```
#include <iostream>
#include <opencv2/opencv.hpp>

using namespace std;
using namespace cv;

void on_trackbar(int, void*) {}

void onMouse(int event, int x, int y, int flags, void* param)
{
    switch (event)
    {
    case EVENT_LBUTTONDOWN:
        cout << "마우스 왼쪽버튼 누르기" << endl;
        break;
    case EVENT_RBUTTONDOWN:
        cout << "마우스 오른쪽 버튼 누르기" << endl;
        break;
    case EVENT_RBUTTONUP:
        cout << "마우스 오른쪽 버튼 떼기" << endl;
        break;
    case EVENT_LBUTTONDBLCLK:
        cout << "마우스 왼쪽버튼 더블클릭" << endl;
        break;
    }
}

void onMouse2(int event, int x, int y, int flags, void* param)
{
    if (event == EVENT_LBUTTONDOWN) {
        Mat& img = *(Mat*)(param);
        circle(img, Point(x, y), 200, Scalar(0, 255, 0), 10);
        putText(img, "I found a dog!", Point(x, y + 200),
            FONT_HERSHEY_PLAIN, 2.0, 255, 2);
        imshow("src", img); // 영상이 변경되면 다시 표시한다.
    }
    else if (event == EVENT_RBUTTONDOWN) {}
    else if (event == EVENT_MBUTTONDOWN) {}
    else if (event == EVENT_MOUSEMOVE) {
    }
}

Mat img;
int red, green, blue;
```

```
int drawing = false;
void drawCircle(int event, int x, int y, int, void* param) {
    if (event == CV_EVENT_LBUTTONDOWN)
        drawing = true;
    else if (event == CV_EVENT_MOUSEMOVE) {
        if (drawing == true)
            circle(img, Point(x, y), 3, Scalar(0, 0, 255), 10);
    }
    else if (event == CV_EVENT_LBUTTONUP)
        drawing = false;
    imshow("Image", img);
}

void drawCircle2(int event, int x, int y, int, void* param) {
    if (event == CV_EVENT_LBUTTONDOWN)
        drawing = true;
    else if (event == CV_EVENT_MOUSEMOVE) {
        if (drawing == true)
            circle(img, Point(x, y), 3, Scalar(blue, green, red), 10);
    }
    else if (event == CV_EVENT_LBUTTONUP)
        drawing = false;
    imshow("img", img);
}

string title = "트랙바 이벤트";
Mat image;
void onChange(int value, void* userdata)
{
    int add_value = value - 130;
    cout << "추가 화소값 " << add_value << endl;

    Mat tmp = image + add_value;
    imshow(title, tmp);
}

void page4()
{
    Mat image1(300, 400, CV_8U, Scalar(255));
    Mat image2(300, 400, CV_8U, Scalar(100));

    string title1 = "white 창 제어";
    string title2 = "gray 창 제어";
```

```
    namedWindow(title1, WINDOW_AUTOSIZE);
    namedWindow(title2, WINDOW_NORMAL);

    moveWindow(title1, 100, 200);
    moveWindow(title2, 300, 200);

    imshow(title1, image1);
    imshow(title2, image2);

    waitKey();
    destroyAllWindows();
}

void Page6()
{
    Mat image(300, 400, CV_8U, Scalar(255));
    string title1 = "창 크기변경1 - AUTOSIZE";
    string title2 = "창 크기변경2 - NORMAL";

    namedWindow(title1, WINDOW_AUTOSIZE);
    namedWindow(title2, WINDOW_NORMAL);
    resizeWindow(title1, 500, 200);
    resizeWindow(title2, 500, 200);

    imshow(title1, image);
    imshow(title2, image);
    waitKey();
}

void Page9()
{
    Mat image(200, 300, CV_8U, Scalar(255));
    namedWindow("키보드 이벤트", WINDOW_AUTOSIZE);
    imshow("키보드 이벤트", image);

    while (1)
    {
        int key = waitKey(100);
        if (key == 27) break;

        switch (key)
        {
        case 'a': cout << "a키 입력" << endl; break;
        case 'b': cout << "b키 입력" << endl; break;
```

