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Review Paper on Visual Control of Unmanned Aerial Vehicle for Handling Disaster Management Issue

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Abstract-In order to get the information of any vehicle which is travelling on the way we required to rely on Global Positioning System. The GPS provides the Global Positioning Information of vehicle, which relies on external source called satellites. But the satellite signal may get cut or have small signal strength in cluttered areas or is less reliable at low altitude areas. So I think of to use the Unmanned Aerial Vehicle, not only this by attaching the Rispberry pi which is a credit size single cheap computer in order to classify the object that we want. It is a multifunctional UAV which will monitor and classify the object along with it also perform the explosive detection. It plays a great role in disaster occurred areas in order to detect the human beings or finding the objects. It also plays a role in detecting the explosive material in a cluttered area. In a flooded area in order to monitor or detect the humans it is easy for UAV to move above the surface of the ground and water. And provides the detection as well as live streaming of the particular area and images can be captured by it. It has a sensor IED in order to detect the explosive material. It can provide the full image of the object by moving around the object. It is operated by remote control. At the transmitting side you can see the live streaming and images of the area on the display. You can also able to see the detected sign indicating object with a particular object.

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I. INTRODUCTION

An unmanned aircraft system is just that – a system. It must always be considered as such. The system Comprises a number of sub-systems which include the aircraft (often referred to as a UAV or unmanned air vehicle), its payloads, the control station(s) (and, often, other remote stations), aircraft launch and recovery sub-systems where applicable, support sub-systems, communication sub-systems, transport sub-systems, etc. It must also be considered as part of a local or global air transport/aviation environment with its rules, regulations and disciplines.

UAS usually have the same elements as systems based upon manned aircraft, but with the airborne element, i.e. the aircraft being designed from its conception to be operated without an aircrew aboard. The aircrew (as a sub-system), with its interfaces with the aircraft controls and its habitation is replaced by an electronic intelligence and control subsystem.

The other elements, i.e. launch, landing, recovery, communication, support, etc. have their equivalents in both manned and unmanned systems. Unmanned aircraft must not be confused with model aircraft or with ‘drones’, as is often done by the media. A radio-controlled model aircraft is used only for sport and must remain within sight of the operator. The operator is usually limited to instructing the aircraft to climb or descend and to turn to the left or to the right. A drone aircraft will be required to fly out of sight of the operator, but has zero intelligence, merely being launched into a pre-programmed mission on a pre-programmed course and a return to base. It does not communicate and the results of the mission, e.g. photographs, are usually not obtained from it untilit is recovered at base.

A UAV, on the other hand, will have some greater or lesser degree of ‘automatic intelligence’.It will be able to communicate with its controller and to return payload data such as electro-optic or thermal TV images, together with its primary state information – position, airspeed, heading and altitude. It will also transmit information as to its condition, which is often referred to as ‘housekeeping data’, covering aspects such as the amount of fuel it has, temperatures of components, e.g. engines or electronics. If a fault occurs in any of the sub-systems or components, the UAV may be designed automatically to take corrective action and/or alert its operator to the event. In the event,
for example, that the radio communication between the operator and the UAV is broken, then the UAV may be programmed to search for the radio beam and re-establish contact or to switch to a different radio frequency band if the radio-link is duplexed.

A more ‘intelligent’ UAV may have further programmed which enable it to respond in an ‘if that happens, do this’ manner. For some systems, attempts are being made to implement on-board decision-making capability using artificial intelligence in order to provide it with an autonomy of operation, as distinct from automatic decision making. The definition of UAS also excludes missiles (ballistic or homing). The development and operation of UAS has rapidly expanded as a technology in the last 30 years and, as with many new technologies, the terminology used has changed frequently during that period. The initials RPV (remotely piloted vehicle) were originally used for unmanned aircraft, but with the appearance of systems deploying land-based or underwater vehicles, other acronyms or initials have been adopted to clarify the reference to *airborne* vehicle systems. These have, in the past, included UMA (unmanned air vehicle), but the initials UAV (unmanned aerial vehicle) are now generally used to denote the aircraft element of the UAS. However, UAV is sometimes interpreted as 'uninhabited air vehicle' in order to reflect the situation that the overall system is 'manned' in so far as it is not overall exclusively autonomous, but is commanded by a human somewhere in the chain. 'Uninhabited air vehicle' is also seen to be more politically correct! More recently the term UAS (unmanned aircraft system) has been introduced. All of the terms: air vehicle; UAV; UAV systems and UAS will be seen in this volume, as appropriate, since these were the terms in use during its preparation.

