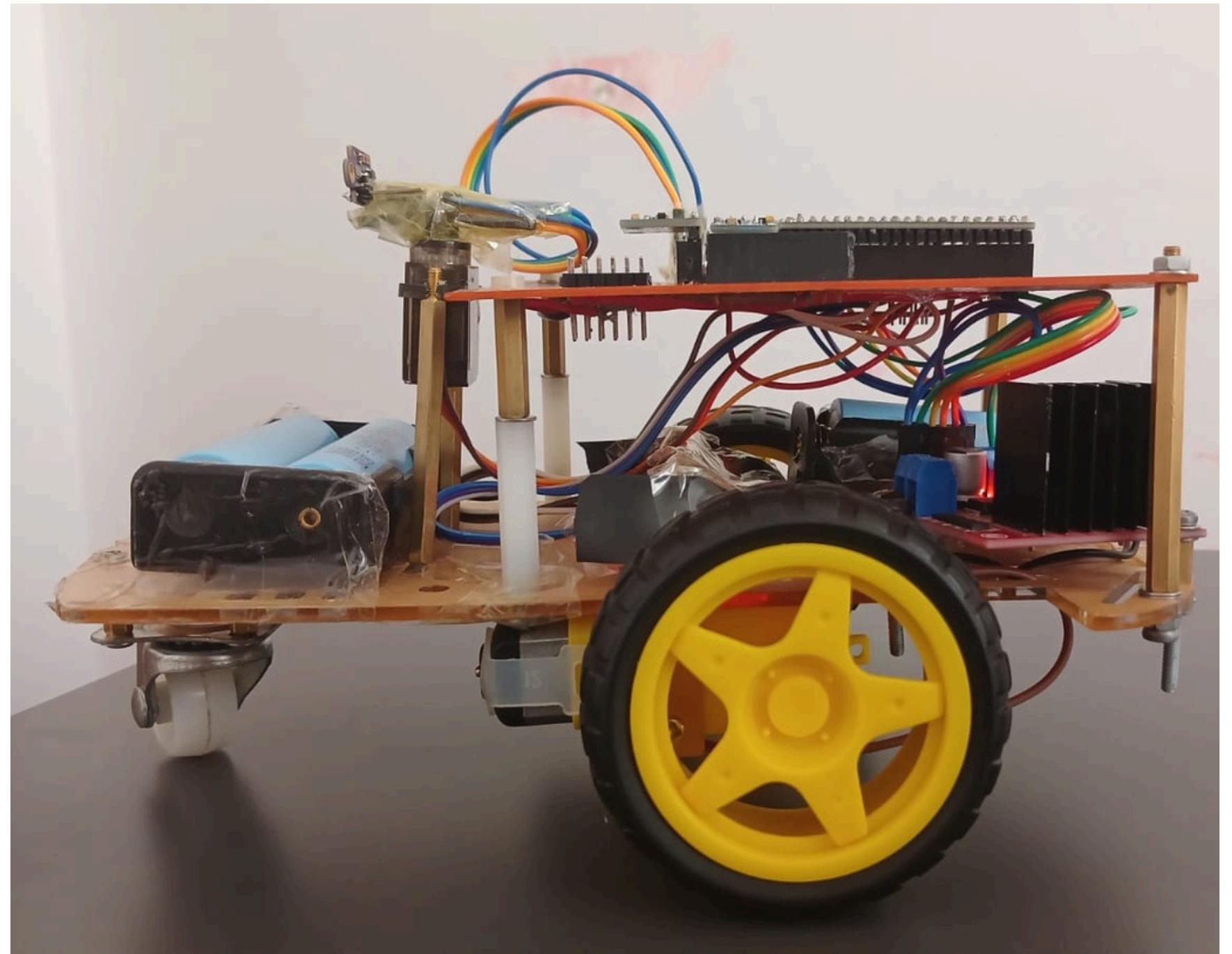


Sistem Bağlantı Şeması

Gerçek Sistem Görüseli

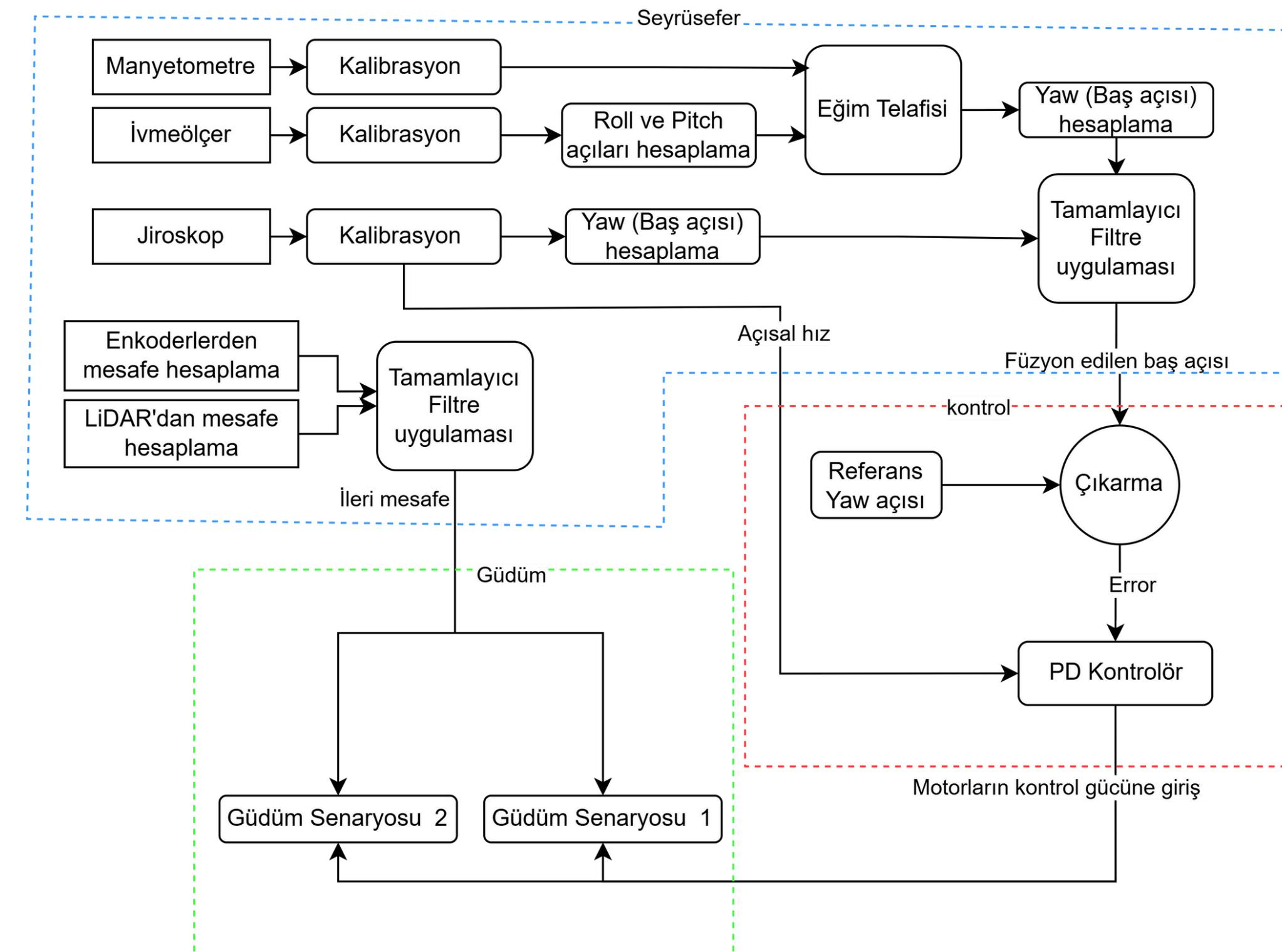


Sistem üstten görünüşü



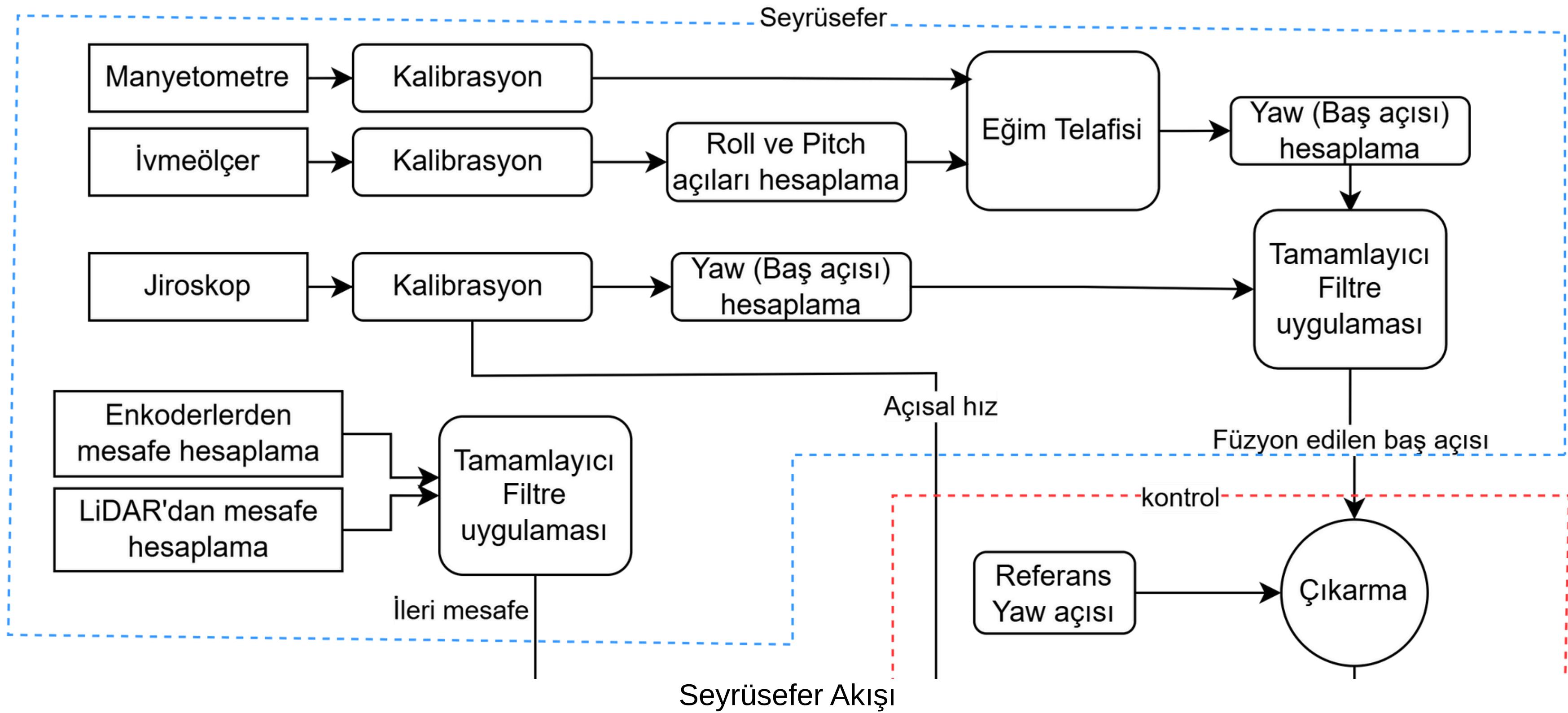
Sistem yandan görünüşü

Yazılım Mimarisi Akışı

