

Track3 – Long system description

DYS-BUPT

In recent years, indoor location system plays an important role in human society, which can estimate user's location information by using a variety of technologies. Usually there are GPS, image and video processing technology, inertial unit navigation, WiFi and BLE fingerprint matching. However, every single sensor has its disadvantages, which have not been well solved at present. For example, GPS systems cannot receive signals in indoor environments; Image-based positioning is seriously affected by ambient illumination. RSSI requires known signal source location in advance to achieve accurate positioning, and filtering will reduce the real-time performance of the algorithm. IMU - based pedestrian dead reckoning will lead to system error. Therefore, multi-sensor fusion can make up for the deficiency of single sensor and achieve a better positioning effect.

This project is based on smart phones, through the integration of various sensors built into the phones, to achieve user positioning. The data generated by the built-in IMU module and the pose sensor are used as the main data for positioning, and the error is controlled by WiFi data. This is because in the sensor data generated by mobile phones, the frequency of these data is higher than other data, so the real-time performance is good, and the location can be accurately estimated.

In addition, there is an integral process in the PDR solution steps based on IMU and navigation, which will produce cumulative errors with the extension of time, leading to deviation from the positioning route. In addition, the magnetometer in IMU is also affected by the earth's magnetic field and the surrounding environment, which may lead to signal mutation or fluctuation in the process of movement. Finally, the IMU of mobile phone is susceptible to the interference of user movements, which may produce irrelevant redundant data. In consideration of the above factors, this project firstly carried out mutation removal and chattering elimination operation on IMU sensor to eliminate the influence brought by the environment. Then the peak detection method is used to detect the step size of acceleration signal to eliminate the noise that does not belong to the normal walking range. At the same time, in order to further offset the accumulated error caused by the integral calculation, the speed is corrected to zero by taking advantage of the temporary zero speed state existing in the pedestrian walking cycle. The above operations can effectively reduce the error value of inertial navigation calculation.

Since the precision of IMU module inside smart phone is not high and only meets the function of rough step counting, this project plans to use WiFi fingerprint information to assist IMU positioning. Firstly, in order to eliminate the interference of unconnected equipment and environmental noise in RSSI, a filtering algorithm is designed to improve the quality of RSSI information. Then, the filtered RSSI was constructed as fingerprint image to increase the pertinence of fingerprint

distinguishing location information. Finally, a deep convolutional neural network is designed based on the fingerprint image constructed above. In the preparation stage, the network is trained with the provided training data and adjusted to achieve the position prediction effect with appropriate accuracy. In the competition stage, combined with the above PDR positioning method, the position information is comprehensively predicted to achieve high-precision positioning effect.

The height can be determined by using a built-in barometer, and the air pressure value can be filtered to calculate the floor height. In addition, GNSS information can be used outdoors. This project plans to adopt the indoor and outdoor dual-mode positioning method. When using IMU combined with GNSS for calibration outdoors, IMU and WiFi are used for matching indoors. Light sensors and GNSS signals can be used to determine whether the environment is indoor or outdoor.

Based on smart phones, this project uses a variety of sensors to fuse and automatically select appropriate sensors and algorithms according to different scenes and environmental characteristics, so as to achieve high-precision positioning in large indoor and outdoor scenes.