The earlier system were used for Military Application and the system was too big and were operated with a base station which require a large setup. The earlier system used were only used for viewing the live picture. It was not able to detect the particular object if required.

The system I am going to design is small in size and operated with remote control and Autonomously that means it work in auto mode in order to detect the object. I am going to detect the object with the help of Rispberry pi depending upon the motion that is motion detection object recognition. I am also making it to detect the explosive material with the help of IED sensor as per the availability of sensor. I am making the UAV able to used in the Disaster Management in order to detect the object. It also have functionality to follow a particular object continuously with given Instruction.

II. LITREATURE REVIEW

UAVs have been in production since before the Wright Brothers first took their historic flight. The earliest account can be traced back to the American Civil War, when an inventor patented an unmanned balloon that carried explosives that could be dropped after a time-delay fuse mechanism triggered a basket to overturn its contents [2]. While this is a relatively primitive idea of what the world has come to know today as "drones" it goes to show how early man began thinking about unmanned aerial systems. This technology began taking small leaps in the years following the American Civil War - the first military aerial reconnaissance photos were taken in 1898 during the Spanish-American War via a camera attached to a kite [2]. As the trend shows, many of the advancements in this technology arose during times of war, whether it was used to help with an offensive strike or just to acquire intelligence on enemy locations and activities. This is seen throughout the history and progress of unmanned aerial technologies. Advancements took place in Britain during the 1930s, where a radio-controlled UAV (dubbed the Queen Bee) served as aerial target practice for British pilots, and also during World War II, during which 10 time the Nazi's developed an unmanned flying bomber known as the V-1 [2]. It wasn't until the 1970s that Israel developed the Scout and the Pioneer, which started the development toward the more widely known glider-type UAVs [2]. It was from this design that the Predator drone came to be; the Predator is the most sophisticated UAV in existence to date, these drones have come a long way from the "balloons" of the past. It's autonomous control networks show just how much this technology has evolved.

The structural design of UAVs has changed over their developmental history in order to serve a variety of purposes. UAV design and advancement is a global activity. As technology and needs change, UAVs can be improved to serve these needs. There are several design considerations that are constant.

The first of these design criteria is the degree of autonomy. Early UAV designs were mostly set to fly a specified path until they ran out of fuel. They carried a camera onboard, which would be recovered after the UAV landed. Later, the advent of radio control systems allowed UAVs to be piloted from the ground. Modern UAVs often combine these two basic functionalities. These two modes of operation do not strictly signify autonomy. True autonomy suggests the ability of the aircraft to operate without human interaction. In this regard, UAVs are still very immature. UAV autonomy technology is divided into the following categories:

- **Sensor fusion**: On board the vehicle a combination of sensors are used.
- **Communications**: Communication and coordination will be handled between multiple sources in the existence of curtailed and imperfect information.
- **Motion planning (also called Path planning)**: Determining the optimal path for the vehicle in accordance with specific objectives and constraints such as obstacles go.
- **Trajectory Generation**: Designed for optimal control and maneuverability to follow a particular route or to go from one place to another.
- **Task Allocation and Scheduling**: Set the optimal distribution of tasks between a group of agents, with time constraints and equipment limitations.
- **Cooperative Tactics**: The optimal sequence and spatial distribution of activities between agents in order to make the most of the chances of success in any case or situation. [3]

The ultimate goal of UAVs is to replace human pilots altogether. Another major design criterion is UAV endurance (range). Since there is no human pilot onboard, there is no concern for pilot fatigue. UAVs can be designed to maximize flight times to take advantage of this fact. Different systems can afford a wide variety of maximum range. Internal combustion engines require relatively frequent refueling and in-flight refueling is a major obstacle for this type of propulsion system. Photovoltaic UAVs offer the potential for unlimited range and there is much research in this field. One more type of fuel system is hydrogen, which is proposed for use with certain models of stratospheric persistent UAVs. The Aero Vironment's Global Observer is one such UAV. This aircraft runs on hydrogen and has a range of 7 days. The idea is for two of such UAVs to be used in tandem to provide continuous, uninterrupted operation 365 days a year. [5]