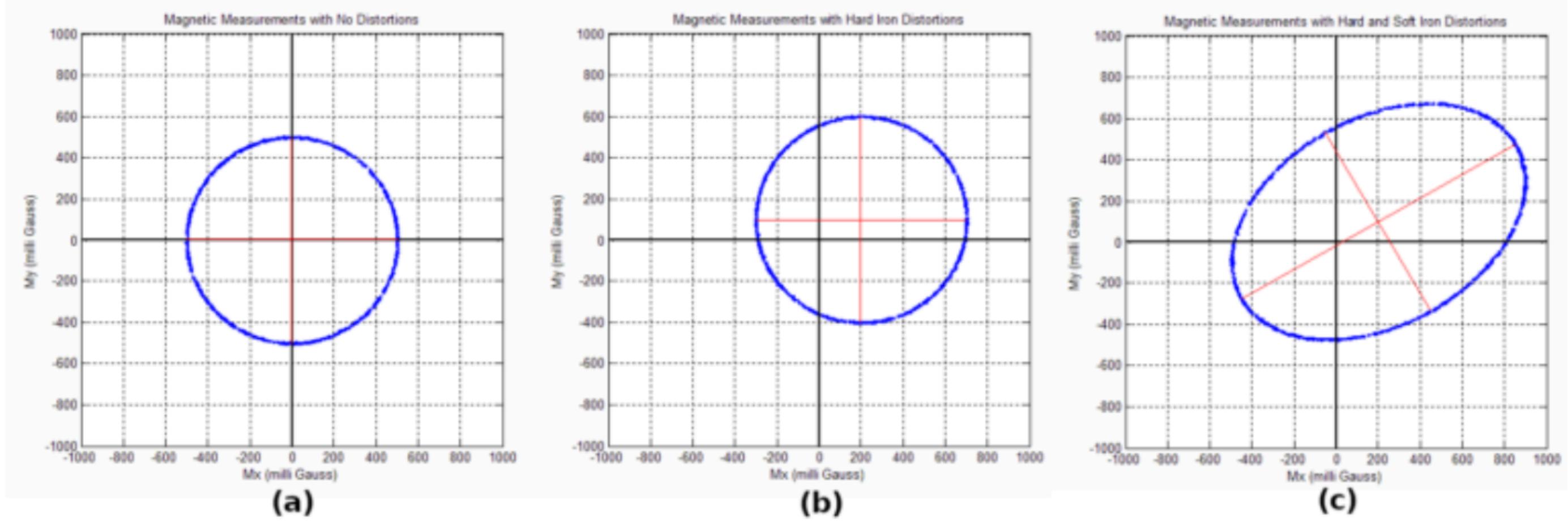


Yazılım Mimarisi Akışı

Yazılım Mimarisi Akışı



Sensör Kalibrasyonu



a- ideal durumu

b- sadece Hard Iron görültülü

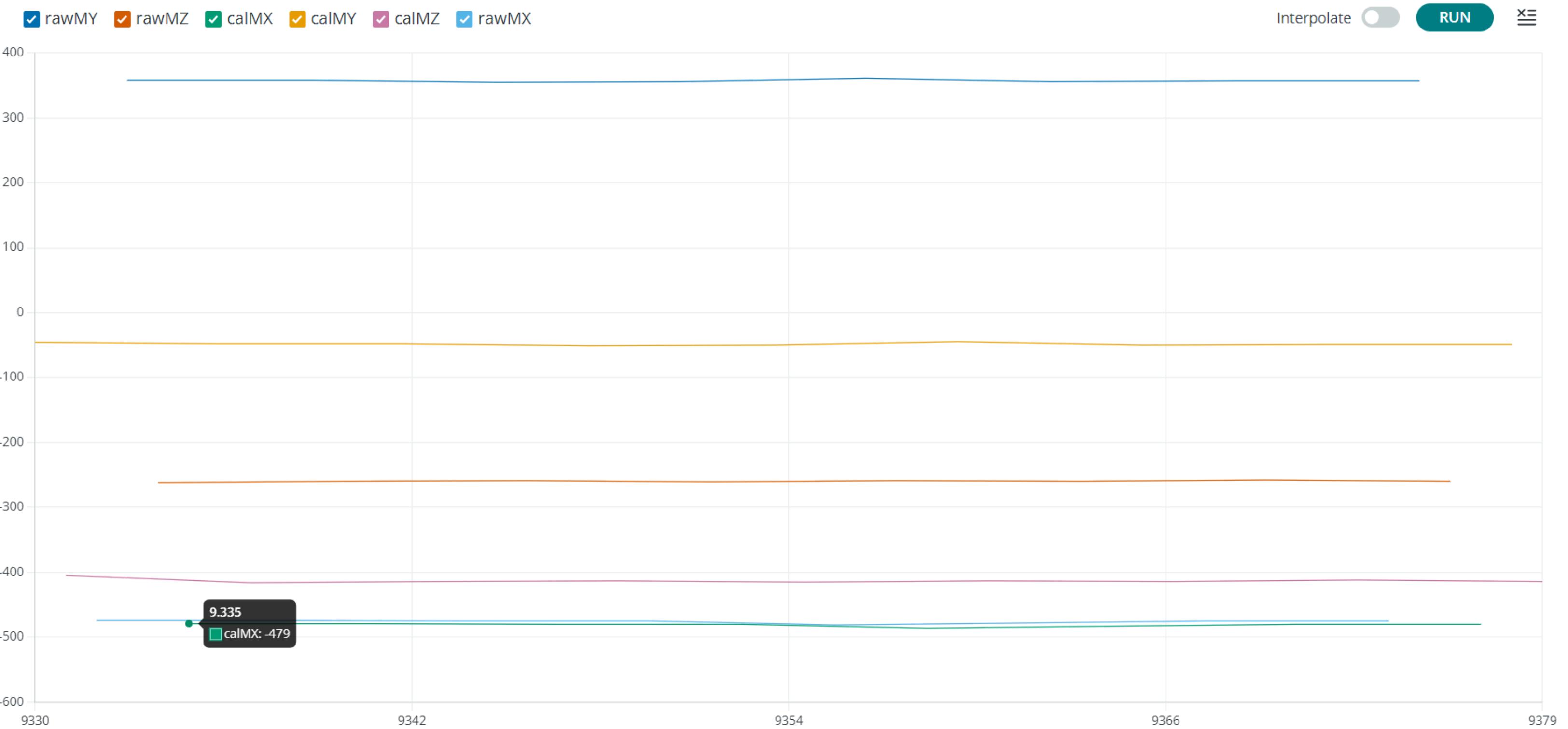
c- Hard + Soft Iron görültülü