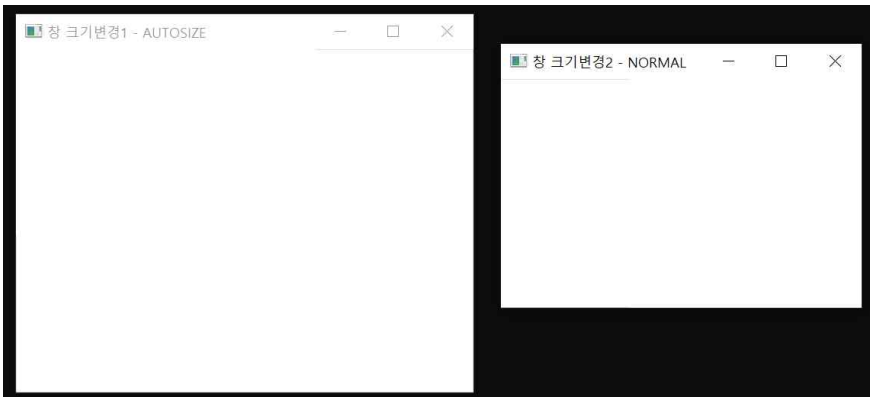
```
            case 0x41: cout << "A키 입력" << endl; break;
            case 66: cout << "B키 입력" << endl; break;

            case 0x250000: cout << "왼쪽 화살표 키 입력" << endl; break;
            case 0x260000: cout << "윗쪽 화살표 키 입력" << endl; break;
            case 0x270000: cout << "오른쪽 화살표 키 입력" << endl; break;
            case 0x280000: cout << "아래쪽 화살표 키 입력" << endl; break;
            }
    }
}

void Page12()
{
    Mat img;
    img = imread("dog.jpg", IMREAD_COLOR);
    if (img.empty()) { cout << "영상을 읽을 수 없음" << endl; }

    imshow("img", img);
    int x = 300;
    int y = 300;

    while (1) {
        int key = waitKey(100);
        if (key == 'q') break;
        else if (key == 'a')
            x -= 10;
        else if (key == 'w')
            y -= 10;
        else if (key == 'd')
            x += 10;
        else if (key == 's')
            y += 10;

        circle(img, Point(x, y), 200, Scalar(0, 255, 0), 5);
        imshow("img", img);
    }

}

void Page15()
{
    Mat src = imread("photo1.jpg", IMREAD_COLOR);
    if (src.empty()) { cout << "영상을 읽을 수 없음" << endl; }
```

```
    imshow("src", src);

    while (1) {
        int key = waitKeyEx(); // 사용자로부터 키를 기다린다.
        cout << key << " ";
        if (key == 'q') break; // 사용자가 'q'를 누르면 종료한다.
        else if (key == 2424832) { // 왼쪽화살표 키
            src -= 50;// 영상이 어두워진다.
        }
        else if (key == 2555904) { // 오른쪽화살표 키
            src += 50; // 영상이 밝아진다.
        }
        imshow("src", src); // 영상이 변경되었으므로 다시 표시한다.
    }
}

void Page19()
{
    Mat image(200, 300, CV_8U);
    image.setTo(255);
    imshow("마우스 이벤트1", image);
    imshow("마우스 이벤트2", image);

    setMouseCallback("마우스 이벤트1", onMouse, 0);
    waitKey(0);
}

void Page24()
{
    Mat src = imread("dog.jpg", IMREAD_COLOR);
    if (src.empty()) { cout << "영상을 읽을 수 없음" << endl; }
    imshow("src", src);
    setMouseCallback("src", onMouse2, &src);
    waitKey(0);
}

int Page27()
{
    img = imread("bug.jpg");
    if (img.empty()) { cout << "영상을 읽을 수 없음" << endl; return -1; }
    imshow("Image", img);
    setMouseCallback("Image", drawCircle);
    waitKey(0);
    imwrite("bug1.jpg", img);
```