With the sophistication that these systems have arrived at, the market for them has grown astronomically. While the United States still has the largest stockpile of unmanned aircraft, the rest of the world is beginning to follow suit. More than 50 countries have purchased surveillance drones, and many have started in-country development programs for armed versions [4]. More than two-dozen different models were shown at a recent aviation show in China [4]. Due to the changing landscape of the theater of war, many nations are leaning toward unmanned aircraft to handle delicate situations in which human lives need not be put at risk. Also, taking into account the fact that drones sell for a fraction of the cost of manned airplanes, the amount of UAVs a nation can purchase at once has enticed many nations into entering the drone zone.

In general, UAVs fall into one of six functional categories:

- **Target and Decoy:** simulating enemy missiles or aircraft for ground and air gunnery
- **Reconnaissance:** battlefield intelligence gathering
- **Logistics:** cargo and logistics application
- **Research and Development:** used for UAV technology development
- **Civil and Commercial:** specifically designed for civil and commercial applications [6]
- **Competition details:** The basis of the competition is a reconnaissance mission for the US Marines for specified target accusation as well as added fight directions mid-flight. The story is that an island has had storms and pirates have invaded the island. The UAV is to stay within a specified area and transmit the images back to base as well as locations for desired targets. [7]

Students are judged on how well the UAV performs the desired task and top teams receive prize money. The competition requires a submittal of a final journal paper, oral presentation, and demonstration of UAV capabilities. At the start of the competition a statement of work will be provided and it is the team's job to figure out the best system design and development to complete the task. [7]

A fact sheet will be needed by committee to review prior to competition of each plane to verify qualifications for the competition. Also well as the journal paper describing in detail each aspect of the plane with a detailed description of functions. The oral presentation is not an overview of the journal paper but rather a briefing of the plane and safety checks, Static checks, and testing development descriptions. Afterwards there will be a preflight brief done by safety inspectors. [7]

The flight demonstration will consist of taking off and landing in specified landing/takeoff zones as well as autonomous flight within given flight path, guided by GPS being able to stay out of no-fly zones. Targets should be recognized along this path and will be different geometric shapes, of different color and size. This mission should be able to be completed within 40 minutes and will receive extra points for any saved time down to 20 minutes. [7]

The requirements and parameters of the plane are a few to insure the safety of the competitors. The gross weight should not exceed 55 pounds. GPS location and flight height must be transmitted to judges at all times to ensure that plane is not in a no fly zone or altitude. There must be a manual override by the safety pilot in case of emergencies. The plane should have a return home activation if loss of signal for more than 30 seconds as well as being able to be activated by an operator. If signal is lost for more than 3 minutes a terminate flight system should be activated automatically by the plane as well should be able to be activated by the operator. The speed of 16 the plane should not exceed 100 KIAS. Batteries and plane should have some bright colors in the case of a crash the materials can be found easily. [7]

III SYSTEM CONCEPT

A INTRODUCTION TO SYSTEM

The present system which I am developing is for disaster monitoring with a camera mounted on it which is operated through the Rispberry pi. Through this system I can detect the particular object. I am also providing a sensor in order to detect the explosive material called IED sensor. Depending on the availability of the IED sensor will be mounted on the UAV. In order to get the information of any vehicle which is travelling on the way we required to rely on Global Positioning System. The GPS provides the Global Positioning Information of vehicle, which relies on external source called satellites. But the satellite signal may get cut or have small signal strength in cluttered areas or is less reliable at low altitude areas. So I think of to use the Unmanned Aerial Vehicle, not only this by attaching the Rispberry pi which is a credit size single cheap computer in order to classify the object that we want.

It is a multifunctional UAV which will monitor and classify the object along with it also perform the explosive detection. It plays a great role in disaster occurred areas in order to detect the human beings or finding the objects. It also plays a role in detecting the explosive material in a cluttered area. In a flooded area in order to monitor or detect the humans it is easy for UAV to move above the surface of the ground and water. And provides the detection as well as live streaming of the particular area and images can be captured by it. It has a sensor IED in order to detect the explosive material. It can provide the full image of the object by moving around the object. It is operated by remote control. At the transmitting side you can see the live streaming and images of the area on the display. You can also able to see the detected object with a sign indicating particular object.

