Работа победителя заключительного этапа

командной инженерной олимпиады школьников

Олимпиада Национальной технологической инициативы

Профиль «Водные робототехнические системы»

Русинович Андрей Сергеевич

Класс: 10

Город: г. Благовещенск

Школа: Лицей БГПУ

Регион: Амурская область

Уникальный номер участника: 255264

Команда на заключительном этапе: Underwater power

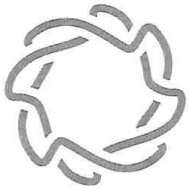
Параллель: 10-11

Результаты заключительного этапа:

Индивидуальная часть																	Командная часть				Результат
Физика				Информатика											Итого:	Макс. Балл					
1	2	3	4	1	2	3	4	5	6	7	8	9	10	11			1	2	3	Всего	
0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2	200	12	10	13	35	21,5

Индивидуальная часть

Персональный лист участника с номером 255264:



Олимпиада НТИ

ФИО Русинович Андрей Сергеевич

Город Благовещенск

Школа № Лицей БГПУ

Физика

Командная инженерная олимпиада «Олимпиада НТИ»

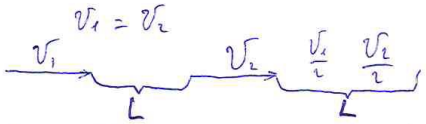
Направление ВРС

Предмет

Номер участника 255264

3.1. 1,6 Σ 1,6

1.1. $v_1 = v_2$



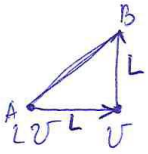
$L_1 = v_1 t$

$L_2 = L + v_2 t$

$L = v \cdot 2 \cdot t$, т.к. $v = \frac{1}{2} v_1 \Rightarrow L_2 = \frac{vt}{2} + v_2 t$

$L_{сос.} = \frac{\frac{vt}{2} + \frac{vt}{2}}{\frac{vt}{2}} = \frac{\frac{vt}{2}}{\frac{vt}{2}} + \frac{\frac{vt}{2}}{\frac{vt}{2}} = 1 + 1 \Rightarrow \frac{L}{2}$ Ответ: $\frac{L}{2}$ О

1.3.

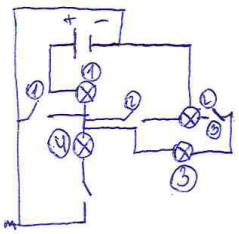


Я буду долго двигаться перпендикулярно по направлению движения второго. $\Rightarrow L_1 = L\sqrt{2} \Rightarrow t = \frac{L\sqrt{2}}{2v}$ О

4.1 $\frac{L_1}{L_2} = \frac{n_2}{n_1}$

$\frac{0,3}{L_2} = \frac{1}{1,33} \Rightarrow L_2 = 0,4$ м. Ответ: 0,4 м. О.

3.1.



0,8.

Командная часть

Результаты были получены в рамках выступления команды: Underwater power

Личный состав команды:

- Русинович Андрей Сергеевич
- Кривега Владислав Алексеевич

```
#include <murAPI.hpp>
#include <thread>

int detectCircle(cv::Mat &&img) {

    int count = 0;

    if (img.empty()) {
       return 0;
    }

    static cv::Mat image;
    static std::vector<std::vector<cv::Point> > contours;
    static std::vector<cv::Point> hull;
    image = img.clone();
    cv::Mat toDraw = img.clone();
    cv::cvtColor(image, image, CV_BGR2GRAY);
    cv::GaussianBlur(image, image, cv::Size(5, 5), 2);

    double cannyParams = cv::threshold(image, image, 0, 255,
CV_THRESH_BINARY_INV + CV_THRESH_OTSU);
    cv::Canny(image, image, cannyParams, cannyParams / 2.0F);
    cv::findContours(image, contours, CV_RETR_TREE, CV_CHAIN_APPROX_NONE);

    Object objectToRet;
    for (std::size_t i = 0; i < contours.size(); i++) {
        if (contours.at(i).size() < 5) {
            continue;
        }
        if (std::fabs(cv::contourArea(contours.at(i))) < 300.0) {
            continue;
        }
        cv::RotatedRect bEllipse = cv::fitEllipse(contours.at(i));
        cv::convexHull(contours.at(i), hull, true);
        cv::approxPolyDP(hull, hull, 15, true);
        if (!cv::isContourConvex(hull)) {
            continue;
        }

        double area = cv::contourArea(contours.at(i));
        cv::Rect r = cv::boundingRect(contours.at(i));
        double radius = r.width / 2.0;

        if (std::abs(1.0 - ((double) r.width / (double) r.height)) <= 0.2
&&
```

```
            std::abs(1.0 - (area / (CV_PI * std::pow(radius, 2.0)))) <=
0.2) {
                count++;
                cv::circle(toDraw, bEllipse.center, radius,
cv::Scalar(255, 255, i * 10), 3);
        }
        cv::waitKey(1);
    }
    return count - count / 2;
}

void keepYaw(double& yts) {
    double e = mur.getYaw() - yts;
    int kp = 2;
    mur.setPortA(15 - e * kp);
    mur.setPortB(15 + e * kp);
}

void keepDepth(double& dts) {
    double depth = mur.getInputAOne();
    mur.setPortC((dts - depth) * 10 * (-1));
}

void rotate_line(double& yts, bool& line) {
    if (!line) {
        for (auto obj : mur.getDetectedObjectsList(0)) {
            if (obj.type == Object::RECTANGLE) {
                if (obj.angle < 90) {
                    yts += obj.angle;
                } else {
                    yts -= std::fabs(90 - obj.angle);
                }
                mur.removeDetectorFromList(Object::RECTANGLE, 0);
                mur.add
                line = true;
            }
        }
    }
}


int main() {
    double yts = 0.0, dts = 120.0;
    bool line = false;
    mur.addDetectorToList(Object::RECTANGLE, 0);
    while (1) {
        keepYaw(yts);
        keepDepth(dts);
        rotate_line(yts, line);
        int cnt = 0;
        if (line) {
            for (auto obj : mur.getDetectedObjectsList(0)) {
                if (obj.type == Object::CIRCLE) {
                    cnt = detectCircle(mur.getCameraOneFrame());

                    }
                }
            }
        }
   }
   return 0;
```

```
}



#include <murAPI.hpp>
#include <thread>



Object red (cv:: Mat img) {
    cv::Scalar lower(0, 144, 42);
    cv::Scalar upper(13, 255, 249);
    cv::cvtColor(img, img, CV_BGR2HSV);
    cv::inRange(img, lower, upper, img);
    std::vector<std::vector<cv::Point>>contours;
    cv::findContours(img, contours, CV_RETR_TREE, CV_CHAIN_APPROX_NONE);
    Object objectToRet;

    for (std::size_t i = 0; i < contours.size(); i++) {
        if (contours.at(i).size() < 100) {
            continue;
        }
        if (std::fabs(cv::contourArea(contours.at(i))) < 300.0) {
            continue;
        }

        cv::RotatedRect bEllipse = cv::fitEllipse(contours.at(i));
        objectToRet.x = (int) bEllipse.center.x;
        objectToRet.y = (int) bEllipse.center.y;
        objectToRet.angle = bEllipse.angle;
        for (auto obj : mur.getDetectedObjectsList(0)) {
            if (obj.type == Object::CIRCLE) objectToRet.type =
Object::CIRCLE;
        }
        return objectToRet;
    }
    return objectToRet;
}

Object yellow (cv:: Mat img) {
    cv::Scalar lower(6, 135, 44);
    cv::Scalar upper(38, 255, 249);
    cv::cvtColor(img, img, CV_BGR2HSV);
    cv::inRange(img, lower, upper, img);
    std::vector<std::vector<cv::Point>>contours;
    cv::findContours(img, contours, CV_RETR_TREE, CV_CHAIN_APPROX_NONE);
    Object objectToRet;