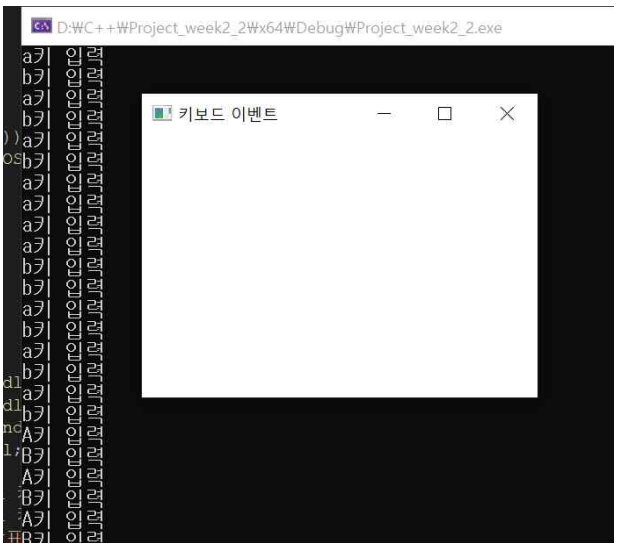
```
    return 0;
}

void Page30()
{
    int value = 128;
    image = Mat(300, 400, CV_8UC1, Scalar(120));

    namedWindow(title, WINDOW_AUTOSIZE);
    createTrackbar("밝기값", title, &value, 255, onChange);

    imshow(title, image);
    waitKey(0);
}

void Page34()
{
    img = imread("bug.jpg");
    if (img.empty()) { cout << "영상을 읽을 수 없음" << endl; }
    namedWindow("img", 1);
    imshow("img", img);
    setMouseCallback("img", drawCircle2);
    createTrackbar("R", "img", &red, 255, on_trackbar);
    createTrackbar("G", "img", &green, 255, on_trackbar);
    createTrackbar("B", "img", &blue, 255, on_trackbar);
    waitKey(0);
}

int main()
{
        page4();
    Page6();
    Page9();
    Page12();
    Page15();
    Page19();
    Page24();
    Page27();
    Page30();
    Page34();

        return 0;
}
```