B TYPES OF UAV FRAME

1) Tricopter:

Fig.1 Tricopter

Description

A UAV which has three arms as shown in Fig. 1, each connected to one motor. The front of the UAV tends to be between two of the arms (Y3). The angle between the arms can vary, but tends to be 120 degrees. In order to move, the rear motor normally needs to be able to rotate (using a normal RC servo motor) in order to counteract the gyroscopic effect of an uneven number of rotors, as well as to change the yaw angle. A Y4 is slightly different in that it uses two motors mounted on the rear arm, which takes care of any gyroscopic effects – no servo is therefore needed.

Advantages

Different “look” for a UAV. Flies more like an airplane in forward motion. Price is theoretically lowest among those described here since it uses the fewest number of brushless motor (and ESC).

Disadvantages

Since the copter is not symmetric, the design uses a normal RC servo to rotate the rear motor and as such, the design is less straightforward than many other multi-rotors. The rear arm is more complex since a servo needs to be mounted along the axis. Most, though not all flight controllers support this configuration.

2)Quadcopter:

Fig. 2 Quadcopter

Description

A “quadcopter” drone which has four arms as shown in Fig. 2, each connected to one motor. The front of the UAV tends to be between two arms (x configuration), but can also be along an arm (+ configuration).

Advantage

Most popular multi-rotor design, simplest construction and quite versatile. In the standard configuration, the arms / motors are symmetric about two axes. All flight controllers on the market can work with this multirotor design.

Disadvantages

There is no redundancy, so if there is a failure anywhere in the system, especially a motor or propeller, the craft is likely going to crash.

3)Y6 Hexacopter:

Fig. 3 Y6 Hexacopter

Description

A Y6 design is a type of hexacopter but rather than six arms, it has three support arms, with a motor connected to either side of the arm (for a total of six motors) as shown in Fig. 3. Note that the propellers mounted to the underside still project the thrust downward.

Advantages

A Y6 design actually eliminates a support arm (as compared to a quadcopter), for a total of three. This means the copter can lift more payload as compared to a quadcopter, with fewer components than a normal hexacopter. A Y6 does not have the same issue as a Y3 as it eliminates the gyro effect using counter-rotating propellers. Also, should a motor fail, there is still a chance the copter can land rather than crash.

Disadvantages

This uses additional parts, so compared to a quadcopter which uses the same components, the equivalent hexacopter would be more expensive. Additional motors and parts add weight to the copter, so in order to get the same flight time as a quadcopter, the battery needs to be larger (higher capacity) as well. The thrust obtained in a Y6 as opposed to normal hexacopter is slightly lower (based on experience), likely because the thrust from the top propeller is affected by the lower propeller. Not all flight controllers support this configuration.

Plan for Emergencies-

Most emergencies result in the UAV crashing, and most crashes occur when you're just getting started in the field and/or with a new UAV. The list below is intended to give you things to think about and some ideas as to how to react and why for new pilots. This is case by case and in some situations the opposite of what is suggested here may be appropriate, so know yourself, know your environment and be safe! In almost all cases, it's better to lose the UAV than risk hitting people or property.

- UAV is very far away and you don't know which way the UAV is facing.
    - Throttle down and see if the UAV responds (testing to see if you still have communication).
    - If the UAV responds to the throttle, try landing right there (if you can).
    - If the spot is not good for a landing, gently try pitching the UAV forward (nothing drastic) and if the UAV responds based on yourviewpoint by moving left or right in the sky; this will help you determine its orientation. If it does not seem to go left or right, it may be moving towards or away from you, so undo what you just did and try yawing left.
- UAVsuddenly veers off course drastically (with or without reason).
    - If you're not skilled at piloting (to try to recover it), throttle down completely and let it crash: Making drastic corrections may cause you to lose sight of the UAV or worse, increase its altitude for a crash from a greater height.
- UAV is quickly heading for people.
    - Throttle up to max to have it go up and over them; your UAV is likely still be in the correct general orientation, so it's better to lose the UAV than to hit people.
    - Once it's high enough in the sky, try your best to regain control and position it such that it's over a clear landing spot.
- UAV is heading quickly for you.
    - Throttle down to zero; have it ram the ground as opposed to risking hitting your head.
- UAV does not respond to input from the controller.
    - Nothing you can do. If your UAV is still in the air, your transmitter's batteries may be dead.
- UAV loses a propeller.
    - Losing a propeller affects both thrust and yaw; try to correct for yaw first (you'll likely need to keep the joystick associated with yaw at an extreme position), and then simultaneously throttle up gently to try to prevent a crash, then throttle down.