    for (std::size_t i = 0; i < contours.size(); i++) {
        if (contours.at(i).size() < 100) {
            continue;
        }
        if (std::fabs(cv::contourArea(contours.at(i))) < 300.0) {
            continue;
        }

        cv::RotatedRect bEllipse = cv::fitEllipse(contours.at(i));
        objectToRet.x = (int) bEllipse.center.x;
        objectToRet.y = (int) bEllipse.center.y;
```

```
        objectToRet.angle = bEllipse.angle;
        for (auto obj : mur.getDetectedObjectsList(0)) {
            if (obj.type == Object::CIRCLE) objectToRet.type =
Object::CIRCLE;
        }
        return objectToRet;
    }
    return objectToRet;
}

Object green (cv:: Mat img) {
    cv::Scalar lower(50, 66, 5);
    cv::Scalar upper(110, 255, 210);
    cv::cvtColor(img, img, CV_BGR2HSV);
    cv::inRange(img, lower, upper, img);
    std::vector<std::vector<cv::Point>>contours;
    cv::findContours(img, contours, CV_RETR_TREE, CV_CHAIN_APPROX_NONE);
    Object objectToRet;

    for (std::size_t i = 0; i < contours.size(); i++) {
        if (contours.at(i).size() < 100) {
            continue;
        }
        if (std::fabs(cv::contourArea(contours.at(i))) < 300.0) {
            continue;
        }

        cv::RotatedRect bEllipse = cv::fitEllipse(contours.at(i));
        objectToRet.x = (int) bEllipse.center.x;
        objectToRet.y = (int) bEllipse.center.y;
        objectToRet.angle = bEllipse.angle;
        for (auto obj : mur.getDetectedObjectsList(0)) {
            if (obj.type == Object::CIRCLE) objectToRet.type =
Object::CIRCLE;
        }
        return objectToRet;
    }
    return objectToRet;
}

int detectCircle(cv::Mat &&img) {

    int count = 0;

    if (img.empty()) {
       return 0;
    }

    static cv::Mat image;
    static std::vector<std::vector<cv::Point> > contours;
    static std::vector<cv::Point> hull;
    image = img.clone();
    cv::Mat toDraw = img.clone();
    cv::cvtColor(image, image, CV_BGR2GRAY);
    cv::GaussianBlur(image, image, cv::Size(5, 5), 2);

    double cannyParams = cv::threshold(image, image, 0, 255,
CV_THRESH_BINARY_INV + CV_THRESH_OTSU);
    cv::Canny(image, image, cannyParams, cannyParams / 2.0F);
    cv::findContours(image, contours, CV_RETR_TREE, CV_CHAIN_APPROX_NONE);
```

```
    Object objectToRet;
    for (std::size_t i = 0; i < contours.size(); i++) {
        if (contours.at(i).size() < 5) {
            continue;
        }
        if (std::fabs(cv::contourArea(contours.at(i))) < 300.0) {
            continue;
        }
        cv::RotatedRect bEllipse = cv::fitEllipse(contours.at(i));
        cv::convexHull(contours.at(i), hull, true);
        cv::approxPolyDP(hull, hull, 15, true);
        if (!cv::isContourConvex(hull)) {
            continue;
        }

        double area = cv::contourArea(contours.at(i));
        cv::Rect r = cv::boundingRect(contours.at(i));
        double radius = r.width / 2.0;

        if (std::abs(1.0 - ((double) r.width / (double) r.height)) <= 0.2
&&
            std::abs(1.0 - (area / (CV_PI * std::pow(radius, 2.0)))) <=
0.2) {
                count++;
                cv::circle(toDraw, bEllipse.center, radius,
cv::Scalar(255, 255, i * 10), 3);
        }
        cv::waitKey(1);
    }
    return count - count / 2;
}

void keepYaw(double& yts, bool& circ) {
    if (!circ) {
        double e = mur.getYaw() - yts;
        int kp = 2;
        double powerA = 15 - e * kp, powerB = 15 + e * kp;
        mur.setPortA(powerA);
        mur.setPortB(powerB);
    }
}

void keepDepth(double& dts, bool& circ) {
    if (!circ) {
        double depth = mur.getInputAOne();
        mur.setPortC((dts - depth) * 10 * (-1));
    }
}

void rotate_line(double& yts, bool& line, bool& circl) {
    if (!line) {
        for (auto obj : mur.getDetectedObjectsList(0)) {
            if (obj.type == Object::RECTANGLE) {
                if (obj.angle < 90) {
                    yts += obj.angle;
                } else {
                    yts -= std::fabs(90 - obj.angle);
                }
                mur.removeDetectorFromList(Object::RECTANGLE, 0);
                mur.addDetectorToList(Object::CIRCLE, 0);
                circl = true;
```

```
                line = true;
            }
        }
    }
}


int main() {
    double yts = 0.0, dts = 135.0;
    bool line = false, circ = false, cnt1 = true, cnt2 = true, cnt3 =
true,circl = false, to180 = false;
