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/**
 * @file robot.c
 * @brief More general things related to the robot
 * Copyright (C) 2017 Ethan Wells
 *
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 */

#include "../include/robot.h"

#define RED      "\x1b[31m"
#define GREEN    "\x1b[32m"
#define YELLOW   "\x1b[33m"
#define BLUE     "\x1b[34m"
#define MAGENTA  "\x1b[35m"
#define CYAN     "\x1b[36m"
#define RESET    "\x1b[0m"

double inch =
    (1 / (M_PI * (DRIVE_WHEEL_DIAMETER / 360) * (1 / DRIVE_ENCODER_RATIO)));

// Sensors
Sensor gyro, *sonic, liftLimit[2], line[3];

// Motors and servos
Motor intake, lift, manip, mogo, drive[2];

// PID settings
PIDSettings liftSettings = {
    DEFAULT_PID_SETTINGS,
    .kP      = .132f,
    .kI      = .09f,
    .kD      = .083f,
    .root    = &lift,
    .target  = 10,

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};

PIDSettings manipSettings = {
    DEFAULT_PID_SETTINGS,
    .kP      = .45f,
    .kI      = .62f,
    .kD      = .26f,
    .root     = &manip,
    .tolerance = 35,
    .precision = 175,
};

#define _DRIVE_SETTINGS_(index) \
    DEFAULT_PID_SETTINGS, \
    .kP      = .170f, \
    .kI      = .043f, \
    .kD      = .253f, \
    .tolerance = 200, \
    .precision = 275, \
    .root     = &drive[index]

PIDSettings driveSettings[2] = {
    { _DRIVE_SETTINGS_(0) },
    { _DRIVE_SETTINGS_(1) },
};

#define _GYRO_SETTINGS_(index, m) \
    DEFAULT_PID_SETTINGS, \
    .kP      = m * 2.8625f, \
    .kI      = m * 0.5877f, \
    .kD      = m * 2.3363f, \
    .tolerance = 2, \
    .precision = 425, \
    .root     = &drive[index], \
    .sensor    = &gyro

PIDSettings gyroSettings[2] = {
    { _GYRO_SETTINGS_(0, 1) },
    { _GYRO_SETTINGS_(1, -1) },
};

void altRefresh(Sensor *s) {
    mutexTake(s->_mutex, 5);
    s->value = analogReadCalibrated(s->port);
    mutexGive(s->_mutex);
} /* altRefresh */

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void init();

void reset() {
    // free mutexes
    mutexGive(gyro._mutex);
    mutexGive(gyro.child->_mutex);
    mutexGive(lift.sensor->_mutex);

    mutexGive(intake._mutex);
    mutexGive(lift._mutex);
    mutexGive(lift.child->_mutex);
    mutexGive(mogo.child->_mutex);

    for (int i = 0; i < 2; i++) {
        mutexGive(drive[i]._mutex);

        mutexGive(drive[i].sensor->_mutex);
        mutexGive(liftLimit[i]._mutex);
    }

    // Reset sensors
    sensorReset(&gyro);
    sensorReset(drive[0].sensor);
    sensorReset(drive[1].sensor);

    // Reset PID times
    liftSettings._time = millis();
    driveSettings[0]._time = millis();
    driveSettings[1]._time = millis();
} /* reset */

void update() {
    motorUpdate(&intake);
    motorUpdate(&mogo);
    motorUpdate(&lift);
    motorUpdate(&manip);

    sensorRefresh(lift.sensor);
    sensorRefresh(intake.sensor);
    sensorRefresh(mogo.sensor);
    sensorRefresh(manip.sensor);

    sensorRefresh(&gyro);
    sensorRefresh(sonic);
    sensorRefresh(&line[2]);
}

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        for (size_t i = 0; i < 2; i++) {
            motorUpdate(&drive[i]);
            sensorRefresh(drive[i].sensor);
            sensorRefresh(&liftLimit[i]);
            sensorRefresh(&line[i]);
        }
    } /* update */

    void info() {
        #ifndef DEBUG_MODE
            return;
        #endif

        static unsigned long time = 0;
        const char *en = isEnabled() ? "\n" : "\r";

        if (millis() - time >= 20) {
            printf(
                RESET "\r"
                RED "%d, " GREEN "%d, " YELLOW "%d, " BLUE "%d, " CYAN \
                RED "%d, " GREEN "%d, " YELLOW "%d, " BLUE "%d, " CYAN \
                "%d, " RED "%d, " GREEN "%d, " YELLOW "%d, %d, %d" BLUE " // %u mV"
                RESET "%s",
                drive[0].sensor->value,
                drive[1].sensor->value,
                lift.sensor->value,
                manip.sensor->value,
                drive[0].sensor->velocity,
                drive[1].sensor->velocity,
                lift.sensor->velocity,
                manip.sensor->velocity,
                mogo.sensor->averageVal,
                gyro.averageVal,
                sonic->value,
                line[0].value,
                line[1].value,
                line[2].value,
                powerLevelMain(),
                en);
            lcdPrint(uart1, 2, "%u mV", powerLevelMain());
            time = millis();
        }
    } /* info */

    bool takeDrive(unsigned long blockTime) {

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    blockTime /= 2;

    if (!mutexTake(drive[0]._mutex, blockTime)) {
        return false;
    } else if (!mutexTake(drive[1]._mutex, blockTime)) {
        mutexGive(drive[0]._mutex);
        return false;
    }
    return true;
} /* takeDrive */

void giveDrive() {
    mutexGive(drive[0]._mutex);
    mutexGive(drive[1]._mutex);
} /* giveDrive */

void driveSet(int l, int r) {
    if (!takeDrive(10)) {
        return;
    }

    drive[0].power = l;
    drive[1].power = r;

    for (int i = 0; i < 2; i++) {
        mutexGive(drive[i]._mutex);
        motorUpdate(&drive[i]);
    }
} /* driveSet */

bool initialized = false;

void initialize() {
    // Call the init function to perform actions in init.c
    if (!initialized) {
        init();
    }
    reset();

    // Wait for initialization to end
    while (!isAutonomous() && !isEnabled()) {
        delay(15);
    }
} /* initialize */

#define stallVel 10 / 100

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bool waitForDriveStall(unsigned long blockTime) {
    unsigned long stop = millis() + blockTime;

    int sV[2] = { drive[0].sensor->value, drive[1].sensor->value };
    int dV[2] = { 100, 100 };
    int p[2] = { drive[0].power, drive[1].power };

    unsigned long sT[2] = { millis(), millis() };
    unsigned long dT[2] = { 1, 1 };

    do {
        delay(10);

        for (int i = 0; i < 2; i++) {
            sensorRefresh(drive[i].sensor);
            dV[i] = abs(drive[i].sensor->value - sV[i]);
            dT[i] = millis() - sT[i];

            if (dV[i] / dT[i] > stallVel) {
                sV[i] = drive[i].sensor->value;
                sT[i] = millis();
            } else {
                p[i] = 0;
            }
        }

        driveSet(p[0], p[1]);

        if (millis() > stop) {
            return false;
        }
    } while (p[0] != 0 || p[1] != 0);

    return true;
} /* waitForDriveStall */

void resetDrive() {
    sensorReset(drive[0].sensor);
    sensorReset(drive[1].sensor);
} /* resetDrive */

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