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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, armLimit[2], line[3];

// Motors and servos
Motor claw, arm, mogo, drive[2];

// PID settings
PIDSettings armSettings = {
    DEFAULT_PID_SETTINGS,
    .kP      = -.7f,
    .kI      = -.22f,
    .kD      = -.08f,
    .root    = &arm,
    .target  = 10,

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};

PIDSettings clawSettings = {
    DEFAULT_PID_SETTINGS,
    .kP      = .245f,
    .kI      = .0f,
    .kD      = 2.3f,
    .root    = &claw,
    .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(arm.sensor->_mutex);

    mutexGive(claw._mutex);
    mutexGive(arm._mutex);
    mutexGive(arm.child->_mutex);
    mutexGive(mogo.child->_mutex);

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

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

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

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

void update() {
    motorUpdate(&claw);
    motorUpdate(&mogo);
    motorUpdate(&arm);

    sensorRefresh(arm.sensor);
    sensorRefresh(claw.sensor);
    sensorRefresh(mogo.sensor);

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

    for (size_t i = 0; i < 2; i++) {

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        motorUpdate(&drive[i]);
        sensorRefresh(drive[i].sensor);
        sensorRefresh(&armLimit[i]);
        sensorRefresh(&line[i]);
    }
} /* update */

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

    static unsigned long time = 0;
    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,
            arm.sensor->value,
            claw.sensor->value,
            drive[0].sensor->velocity,
            drive[1].sensor->velocity,
            arm.sensor->velocity,
            claw.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) {
    blockTime /= 2;

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

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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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