    mur.addDetectorToList(Object::RECTANGLE, 0);
    while (1) {
        keepYaw(yts, circ);
        keepDepth(dts, circ);
        rotate_line(yts, line, circl);
        if (circl) {
          Object obj1 = green(mur.getCameraOneFrame());
            if (obj1.type == Object::CIRCLE) {
                if (cnt1) {
                    circ = true;
                    mur.setPortA(0);
                    mur.setPortB(0);
                    mur.setPortC(-70);
                    sleepFor(5000);
                    circ = false;
                    cnt1 = false;
                }
            }
          Object obj2 = yellow(mur.getCameraOneFrame());
                if (obj2.type == Object::CIRCLE) {
                    if (cnt2) {
                        circ = true;
                        mur.setPortA(0);
                        mur.setPortB(0);
                        mur.setPortC(-70);
                        sleepFor(5000);
                        circ = false;
                        cnt2 = false;
                    }
                }
          Object obj3 = red(mur.getCameraOneFrame());
                if (obj3.type == Object::CIRCLE) {
                    if (cnt3) {
                        circ = true;
                        mur.setPortA(0);
                        mur.setPortB(0);
                        mur.setPortC(-70);
                        sleepFor(5000);
                        circ = false;
                        cnt3 = false;
                        to180 = true;
                        circl = false;
                    }

                }
        }
        if (to180) {
            circ = true;
            float yaw = mur.getYaw();
            float dpth = mur.getInputAOne();
```

```
            float yts = , dts = 100;
            if (yaw > yts) {
                mur.setPortA(0);
                mur.setPortB(30);
            }
            if (yaw < yts) {
                mur.setPortB(30);
                mur.setPortB(0);
            }
            mur.setPortC((dts - dpth) * 10 * (-1));
        }

    }
   return 0;
}



#include <murAPI.hpp>
#include <thread>

Object yellow (cv:: Mat img) {
    cv::Scalar lower(23, 113, 166);
    cv::Scalar upper(33, 153, 252);
    cv::cvtColor(img, img, CV_BGR2HSV);
    cv::inRange(img, lower, upper, img);
    std::vector<std::vector<cv::Point>>contours;
    cv::findContours(img, contours, CV_RETR_TREE, CV_CHAIN_APPROX_NONE);
    Object objectToRet;

    for (std::size_t i = 0; i < contours.size(); i++) {
        if (contours.at(i).size() < 20) {
            continue;
        }
        if (std::fabs(cv::contourArea(contours.at(i))) < 200.0) {
            continue;
        }

        cv::RotatedRect bEllipse = cv::fitEllipse(contours.at(i));
        objectToRet.x = (int) bEllipse.center.x;
        objectToRet.y = (int) bEllipse.center.y;
        objectToRet.angle = bEllipse.angle;
        for (auto obj : mur.getDetectedObjectsList(0)) {
            if (obj.type == Object::CIRCLE) objectToRet.type =
Object::CIRCLE;
        }
        return objectToRet;
    }
    return objectToRet;
}

Object red (cv:: Mat img) {
    cv::Scalar lower(0, 122, 80);
    cv::Scalar upper(185, 199, 166);
    cv::cvtColor(img, img, CV_BGR2HSV);
    cv::inRange(img, lower, upper, img);
    std::vector<std::vector<cv::Point>>contours;
    cv::findContours(img, contours, CV_RETR_TREE, CV_CHAIN_APPROX_NONE);
    Object objectToRet;

    for (std::size_t i = 0; i < contours.size(); i++) {
```

```
        if (contours.at(i).size() < 10) {
            continue;
        }
        if (std::fabs(cv::contourArea(contours.at(i))) < 100.0) {
            continue;
        }

        cv::RotatedRect bEllipse = cv::fitEllipse(contours.at(i));
        objectToRet.x = (int) bEllipse.center.x;
        objectToRet.y = (int) bEllipse.center.y;
        objectToRet.angle = bEllipse.angle;
        for (auto obj : mur.getDetectedObjectsList(0)) {
            if (obj.type == Object::CIRCLE) objectToRet.type =
Object::CIRCLE;
        }
        return objectToRet;
    }
    return objectToRet;
}

Object green (cv:: Mat img) {
    cv::Scalar lower(34, 174, 114);
    cv::Scalar upper(70, 255, 189);
    cv::cvtColor(img, img, CV_BGR2HSV);
    cv::inRange(img, lower, upper, img);
    std::vector<std::vector<cv::Point>>contours;
    cv::findContours(img, contours, CV_RETR_TREE, CV_CHAIN_APPROX_NONE);