İvmeölçer: min max algoritması ile kalibrasyon

Manyetometre: Elipsoid denklemle kalibrasyon (MagMaster 1.0 uygulaması)

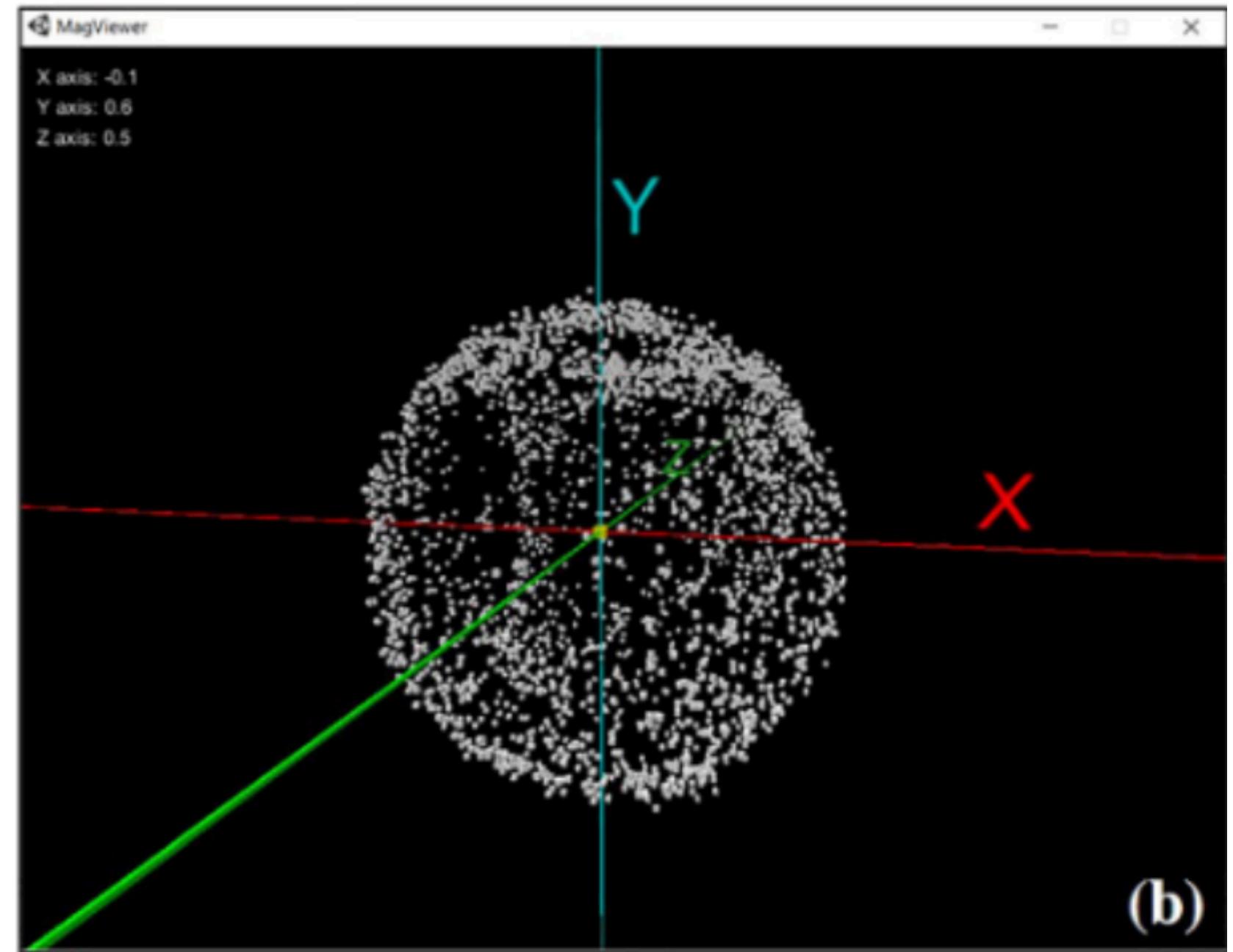
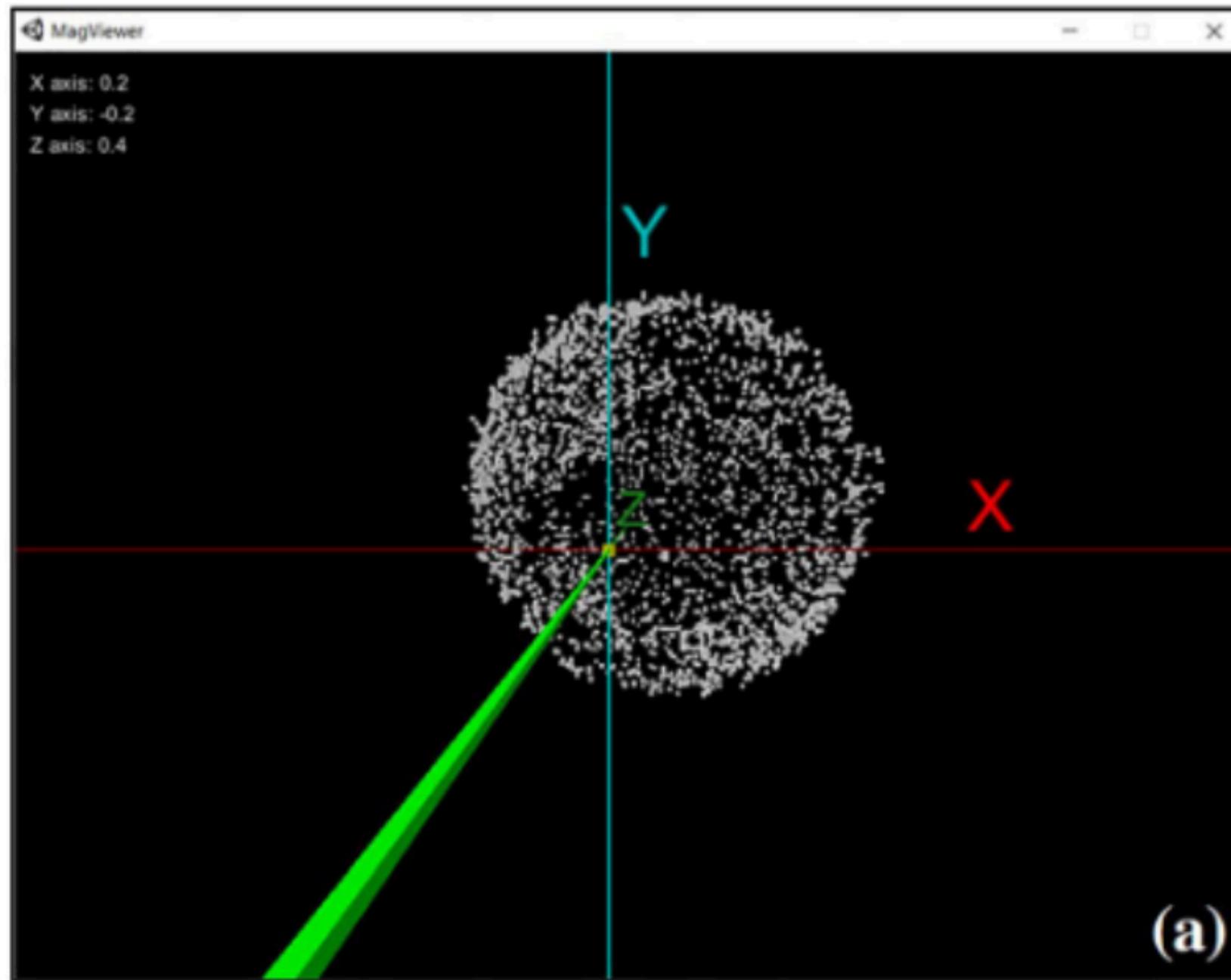
Jiroskop: sistem açıldığında az bekletip ofsetleri almamız yeterli