page4 결과화면

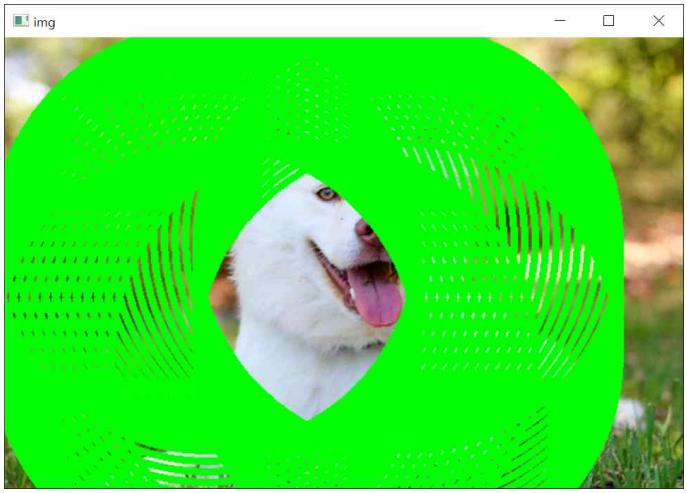
page6 결과화면



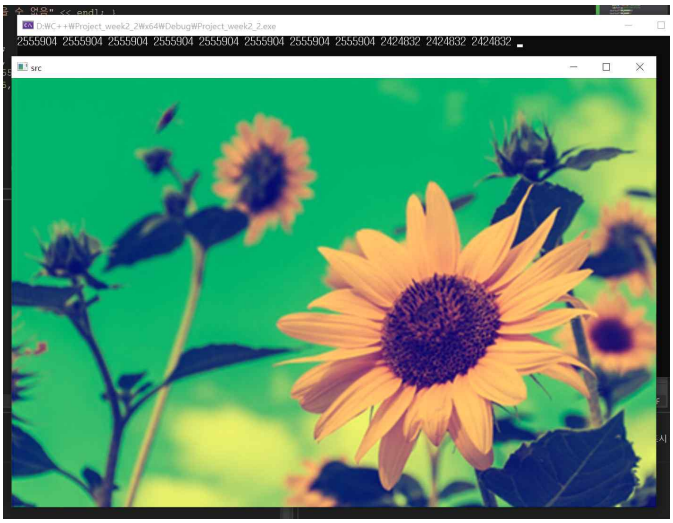
page9 결과화면



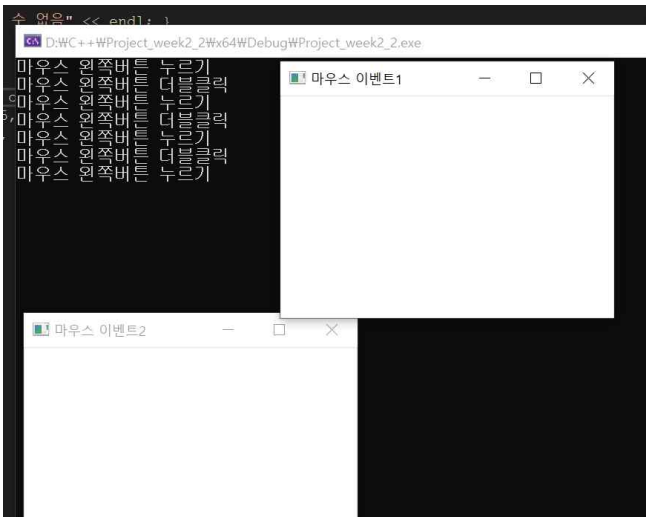
page12 결과화면



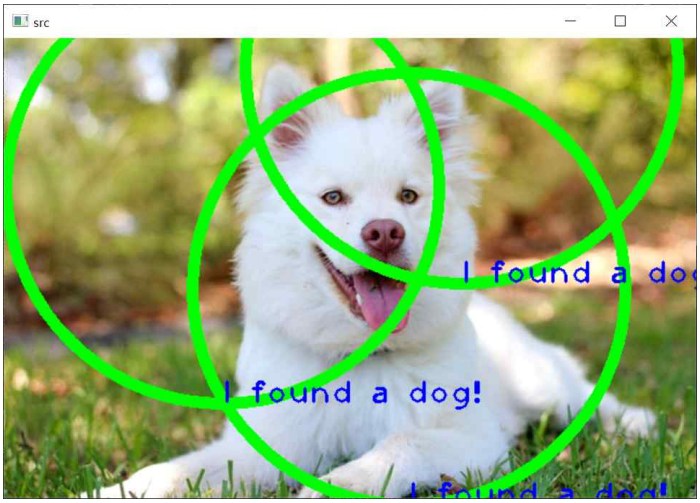
page15 결과화면



page19 결과화면

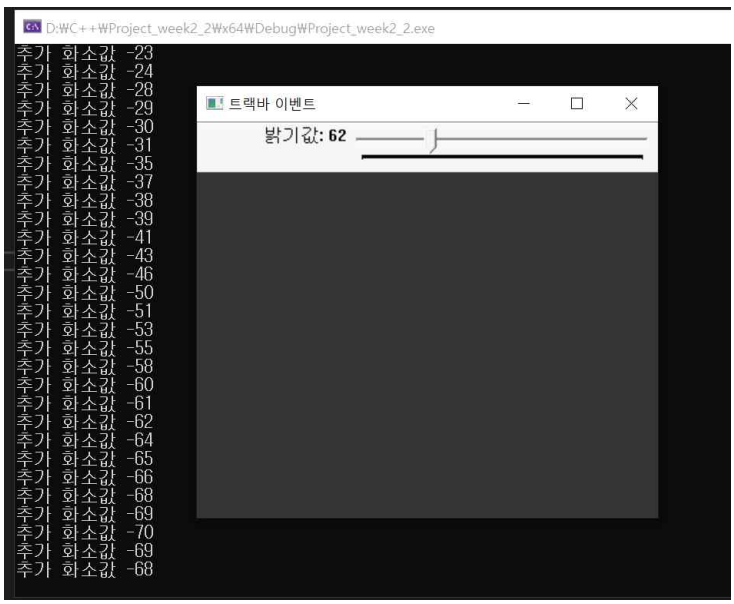


page24 결과화면



page27 결과화면

page30 결과화면



page34 결과화면