    Object objectToRet;

    for (std::size_t i = 0; i < contours.size(); i++) {
        if (contours.at(i).size() < 10) {
            continue;
        }
        if (std::fabs(cv::contourArea(contours.at(i))) < 100.0) {
            continue;
        }

        cv::RotatedRect bEllipse = cv::fitEllipse(contours.at(i));
        objectToRet.x = (int) bEllipse.center.x;
        objectToRet.y = (int) bEllipse.center.y;
        objectToRet.angle = bEllipse.angle;
        for (auto obj : mur.getDetectedObjectsList(0)) {
            if (obj.type == Object::CIRCLE) objectToRet.type =
Object::CIRCLE;
        }
        return objectToRet;
    }
    return objectToRet;
}

int main() {

    mur.initCamera(0);
    mur.addDetectorToList(Object :: CIRCLE, 0);

    int i = 0, cur = 0;
    int first = mur.getInputAOne() / 10, second = (int)mur.getInputAOne()
% 10, third = mur.getInputATwo() / 10;
    std::vector <int> cor = {1, 2, 3};
```

```
    bool circ = true, circle = true, circ_find_green = true, circ_find_red
= true, circ_find_yellow = true;
    const int toSet = 50;
    const int kP = 7;
    int powerB = -40, powerA = -55;

    while (1) {
        int depth = mur.getInputBOne();
        int power = (depth - toSet) * kP * (-1);
        float yaw = mur.getYaw();
        float yts = yaw - 180;
        if (circ) {
            if (yts > 0) {
                mur.setPortA(0);
                mur.setPortB(powerB);
            }
            if (yts < 0) {
               mur.setPortA(powerA);
               mur.setPortB(0);
            }
            mur.setPortC(power);
        }

        if (circle) {
           Object obj1 = green(mur.getCameraOneFrame());
           Object obj2 = yellow(mur.getCameraOneFrame());
           Object obj3 = red(mur.getCameraOneFrame());

           if(circ_find_green) {
               if (obj1.type == Object :: CIRCLE) {
                   cur++;
                   circ_find_red = true;
                   circ_find_yellow = true;
                   circ_find_green = false;

                }
           }

           if (circ_find_yellow) {
               if (obj2.type == Object::CIRCLE) {
                    cur++;
                    circ_find_red = true;
                    circ_find_green = true;
                    circ_find_yellow = false;
               }
           }

           if (circ_find_red) {
               if (obj3.type == Object::CIRCLE) {
                    cur++;
                    circ_find_green = true;
                    circ_find_yellow = true;
                    circ_find_red = false;
               }
           }

               if (cur == cor[i]) {
                   circ = false;
                   mur.setPortA(0);
                   mur.setPortB(0);
                   mur.setPortC(70);
```

```
                    sleepFor(12000);
                    i++;
                    circ = true;
                    if (cur > cor[i]) {
                        powerA *= -1;
                        powerB *= -1;
                    }
                    if (cur < cor[i]) {
                        powerB = -40;
                        powerA = -55;
                    }
                    if (cur == 3) cur = 1;
                }

        }
    }
}



#include <murAPI.hpp>
#include <thread>

int main() {

    int power = -40;

    mur.setPortC(70);
    sleepFor(3000);

    mur.setPortC(-70);
    sleepFor(3000);

    mur.setPortC(0);

    Timer time;
    time.start();

    while (1) {

        float yaw = mur.getYaw() - 180;

        if (time.elapsed() < 24000) {

            if (yaw < 0.0) {
                mur.setPortA(power);
                mur.setPortB(0);
            }

            if (yaw > 0.0) {
                mur.setPortA(0);
                mur.setPortB(power);
            }
        }

        if (time.elapsed() > 24000 && time.elapsed() < 26000) {
            mur.setPortA(50);
            mur.setPortB(52);
        }

        if (time.elapsed() > 26000) {
```

```
                mur.setPortA(-50);
                mur.setPortB(50);
                sleepFor(5000);

                mur.setPortA(50);
                mur.setPortB(-50);
                sleepFor(5200);

                mur.setPortA(0);
                mur.setPortB(0);
                sleepFor(100000);

            }
        }
        return 0;
}
```