Manyetometre kalibrasyonu



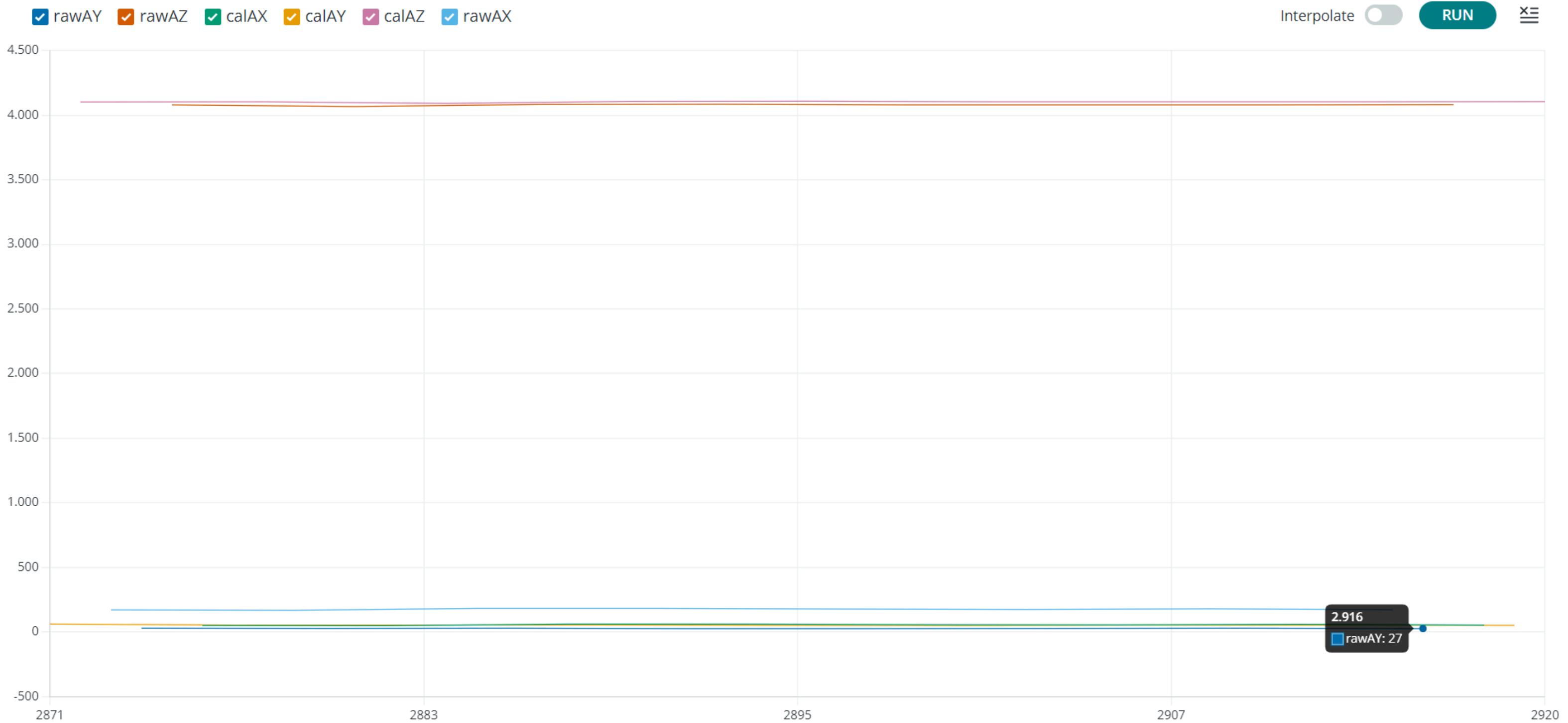
Manyetometre kalibrasyon önce ve sonra çıkan değer grafiği