C OPENCV PROGRAMMING

This literature was write by Vadim Pisarevsky, the Senior Software Engineer of Intel Corporation, Software and Solutions Group. This literature introduce general information of OpenCV, Getting Started with OpenCV, Modules Description, Interaction with Intel IPP, Python Interface, Some Usage Examples and Summary.

What is OpenCV? OpenCV (Open Source Computer Vision Library) is a library of programming functions mainly direct at real time computer vision, open up by Intel, and now stand by Itseez and Willow Garage. Free for use under the open source BSD license. The library is cross-platform. It is central mainly on real time image processing. If the library finds Intel's Integrated Performance Primitives on the system, it will use these proprietary optimized routines to accelerate itself.

Why we need OpenCV? Now, computer Vision Market is large and still growing. But there is no standard API (like OpenGL and DirectX in graphics, or OpenSSL in cryptography), most of CV software is of 3 kinds:

1. Research code (slow, unstable, independent/incompatible data types for every library/toolbox)
2. Very expensive commercial toolkits (like Halcon, MATLAB+Simulink, …)
3. Specialized solutions bundled with hardware (Video surveillanceManufacturing control systems, Medical equipment …)

So, we need a standard library that simplifies development of new program and solutions much easier. So, Intel develop OpenCV, and Intel optimization for Intel Platforms that creates new usage models by achieving real-time performance for quite"heavy" algorithms and makesOpenCV (Open Source Computer Vision Library) is a library of programming functions mainly direct at real time computer vision, open up by Intel, and now stand by Itseez an Willow Garage. Free for use under the open source BSD license. The library is cross-platform. It is central mainly on real time image processing. If the library finds Intel's Integrated Performance Primitives on the system, it will use these proprietary optimized routines to accelerate itself.

OpenCV is written in C++ and its primary interface is in C++, but it still retains a less comprehensive though extensive older C interface. There are now full interfaces in Python, Java and MATLAB. The API for these interfaces can be found in the online documentation. Wrappers in other languages such as C#, Ruby have been developed to encourage adoption by a wider audience. All of the new developments and algorithms in OpenCV are now developed in the C++ interface.

In this project I have work on Rispberry pi learn first how to use the Rispberry pi. In order to use the Rispberry pi I need to learn the operating system for it. The main objective of my UAV to detect the object for that purpose I have written the

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Motion Detection Code. I also studied the various command to operate the Rispberry pi.

Fig. 4 Rispberry Pi Board

4) System Block Diagram and Description:

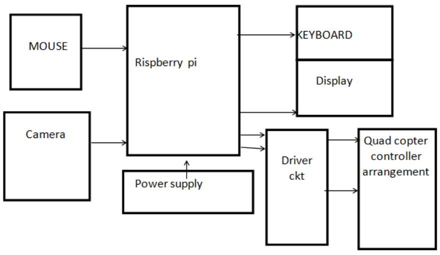

Fig. 5 System Block Diagram

The camera connected to Rispberry pi will capture the image as shown in Fig. 4 and the image is givent to Rispberry pi for further processing that means the object is detected using the Rispberry pi. When the particular image is capture it is stored in a folder. The display connected to it will show the folders consisting images. The mouse and the keyboard are used in order to give the inputs.The Driver circuit output is connected to Quad copter controller arrangement in order to control the copter Action. The Unmanned Aerial vehicle is nothing but the Quad copter.

The detected motion for the Motion Detection object code is as follow.