Manyetometre kalibrasyonu



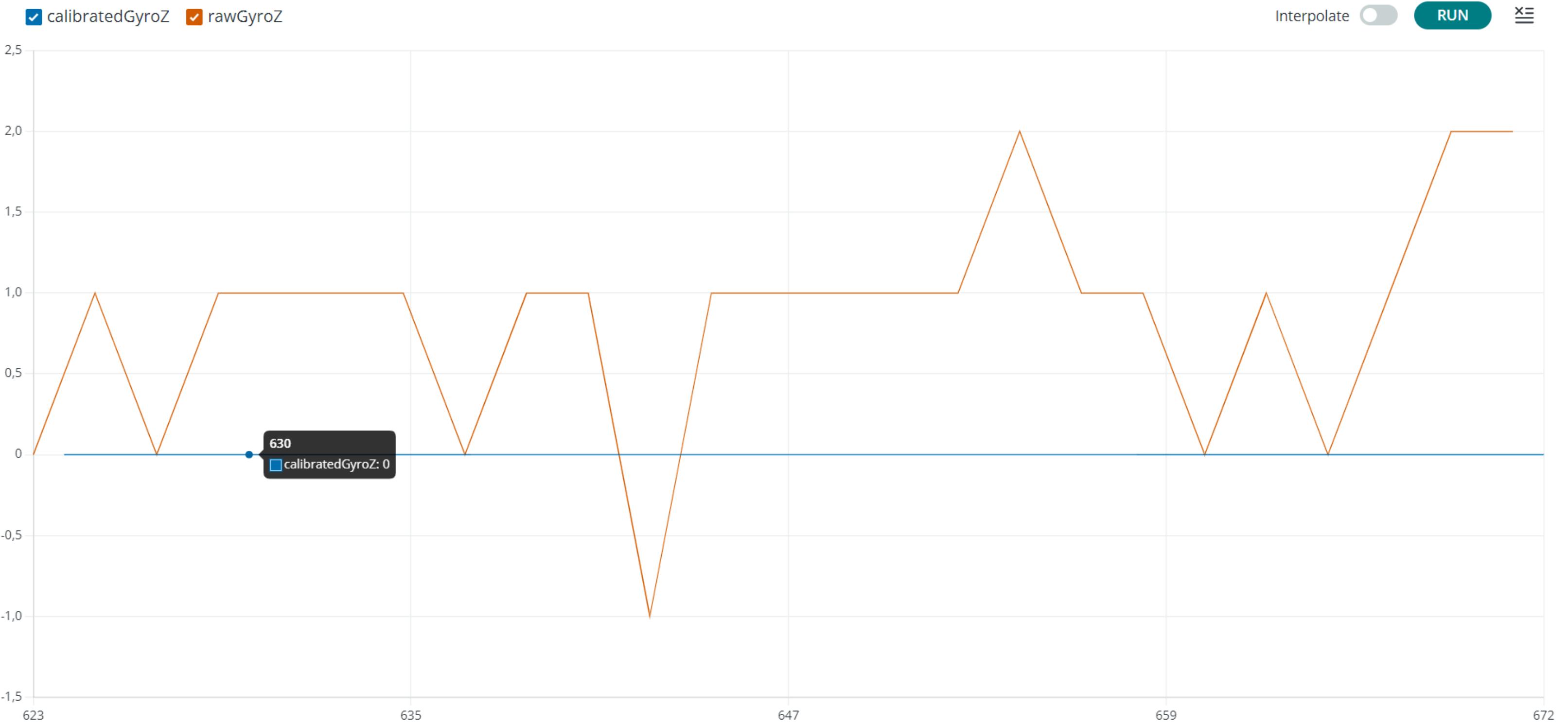
Manyetometre kalibrasyon önce (a) ve kalibrasyon sonra (b) çıkan değer 3D şekli

İvmeölçer Kalibrasyonu



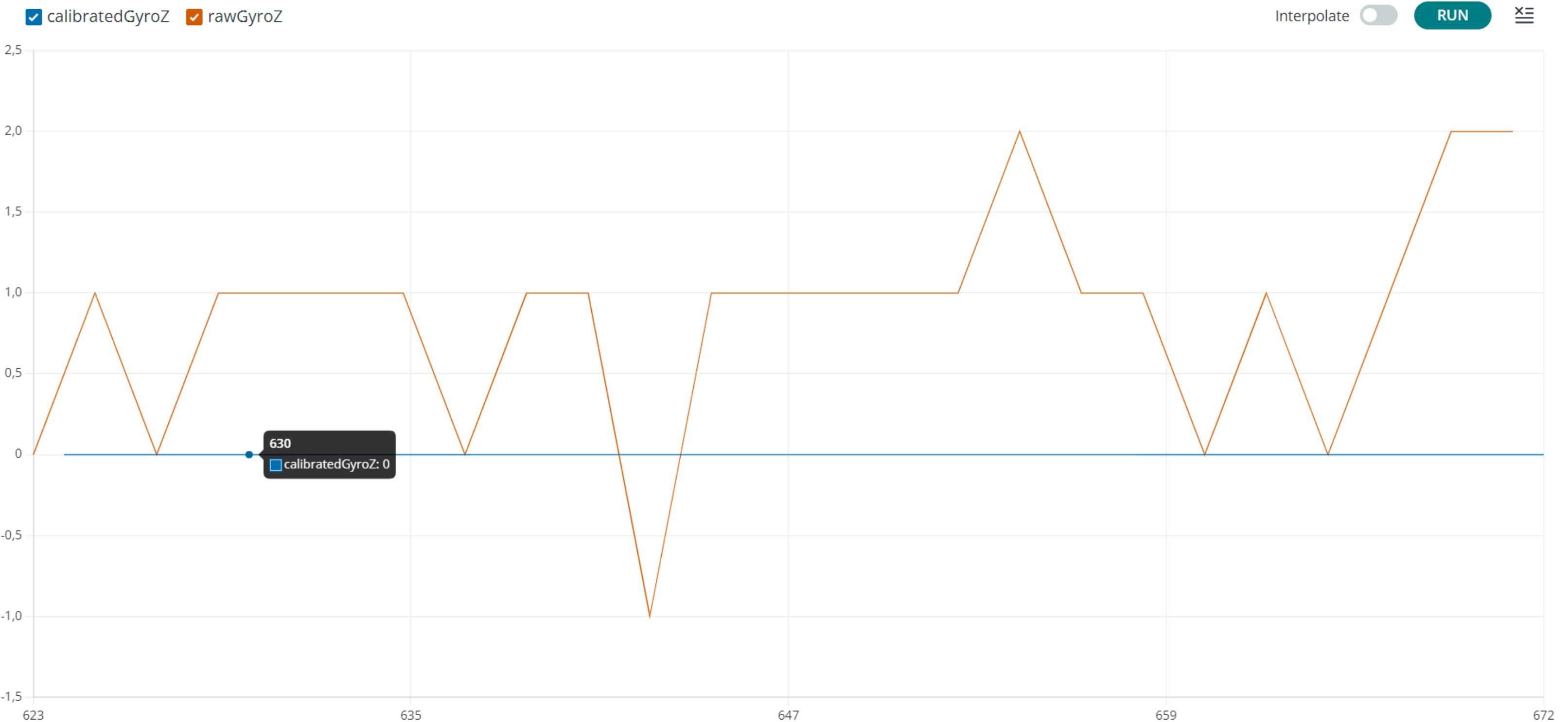
İvmeölçer kalibrasyon önce ve kalibrasyon sonra çıkan değer grafiği

Jiroskop Kalibrasyonu



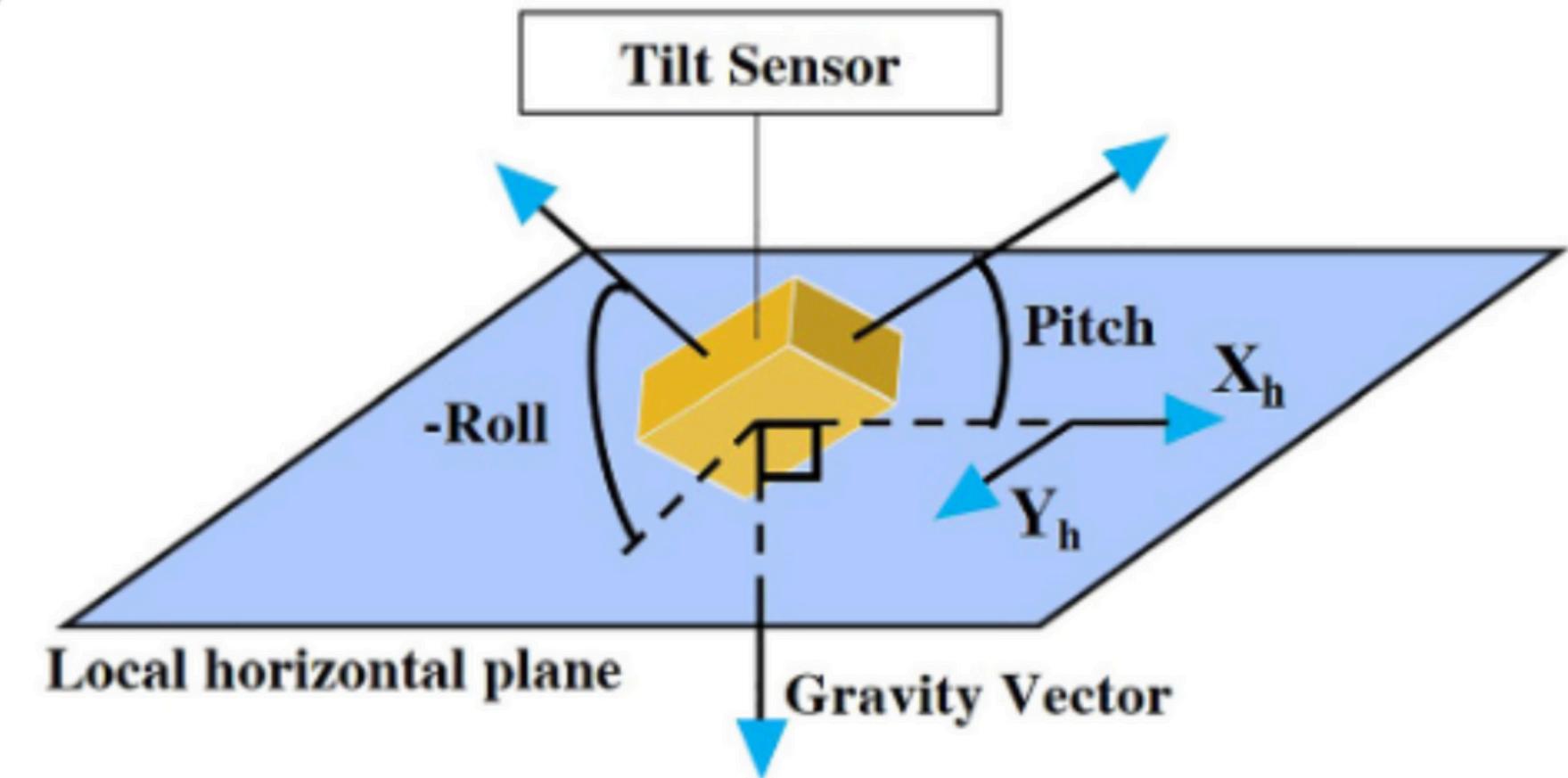
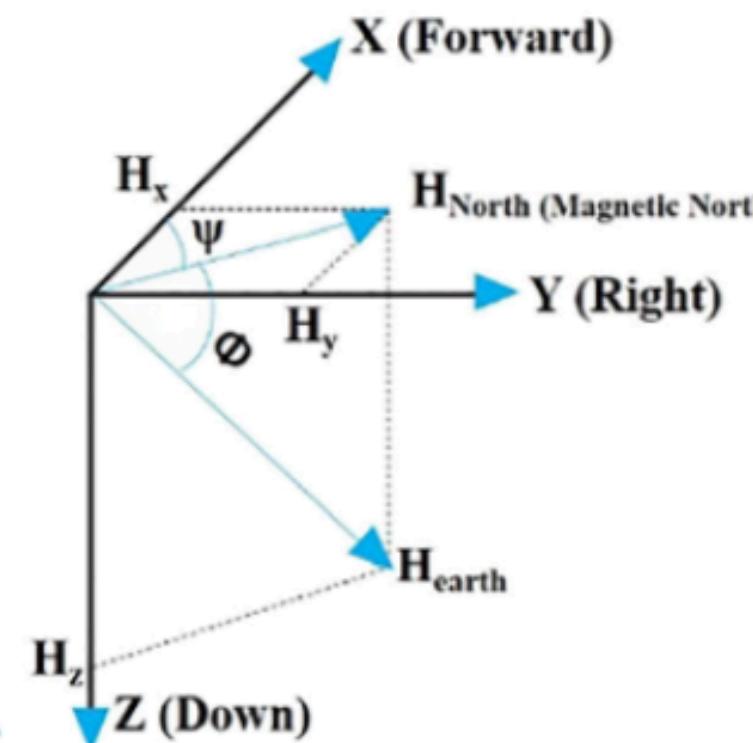
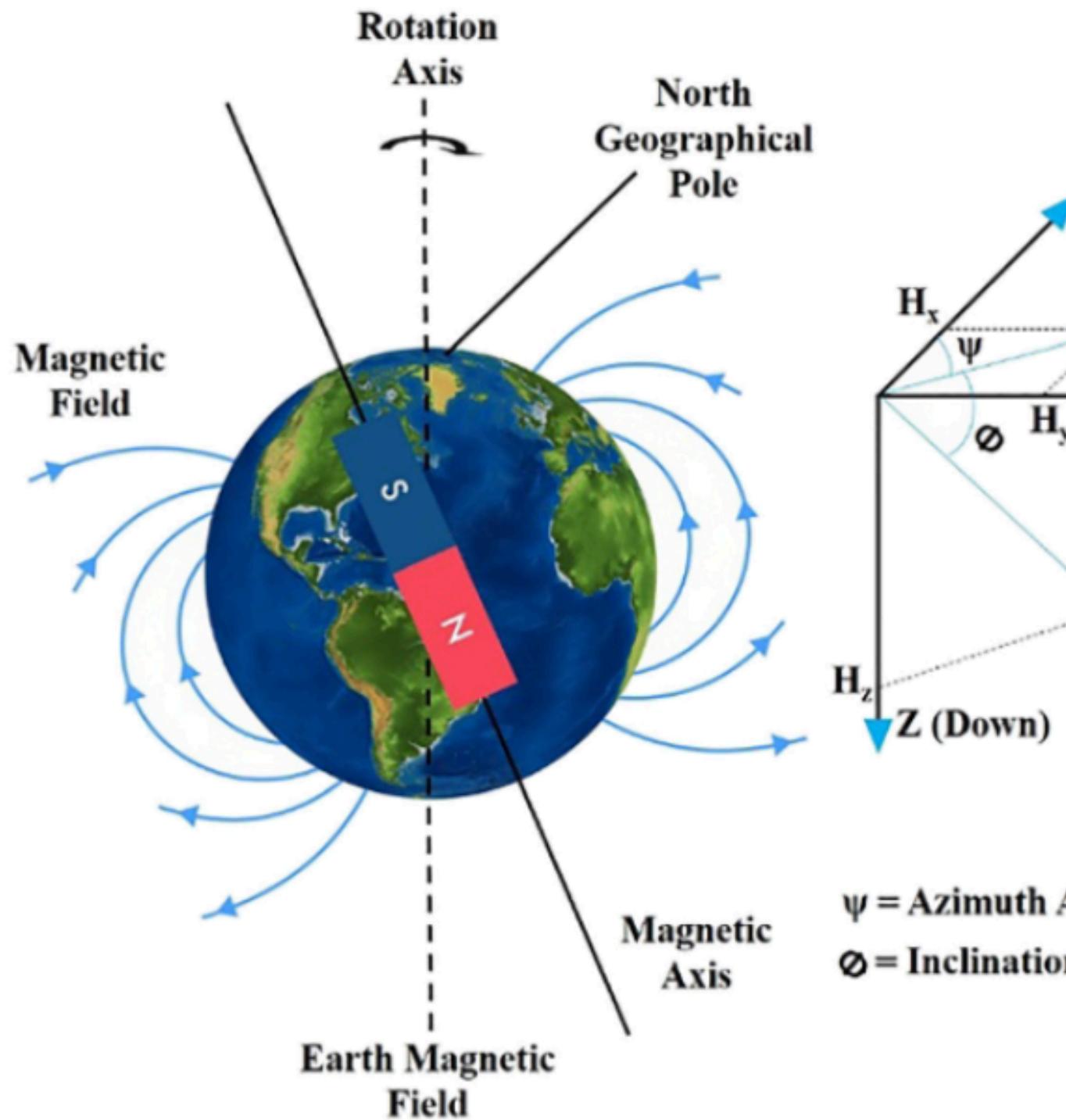
Jiroskop kalibrasyon önce ve kalibrasyon sonra çıkan değer grafiği