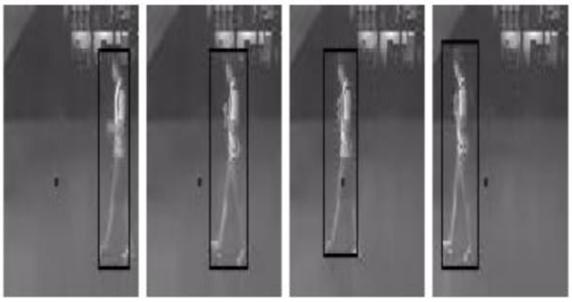

Fig. 6 Motion Detected Object

MOTION DETECTION CODE

```
#include <opencv2/opencv.hpp>
#include <iostream>
#include <time.h>
#include <dirent.h>
#include <sstream>
#include <sys/time.h>
#include <sys/types.h>
#include <sys/stat.h>
using namespace std;
using namespace cv;
bool directoryExists( const char* pzPath )
{
if ( pzPath == NULL) return false;

        DIR *pDir;
bool bExists = false;
pDir = opendir (pzPath);
if (pDir != NULL)
{
bExists = true;
(void) closedir (pDir);
}
return bExists;
}bool saveImg(Mat image, const string DIRECTORY, const string EXTENSION, const char * DIR_FORMAT, const char * FILE_FORMAT)
{
stringstream ss;
time_t seconds;
struct tm * timeinfo;
char TIME[80];
time (&seconds);

        timeinfo = localtime (&seconds);
// convert dir...
strftime (TIME,80,DIR_FORMAT,timeinfo);
ss.str("");
ss << DIRECTORY << TIME;
if(!directoryExists(ss.str().c_str()))

        mkdir(ss.str().c_str(), 0777);
// convert image name
strftime (TIME,80,FILE_FORMAT,timeinfo);
ss.str("");
//num.str("");
ss << DIRECTORY << TIME<<EXTENSION;
// save image
return imwrite(ss.str().c_str(), image);
}
int main (int argc, char * const argv[]){
// const
const string DIR = "/usr/share/nginx/www/pics/";
const string EXT = ".jpg";
const int DELAY = 20; // mseconds
std::ostringstream num;
std::ostringstream num1;
std::ostringstream num2;
int n=1;
string DIR_FORMAT = "%d-%m-%Y";
```

```
string FILE_FORMAT = DIR_FORMAT+ "/" + "%d-%m-%Y_%H:%M:%S-";

            num<<n;
string ary2 = "%S";
// create all necessary instances
CvCapture * camera = cvCaptureFromCAM(CV_CAP_ANY);
Mat original = cvQueryFrame(camera);
Mat next_frame = original;
Mat current_frame = cvQueryFrame(camera);
Mat prev_frame = cvQueryFrame(camera);
cvtColor(current_frame, current_frame, CV_RGB2GRAY);
cvtColor(prev_frame, prev_frame, CV_RGB2GRAY);
cvtColor(next_frame, next_frame, CV_RGB2GRAY);
Mat d1, d2, result;
int window = 200;
bool movement;

            while (true){
movement = false;
absdiff(next_frame, current_frame, d1);
absdiff(current_frame, prev_frame, d2);
bitwise_xor(d1, d2, result);
int middle_y = result.rows/2;

            int middle_x = result.cols/2;
// Center window
threshold(result, result, 140, 255, CV_THRESH_BINARY);
for(int i = middle_x-window; i < middle_x+window; i++)
for(int j = middle_y-window; j < middle_y+window; j++)
if(result.at<int>(j,i)>35)
{
movement = true;
break;
}
if(movement==true)
{
string FILE_FORMAT = DIR_FORMAT+ "/" + "%d-%m-%Y_%H:%M:%S-";
FILE_FORMAT+=num.str();
saveImg(original,DIR,EXT,DIR_FORMAT.c_str(),FILE_FORMAT.c_str());
string ary1 ="%S";
num1<<ary1;
num2<<ary2;
string ary3= num1.str();
string ary4 = num2.str();

            num1.str("");
            //size_t comp = ary3.compare(ary4);
size_t comp = ary3.compare(1,2,ary4,1,2);
if(comp == 0)
{
n++;
num.str("");
num<<n;
}
else if (comp !=0 )
{
num.str("");
num1.str("");
num2.str("");
n=1;
num<<n;
}
}
prev_frame = current_frame;
current_frame = next_frame;
// get image from webcam

            next_frame = cvQueryFrame(camera);
cvtColor(next_frame, next_frame, CV_RGB2GRAY);
// delay and quit when press Q/q
int key = cvWaitKey (DELAY);
if (key == 'q' || key == 'Q')
break;
}
return 0;
}
```

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