Jiroskop Kalibrasyonu



Jiroskop kalibrasyon önce ve kalibrasyon sonra çıkan değer grafiği

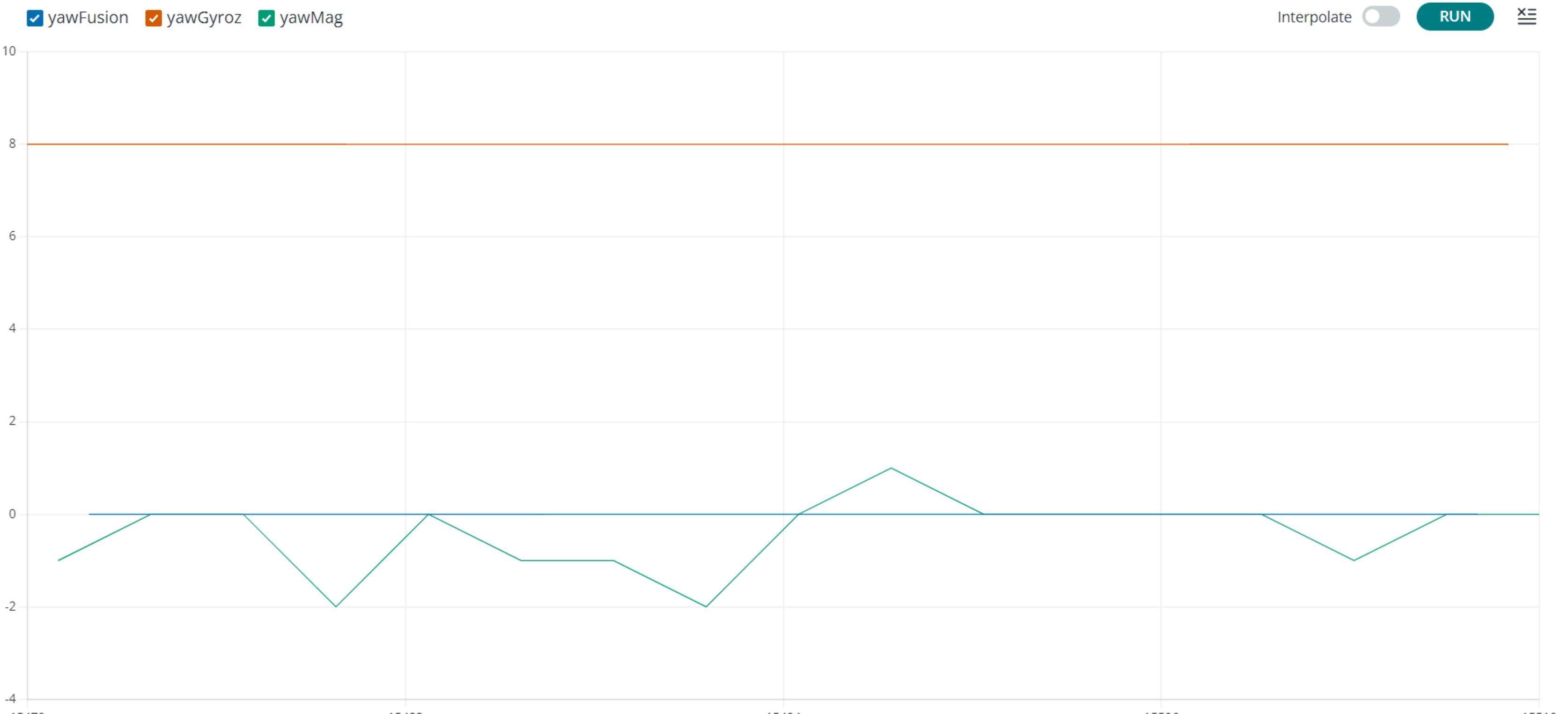
Sensörün Eğim Telafisi



Manyetometre yatay düzleme eğimlidir

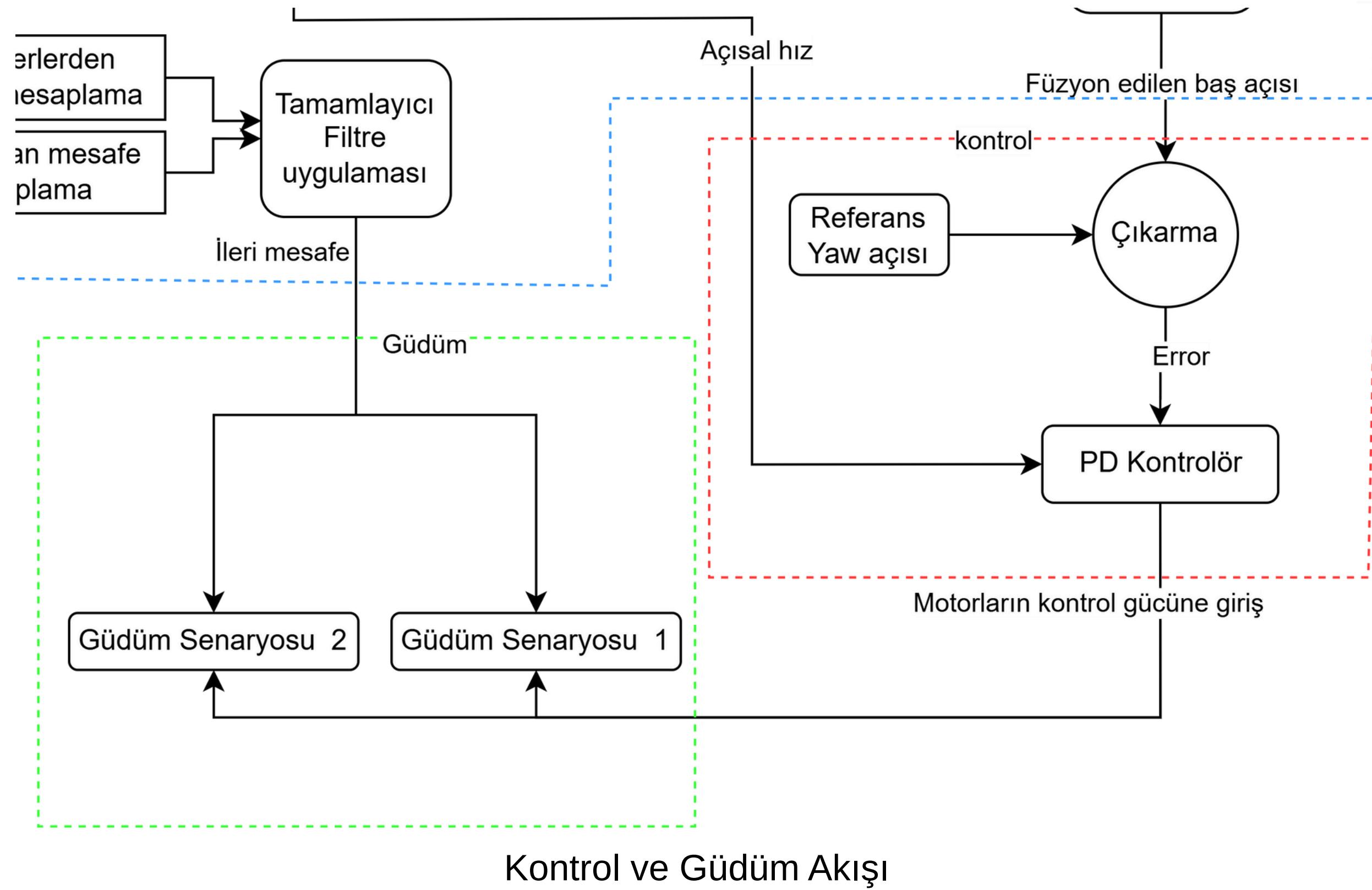
Dünya Manyetik Alanı

Sensör Füzyonu Sonucu



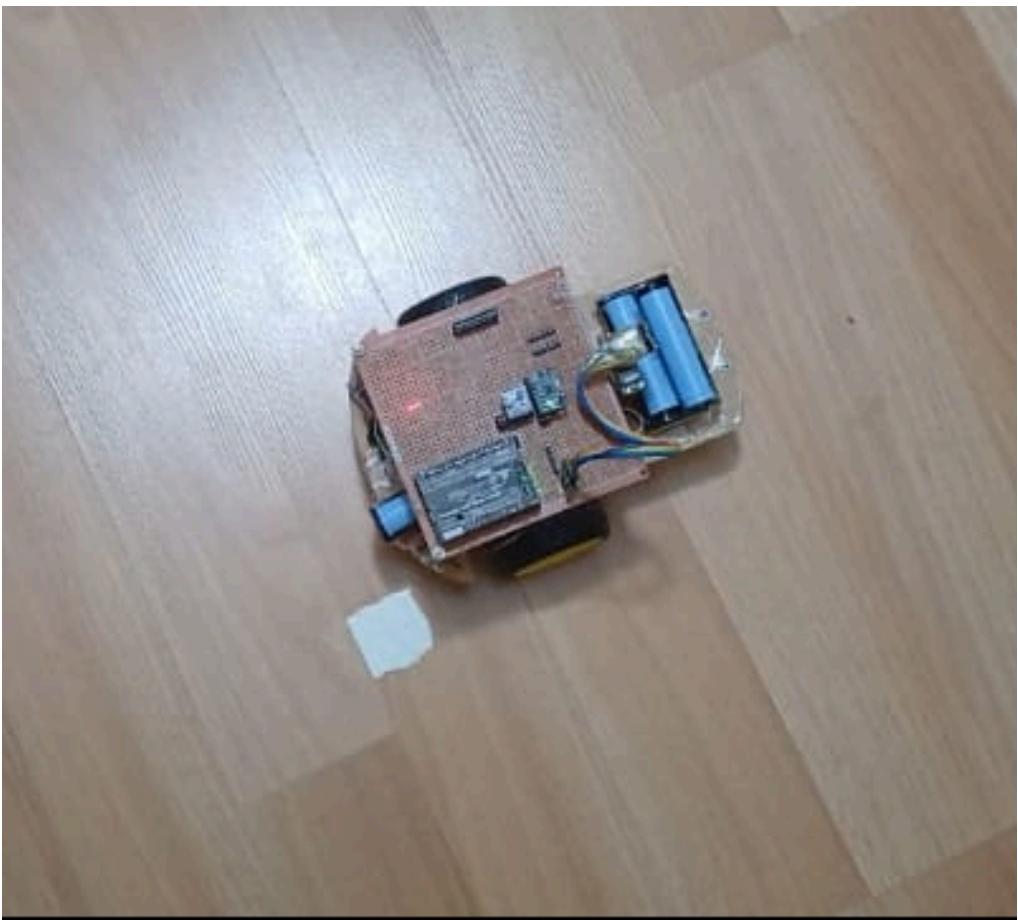
Açısal hızın integralinde oluşan kayma hatası etkisi ve sensör füzyonu

Yazılım Mimarisi Akışı

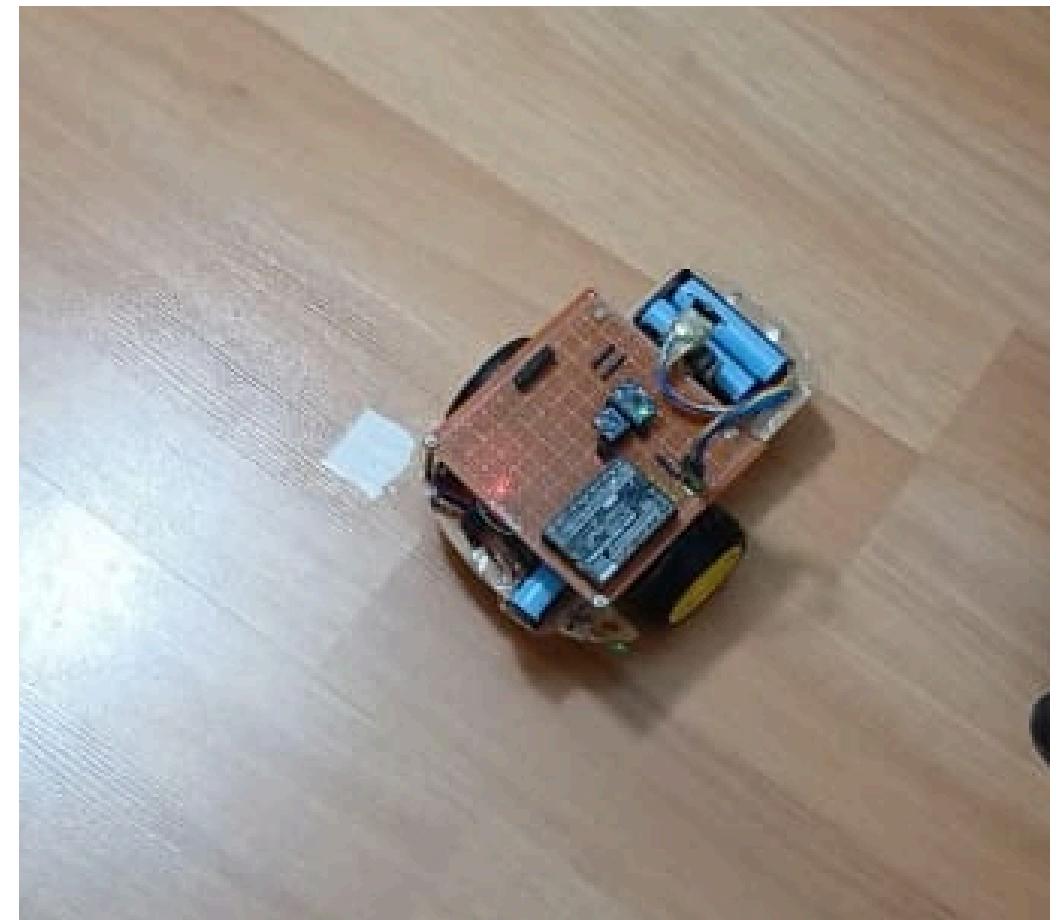


Güdüm Senaryoları

- Senaryo 1 videosu
- Senaryo 2 videosu LiDAR ile birlikte



Senaryo 2 LiDAR ile birlikte



Senaryo 2 LiDAR Kullanmadan

Kaynakça

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- [1] Noh, Y., & Yeo, J. (2022). *Simplification of calibration of low-cost MARG sensors without high-precision laboratory equipment*. ResearchGate. <https://www.researchgate.net/publication/366493596>
 - [2] Infineon Technologies. (n.d.). *PSoC 1 - Sensing Magnetic Compass with Tilt Compensation* (Application Note AN2272, v04.00). <https://www.infineon.com/dgdl/Infineon-AN2272>
 - [3] MAGE Project. (n.d.). *Geomagnetism Field Model Top Page*. <http://mage-p.org/mage/gmf-top-e.html>
 - [4] YuriMat. (2023). *MagMaster: Magnetometer Hard/Soft Iron Calibration Tool* [GitHub repository]. <https://github.com/YuriMat/MagMaster>
 - [5] Atadiat. (2020). *Magnetometer Soft Iron and Hard Iron Calibration: Why & How*. <https://atadiat.com/en/e-magnetometer-soft-iron-and-hard-iron-calibration-why-how/>